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Review article on Characterization Techniques and Optical Properties of Luminescent Materials

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Abstract

In this paper different sample preparation methods are discussed and compared which are useful for Luminescent materials. In all these Solid State Reaction technique is most important technique for Characterization other techniques like X-rays diffraction (XRD), Scanning electron microscope (SEM), Transmission electron microscope (TEM), EDX and FTIR are discussed here in detail. Optical parameters have been discussed by using Photoluminescence (PL), Thermoluminescence (TL) and Mechnoluminescence (ML). This paper will be a key factor for researchers in the field of Luminescent materials. On the basis of review papers we have also explained important conclusion related with Luminescent materials.

Keywords: XRD, PL, TL, ML and Luminescent materials

I INTRODUCTION

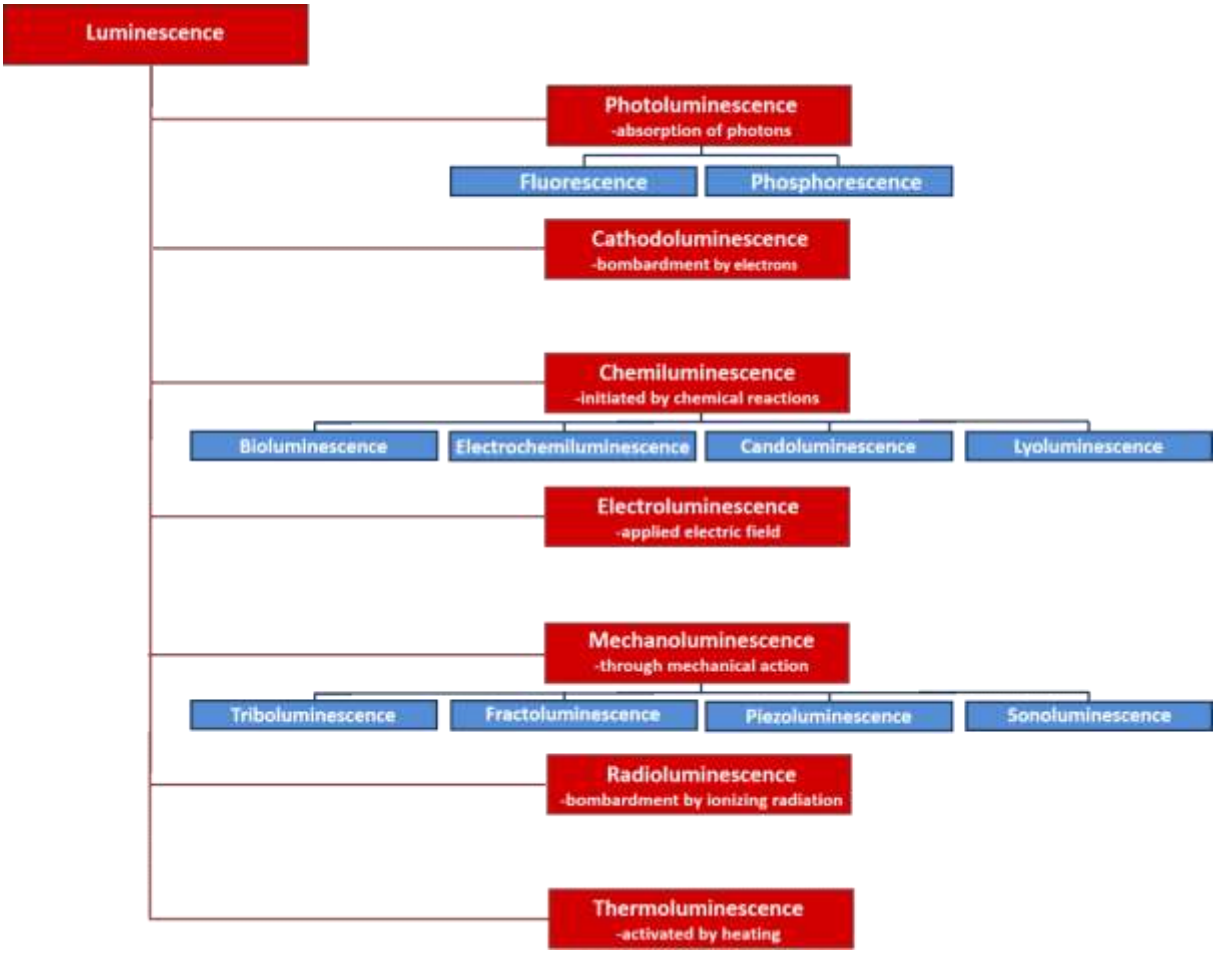
Luminescence is a process by which light is emitted by a substance without resulting of heat, thus it referred as cold body radiation. It can be occurred by UV or visible light, chemical reaction, pressure on crystal, electric field, energetic electrons and subatomic movement. In these sources luminescence emission takes place when material observed suitable amount of energy. The atom excited into higher energy level i.e. unstable, to get stability atom return tolower energy level or ground state. At the time of returning the absorbed energy of atom is released in the form of light. The word –luminescence‖ was first used by German physicist Eilhard Wiedemann in 1888 [1-2].

On the basis of excitation source luminescence can be classified by as given chart [3]

Luminescence has wide range of application in today's urbanised life style of mankind suchas organic and inorganic light emitters for flat panel and flexible display such as plasma display, LCD displays, and OLCD displays etc.

A phosphor is solid materials that manifest the phenomenaof luminescence; it emits light when exposed to different type of radiant energy. When the phosphor is exposed to radiation the electrons in the molecule excited to higher energy level,which is unstable condition for electrons after few second they return to the lower energy state they emits the energy in forms of some light color. Phosphors are classified two types fluorescent and phosphorescent, fluorescent material emits the energy immediately and stop glowing when the radiation source is turned off while phosphorescent is long-lived

photoluminescence that continuous long after the photo excitation has turn off [4].



Presently alkaline earth silicates and aluminates doped with rare earth ions have attracted extensively research interest in the field of photoluminescence because they are suitable hosts with high chemical stability. They have wide application in traffic signs, decoration, emergency exit routes and textile printing [5]. Rare earth metals define as group of seventeen elements. The group includes 15 lanthanides elements (lanthanum, cerium, praseodymium,neodymium, promethium,samarium, europium, gadolinium, terbium,dysprosium, holmium, erbium, thulium, ytterbium,and lutetium) plus scandium and yattrium. These metals have unusual fluorescent, conductive, and magnetic properties—which make them very useful when alloyed, or mixed, in small quantities . When rare earth metals doped with host material different colours are emitted depending on the host material and rare earth metal [6].

In rare earth metal phosphors constitute 9% of them. Ninety seven per cent of theses phosphors are involve in lighting and display application. Rare earth metals are extensively used in such application where light emission is a norm of performance. This is mainly applied in lighting device and displays [7].

Given table 1 shows rare earth metal and their applications [8]:-

Table 1 Overview of rare-earth metal properties

S. No	Rare earth metal	Symbol	Atomic No.	Application
1	Scandium	Sc	21	Aerospace components
2	Yttrium	Y	39	Lasers, TV and computer displays microwaves filters, light emitting diode, plasma display
3	Lanthanum	La	57	Camera lenses, light emitting diode,
4	Cerium	Ce	58	Plasma display, glass lens production, medical equipment
5	Praseodymium	Pr	59	Aircraft engines, carbon arc light
6	Neodymium	Nd	60	Cell phones, computer Hard devices
7	Promethium	Pm	61	Portable x-ray machines ,
8	Samarium	Sm	62	PCB cleansers
9	Europium	Eu	63	TV and computer displays , lasers optical electronics , afterglow pigments
10	Gadolinium	Gd	64	MRI contrast agent
11	Terbium	Tb	65	Fluorescent lamps, sonar systems
12	Dysprosium	Dy	66	Lasers, afterglow pigments,
13	Holmium	Ho	67	Lasers
14	Erbium	Er	68	Fiber optical, nuclear reactor control rods
15	Thulium	Tm	69	x-ray machines, superconductors
16	Ytterbium	Yb	70	Portables x-ray machines
17	Lutetium	Lu	71	Phototherapy lamps, medical
				equipment , LED light bulbs

Colour emission is based on the addition of photons. A white light source is, for example, provided when blue, red, and green photons are added.

II REVIEW OF PAPER

Lin et al. [9] prepared a white long lasting phosphor $Ca_2MgSi_2O_7 : Dy^{3+}$ by solid statereaction method. In this method starting material $Mg(OH)_2.4MgCO_3.6H_2O$(AR), $CaCO_3$(AR), Dy_2O_3(99.99%) and SiO_2(AR) taken as stoichiometric amount, they were mixed and sintered at 1300 ℃ for 5 h. Photo-luminescence properties of the sample shows strong excitation band at 260 nm due to oxygen deficiency, this exhibited white long lasting afterglow which was mainly due to 4f-4f transition of Dy^{3+} ions. The chromaticity coordinates CIE of the phosphorescence spectra is found in white colour range, ensuring a white afterglow of the sample. The Thermoluminescence curve of the sample shows depths and frequency factors of traps centers, which indicate that trap center corresponding to 414 k band were more help to the long lasting phosphorescence.

Parganiha et al. [10] synthesis Gd_2SiO_5: Ce^{3+} phosphor sample prepared by modified solid state reaction method. The stoichiometric ratio of precursors Gd_2O_3, SiO_2, CeO_2 and H_3BO_3 (as flux) taken with variable molar concentration of Ce^{3+}, they mixed thoroughly for 45 minusing mortar and pestle, grinded sample first calcinate at 1000 ℃ for 1h in muffle furnace, sample again grinded and heated at 1250 ℃ for 3h for sintering. The lattice parameter of thesample obtain by powder diffraction pattern, crystalline size calculated by the Scherer's formula, XRD pattern of the sample shows monoclinic body centered structure with space group P21/c. XRD studies confirms the phosphors are mostly in single face and nano crystallites. Peaks in FTIR confirm the formation of Gd_2SiO_5: Ce^{3+}. Surface morphology and particle size of prepared sample were carried out by Field emission gun scanning electron microscope (FEGSEM) which shows sponge and small spherical like shapes. Exact particle size and morphology were carried out by transmission electron microscope (TEM). PL excitation spectra was found at 260 nm and emission spectra was found 365, 378, 555,602 607 and 627 nm for lower concentration of Ce^{3+} which are attributed to the Gd^{3+}ion transition, for higher concentration of Ce^{3+} they found broad emission peaks at 350 and 550 nm which is attributed to the Ce^{3+} ion transition, which gives blue light emission used in solid state lighting and display devices.TL glow curves recorded for different doses of UV exposure and gamma ray dose, the kinetic parameters such as activation energy, order of kinetics and frequency factor have been calculated using peak shape method. In the gamma ray exposure phosphor shows linear response with high intensity and show first order kinetics, this show phosphor may be useful in TL dosimetry.

Shrivastava et al. [11] synthesis Europium- and dysprosium-doped strontium magnesium silicate powder with different concentration ratios of dysprosium using solid state reaction method. SiO_2, $SrCO_3$, MgO, Dy_2O_3 and Eu_2O_3 were taken as starting materials, they thoroughly grounded for approximately 1 h in a mortar, pre-sintered at 900 ℃ then fired at 1,300 ℃ for approximately 2 h, with H_3BO_3 (1.6 mol.%) used as flux . Confirmation of prepared sample was taken by XRD pattern. This is done by comparison between the XRD pattern of $Sr_2MgSi_2O_7$ (Eu/ Dy = 0.5/1.5) as prepared, and the standard XRD pattern (COD card No. 96-431-7124). Figure of merit while matching these was 0.9194 which illustrates that the phase of the prepared sample agrees with the standard pattern COD card No. 96-431-7124. Photoluminescence (PL) characterization shows by excitation and emission spectra.
The emission spectra centred at 480 nm wavelength prominent blue color emission was obtain under UV excitation. Thermoluminescence (TL) glow curves of the sample were measured at various delay times. With increased delay time, the intensity of the TL peakdecays and the position of the TL peak

shifts towards a higher temperature, indicating the considerable retrapping associated with general order kinetics.

Chandrakar et al. [12] studied the synthesis and characterization of Er^{3+} doped CeO_2 phosphor with variable concentrations of erbium. The sample was synthesized using a solid- state reaction method and characterized using XRD, FEGSEM, FTIR and PL; CeO_2 (99.99%) and Er_2O_3 (99.99%) were taken in stoichiometric amount as the starting material to prepare the phosphor. XRD pattern confirms that the prepared phosphor has pure cubic fluorite crystal structure, single phase and nano crystallites. The surface morphology of the phosphor was determined by field emission gun scanning electron microscopy (FEGSEM) good
surface morphology with some agglomerates was found. The functional group in the preparedsample was analysed by Fourier transform infrared (FTIR) spectroscopy also confirms the formation of CeO_2 : Er^{3+}. In photoluminescence analysis excitation spectra of the prepared phosphor shows broad excitation centred at 251 nm. Emission spectra at different concentrations of Er3+ show strong peaks at 413 and 470 nm and a weaker peak at 594 nm.
The dominant peaks at 413 and 470 nm are caused by the allowed electronic transition
$^4S_{3/2} \rightarrow {}^4I_{15/2}$ and the weaker transition at 594 nm is due to the transition $^4F_{9/2} \rightarrow {}^4I_{15/2}$.
Spectrophotometric determinations of peaks were evaluated using the Commission Internationale de I'Eclairage (CIE) technique. The emission spectra were also observed usingan infrared (IR) laser 980 nm source, and three distinct peaks were found in the IR region at 848, 870 and 980 nm. The prepared phosphor has utility for application in display devices.

Kaur et al. [13] synthesized CeO_2:Eu^{3+} with different concentration of dopant by solid state reaction technique. XRD analysis the prepared phosphor exhibits cubic fluorite crystal structure with average crystallite size 46.5 nm. Luminescence properties of CeO_2:Eu^3+ phosphors were studied by observing photoluminescence excitation and emission spectra.
Under the excitation of 295 nm, a strong emission peak at 592 nm and two shoulder peaks at 612 nm and 633 nm were found, which show orange— red emission with good intensity which introduces CeO_2:Eu^3+ as promising and high performance luminescent material for display devices application. The effect of different doping concentration on photoluminescence properties of samples were also discussed

K. Mondal, J. Manam [14] prepared a series of Dy3+ doped and Dy^{3+}, Eu^{3+} co-doped CZS phosphors by using the solid state reaction method. The XRD and FE-SEM results show that the prepared phosphors have tetragonal crystal structure and particles in agglomerate form. The energy band gaps of doped and co-doped phosphors were found to be increased as compared to undoped CZS. From the PL spectra, it was found that the energy transfer from sensitizer (Dy^{3+}) to activator (Eu^{3+}) ion in co-doped CZS: Dy^{3+}, Eu^{3+} phosphors were mainly due to quadrupole-quadrupole interaction. The prepared CZS: Dy^{3+}, Eu^{3+} phosphor the emission intensity retained almost 80% at 425 K of that measured at 300 K. The emission color had tuned with the incorporated of Eu^{3+} ion CZS: Dy^{3+} phosphor. All the results of CZS: Dy^{3+}, Eu^{3+} phosphors showed a great potential application as a white-emitting phosphorfor solid state lighting.

J. Kuang et al. [15] investigated on a luminescent phenomenon in Dy^{3+}-doped $SrSiO_3$ long- lasting phosphor. Powder samples were prepared by the conventional high temperature solid-state technique. $SrCO_3$ (499.9%), SiO_2 (499.99%) and Dy_2O_3 (499.99%) were taken as starting material. The Dy^{3+} dopant concentrations ranged from 0 to 5 mol.% of Sr^{2+} ions in $SrSiO_3$. After having taken the starting materials in stoichiometric proportions and homogenized thoroughly, the mixture was sintered at 1300 °C for 3 h using alumina crucibleswith alumina lids in air atmosphere with subsequent air cooling to get the products. Crystal structure of prepared samples were examined by D/max-IIB X-ray diffractometer and XRD patterns matched quite well with the standard JCPDS files no. 36-0018. When the prepared sample was irradiated by 254 nm UV source for 5 min, it emits white light long lasting phosphorescence for more than 1 h even after the irradiation source has been removed. Photoluminescence and thermoluminescence (TL) spectra are used to explain this phenomenon. Photoluminescence spectra disclose that the white light-emitting long-lasting phosphorescence generated from the two mixtures of Dy^{3+} characteristic luminescence, the 480 nm blue emission and the 572 nm yellow emission. TL spectra shows that the introduction of Dy^{3+} ions into the SrSiO3 host produces a highly dense trapping level at 377 K (0.59 eV), which is responsible for the long-lasting phosphorescence at room temperature. A possible mechanism of the long-lasting phosphorescence based on the experimental resultsis proposed. It is considered that the long-lasting phosphorescence is due to persistent energy transfer from the electron traps to the Dy^{3+} ions, which creates the persistent luminescence ofDy^{3+} to produce the white light emitting long-lasting phosphorescence.

R. Rajeswari et al. [16] synthesized Y_2CaZnO_5 (YCZ) nanophosphor doped with various Dy^{3+} ion concentrations (0.1, 0.5, 1.0, 2.5, 5.0 and 7.5 mol%). These samples were prepared by the modified citrate gel combustion method. High purity Y_2O_3, ZnO, $CaCO_3$, Dy_2O_3 and $C_6H_8O_7$ (citric acid) from Sigma-Aldrich were taken as starting materials. In a typical experiment, stoichiometric amounts of all the oxides and carbonates were dissolved in concentrated nitric acid to make $Y(NO_3)_3$, $Zn(NO_3)_2$, $Ca(NO_3)_2$and $Dy(NO_3)_3$. These nitrateprecursors were added with citric acid, which was dissolved in water (by adjusting the ratio of citric acid to metal nitrates as 4:1). Citric acid acts as the monomer to form a transparent complex gel upon drying for 12 h in an oven at 75 1C. Then the gel was taken in a quartz boat and introduced in a pre-heated furnace at 800 °C. Initially the citrate complex geltransforms to a black fluffy mass nearly ten times the gel volume and starts decomposing to CO_2 and H_2O vapours. After 15–30 min a white voluminous mass of the YCZ:Dy^{3+} nanophosphor is obtained which could easily be crushed to ultra-fine powder used for further characterization. Synthesis of size-controlled nanophosphor particles with high yield (~90%) is one of the highlights of this method. Crystalline structure was taken by XRD, Bruker D-8 advanced powder X-ray diffractometer and it's a found triclinic. The FTIR spectral studies were carried out to study the functional groups in the YCZ host. The energy dispersive X-ray analysis (EDAX) shows the confirmation of proper formation of the sample. The Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) were taken for surface morphology. . Luminescence properties have been characterized using photoluminescence (PL), excitation spectra and decay time measurements. Intense broad excitation peak is observed in 420-450 nm region which is blue and yellow. CIE chromaticity coordinates and correlated color temperature studies have shown the possibility of using this compound for white light emission.

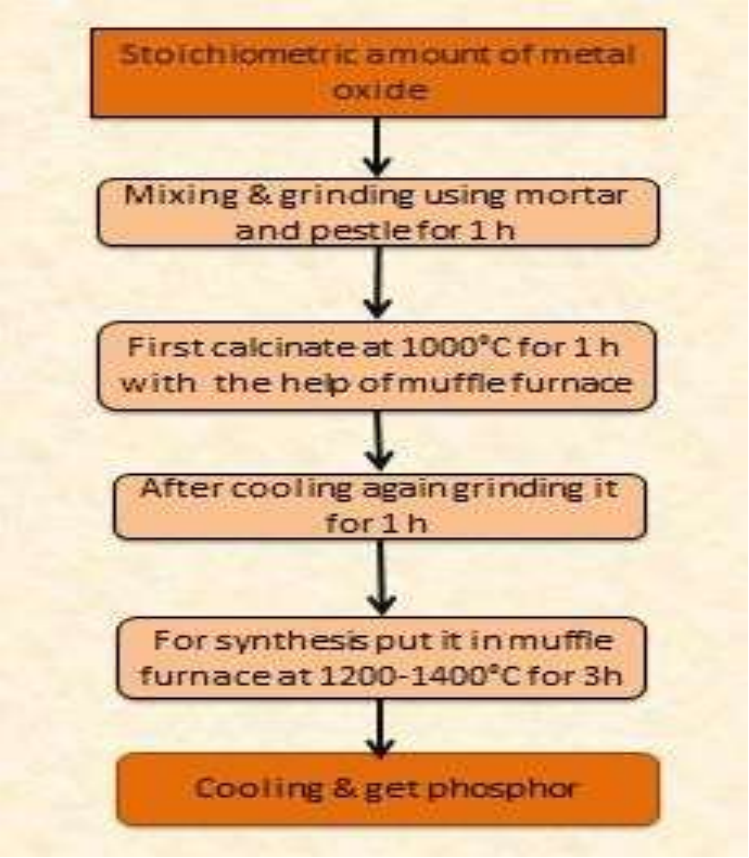
In all above discussed papers sample is mostly prepared by solid state reaction method. Prepared sample is characterized by different techniques like XRD, SEM, TEM, FTIR, EDX,TL, ML and PL. So

in this paper we discussed about these technique.

III SAMPLE PREPARATION METHOD

Sample can be prepared by using different methods; these are Sol-gel method, Combustion method, Spray pyrolysis method, Solid state Reaction method and Controlled hydrolysis method. In all the given methods Solid state Reaction (SSR)method is mostly used because it provides large range for selection of starting rawmaterials like oxides and carbonates.

Almost all good inorganic compound phosphors consist of a crystalline –host material‖ in which small amounts of certain impurities, called –activators‖ are dissolved. These activators are primarily responsible for occurring luminescence in phosphors. The activators are diffused into the host crystal during the firing at elevated temperatures, called –firing temperature‖ which is below the melting temperature of host material and this is performed by solid state reaction between starting raw materials. Flow Chart (1) shows the preparation of Sample by Solid state Reaction method. Fig (1) shows the instrument used for sample preparation



Flow Chart (1): Sample Preparation by Solid state Reaction method

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Fig (2): Shows the instrument used for sample preparation

IV CHARACTERIZATION TECHNIQUES

4.1.X-RAY DIFFRACTION (XRD)

X- Ray is an electromagnetic radiation and has wavelengths from 0.1 to 100 Å, which are located between γ- radiation and ultraviolet radiation. X-rays are generated by a cathode ray tube, when the condition of Bragg's law satisfy, $n\lambda = 2d \sin\theta$. where, λ is wavelength of incident X-ray, θ is the diffraction angle or Bragg's angle and d is inter atomic spacing in a crystalline sample. X-ray powder diffraction method is mostly used for the identification of unknown crystalline materials, determination of unit cell dimensions, determine crystal structures using Rietveld refinement and find the crystalline size [17]. The crystallite size of prepared sample has been calculated by full width half maximum (FWHM) of some peaks using Scherrer's formula [18-19]. The Scherrer's formula is given by:

$$D = \frac{0.9\,\lambda}{\beta \cos\theta}$$

Here D is Crystallite size, λ is wavelength of X-ray, β is FWHM and θ is diffraction angle.

4.2 Scanning electron microscope (SEM)

Surface morphology and particle size of prepared sample was carried out by SEM. The scanning electron microscope (SEM) uses a focused beam of high-energy electrons to generate

a variety of signals at the surface of solid specimens. The signals that derive from electron-sample interactions reveal information about the sample including external morphology (texture), chemical composition, crystalline structure and orientation of materials [20]

4.3 Transmission electron microscope (TEM)

The better estimation of particle size is taken by TEM. Transmission electron microscope (TEM) is a microscopy technique in which a beam of electrons is transmitted through a specimen. An image is formed from the interaction of the electrons transmitted through the specimen; the image is magnified and focusedon to an imaging device, like a florescent screen, on a layer of photographic screen, or to be detected by a sensor such as a CCD camera [21]

4.4 Fourier Transform Infrared Spectroscopy(FTIR) and Energy Dispersive X- ray (EDX) spectrum

FTIR offers quantitative and qualitative analysis for organic and inorganic samples.

The spectra produce a distinctive molecular fingerprint that can be used to screen and scan samples for many different components [22]. Energy Dispersive X-ray spectrum confirms the cationic composition of prepared sample.

4.5 Thermoluminescence (TL)

Thermoluminescence is a form of luminescence that is exhibited by certain crystalline materials, such as some minerals, when previously absorbed energy from electromagnetic radiation or other ionizing radiations re-emitted as light upon heating of the material. The phenomenon is distinct from that of black-body radiation.

Thermoluminescence

Glow curve was recorded at room temperature by using TLD reader 11009 supplied by Nucleonix Sys. Pvt. Ltd. Hyderabad [23-24]. Fig (2) shows the Setup of TLD reader used in our Lab.



Fig (2): Setup of TLD Reader

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Photoluminescence (PL)

Photoluminescence is the emission of light which is caused by the irradiation of a substance with other light. It is initiated by photoexcitation (excitation by photons), hence the prefix *photo-*. Following excitation various relaxation processes typically occur in which other photons are re-radiated [25-26].

Photoluminescence spectra recorded by Ocean View Spectrometer operatingsoftware. Fig (3): Shows PL Setup Miniature Spectrometer used in our lab.



Fig (3): PL Setup – Miniature Spectrometer

4.6 Mechanoluminescence (ML)

Mechanoluminescence is a type of luminescence include during any mechanical action on solids. It can be excited by grinding, cutting, rubbing, shaking, scratching, compressing or crushing of solids [27]. Fig (4) shows ML setup usedin our lab.

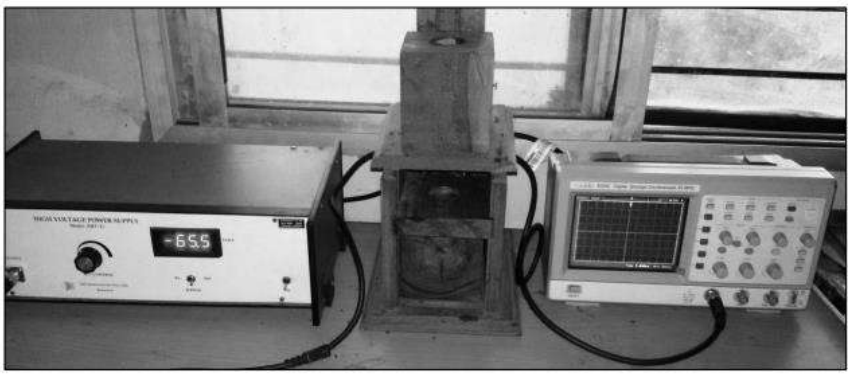


Fig (4): ML measuring device

V CONCLUSION

1. SSR technique is more versatile than other technique and enhances possibilities of obtaining phosphors with suitable properties for luminescentapplications.
2. The XRD is used to identify the crystalline phases and crystallite size.
3. SEM is used to determine the morphology of the sample.
4. Transmission electron microscope (TEM) was shows the better estimation of crystal size.
5. EDX and FTIR show the well composition of prepared sample.
6. Kinetic Parameters are finding by TL glow Curve.
7. Excitation and Emission Spectra were recorded by PL.
8. ML emission samples gets fractured and creation of piezoelectricity**.**

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Original research article

Composite nature of thermo luminescence studies in Dy^{3+} activated $Sr_2ZnSi_2O_7$ phosphor

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ABSTRACT

Herein, we have reported the thermoluminescent properties of Dy^{3+} activated $Sr_2ZnSi_2O_7$ phosphors synthesized via solid-state reaction method. The synthesized phosphors were characterized via X-ray diffraction, transmission electron microscopy, Fourier transform infrared spectroscopy and thermoluminescent techniques. Thermoluminescence (TL) glow curve analysis of prepared Dy^{3+}-activated $Sr_2ZnSi_2O_7$ phosphors were recorded for different UV exposure time and found linear response with dose. The TL glow curve shows composite in nature and broad glow curve centered at 309 °C were found. Composite TL glow curve extracted by glowfit program using computerized glow curve deconvolution (CGCD) technique and corresponding kinetic parameters are calculated. The obtained results indicate that the synthesized phosphors find potential applications in the fields of dosimetric applications.

1. Introduction

Dysprosium activated $Sr_2ZnSi_2O_7$ phosphors find vast applications in various optoelectronic, display devices and finger print detection [1–4]. This is owing to the f-f transitions in the rare-earth elements that lead to the sharp, narrow and distinct emission spectra. To exhibit white light emission phenomena, Dy^{3+} doped phosphors are generally used due to its transitions. However, host material plays a significant role in achieving white light [5,6].

In the present study, we have synthesized Dy^{3+} doped $Sr_2ZnSi_2O_7$ phosphors via solid-state reaction method and studied their thermoluminescent properties in detail. The concentration of Dy^{3+} ions is varied from 0.1 to 2 mol% in the host lattice. All the structural, morphological and trap parameters are studied in detail.

2. Experimental

2.1. Preparation of hardystonite ($Sr_2ZnSi_2O_7$) doped with Dy^{3+} phosphor

$Sr_2ZnSi_2O_7$:Dy^{3+} phosphors were prepared by solid-state reaction method with varying concentration of Dy^{3+} ions (0.1–2.0 mol%). $SrCO_3$, ZnO, SiO_2 and Dy_2O_3 used as a starting material with a proper stoichiometric ratio, H_3BO_3 (1.6 mol%) is used as a flux. All materials were thoroughly grinded nearly 2 h (using acetone for liquid griding) to obtain a homogeneous powder with the help of

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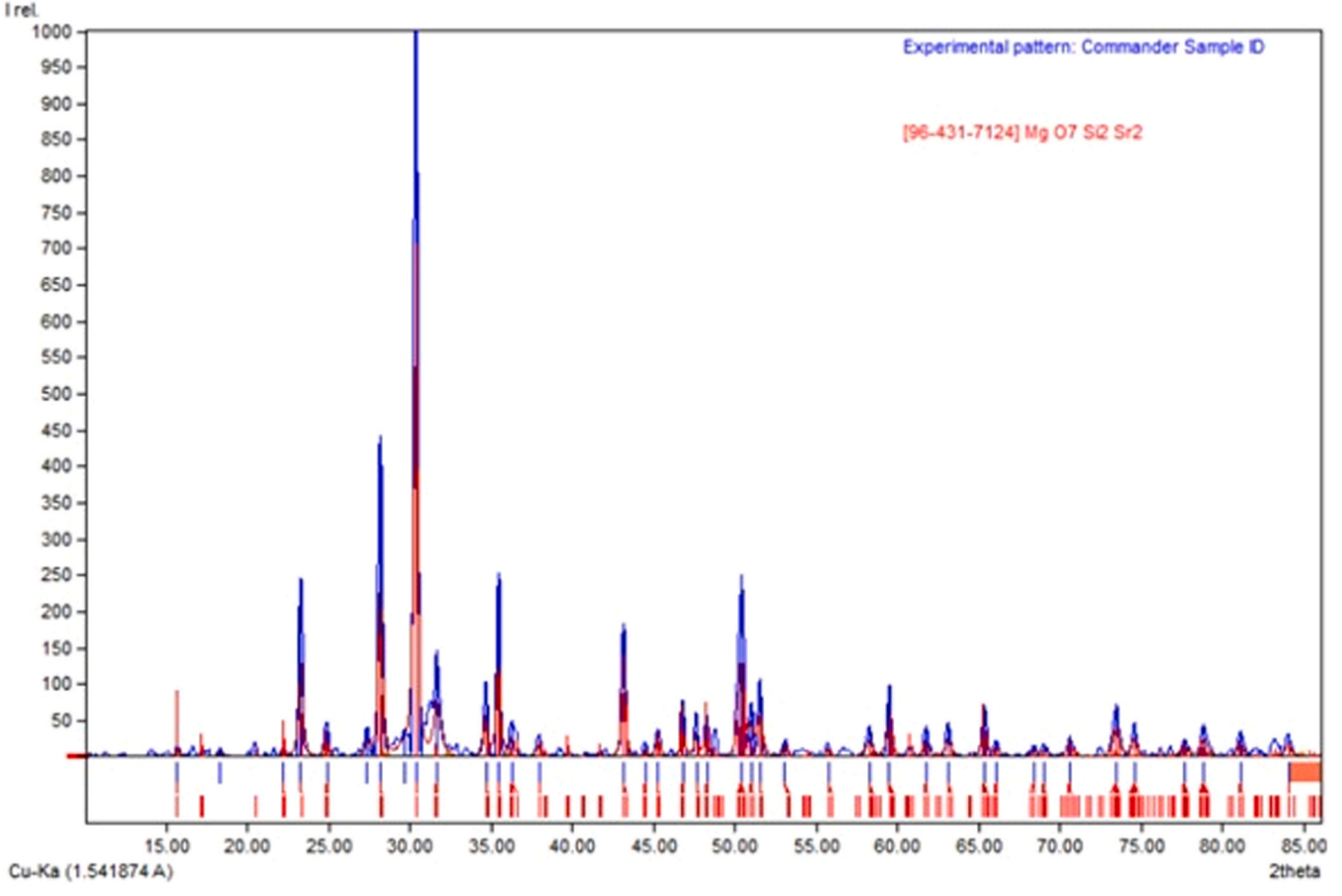


Fig. 1. Observed and calculated plot of $Sr_2ZnSi_2O_7 : Dy^{3+}$ (2.0 mol%).

Table 1
Refined lattice parameter of $Sr_2ZnSi_2O_7$ Doped with Dy^{3+}. (Matched with Card No. Crystallographic Open Database:- 96-431-7124 for Sr2MgSi2O7).

Initial values: (Refinement keys on 2nd line)										
Zero			Lambda	a	b	c	alpha	beta	gamma	Vol.
0			1.5418	8.0107	8.0107	5.1636	90	90	90	331.4
0			0	1	0	1	0	0	0	
Final values: (Standard errors on 2nd line)										
Zero			Lambda	a	b	c	alpha	beta	gamma	Vol.
0			1.5418	7.9839	7.9839	5.1593	90	90	90	328.9
0			0	0.0109	0	0.0013	0	0	0	
h	k	l	2 T(Obs)	2 T-Zero		2Th(Cal)		Dif		
1	1	1	23.421	23.421		23.3566		0.0644		
2	0	1	28.328	28.328		28.2655		0.0625		
1	2	1	30.502	30.502		30.445		0.057		
0	0	2	34.809	34.809		34.7756		0.0334		
1	3	0	35.597	35.597		35.5572		0.0398		
2	1	2	43.26	43.26		43.2676		-0.0076		
2	2	2	47.746	47.746		47.7613		-0.0153		
3	1	2	50.549	50.549		50.5854		-0.0364		
3	3	1	51.673	51.673		51.7049		-0.0319		
2	1	3	59.64	59.64		59.6752		-0.0352		

Bragg Reflections and 2θ values for XRD peaks of $Sr_2ZnSi_2O_7$ Doped with Dy^{3+}.

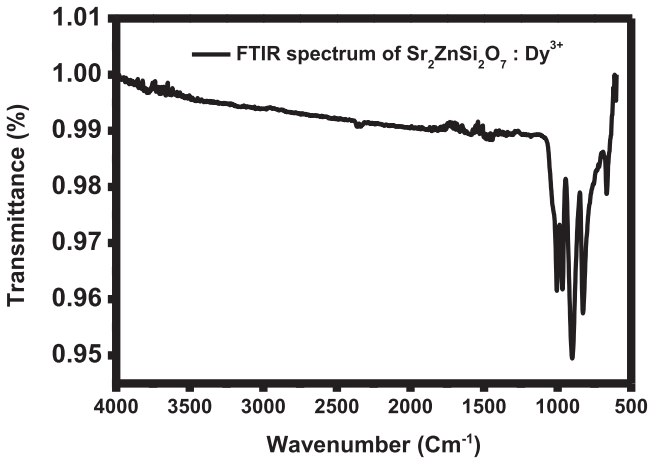


Fig. 2. FTIR spectra of $Sr_2ZnSi_2O_7$:2 mol% Dy^{3+} phosphor.

mortar and pestle. The ground mixture was transferred to the alumina crucible and heated at 1000 °C for 2 h in a muffle furnace. The calcined samples were ground again and subjected to heat at 1250 °C for 4 h. The final calcined samples were ground to form fine powder and used for further characterization. The whole synthesis can be represented by the following equation:

$$2SrCO_3 + ZnO + 2SiO_2 + Dy_2O_3 \xrightarrow[H3BO3]{1000\,^{\circ}C} Sr_2ZnSi_2O_7{:}Dy^{3+} + 2CO_2\uparrow \xrightarrow{1250\,^{\circ}C} Sr_2ZnSi_2O_7{:}Dy^{3+}$$

XRD diffractogram was recorded using Bruker AXS D8 Advance X-Ray Powder Diffractometer with Cu-Kα radiation (1.5406 Å) in 2θ range 4–80°. SEM images were recorded using scanning electron microscope (JEOL/JSM-6390LV Model). Quantitative analysis (EDS) was performed by OXFORD XMX N. TEM images were examined by JEOL/JEM 2100 Model. FTIR spectra were observed by BRUKER ALPHA II ECO ATR with scanning range 600–4000 cm^{-1}. Thermoluminescent (TL) glow curves were recorded using TLD reader model no. I1009 and kinetic parameters are calculated using glowfit software [12–15].

3. Result and discussion

3.1. XRD analysis of prepared phosphors

XRD spectra of the $Sr_2ZnSi_2O_7$:Dy^{3+} were studied using Match software (version 2.3.1). Fig. 1 shows the comparison between

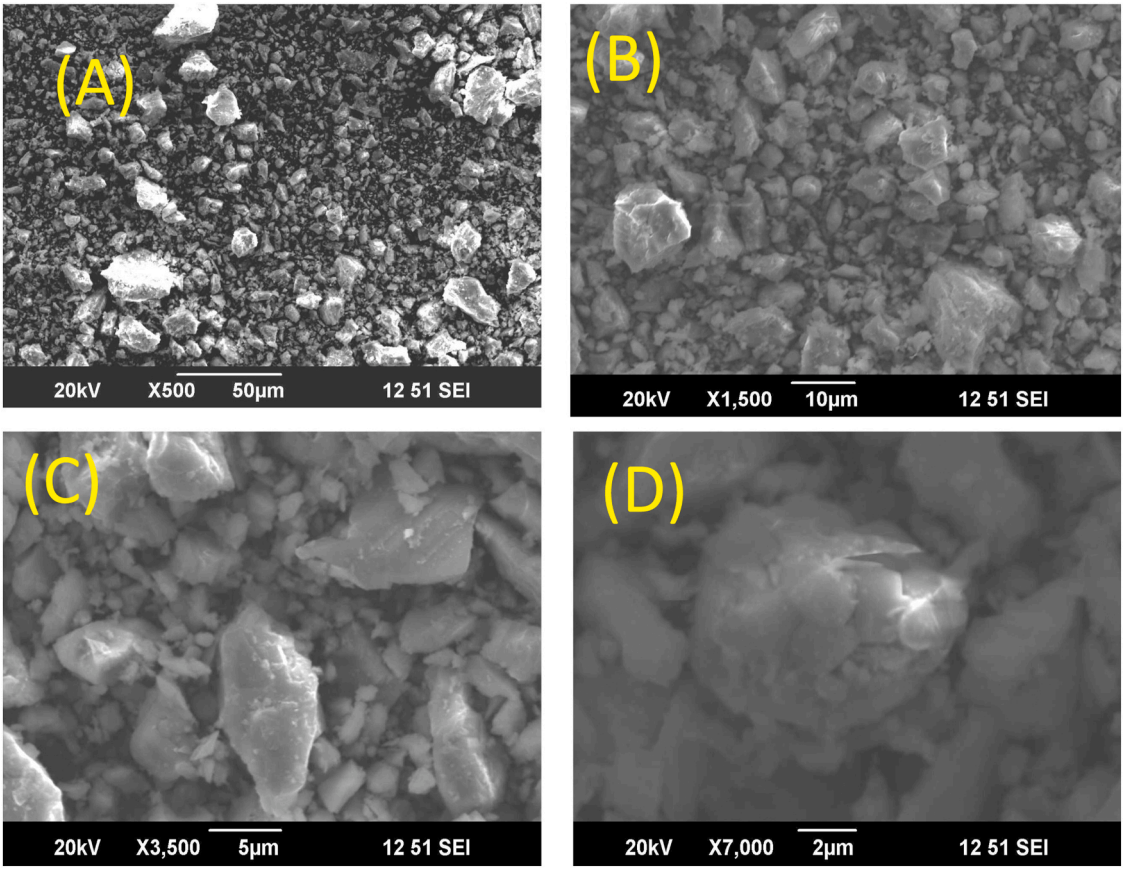


Fig. 3. (A–D) SEM images of prepared phosphor Dy^{3+} (2 mol%) doped $Sr_2MgSi_2O_7$.

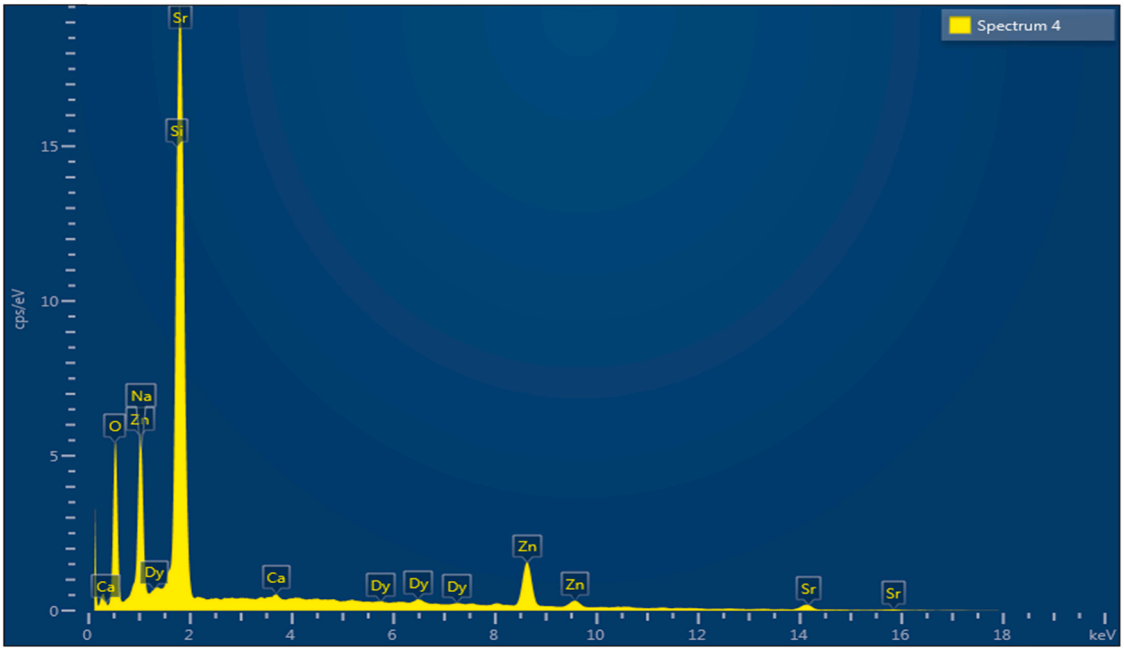


Fig. 4. EDX pattern of prepared phosphor Dy^{3+} (2 mol%) doped $Sr_2ZnSi_2O_7$.

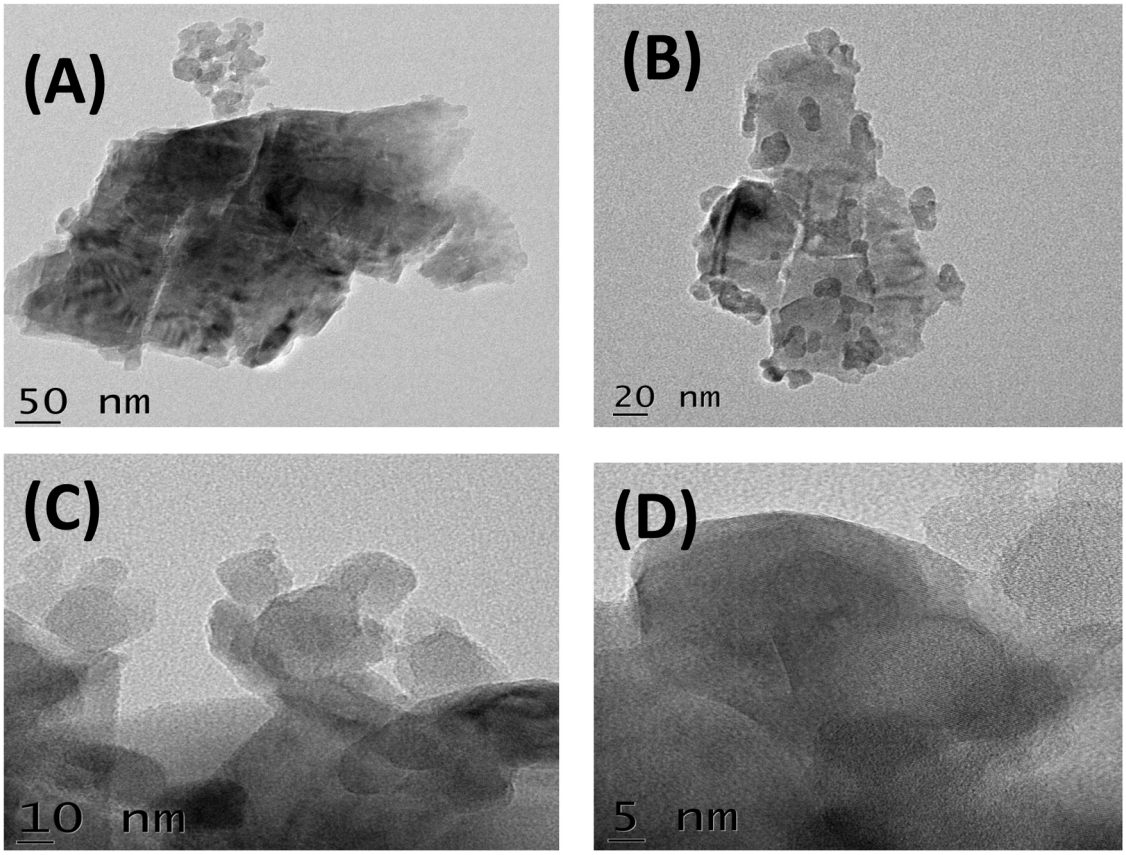


Fig. 5. (A–D) TEM images of prepared phosphor Dy^{3+} (2 mol%) doped $Sr_2MgSi_2O_7$.

observed, calculated and standard (matched) XRD pattern of $Sr_2ZnSi_2O_7$:Dy^{3+}. XRD patterns were matched convincingly with crystallographic open database (COD) card no. 96-431-7124 with figure of merit (FOM) 86% and tetragonal structure with space group $P42_1$ m (113). Table 1 represent the refined lattice parameter of $Sr_2ZnSi_2O_7$ with Dy^{3+} 2.0 mol%. XRD data was refined using Celref version 3 (Collaborative Computational Project No. 14 [CCP14] [16,17]. It is observed from Table 1 volume calculated for standard COD and calculated XRD patterns are same, except variation in the diffraction angles due to variation in the ionic radii of the dopant and host lattice ions [7–12].

3.2. Fourier transform infrared (FTIR) analysis

Fig. 2 represents the FTIR spectra of $Sr_2ZnSi_2O_7$:2 mol% Dy in the range from 500 to 4000 cm^{-1}. The bands appearing in the range 500–971 cm^{-1} are attributed to the presence of stretching and bending modes of metal-oxygen (M-O) group. The bands in the range from 618 to 524 cm^{-1} are corresponding to the Si-O-Si bending modes. Thus, FTIR confirms the presence of different functional groups in the sample.

3.3. SEM images and EDX pattern of prepared sample

The surface morphology of the samples is studied using scanning electron microscopy. Fig. 3(A–D) represents the SEM micrographs of $Sr_2ZnSi_2O_7$:2 mol% Dy^{3+} phosphor at different magnifications. The EDX spectra corresponding to the $Sr_2ZnSi_2O_7$:2 mol%Dy^{3+} phosphor is shown in Fig. 4. The spectra represent the presence of strontium, zinc, silicon, oxygen and dysprosium atoms, thus representing the formation of pure hardystonite.

3.4. Transmission electron microscopy (TEM) analysis of $Sr_2ZnSi_2O_7$:2 mol% Dy^{3+} phosphor

For the better surface morphology of the samples is studied using transmission electron microscopy. Fig. 5(A–D) represents the TEM micrographs of $Sr_2ZnSi_2O_7$:2 mol% Dy^{3+} phosphor at different magnifications. It is clearly indicate the good surface morphology of the sample with particle size distribution from 5 to 50 nm ranges. n.

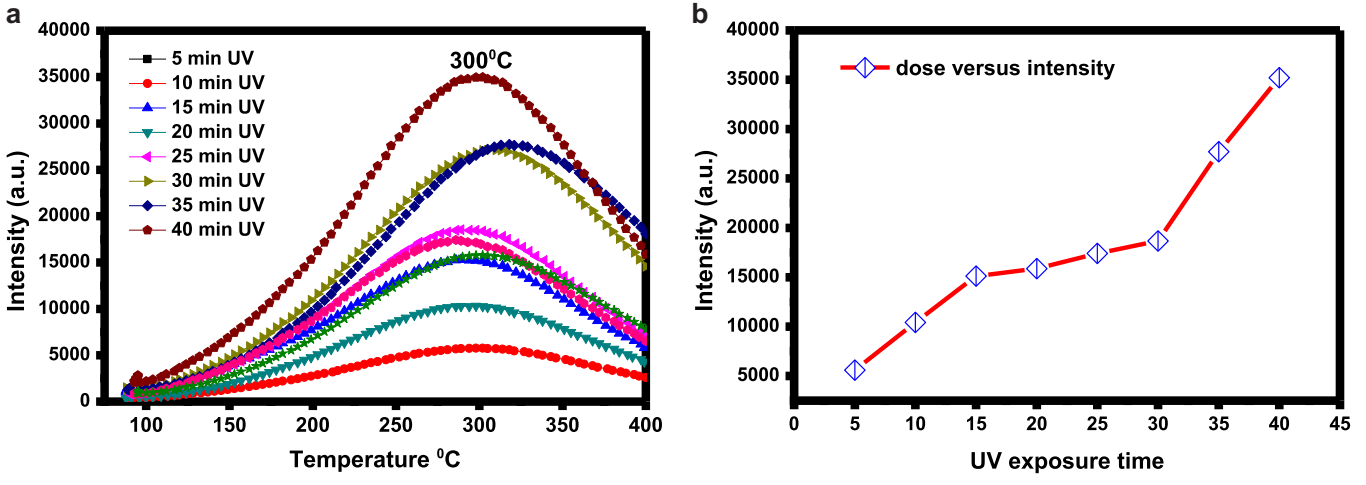


Fig. 6. (a) TL glow curve analysis of $Sr_2ZnSi_2O_7:Dy^{3+}$ phosphor (2 mol% of Dy^{3+} ion) with variable UV exposure time (5–40 min). (b) Dose versus intensity plot of variable UV exposure time (5–40 min).

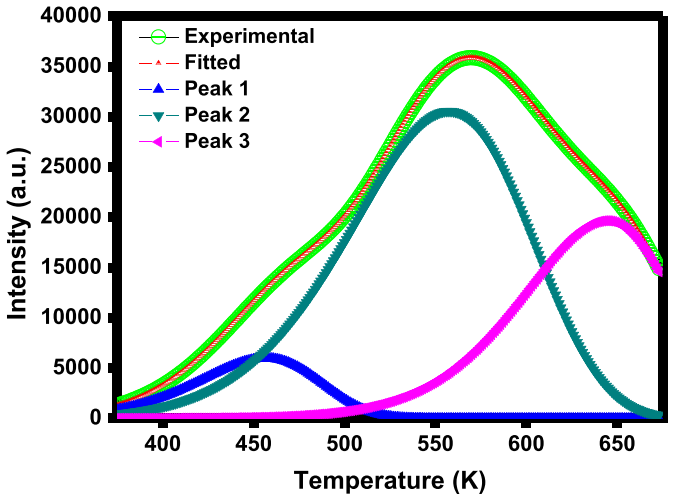


Fig. 7. CGCD pattern of $Sr_2ZnSi_2O_7$:2 mol%Dy^{3+} phosphor (2 mol% of Dy^{3+} ion) fixed UV exposure time 40 min.

Table 2
Summarization of Bragg angle, FWHM, d-spacing and crystalline size of $Sr_2ZnSi_2O_7$: Dy^{3+} (2.0 mol%) phosphor.

Peak #	2Theta (degree)	Height	FWHM (degree)	d-spacing (Å)
1	23.421	434.7	.45	3.795
2	28.328	658.6	.45	3.148
3	30.502	1424.4	.5	2.928
4	34.809	186.7	.45	2.575
5	35.597	351.4	.5	2.520
6	43.26	264.5	.5	2.089
7	47.746	126.9	.4	1.903
8	50.549	307.5	.5	1.804
9	51.673	176.3	.45	1.767
10	59.64	151.8	.5	1.549

Table 3
Kinetic parameters of Dy activated $Sr_2ZnSi_2O_7$:2 mol%Dy^{3+} using CGCD technique.

Peaks	T_1 (K)	T_m (K)	T_2 (K)	τ	δ	ω	μ = δ/ω	Activation energy E (eV)	Frequency factor s (s^{-1})
1	412	456	487	44	31	75	0.41	1.39	2×10^{09}
2	494	557	608	63	51	114	0.44	1.54	2×10^{11}
3	588	644	674	56	30	86	0.34	1.89	4×10^{11}

3.5. Thermoluminescence studies

Fig. 6(a) shows the TL glow curve of $Sr_2ZnSi_2O_7$:2 mol%Dy^{3+} recorded under variable UV exposure times (5–40 min). The TL glow curves exhibited the maximum broad hump at ~300 °C- 309 ^{0}C. The broad TL curve represents the composite nature and consisted of several peaks, which is further calculated using fitting patterns by CGCD pattern. Also, the response of the TL glow curves increases linearly with increase UV dose rate as, shown in Fig. 6(b). The linear increase in the dose rate represents good response and find potential applications in TL dosimeter. Fig. 7 represents the CGCD patterns of the of $Sr_2ZnSi_2O_7$:2 mol%Dy^{3+} phosphor observed for 40 min UV exposure. It can be observed that the broad peak at 300 ℃ consists of three more peaks. This indicates that TL glow curve has composite nature. The calculated kinetic parameters are given in Table 2. The order of kinetics of kinetics is found to be first order (μ ~0.42).

Herein from Table 3 it is clear that activation energy increases with the shifting of peaks, trap depth is low for lower temperature peak (1.39 eV) and high for high temperature peak (1.89 eV). All the peaks shows formation of single trap from the value of shape factor μ~0.42.

Fig. 8 shows the TL glow curve of prepared phosphor with various of different concentration of dysprosium ions and it shows the linearly increase with concentration of doping ion. The intensity increase with variable concentration of dopants.

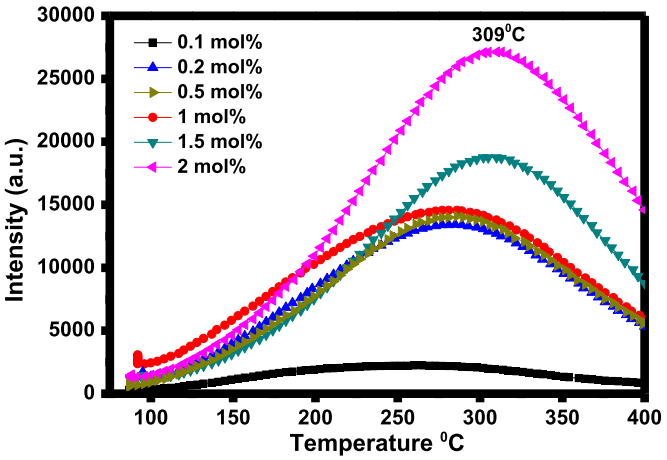


Fig. 8. TL glow curve analysis of $Sr_2ZnSi_2O_7$:Dy^{3+} phosphor (35 min UV exposure) with variable concentration of dopant (0.1–2 mol%).

4. Conclusions

In conclusion, $Sr_2ZnSi_2O_7$ doped with Dy^{3+} ions were synthesized via solid-state reaction method. XRD results confirmed the formation of pure hardystonite phase. SEM results showed that size of the synthesized phosphors lies in the micrometer range. FTIR patterns confirmed the presence of different functional groups. TL glow curve exhibited maximum intensity at 300 ℃ having composite nature. The order of kinetics followed first order and TL response rate increases with increase in UV exposure linearly. Thus, the synthesized phosphors find tremendous application in dosimeters.

Declaration of Competing Interest

I hereby declare that this manuscript is our pure and experimental work. There is no any conflict of interest.

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RESEARCH ARTICLE

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White light emission and thermoluminescence studies of Dy^{3+}-activated hardystonite ($Ca_2ZnSi_2O_7$) phosphor

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Abstract

Here, we report the photoluminescence and thermoluminescent properties of Dy-activated $Ca_2ZnSi_2O_7$ phosphors synthesized using the solid-state method. The synthesized phosphors showed hardystonite type structure, and had micron-sized particles. Fourier transform infrared spectroscopy (FTIR) showed the existence of the functional groups and confirmed the formation of phosphor and photoluminescence techniques. The phosphors under excitation at 239 nm exhibited green-yellow emission spectra in the region 481–575 nm corresponding to the $^4F_{9/2} \rightarrow {}^6H_{15/2}$ and $^4F_{9/2} \rightarrow {}^6H_{13/2}$ transitions of Dy^{3+} ions. The Commission Internationale de l'Eclairage (CIE) coordinates were achieved to be (0.25, 0.27), which was narrowly close to the white region. Thermoluminescence (TL) glow curve analysis of prepared Dy^{3+}-activated $Ca_2ZnSi_2O_7$ phosphors were recorded for different ultraviolet (UV) light exposure times and found to have a linear response with dose. The TL glow curves, recorded with various UV exposure times ranging from 5 to 25 min, showed a linear response with dosage. The corresponding kinetic parameters were also calculated using a computerized glow curve deconvolution (CGCD) technique. Activation energy was observed to enhance the increase in the peak temperature and its value was substantially higher for the third peak fitted using CGCD. The obtained results indicated that the synthesized pristine phosphors could be potentially used for lighting, displays, and dosimetric applications.

KEYWORDS
dysprosium, hardystonite, phosphors, solid-state method, TL glow curve

1 | INTRODUCTION

Rare-earth-doped white light-emitting phosphors find vast applications in various optoelectronic and display devices.[1–4] This is due to the f→f transitions in the rare-earth elements that lead to the sharp, narrow, and distinct emission spectra. To exhibit white light emission phenomena, Dy^{3+}-doped phosphors are generally used due to their transitions. However, the host material plays a significant role in achieving white light.

Among the various host lattices, silicates are promising candidates due to their low phonon energy, water resistant property, high thermal and mechanical durability, effective cost fabrication, and wide band gap structure.[5–8] To date, many silicates such as $Ca_2MgSi_2O_7$,Sr_2SiO_4, and $SrSiO_3$ are doped with Dy^{3+} ions to generate white light emission.[9–12] In the silicate family, compounds with the general structure $X_2MY_2O_7$ (X = Ca, Sr, Na; M = Mg, Zn; Y = Si, Al, B) form a melities group with a tetragonal crystal structure.[13–22]

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In the present study, we synthesized Dy^{3+}-doped $Ca_2ZnSi_2O_7$ phosphors using a solid-state method and studied their photoluminescence and thermoluminescent properties in detail. The concentration of Dy^{3+} ions was varied from 0.1 to 2 mol% in the host lattice. All the structural, morphological, and optical properties were studied in detail.

2 | EXPERIMENTAL

2.1 | Preparation of hardystonite ($Ca_2ZnSi_2O_7$) doped with Dy^{3+} phosphor

$Ca_2ZnSi_2O_7$:Dy^{3+} phosphors were prepared using a solid-state reaction technique with varying concentrations of Dy^{3+} ions (0.1–2.5 mol%). $CaCO_3$, ZnO, SiO_2, and Dy_2O_3 were used as the starting material with a proper stoichiometric ratio, H_3BO_3 (1.6 mol%) was used as a flux. All materials were thoroughly ground for nearly 2 h (using acetone for liquid griding) to obtain a homogeneous powder with the help of a mortar and pestle. The ground mixture was transferred to an alumina crucible and heated at 1000°C for 2 h in a muffle furnace. The calcined sample was ground again and subjected to heat at 1250°C for 4 h. The final calcined samples were ground to form a fine powder and used for further characterization.

X-ray diffraction (XRD) diffractograms were recorded using a Bruker AXS D8 Advance X-ray powder diffractometer with CuKα radiation (1.5406 Å) in the 2θ range 4–800. Scanning electron microscopy (SEM) images were recorded using a scanning electron microscope (JEOL/JSM-6390LV model). Quantitative analysis (EDS) was performed using an Oxford XMX N detector. Transmission electron microscopy (TEM) images were examined using a JEOL/JEM 2100 model. FTIR spectra were observed using a Bruker Alpha II ECO ATR with scanning range 600–4000 cm^{-1}. A Shimadzu RF-5301 PC spectrofluorometer was used at room temperature to observe photoluminescence (PL) emission and excitation spectra using a xenon lamp as the excitation source.[23,24] Thermoluminescence (TL) glow curves were recorded using a thermoluminescence dosimetry (TLD) reader model no. I1009 and kinetic parameters were calculated using glowfit software.[25–28]

3 | RESULTS AND DISCUSSION

3.1 | XRD analysis of prepared phosphors

XRD spectra of the Ca_2ZnSi_2O7:Dy^{3+} were studied using Match software (v.2.3.1). Figure 1 shows the comparison between observed, calculated and standard (matched) XRD patterns of $Ca_2ZnSi_2O_7$:Dy^{3+}. XRD patterns were matched convincingly with crystallographic open database (COD) card no. 96-900-8188 with figure of merit (FOM) 87% and tetragonal structure with space group $P\bar{4}2_1m$ (113). Table 1 represent the refined lattice parameters of $Ca_2ZnSi_2O_7$ with Dy^{3+} 2.0 mol%. XRD data were refined using Celref v.3 [Collaborative Computational Project No. 14 (CCP14)].[29] It was observed from Table 1 that volumes calculated for standard COD and calculated XRD patterns were the same, except that variation in the diffraction angles was due to variation in the ionic radii of the dopant and host lattice ions. The average crystallite size was calculated using Debye and Scherrer formula and observed to be in the range 16–20 nm.[25–28]

3.2 | Fourier transform infrared (FTIR) analysis

Figure 2 represents the FTIR spectra of $Ca_2ZnSi_2O_7$:2mol%Dy in the range 450–3500 cm^{-1}. The bands that appeared in the range 400–971 cm^{-1} were attributed to the presence of stretching and bending modes of the metal–oxygen (M–O) group. The bands in the range from 618 to 424 cm^{-1} corresponded to the Si–O–Si bending modes. Therefore, FTIR analysis confirmed the presence of different functional groups in the sample.

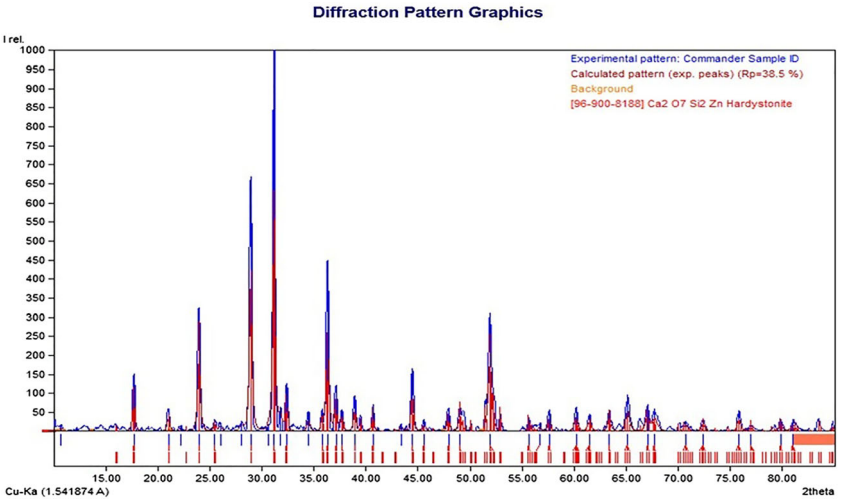


FIGURE 1 Comparison of standard (matched) and observed calculated XRD patterns of $Ca_2ZnSi_2O_7$:Dy^{3+}

TABLE 1 Refined lattice parameter of $Ca_2ZnSi_2O_7:Dy^{3+}$

Initial values: (refinement keys on second line)								
Zero	λ	a	b	c	α	β	γ	Volume
0	1.5418	7.8162	7.8162	5.0065	90	90	90	305.9
0	0	1	0	1	0	0	0	
Final values: (standard errors on second line)								
Zero	λ	a	b	c	α	β	γ	Volume
0	1.5418	7.8164	7.8164	5.0066	90	90	90	305.9
0	0	0.0067	0	0.0024	0	0	0	
h	K	l	2 T(Obs)	2 T-Zero	2Th(Cal)	Dif		
0	0	1	17.758	17.758	17.715	0.043		
1	0	1	21.101	21.101	21.0722	0.0288		
1	1	1	24.029	24.029	23.9819	0.0471		
2	0	1	29.008	29.008	28.9827	0.0253		
1	2	1	31.224	31.224	31.2058	0.0182		
2	2	0	32.425	32.425	32.3957	0.0293		
1	3	0	36.347	36.347	36.3453	0.0017		
2	2	1	37.181	37.181	37.1602	0.0208		
3	0	1	38.963	38.963	38.9681	−0.0051		
1	3	1	40.702	40.702	40.7081	−0.0061		
2	1	2	44.477	44.477	44.5157	−0.0387		
3	1	2	51.947	51.947	51.9908	−0.0438		

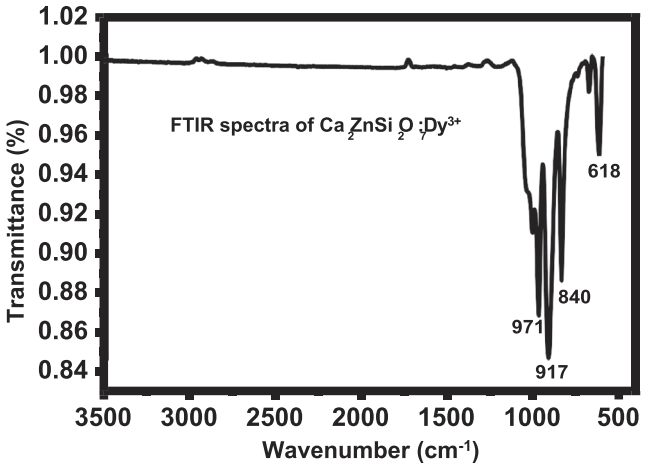


FIGURE 2 FTIR spectra of $Ca_2ZnSi_2O_7$:2mol%Dy^{3+} phosphor

3.3 | SEM images and energy-dispersive X-ray (EDX) patterns of the prepared sample

The surface morphology of the samples was studied using SEM. Figure 3(a–d) represents the SEM micrographs of the $Ca_2ZnSi_2O_7$:2mol%Dy^{3+} phosphor at different magnifications and shows the distribution of particles some of which were in the micron range.

3.4 | Photoluminescence studies

Figure 4 represents the PL emission spectra of $Ca_2ZnSi_2O_7$ doped with Dy^{3+} with varying concentrations from 0.5 to 2.5 mol%. The spectra consisted of peaks at 481, 489 and 575 nm corresponding to blue, bluish-green, and green emissions, respectively. These emission peaks were attributed to the $^4F_{9/2}$ transitions of Dy^{3+} ions. The phosphors under excitation at 239 nm exhibited green-yellow emission spectra in the region 481–575 nm corresponding to the transitions from $^4F_{9/2}\rightarrow 6H_{15/2}$ and $^4F_{9/2}\rightarrow {}^6H_{13/2}$ of Dy^{3+} ions. Among all the peaks, the peak at 481 nm was found to be an intense peak, which corresponded to the blue emission. The overall emission of the synthesized phosphors lay in the white region, which was further confirmed using the CIE coordinates.

Figure 5 represents CIE coordinates of $Ca_2ZnSi_2O_7$:2mol%Dy^{3+} phosphor. CIE coordinates were calculated using CIE coordinate finder software and found to be $x = 0.25$ and $y = 0.27$. These values lay in the bluish region and touched the white light boundary. This indicates that synthesized phosphor can be used for the fabrication of white light-emitting diodes and other solid-state and lighting applications. From the CIE coordinates it is clear that the 1.5 and 2 mol% Dy-doped phosphor was narrowly close to the white region compared with other mol%.

With the increase in Dy concentrations, the emission intensity increased systematically without any change in the peak position variation of emission intensity with Dy concentration, indicating that

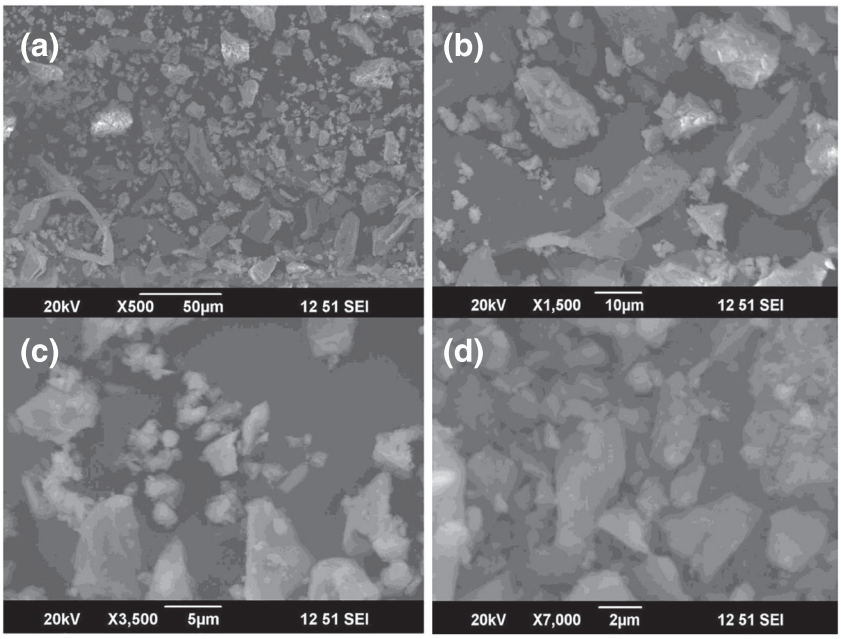


FIGURE 3 (a–d) SEM images of prepared phosphor Dy^{3+} (2 mol%)-doped $Ca_2MgSi_2O_7$

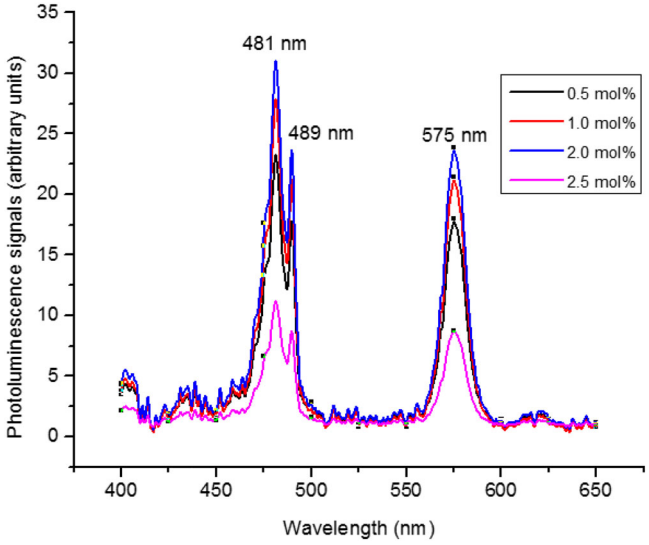


FIGURE 4 PL emission spectra of $Ca_2ZnSi_2O_7:Dy^{3+}$ with Dy^{3+} (0.5–25 mol%)

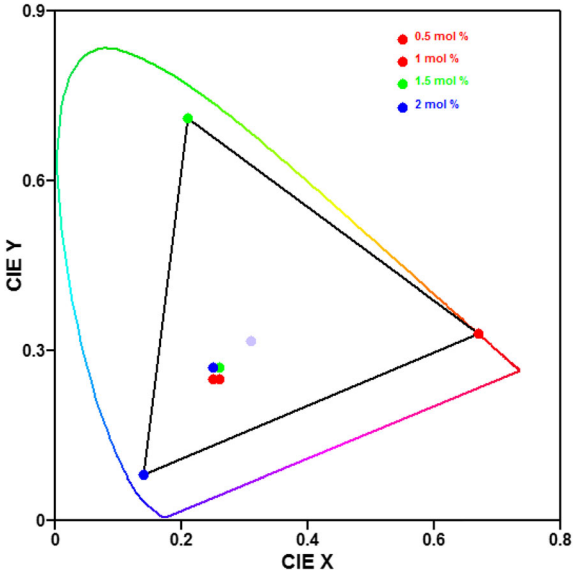
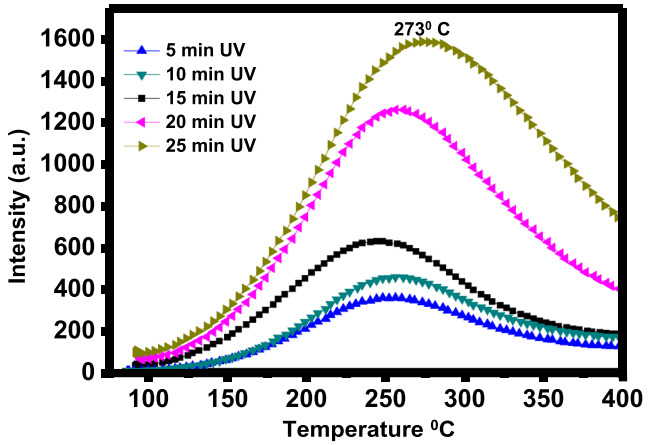


FIGURE 5 CIE coordinates of $Ca_2ZnSi_2O_7:Dy^{3+}$ phosphor (05–2 mol% Dy^{3+} ion)

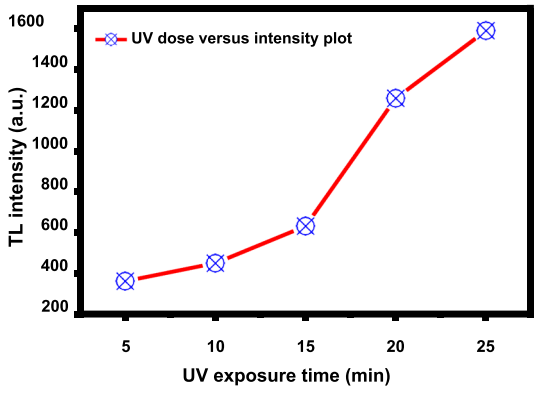
the concentration quenching occurred at 2.0 mol% of Dy ion concentration due to energy transfer from one Dy ion to another Dy ion by the coupling of phonons with electrons or by multiple interaction.[30–32]

3.5 | Thermoluminescence studies

Figure 6(a) shows the TL glow curve of $Ca_2ZnSi_2O_7$:2mol%Dy^{3+} recorded under variable UV exposure times (5–25 min). The TL glow curves exhibited a maximum broad hump at ~273°C. The broad TL curve represents the composite nature and consisted of several peaks, which was further calculated using fitting patterns and the CGCD pattern. The response of the TL glow curves increased linearly with increase in dose rate as shown in Figure 6(b). The linear increase in the dose rate represents a good response and finds potential applications in TL dosimeters. Figure 7 represents the CGCD patterns of the $Ca_2ZnSi_2O_7$:2mol% Dy^{3+} phosphor observed for 25 min UV exposure. It can be observed that the broad peak at 273°C consisted of three more peaks. This indicated that TL glow curve had a composite nature. The calculated kinetic parameters are given in Table 2. The order of kinetics was found to be first order (μ ~ 0.42).[33–45]



(a) TL glow curve analysis of $Ca_2ZnSi_2O_7:Dy^{3+}$ phosphor (2 mol% of Dy^{3+} ion) with variable UV exposure time (5-25 minutes)



(b) dose versus intensity plot for TL glow curve

FIGURE 6 (a) TL glow curve analysis of $Ca_2ZnSi_2O_7:Dy^{3+}$ phosphor (2 mol% Dy^{3+} ion) with variable UV exposure time (5–25 min). (b) Dose versus intensity plot for TL glow curve

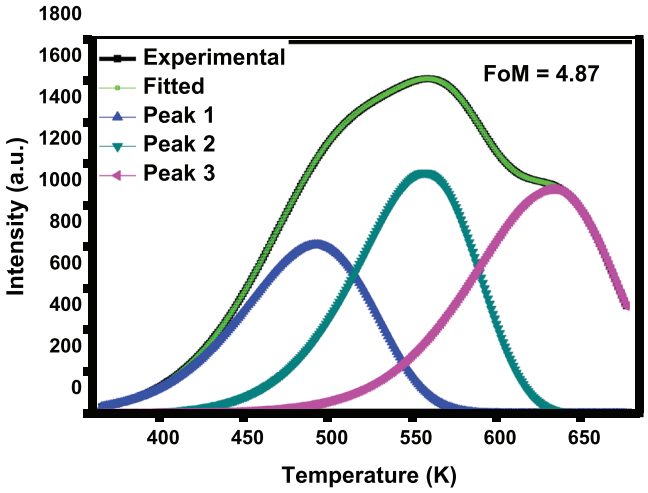


FIGURE 7 CGCD pattern of $Ca_2ZnSi_2O_7:2mol\%Dy^{3+}$ phosphor (2 mol% Dy^{3+} ion) fixed UV exposure time 25 min

TABLE 2 Shape factors (μ) determines order of kinetics, activation energy (E) and frequency factor (s) for $Ca_2ZnSi_2O_7:2mol\%Dy^{3+}$ phosphor fixed for a 25 min UV exposure

Peaks	T1 (K)	Tm (K)	T2 (K)	τ	δ	ω	μ = δ/ω	Activation energy (E) eV	Frequency factor S (s^{-1})
1	444	493	530	49	37	86	0.43	1.52	1×10^{10}
2	511	558	593	47	35	82	0.42	1.81	2×10^{11}
3	577	635	676	58	41	99	0.41	1.88	8×10^{12}

4 | CONCLUSION

In conclusion, $Ca_2ZnSi_2O_7$ doped with Dy^{3+} ions were synthesized using a solid-state method. XRD results confirmed the formation of a pure hardystonite phase. SEM results showed that size of the synthesized phosphors lay in the micrometre range. FTIR patterns confirmed the presence of different functional groups. PL intensity was found for the sample doped with 2 mol% Dy ions and CIE coordinates lay close to the white region boundary. The main PL peaks were observed at 481, 489 and 575 nm. TL glow curves exhibited maximum intensity at 273°C having a composite nature. The order of kinetics followed first order and TL response rate increased linearly with increase in UV exposure. Therefore, the synthesized phosphors would find tremendous applications in optoelectronic devices and dosimeters.

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Disturbances in solar wind plasma flow and geomagnetic field disturbances during the period of 2012-2020

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Abstract

We have analyzed intense geomagnetic storms (≤-100nT) observed between 2012 and 2020 with disturbances in solar wind plasma parameters southward component of interplanetary magnetic fields (IMFBz) GSE, interplanetary magnetic field (IMF), solar wind plasma pressure (P), and solar wind plasma temperature (T). We have observed that all the intense geomagnetic storms are associated with disturbances in solar wind plasma parameters. We have determined a large positive correlation with a correlation coefficient of 0.61 between the magnitude of intense geomagnetic storms and the peak value of disturbances in IMFBz, 0.60 between the magnitude of intense geomagnetic storms and magnitude of disturbances in IMFBz. 0.71 between the magnitude of intense geomagnetic storms and the peak value of disturbances in interplanetary magnetic fields (IMFB),0.66 between the magnitude of intense geomagnetic storms and magnitude of disturbances in interplanetary magnetic fields(IMFB). Further, we have obtained large positive correlation with a correlation coefficient of 0.68 between the magnitude of intense geomagnetic storms and the peak value of disturbances in solar wind plasma pressure and 0.62 between the magnitude of intense geomagnetic storms and magnitude of disturbances in solar wind plasma pressure. Positive correlation with correlation coefficient 0.37 between the magnitude of intense

geomagnetic storms and the peak value of disturbances in solar wind plasma temperature, 0.33 between the magnitude of intense geomagnetic storms and magnitude of disturbances in solar wind plasma temperature has also been determined. We have concluded that disturbances in solar wind plasma parameters southward component of interplanetary magnetic fields, interplanetary magnetic fields, solar wind plasma pressure play a crucial role to generate intense geomagnetic storms.

Keywords: Intense geomagnetic storms, Interplanetary magnetic fields, Southward component of interplanetary magnetic fields, solar wind plasma temperature and solar wind plasma pressure.

1. INTRODUCTION

The solar wind consists of charged particles, primarily electrons, and protons, flowing outward from the Sun, It contains a large amount of kinetic and electrical energy. When the energy centers inside the magnetosphere it creates turmoil to the geomagnetic activity which ultimately results in the geomagnetic storms, sub-storms, and aurora (Chapman, Bartels 1962, Gonzalez et.al, 1994). All the geomagnetic disturbances occurring over short periods are measured by geomagnetic indices. The main indices used to measure variations in the earth's magnetic field strength are- Dst index and the AE index (Rostoker, 1972). The short time disturbance (Dst) index is the index that is used to monitor the worldwide magnetic storm level. It is constructed by averaging H from mid-latitude and equatorial magnetograms from all over the world. The values of the Dst index are negative which means that a magnetic storm is in progress. This is due to the storm time ring current which flows around the earth from east to west in the equatorial plane. The more negative value of Dst the more the intensity of the magnetic storm. The geomagnetic storms are classified into the four categories as per the value of Dst as suggested as weak (-30nT to -50nT); moderate (-50nT to -99nT); intense (-100nT to -250nT) and very intense (-250nT an above) (Gonzalez.et.al; 1994). The occurrence of a geomagnetic storm depends upon the solar conditions, particularly the southward interplanetary

magnetic field (IMF) component and most strong geomagnetic storms are associated with high-speed streams of solar wind plasma related to corotating interaction regions (CIRs) or coronal mass ejections (CMEs) (Gosling et al., 1991; Tsurutani et al., 1995; Gosling,1993; Crooker and Cliver, 1994; McAllister and Crooker, 1997; Kamide et al., 1998; Gonzalez et al., 1999). The primary cause of geomagnetic storms is a strong dawn-to-dusk electric field associated with southward IMF (Tsurutani et al., 1992; Gonzalez et al., 1994). It may also be a result of a shocked and compressed ambient field due to the interaction of high-speed plasma with slower solar wind plasma (Gosling et al., 1991; Gosling, 1993; Tsurutani et al., 1992, 1995; Crooker and Cliver, 1994; McAlister and Crooker, 1997). Lyatsky and A. Tan (2003) have studied geomagnetic storms with solar disturbances and concluded that the averaged disturbance in the solar wind responsible for geomagnetic storms is associated with the compression of ambient solar wind plasma and interplanetary magnetic field (IMF) ahead of high-speed plasma flow. The magnetic field strength and plasma density start to increase several hours before the geomagnetic storm onset. Some other scientists have studied disturbances in solar wind plasma velocity, density, speed temperature, and interplanetary magnetic field and concluded that geomagnetic storms are well associated with disturbances in solar wind plasma parameters (Pizzo,1997; Vandas et al., 1997; Crooker et al., 2000; Wu et al.,2001, Vrma 2009, Verma, 2012, Verma 2014). Weigel (2010) quantified the influence of solar wind density using two statistical measures and concluded that the solar wind density modifies the ability of a given value of the solar wind electric field to create a Dst perturbation. Ayush et al. (2017) studied the association between geomagnetic storms and solar wind plasma parameters IMF Bz, density, temperature, and velocity and results obtained strongly suggest that IMF Bz has a strong impact on the cause of geomagnetic storms. Balveer, S., et al (2014) have reported that the Dst of geomagnetic storms had a strong correlation with solar wind velocity, IMF B.

2. Experimental Data

Table - Intense geomagnetic storms and associated disturbances in solar wind plasma parameters for the period of 2012-2020.

Intense Geomagnetic Storms			Disturbance in IMFBz (GSE)			Disturbance in IMFB			Disturbance in Solar wind plasma pressure			Disturbance in solar wind plasma temperature		
Year	0nset Time	Magnitude Dst (nT)	Disturbance Start time	Disturbance Peak value	Disturbance Magnitude	Disturbance Start time	Disturbance Peak value	Disturbance magnitude	Disturbance Start time	Disturbance Peak value	Disturbance magnitude	Disturbance Start time	Disturbance Peak value (k)	Disturbance magnitude
2012	68(13)	-145	69(2)	-16.1	-9.6	69(1)	16.6	10.8	68 (22)	7.61	6.71	68(20)	1818664	1558851
2012	114(8)	-118	114(16)	-14.7	-11.2	114(11)	15.4	7.1	116 (20)	8.33	7	114(3)	155265	98307
2012	196(23)	-137	197(6)	-17.7	-14.5	197(5)	27.3	24.5	197 (2)	14.38	10.15	196(16)	356942	319093
2012	274(14)	-127	274(21)	-17.1	-14.3	274(19)	20.6	13.6	274 (18)	6.49	5.13	276(0)	151414	126172
2012	281(17)	-106	282(18)	-15.6	-17.5	282(13)	16.1	8.1	283 (12)	4.76	3.22	283(12)	294321	274900
2012	318(18)	-106	318(22)	-17.5	-11.2	318(4)	22.8	17.5	318 (21)	4.58	3.51	319(2)	528307	506750
2013	76(7)	-127	76(15)	-10	-6.1	76(7)	14.6	13.3	76 (5)	12.24	11.24	76(4)	516490	457921
2013	151 (15)	-123	151(17)	-17.5	-12.6	151(19)	17.8	13	152 (5)	6.57	2.97	152(16)	566494	367429
2013	179(1)	-105	179(16)	-11.5	-4.4	179(13)	12.4	3.5	180 (3)	4.41	2.73	181(8)	234652	149922
2014	49 (14)	-118	50(2)	-14.5	-9.3	49(13)	18.3	15.2	50 (10)	11.44	8.15	49(23)	310812	286184
2015	76(7)	-217	76(9)	-24.1	-23.5	76(2)	30.5	23.9	76 (4)	17.99	12.86	76(4)	649319	609355
2015	173(18)	-196	173(17)	-26.3	-24.2	173(12)	37.7	30.2	173 (15)	37.89	33.12	173(20)	1222590	686176
2015	280(2)	-115	280(18)	-4.9	-4.8	280(2)	20.4	10	280(7)	9.51	5.6	280(13)	562108	478699
2015	353(10)	-153	354(12)	-18.1	-9.1	354(11)	19.5	12.1	354 (2)	19.72	12.92	353(14)	74994	38107
2015	365(4)	-106	365(14)	-16.1	-12.3	365(14)	16.7	9	365 (1)	10.35	8.04	1(4)	151919	141548
2017	147(13)	-130	147(20)	-21.4	-20.8	147(20)	22.5	20.8	147 (10)	15.37	14.47	148(17)	90995	53310
2017	250 (19)	-135	250(22)	-23.6	-15.5	250(20)	24.9	17.9	251 (4)	7.93	5.17	253(7)	269221	175246
2018	237(18)	-166	237(16)	-14.7	-11.1	237(11)	18.1	12.4	238 (2)	6.02	2.37	238(7)	305987	289415

In this investigation, hourly Dst indices of geomagnetic field have been used over the period 2012 through 2020 to determine onset time, maximum depression time, the magnitude of intense geomagnetic storms. This data has been taken from the NSSDC Omni web data system (http;//omniweb.gsfc.nasa.gov/form/dxi.html)).which has been created in late 1994 for enhanced access to the near-earth solar wind, magnetic field, and plasma data of Omni data set, which consists of one-hour resolution near the earth, solar wind magnetic field and plasma data, energetic proton fluxes and geomagnetic and solar activity indices. To determine disturbances in solar wind plasma parameters, hourly data of solar wind plasma temperature, pressure and interplanetary magnetic field, the southward component of interplanetary magnetic fields has been used and these data have also been taken from Omni web data (http;//omniweb.gsfc.nasa.gov/form/dxi.html)). We investigate 18 intense geomagnetic storms observed between 2012 and 2020 with solar wind plasma parameters southward component of interplanetary magnetic fields (IMFBz) GSE, interplanetary magnetic fields (IMFB), solar wind plasma temperature, and solar wind plasma pressure. We used statistical methods association and correlation for the data analysis of intense geomagnetic storms and solar wind plasma parameters**.**

3. DATA ANALYSIS AND RESULTS

This study uses statistical method association and correlation for data analysis of the observed intense geomagnetic storms with disturbances in solar wind plasma parameters. Statistical method correlation has been used to see how the magnitude of intense geomagnetic storms is correlated with disturbances in solar wind plasma parameters.

1-From the data analysis of intense geomagnetic storms and associated disturbances in a southward component of interplanetary magnetic fields (IMFBz) given in Table and Figure 1,2 it is observed that all the intense geomagnetic storms are associated with disturbances in the southward component of interplanetary magnetic fields (IMFBz) with lowest peak value -4.9 nT to highest peak value -26.3nT and lowest magnitude -4.8nT to highest magnitude -24.2 nT. Most of the intense geomagnetic storms of higher magnitudes are associated with relatively higher peak value disturbances in IMFBz. The trend line of scatter plot between the magnitude of intense geomagnetic storms and the peak value of IMFBz given in Figure 1 and magnitude of intense geomagnetic storms and magnitude of disturbances in IMFBz given in Figure 2 shows a strong positive correlation. A large positive correlation with correlation coefficient 0.61 between peak values of disturbances in IMFBz and magnitude of intense geomagnetic storms and 0.66 between the magnitude of disturbances in IMFBz and magnitude of intense geomagnetic storms have been obtained by statistical methods.

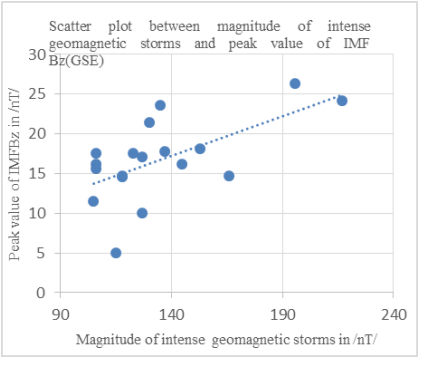


Figure 1-Shows scatter plot between the magnitude of intense geomagnetic storms and the peak value of disturbances in IMFBz (GSE).

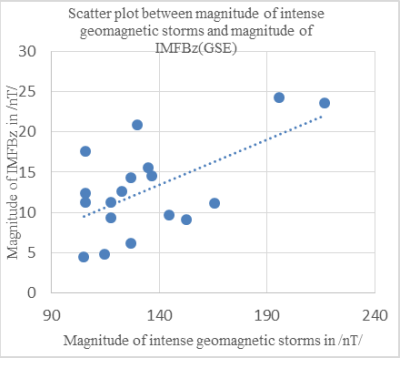


Figure 2-Shows scatter plot between the magnitude of intense geomagnetic storms and the magnitude of disturbances in IMFBz (GSE).

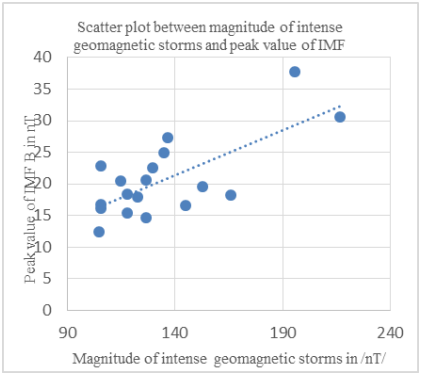


Figure 3-Shows scatter plot between the magnitude of intense geomagnetic storms and the peak value of disturbances in IMFB.

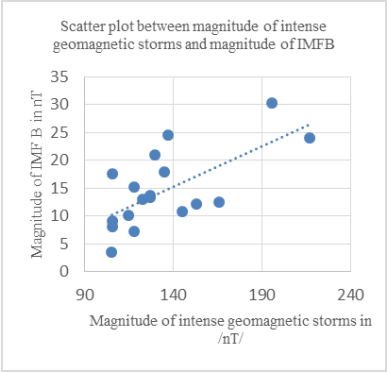


Figure 4-Shows scatter plot between the magnitude of intense geomagnetic storms and the magnitude of disturbances in IMFB.

2-The results of the data analysis of intense geomagnetic storms and associated disturbances in interplanetary magnetic fields (IMFB) given in Table and Figure 3,4 shows that all the intense geomagnetic storms are associated with disturbances in interplanetary magnetic fields (IMFB) with the lowest peak value 12.4nT, and highest peak value 37.7nT and lowest magnitude 3.5nTand highest magnitude 30.2nT. It is also seen that the disturbances in IMFB following the onset time of intense geomagnetic storms. The trend line of the scatter plot between the magnitude of intense geomagnetic storms and the peak value of IMFB (Figure 3) and magnitude of intense geomagnetic storms and magnitude of disturbances in IMFB given in Figure 4 shows a strong positive correlation. We have determined a large positive correlation with a correlation coefficient of 0.71 between peak values of disturbances in IMFB and magnitude of intense geomagnetic storms and 0.66 between the magnitude of disturbances in IMFB and magnitude of intense geomagnetic storms have been by statistical methods.

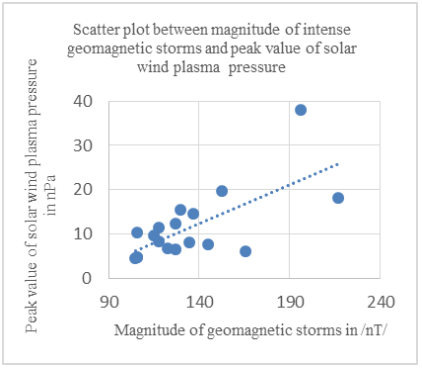


Figure 5-Shows scatter plot between the magnitude of intense geomagnetic storms and the peak value of disturbances in solar wind plasma pressure

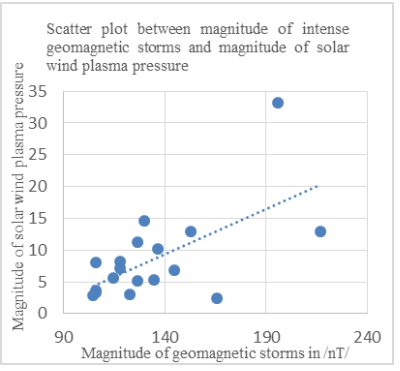


Figure 6-Shows scatter plot between the magnitude of intense geomagnetic storms and the magnitude of disturbances in solar wind plasma pressure

3-The association and correlation results between intense geomagnetic storms and disturbances in solar wind plasma pressure given in Table and Figure 5,6 shows that all the intense geomagnetic storms are associated with disturbances in solar wind plasma pressure with the lowest peak value 4.41 nPa, and highest peak value 12.24 nPa , lowest magnitude 2.37nPa and highest magnitude 33.12 nPa. The trend line of scatter plot between the magnitude of intense geomagnetic storms and the peak value of solar wind plasma pressure (Figure 5) and magnitude of intense geomagnetic storms and magnitude of disturbances in solar wind plasma pressure given in Figure 6 shows a strong positive correlation. A large positive correlation with a correlation coefficient of 0.68 between the peak value of disturbances in solar wind plasma pressure and magnitude of intense geomagnetic storms and 0.62 between the magnitude of disturbances in solar wind plasma pressure and magnitude of intense geomagnetic storms have been obtained by statistical methods.

4-From the data analysis of intense geomagnetic storms and associated disturbances in solar wind plasma temperature given in Table and Figure 7,8 it is observed that all the intense geomagnetic storms are associated with disturbances in solar wind plasma temperature with the lowest peak value 74994^{o}k and highest peak value 1818664 ^{o}k and lowest magnitude 38107 ^{o}k and highest magnitude1558851 ^{o}k. The trend line of scatter plot between the

magnitude of intense geomagnetic storms and the peak value of solar wind plasma temperature (Figure7) and magnitude of intense geomagnetic storms and magnitude of disturbances in solar wind plasma pressure given in Figure 8 shows positive correlation. Positive correlation with correlation coefficient 0.37 between the peak value of disturbances in solar wind plasma temperature and magnitude of intense geomagnetic storms and 0.33 between the magnitude of disturbances in solar wind plasma temperature and magnitude of intense geomagnetic storms have been obtained by statistical methods.

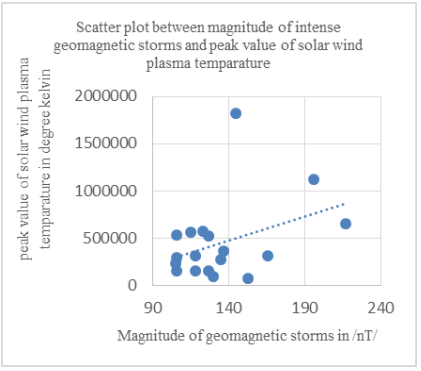


Figure 7-Shows scatter plot between the magnitude of intense geomagnetic storms and the peak value of disturbances in solar wind plasma temperature.

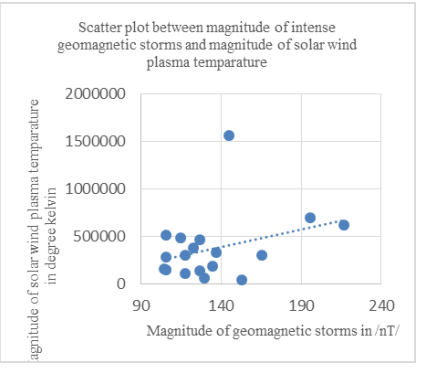


Figure 8-Shows scatter plot between the magnitude of intense geomagnetic storms and the magnitude of solar wind plasma temperature.

4. CONCLUSION

In this study, intense geomagnetic storms observed from 2012 to 2020 are studied with disturbances in solar wind plasma parameters. From the analysis of intense geomagnetic storms and their association with disturbances in solar wind plasma parameters, it is seen that all the intense geomagnetic storms are associated with disturbances in plasma parameters. To see the trend of the correlation, scatter plots has been plotted between the magnitude of intense geomagnetic storms and magnitudes of associated disturbances in solar wind plasma parameters interplanetary magnetic fields and the southward component of interplanetary magnetic fields, solar wind plasma pressure, temperature (Figure-1,2,3,4,5,6,7,8), the trend line of the figure shows the positive correlation between the magnitude of

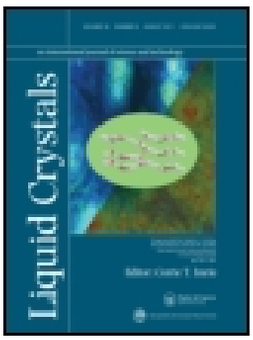
intense geomagnetic storms and peak values of associated disturbances in solar wind plasma parameters and magnitude of intense geomagnetic storms and magnitude of associated disturbances in solar wind plasma parameters. A large positive correlation with a correlation coefficient of 0.61 has been found between the magnitude of intense geomagnetic storms and the peak value of disturbances in the southward component of interplanetary magnetic fields (IMFBz) and 0.60 between the magnitude of intense geomagnetic storms and magnitude of disturbances in the southward component of interplanetary magnetic fields (IMFBz). A large positive correlation with a correlation coefficient of 0.71 has also been found between the magnitude of intense geomagnetic storms and the peak value of disturbances in interplanetary magnetic fields (IMFB) and 0.66 between the magnitude of intense geomagnetic storms and magnitude of disturbances in interplanetary magnetic fields (IMFB). 0.68 between the magnitude of intense geomagnetic storms and the peak value of disturbances in solar wind plasma pressure and 0.62 between the magnitude of intense geomagnetic storms and magnitude of disturbances in solar wind plasma pressure. From the further analysis, a positive correlation with a correlation coefficient of 0.37 has been determined between the magnitude of intense geomagnetic storms and the peak value of disturbances in solar wind plasma temperature and 0.30 between the magnitude of intense geomagnetic storms and magnitude of disturbances in solar wind plasma temperature. The study of an intense geomagnetic storm is an important issue for the study of space weather. The solar wind plasma pressure, temperature, specially IMFB and IMFBz is an important parameter that indicates the presence of the geomagnetic storm. In this research, we study solar wind parameters southward component of interplanetary magnetic fields (IMFBz) GSE, interplanetary magnetic fields (IMFB), solar wind plasma pressure, solar wind plasma temperature, and intense geomagnetic storms using the Dst index. We have used correlation analysis of the magnitude of intense geomagnetic storms with peak and magnitude of associated disturbances in solar wind plasma temperature, pressure, interplanetary magnetic field (IMFB), and the southward component of the interplanetary magnetic field (IMFBz) GSE. we have observed that the correlation coefficient which we obtained from this research

work, strongly suggests that the solar wind plasma pressure, interplanetary magnetic fields, and the southward component of interplanetary magnetic fields has a strong impact to generate intense geomagnetic storms in the magnetosphere of the earth.

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Liquid Crystals

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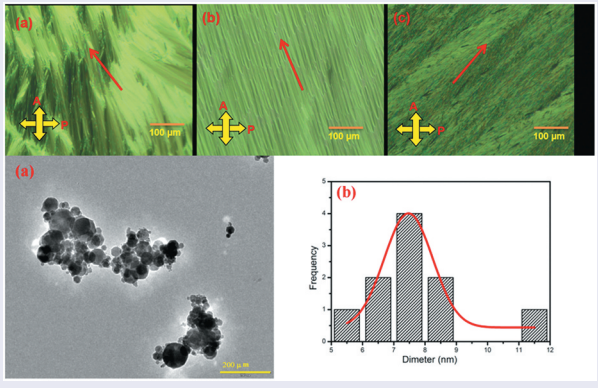
Dielectric and electro-optical properties of ferric oxide nanoparticles doped 4-octyloxy-4′ cyanobiphenyl liquid crystal-based nanocomposites for advanced display systems

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ABSTRACT

Doping of ferric oxide (Fe_2O_3) nanoparticles in 4-octyloxy-4′ cyanobiphenyl (8OCB) liquid crystal compound embedded in sample cells formed by photolithographic technique. The dielectric spectroscopy is investigated over a wide frequency from 500 Hz to 10 MHz. Various parameters such as switching time (τ_{on} and τ_{off}), dielectric permittivity (ε′), dielectric loss (ε″), relaxation frequency and optical texture of pristine 8OCB and 8OCB-Fe_2O_3 nanocomposite were investigated as functions of frequency and temperature. Moreover, splay elastic constant (k_{11}), rotational viscosity (γ) as a function of weight % of Fe_2O_3 NPs have also been investigated. These values are strongly affected by the presence of Fe_2O_3 NPs due to the enhancement of molecular ordering. The doped Fe_2O_3 NPs within the 8OCB LC may align along the director $\tilde{\boldsymbol{n}}$ strongly favours a splay distortion of $\tilde{\boldsymbol{n}}$ as the orientational order is increased. Optical image showed an improved molecular ordering of 8OCB with doping of Fe_2O_3 NPs. The dielectric anisotropy (Δε) of 8OCB-Fe_2O_3 nanocomposites was found to be reduced whereas threshold voltage (V_{th}) increased with increasing the doping of Fe_2O_3 NPs within the 8OCB. In addition to this, Fe_2O_3 NPs alter the magnitude of the perpendicular and parallel component of dielectric permittivity of nanocomposite.



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Dielectric permittivity; dielectric relaxation spectra; nanoparticles; response time; threshold voltage; doping; splay elastic constant; rotational viscosity

I. Introduction

Liquid crystals (LCs)-based composites and nanocomposites are found to be most promising materials for display and photonic devices [1–5]. Among all emerging research on LCs, one of the current research areas is the doping of nanostructure materials. In last few years, LC nanocomposites consisting nanoparticles (NPs) have attractive great deal of attention towards the development of multifunctional LC-based devices [6–15]. Efforts have been made to enhance the properties of LCs by dispersion of NPs with different shape and size [6–15]. The increasing interests towards LC nanocomposites have been made for various mesogenic phases with different NPs [12–15]. The characteristic feature of NPs found to tune the properties of nematic, cholesteric, smectic and smectic C* (ferroelectric) LC mixtures [12–15]. For illustration, nematic and cholesteric LCs should be perfectly aligned in

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homeotropic and planar geometries with the aid of doping NPs. A NP has the characteristic that at least one of its measurements is limited to between 1 and 100 nm. The finding of combinations where each variable incorporates a qualitatively different behaviour in composites is an important fact. These nanocomposites are expected to play a critical part within the developing field of nanotechnology having some unique material properties. The ability of controlling the orientation of the LC molecules in nanocomposite is essential for many applications such as liquid crystal displays (LCD) [12], field-effect transistors [13], optically active coatings and sensors [14–16]. The commercial use of nanocomposites in the LCD market has been fully appreciated based on the advantages of the LC phase, combining orders and mobility allowing low power consumption, high efficiency, low cost and compactness of devices. Homogeneous alignment of LC molecules can be achieved by the deposition of NPs on the polymer substrates or by the doping of NPs in pristine mixture to alter the properties of LC [17–19]. NPs should be proper mix in long range order of nematic LC with no aggregation. With respect to the director, the mixture can be realigned in the direction of the electric field. In addition, a parallel and homeotropic geometry can be anchored by specifying the different aspect ratio of NPs doped in the LC [19,20]. Many researchers studied on the properties for the doping of NPs in LCs with the function of temperature and frequency. They have found the increases in the dielectric properties of LC with the addition of NPs. Kaur et al [6] studied the effect of silica NPs on the dielectric and electro-optical properties of ferroelectric LC, and observed that due to the presence of silica NPs the values of spontaneous polarisation are decreased whereas the dielectric permittivity and conductivity have improved. Interestingly, efforts have also been made [6–10] to analysed the electrical properties of LC with the doping of NPs to tune the electro-optical parameters of LC under the electric and magnetic field. Mair et al [21] has studied the electric field response and contrast agent based on LCs and magnetic NPs. They reported an increased layer spacing and electric field excitation with the doping of magnetic NPs in smectic mesogenic phase. The interaction of the excited NPs with LC layer spacing in increased. Singh et al [22] has first time reported the V–I (voltage-current) characteristics of the CdSe quantum dots assembly in ferroelectric liquid crystal (FLC). They found current sensitivity upto pico-ampere due to the formation of charge transfer complex between NPs and FLC molecules. Previously, our group has [23] also reported the doping of polymer in nematic MBBA (p-methoxybenzylidene-p-butylaniline) LC with function of frequency and temperature. They have found fast switching of LC molecules and beautiful flower texture in the polymer stabilised LC. Much attention has recently been paid to studying the behaviour of suspensions of NPs in mesogenic phases. The significant properties of LC based nanocomposites such as dielectric permittivity, dielectric loss, threshold voltage, splay constant, rotational viscosity and response is influenced by varying electric field, temperature and frequency. The size and shape of NPs inside LC molecules does not cause any defects, but significantly alters the physical and phase transition properties of nanocomposite LCs [24–27]. If NPs have magnetic and electric dipole moments, then coupling takes place between these moments and hence the orientation field enhanced or altered the response of molecules with applied electric field [24–27]. Loudit and Poulin [28] examined defects around a large particle under an applied electric field in LCs, whereas Qi et.al [26] found a strong influence of gold nano-clusters on the Frederick's transition. Kundu et al. [29] studied the temperature dependence of splay and bend elastic constants in the nematic phase mixtures of 8OCB and bent-core compound. They have described the results on the basis of mutual orientation of 8OCB LC in the existence of short-range smectic fluctuations. In present paper, we prepared Fe_2O_3 NPs doped 8OCB LC nanocomposites and evaluated various properties necessary for the development of an advanced display. However, the switching behaviour of the LC devices is an important factor to the improving the quality of display. The electro-optical switching response of LC molecules ($\Delta\varepsilon > 0$) has been measured by using the planar aligned sample cells. The optical switching time of LC is generally divided into two parts, namely, rise time and fall time. Both parts are very sensitive to LC physical parameters, cell conditions and electrical operations. The switching time of nematic LC devices is usually in the range of milliseconds. It is noteworthy that the attempts were developed for faster response of LC molecules, including alignment technology and doping of Fe_2O_3 NPs in pristine 8OCB LCs. The response time of all these devices, however, is still in the range of several milliseconds, and not feasible for the faster speeds needed for multifield sequential displays. It has been

shown that, doping of Fe_2O_3 NPs is an efficient way to tune the dielectric and electro-optic properties of 8OCB. The dielectric parameters of Fe_2O_3 NPs and its nanocomposites such as dielectric permittivity, dielectric loss and relaxation frequency along with electro-optical parameter such as threshold voltage, rise and fall time were measured with respect to the change of temperature, frequency and the electric field.

Experimental details

Materials

8OCB and Fe_2O_3 NPs were purchased from Sigma-Aldrich India. The structural formulae and phase sequences are shown in Figure 1. 8OCB is a single molecular compound with a positive dielectric anisotropy due to the cyano end group.

Preparation of Fe_2O_3 NPs-doped 8OCB nanocomposite

The Fe_2O_3 NPs of size around 6 ~ 12 nm were dispersed in chloroform ($CHCl_3$) and stirred for some time to minimise particles agglomeration. Thereafter, 0.5 and 1.0 wt % of Fe_2O_3 NPs solution was mixed with 8OCB in glass vessels. The resulting nanocomposite mixture was sonicated for 2 hours. The proper mixing of Fe_2O_3 NPs with 8OCB in LC sample cells was confirmed by polarising optical microscope (POM) image. This uniform mixture showed no evidence of sedimentation over a period of weeks. The glass vessel together with stirrer was placed in a fume hood, and chloroform was allowed to gradually evaporate at ~70°C at ambient pressure until the sample showed constant mass. The samples were subjected for the constancy. The evaporation of chloroform in 8OCB and Fe_2O_3 NPs doped LC filled in sample cells by capillary action at a temperature 5°C above the isotropic temperature.

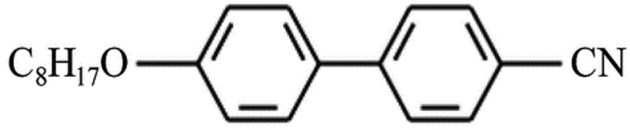
Sample cell fabrication

LC sample cells were prepared by using two indium tin oxide (ITO)-coated glass plates. The required pattern on ITO glass plates were fabricated by photolithography techniques. The thickness of the two ITO glass plates was uniformly sustained by placing a mylar spacer between them. The planar alignment on the striped glass plates was achieved by using regular rubbed polyimide techniques [23]. To obtain the cells with planar and homeotropic alignment, nylon, 6/6 and lecithin were spin coated on the substrate surfaces, respectively. Spin coating was done at 3000 RPM for 30 second. The coated substrates were prebaked at 100°C for 10 minutes on a hot plate and annealed at 180°C for 1 hour. The pristine and Fe_2O_3 NPs doped LC were filled into 6 μm thick aforementioned cell via capillary action. The structure was then sealed with epoxy, and placed inside an Instec (HCS-302) hot stage with a temperature precision of ±0.1°C. The temperature was adjusted to 80°C and to obtain isotropic phase. The samples cells were then cooled down with a rate of 0.2°C/min in the presence of the electric field. The LC director aligned along the electric field, and structural evolution was investigated systematically while cooling down to 66°C.

Characterisation

Dielectric measurement

The dielectric parameter of pristine and Fe_2O_3 NPs-doped LC was estimated with the help of Impedance/Gain Analyser (HP4194A) using the cell as a capacitor (area 25 mm^2 and thickness 6 μm) in the frequency range (500 Hz to



Molecular weight 307.43 g

Cr 52.86 SmA 66.5 N 79.10 I (°C)

Figure 1. Molecular structures and phase sequences exhibited of 4-n-octyloxy 4′-cyanobiphenyl (8OCB) compound.

10 MHz). The dielectric permittivity and dielectric loss were calculated from the measured capacitance and conductance. The experiments were performed at a very slow heating rate by using Instec Hot plate (HCS-302) with a precision of ±0.01°C. After reaching the desired temperature the sample holder was kept for 10 minutes at the same temperature before measurement to ensure that the thermal equilibrium is sustained between the hot plate and the sample cells. The components of the complex dielectric permittivity in pristine and NPs doped LC in two geometries, $E_{\parallel}n$ and $E\perp n$.

Electro-optical switching measurement

The electro-optical response of pristine and Fe_2O_3 NPs-doped LC were measured by phase modulation optical switching technique using a planar alignment cell as a response of applied voltage and temperature [30]. In this technique a waveform (frequency 1 kHz and amplitude 28Vpp, offset 0 V, positive half cycle) was applied to the planar aligned cell. The optical response of the LC molecules received from the photodetector (Instec-PD02LI) was directly integrated to the digital storage oscilloscope (Tektronix TDS-2024 C). The output electrical signal is then used to estimate the switching time (rise and fall time) of pristine and 0.5 and 1.0 wt.% Fe_2O_3 NPs-doped LC. The rise time (τ_{on}) and fall time (τ_{off}) have been evaluated by using equation (1) [30].

$$\tau_{on} = \tau_{90} - \tau_{10} \text{ and } \tau_{off} = \tau_{10} - \tau_{90} \quad (1)$$

Where τ_{90} and τ_{10} are the time taken by the output waveform to reach 90% and 10% compared to the reference square wave. The rise time of the pristine and nanocomposites has been measured by using planar aligned cells was monitored placing it at ±45° with respect to crossed position of polariser and analyser. A laser beam (He-Ne, λ = 632.8 nm) goes through the polariser (P), planar aligned sample cells and the analyser (A) with the polarisation orientation perpendicular to that of the polariser [30,31].

Results and discussion

To check the size and shape of Fe_2O_3 NPs, high resolution transmission electron microscope (TEM) analysis was performed by using FEI: Technai $20G^2$ and images are shown in Figure 2(a). It is evident from the figure that the particles are spherical in shape, with an average diameter of 6 ~ 12 nm and a small size distribution. The size of NPs was estimated using Image J software and shown in Figure 2(b). The average particle size of Fe_2O_3 NPs was found to be 8 nm. In addition, the polarising optical texture of pristine and NPs-doped LC is shown in Figure 3. From the figure it is clear that, the alignments of LC molecules were improved with the doping of Fe_2O_3 NPs. The alignment mechanism is related to the orientation ordering of LC molecules that in fact depends on the intermolecular interactions between LC molecules and polyimide layer. Hwang et. al [15] have also reported the alignment and controlling of LC molecules doping different concentrations of polyhedral oligomeric silsesquioxane (POSS) NPs in nematic LC.

Dielectric properties

The dielectric permittivity (ε′) and dielectric loss (ε″) are two essential parameters for calculating

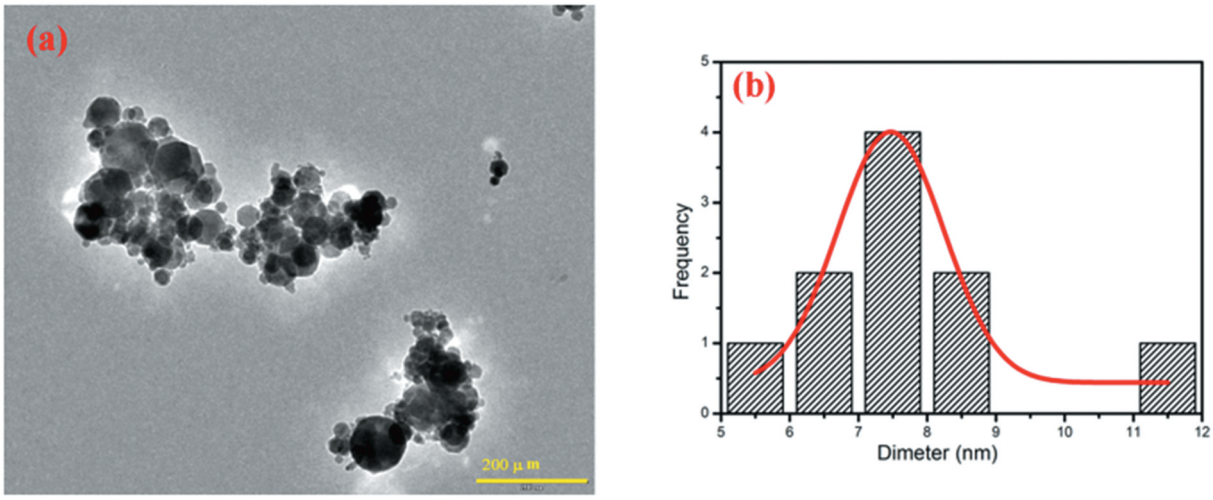


Figure 2. (Colour online) (a) Transmission electron micrograph (TEM) image of the Fe_2O_3 NPs, (b) histogram of the particle size (diameter) distribution of Fe_2O_3 NPs.

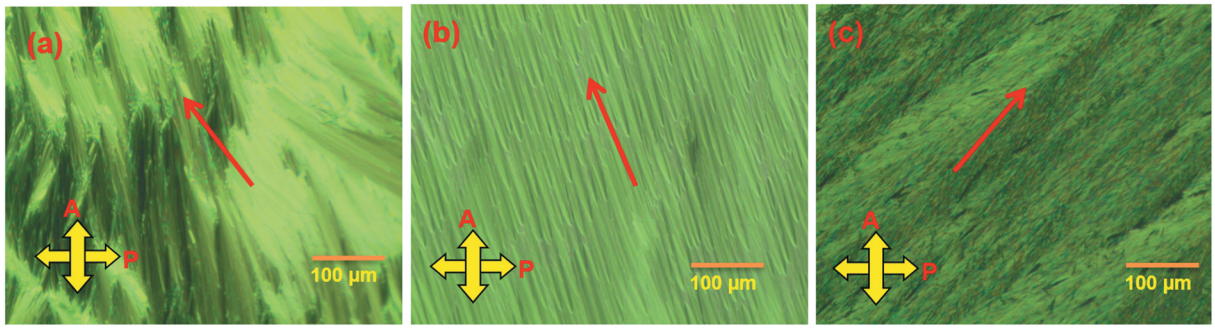


Figure 3. (Colour online) Polarising optical micrographs of (a) pristine 8OCB at 68°C, (b) 0.5 wt.% NPs +8OCB at 68°C and (c) 1.0 wt.% NPs +8OCB at 68°C. Arrows show the rubbing directions and crossed arrows a crossed polariser (P) and analyser (A).

the molecular dynamics of LC to assess its utility in many applications [30–32]. The dielectric permittivity illustrates the polarising strength of a sample in the influence of an applied external electric field as a function of frequency which can be described by equation (2),

$$\varepsilon^* = \varepsilon' - j\varepsilon'' \tag{2}$$

where ε′ and ε″ represent the real and imaginary components of the complex dielectric permittivity and j the imaginary unity ($j^2 = -1$). The ε′ is proportional to the capacitance and measures the alignment of dipoles or polarisation, although the imaginary part of ε" is dielectric loss and is proportional to conductance and described the energy needed to align the dipoles. The dielectric data are calibrated for low and high frequency region due to the attributed to the prevalence of lead inductance and ITO sheet resistance [30–32]. The frequency dependence of both component of dielectric permittivity (ε⊥′ and $\varepsilon_{\parallel}'$) are plotted for pristine and Fe_2O_3 NPs doped LC at temperature 74°C. The dielectric permittivity of LC increased with increasing doping concentration of Fe_2O_3 NPs. Figure 4(a and b) shows the ε⊥′ (with electric fields perpendicular to the axis) and $\varepsilon_{\parallel}'$ (electric field parallel to the axis) for pristine and Fe_2O_3 doped nanocomposites. It can be seen that the ε⊥′ remains constant in the mid frequency range from 1 kHz to 10 kHz and after that its value decreased at higher-frequency region. The NPs-doped LC show a significant frequency dispersion at a lower frequency accompanied by a frequency-independent region above 1 kHz. The higher value of dielectric permittivity at a lower-frequency region (less than 1 kHz) has been observed in both pristine and Fe_2O_3 nanocomposites. This observed phenomenon is attributed to the ionic polarisation and Maxwell-Wagner effect. There are two references of dipoles exist in LC. One is due to separation of LC ions (cations and anions) and another is due to connecting cyno (CN) group. The maximum number of ions can be generated due the doping of NPs. The acquired ions form a polarisation region due to an increase of charge particles and hence at low frequency,

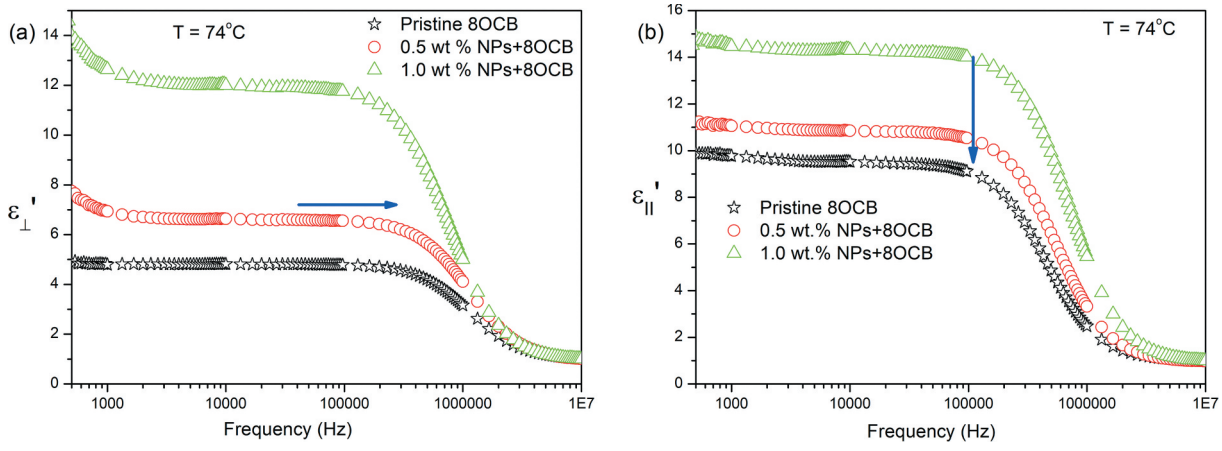


Figure 4. (Colour online) Frequency dependent relative dielectric permittivity (ε′) of (a) perpendicular and (b) parallel component for pure and NPs dispersed LC at 74°C (blue straight lines are showing the nonlinear fitting curve).

the high value of dielectric permittivity resulted owing to the appearance of NPs ion pairs that behave like localised dipoles in the immobilised state. However, the value of dielectric permittivity was to be decreased of both pristine and Fe_2O_3 nanocomposites in higher frequency range, i.e. beyond < 100 kHz which could be due to polarisation dependent behaviour of LC molecules. Manifestation of strong coupling and intermolecular interaction between NPs and LC molecules can also be seen through the frequency dependent dielectric permittivity (ε′). Moreover, from Figure 4, the magnitude of ε⊥′ and $\varepsilon_{\parallel}'$ was found to be increased from 4.7 to 11.9 and 9.5 to 14.5 respectively, after dispersion of Fe_2O_3 NPs into LC at < 100 kHz. It is found that the effect of Fe_2O_3 NPs is more pronounced in the planar aligned as compared to homeotropic aligned cells. This implies that the surface potential plays an important as the surface area of planar geometry is more comparable to homeotropic one. The value of dielectric permittivity is very large in higher concentration of Fe_2O_3 NPs as compared to low doping concentration that is mainly due to the higher intermolecular association between ferric oxide NPs and LC molecules. The dielectric relaxation frequency is generally remaining constant in homeotropic geometry for pristine and NPs-doped LC (Figure 4(b)). In the planar geometry the relaxation frequency is shifted towards the low-frequency region from increasing the concentration of Fe_2O_3 NPs in pristine LC. The nature of dielectric permittivity of pristine and Fe_2O_3 nanocomposites was observed to be similar as reported by B. Kundu et al [29]. The 8OCB LC compound shows positive dielectric anisotropic nature (Δε) due to higher contribution of the dipole moment of a parallel component as compared to the dipole moment of perpendicular component of LC molecules. The temperature dependence of both component of dielectric permittivity ($\varepsilon_{\perp}'$ & $\varepsilon_{\parallel}'$) of pristine, 0.5 and 1.0 wt.% NPs doped LC sample cells have shown in Figure 5(a–c), respectively. It has been shown that the $\varepsilon_{\perp}'$ & $\varepsilon_{\parallel}'$ increased with increasing the temperature. The dielectric permittivity increases linearly by rising the temperature and its values decreased near the isotropic temperature for pristine and Fe_2O_3 nanocomposites. As the temperature increases upto certain limit, the LC undergoes a phase transition. In the present case Fe_2O_3 NPs does not affect phase transition but alters the dielectric permittivity and hence it influences the dipole moment of 8OCB LC compound. The dipole moment of Fe_2O_3 NPs leads to the intense interaction of linking group of LC compound. From the Figure 5, it is clear that the interaction of NPs in LC molecules depends upon the geometry. The dipolar interaction is more predominant in planar geometry as compared with homeotropic geometry. The value of $\varepsilon'_{\perp}$ and $\varepsilon'_{\parallel}$ was found to be increased with the doping of Fe_2O_3 NPs due to strongly interaction of the dipole moment due the cyno linking group of LC in presence of electric field. The results of dielectric anisotropy (Δε) and threshold voltage (V_{th}) of Fe_2O_3 NPs and its nanocomposites are shown Figure 6(a and b) at 74°C. The $\Delta\varepsilon = \varepsilon'_{\perp} - \varepsilon'_{\parallel}$ of the pristine and Fe_2O_3 nanocomposite sample were calculated according to the Maier and Meier theory [33,34]. The dielectric polarisation of LC takes place on the account of the molecular anisotropic polarisability. The orientations of dipole moment in the molecular frame due to the arrangement of planar and homeotropic sample cells with applied electric filed. The dielectric anisotropy can be explained by using the following equation (3),

$$\Delta\varepsilon = \frac{NFh}{\varepsilon_0}\left[\Delta\alpha - \frac{F\mu^2}{2k_BT}\left(1 - 3cos^2\beta\right)\right]S \qquad (3)$$

Where, k_B is the Boltzmann constant, β is the angle the molecular dipole moment and the long molecular axis. According the Maier Meier formula the Δε relies on the angle β. The maximum positive and negative value of Δε have a perfect alignment of dipole moment with the

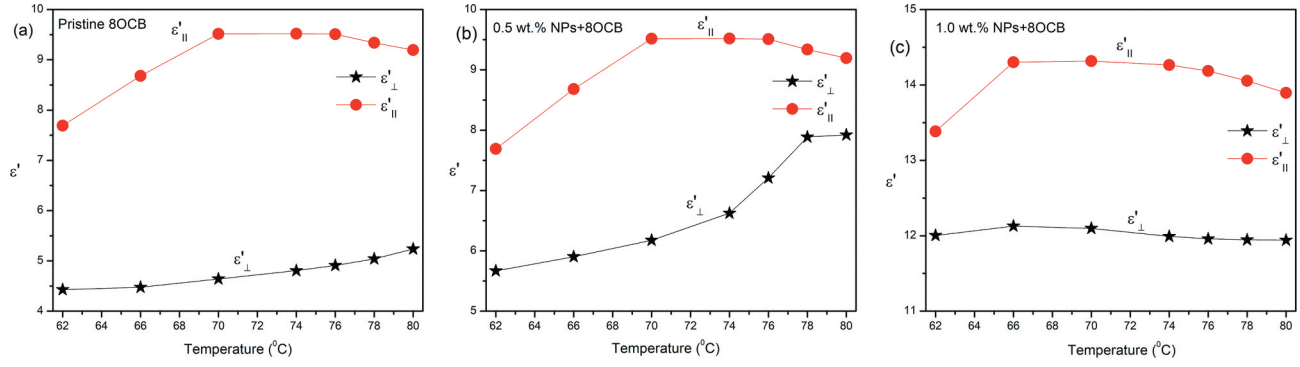


Figure 5. (Colour online) Dependence of parallel and perpendicular component of dielectric permittivity (a) pristine 8OCB, (b) 0.5 wt.% NPs+8OCB and (c) 1.0 wt.% NPs+8OCB on the relative temperatures at 5 kHz.

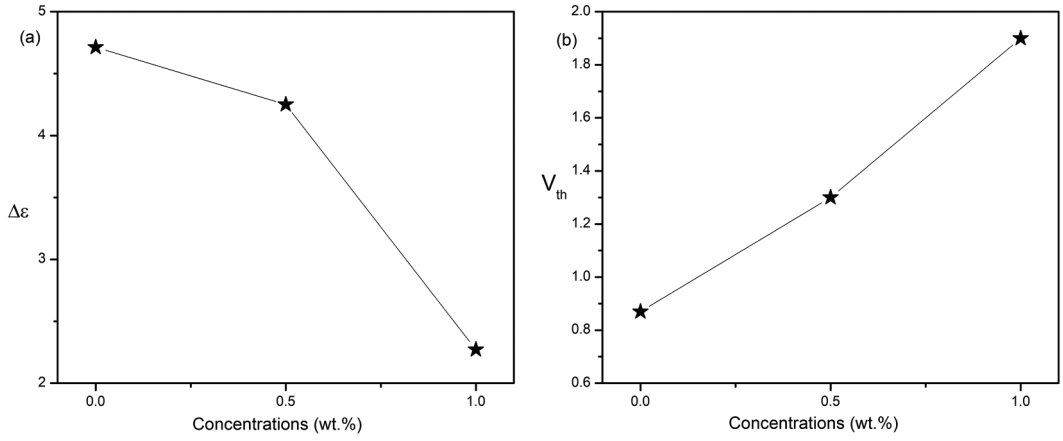


Figure 6. Dependence of (a) dielectric anisotropy and (b) threshold voltage of pristine 8OCB and concentration of Fe_2O_3 NPs at 74°C.

long molecular axis (β = 0°) and the dipole moment is oriented perpendicular to the molecular axis (β = 90°). The dipole moment of LC molecules is independently at β = 54°. It is observed that, the value of Δε was found to be reduced with doping of Fe_2O_3 NPs into 8OCB LC which may be attributed to the contribution of net dipole moment of LC in planar geometry. At low concentration the interaction of NPs-LC molecule is more prominent than that of LC-LC interaction, however, at higher concentration NPs-NPs interaction more active as relative to NPs-LC and LC-LC interactions. The increases the value dielectric permittivity ($\varepsilon'_{\perp}$ & $\varepsilon'_{\parallel}$) of Fe_2O_3 nanocomposites and improvement of their orientation ordering of LC molecules due to Fe_2O_3 NPs have large dipole moment. The molecular order of LC molecules can be easily modulated by NPs in the presence of electric field, and thus improve the perpendicular component of dielectric permittivity of LC (planar aligned sample cells). It is very interesting to enhance to the alignment of LC molecules with applied electric field i.e. orientation ordering. The orientation ordering of the NPs increased due the interaction between the dipole moment of the NPs and electric field: the NPs dipoles aligned in the direction of electric field and, due to the polarisation effect, the LC molecules aligned with the NPs. Measurement of the threshold voltage (V_{th}) of pristine and Fe_2O_3 nanocomposite planar sample cells as a function of step by step applied voltage by using optical transmittance method [30,35]. The optical transmittance intensity is constant at the beginning of applied voltage because the electric field was not enough to align the molecules perpendicular to its direction. To find out the threshold voltage of pristine 8OCB and Fe_2O_3 nanocomposites planar sample cells transmitted light intensity change 10% of the initial light intensity. Figure 6 shows the threshold voltage of pristine and Fe_2O_3

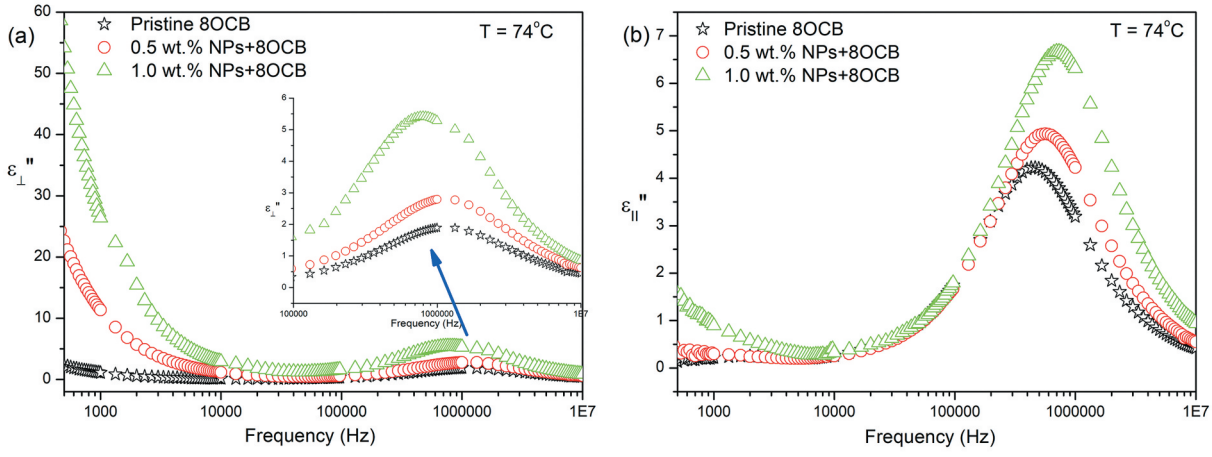


Figure 7. (Colour online) Frequency dependent dielectric loss (ε′) of (a) planar and (b) homeotropic geometry for pure and ferric oxide NPs dispersed LC at 74°C (blue straight lines are showing the nonlinear fitting curve).

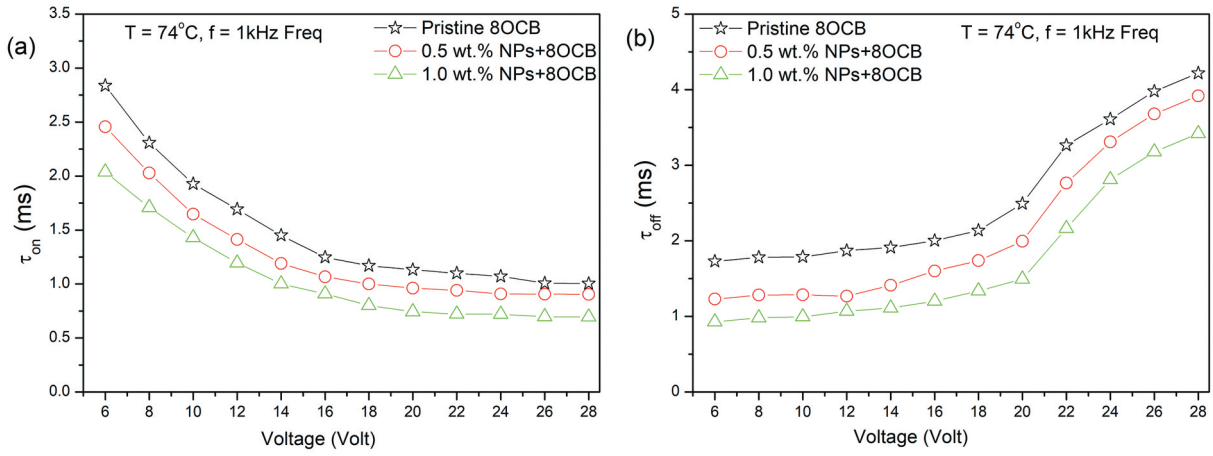


Figure 8. (Colour online) Response time of pure and NPs dispersed LC for the planar aligned cells as a function of the applied electric field at 74°C;1 kHz (a) rise time and (b) fall time.

nanocomposites for planar aligned sample cells. The value of V_{th} depends upon the dielectric anisotropy [30,35]. It can be seen the nature of threshold voltage (V_{th}) from relation, $V_{th} \propto (\Delta\varepsilon)^{-1/2}$.

Figure 7 shows the behaviour of dielectric loss ($\varepsilon''_{\perp}$ and $\varepsilon''_{\parallel}$) of pristine and Fe_2O_3 NPs-doped LC with variation of frequency at 74°C. It can be seen through the figure that two-dispersion region were observed for pristine and Fe_2O_3 nanocomposites (Figure 7). Each dispersion region belongs to different polarisation of LC molecules. Ionic polarisation peak appears at low frequency region whereas high relaxation peak occurs due to dielectric polarisation. Dielectric polarisation of pristine and Fe_2O_3 nanocomposites with respect to the director is related to the angular motion of the dipole moment of LC molecules. The LC molecules at the interface orient in a particular direction depending primarily on the surface area (interfacial energy) of the planar and homeotropic geometry in absence of electric filed [36]. The relaxation frequencies were observed at 1.3 MHz, 1.3 MHz and 800 kHz for pristine, 0.5 wt.% and 1.0 wt.% Fe_2O_3 NPs doped into LC, respectively. Figure 7(a) shows that the relaxation frequency is the same for pristine and 0.5 wt.% Fe_2O_3 NPs-loaded nanocomposites, which could be due to the interaction of LC-LC molecules rather than LC-Fe_2O_3 NPs. In order to increase the concentration of Fe_2O_3 NPs to 1.0 wt.%, the relaxation frequency is moved to a lower region which can be due to the massive interaction between the LC-NPs over LC-LC interaction. The dielectric relaxation spectra provide information on molecular dynamics properties of LC and the interfacial interaction between the electrodes of LC molecules. The molecular dynamics structure of LC molecules is affected by the doping of NPs and also improved the molecular ordering. The relaxation processes have the momentary delay with varying applied electric filed direction with respect to the director. It is causes due to the molecular polarisation with respect to varying electric field in pristine and nanocomposites. Moreover, for homeotropic geometry (Figure 7(b)) the relaxation frequencies have been observed at 400 kHz, 500 kHz and 630 kHz in case of pristine, 0.5 wt.% and 1.0 wt.% NPs doped LC, respectively. It can be inferred that the relaxation frequency is varying (in kHz region) for homeotropic aligned sample cells.

Electro-optic switching properties

The millisecond dynamics of pristine and Fe_2O_3 nanocomposites have been observed on the various applied electric fields and temperature and the results are shown in Figures 8 and 9. The rise times (τ_{on}) and fall time (τ_{off}) of pristine and Fe_2O_3 nanocomposites were found to be order of milliseconds. Temperature and voltage dependence of switching time of pristine and Fe_2O_3 nanocopmosites are also shown in Figures 8 and 9. The τ_{on} and τ_{off} of pristine and Fe_2O_3 nanocomposites at a certain temperature can be explained by the following equations [37],

$$\tau_{on} = \frac{\gamma d^2}{K_{11}\pi^2\left[\left(\frac{V}{V_{th}}\right)^2 - 1\right]} \tag{4}$$

$$\tau_{off} = \frac{\gamma d^2}{K_{11}\pi^2\left[\left(\frac{V_b}{V_{th}}\right)^2 - 1\right]} \tag{5}$$

where, γ is the rotational viscosity, K_{11} is the splay elastic constant, d is the thickness of the sample cell and V_{th} and V_b are threshold and bias voltages, respectively. The results of switching time (τ_{on} and τ_{off}) of pristine and Fe_2O_3 nanocomposites could be described by using above equation. The assumption that the low applied electric field often quenches oscillations in the director through a strong dipole coupling between the NPs and LC molecules. Whenever increasing the concentration of Fe_2O_3 NPs in pristine 8OCB LC the rise time decreases and fall time increases over the whole applied electric field region. The rise time is decreased for NPs doped LC that implies the better response of the LC molecules in such nanocomposites better applicability in display devices. The rise time, mainly depends upon the intermolecular interaction between the NPs and LC molecules. The NPs are very large dipole moment as compared to LC molecules as well as improved the molecular ordering of LC molecules. This is clear that the orientation ordering of LC molecules, enhanced with the doping of NPs. The rise time of LC also depends upon the cell thickness, rotational viscosity, splay elastic constant and applied voltage. If the voltage increases the rise time decreases and fall time increases. Its value depends on the elastic constants, bend, twist and splay, characterising the LC elastic deformations and on the dielectric anisotropy of the LC. Above threshold voltage the LC molecules is very high response due to the director and tilt fluctuation (tilt angle) in the LC layers. Tilt angle is the angle between the director of the LC molecules and the electric field at a particular position in the nematic layer, for example when no voltage is applied of the planar aligned sample cell that means the tilt angle $\theta = 0°$ and the birefringence is maximum. As the voltage increases, the rise time is decreased exponentially. The rise time is remaining constant for both pristine and Fe_2O_3 nanocomposites after 20 volt. That means all LC molecules are fluctuating to the director and the direction electric field. At high voltages the strongly pinned molecules at the surfaces contribute the most to hinder in the LC layer. However, the LC molecules are remarkable to sensitive to interfacial interaction. The dynamics response (τ_{on} and τ_{off}) of pristine and Fe_2O_3 nanocomposites are to be more complicated way to drive the LC molecules in the surface due to anchoring strength. The better switching response of LC molecules to be need at higher applied voltage. This diminish credited to higher electrical torque on the application of an electric field which leads towards quicker switching inside the Fe_2O_3 nanocomposites. The nature of dynamic response (pristine and nanocomposites) exponentially decrease with increase applied field. The remarkable result of the nanocomposites and pristine LC due to the effect is attributed to the enhanced dielectric coupling between NPs and LC molecules. The dynamics response is related directly to molecular stacking of the structured nanocomposite material due to increases the rotational viscosity with addition of Fe_2O_3 NPs. By using mechanically reoriented the LC molecules with the function of temperature and we can estimate the dynamics response in term of rise and fall time of the LC with the doping of NPs. It can be seen that the from Figure 9 shows

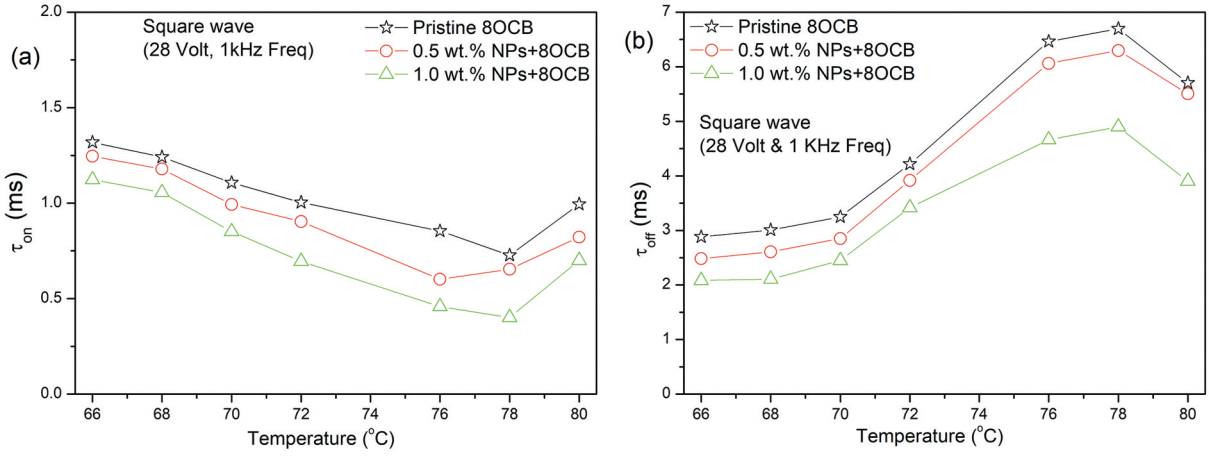


Figure 9. (Colour online) Response time of pure and NPs dispersed LC for the planar aligned cells as a function of the temperature at 28 V and 1 kHz (a) rise time and (b) fall time.

the temperature dependence of rise and fall time for pristine and NPs-doped LC at 1 kHz frequency and 28 V applied electric field. From this figure we can see that rise time is very low and fall time is very high near the isotropic transition temperature but suddenly its value is reversed after the isotropic phase [38]. From the Figure 9 we can see that the value of rise time decreased and fall time increased of pristine and nanocomposites with rise the temperature. The behaviour of rise and fall time is attributed to be the rotational viscosity and molecular ordering. It is clear that the dynmaic response of LC molecules improve with doping of NPs, its reliability and reproducibility for display technology.

The splay constant (K_{11}) and rotational viscosity (γ) of an aligned LC sample cell represents internal friction between LC directors and applied electric field. The magnitude of rotational viscosity depends on the molecular structure, constituent, intermolecular association and temperature. The K_{11} and γ are very important parameters for the application electro-optical devices. Splay elastic constant and rotational viscosity has been investigated by the measurement of dielectric parameter and threshold voltage for the pristine and Fe_2O3 nanocomposites at 74°C. The K_{11} and γ were calculated by using equations,

$$K_{11} = \frac{\varepsilon_0 \Delta\varepsilon (V_{th})^2}{\pi} \tag{6}$$

$$\gamma = \frac{\tau_o K_{11} \pi^2}{d^2} \tag{7}$$

Where ε_0 is the permittivity of free space and all symbols are mentioned above. Oseen-Frank and Erickson-Leslie equation have described the static and dynamics deformation of LC directors due to the balance between the elastic torque and electric field [39–41]. Figure 10(a and b) show the splay elastic constant and rotational viscosity of pristine and Fe_2O_3 nnaocomposites. It observed that the splay elastic constant increases of pristine LC with the addition of Fe_2O_3 NPs. The splay elastic constant of Fe_2O_3 nanocomposites increases due to the increment of molecular ordering of pristine LC, which plays a significant role in improving K_{11}. It is noteworthy that on increasing the concentration of NPs into pristine LC molecules the orientation ordering of molecules along with coupling interaction between NPs and LC molecules occurs. Figure 10(b) shows the rotational viscosity of pristine and Fe_2O_3 nanocomposites. As seen from this figure, the rotational viscosity of Fe_2O_3 nanocomposites was found to be increased with increasing the concentration of Fe_2O_3 NPs. With increase of the volume fraction of NPs, γ increase due to the enhanced molecular ordering of nematic LC. The existence of Fe_2O_3 in 8OCB compound to improve the intermolecular interaction and molecular stacking through the structural consistency and lead to improve the rotational viscosity of Fe_2O_3 nanocomposites. The rotational viscosity does not linearly depend on the concentration of NPs as the volume fraction of the pristine sample. In Fe_2O_3 nanocomposites (0.5 and 1.0 wt.%) the molecular rotational motion attribute the coupling interaction between them. The molecular fluctuations in the nanocomposites orientation order parameter affects certain physical properties including the viscosity coefficient [42]. The similar

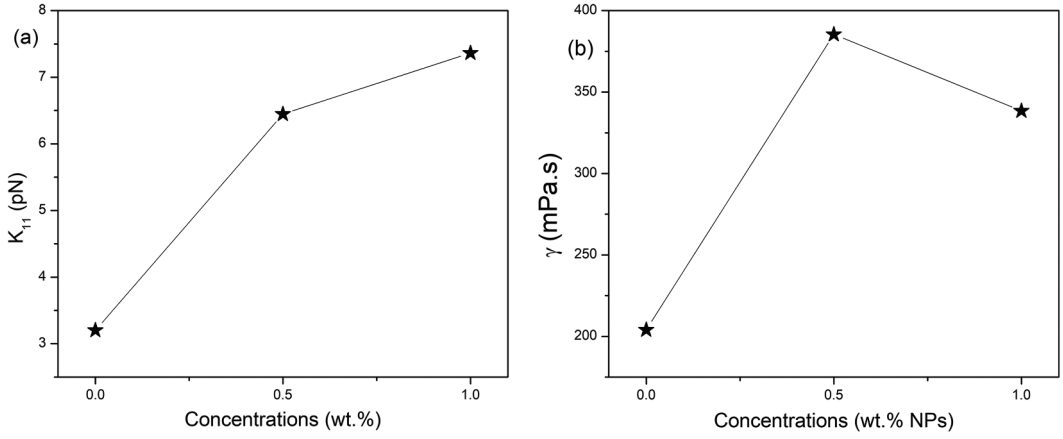


Figure 10. Dependence of (a) splay elastic constant and (b) rotational viscosity of pristine 8OCB and concentration of Fe_2O_3 NPs at 74°C.

results are also found that the value of rotational viscosity of LC is good approached to developed the theoretical models and explain the behaviour of rotational viscosity near to phase transition [43,44].

Conclusion

The dielectric and electro-optical properties of 8OCB LC compound was tailored through the doping of Fe_2O_3 NPs. Molecular ordering of Fe_2O_3 nanocomposites was found to be improved due to the proper and homogenous dispersion of Fe_2O_3 NPs into 8OCB LC without any agglomeration. Threshold voltage, splay elastic constant and rotational viscosity of nanocomposites was also found to higher as compared to pristine LC. The observed improvement is attributed the dynamical motion of LC molecules with respect to the director in the direction of applied electric filed. The orientational ordering of LC molecules achieved by the doping of Fe_2O_3 NPs, since the different shape and nature of NPs are strongly affected the physical parameters of LC. The switching of LC molecules and the threshold voltage is also increased considerably, which is beneficial for the low power display technology. The reduction in the rise, fall time of the nanocomposite display material invariably reduced the response time and hence faster display is feabile. The relaxation occurs in MHz region of the frequency spectrum for pristine and 0.5 wt % doped Fe_2O_3 nanocomposite (planar aligned cells). However, the relaxation of pristine and Fe_2O_3 nanocomposites (0.5 and 1.0 wt.%) occur in kHz region of the frequency spectrum for homeotropic geometry. The relaxation frequency variation is attributed to the surface potential and interaction between Fe_2O_3 NPs and 8OCB molecules.

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Disclosure statement

No potential conflict of interest was reported by the author.

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Higher Order Statistics Based Blind Steg analysis using Deep Learning

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Abstract: Universal isteganalysis of grey level JPEG images is addressed by modelling the neighbourhood relationship of the image coefficients using the higher order statistical method developed by two-step Markov Transition Probability Matrix (TPM). The implementation of TPM together with the neighbouring pixel relationship provides a better and comparable detection results. The detection accuracy is evaluated on the stego image database using eXtreme Gradient Boosting (XGBoost) with Principal Component Analysis (PCA) on nsF5 and JUNIWARD hiding techniques. Execution time is also compared for all the classifiers. The images are taken from Green spun library and Google website- eXtreme Gradient Boosting.

Keywords: Steganography, Steganalysis, CNN, DWT, DCT.

Introduction

Image steganography is the art of concealing data in an image and in contrary steganalysis iis the detection of hidden data in an image. There is rigorous progress in the JPEG steganography and steganalysis techniques. In the journey of the steganalysis research, the researchers tried to develop more and more complex hiding process so that it can be less detectable. So it becomes the requirement to embellish the steganalysis methodology for increasing the detection capability.

The complexity of the hiding technique gets increased in the introduction of the content adaptive steganography which makes more difficult to design detection technique. In the non-adaptive steganography i.e. in Jsteg (JPG,2020), Outguess (outgues,2020), F5 (Westfeld et al., 2001), nsF5 (Fridrich et al., 2007)], Model Based (MB) (Song et al., 2015) and Perturbed Quantization (PQ) (Fridrich et al., 2004) are few techniques developed and later the content adaptive hiding techniques such as Texure Adaptive PQ (PQt) (Filler et al., 2011), Model Optimized Distortion (MOD) (Guo et al., 2014), Uniform Embedding Distortion (UED) (Holub et al., 2013) and JPEG UNIversal Wavelet Relative Distortion (JUNIWARD) (Chhikara et al., 2018) are being developed. In all the content adaptive steganography the distortion function is first to find out and then messages are embedded while minimizing the distortion function which increases the steganography security. The different content adaptive steganographic technique used different distortion function statistical which is based on the texture and energy content of the image. The content adaptive steganography is more secure than non-adaptive steganography. In this paper, our concentration is on the steganalysis for the content adaptive steganography.

Literature Review

In the history of universal steganalysis, the trend is to extract the image features which get transformed after information hiding because of their existing correlation. The features can be obtained either from the spatial domain or in the domain where image gray level values are transformed to other values by implementing any specific transformation mathematics. Almost in all the image steganalysis, it is tried to find out the image statistical features that represent the statistical variations of the image coefficients. These statistical features are extracted from various pre-processed images. Various pre-processing used are finding of Discrete Cosine Transformation (DCT) (Holub et al., 2013), Discrete Wavelet Transformation (DWT) (Laimeche et al., 2018), Image Segment and Calibration (Bashkirova et al., 2015), Intra and Inter Block Difference Block from spatial and transform domain (Karimi et al., 2015) and Short Time Fourier Transform (STFT) (Song et al., 2015) (Clausi et al., 2005) or Gabor Transform.

The different features in the transform domain are mathematical statistics of wavelet coefficients (Lyu et al., 2002), higher order statistics of DCT coefficients with the calibration concept (Fridrich et al, 2004), Markov's features (Chen et al, 2014), Merged DCT and Markov's features named as Cartesian Calibrated Features

(CCPEV) (Penvy et al., 2007). In almost all the cases the feature dimension goes on increasing and the target is to increase the detection accuracy. In the recent trend in the steganalysis designing, the concentration is more towards the designing of the projection model which is constrained to the complex texture region of the image which mainly targets to detect the content adaptive steganography. The CC-JRM (Cartesian Calibrated JPEG Rich Model (CC-JRM) is based on the intra and inter-block co-occurrence (Kodovsky et al., 2012) is one of them. There came a great change in the steganalysis designing with the introduction of DCTR (Discrete Cosine Transform Residual) (Holub et al., 2014) technique. In DCTR feature, the convolution of the uncompressed JPEG image is done with every 64 kernels of the DCT and then by subsampling the residual images the histogram of the quantized noise residuals are obtained. This technique provides better detection accuracy than the previous techniques. Again a better technique was introduced i.e. Phase-Aware Projection Model (PHARM) (Holub et al., 2015), which utilizes the pixel residuals of JPEG images and their phase for an 8 × 8 grid. A 2D Gabor filter was introduced for finding the texture of image characteristics obtained from various scales and orientations and the first and higher order statistical features are obtained in GFR (Song et. al., 2015) and Gabor Rich Filter (GRF) (Song et al., 2017). Since the introduction of Gabor filter increases the detection accuracy of the content adaptive steganography such as J-UNIWARD (Denmark et al., 2016). The accuracy of the JUNIWARD which is content-adaptive JPEG steganographic schemes is more accurate. Deploying of the Gabor filter in the steganalysis verified to be a better tool for the scheming of the image steganalysis.

The acquired statistical features from the stego and non-stego images are deployed for the training and the testing of the adopted classifier so that it developed to be a software based empirical machine for the. Perception of any secret messages in an unknown media image. Various well known feasible classifiers are Fischer Linear Discriminator (FLD) (Holub et al., 2014), Support Vector Machine (SVM) (Gul et al., 2013) (Pathak et al., 2014), Ensemble Classifier (Song et al., 2017), Convolutional Neural Network (CNN) (Bashkirova et al., 2016) and Random Forest (Laimeche et al., 2018) (Bera et al., 2018) as suggested in the popular research papers. The referred research paper deduces that the feature dimensions goes on increasing with the introduction of improved steganalysis technique. Although increasing feature set increases the detection accuracy but increases the execution time and the memory cost. So, proper feature selection and reduction skill technique can be is introduced which reduces the feature dimension without affecting the detection accuracy. Few of them suggested in the cited research papers are Markov Random Field (MRF) Cliques (Gul et al., 2013), ITERATIVE BEST Strategy (Kodovsky et. al., 2012), Improved Firefly Algorithm-DyFA and Fitness function–SVM [Chhikara et al., 2018), Analysis of Variance (ANOVA) (Laimeche et al., 2018), Artificial Bee Colony (ABC) (Mohammadi et al., 2014) and on the basis of highest detection accuracy [Song et al., 2017). Global Local PSO (GLBPSO) is an improved version of discrete PSO is applied on Markov features (486-Dimensional) for the feature selection purpose and obtained better results (Kumari et. al., 2017). Binary Bat Algorithm.(BBA) feature selection technique is implemented on SPAM features. Various classifiers had been implemented but SVM performed better (Liu et al., 2019). First Order features, Second Order features, Extended DCT features and Markov features are extracted from F5 stego images and SVM classifier is implemented. Six different kernels and four different sampling were used for finding the detection results. The dataset that had undergone cross-validation. The radial kernel and epanechnikov kernel had given very low percentage when the dataset was not cross-validated. The linear sampling has always given less detection percentage. ANOVA gives a better result. (Shankar et al., 2018).

The major challenge of the present work can be summarized as; Application of a suitable image feature extraction technique to get better detection performance for the JPEG gray level images along by implementing efficient machine learning tool. This paper represents the blind steganalysis based two-step Markov's TPM on JPEG hiding techniques. In the following sections, the statistical methods have been discussed for the generation of the image features and then, the experimental set up has been discussed. Further results and conclusions are drawn.

Proposed Methodology

Image Features Generation

The difference of absolute values of two immediately neighbouring BDCT coefficients is highly concentrated around zero, having a Laplacian like distribution. Almost all the values are within the -4 to +4 values. So instead of using all the DCT coefficients for generating the features only coefficients whose values are within -4 to +4 are considered for the feature calculation. This is known as thresholding. The feature dimension of TPM depends on the range of the values selected. The -4 to +4 is the widely used range in the various research works. In most of the researches, the range of the values is also selected as -3 to +3. The feature dimension depends on the value of the threshold selected. The image features here is the TPM of second step which is a higher order statistical parameter that can be calculated from the difference neighboring matrix which representing the regional correlation. In this work, the final image features consists of the TPM for both test image and its calibrated image. The calibrated image for a test image is having similar statistics similar to the test image if it is

not containing any secret data hidden in it. The number of feature parameters in the final image features is known as feature dimension. The dimension image feature depends on the threshold value selected and the number of the step used in transition probability matrix.

The implemented techniques are explained in five steps. In the first section, the block image coefficients are discussed and in the second section the difference neighbouring matrix is introduced. In the third section, second step Markov's transition probability matrix based feature extraction is explained, in the fourth section, generation of calibrated image is explained and in the fifth section the final image feature generation is discussed.

Block Image Coefficients

The two dimensional discrete cosine transformations are applied on the input graylevel JPEG image and frequency components of the gray levels of the image are obtained using equation 1. The block size is 8 x 8. The figure 1 represents the image blocks after transformation.

$$F(u,v) = \left(\frac{2}{N}\right)^{\frac{1}{2}}\left(\frac{2}{M}\right)^{\frac{1}{2}}\sum_{i=0}^{N-1}\sum_{j=0}^{M-1}A(i)A(j).\cos\left[\frac{\pi.u}{2.N}(2i+1)\right]\cos\left[\frac{\pi.v}{2.M}(2j+1)\right].f(i,j)$$

The obtained transform image coefficient matrices have maximum values nearer to zero. The first coefficients are DC coefficients and rests are middle and high frequency.

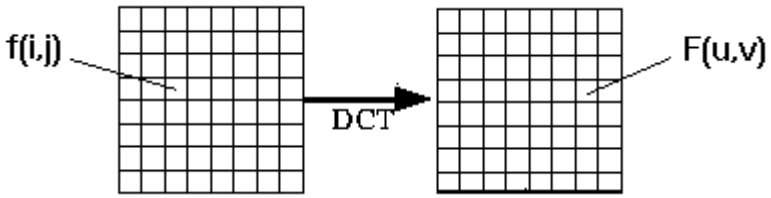


Figure 1. Representation of the Discrete Cosine Transformation in an Image

A.C. coefficients. The absolute value of the DCT coefficients is used for finding the neighbouring image coefficients. In the steganographic technique, the DC coefficients and high frequency components of the DCT coefficients are untouched while embedding the data but middle frequency component is used for embedding. So, it is required to find the deviations of the middle frequency components. The absolute values of the quantized block DCT coefficients construct the block image coefficients. The reason for taking absolute values is because these JPEG DCT coefficients can be either positive, or negative, or zero. So, for findings difference absolute values are required. The DCT coefficients in general do not obey Gaussian distribution; however, these

coefficients are not statistically independent of each other. There exists the correlation among the coefficients among all the four direction of an individual coefficient i.e. the neighbouring coefficients. The transformed and quantized image block coefficient matrices are known as image blocks coefficient matrix.

Difference Neighbouring Array

The smoothness, regularity, continuity and periodicity of the original image get deviates due to data hiding. The deviations caused due to the data hiding will be more exaggerated if the differences of the neighbouring elements in the block image coefficients are find out. For this purpose, four difference neighbouring matrices are considered which is evaluated from the obtained image block coefficient matrix.

$$B_t = \frac{(rxc)}{64} \quad \text{... (2)}$$

In the image block coefficients matrix, let named as $F(u,v)$ where $u \in [1, S_u], v \in [1, S_v]$ and S_u is the size of the block image coefficients in the horizontal direction and S_v is in the vertical direction. The number of blocks for an image is represented by B_t. Where B_t is having the dimension rxc where r is the number of rows and and c is the number of columns in the image as shown in equation 2.

In the present work, the dimensions of all the images are 640 x 480 and the size of each block is $S_u = S_v = 8$. So, in total there is 4,800 number of image coefficient blocks. There exist strong relationship

between the image pixel and its nearest four neighbours. The four neighbourhood relationship is within an image block is considered to be strong tool for measuring the pixel relationship. These difference neighbouring arrays are generated using equation 3 for each block for the four neighbour pixels shown in figure 2.

$$\begin{aligned} F_f(u,v) &= F(u,v) - F(u,v+1) \\ F_u(u,v) &= F(u,v) - F(u-1,v) \\ F_r(u,v) &= F(u,v) - F(u,v-1) \\ F_d(u,v) &= F(u,v) - F(u+1,v) \end{aligned} \quad \cdots (3)$$

If F_f, F_r, F_u and F_d denote the forward, reverse, up and down difference arrays respectively. The calculation of the differences of the pixels is within the same block. The values of the difference neighbouring arrays are restricted in the range of -4 to +4 value. That means if the values of the arrays are more than +4, the actual value is limited to +4 and if the values of the arrays are less than -4, the actual value is limited to -4. So, the values of the difference neighbouring array are -4, -3, -2, -1, 0, +1, +2, +3, +4. This is known as thresholding which decreases the complexity and time without much affecting the detection accuracy.

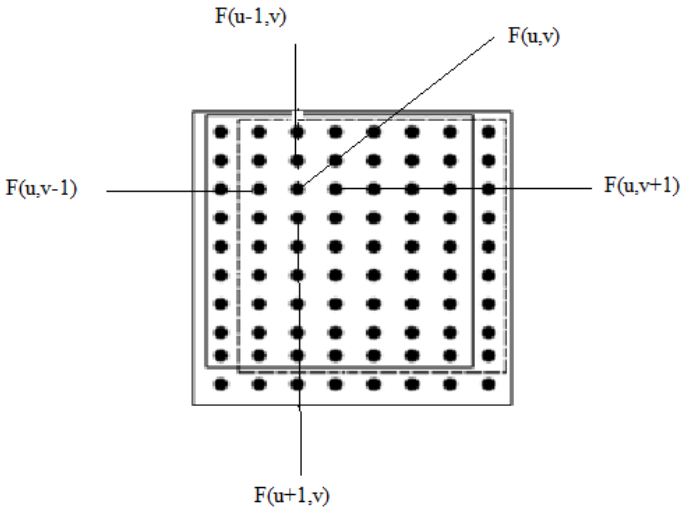


Figure 2. Four Neighbouring Pixel Arrays

Markov's Transition Probability Matrix

A random process is a collection of random variables indexed by some set taking values in some other set. For any random process the condition is that the current state of the process is based on the past condition and then the random process is called a Markov Process. Markov chains were introduced in 1906 by Andrei Andreyevich Markov (1856–1922) and were named in his honor.

Let I be a countable set, $\{i, j, k.....\}$. Each $i \in I$ is called a state and I is called the state-space.

Having probability space (Ω, F, P). Here Ω is a set of outcomes, F is a set of subsets of Ω, and for $A \in F$, $P(A)$ is the probability of A.

Let the sequence of random variables be $X_0, X_1, ...$ (taking values in I).

A random variable X with values in I is a function $X :\rightarrow I$.

A row vector $\lambda = (\lambda_i : i \in I)$ is called a measure if $\lambda_i \geq 0$ for all i.

If $\sum_i \lambda_i = 1$ then it is a distribution (or probability measure). We start with an initial distribution over I, specified by $\{\lambda_i : i \in I\}$ such P that $0 \leq \lambda_i \leq 1$ for all i and $\sum_{i \in I} \lambda_i = 1$.

The special case that with probability 1 we start in state i is denoted $\lambda = \delta_i = (0,... 1,..., 0)$.

Then a transition matrix $P = (p_{ij} : i, j \in I)$ with $P_{ij} \geq 0$ for all i, j.

It is a stochastic matrix, meaning that $P_{ij} \geq 0$ for all $i, j \in I$ and $\sum_{i \in i} P_{ij} = 1$.

(i.e. each row of P is a distribution over I).

$(X_n)_{n>0}$ is Markov chain with initial distribution λ and transition matrix P if for all $n \geq 0$ and $i_0, ..., i_{n+1} \in I,$

$(i) P(X_0 = i_0) = \lambda_{i0}$

$(ii) P(X_{n+1} = i_{n+1} \mid X_0 = i_0, ..., X_n = i_n) = P(X_{n+1} = i_{n+1} \mid X_n = i_n) = P_{i_n i_{n+1}}$ ... (4)

By checking the conditions (i) and (ii) it can be determined whether a random process be a Markov's process or not.

Let A be an event probability of i^{th} instant

$$P_i(0) = P(A \mid X_0 = i)$$

Then n- step transition probabilities can be represents as

$$P_{ij}(n) = P[X_{n+k} = j \mid X_k = i]_{n \geq 0, i, j \geq 0} \text{ ... (5)}$$

If first-step transition probabilities are consider then probability of going from state at $t = 0$ to state at $t = 1$ is

$$P[X_1 = j \mid X_0 = i] = \frac{P[X_1 = j, X_0 = i]}{P[X_0 = i]} \text{ ... .6)}$$

Similarly second-step transition probabilities are the probability of going from state i at $t = 0$, passing through state k at $t = 1$, and ending at state at $t = 2$ is

$$P[X_2 = j, X_1 = k \mid X_0 = i] = \frac{P[X_2 = j, X_1 = k, X_0 = i]}{P[X_0 = i]}$$

$$= \frac{P[X_2 = j \mid X_1 = k] P[X_1 = k \mid X_0 = i] P[X_0 = i]}{P[X_0 = i]} \quad \text{...(7).}$$

$$= P_{ik}(1) P_{kj}(1)$$

$P_{ik}(1) P_{kj}(1)$ is the one-step transition probability matrix.

Now considering the probability of going from state i at $t = 0$, passing through k at $t = m$ and ending at state j at time $t = m + n$. For all the values of i and j the n-step transition probability matrix is

$$P_{ij}(m+n) = \sum_k P_{ik}(m) P_{kj}(n) \qquad \text{all } n, m \geq 0 \quad \text{all } i, j \text{ ... (8)}$$

This is known as Chapman-Kolmogorov equations.

First-step transition probability matrix is used in several papers and second-step transition probability matrix will give the better result because the transition of the quantized DCT values of the pixel is not only checked for nearest pixel but for the alternate pixel also. In this work, the Markov's two-step transition probability matrix for all four difference neighbouring arrays is used for obtaining the image features using equation (9). The probability is calculated for the values $u, v \in (m, n)$ where m and n value is the row and the column number of the image coefficient matrix.

$$P\left[F_f(u,v+2)=j,F_f(u,v+1)=k\mid F_f(u,v)=i\right]=\frac{P\left[F_f(u,v+2)=j,F_f(u,v+1)=k,F_f(u,v)=i\right]}{P\left[F_f(u,v)=i\right]}$$

$$P\left[F_r(u,v+2)=j,F_r(u,v+1)=k\mid F_r(u,v)=i\right]=\frac{P\left[F_r(u,v+2)=j,F_r(u,v+1)=k,F_r(u,v)=i\right]}{P\left[F_r(u,v)=i\right]}$$

$$P\left[F_u(u,v+2)=j,F_u(u,v+1)=k\mid F_u(u,v)=i\right]=\frac{P\left[F_u(u,v+2)=j,F_u(u,v+1)=k,F_u(u,v)=i\right]}{P\left[F_u(u,v)=i\right]} \quad \ldots(9)$$

$$P\left[F_d(u,v+2)=j,F_d(u,v+1)=k\mid F_d(u,v)=i\right]=\frac{P\left[F_d(u,v+2)=j,F_d(u,v+1)=k,F_d(u,v)=i\right]}{P\left[F_d(u,v)=i\right]}$$

Where i, k, j ϵ { -4, -3, -2, -1, 0, 1, 2, 3, 4} and

The value of the probability is 1 if condition is satisfied and the value will be zero if the condition fail.

Let T_f , T_r T_u and T_d are the four second-step transition probability matrices using equation (10). T_f is the forward transition probability matrix, T_r is the reverse transition probability matrix, T_u is the upper transition probability matrix and T_d is for the downward transition probability matrix.

$$T_f(i,k,j)=\sum_{B_t}\sum_{S_u}\sum_{S_v}P\left(F_f(u,v+2)=j,F_f(u,v+1)=k\mid F_f(u,v)=i\right)$$

$$T_r(i,k,j)=\sum_{B_t}\sum_{S_u}\sum_{S_v}P\left(F_r(u,v+2)=j,F_r(u,v+1)=k\mid F_r(u,v)=i\right)$$

$$T_u(i,k,j)=\sum_{B_t}\sum_{S_u}\sum_{S_v}P\left(F_u(u,v+2)=j,F_u(u,v+1)=k\mid F_u(u,v)=i\right) \quad \ldots.(10)$$

$$T_d(i,k,j)=\sum_{B_t}\sum_{S_u}\sum_{S_v}P\left(F_d(u,v+2)=j,F_d(u,v+1)=k\mid F_d(u,v)=i\right)$$

The number of elements of the transition probability matrix is (2 x 4+1) x (2 x 4+1) i.e. 9 x 9= 81. In total, there are 81 x 4=324 elements obtained from all the four transition probability matrices. These elements are termed as image features. Further to decrease the feature dimension, the average value is considered in equation 11 (Shi et al., 2006) and final features are obtained using equation 12.

$$TPM=\frac{T_f+T_r+T_u+T_d}{4} \quad \ldots(11)$$

$$TPM(Final)=\|TPM(J_1)-TPM(J_2)\| \quad \ldots(12)$$

Calibrated Image

J_1 is the input stego image. The stego image J_1 is decompressed and then cropped by 4 pixels in each direction and then recompressed with the same quantization table as J_1 to J_2 obtain represents in figure 3. It is found that most of the macroscopic features of the original cover image are similar to the calibrated image obtained from the stego images. So, it is expected that the DCT coefficients of original cover image and calibrated image is similar and hence provide the same image features. The cropping and recompression produced an approximated cover image of the input stego image. In the research introduced by Jessica Fridrich in 2005, the inclusion of calibration technique increases the accuracy of detection

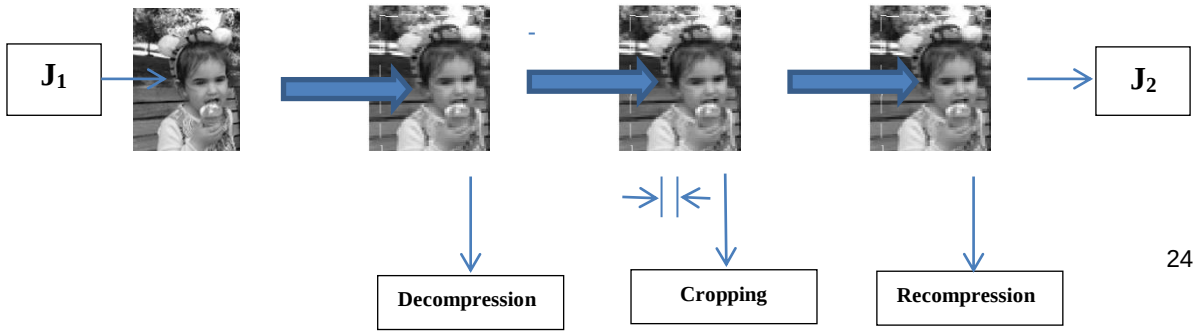


Figure 3. Generation of Calibrated Image

Experimental Implementation and Results

In the experiment, 2000 grayscale images are obtained from Greenspun library available in www.philip.greenspun.com and from Google website. These images are cropped in size 640x480 and recompressed with quality factor of 95 which consists cover images. Then stego image database is generated from the 2000 JPEG images by implementing nsF5 and JUNIWARD JPEG hiding techniques for the capacity 0.05, 0.1 and 0.2 bpac payloads. All the steganography codes are downloaded [Binghamton, 2020]. Figure 4 and figure 5 represents the Markov's feature for JUNIWARD and nsF5.

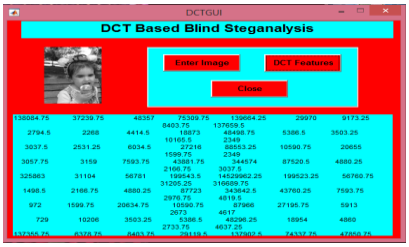


Figure 4. Image Features for JUNIWARD of capacity 0.05 bpac

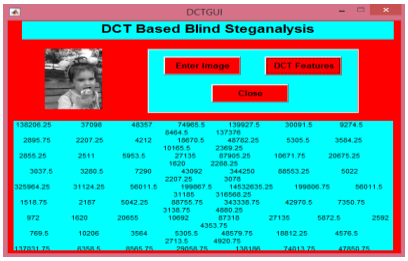


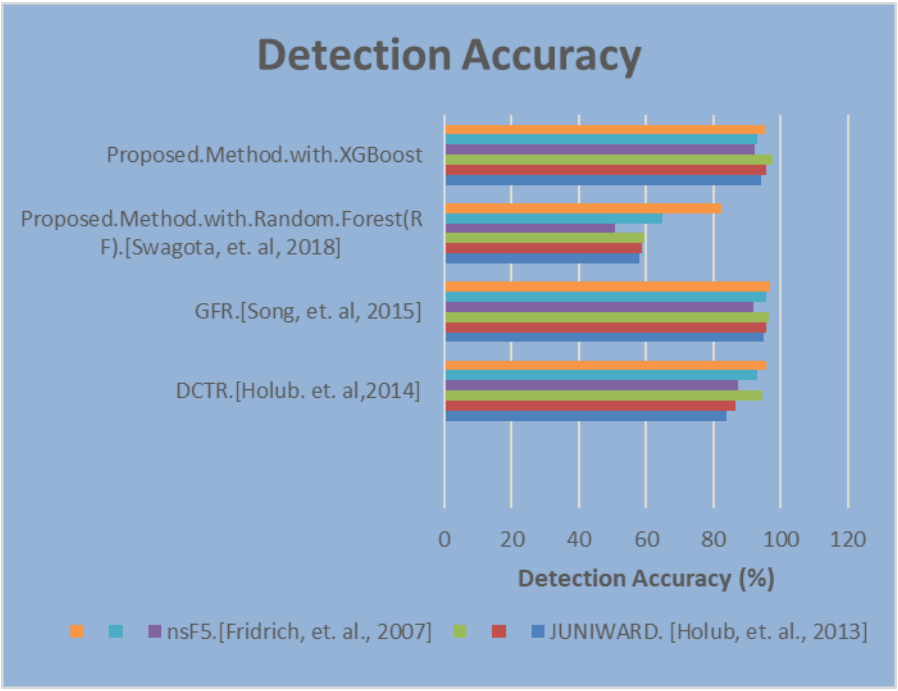
Figure 5. Image Features for nsF5 of capacity 0.05 bpac

XGBoost is used for the classification purpose having the values as: seed=7, test size=0.33. 80% of the dataset is used for training and rest is used for testing purpose. In Table (1), the obtained detection accuracy is presented and compared with the competitive techniques. It is also observed that computation time also get reduced drastically besides increasing the accuracy. In table (1) the obtained detection accuracy is presented and compared with the competitive techniques.

Table 1: Comparison of the Proposed Detection Technique with the Present State of Art

JPEG Steganography	Embedding Capacity (bpnc/ bpac)	Detection Accuracy (%)		Computation Time for Reference Methods	Detection Accuracy (%)		Computation time for Proposed Method with XGBoost
		DCTR.[Holub. et. al, 2014]	GFR.[Song, et. al, 2015]		Proposed Method with Random Forest (RF).[Swagota, et. al, 2018]	Proposed Method with XGBoost	
JUNIWARD [Holub et, al, 2013]	0.05	83.73	94.79	264.43	57.8	**94.31**	23.49
	0.1	86.73	95.73	278.23	58.84	**95.89**	23.88
	0.2	94.63	96.52	279.59	59.48	**97.79**	28.11
nsF5 [Fridrich et. al, 2007]	0.05	87.36	91.79	148.76	50.8	**92.42**	23.75
	0.1	93.05	**95.89**	159.38	64.823	93.2	26.87
	0.2	95.58	**96.84**	163.22	82.203	95.26	28.28

With the help of the graph 1 it is well presented that in most of the cases, XGBoost is performing better for the purpose of the Steganalysis.



Graph 1: Detection Accuracy with respect to hiding techniques

Conclusion

With the introduction of eXtreme Gradient Boosting (XGBoost) as classifier and PCA, there is improvement in the detection accuracy as compared to RF results. The thresholding in the calculation of transition probability matrices and averaging reduced the computational complexity and also reduced the feature dimensionality. The proposed technique outperforms JUNIWARD for all hiding capacities but outperforms in only 0.05 bpac in case of nsF5.

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Thermoluminescence glow curve analysis and trap parameters calculation of UV-induced $La_2Zr_2O_7$ phosphor doped with gadolinium

Neha Dubey, Vikas Dubey, Janita Saji & Jagjeet Kaur

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Abstract

Thermoluminescence (TL) glow curve analysis and calculation of trap parameters are reported for gadolinium (Gd^{3+})-doped $La_2Zr_2O_7$ (LZO) phosphor. Phosphors were prepared by modified solid-state reaction method with varying concentration of Gd^{3+} (0.1–2.5 mol%) including proper calcination and sintering temperature. Structural analysis of prepared phosphor for optimized TL concentration was recorded by X-ray diffraction analysis technique. Morphology was analyzed by scanning electron microscopic technique. The UV ray induced to the phosphor and effect of dose response recorded for variable dose rates of UV and TL glow curve were observed. The experimental and theoretical comparison was done by computerized glow curve deconvolution technique which determines the trap parameters such as trap depth, order of kinetics, and frequency factor for optimized concentration of dopant. The trap parameters and trap model are discussed in detail.

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Exploration of Thermoluminescence and Photoluminescence Properties of Eu^{3+} Doped $La_2Zr_2O_7$ Phosphors

Mamta Parganiha, Vikas Dubey, Ravi Shrivastava & Jagjeet Kaur

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Abstract

In this article, thermoluminescence (TL) and photoluminescence (PL) of Eu^{3+} doped $La_2Zr_2O_7$ (LZO) phosphor with various concentrations were reported. A conventional solid-state reaction method was used for the preparation of phosphor. Boric acid is used as a flow and the materials are required for the formulation of phosphor with varying concentrations of Eu^{3+} (0.2 - 2 mol %) in Eu_2O_3, ZrO_2, and La_2O_3. For the investigation of morphology, structural and luminescence properties of the sample, techniques used were X-ray diffraction (XRD), scanning electron microscopy (SEM), photoluminescence spectra (PL), thermoluminescence (TL), and

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Thermoluminescence Studies of β and γ–Irradiated Geological Materials for Environment Monitoring

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Abstract

In the present report, thermally stimulated luminescence (TSL) of quartz and limestone samples irradiated with β and γ-rays has been investigated. Herein the formation of trap depths and calculation of kinetic parameters of β and γ - irradiated quartz and limestone samples were studied through thermoluminescence (TL) glow curve analyses. The quartz and limestone samples were collected from various sites of Chhattisgarh (Patharia and Dalli-Rajhara mines). The collected raw samples were annealed at 400 °C. The phase formation of collected samples is confirmed by X-ray diffraction studies. The grain sizes of the samples are determined by using Debye-Scherrer formula. TL glow curves of the collected samples were recorded for various doses of β and γ-rays. Kinetic parameters such as order of kinetics frequency factor and trap depth were calculated by employing CGCD methods. A comparative study on the TL properties of the geological materials under β and γ-irradiation was done. The trap model analysis was executed to determine the nature of traps responsible for dominant TL peaks of β and γ-irradiated limestone and quartz samples.

Keywords: Limestone; Quartz; TL glow curve; β and γ - rays.

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Spectroscopic, dielectric and nonlinear current–voltage characterization of a hydrogen-bonded liquid crystalline compound influenced via graphitic nanoflakes: An equilibrium between the experimental and theoretical studies

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ABSTRACT

Herein, we investigate a hydrogen-bonded liquid crystal compound, namely 4-(Heptyloxy) benzoic acid (7OBA), and its composites by dispersing Graphene and reduced graphene oxide (rGO) flakes into an optimized concentration. The pristine 7OBA and its composites are characterized by different instrumental techniques like polarized optical microscopy, differential scanning calorimetry (DSC), dielectric, UV-visible, and Fourier-transform infrared (FTIR) spectroscopy. DSC thermograms of the 7OBA composites evince the down-shift in the smectic C–nematic and nematic–isotropic phase transition temperatures. The polarized optical micrographs (POMs) of composites reveal the homogeneous distribution of graphene and rGO flakes in the 7OBA compound without any aggregation. The π-π^* transitions in phenyl ring of 7OBA compound and π-π^* transitions in C═C bonds of graphitic materials are superimposed to each other providing an enhanced UV absorbance nearly at 255 nm for the composites. The presence of graphene and rGO enhances the tan δ and electrical conductivity of the composites, whereas dielectric anisotropy, $\Delta\epsilon$, reduces as a function of temperature in comparison to the pristine 7OBA compound. The sign inversion of $\Delta\epsilon$ has been observed for the 7OBA/rGO composite which has been explained via dipole–dipole interactions. The I–V behavior of the pristine 7OBA compound yields the ohmic I–V curve with a non-zero current at 0 V attributing to the pseudocapacitance effect, whereas, after the dispersion of graphene and rGO flakes, nonlinear diode like I–V curves having a hundred times larger conduction current were obtained. Furthermore, the molecular interactions have been analyzed by the FTIR which confirms the formation of hydrogen bonding in the 7OBA/rGO composite. At last, these experimental findings are compared with the simulated results by DFT. The experimental and theoretical simulations are commensurable to each other. The studied composites have shown their vital applications in nonlinear electronics.

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1. Introduction

In general, the physical properties of liquid crystalline materials are governed by the structure-property correlation [1,2]. These physical properties can be tailored by altering the molecular structure. Internal change in the molecular structure of such materials or the formation of hydrogen-like bonding leads to superior properties. Nowadays, considerable attention has been directed towards the formation of hydrogen-bonded liquid crystalline systems by researchers all around the world. Based on the particular interest, several hydrogen-bonded liquid crystalline systems have been synthesized and investigated for fundamentals and device applications [3-6]. Bradfield and co-workers first time analyzed that *p-n*-propoxy- and *p-n*-butoxy-benzoic acids are capable of forming a liquid crystalline phase [7]. In the following years, phase transition studies on

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this homologous series have also been carried out [8]. In 1992, the first non-mesogenic application of such compound was proposed by Sabbah and Watik in which they used benzoic acid as a reference material for temperature and energy calibration in the calorimetric measurements [9].

The first hydrogen-bonded LC system was reported by Kato et al. [10] in which they synthesized a mesogenic structure by adding the 4-alkylbenzoic acid (*n*OBA) and 4,4′ -bipyridine (BPy) in 2:1 molar ratio. The first two members ($n = 1,2$) of the homologous series of 4-*n*-alkoxy benzoic acid (nOBA) are non-mesogenic whereas the members with $n =$ 3–6 yield nematic mesophase. Interestingly, the other members with $n > 6$ show both smectic and nematic mesophases. Another research group [11] studied the thermal and phase behavior of the SA:nOBA; mixing of non-mesogenic salicylic acid into nOBA ($n =$ 4–8, 10–12 and 16) and assigned that benzoic acid-based compounds can exhibit the liquid crystalline nature with the addition of a non-mesogenic compound via hydrogen bonding. Recently, Sharma et al. [12] have theoretically studied this homologous series for their optical, thermal and electronic properties. They have concluded that odd–even effect was not noticed for this homologous series but physical properties linearly depend on the homologous number. Few other groups [13-15] have also studied these compounds but principal investigation in these reports is focused on the phase transition behavior. The study of the above-mentioned compounds with any external dopant is rarely reported which provides an opportunity to investigate such compounds in the presence of a dopant.

Fundamentally, graphene has superior physical properties than graphite and it is analogous to a single layer of graphite, in which sp^2 bonded carbon atoms are arranged in a hexagonal lattice. Graphene oxide (GO) is produced from graphite by chemical oxidation and subsequent exfoliation. In this conversion mechanism, the electronic properties are compromised depending upon the degree of oxidation and pure GO is electrically insulating. Graphene and its counterparts have shown groundbreaking applications in all fields of science and technology; particularly in electronic applications like solar cells [16], field-effect transistors [17], super-capacitors [18,19], etc. Graphene and rGO have proven themselves to be extraordinary materials for the battery as well [20]. In addition to the aforementioned thrust areas, liquid crystal (LC) research is also accelerated by this outstanding material [21,22]. The research objectives of liquid crystals have been equally benefitted by the dispersion of these graphitic nanostructures and composites resulted in the form of various superior properties like enhanced electro-optical response [23-26], induced electron–phonon coupling [27], dual photoluminescence [28], opto-electronics [29], light scattering device [30], etc.

In our recent article [31], we have extensively studied the molecular interaction of 4-*n*-octyl-4′ -cyanobiphenyl (8CB) LC molecules with the GO flakes and shown that the presence of GO significantly modifies the LC molecular orientation. We have also determined a critical concentration (0.4 wt%) of GO in the LC matrix that has globally changed the molecular orientation from the planar to homeotropic [31]. Those circumstantial pieces of evidence encouraged us to carry forward more investigations on similar calamitic LCs. It is a fact that formation of hydrogen bonding leads to superior physical properties along with some effects on the orientation; therefore, 4-(Heptyloxy) benzoic acid liquid crystal (7OBA) material has been taken as a host matrix in this investigation and previously observed critical concentration of graphene and reduced graphene oxide (rGO) flakes is used to be dispersed in the host matrix. Pristine 7OBA and composites are characterized by the dielectric spectroscopy, polarized optical microscopy, UV–visible and Fourier-transform infrared spectroscopy, differential scanning calorimetry, and current–voltage (I–V) techniques. The observed nonlinear I–V curves are impressive for the non-ohmic electronic applications. Furthermore, theoretical studies have also been performed via density functional theory (DFT). The experimental and theoretical results are compared and discussed in the light of molecular interactions, the role of hydrogen bonding and oxygen vacancy effects in the composites.

2. Experimental details

2.1. Host material: 4-(Heptyloxy) benzoic acid liquid crystal material

A commercially available liquid crystalline (LC) compound namely 4-(Heptyloxy) benzoic acid (7OBA), [Sigma-Aldrich, Product number-361666], having molecular weight 236.311 g mol^{-1}, and molecular length ≈17 Å, has been taken as a host material for the present study. This LC compound consists of three acceptor hydrogen bonds, one donor hydrogen bond, and eight rotatable bonds. Fig. 1 represents the chemical structure of the 7OBA compound and its LUMO and HOMO surfaces. It exhibits smectic C and nematic mesophases. The phase sequence of this LC compound is given below-

Crystalline 92.3 (117.7) Smectic C 98.4 (6.54) Nematic 146.0 (5.86) Isotropic

All transition temperatures are presented in °C whereas corresponding transition enthalpies are mentioned in brackets with units in Jg^{-1}.

2.2. Dopant material: graphene and reduced graphene oxide nanoflakes

Graphene nanopowder consisting few layer flakes were purchased from the Graphene super market (Graphene Laboratories Inc. NY, United States), whereas chemically reduced graphene oxide (rGO) powder was purchased from Graphenea (Spain). rGO has electrical conductivity of order 667 S/m.

In contrast to the claims of companies about the flakes sizes, the average size of graphene and rGO nanoflakes was found to be 100–600 nm and 400 nm–1 μ m, respectively. The scanning electron microscopic (SEM) images of graphene and rGO nanoflakes are shown in Fig. 2 (a) and (b), respectively. For recording the SEM image of graphene and rGO nanoflakes, their suspension in DMF was deposited on a TEM grid and measurements have been carried out. Other details of these materials can be retrieved from the aforementioned commercial firms.

2.3. Preparation of composites

0.1 mg ml^{-1} suspension of graphene and rGO was first prepared in the dimethylformamide (DMF). The suspension was homogenized by ultrasonication for 3 h. After obtaining a homogenous suspension of DMF/Graphene and DMF/rGO, it was added to the pristine 7OBA compound maintaining the wt/wt% equivalent to 0.4. The motive to adopt this optimized dispersion concentration has been taken from our previous article in which we observed a bulk change in the molecular orientation at this particular concentration.

Pristine 7OBA compound and its composites made with graphene and rGO were filled in 9.2 μ m thick commercially available sample cells (AWAT, Poland) to perform polarized optical microscopy, dielectric spectroscopy and I–V measurements.

2.4. Differential scanning calorimetry (DSC)

Phase thermograms were obtained using the TA Instruments Q1000 Differential Scanning Calorimeter with a 2 K min^{-1} heating rate.

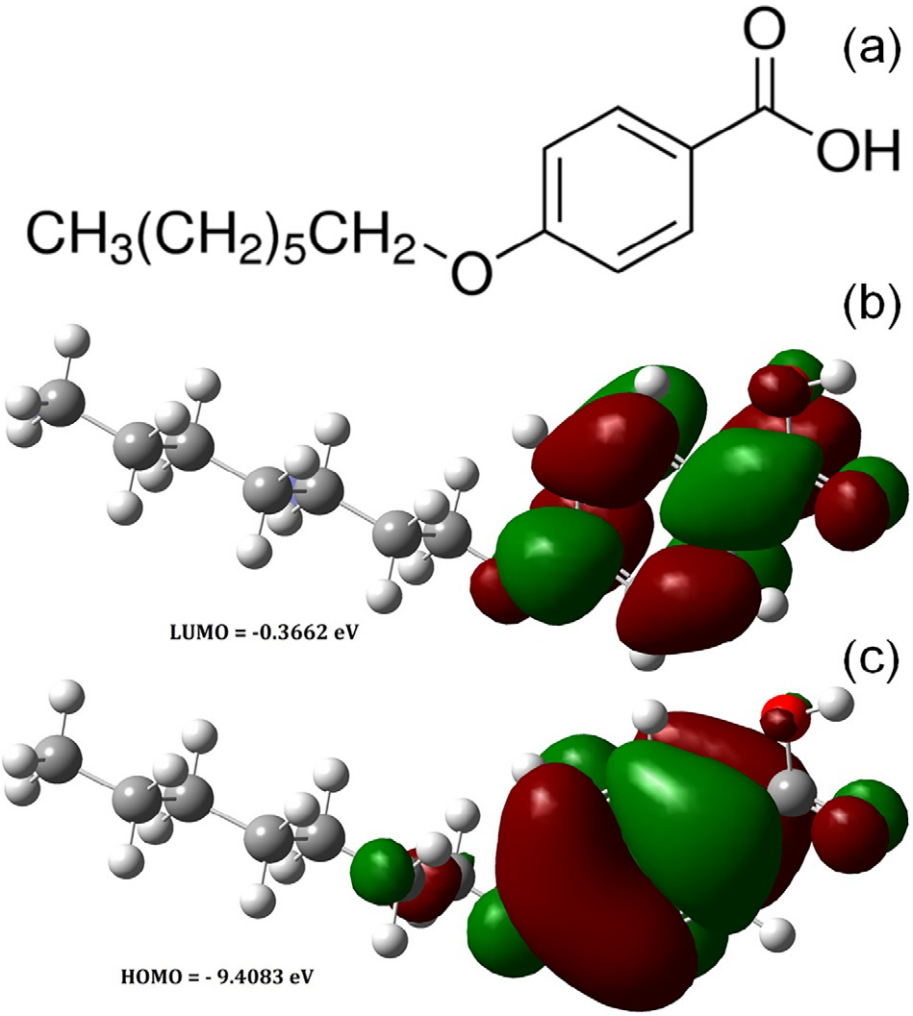


Fig. 1. (a) Chemical structure, (b) LUMO, and (c) HOMO of the 4-(Heptyloxy) benzoic acid (7OBA) liquid crystalline compound. The LUMO (−0.3662 eV) and HOMO (−9.4083 eV) values were obtained from the DFT-B3LYP/6-31G(d,p) simulation using a hybrid function AM1/opt +freq level with the help of Gaussian 09 W software package.

2.5. Polarized optical microscopy

Polarized optical microscopy observations were performed on ZEISS AXIO equipped with Infinity2 image capturing software. During the POM measurements, the temperature of materials was controlled with a Linkam TMS 94 hotstage.

2.6. Dielectric spectroscopy

Dielectric spectroscopy of all materials was performed on HP Hewlett Packard 4284 A impedance analyzer in the frequency range of 20 Hz–1 MHz. The dielectric parameters such as loss factor and dielectric anisotropy are calculated from this study. The experiment was performed at a very slow heating rate with an accuracy of ±0.01 °C.

2.7. UV–visible and Fourier-transform infrared spectroscopy (FTIR)

UV–visible absorbance measurements were performed using a UV–VIS-NIR spectrophotometer (VARIAN 5000). UV–visible and FTIR spectra were recorded in solution state,(1 mg ml^{-1}), using DMF as solvent. Nicolet iS5 (Thermo Scientific) spectrophotometer was used to obtain the FTIR spectra of pristine 7OBA compound and its composites in the range of 1000–3700 cm^{-1} using attenuated total reflection (ATR) accessory. Before performing the FTIR measurements on the compounds, background and reference scans were carefully filtered [32].

2.8. Density functional theory (DFT)

To determine the electronic structure of an atom or a molecule, density functional theory (DFT) is a fantastic tool that includes single electron wave function and calculates overall electron density distribution and thus; total electronic energy. Gaussian 09 Software [33,34] was used for the DFT calculations. All the investigated atomic/molecular systems (7OBA liquid crystal, pure graphene, reduced graphene, 7OBA + graphene) were optimized by the DFT using Gaussian 09 software package and B3LYP/6-31G(d,p) basis set [33]. The reduced graphene was optimized step by step with the addition of an oxygen atom with the graphene. The intermolecular interactions between liquid crystal and graphene/rGO were calculated by Gaussian 09 software package.

2.9. I–V characteristics

Current–voltage(I–V) characteristics of the 7OBA compound and its composites were investigated using a Keysight B2902A Precision Source/Measure Unit (SMU). During the I–V measurements, the temperature of samples was maintained with an accuracy of ±0.1 °C using the Linkam TMS 94 hotstage.

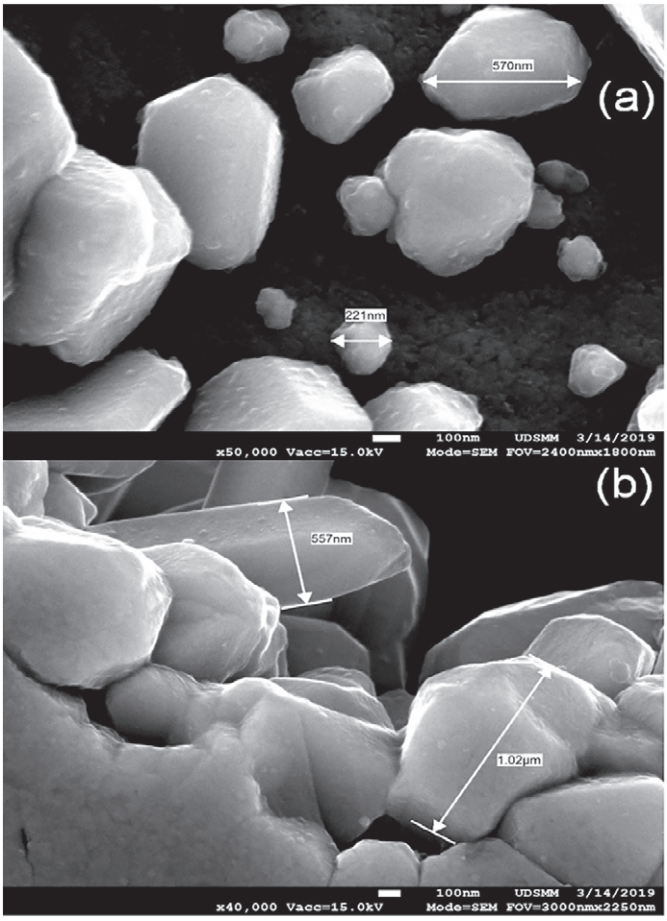


Fig. 2. Scanning electron microscopic (SEM) images of (a) graphene, and (b) reduced graphene oxide (rGO) flakes.

3. Results and discussion

It has been seen that the guest-host interactions often change the phase behavior; subsequently, phase transition temperature is also found to be changed. To analyze the effect of dopant materials (i.e., graphene and rGO flakes) on the phase transition temperatures of 7OBA compound, DSC has been performed and DSC thermograms are shown in Fig. 3. DSC thermograms have disclosed the existence of the smectic and nematic mesophases in the pristine 7OBA compound as well as in the composites. Due to the presence of graphene and rGO, the intensities of the SmC–N(second-order) and N-Isotropic(first-order) phase transition peaks are reduced; whereas, the Cr–SmC phase transition peaks are found to be of same sharpness. The reduction of the intensity of SmC–N and N-Isotropic phase transition peaks might be due to the impurity and/or disordering effects produced by the dopants in the composite matrix. In addition to this, the dispersion of graphene and rGO also causes the shifting of SmC–N and N–Isotropic phase transitions towards lower temperature side which is a commonly observed mechanism due to a combined effects of impurity and anchoring [35]. The width of SmC phase (i.e., difference between the SmC–N and Cr–SmC phase transition temperatures) is found to be 6.1, 5.1 and 5.3 °C for the pristine 7OBA, 7OBA + graphene and 7OBA + rGO, respectively; whereas SmC–N phase width (i.e., difference between the SmC–N and N–Iso phase transition temperatures) is noticed to be 47.5, 45.3 and 48.4 °C for the same. Enthalpy (heat energy of the system) is an important physical parameter of a phase transition that provides information on how much energy a system holds. When any compound (or system)

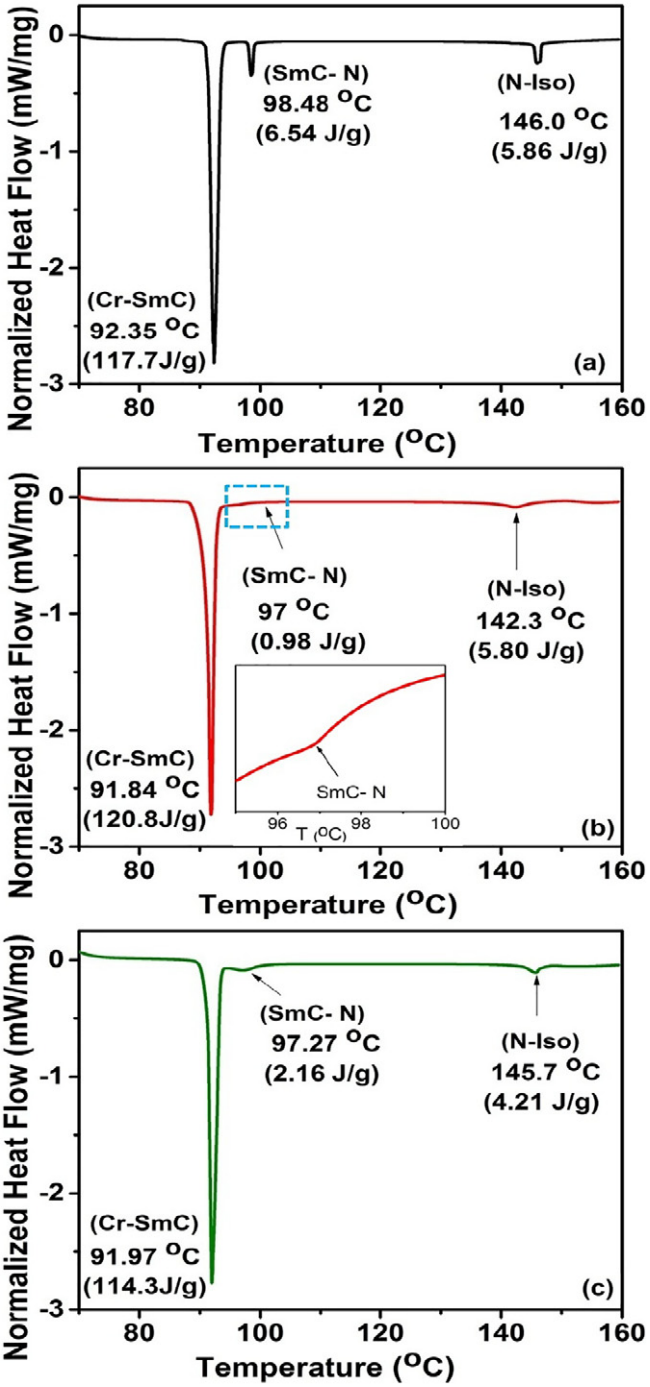


Fig. 3. Normalized differential scanning calorimetric (DSC) curves of (a) 7OBA, (b) 7OBA + graphene and (c) 7OBA + rGO with a heating rate of 2 K min^{-1}. Inset of Fig. 3(b) represents an enlarge view of the SmC–N phase transition.

undergoes a phase transition, enthalpy change takes place giving insight information that how much heat energy can be converted into useful work following the first law of thermodynamics. For pristine 7OBA compound, the enthalpy values for the Cr–SmC, SmC–N and N-Isotropic phase transitions were found to be 117.7, 6.54 and 5.86 J g^{-1}. Similarly, for the 7OBA/graphene composite, it is observed to be 120.8, 0.98, and 5.80 J g^{-1} and for the 7OBA/rGO composite, the same is noticed to be 114.3, 2.16, and 4.21 J g^{-1}. These values of enthalpies signify that composite systems hold lesser heat energy as compared to pristine 7OBA compound leading to a more lossy system

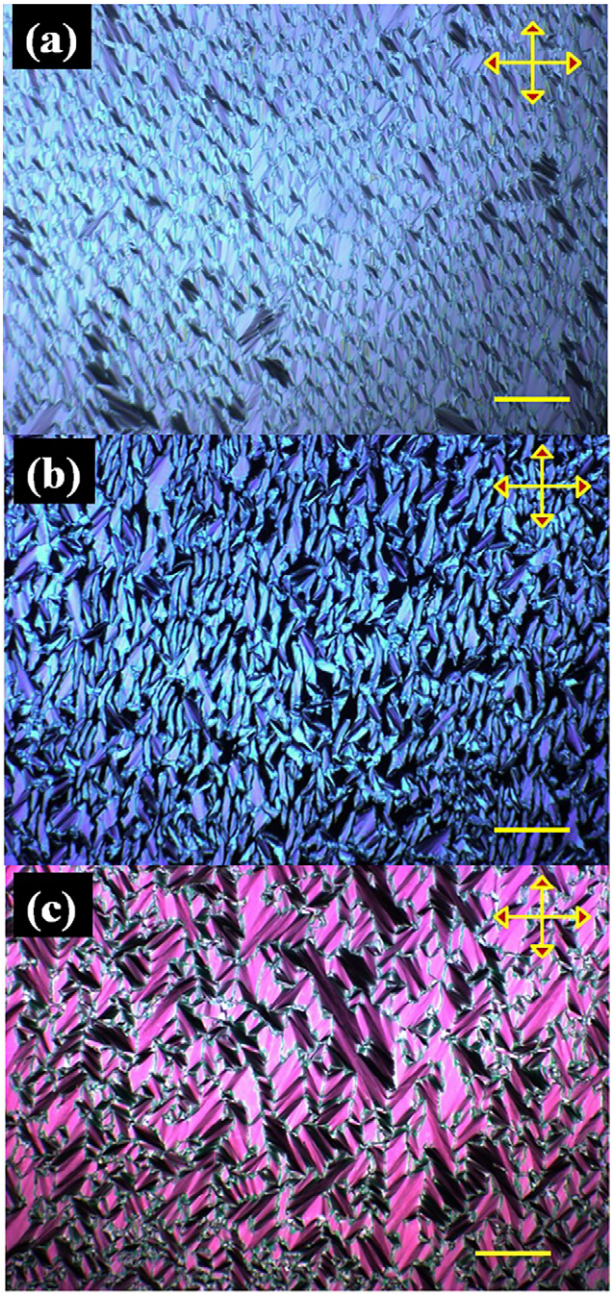


Fig. 4. Polarized optical micrographs of (a) 7OBA, (b) 7OBA + graphene and (c) 7OBA + rGO in smectic C phase at 94 °C under the crossed polarizers condition. The scale bars represent the length of 100 μm.

due to the high thermal conductivity of dopant materials and low thermal resistance of 7OBA/graphene or rGO interface.

The homogeneity and uniform dispersion of graphene and rGO flakes in 7OBA LC compound has been confirmed by using polarized optical microscopy without applying any external voltage on the sample cells. It is already explained that for measuring the POMs, we filled pristine 7OBA compound and its composites in the 9.2 μ m thick ITO cells. The POMs were recorded for the SmC phase under the crossed polarizer condition and at temperature 94 °C. Fig. 4 depicts the polarized optical micrographs (POMs) for the pure 7OBA and 7OBA composites having an optimized dispersion concentration of 0.4% wt/wt of graphene and rGO. For the pristine 7OBA compound, we observed strip-like fan texture, whereas, after the dispersion of graphene, strip-like fan texture is converted into batonnets like strips. Interestingly, the dispersion of rGO has resulted in the bigger domains with strip-like fan texture along with the color. These observations indicate that the presence of an external dopant not only changes the molecular orientation but also the refractive index or birefringence of the composite matrix. It is a well-documented fact that the observed color change in the POM of pristine LC system is associated with the change in refractive index and/or birefringence [28,36-38]. As we know that reduced graphene oxide (rGO) is a form of GO, processed by chemical or other methods to reduce the oxygen content; therefore, the functional groups attached to the rGO can interact with that of 7OBA molecule. The honeycomb structure of rGO superposes over the phenyl part of the 7OBA molecule which aligns the molecules in a preferred orientation [38,39], and results in large size domains as observed in the texture of composite. Additionally, the formation of hydrogen bonding is also helpful for obtaining a more orientated molecular matrix in the case of 7OBA/rGO composite.

Fig. 5 shows the UV–visible absorbance spectra of the pure 7OBA and its composites with graphene and rGO as a function of wavelength. For pristine 7OBA compound, the principal absorption peak is observed at 255 nm (λ_{max}) due to π-π^* transitions in the phenyl part. It is evident from Fig. 5 that the absorption of pristine 7OBA enhances with the addition of graphene and rGO. In graphitic materials, π-π^* transitions associated with C= C bonds are also observed nearly at 255 nm; therefore, the superposition in absorbance bands of the guest and the host system is expected to take place in the composites. This superposition causes the enhancement in the magnitude of absorbance. The second possible reason for the enhancement of absorption is supported by the Beer–Lambert law, which is as follows

$$I/I_o = \exp(-\varepsilon cl) \quad (1)$$

where, I_o and I are the intensities of incident and transmitted radiations, respectively. c and l are the sample concentration and optical path length, respectively, and ε is the absorption coefficient.

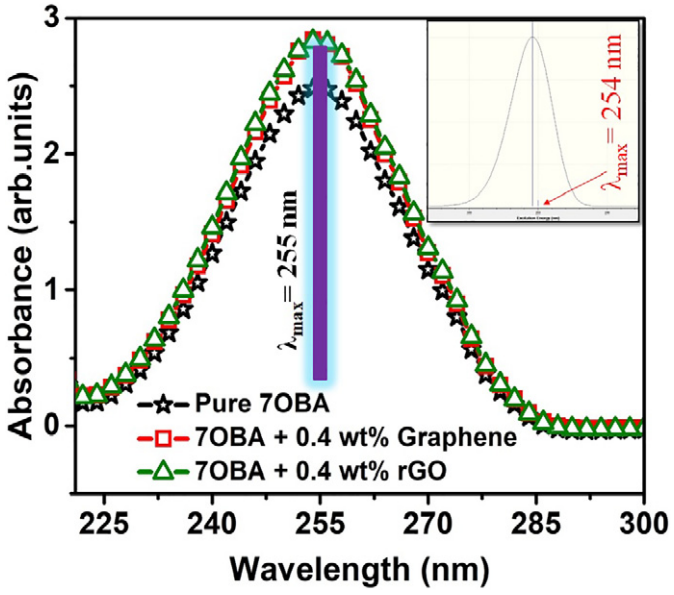


Fig. 5. UV–visible absorbance of 7OBA liquid crystalline compound and its composites with graphene and rGO. Inset represents the theoretically obtained UV–visible absorption spectrum.

Beer–Lambert law, Eq. (1), states that the transmitted intensity from a material is directly proportional to its concentration which implies that a concentrated material absorbs higher energy in comparison to a diluted one. It is already reported that the dispersion of graphene flakes enhances the viscosity of a nematic LC, if the doping concentration is less than 1 wt% [40]. In our case, the optimized dispersion concentration of dopants (i.e., graphene and rGO flakes) is 0.4 wt% and viscosity is expected to be enhanced in the composites. Thus, the enhanced viscosity increases the absorbance.

Dielectric parameters like tan δ (i.e., ϵ''/ϵ'), conductivity (σ), and dielectric anisotropy ($\Delta\epsilon$) have also been investigated for the pristine 7OBA compound and its composites. These dielectric parameters as a function of frequency/temperature are shown in Fig. 6. The quantity, tan δ refers to phasor in the complex plane and represents a ratio of the imaginary to real parts of the complex dielectric permittivity ($\epsilon^* = \epsilon' - j\epsilon''$). It signifies the loss factor (inherent dissipation of the electromagnetic energy) of a system. The frequency variation of tan δ for the pristine 7OBA, and its composites with graphene and rGO is presented in Fig. 6 (a) which clearly indicates that the loss factor in composites is higher than that of the pristine 7OBA compound. Graphene and rGO have large radiative energy transfer coefficients which might be coupling with the electrically fluctuating dipoles of the 7OBA compound [41]; that produces more dissipation of energy in the composite under resonance condition. The observed behavior of tan δ shows good agreement with that of the DSC and UV–visible results.

Furthermore, the electrical conductivity, (σ), has also been determined as a function of temperature for the pristine 7OBA compound and its composites Fig. 6 (b). The temperature-dependent conductivity has been analyzed by the well-known Arrhenius equation, $\sigma(T) = \sigma_o \exp(-E_a/RT)$, where σ_o and E_a are the exponential prefactor and activation energy, respectively. It is evident that the electrical conductivity remains almost constant in the Cr phase, and it increases with increasing temperature in the SmC phase. This is because of the less ordering of the SmC phase as compared to the Cr phase. In the SmC phase of the pristine 7OBA compound, electrical conductivity was found to be in order 10^{-9} S/m, whereas it is almost a hundred fold higher in the composites. The formation of nano/microchannel (percolation behavior of graphene/rGO flakes) which improves the charge migration leading to an enhancement in the conductivity by 10^2 times. Due to their improper dielectric nature and low conductivity, LCs couldn't be utilized in the electronic devices. This limitation can be overcome by adding an external guest material, (e.g. graphene), which is rich in electronic properties. It is evident in the present study that the addition of a small amount of graphene and rGO significantly enhances the electronic properties of the 7OBA LC material and subsequently, these composites are suitable to be applied in the nonlinear electronic devices.

Anisotropy is an essential physical property of the LCs that originates due to the long-range molecular ordering. We have determined the dielectric anisotropy ($\Delta\varepsilon = \epsilon'_{\parallel} - \epsilon'_{\perp}$) in the SmC phase for the pristine 7OBA compound and its composites. Dielectric anisotropy as a function of temperature is shown in Fig. 6 (c). Dielectric anisotropy of the pristine 7OBA compound is found to be ≈0.35 which remains almost constant in the SmC phase. The low value of dielectric anisotropy is associated with the small dipole moment (≈3 Debye) of the 7OBA compound. For the composites, dielectric anisotropy is found to be decreased. In the case of 7OBA/graphene composite, a feeble induced homeotropy is observed; therefore, the decrement in the dielectric anisotropy is associated with the higher contribution of homeotropic component ($\epsilon_{\parallel}$), of the dielectric permittivity [42]. For the rGO dispersed 7OBA composite, the sign inversion of dielectric anisotropy is observed which vanishes nearly at SmC–N phase transition. The study on sign reversal of dielectric anisotropy has been investigated for the nematic [43,44], bent core nematic [45], and ferroelectric LCs [46]. The above-mentioned groups have explained

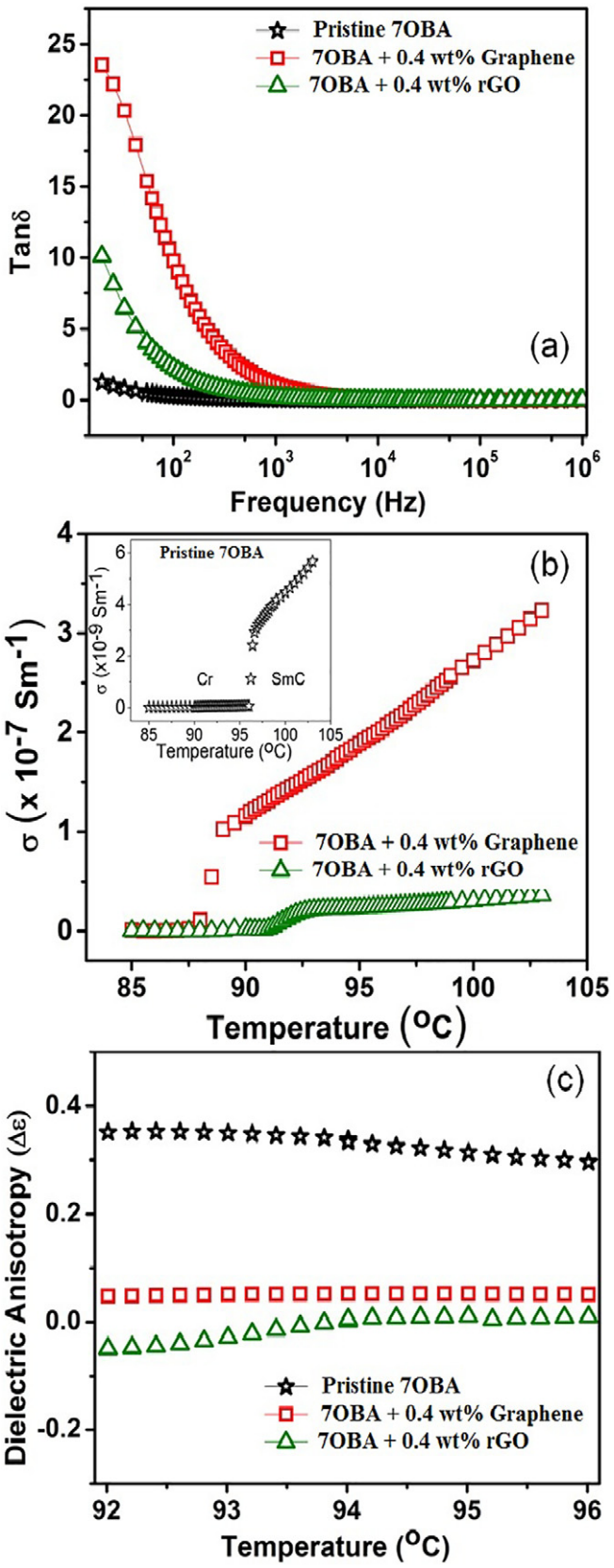


Fig. 6. (a) represents the tan δ versus frequency curve at 94 °C whereas (b) and (c) show the variation of electrical conductivity and dielectric anisotropy as a function of temperature for the pristine 7OBA, 7OBA + graphene, and 7OBA + rGO. Inset of (b) represents the conductivity Vs. temperature of pristine 7OBA compound.

this sign inversion phenomenon by the dipole–dipole interaction theory, change in molecular ordering, formations of conformers, and hydrocarbon chain dynamics. It is a well-established fact that any external dopant, like nanoparticles, quantum dots, graphene, etc., can change the electro-optical properties of a pure LC material. Besides, the dopant dispersed LC system can show a homeotropic alignment in contrast to the planar alignment of LC molecules on a polyimide alignment layer. This dispersion somehow behaves like a LC system with negative dielectric anisotropy. But, such a phenomenon is purely circumstantial and can be varied with the experimental condition. In our investigation on the rGO dispersed 7OBA LC system, we didn't observe any induced homeotropic alignment; therefore, the possibility of induced homeotropic behavior of dispersed system showing a negative dielectric anisotropy is ruled out.

Presently, we explain this sign inversion of dielectric anisotropy using the mechanism of dipole–dipole interactions in the guest–host system. The total dipole moment, (μ_T), of the 7OBA/rGO composite system is the sum of its longitudinal (μ_l) and transverse (μ_t) counterparts. In the rGO dispersed 7OBA composite, thermally influenced hydrogen bonding is formed between the oxygen atoms of 7OBA compound and hydrogen atoms present on the rGO surface (model presented in Fig. 8). Therefore, the orientation of resultant dipole moment lies out of the plane with respect to the orientation planes of the rGO and 7OBA molecules in such a way that the overall dipole moment of 7OBA/rGO composite is higher as compared to that of the pristine 7OBA molecular system. This effect causes a temperature-dependent sign inversion of dielectric anisotropy. In addition to this, the observation of sign inversion of $\Delta\varepsilon$ might also be related to the presence of rGO clusters which could make short-range smectic ordering as discussed by Vij et al.[45]. Our hypothesis is also supported by the simulation results which have shown that the dipole moment of 7OBA/rGO composite is higher than the 7OBA compound.

Electronic devices with nonlinear I–V characteristics in "reverse bias" mode are essentially important for the voltage regulation purpose in which a stabilized voltage output is obtained with low ripple under varying load current conditions. In general, the working principle of these devices is different from the ohmic-circuit based electronic system. In this investigation, we have also determined the nonlinear I–V characteristics of the pristine 7OBA compound and its composites in the SmC phase. The nonlinear I–V curves are depicted in Fig. 7. It is clear from Fig. 7 (a) that the pristine 7OBA compound exhibits a linear I–V character. It shows a critical ohmic behavior similar to a normal dielectric material. In LCs, such behavior is often observed due to the presence of free ionic charge carriers [47]. In the pristine 7OBA compound, a non-zero current at 0 V is attributed to the pseudocapacitance effect originated due to the presence of ionic charges near the electrodes (ITO) [31]. The magnitude of current is found to be ≈20 nA at 40 V. Also, a positive current is recorded even after applying an external bias voltage of −20 V. Such character clearly indicates that the observed current is attributed to ionic charge carriers. The I–V curves of graphene and rGO dispersed 7OBA are presented in Fig. 7 (b) and (c), respectively. The observed I–V behavior of the dispersed system is particularly interesting in which we noticed two captivating features; first, the nonlinear nature, and second, nearly a hundred-fold larger conduction current. In the graphene/7OBA composite system, we observed almost zero current at 0 V which indicates that the ionic current contribution has been suppressed. Additionally, the I–V curve is similar to the diode characteristics. Globally, I–V behavior of the 7OBA compound and its composites with graphene and rGO can be written as

$$I=\sum_{i=1}^{\infty}A_i e^{(\kappa V/R)} = Ao + A_1\kappa(V/R) + A_2\kappa'(V/R)^2/2! + A_3\kappa''(V/R)^3/3! + \ldots\ldots \quad (2)$$

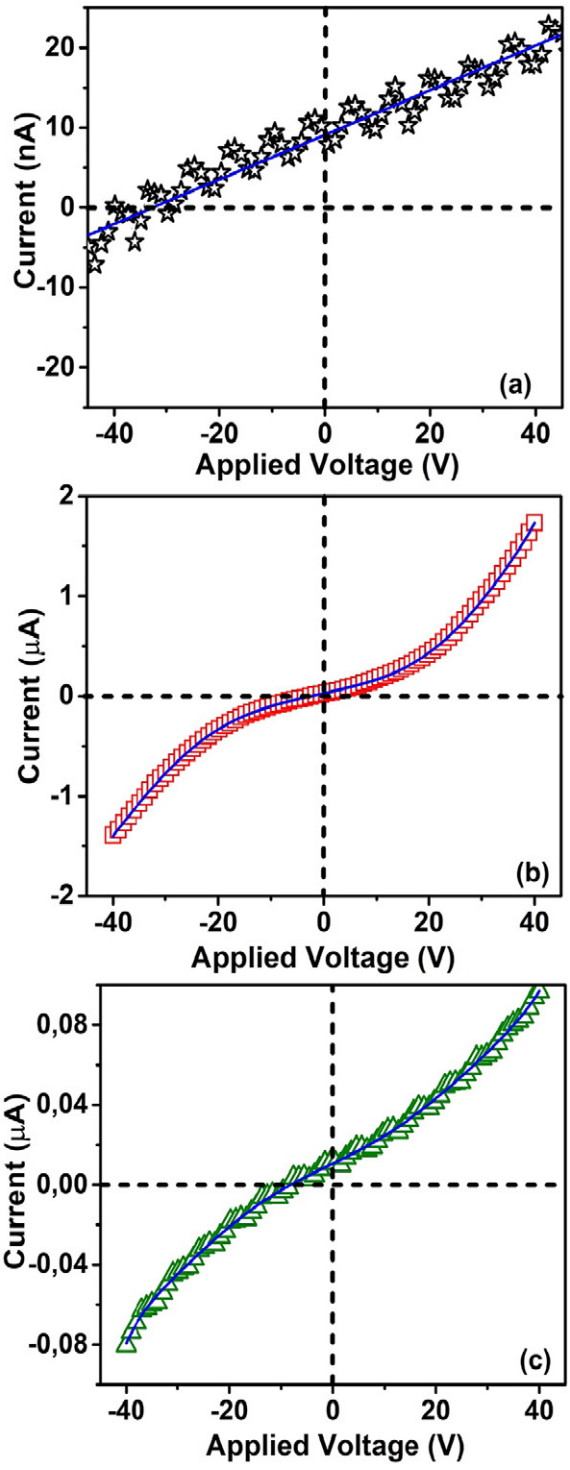


Fig. 7. Current –Voltage (I–V) characteristics of (a) pristine 7OBA compound, (b) 7OBA + Graphene, and (c) 7OBA + rGO at 94 °C. Blue solid line depicts the linear/nonlinear fitting of the experimental data. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

where I, V and R are the current, applied voltage and resistance of the material, respectively. A_i is the proportionality constant and $\kappa = \beta/(k_B.T)$, where k_B is the Boltzmann constant, T is the temperature, and β is the field lowering coefficient.

Eq. (2) represents the I–V behavior of the pristine 7OBA material and its composites under a boundary condition. For the pristine 7OBA compound, higher-order terms ($i > 1$) are negligible; therefore,

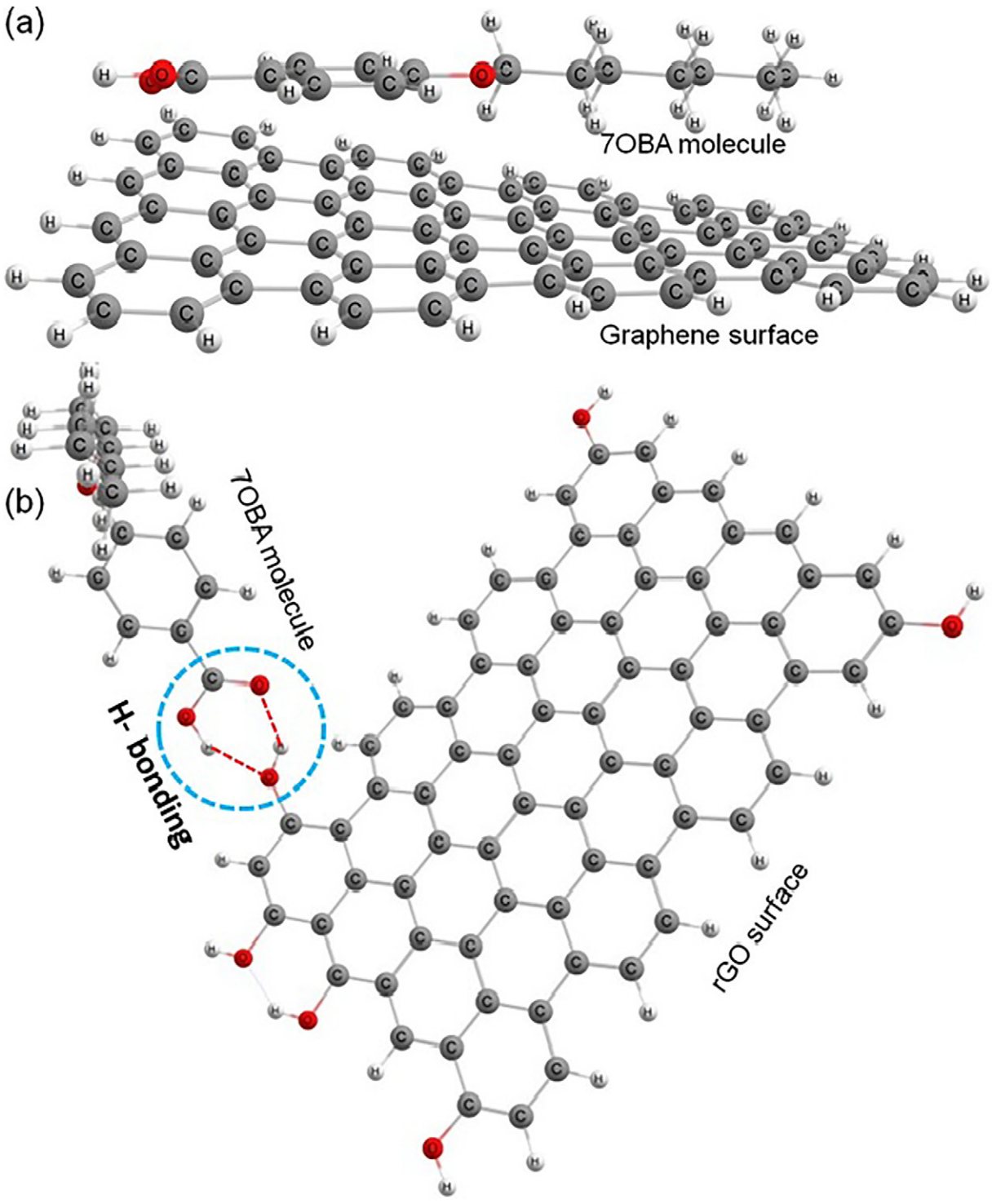


Fig. 8. (a) and (b) represent the optimized geometries of molecular interactions between the 7OBA + graphene and 7OBA + rGO, respectively.

the expression for the current only includes a linear relation, i.e., $I = Ao + A_1 \kappa (V/R)$. For the 7OBA/graphene/rGO composites, higher-order terms ($A_2 \kappa' (V/R)^2/2! + \ldots$) come into the existence due to nonlinearity in the I–V behavior which might be associated with the formation of a Schottky barrier at the 7OBA/graphene/rGO interface [31,48].

The observed knee voltage (the positive bias voltage at which current rises rapidly), and breakdown voltage (the negative bias voltage at which current increases sharply) for the 7OBA/graphene composite system was found to be +8 V and −10 V, respectively. The present study reveals that the observed breakdown voltage, (i.e., −10 V), for the 7OBA/graphene composite is higher than that of the previously reported systems like FLC/Cdse, Ppy/CdSe, PMeT/CdSe as described by Singh et al. [49]. In the case of rGO dispersed 7OBA composite, the I–V curve is somehow similar to the 7OBA/graphene system having some amount of leakage current; i.e., non-zero current at 0 V which is attributed to the formation of hydrogen bonding [50], however, hydrogen bond dynamics at the molecular level is

Table 1
A comparison of the experimental and simulation results. The abbreviations, E and S refer to the experimental and the DFT-B3LYP/6-31G(d,p) simulated values, respectively. The refractive indices were measured at 24 °C.

Properties	Pristine 7OBA	7OBA + Graphene	7OBA + rGO
Refractive index (in toluene)	1.5084 (E)	1.5010 (E)	1.5011 (E)
	- (S)	- (S)	- (S)
λ_{max} (nm)	255 (E)	255 (E)	255 (E)
	254 (S)	254 (S)	254 (S)
Dipole moment (Debye)	- (E)	- (E)	- (E)
	3.18 (S)	1.16 (S)	9.27 (S)
ν (cm^{-1})	1168; O—H scissoring (E)	1167 (E)	1166 (E)
	1292; C—O alkoxy stretching (E)	1293 (E)	1291 (E)
	1427–1466; rocking in C—H (E)	1426–1466 (E)	1410–1467 (E)
	1664; aromatic C—C sym. stretching (E)	1666 (E)	1659 (E)
	1724; C═O stretching (E)	1724 (E)	1724 (E)
	2847–3100; sym. and asym. C—H stretching (E)	2847–3100 (E)	2847–3100 (E)
	3638; sym O—H stretching (E)	3640 (E)	3628 (E)
	1197; O—H scissoring (S)	1215; rocking in O—H (S)	1207; rocking in O—H (S)
	1391; C—O alkoxy stretching (S)	1342 (S)	not observed (S)
	1393–1462; rocking in C—H (S)	1388–1400 (S)	1380–1384 (S)
	1667; aromatic C—C sym. stretching (S)	1648 (S)	1647 (S)
	1722; C═O stretching (S)	1693; scissoring in C—O (S)	1662 (S)
	3000–3114; sym. and asym. C—H stretching (S)	2999–3100 (S)	3000–3124 (S)
	3630; sym O—H stretching (S)	3648 (S)	3353–3694 (S)

extremely difficult to directly investigate. In this case, the observed change in the magnitude of current is analogous to degree of reduction from graphene to reduced graphene oxide. For the composite systems, the enhancement in conduction current is globally associated with the increased charge carrier mobility and the formation of graphene and rGO networks in the 7OBA matrix [31].

We have also compared our experimental results with that of the simulated parameters using DFT. Physical parameters for the pristine 7OBA, 7OBA/graphene, and 7OBA/rGO composites were optimized using the B3LYP/6-31G(d,p) basis set. The comparison between the experimental and theoretical results are tabulated in Table 1. The physical properties of a composite depend on the guest–host interactions in which the formation of hydrogen bonding plays a crucial role. These interactions and the formation of hydrogen bonding are further examined and discussed with the help of the simulated model as shown in Fig. 8. The simulated model, obtained by the DFT, for the 7OBA/graphene composite illustrates the absence of any chemical bonding between the 7OBA molecule and graphene flakes, but face-on (the plane of orientation of 7OBA molecule is parallel to that of the graphene flakes) interactions are taking place between the guest and host. In contrast, rGO flakes are bonded with the 7OBA molecules via a hydrogen bonding. In the rGO dopant, few binding sites (oxygen vacancies) are available for the bonding with a hydrogen atom of the 7OBA molecules; this leads to the formation of hydrogen bonding in the 7OBA/rGO composite. The presence of hydrogen bonding causes a change in physical properties. The modified characteristics of the 7OBA/graphene and 7OBA/rGO composites, in comparison to pristine 7OBA, are analogous to the physical and chemical changes, respectively.

At last, Fourier-transform infrared spectroscopy (FTIR) was performed to confirm our hypothesis about the physical and chemical interactions between the host 7OBA material and the guest dopants i.e., graphene and rGO flakes. FTIR spectra, performed at room temperature (27 °C), are shown in Fig. 9. As LCs are composed of a central core, a flexible aliphatic chain, and some functional groups; therefore, various fundamental molecular vibrational bands like C—H, C—C, C—O, C═O, C≡N, etc., can be observed in the FTIR study. Further, these bands can be influenced in the presence of an external dopant proving intuitive information about the interactions between them. In the pristine 7OBA compound, the rocking in C—H has been noticed at 1400–1462 cm^{-1}, whereas the aromatic C—C symmetric and C═O stretching bands were observed at 1667 and 1724 cm^{-1}, respectively. Scissoring in O—H and alkoxy (C—O) stretching vibrations were taking place nearly at 1170 and 1299 cm^{-1}, respectively. Symmetric and asymmetric C—H stretching vibrations corresponding to C_7H_{15} aliphatic chain have been observed between 2850 and 3100 cm^{-1}. Symmetric O—H stretching vibration was additionally found at 3635 cm^{-1}. The presence of graphene/rGO flakes in the 7OBA compound causes the modification in the vibration bands. In the 7OBA/graphene composite, the aforementioned bands are alike to that of pristine 7OBA, but intensities of these bands have been enhanced which is due to the physical interactions between the guest graphene flakes and the host 7OBA compound. There was no evidence of the chemically induced new band; therefore, the possibility of a chemical interaction has been overlooked. The 7OBA/rGO composite shows some interesting features which provide a piece of information about the interaction between the rGO and 7OBA compound. The presence of rGO significantly suppresses the symmetric and asymmetric C—H stretching vibrations taking place in the C_7H_{15} aliphatic chain. During the synthesis of rGO, the reducing agent causes the modification in the carbon to oxygen ratio and introduce some oxygen vacancies. These oxygen vacancy defects reduce the terminal vibrations corresponding to the aliphatic

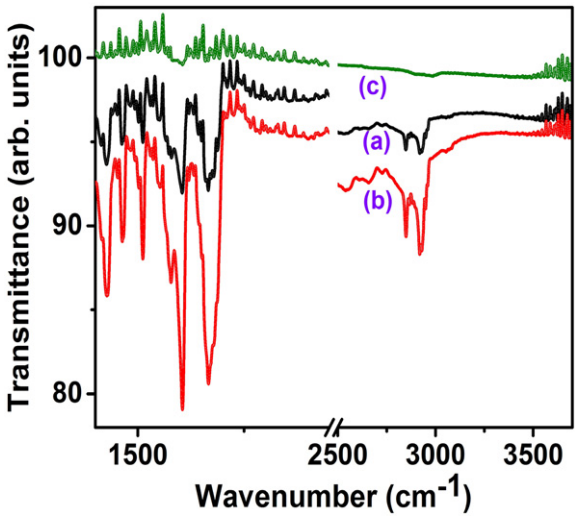


Fig. 9. Fourier-transform infrared spectra of (a) pure 7OBA, (b) 7OBA + Graphene and (c) 7OBA +rGO composites.

chain due to the formation of hydrogen bonding [51]. In addition to this, the symmetric O—H stretching vibrations are down shifted and observed at 3460 cm^{-1} which is an evidence of the formation of a hydrogen bonding. This induced hydrogen bonding between the rGO and 7OBA molecule is responsible for the intriguing properties of the 7OBA/rGO composite.

4. Conclusions

In brevity, an optimized concentration of graphene and rGO flakes was dispersed in a commercially available 4-(Heptyloxy) benzoic acid (7OBA) liquid crystalline (LC) material and characterized via spectroscopic, dielectric, and electrical techniques. The principal idea about the preparation of such composite was to analyze the orientation of the 7OBA molecules, having the molecular length of ≈17 Å, along with the orientational plane of large-size graphene (100–600 nm) and rGO flakes (400 nm–1 μ m) and subsequent effects on their physical properties. The pristine 7OBA compound exhibited two mesophases, viz. smectic C (SmC) and nematic (N). The differential scanning calorimetric measurements revealed that the SmC–N and N–Isotropic phase transitions of the 7OBA compounds are remarkably modified after the dispersion of graphene and rGO flakes. The presence of graphene and rGO not only downshifts the SmC–N and N–Isotropic phase transition temperatures but also changes the enthalpies of phase transitions which was analogous to the influence of high thermal conductivity of the graphene and rGO flakes. The homogeneous distribution of flakes in the 7OBA matrix was confirmed by the polarized optical microscopy. The pristine 7OBA compound showed the strip-like fan texture, whereas, after the dispersion of graphene, strip-like fan texture was converted into batonnets like strips. In the 7OBA/rGO composite, bigger domains with strip-like fan texture have been observed. In addition to this, the polarized optical micrographs (POMs) evince the transformation of texture color, which is attributed to the change in the refractive index and/or birefringence of the medium. Principally, the 7OBA compound absorbs UV light of wavelength 255 nm corresponding to π-π^* transitions in the phenyl rings. The graphitic materials also absorb UV light nearly at 255 nm due to π-π^* transitions in the C= C bonds. The superposition of these π-π^* transitions of the host 7OBA compound and the guests graphene and rGO flakes results in the enhanced absorption of the composites. Dielectric spectroscopy has also been carried out for the pristine 7OBA compound and its composites with graphene and rGO flakes in order to calculate the tan δ, conductivity (σ), and dielectric anisotropy ($\Delta\epsilon$) as a function of temperature in the SmC phase. The tan δ and σ of the pristine 7OBA compound are found to be enhanced after the addition of graphene and rGO, whereas, the $\Delta\epsilon$ has been reduced for the composite systems. The sign inversion of $\Delta\epsilon$ was observed for the 7OBA/rGO composite which has been explained via dipole–dipole interactions and change in the molecular orientation. Very interesting features were obtained in the I–V behavior of the studied materials in which pristine 7OBA compound yields the ohmic I–V curve with a non-zero current at 0 V attributing to the pseudo-capacitance effect. After the dispersion of graphene and rGO flakes, nonlinear diode like I–V curves having a hundred times larger conduction current were acquired. The global behavior of I–V curves has been explained via an empirical relation. The observed knee voltage for the composites was found to be superior as compared to previously reported articles. Furthermore, the change in physical properties has been analyzed by the FTIR which indicated that the formation of hydrogen bonding plays a crucial role in determining the physical properties of 7OBA/rGO composite. At last, these experimental findings were compared with the simulated results by DFT which are found to be in good agreement with each other. The investigated composites have shown their potential applications for the nonlinear electronics and voltage/current regulated electronic devices.

Declaration of competing interest

The article is original and has been written by the stated authors who are aware of its content and approve its submission. This article has neither been published previously nor under consideration for the publication elsewhere. We also declare “No conflict of interest exists”.

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ORIGINAL RESEARCH

Silver nanoparticles dispersed in nematic liquid crystal: an impact on dielectric and electro-optical parameters

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Abstract
In the present study, nematic liquid crystal (NLC) 4′-(Octyloxy)-4-biphenylcarbonitrile dispersed with three different concentrations of silver nanoparticles (Ag NPs) is characterized by electro-optical and dielectric spectroscopy method. The dispersion of Ag NPs into NLC material leads to the change in physical parameters such as dielectric permittivity, photoluminescence, threshold voltage, response time and splay elastic constant. The AC conductivity and threshold voltage of Ag NPs-dispersed composite system have increased significantly. The increase in the AC conductivity for the composite system is attributed to the Ag NPs-assisted induced charge transfer mechanism in the system. Moreover, the increase in AC conductivity value for Ag NPs/NLC composite system discloses its importance in photovoltaic solar cell.

Keywords Nematic liquid crystal · Silver nanoparticles · Dielectric anisotropy · Threshold voltage

Introduction

Liquid crystals (LCs) represent a fascinating class of soft condensed matter where the subtle balance between order and fluidity of the molecules exists. They show a range of exceptional properties that not only are fascinating from basic science point of view, but also hold tremendous potential for various innovative applications [1, 2]. Nematic liquid crystal (NLC) is the simplest of all LC phases and widely used in the ubiquitous liquid crystal displays (LCDs) and many nondisplay applications. With the advancement of technology, LCD also needs advancement such as low power consumption, faster response and greater vision angle. In past few years, much emphasis has been given to tailor the properties of liquid crystals by dispersing suitable nonmesogenic materials (dyes, polymers, nanoparticles, carbon nanotubes, quantum dots, etc.) into the host LC matrix [3–7]. Liquid crystals containing dispersed nanoparticles (NPs) of various shapes and sizes are promising materials for the display and sensor industries, fast electro-optical switchers and shutters, memory cells, tunable filters, nonlinear optical valves for optical processing systems, etc. [8–10]. The coupling of the anisotropic elasticity of LCs to the optical, conductive or magnetic properties of NPs is expected to have an additional benefit with the relevant technologies. It is thus imperative to control NPs interaction with LC molecules so that the macroscopic properties as a whole can be tailored for specific applications.

Among all the NPs, metal NPs are highly studied and extensively used because of their exploitable optical properties. Silver (Ag) NPs are one of the well-known and widely used metal NPs due to their conductivity, chemical stability, intense calorimetric effect at nanoscale range and medical applications [11–13]. The comprehensive study by Vimal et al. revealed that the presence of silver nanoparticles into the pure ferroelectric liquid crystal significantly modified the phase transitions, molecular alignment and various other LC parameters [14]. Singh et al. reported that the dispersion of small amount of Ag NPs in the room-temperature NLC increased the nematic–isotropic transition temperature and decreased threshold voltage [15]. Tripathi et al. doped Ag

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NPs in 6CHBT NLC and found that the dielectric anisotropy, threshold voltage and splay elastic constant have decreased for nanocomposites [16]. The effect of Ag NPs, polyaniline and polyaniline/Ag nanocomposites on NLC material was investigated by our group, and we observed that the isotropic temperature has decreased for all the mixtures and ordering of LC molecules can be tuned by doping of polyaniline/Ag nanocomposites [17]. Fast response of supertwisted nematic cells was achieved with the dispersion of Ag/Pd NPs at low temperature [18]. Recently, Shen et al. presented a very nice review indicating the impact of various kinds of nanodopants on the physical properties of LCs, which is attributed to the different size, shape, dispersibility and functionalization of NPs [19].

In the present work, an effort has been made to study the effect of Ag NPs on the dielectric, optical and electro-optical parameters of NLC (8OCB). To understand the influence of Ag NPs on the molecular dynamics of NLC, we have measured dielectric permittivity and dielectric anisotropy. The voltage dependence of rise time and fall time has been examined for both pure and NPs-dispersed NLC. Further, the splay elastic constant and threshold voltage have been calculated for various concentrations of NPs. The investigated Ag NPs/NLC composites are useful for the development of energy-efficient electro-optical devices.

Experimental details

Materials

Positive dielectric anisotropic nematic liquid crystal 8OCB has been used as host material in the present investigation. The phase transition sequence of nematic LC is as follows:

Cryst. ⟶ 51°CNematic ⟶ 77°CIso.

Silver nanoparticles capped with hexanethiol and having the spherical size less than 10 nm have been used as a dopant to disperse into the pure NLC 8OCB.

Preparation of LC sample cell and NPs–LC composites

The LC sample cells were prepared by using two optically active indium tin oxide (ITO)-coated flat glass substrates through the photolithography. The planar alignment has been achieved by the treatment with nylon (6/6) and rubbing unidirectionally. Mylar spacer has been used to maintain a constant thickness of the sample cell. For homeotropic alignment, the glass substrates were coated with a dilute solution of lecithin (cetyltrimethylammonium bromide). The empty sample cells have been calibrated using analytical reagent (AR) grade benzene (C_6H_6) as a standard reference. The details of LC cell fabrication have been already reported by our group [20].

Three composites were prepared by dispersing an appropriate amount of Ag NPs 0.5 wt./wt.% (Mix.1), 1 wt./wt.% (Mix.2) and 2 wt./wt.% (Mix.3) into the pure NLC material. For the preparation of homogeneous mixture of NPs-dispersed nematic liquid crystal, we have first dissolved the NPs in propanol-2 solution and then the suitable amounts of NPs and NLC were taken and homogenized in an ultrasonic mixer for 2 h. The assembled sample cells were filled with pure NLC and NPs-NLC composites by capillary action at above the isotropic temperature of the NLC material. The uniform mixing of NPs in NLC was checked by the polarizing optical microscope (Radical RXLr-5).

Dielectric and electro-optical measurements

The dielectric spectroscopy of pure NLC and NPs-dispersed NLC has been carried out in a frequency range of 100 Hz–40 MHz using a computer-controlled impedance gain/phase analyzer (HP 4194A). The value of dielectric permittivity varies with the frequency of the applied AC field. At very low and high frequencies (<50 Hz and $>10^6$ Hz), data obtained from the instruments suffer from some inadequacies. To remove these inadequacies, we fit the data by using correction terms for low- and high-frequency regime. The frequency range from the hundred to kilo hertz suffers minimum inadequacies for nematic liquid crystal, so we choose any frequency in between this range to present our data and in this particular study we have chosen 5 kHz for data representation. The temperature has been maintained by a computer-controlled INSTEC hot plate with an accuracy of ± 0.5 °C.

To study the electro-optical behavior of the pure NLC and Ag NPs-dispersed NLC, an arbitrary square wave of frequency 5 Hz has been applied to the planar aligned cell using a function generator (Tektronix AFG-3021B). A He–Ne laser beam of wavelength 632 nm was used as the input signal, and the output signal was detected by a photodetector (Instec-PD02LI) fed to a digital storage oscilloscope (Tektronix TDS-2024C) in an electrical form. The rise time (τ_{on}) and fall time (τ_{off}) for the pure NLC and Ag NPs-dispersed NLC were calculated by using the following equations.

$$\tau_{on} = t_{90} - t_{10} \text{ and } \tau_{off} = t_{10} - t_{90} \quad (1)$$

τ_{on} is the time required for the transmittance to rise from 10 to 90% and τ_{off} is the time required for the transmittance to fall from 90 to 10% [21].

Results and discussion

The variation in conductivity with the change in frequency in disordered solids, such as polycrystalline semiconductors, polymers, glasses and transition metal oxides, is an important parameter in transport mechanisms. Frequency spectrum of conductivity explains the role of disordering in transport of ions in such systems. In above-mentioned disordered systems, universal law is applied to understand the behavior of composites having foreign particles. It has been observed that at low frequencies, conductivity is constant (illustrated as σ_{dc}), while above a critical frequency (f_o), it becomes strongly frequency dependent and written as σ_{AC}. The Jonscher's universal description employs the following explicit expression for $\sigma(f)$:

$$\sigma(f) = \sigma_{dc} + \sigma_{ac} \text{ Or } \sigma(f) = \sigma_{dc} + kf^n \quad (2)$$

Here, k is constant and the exponent n has the limits $0 < n < 1$ for disordered solids. With the help of impedance spectroscopy of the material, we get to know about the permittivity and dielectric loss as a function of frequency and temperature. By drawing and fitting the Cole–Cole plot, we get the value of DC conductivity (σ_{dc}) which remains constant throughout the frequency spectrum as it does not interfere with the dipoles [22, 23]. However, the AC conductivity (σ_{ac}) varies with the frequency and can be further written as [24]:

$$\sigma_{ac} = 2\pi f \varepsilon_o \varepsilon'' \quad (3)$$

Here, ε_o is permittivity of the free space, ε'' represents the dielectric loss and f is the frequency of the applied field. The AC conductivity has been calculated for the pure and composite system by using above formula. Figure 1 presents the AC conductivity versus temperature curve for pure NLC 8OCB and Ag NPs-dispersed composite systems.

From the figure, it is observed that the AC conductivity of composite system has been enhanced as compared to pure NLC, which may be due to the presence of metal nanoparticles. It has been suggested by Urbanski et al. [25] that the ligand molecules from the organic capping layer of nanoparticles act as trap for ionic impurities. A partial release of these impurities occurs, while the ligand shell interacts with the uniaxial nematic host material. According to their results, the releasing of these impurities is the most likely source for the increased conductivity of doped system. As the temperature increases, the AC conductivity of pure and composites also increases in the same manner. This is due to the increase in the kinetic energy of the silver nanoparticles.

Figure 2 indicates the photoluminescence (PL) intensity of the pure 8OCB and Ag NPs-dispersed composites. A sharp emission peak has been found at 362 nm, and no shift in emission peak was observed for composites. But the PL intensity of the pure NLC has been quenched after the addition of silver NPs. This quenching in luminescence of the composites shows a dependence on the concentration of Ag NPs. Absorption of major portion of PL emission of the pure NLC material by the Ag NPs might be responsible for reduction in the PL intensity of the composites. When Ag NPs are dispersed in the NLC material, NP–NP dipolar interaction takes place along with NLC–NLC dipolar interaction. The momentum originating from these interactions reduces the charge transfer between Ag NPs and LC molecules, which results in the reduced transfer of photonic energy between the LC molecules and NPs. This can be termed as nonradiative excitation energy transfer from LC molecules to Ag NPs.

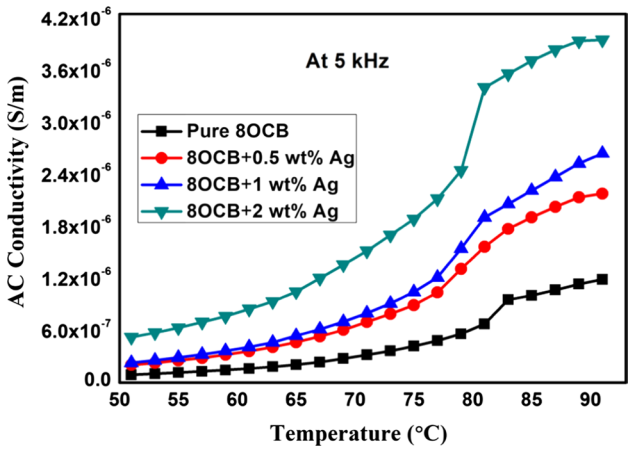


Fig. 1 AC conductivity versus temperature graph for pure NLC 8OCB and 8OCB/Ag NPs composites

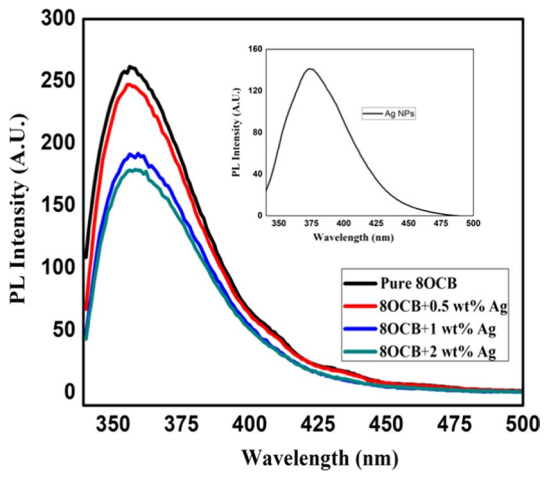


Fig. 2 Photoluminescence curve for pure NLC 8OCB and 8OCB/Ag NPs composites

Figure 3 represents the variation of parallel and perpendicular component of dielectric permittivity with the temperature. These components have been calculated with the help of method given in Ref. [26]. Since the NLC used in the present study is a positive dielectric anisotropic material, the parallel component of dielectric permittivity (ε‖) will always show higher value as compared to perpendicular component of dielectric permittivity ($\varepsilon_\perp$). As the temperature increases, the difference between parallel and perpendicular components of permittivity becomes narrower. It is interesting to note that the presence of Ag NPs in the pure 8OCB causes a decrement in the parallel and perpendicular component of permittivity. The reduction in the dielectric permittivity of the composite system may be accredited to the strong antiparallel dipolar interaction between the NLC molecules and NPs and change in the orientation of the NLC molecules also. Ag NPs develop antiparallel dipole moment [27–29], and hence resultant dipole moment of the composite system decreases, which results in the decrement in permittivity. On increasing the dopant concentration, the antiparallel dipolar interaction between the NPs and the LC molecules becomes high, which is responsible for affecting the permittivity.

Figure 4 shows the variation in $\varepsilon_\perp$ with respect to the concentration of the dopant. For the similar physical conditions, a LC molecule demonstrates different values of $\varepsilon_\perp$ for different orientations and the minimum value of $\varepsilon_\perp$ is found for perfectly aligned planer sample cell. From the figure, it can be observed that $\varepsilon_\perp$ is decreasing continuously with the increasing concentration of dopant, which suggests that the system becomes more ordered as we increase the concentration of Ag NPs in the host NLC material. The self-assembling nature of NPs improves the molecular alignment of the system as coupling between the NP–LC is higher in comparison with the coupling between the LC–LC molecules.

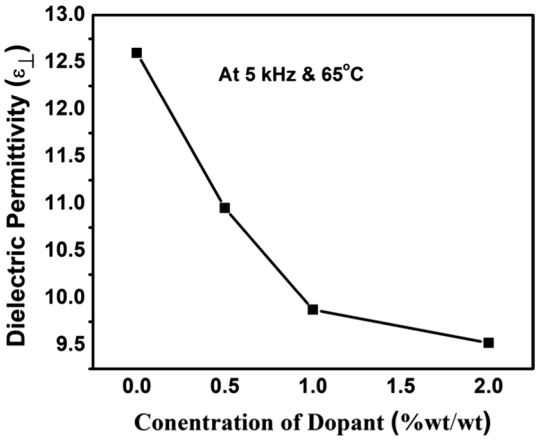


Fig. 4 Variation in dielectric permittivity with different concentrations of dopant

Therefore, these self-assemblies offer a local ordering to the system, which in turn provides the better alignment of molecules in the planar geometry and causes a lower permittivity value.

The variation in dielectric anisotropy with respect to temperature is depicted in Fig. 5. Static dielectric anisotropy (Δε) of the nematic phase of LC material is governed by the Maier and Meier theory [30]:

$$\Delta\varepsilon = \frac{NHF}{\varepsilon_0}\left[\Delta\alpha - \frac{F}{2kT}\mu^2\left(1 - 3\cos^2\beta\right)\right]S \tag{4}$$

where N is the number density of molecules (the number of molecules per unit volume), H and F are internal field factors, $\Delta\alpha$ is the anisotropy of the polarizability, kT is the thermal energy, μ is the resultant dipole moment of the

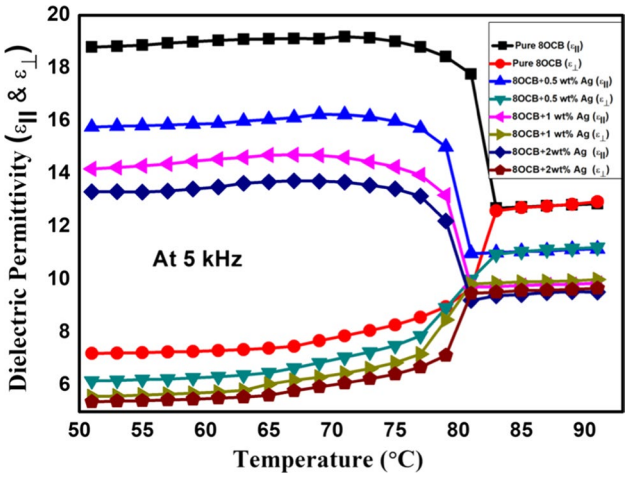


Fig. 3 Dielectric permittivity versus temperature graph for pure NLC 8OCB and 8OCB/Ag NPs composites

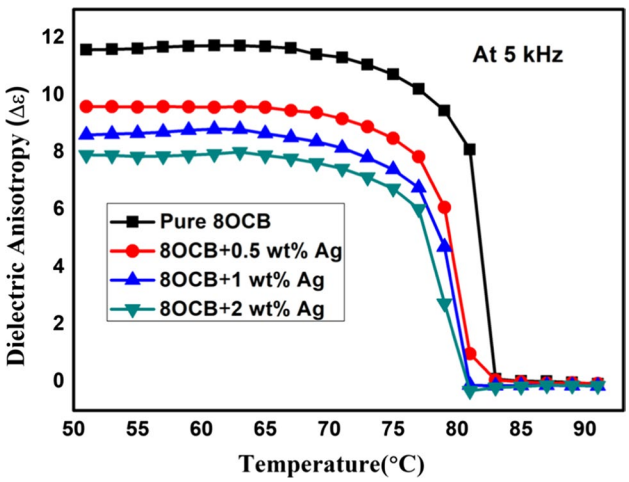


Fig. 5 Dielectric anisotropy versus temperature curve for pure NLC 8OCB and 8OCB/Ag NPs composites

molecules, β is the angle between the dipole moment and long molecular axis of the molecule and S is rotational order parameter. According to the theory, the value of $\Delta\varepsilon$ is mainly determined by the N, $\Delta\alpha$, μ and S. N is expected to decrease for the doped system, due to which $\Delta\varepsilon$ must decrease. The dielectric anisotropy depends on the interaction strength of the LC with an applied electric field and is therefore an important parameter which can influence the threshold voltage. Each composite of 8OCB NLC dispersed with Ag NPs exhibits the decrement in the dielectric anisotropy. The more the concentration of Ag NPs in the pure 8OCB, the more the decrement in the observed dielectric anisotropy. The reason for this decrement is various factors; (1) spherical shape of the nanoparticles, (2) the net dipole moment of the system decreases after doping of the Ag NPs in the 8OCB. The Ag NPs dipole correlation is not in favor of the dipole moments of the pure 8OCB. Due to opposite or inclined orientation of dipole moments, the net dipole moments of Ag NPs are not get aligned parallel to the dipole moments of 8OCB molecules. This decreased dipole moment may cause the decrement in the dielectric anisotropy of Ag NPs-dispersed 8OCB sample. Therefore, according to Maier and Meier theory, if dipole moment and order parameter decrease, then, consequently, the dielectric anisotropy also decreases.

The electro-optical response of LC molecules under the influence of electric field is the major characteristics used in industrial applications. To estimate the performance of the liquid crystal dispersions for display device application, we have measured response time of the sample. The electro-optical switching of 8OCB molecules in the nematic phase is recorded as a function of voltage at 5 Hz frequency of applied field. The voltage variation of rise time and fall time of the pure 8OCB and Ag NPs-dispersed samples is shown in Fig. 6a, b. The rise time and fall time decrease on increasing the applied electric field. It is also noticed that the rise time and fall time increase on increasing the dopant concentration. This increment in the rise and fall time is due to the hindrances produced by the spherical Ag NPs. When we increase the dopant concentration in the pure 8OCB NLC, it means more Ag NPs are added into the NLC material. Consequently, more hindrances are produced by Ag NPs on the movement of 8OCB molecules. Therefore, the rise time and fall time (response time) increase considerably of the composite system. The response time is related to the elastic constant of the samples. The strong π–π electron interaction between 8OCB molecules and Ag NPs might be responsible for the increase in the rise time.

The total response time can be given as

$$\tau_{\text{total}} = \tau_{\text{rise}} + \tau_{\text{fall}} \tag{5}$$

The threshold voltage (V_{th}) is an imperative parameter of the NLCs. Figure 7 represents the variation in V_{th} with

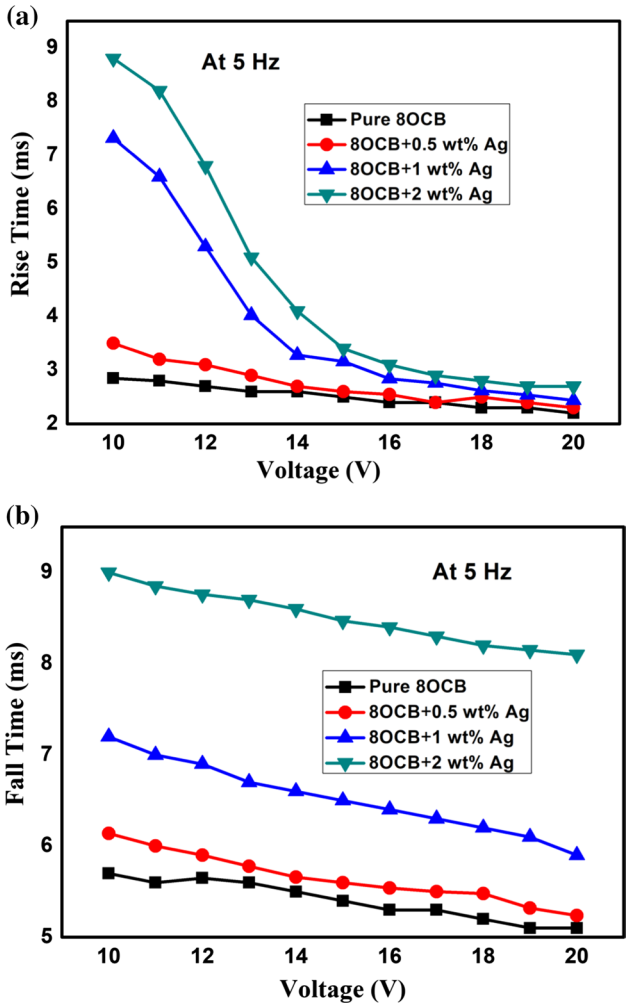


Fig. 6 **a** Rise time versus voltage curve for pure NLC and its nanocomposites. **b** Fall time versus voltage curve for pure NLC and its nanocomposites

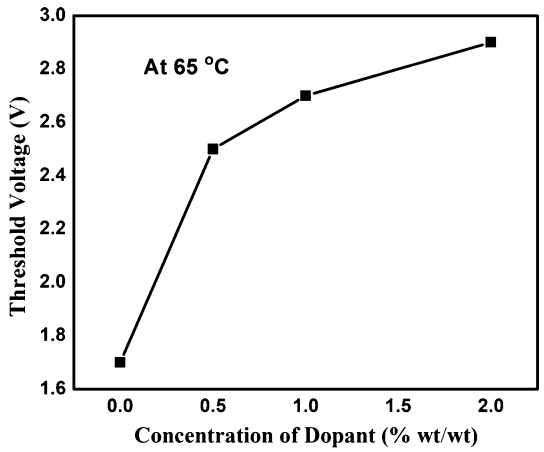


Fig. 7 Variation in threshold voltage with different concentrations of dopant

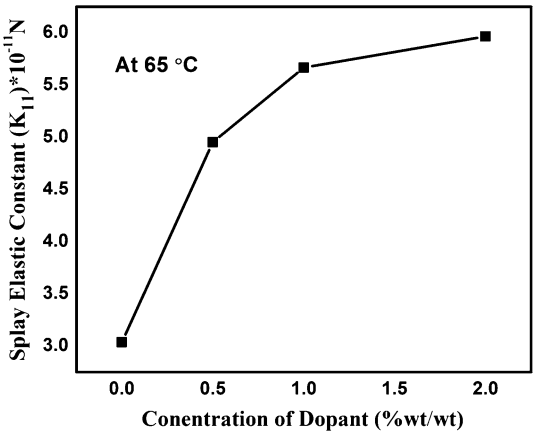


Fig. 8 Variation in splay elastic constant with different concentrations of dopant

different concentrations of dopant in the pure NLC material 8OCB. These voltages were determined by measuring the intensity of transmitted light of sample cells as a function of applied voltage. With the application of step change AC voltage and then detecting the change in transmitted light intensity, we have measured the threshold voltage (the voltage under which the transmitted intensity is changed by the 10%). Freedricksz's threshold voltage (V_{th}) is related to the splay elastic constant (K_{11}) and dielectric anisotropy ($\Delta\varepsilon$) by the following relation [21]:

$$V_{th} = \left[\frac{k_{11}\pi^2}{\varepsilon_0|\Delta\varepsilon|}\right]^{1/2} \tag{6}$$

The above relation clearly indicates that the threshold voltage strongly depends upon the splay elastic constant and dielectric anisotropy. From Fig. 7, we can see that the threshold voltage of composites is higher than that of pure NLC. The inverse relation between the threshold voltage and dielectric anisotropy explains the increment in the value of threshold voltage. Since the dielectric anisotropy has been decreased after the addition of Ag NPs to pure NLC, an increment in value of threshold voltage has been observed for the composite systems.

The variation in splay elastic constant as a function of dopant concentrations is depicted in Fig. 8. The splay elastic constant is an important parameter which can govern the switching of nematic LC in display devices. K_{11} is determined from the threshold voltage and dielectric anisotropy. From the figure, we can see that the value of K_{11} increases on increasing the concentration of Ag NPs in the pure NLC matrix. The splay elastic constant basically depends upon the threshold voltage and also depends upon the number and size of the molecule. So, the enhancement in the value of K_{11} for composites may be attributed to the increment in the threshold voltage of composites.

Conclusions

In brevity, we had demonstrated the immense effects of silver nanoparticles on the dielectric, electro-optical and luminescence properties of host NLC material. The AC conductivity of all the nanocomposites has increased due to the presence of metal nanoparticles. The dielectric permittivity of the composite system is reduced, which may be attributed to the strong antiparallel dipolar interaction between the NLC molecules and NPs. The photoluminescence intensity of the pure NLC is quenched after the addition of Ag NPs into it due to absorption of major portion of PL emission by the Ag NPs. These properties of the composites make them suitable toward the development of novel materials for different applications.

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Mitigation of toxic arsenic (V) from aqueous solution in fixed-bed column using functionally modified bio-polymer

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ABSTRACT

The presence of arsenic in groundwater, eventually in drinking water, has been recognized as a serious community health problem due to its highly toxic nature, and therefore, its removal is highly essential. To enhance the adsorption capacity of chitosan for As (V), chitosan which is a natural biopolymer was modified by grafting with 2-Hydroxyethylmethacrylate (HEMA) and Sodium Styrene Sulfonate (SSS). Modified chitosan was characterized by SEM and FTIR spectroscopy. Maximum Removal percentage of As (V) was found to be higher (95%) at inlet concentration of As (V) 60 mg/L, flow rate 1 ml/min, pH 3.5, and bed depth 3 cm. The bed depth service time model and Thomas model are used to analyze the column data in terms of As (V) uptake rate and column capacities. Developed grafted adsorbent could be successfully regenerated using 0.1 M NaOH. Recycle studies suggested that maximum reusability of grafted polymer up to 8 cycles.

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KEYWORDS
Chitosan; grafting; adsorption; arsenic (V); gamma radiation; desorption

Introduction

The impact of water contamination by toxic arsenic on human health remains a significant problem throughout the world. The elevated concentration of arsenic (As) in the groundwater of many countries worldwide has received much attention during recent decades.[1] Natural biogeochemical processes and anthropogenic activities may lead to the contamination of groundwater by increased Arsenic concentrations.[2] Arsenic exists in high concentrations in water bodies such as rivers, hot springs, groundwater and drainage from abandoned mines. Water-soluble inorganic arsenic species are more toxic and generate a high health risk for living beings and humanity because they can accumulate in living tissues causing various health disorders and diseases such as skin lesions, cardiovascular and hematological effects, and neurological disturbances effects, etc.[3]

Numerous conventional methods have been reported by many scientists for toxic metal ions removal that include ion-exchange[4] chemical precipitation[5] coagulation, membrane separation,[6] and reverse osmosis,[7] etc. However, these methods are insufficient in treating large amounts and also an expensive one. Adsorption technique is the most feasible option because it is both efficient and cheap compared to other conventional methods for removing toxic metal ions from effluents in industrial processes for a variety of purification and removal purposes.

Various adsorbents[8–14] have been reported for arsenic removal from the aqueous solutions but the removal and adsorption capacity caused by these, are not efficient as well as expensive and use of these chemicals as adsorbent creates a secondary waste problem. Recently, considerable interest has been created in the development of polymeric adsorbents as a tool for removing arsenic from water. Polysaccharides are rich resources of structurally and functionally different chemical moieties and possess the additional advantage of undergoing simple chemical modifications. Among various polysaccharides, chitosan finds a variety of applications in many industries due to its unique properties such as bio-compatibility, biodegradability, and non-toxicity. Chitosan plays an important role in water treatment due to its low cost and consisting of reactive functional groups such as amino and hydroxyl groups, which show active sites for the removal of various water pollutants. [15] However, chitosan gives some major difficulties in the sorption process, i.e., solubility in acidic media, high swelling ratio, and limited sorption capacity for a few metal ions. To overcome these problems, much attention has been paid to the modification of chitosan. Graft copolymerization is expected to be one of the most promising approaches to a wide variety of molecular designs leading to novel types of hybrid materials, which are composed of bio- and synthetic-polymers. The main grafting techniques are chemical[16] and radiation grafting techniques.[17] Radiation-induced graft polymerization is a useful method to introduce a functional group onto polymeric materials. The advantages of this method are rapidly creating radicals in a trunk polymer by irradiation without any chemical reagents and significant changes in the properties of the trunk polymer.[18,19] Therefore, keen attention and serious efforts are required to generate more efficient and low-cost

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Synthesis of Chitosan-Co-Lactic Acid Nanoparticles and their Potential as a Carrier of Anticancer Drug

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Abstract

This study aims to design some medicinally important biopolymer based Nano carriers. The study undertakes synthesis, characterization of Chitosan-co-lactic acid nanoparticles and optimization of swelling ratio. The Chitosan-co-lactic acid nanoparticles were prepared by the shaking of lactic acid emulsion in Chitosan solution by emulsion crosslinking method and characterised by transmission electron microscope (TEM) analysis (size), and Fourier transform infrared spectra (FTIR) (structural) and SEM (morphology). The particles were dispersed in a phosphate buffer saline (PBS) and the swelling response of these nanoparticles was studied as a function of chemical composition, pH and temperature of swelling medium. To determine the encapsulation efficiency, a centrifugation method was applied. Also, the assessment of biocompatibility has been made on the basis of two in-vitro test which are BSA adsorption test and haemolysis assay. Our result revealed that equilibrium swelling was influenced by the composition of nanoparticles and the swelling medium. These observations and assessment indicate that these nanoparticles have good capability for use in drug delivery and suitable for biomedical application.

Keywords: Chitosan; Nanoparticles; Swelling Behaviour; Drug Delivery Devices; Lactic Acid

Introduction

Cancer is a disease which refers to a group of tumour which is formed by an excessive growth of abnormal cells [1]. Cancer is characterized by uncontrolled cell growth, and the potential to get larger into neighbouring tissues and to metastasize. Surgery may not be always more effective due to the involvement of the tumour with neighbouring tissues [2]. In such conditions, Chemotherapy (a destructive agent) is a conventional approach with the major potential to cure localized and metastasized cancers. Chemotherapy is a general term used to describe using several drugs that are destructive to malignant cells and tissues [3]. Anticancer drugs are effective against a wide range of tumours, formulated to treat wide range of tumours but its clinical applications are inhibited due to its poor solubility [4]. The main drawback of these drugs is that they not have enough of selectivity towards tumour cells. Because of the weak selectivity, they kill both normal and cancer cells and result in toxicity to normal tissues [5,6]. The target site-specific delivery can be attained by a drug delivery system. Drug delivery systems can reduce the side effects of anticancer drugs via encapsulation methods, which decrease the scrape of toxic drugs, protect the chemotherapeutic drug prior to attaining the target cells. Encapsulation is one of the effective procedures, as this not only enhances water solubility of the drug but also reduces gastrointestinal impatience and provides a long-lasting release rate [7,8]. The purpose of chemotherapy is the sustained, controlled, and targeted delivery of anticancer drugs for a long period which can be achieved by polymeric nanoparticles [9].

A drug delivery system is generally associated with particulate carriers, such as polymeric micelles [10], emulsions, liposomes [11] and nanoparticles (NPs) [12], which are devised to localize drugs at the target sites. The nanoparticles are submicron-sized, colloidal particles that carry drugs to the target or release drugs in a controlled manner in the body. Controlled drug delivery offers advantages like reduced dosing frequency, better therapeutic control, reduced side effects, and, consequently, better patient compliance. After preparation, nanoparticles are usually

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In vitro investigation of swelling triggered release of 5-fluorouracil from gelatin coated gold nanoparticles

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ABSTRACT

In the present study gelatin coated-gold nanoparticles were synthesized and release study of the drug "5-fluorouracil" (5-FU) was carried out in a controlled manner. Gelatin nanoparticles were prepared by single water in oil (W/O) emulsion crosslinking technique and gold (Au) nanoparticles by Turkvitch method. For preparing gelatin coated-Au nanoparticles, *in situ* method was adopted. The release kinetics of entrapped drug was investigated as a function of various experimental factors such as chemical composition of prepared nanoparticles, pH, temperature and simulated biological fluids as the release media. The 5-FU drug loaded nanoparticles were characterized by FTIR, SEM, TEM, XRD and *in vitro* cytotoxicity techniques. The drug release process was analyzed kinetically using Ficklan power law, zero order, first order and Korsmeyer–Peppas models, respectively, and a correlation was established between the quantity of the released drug and swelling of the nanoparticles.

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KEYWORDS
Gelatin; gold nanoparticles; 5-FU; drug delivery; swelling controlled release

1. Introduction

In current years, nanotechnology has emerged as one of the rapidly developing fields in science and engineering disciplines. The results of fast development in this area are the discovery of the huge number of functional materials having dimension in the range of 1 to 100 nm.[1] The reason for using nanoparticles in therapeutic applications is their small size, which is comparable to many of the proteins and other macro-drugs.[2] Some of the most important examples of noble metal nanostructures are, such as, nanoparticles,[3] nanowires,[4] nanorods,[5] nanoarchitectonics,[6] and many others. Nanotechnology mainly provides tools to analyze nanoscale phenomena and manipulate nano-scale objects; it cannot be a universal methodology for material production. There exists, therefore, a need to construct or architecturally manipulate functional material systems from nano-sized units.[7,8] In nature, the facile development of functional systems and advanced materials, that is, "architectonics" has become a unique approach for the future development of nanotechnology and nano-materials.[9] The nanoarchitectonics concept is basically applicable to various materials and systems. This concept has been applied to a wide range of current research targets such as functional materials production, structural fabrications, catalysis, detection/sensing, energy production/storage, environmental problem, device, biological research, and biomedical usages.[10] Nanoparticles based drug delivery systems are invented to take advantage of the enhanced permeability and retention effect (EPR), which results from the leaky capillaries and the lack of functional lymphatic drainage in tumor tissue.[11]

One of the most leading causes of worldwide death is cancer and tumor related diseases.[12] The word cancer is derived from a Latin word meaning "crab", and is a highly fatal disease caused due to the abnormal type of tissue growth in which the cells exhibit an uncontrolled division and continuous enhancement in the number of dividing cells.[13] Due to this reason, the common treatment methods of cancer include surgery, chemotherapy, radiation etc. The current challenges in cancer treatment therapies are lack of early disease detection, nonspecific systemic distribution, insufficient drug concentration reaching the tumor, and incapability to detect therapeutic responses.[14,15] Hence, there is an increasing demand for treating cancer by the use of an efficient therapy.[16,17] Chemotherapy is a widely used strategy for the treatment of cancer and recently various compounds have been used as anticancer drugs such as cisplatin, 5-flurouracil, tamoxifen, paclitaxel, doxorubicin etc.[18]

5-fluorouracil (5-FU), a water soluble anticancer drug, is reported to be effective when administrated in smaller doses for a longer period of time.[19] It has been mostly used as clinical radiosensitizer, antineoplastic and in the treatment of carcinoma of colon.[20] This drug is also used in the treatment of different kind of cancers such as pancreas, ovary, liver, brain and breast cancer.[21]

Gelatin is a thermally sensitive biopolymer which is obtained from a fibrous, insoluble protein "collagen" by its controlled hydrolysis. Gelatin contains a triple-helical

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ORIGINAL PAPER

Control of surface functionalization of graphene-metal oxide polymer nanocomposites prepared by a hydrothermal method

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Abstract

The study of nanocomposites formed by doping of graphene oxide with a metal and polymer is presented in this paper. The graphene oxide contains oxygenated functional groups, like epoxy, hydroxyl and carboxyl, as shown by Fourier transform infrared spectroscopy (FTIR) studies. The existence of these functional groups on the surface of graphene oxide disperses the polymer chain and leads to a good interaction with the metal. The characterization of the prepared nanocomposite was done by X-ray diffraction, energy dispersive X-ray analysis, FTIR, Raman spectroscopy, scanning electron microscopy and high resolution transmission electron microscopy. The results showed that the obtained nanocomposite comprises nano-shaped thin stacked flakes with a well-defined multilayered edge structure. It was also seen that the metal particles were uniformly dispersed on the graphene surface with an average particle size of 1–25 nm. The synthesized nanocomposites can be used for adsorption and degradation of dyes.

Keywords Graphene oxide · Graphene oxide/metal oxide · Graphene oxide/metal oxide/polymer

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ARTICLE

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Degradation of methylene blue and methyl violet using graphene oxide/NiO/β-cyclodextrin nanocomposites as photocatalyst

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ABSTRACT

We report the synthesis of graphene oxide/nickel oxide/β-cyclodextrin (GO/NiO/β-CD) nanocomposite and the efficiency of the nanocomposite in decolourising two different dyes, methylene blue (MB) and methyl violet (MV). GO was prepared by modified Hummer's method while hydrothermal method was used for the preparation of GO/NiO/β-CD. The as-synthesised nanocomposites were characterised by X-ray diffraction (XRD), and Fourier transform infrared (FTIR) spectroscopy, Raman spectroscopy and high resolution transmission electron microscopy (HR-TEM). Photocatalytic degradation was carried out under solar light by monitoring the concentration of MB and MV dyes. Degradation reaction followed Langmuir-Hinshelwood pseudo first-order kinetic model. The apparent reaction rate constant (k) for MB increased as compared to MV under solar light irradiation. The MB showed better photocatalytic degradation efficiency by GO/NiO/β-CD composites. GO/NiO/β-CD nanocomposite has been very favourable for photocatalytic application.

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KEYWORDS
GO; GO/NiO; GO/NiO/β-CD; photocatalyst; photodegradation; kinetic model

1. Introduction

The modern era experiences rapid industrialisation with rise in textile industries and consequent uses of dyes. According to a World Bank report, almost 20% of global industrial water pollution comes from the dyeing industries and finishing processes of textiles [1]. A variety of organic dyes have been widely used for a long time in many industrial fields, such as paper making, coating and textiles [2]. Organic dyes are harmful because of their stable structures and their by-products have caused a mutagenic or carcinogenic impact on human beings as well as aquatic life. The discharge of stable and carcinogenic dyes into water bodies are harmful to human health, and cause illness such as cholera, diarrhoea, precordial pain, dizziness, abdominal pain, bladder irritation, staining of skin etc [3]. Dyes also affect aquatic life by hindering the photosynthesis process of aquatic plants, eutrophication and perturbation [4–6]. Therefore, much attention should be paid to treat dyes before their discharge [6].

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Intensified elimination of aqueous heavy metal ions using chicken feathers chemically modified by a batch method

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ABSTRACT

Modified chicken feathers (MCFs) were used as adsorbents for the removal of Co(II), Cu(II), Fe(II) and Ni(II) heavy metal ions from water by varying pH, adsorbent concentration and time. MCFs were characterized using Fourier Transform Infrared (FTIR) spectroscopy, Scanning Electron Microscopic (SEM) analysis, Energy Dispersive X-ray (EDX) spectroscopy, Adsorption of N_2 at −196 °C, Thermogravimetric analysis (TGA) and X-ray Diffraction (XRD) analysis. The adsorption isotherm for the metal ions could be well explained by the Langmuir model. The maximum adsorption capacities were 200.0, 50.0, 43.47, and 4.85 mg/g, following the sequence: Cu(II) > Co(II) > Fe(II) > Ni(II), respectively. Removal efficiencies of Co(II), Cu(II), Fe(II) and Ni(II) ions were 98.7%, 98.9%, 98.7% and 99%, respectively, for 20 mg/L concentration. The study of the adsorption kinetics for metal ions on MCFs confirmed that the process followed a pseudo second order kinetic model in all cases. The thermodynamics showed that the adsorption processes for metal ions adsorption on MCFs were spontaneous and endothermic. MCFs exhibited a good recyclability and high adsorption efficacy after 7 cycles using a 0.1 M EDTA solution, maintaining 90% of the adsorption ability.

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1. Introduction

Many industries produce toxic wastewaters containing heavy metals and such pollution is a major problem. Mercury, arsenic, cadmium, lead, chromium, copper, nickel and cobalt are very toxic heavy metals with harmful effects [1,2]. Even low concentrations of such ions cause damages to the environment and public health, as they are non-biodegradable and highly toxic. The majority of heavy metals present in wastewater come from pesticides, fertilizers, metals present in paints, pigments, textile industries, chemical industries and battery manufacturing [3]. Copper (II), cobalt (II), iron (II) and nickel (II) are common examples of heavy metal ions commonly found in industrial wastewater.

Copper is a micronutrient essential to humans but higher concentrations of this metal, continually ingested, can have harmful effects on humans, such as Alzheimer's and Wilson diseases, liver and kidney damage, insomnia, vomiting, diarrhoea and lung cancer [4,5].The maximum limit allowed for Cu set by the American Environmental Protection Agency (EPA) for drinking water is 1.3 mg/L [6].

Cobalt is an essential dietary component to humans but is also toxic and dangerous at higher concentrations [7]. It can be found at the wastewaters of nuclear power plants and is used in various industrial applications. Severe cobalt poisoning may cause serious human health problems, such as allergic dermatitis, rhinitis, asthma, heart damage and heart failure [8].

Iron is also an essential element, with extreme importance in oxygen transportation and storage (in the forms of haemoglobin and myoglobin, both containing Fe(II) ions [9]). However, Fe can be present in high concentrations in effluents from industry, namely from steel tempering, mining and coal. The intake of high amounts of iron can cause various health problems, such as stomach pain, nausea and vomiting; in higher concentrations, cancer and fatal damages to the brain and liver.

Nickel is also toxic at higher concentrations, being found in chemical industries, electroplating, mining, refining, paints and ink formulation units [10]. Nickel can lead to a skin disease called nickel-eczema and other adverse health effects, such as nausea, chronic asthma, coughing and cancer. EPA set the maximum allowed level of nickel for drinking water as 0.015 mg/L [11].

Several techniques, including physical and chemical processes, were reported for the elimination of heavy metal ions, namely, chemical precipitation, ion exchange, adsorption, reverse osmosis, etc. [12–15].

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Research Article

Mechanistic investigation of osmium(VIII)catalyzed oxidation of brilliant green dye by chloramine-T in alkaline medium: a spectrophotometric kinetic study

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Abstract
Wastewater generated by dyeing industries is of great threat to the globe and is major area of concern. In present paper, we deals with oxidation of brilliant green (BG) by catalytic route in alkaline medium at 298 K. Osmium(VIII) used as catalyst and the reaction showed first-order and zero-order behavior with respect to [BG] and [CAT] respectively. The reaction followed fractional-order kinetics with respect to [NaOH] and [Os(VIII)]. Negligible effect of [Cl^-], [PTS] and ionic strength of the medium on the rate of oxidation have also been noted. Decrease in the rate of reaction with decrease in the dielectric constant of the medium was also observed. Comparative studies between catalyzed and uncatalyzed reaction have also been reported. It is found that catalyzed reaction is four fold faster than uncatalyzed reaction. Activation parameter and catalytic constant (K_C) have also been calculated at different temperatures. GC–MS analysis identified the oxidation products of the BG i.e. *N*, *N*-diethylaminobenzophenone and p-*N*, *N*-diethylamino phenol while the stoichiometry of the reaction was found to be 1:1. On the basis of kinetic results, a plausible mechanism has been proposed and verified.

Keywords Oxidation · Kinetics · Brilliant green dye · Os(VIII) catalyst

1 Introduction

Harmful chemicals, dyes, oils etc. pollute the water. Among the pollutants of water, a major role is played by dyes. Most of the dyes released from the pharmacy and textile industries, as they are mutagenic and teratogenic can cause serious health hazards to humans and livestock [1]. Dyes released into aquatic environment decrease or stop capacity of water re-oxygenation by blocking sunlight thereby increasing BOD valueand it can also impart color to water [2, 12, 13]. Therefore these conditions generally disturb or prevent the growth of aquatic plants and animals [3, 4]. BG being carcinogenic in nature has been banned in many countries [5]. BG, besides being a compound of biological interest [6] has a major use in biological staining, modern textile and leather industries [7]. It is also used in antiseptic preparations active against gram-positive bacteria. It is irritating to skin, respiratory system and gastrointestinal tract [8, 9] and can cause serious damage to eyes. It can also produce serious health damage [10] on inhalation and it is also investigated as a mutagen in microorganism. BG causes some degree of carcinogenicity, hypersensitivity reactions, microbial and fish toxicity [11].

For the oxidation of variety of organic compounds, aromatic N-halosulphonamides, a group of mild oxidizing agents, have been extensively used [14–16]. These oxidants have strongly polarized N-linked halogens which are in the + 1 state. They undergo two electrons change which forms halide ions and corresponding sulphonamides. Sodium N-chloro-p-toluenesulphonamide (CAT or RNClNa) is a prominent member of this class of oxidant. In both acidic and alkaline media it behaves as an oxidizing

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Effect of micelles on hydrolysis of di-2,3-dichloroaniline phosphate

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The effect of anionic surfactant, di-octylsodium sulphosuccinate (AOT) and nonionic surfactant, polyoxyethylene sorbitanmonooleate (Tween-80) on the hydrolysis of di-2,3-dichloroaniline phosphate was studied spectrophotometrically at 303 K. The influence of inorganic salts on the reaction rate was studied. The added salts viz. KCl, KNO_3, and K_2SO_4 accelerated the rate of the reaction in the presence of anionic and nonionic micelles. The role of anionic and non-ionic micelle has been explained by the Menger-Portnoy, and Piszkiewicz models. The binding constant (K_s), rate constant (k_w) in the micellar phase, co-operativity index (n) and various thermodynamic activation parameters viz. ΔE_a, $\Delta S^{\neq}$, $\Delta H^{\neq}$, $\Delta G^{\neq}$ etc. have been evaluated. Possible reaction mechanism has been proposed on the basis of the observed kinetic data.

Keywords: Hydrolysis, Di-2,3-dichloroanilinephosphate, Menger-Portnoy's, Piszkiewicz's, Berezin models

Phosphate esters are key ingredients in biological systems. These esters are involved in countless biological processes, most prominently the storage and transmission of genetic information involving DNA and RNA. Phosphate esters are widely used as surfactants in many fields, such as textile, leather, household and personal care products, paint, extractants for metal ions, and so on, due to their outstanding emulsibility, antistatic property, biodegradability, low cutaneous irritation, and dispersity[1,2]. Phosphate esters are used as pesticides for protection against agricultural and household pests[3,4]. The hydrolysis of phosphate esters has been the subject of numerous experimental and theoretical studies over many years[5]. Phosphate ester hydrolysis is a crucially important reaction in biological systems, being involved in, among other things, signal and energy transduction, biosynthesis, protein synthesis, and replication of the genetic material[6-8].

Surfactants are surface active substances which reduce the liquid surface tension when dissolved in aqueous solution[9]. Surfactants have a wide range of applications in agriculture, industries, detergent, textile, food, cosmetics and the drug or pharmaceutical[10-12]. Due to their immense application potential, surfactant-based systems are a topic of major research interest for both academician and industrialist[13]. Surface-active molecules self-assemble in aqueous media to form nano-sized aggregates called micelles. Micelle formations are important in clinical or pharmaceutical applications specifically in physiological conditions; since they directly affect DNA/cationic surfactant interaction driven by both electrostatic attraction and hydrophobic effect[14-18]. The micelles have a tendency to influence the reaction rates by enhancing it or by retarding the rates of reaction[19]. The effects of surfactant and its micelle on chemical reactions are always an interesting field of research for chemists and biologists[20].

Micelles have been the subject of intense investigation for a number of years. Formation of micelles and their dependence on environmental factors, temperature, additives and catalyzing functions, etc, are important physicochemical aspects, which are used for both fundamental understanding and application prospects. Due to analogy between enzyme catalyzed and micellar catalyzed reactions, the micellar catalysis has received a considerable attention of investigators[21]. Micelles and similar colloids assemblies generally increase the nucleophilic reactivity and their hydrolytic reactions with different surfactants. The use of novel surfactants in assisting a variety of organic reactions is highly promising for basic and applied research. Therefore the effect of surfactant on chemical reactions is an interesting field of research for chemists and biologists. Hydrolytic studies of phosphate esters have been done mostly in the

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Catalytic Properties of Graphene Oxide Synthesized by a "Green" Process for Efficient Abatement of Auramine-O Cationic Dye

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Abstract: The management of water pollution in the world is an important need and easy to implement methods are urgently needed for water purification. In this study, efforts were made to assess the efficiency of graphene oxide (GO) as a catalyst in the Fenton process to degrade water pollutants, using the Auramine-O (AM) dye as a model compound. GO was synthesized by the green and direct method using a muffle furnace and was used as a catalyst for dye degradation, along with hydrogen peroxide. The prepared GO was characterized in terms of crystalline properties, morphology and stability using various techniques, including X-ray diffraction (XRD), scanning electron microscopy (SEM), high-resolution transmission electron microscopy (HRTEM), and thermogravimetric analysis (TGA). Dye degradation was monitored at pH 5. The effect of experimental conditions, i.e., pH, amount of GO, dye and H_2O_2 on dye degradation was determined. Further, studies were conducted on the reusability of the GO.

Key words: Graphene oxide, catalyst, wastewater, heterogeneous fenton process.

Introduction

Graphene is a 2D carbon material with unique features, such as a large surface area, thermal stability, electrical and mechanical properties, synthesized from naturally occurring graphite [1-3]. The oxidation of graphite results in the accumulation of oxygen functionalities such as hydroxyl, carbonyl and epoxy groups in the graphene layer to form GO [4]. This material has a number of applications, such as sensors [5-6], adsorbent [7], catalysts [8], energy storage [9], antibacterial agent [10] and drug delivery [11]. It has a sp [2] hybridized carbon structure that is the base for 0D buckyball structures, 1D nanotubes and 3D graphite [12]. Even, among all nanomaterials graphene based nanocomposites have inflamed worldwide researchers for dealing with various environmental issues, i.e., as photocatalyst for gaseous acetaldehyde degradation and water oxidation [13], for hydrogen production [14], dye degradation [15] etc.

There are various dry and wet methods available for GO synthesis. In terms of wet methods, firstly, graphite slurry was oxidized using potassium chlorate in fuming nitric acid [16]. Next is Brodie's method was improved by adding sulfuric acid during oxidation process [17]. Later on, a highly used process to prepare GO is by using $KMnO_4$ and nitric acid in concentrated sulfuric

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ORIGINAL RESEARCH

Zinc oxide nanoparticle incorporated on graphene oxide: an efficient and stable photocatalyst for water treatment through the Fenton process

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Abstract

Textile industries release a huge amount of wastewater that holds a very high ratio of toxic contaminants, such as dyes and various organic compounds. These are harmful to the environment, and their treatment is very much required for a clean and safe environment. So, our work explains the enhanced degradation of dye by heterogeneous Fenton process using zinc oxide-graphene oxide nanohybrid (ZnG) to generate hydroxyl radical from hydrogen peroxide. Initially, ZnG nanohybrid was successfully synthesized via hydrothermal process; later on, UV-visible spectroscopy is employed for absorption spectra and optical properties. The X-ray diffraction pattern is employed for determining the crystal structure and phase identification of nanoparticles. A scanning electron microscope (SEM) helped to find out the morphology. The high-resolution transmission electron microscopy (HRTEM) was used to get an average particle size (4.36–9.77 nm). Fluorescence spectroscopy was used to find electron-hole pair combination in nanohybrid compared to individual ZnO and GO. Finally, the catalytic activity of ZnG was successfully studied for brilliant green (BG) degradation via a heterogeneous Fenton process.

Keywords ZnG nanohybrid · Heterogeneous catalyst · Fenton's process · Brilliant green

1 Introduction

Nanomaterials have secured noteworthy awareness in the research world owing to their useful application, such as antibacterial activity [1], anticorrosive agent [2], water treatment [3], drug delivery [4], sensing [5], and imaging [6]. They have unique optical and electrical properties, which highly depend on quantum confinement effect [7]. The size effect of nanoparticles can bring about tremendous changes in the chemical, electronic, mechanical, and magnetic properties [8]. Nanohybrid materials involve rearrangement of electron-hole pairs, which highly affect the behavior of nanoparticles. This enhances the potential of the materials of this kind for various applications such as biomedical and environmental [9–11], sensor [12], and catalyst [13].

Graphene oxide is the oxidized form of graphene. It has many oxygen-containing functional groups and aromatic region with flat structure [14–16]. Its honeycomb arrangement and sp^2 hybridized carbon monolayer offer the potential to make composites with other nanomaterials [17]. Graphene-based nanocomposites have been appreciated for their high electrical and thermal conductivity, large surface area, high adsorption efficiency, and flexibility with zero band gap [18, 19]. These properties make it a special compound to be made as a nanohybrid, which acts as a photocatalyst [20–23] and solar cell [24, 25]. Titanium dioxide (TiO_2) and zinc oxide (ZnO) are the most widely used photocatalysts with high efficiency and both technically and commercially attractive catalysts for the degradation of dyes [26, 27]. Most of the research works now focus on the photocatalytic techniques using composite nanomaterials for the treatment of the wastewater and degrading dyes due to their high efficiency and low cost.

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Article

Sensing Ability of Ferroelectric Oxide Nanowires Grown in Templates of Nanopores

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Abstract: Nanowires of ferroelectric potassium niobate were grown by filling nanoporous templates of both side opened anodic aluminum oxide (AAO) through radiofrequency vacuum sputtering for multisensor fabrication. The precise geometrical ordering of the AAO matrix led to well defined single axis oriented wire-shaped material inside the pores. The sensing abilities of the samples were studied and analyzed in terms of piezoelectric and pyroelectric response and the results were compared for different length of the nanopores (nanotubes)—1.3 μm, 6.3 μm and 10 μm. Based on scanning electronic microscopy, elemental and microstructural analyses, as well as electrical measurements at bending and heating, the overall sensing performance of the devices was estimated. It was found that the produced membrane type elements, consisting potassium niobate grown in AAO template exhibited excellent piezoelectric response due to the increased specific area as compared to non-structured films, and could be further enhanced with the nanowires length. The piezoelectric voltage increased linearly with 16 mV per micrometer of nanowire's length. At the same time the pyroelectric voltage was found to be less sensitive to the nanowires length, changing its value at 400 nV/μm. This paper provides a simple and low-cost approach for nanostructuring ferroelectric oxides with multisensing application, and serves as a base for further optimization of template based nanostructured devices.

Keywords: ferroelectric oxide; nanostructuring; anodic aluminum oxide; nanowires; piezoelectric response; pyroelectric response; multisensor device

1. Introduction

Ferroelectric oxides are of great scientific interest as they are flexible in terms of properties such as tuning during deposition, technological compatibility with micro-/nanoelectromechanical systems (MEMS/NEMS) fabrication technology, and their applicability in energy harvesting or multisensor devices, due to their piezoelectric and pyroelectric response [1–3]. Ferroelectric nanowires could be incorporated into precise sensors, which have been found to exhibit better characteristics as compared to the bulk or thin film devices which are not nanostructured. Especially attractive are these elements when using them as small area, low power sensors in portable electronics due to the possibility of being autonomous [4,5].

There have been studies of ferroelectric oxides, such as potassium based oxides (sodium, niobium, lithium, tantalum, etc.) with potential applications in mechanical energy harvesting due to their favorable piezoelectric properties and durability at multiple activation. Their response can be precisely

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Review Article

Mn-Doped ZnS Quantum dots–An Effective Nanoscale Sensor

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ABSTRACT

Quantum dots (QDs), due *inter alia* to their colourtunable symmetry, narrow emission, broad absorption, stability, and solution processibility have received an upsurge of interest in the last decade as potential materials for diverse applications. Doped QDs, in particular, have gained significant attention as a new class of luminescent materials since dopants influence the optical behaviour of QDs. Therefore, doped ZnS QDs possess conspicuous properties like longer dopant emission lifetime and lower toxicity. The dopant emission lifetimes of transition-metal ions are longer than the energy-gap and defect-related luminescence of the host as well as the biological background fluorescence to offer immense prospect for removal of background fluorescence for sensing applications. Probes based on phosphorescence or fluorescence enhancement of QDs is crucial for the development of the detection capability. This current review highlights the optical property and various sensing strategies of Mn-doped ZnS QDs that make them exceptional probes for applications in sensing. The review not only intends to present an all-encompassing study of the well-documented usages of QDs, but is also rather addressing the current promising improvements, concepts, and excellent applications in research of doped QDs for chemo- and biosensing. Over 200 publications are overviewed and considered here in the perspective of leading applications in sensing dealing with for instance, fluorescence, phosphorescence, chemiluminescence, electrochemiluminescence and biosensing features.

1. Introduction

Within a steadily increasing database, diverse nanomaterials and nanodevices evoked fascination for promising applications due to their properties and performances prominently different from their counterparts based on bulk solids and molecules. In nanoscience and nanotechnology, it is a substantial issue to understand the mechanism of action of nanomaterials and their tunability to tailor properties as the unique properties of nanoscale materials depend upon their shape, size, and structure [1]. Semiconductor nanomaterials also called quantum dots (QDs), as expected, occupy a unique place in the recent literature with an outstanding track record with high potential, dramatic consequences, and frequently controversial experimental evidence. QDs have excellent properties as robust fluorescent materials, such as, broad absorption spectra along with narrow and symmetric emission spectra and good photo-stability [2–4]. The surface properties also have substantial influences due to high surface-to-volume ratios of these fluorescent QDs [5]. When the spatial dimensions are reduced in a nanometre range, a widening of band gap is caused [6]. QDs are fluorescent nanoscale materials having a radius comparable to that of Bohr excitonic radius of the material [7]. These small nanocrystals can cater the requirements of modern applications, such as biolabels [8,9], sensors [10,11], lasers [12,13], light-emitting diodes [14,15], and in medicines [16]. Moreover, QDs are good components in optical gain devices, regenerative solar cells, and electroluminescent devices [17]. Recently, they have found applications in photocatalysis [18], organic dye removal [19], solar paints [20], cancer targeting and drug delivery [21]. Semiconducting QDs are particles having their physical dimensions between 1 and 10 nm and are composed of groups II–VI or III–V atoms [22]. Furthermore the thermal and photo-stability of QDs can be easily enhanced using various strategies, like organic ligand modification strategies [23–25].

Zinc sulfide (ZnS), one of the significant II–VI semiconducting and crystalline material in QD applications and research [26], with 3.68 eV optical energy-gap for the zinc blende and 3.80 eV for the hexagonal wurtzite phase in the bulk form and high refractive index [27,28]. It also has large exciton binding energy (~40 meV) useful for applications in solar cells, flat panel display, lasers, sensors, imaging, and photocatalytic dye degradation, etc. [29–32]. Preparation of ZnS QDs using various capping agents has been reported, which revealed a strong

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Muffle atmosphere promoted fabrication of graphene oxide nanoparticle by agricultural waste

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ABSTRACT

Graphene is a radiant star in the field of nanomaterials. It has gained prominent interest since of its very good mechanical, thermal, optical and electronic possessions. The basic chemical reaction elaborate in the Hummer's method was the oxidation of graphite, during which harmful toxic gases used to emit. Nowadays green chemistry is blossoming in the field of nanomaterial. In present work, we fabricate graphene oxide (GO) through different agricultural wastes i.e., Rice bran (RB), Sugarcane bagasse (SB), Orange peel (OP), and mixture of all these three wastes i.e., tricomposite agro waste (TAW) were mixed with ferrocene which gave electron transfer reaction to synthesized GO and compared it. At last, we concluded that particle size obtained for OPGO (23.99 nm) > graphite (17.17 nm) > SBGO (15.5 nm) > RBGO (2.235 nm) > TAWGO (1.77 nm). These green strategies are biocompatible and cost effective too. Basic information of GO crystal was obtained by X-ray diffraction (XRD) for determination of crystal structure, scanning electron microscopy (SEM) for morphological study, high resolution transmission electron spectroscopy (HRTEM) used for determine particle size, fourier transform infrared (FTIR) spectroscopy for functional group detection, thermogravametric analysis (TGA)/differential thermal analysis (DTA) for determine thermal stability of GO.

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KEYWORDS
Graphene oxide; green route; agro wastes; muffle atmosphere

1. Introduction

Graphene hold sp^2 hybridization organized in honeycomb lattice which is decorated with a huge number of oxygen-containing functional group arranged the both sides of graphite sheets.[1] Graphene has a two dimensional (2-D) material, in this 2-D material carbon atoms are opaquely stuffed in to benzene ring stripped of their hydrogen atoms. Ongoing popular methods chemical or thermal reduction method are the middle routes for the comprehensive fabrication of graphene from GO.[2] Graphite exfoliation is commonly used as strong oxidizing mediators to obtained graphene oxide, carbon materials which is nonconductive hydrophilic.[3]

The synthesis of the graphene has been one of the very warm topic for the scientist and researchers in current ages because of the astonishing physical, chemical and electrical properties of GO[4,5] and its abundant potential applications popular many fields like composites and devices.[6,7] There are many types of methods used for the synthesis of GO like electro-chemical,[8] chemical[9] mechanical and ultrasonic exfoliation,[10] epitaxial growth,[11] chemical vapor deposition (CVD) techniques etc..[12]

Although the determination of precise construction of GO is very challenging, so it is clear that GO is prepared by aromatic framework of graphene which is interjected by ketone, carbonyls, carboxylic acid, alcohol and epoxide.[13,14] In GO preparation, the two most important steps are: i) reduction (removal of oxygen groups from GO). ii) Chemical functionalization (adding other chemical functionalities to GO). Interlayer spacing of graphite is 0.335 nm which is more than 0.625 nm for GO.[15] Brodie in 1859 had firstly established the method to prepare GO to adding the percentage of potassium chlorate to a slurry of furious nitric acid.[16] Hummer's method is commonly used for the exfoliation of GO. In this popular method, oxidation of graphite is completed by strong oxidant like $KMnO_4$ and $NaNO_3$ in concentrated sulfuric acid.[17] There are several methods are discovered for the synthesis of GO like CVD and mechanical exfoliation techniques, but these techniques are very costly and sophisticated and during the synthesis of GO many toxic and harmful gases are emitted, like NO_2, N_2O_4, and ClO_2 which stay very volatile.[18] So, on the basis of above studies in this paper we demonstrate the simple and rapid method to synthesize GO following a single step. This green, time and cost-effective method is helpful for the industrial scale fabrication of GO and this method is environmentally friendly and biocompatible too.[19]

In present work, we have synthesized GO by using agricultural wastes in both individual and tricomposite form (i.e., Orange peel, sugarcane bagasse and rice bran). Waste

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Chloramine-T/N-Bromosuccinimide/$FeCl_3$/KIO_3 Decorated Graphene Oxide Nanosheets and Their Antibacterial Activity

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Abstract: In this work, we report the synthesis of graphene oxide nanosheets (GO NS) using four different oxidants, namely, chloramine-T (CAT), $FeCl_3$, *N*-bromosuccinimide (NBS), and KIO_3. Fourier transform infrared spectroscopy (FTIR) was used to characterize the functional groups present in the synthesized GO. The microstructure analysis was performed using X-ray diffraction (XRD) and scanning electron microscopy (SEM) to investigate the morphology of GO. High-resolution transmission electron microscopy (HRTEM) studies demonstrated the nanostructure and crystalline phases of GO. The antibacterial activity of the prepared GO NS was investigated against pure cultures of *Pseudomonas pneumonia* and *Staphylococcus aureus*. The synthesized GO NS with CAT-GO (C-GO) exhibited very good antibacterial activity towards pathogens.

Keywords: graphene oxide nanosheets; oxidizing agents; antibacterial activity

1. Introduction

Graphene is an exceptional two-dimensional carbon material [1]. It has several electrical and mechanical properties, such as specific surface area, thermal conductivity, tunable band gap, etc. [2–11], which have attracted a lot of recent attention. Hence, graphene has created new opportunities and applications in the areas of capacitors [12], batteries [13], actuators [14], biosensors [15], etc.

Graphene oxide (GO) is an oxidized form of graphene with various oxygen-containing functionalities, like carboxyl and hydroxyl groups. Several physical techniques, such as epitaxial growth [16], mechanical cleavage [17] and chemical vapor deposition (CVD) [18], have been often used for the fabrication of GO. However, there is currently no efficient and cost-effective method for large-scale production of graphene flakes.

Therefore, much work has been done on the synthesis of GO. One of the most common methods to produce GO is the oxidation of graphite flakes in an aqueous medium. The most common oxidation procedure is the traditional Hummer's method [19,20]. It is widely accepted that different oxidation procedures have significant effects on the properties of the obtained GO. Nevertheless, there have been no comparative studies to understand the effect of each method on the final structure of the obtained GO and the different parameters that can be tuned or controlled. Moreover, different methods also influence the chemical surface structure of GO. In terms of applications dealing with energy, several literature reports deal with the supercapacitance behavior of GO-based electrodes obtained by the usual Hummers' method [21]. However, those studies fail to explain the reason for the chosen synthesis or to determine the best oxidation procedure for a given application.

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Assessing the Photocatalytic Degradation of Fluoroquinolone Norfloxacin by Mn:ZnS Quantum Dots: Kinetic Study, Degradation Pathway and Influencing Factors

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Abstract: Norfloxacin (NOFX), a broadly used fluoroquinolone antibiotic, has been a subject of great concern in the past few years due to its undesirable effect on human beings and aquatic ecosystems. In this study, novel Mn doped ZnS (Mn:ZnS) quantum dots (QDs) were prepared through a facile chemical precipitation method and used as photocatalysts for NOFX degradation. Prior to photodegradation experiments, morphological and optical parameters of the QDs were examined through transmission electron microscopy, scanning electron microscopy, energy dispersive X-ray analysis, Fourier transform infrared spectroscopy, ultraviolet-visible spectroscopy, fluorescence spectroscopy, Brunauer–Emmett–Teller analysis, and differential thermal and thermogravimetric analyses. Mn:ZnS QDs exhibited excellent properties of photodegradation, not only under UV irradiation but also in sunlight, which induced NOFX to photodegrade. The utmost photodegradation efficiency was obtained under optimal conditions (25 mL of NOFX, 15 mg/L, pH 10, 60 min UV irradiation, 60 mgs QDs), adopting first order kinetics. In addition, hydroxyl radicals produced by the conduction band electrons were found to be the primary reason dominating the transformation of NOFX in basic conditions, while holes, oxygen atoms, as well as the doped metal (Mn) enhanced the degradation. The QDs showed excellent reusability and stability in four repeated cycles. Finally, four different pathways were predicted, derived from the identified intermediates, with piperazinyl ring transformation being the primary one. It is expected that the synthesized Mn:ZnS QDs could be utilized as efficient photocatalytic materials for energy conversion and ecological remediation.

Keywords: quantum dots; Mn-doped ZnS; optical properties; photocatalysis; degradation

1. Introduction

In recent years, there has been considerable worldwide expansion in the occurrence, behaviour, and fate of pharmaceutically active compounds used for the treatment of infectious diseases and for enhancing agricultural production [1]. Due to their widespread use and incomplete biodegradability, partial removal of these antibiotics is accomplished in usual wastewater treatment plants and quite large quantities are deliberately discharged into the environment. Consequently, due to the lack of effective treatments of antibiotic wastewater, these can be found in surface waters, causing unfavorable effects on aquatic and terrestrial organisms [2]. In biological treatment systems, fluoroquinolones (FQs) are

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Novel and Green Reduction of Graphene Oxide by Capsicum Annuum: Its Photo Catalytic Activity

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ABSTRACT

Graphene takes concerned noteworthy consideration payable its distinctive thermal, optical as well as mechanical characteristics. There are several chemical methods are available for reduce graphene oxide (r-GO) towards graphene use by many reducing agent's alike hydrazine hydrate and its derivatives. Nevertheless, they are highly explosive and emit harmful gases. Reduction of graphene oxide (GO) employing green approaches by way of plants consumes fascinated much devotion by reason of its competence, sustainable structures, and relatively low in price. Though, the crucial constituents in green extracts and their biological degradation determinations regarding GO continue quiet not well unstated. Now present work, the GO was reduced by *capsicum annuum* (CA) extract. The ideal circumstances for bio reduction existed at volume proportion of chili extract (10 g L^{-1}) and GO (0.5 g L^{-1}) solution aimed at 8 h at 80°C. The r-GO was considered with Raman spectroscopy, Fourier transform infrared spectroscopy (FTIR), Field emission scanning electron microscopy (FESEM), X- Ray diffraction (XRD), Thermo gravimetric analysis/Differential thermal analysis (TGA/DTA), Brunauer-Emmett-Teller (BET), and zeta potential. Outcomes inveterate the oxygen-holding clusters in GO were well detached, development of topping coat on the exterior of r-GO, besides virtuous diffusion of r-GO in aquatic medium. The photo catalytic degradation of GO nano composite was 96% for methyl violet (MV) in 60 minutes.

摘要

石墨烯以其独特的热学、光学和力学特性受到人们的关注. 许多还原剂的水合肼及其衍生物可用于将氧化石墨烯（r-GO）还原成石墨烯用途. 然而，它们具有很强的爆炸性，并释放有害气体. 氧化石墨烯（GO）以其具有竞争力、结构可持续性和价格相对低廉等优点而备受关注. 然而，绿色提取物中的关键成分及其对GO的生物降解测定尚不清楚. 目前的工作是用辣椒提取物降低GO. 生物还原的理想条件为辣椒提取物（10g L-1）和GO（0.5g L-1）溶液在80℃下8h的体积比. 利用拉曼光谱、傅立叶变换红外光谱（FTIR）、场发射扫描电子显微镜（FESEM）、X射线衍射（XRD）、热重分析/差热分析（TGA/DTA）、布鲁纳-埃米特-特勒（BET）和zeta电位对r-GO进行了研究. 结果表明，GO中的含氧团簇分离良好，除在水介质中有良好的扩散外，表面有涂层的发育. GO纳米复合材料对甲基紫（MV）的光催化降解率为96%.

KEYWORDS
GO; capsicum annuum; green reduction; photocatalytic activity

关键词
辣椒; 绿色减排; 光催化活性

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Selective Spectrophotometric Method for the Determination of Mercury(II) in Water Samples

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Abstract: A simple spectrophotometric method is proposed for the rapid determination of mercury(II). The procedure is based on the hydrolysis of iodine in the presence of Hg(II), resulting in the formation of hypoiodous acid, which selectively oxidizes leucocrystal violet to crystal violet. The obtained violet dye shows maximum absorbance at 590 nm. Beer's law was valid in the concentration range of 0-1.0 µg mL^{-1}. The effects of different parameters, i.e., pH, time, temperature were studied. The molar absorptivity for the system was 1.49×10^{5} L mol^{-1} cm^{-1}. The detection limit and the quantification limit were 2.6×10^{-3} µg mL^{-1} and 0.8×10^{-2} µg mL^{-1}, respectively. The proposed method is simple, selective and was successfully applied for the determination of mercury(II) in several water samples.

Keywords: Mercury, iodine, leucocrystal violet, spectrophotometry.

Introduction

Mercury is a highly toxic element for biological systems and one of the most hazardous pollutants in the environment. It can be found in several organic and inorganic forms and has harmful consequences to human health [1]. It causes neurological damages, has teratogenic effects, and can be lethal. The concentration of mercury in water, soil, sediments, plants, fish and even human hair can be determined by monitoring Hg levels [2]. Mercury can exist as elemental or metallic forms, inorganic salts, and organic Hg compounds. The toxicity depends on the form of the chemical species, organomercurials being more toxic than inorganic mercury compounds. The mercurous (Hg^{+}) and mercuric (Hg^{2+}) ions are usually found in the solid state, as mercurous or mercuric salts and Hg compounds with chlorine, sulfur, or oxygen [3]. Major chronic diseases caused by Hg include acrodynia (pink disease), neurological disease, Mad hatter's disease, Hunter-Russell syndrome, leukemia and Minimata disease [4-8]. The maximum acceptable content of Hg(II) for human beings, in drinking water, is 1 µg L^{-1} [9], as recommended by the World Health Organisation (WHO).

Several methods have been reported for the determination of mercury(II), like spectrophotometric analysis [10], inductively coupled plasma mass spectrometry (ICP-MS) [11], inductively coupled plasma atomic emission spectrometry (ICP-AES) [2], gas chromatography (GC) coupled to atomic absorption spectrometry (AAS) [3], cold vapor atomic absorption spectroscopy (CV-AAS) [14], atomic fluorescence spectrometry (AFS) [15], high performance liquid chromatography (HPLC) [16],

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Chicken feathers derived materials for the removal of chromium from aqueous solutions: kinetics, isotherms, thermodynamics and regeneration studies

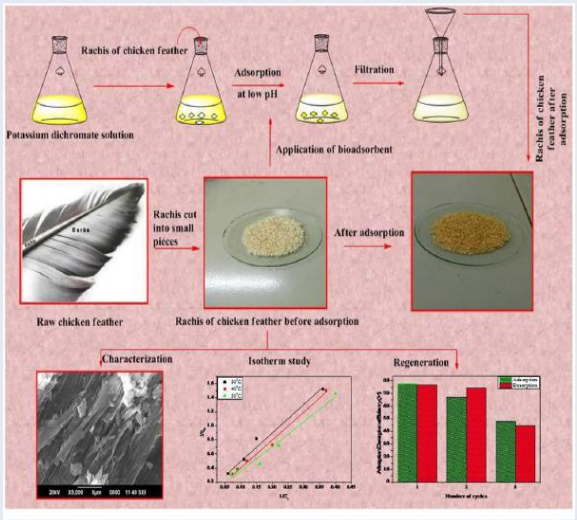
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ABSTRACT

In the present study, chicken feathers (CFs), obtained from animal waste, were used as bio-adsorbent for the removal of hazardous Cr(VI) ions from aqueous solutions. Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), energy-dispersive x-ray spectroscopy (EDX), x-ray diffraction (XRD), adsorption of N_2 at −196 °C, thermogravimetric analysis (TGA), and point of zero charge (pH_{pzc}) determination were used to characterize the adsorbent. The N_2 adsorption results revealed high surface area and microporous structure for the adsorbent. The experimental results in batch adsorption show that optimum conditions are: pH 2.5, equilibrium contact time 180 minutes, concentration of CFs 11 g L^{-1}, and initial Cr(VI) concentration 25 mg L^{-1}. The experimental data on Cr(VI) adsorption were fitted using the Langmuir and Freundlich equations at different temperatures. The Langmuir adsorption model showed the best fit. The maximum monolayer capacity (q_{max}) of CFs was found to be 333.33 mg/g. The kinetic results of Cr(VI) ion were fitted to four kinetic models: pseudo-first-order, pseudo-second-order, intra-particle diffusion, and Elovich . The pseudo-second-order chemisorption model had a higher coefficient. The thermodynamics data showed that the adsorption process of Cr(VI) on CFs was endothermic and spontaneous. The desorption efficiency and reusability of CFs were determined for three adsorption–desorption cycles, which proved to be very effective for the removal of Cr(VI) ions from aqueous solutions.

GRAPHICAL ABSTRACT



Abbreviations: CFs: chicken feathers; FTIR: Fourier transform infrared ; SEM: scanning electron microscopy; EDX: energy-dispersive x-ray spectroscopy; XRD: x-ray diffraction; BET: Brunauer–Emmett–Teller; TGA: thermogravimetric analysis; DTG: differential thermogravimetry; pH_{pzc}: point of zero charge

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Chromium(VI); chicken feathers; adsorption isotherm; kinetics; thermodynamics

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Article

Investigation of Sustained Release of 5- Fluoro Uracil Drug from Chitosan-co-Lactic acid Nanoparticles

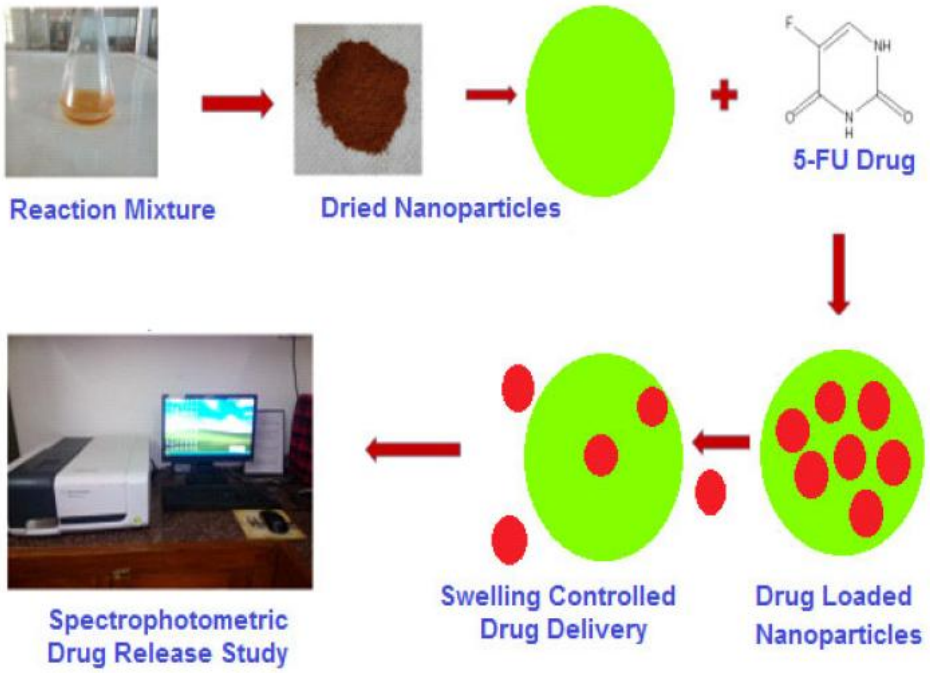
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Graphical abstract



Abstract: There are several anticancer drugs that are sparingly soluble in water and, therefore, one needs to explore novel kind of drug delivery systems for these drugs. In this work, we have reported the synthesis of chitosan-co-lactic acid nanoparticles and evaluated how efficiently do they deliver 5- Fluoro uracil drug. The prepared nanoparticles were loaded with 5- Fluoro uracil and *in vitro* kinetics of 5- Fluoro uracil was studied

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Detoxification of arsenic from contaminated water using chitosan and radiation-induced grafted chitosan: a comparative study

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Government V.Y.T. PG Autonomous College, Durg, India

ABSTRACT

Presence of arsenic in groundwater, eventually in drinking water, has been recognised as a serious community health problem, due to its high toxic nature. Therefore, its removal is highly essential. Chitosan-based adsorbents have been widely used in water treatment in the present scenario due to their abundance and cost-effectiveness. However, there are some problems hindering its practical use, such as low tensile strength and low solubility in acidic mediums. Thus, in this work, to enhance the adsorption capacity of chitosan for the removal of As (V), it has been modified by grafting with monomer HEMA and SSS using gamma radiation. Modified chitosan was characterised by SEM and FTIR spectroscopy. In grafted and ungrafted chitosan, maximum adsorption capacity was found to be (16.8) mg/g and 1.78 (mg/g) using the 0.1 g of adsorbent dose at pH 3–4 in 35 min, and initial As (V) concentration of 60 mg/L. Isotherm study reveals the adsorption process followed by Langmuir isotherm model for both grafted and ungrafted chitosan. Kinetic study suggested that grafted chitosan followed pseudo second order whereas chitosan followed first order kinetics. The thermodynamics indicated that the adsorption process of modified chitosan for As (V) was endothermic and spontaneous in nature.

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KEYWORDS
Chitosan; radiation; adsorption; arsenic (V); kinetics; equilibrium isotherm

1. Introduction

The effect of water contamination by arsenic, which is poisonous to human health, remains a considerable trouble around the globe. The increased concentration of arsenic (As) in the groundwater of many countries around the world has received significant interest during the recent decades [1]. Natural biogeochemical processes and anthropogenic activities lead to increased arsenic concentrations in water bodies such as rivers, hot springs, groundwater, and drainage from abandoned mines [2]. Water-soluble inorganic arsenic species(As(III) & As(V)) are more toxic, and cause major health risks in living organisms, as they can accumulate in living tissues, causing various

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Article

Synthesis, Characterization and Investigation of Water Uptake Capacity of Gelatin Coated Gold Nanoparticles

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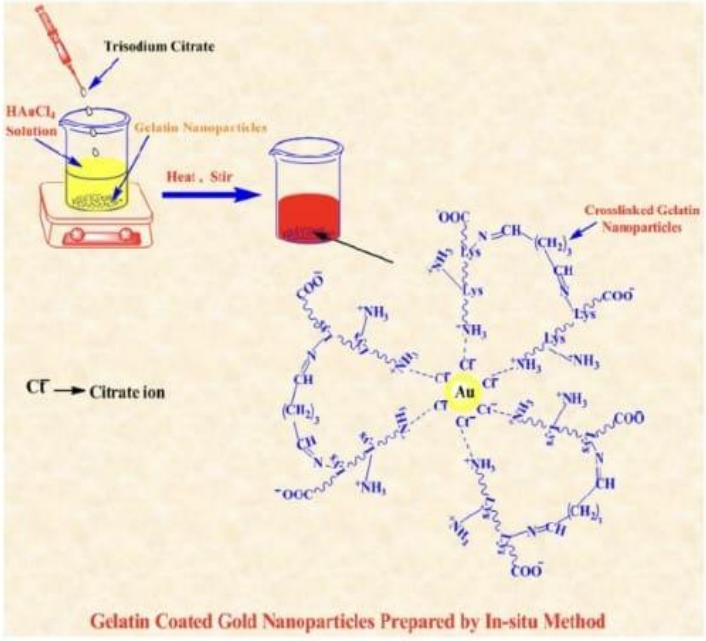
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Graphical Abstract



Gelatin Coated Gold Nanoparticles Prepared by In-situ Method

Abstract: The present research work focuses on the designing of gelatin coated-Au nanoparticles and evaluating their water imbibitions capacity at different experimental conditions. Gelatin nanoparticles were synthesized by single water in oil (W/O) emulsion cross-linking technique and gold nanoparticles by Turkvitch method. For preparing these nanocarriers, *ex-situ* as well as *in-situ* methods were adopted and the prepared gelatin coated-Au nanoparticles were characterized by FTIR, SEM, TEM, XRD and *in-vitro* cytotoxicity techniques. The effect of various experimental conditions, such as amount of gelatin content, pH, temperature,

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Low cost highly efficient natural polymer-based radiation grafted adsorbent-I: Synthesis and characterization

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ABSTRACT

High energy Co-60 gamma radiation was used to graft cationic and anionic monomers onto radiation crosslinked chitosan through mutual radiation grafting technique. The absorbed dose for synthesizing adsorbent of good strength and adsorption capacity was monomer specific. The grafting extent increased with the increase in radiation dose, dose rate and monomer concentration. While a decrease in grafting extent was observed with the increase in crosslinking density of chitosan backbone. The grafted products were characterized for water uptake capacity, surface morphology, thermal stability and elemental analysis by SEM, TGA and EDXA respectively.

1. Introduction

Cellulose and chitin are among the natural polymers that are abundant in nature and can adsorb inorganic and organic pollutants from water (Mansoori et al., 2020). Their low cost and abundance provide great incentive to develop new adsorbents based on these polymers (Basso et al., 2002). Chitosan, an N-deacetylated derivative of chitin is the second most abundant natural biopolymer (after cellulose), made up of D-glucosamine residues. It is extracted from the waste of fishery industry. Chitosan, due to the presence of large number of amino groups in its chain, exhibits pH sensitive behaviour as a weak polybase. However, its hydrophilic character and presence of amino group contributes to its poor mechanical properties strength and solubility in acids. The pH sensitivity of chitosan limits its applications in various fields like biomedicine, waste water treatment, functional membranes, flocculation etc. (Labidi et al., 2019; Vijayasri et al., 2019a; El-Hefian et al., 2012). Thus, it is more of a compulsion to modify chitosan to widen its applications.

Among various methods of polymer modification, graft copolymerization is most easy and attractive. It allows the formation of functional derivatives by covalent binding of a graft molecule onto parent polymer backbone. Grafting of suitable monomers onto chitosan can introduce properties like chelation, complexation, bacteriostatic or adsorption without affecting its inherent properties such as mucoadhesive, biocompatibility, biodegradability etc. Grafting can be initiated chemically, photo-chemically or using ionizing radiation (Goel et al., 2009a, 2011; Vijayasri et al., 2019b). Grafting through ionizing radiation has inherent advantages like absence of any initiator, uniform grafting and it is room temperature process thus even thermo-sensitive polymers can be grafted through this route (Bhattacharya and Misra, 2004; Goel et al., 2013).

Radiation grafting of two monomers onto radiation crosslinked chitosan was investigated. This part of study reports effect of experimental parameters on radiation induced grafting of two water soluble monomers with strong cationic and anionic groups onto chitosan through mutual radiation grafting technique. High energy gamma radiation from Co-60 source was used for grafting. Irradiation generates active radical sites onto backbone either directly or due to abstraction reaction with radiolytically generated species in bulk of the grafting medium (Goel et al., 2009b; Chaudhari et al., 2016a, 2016b). The grafting generates a comb like structure which enhances extent of adsorption as well as uptake kinetics of molecule of interest. Chitosan like other natural polymers, undergoes degradation on exposure to ionizing radiation, therefore it was first crosslinked using gamma radiation under suitable conditions and later crosslinked chitosan was used as backbone matrix for grafting. The novelty of the work lies in the fact that the grafted adsorbent would not put any load on the environment, the backbone polymer a being biodegradable matrix. The nitrogen being a constituent

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REVIEW

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Potentialities of bioinspired metal and metal oxide nanoparticles in biomedical sciences

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To date, various reports have shown that metallic gold bhasma at the nanoscale form was used as medicine as early as 2500 B.C. in India, China, and Egypt. Owing to their unique physicochemical, biological, and electronic properties, they have broad utilities in energy, environment, agriculture and more recently, the biomedical field. The biomedical domain has been used in drug delivery, imaging, diagnostics, therapeutics, and biosensing applications. In this review, we will discuss and highlight the increasing control over metal and metal oxide nanoparticle structures as smart nanomaterials utilized in the biomedical domain to advance the role of biosynthesized nanoparticles for improving human health through wide applications in the targeted drug delivery, controlled release drug delivery, wound dressing, tissue scaffolding, and medical implants. In addition, we have discussed concerns related to the role of these types of nanoparticles as an anti-viral agent by majorly highlighting the ways to combat the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) pandemic, along with their prospects.

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1. Introduction

Nanotechnology mainly focuses on the structures of matter from a dimension of the order of less than 100 nm. Nanoparticles with ranged lengths and specific ratios exhibit unique chemistry and physics, awakening abundant properties. In



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Potentialities of selenium nanoparticles in biomedical science

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Nanotechnology is defined as the branch of science dealing with extremely small-sized particles with a size in the range of 1–100 nm, which are termed nanoparticles. Due to the extremely small size of nanoparticles, they display unique electronic and optical properties, which differentiate them from their bulk form. Thus, due to the unique properties of nanoparticles, they play a crucial role in a variety of fields, including the biomedical, environmental, agricultural, and industrial fields. Selenium belongs to Group 16 of the periodic table with an atomic number of 34 and its nanoparticles have been highlighted as a potential material to alleviate several problems due to the formation of biofilms, production of ROS, low redox activity, *etc.* These nanoparticles can be synthesized through chemical, physical and biological methods. Since existing reviews mainly concentrated on the individual applications of selenium nanoparticles such as in diagnosis and therapeutics, the present review mainly highlights the potential activity of selenium nanoparticles in the biomedical domain, making them a potential theragnostic agent. Specifically, this review will present detailed information on the bioimaging and therapeutic activity, together with the role of selenium nanoparticles in the current scenario of the ongoing pandemic (SARS-CoV-2). It will also focus on procedures for their synthesis and properties that make them potential candidates for applications in various domains. Finally, we provide a detailed future outlook.

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nanomaterials

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Article

Calcium Alginate Beads with Entrapped Iron Oxide Magnetic Nanoparticles Functionalized with Methionine—A Versatile Adsorbent for Arsenic Removal

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Abstract: A novel beads adsorbent, consisting of calcium alginate entrapped on magnetic nanoparticles functionalized with methionine (MFMNABs), was developed for effective elimination of arsenic from water. The material was characterized by FT-IR (Fourier Transform Infrared Spectroscopy), SEM (Scanning Electron Microscopic), XRD (X-ray Diffraction) and TEM (Transmission Electron Microscopy). The arsenic removal capacity of the material was studied by altering variables such as pH of the solution, contact time, adsorbent dose and adsorbate concentration. The maximal removal of As(III) was 99.56% under optimal conditions with an equilibrium time of 110 min and pH 7.0–7.5. The adsorption followed a second order kinetics and data best fitted the Langmuir isotherm with a correlation coefficient of R^2 = 0.9890 and adsorption capacity (q_m) of 6.6533 mg/g. The thermodynamic study showed entropy change (ΔS) and enthalpy change (ΔH) to be 34.32 J mol^{-1} K and 5.25 kJ mol^{-1}, respectively. This study proved that it was feasible to treat an As(III) solution with MFMNABs. The synthesized adsorbent was cost-effective, environmentally friendly and versatile, compared to other adsorbents. The adsorption study was carried by low cost spectrophotometric method using N- bromosuccinimide and rhodamine-B developed in our laboratory.

Keywords: arsenic (III); adsorption; magnetic nanoparticles; methionine functionalized; calcium alginate; spectrophotometric method

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1. Introduction

Arsenic is naturally present in the crust of Earth and has long been recognized as highly toxic and carcinogenic, affecting millions of humans in the world [1,2]. Long-term exposure to arsenic gives symptoms such as vomiting, abdominal pain, diarrhea, severe gastrointestinal irritation, gastrointestinal damage, cardiac damage and several types of cancer [3]. It can result in vascular diseases like black foot disease [4,5]. Arsenic can be found in both organic and inorganic forms, as trivalent arsenite (H_3AsO_3, $HAsO_3^{2-}$ or $H_2AsO_3^{-}$) and pentavalent arsenate (H_3AsO_4, $HAsO_4^{2-}$, $H_2AsO_4^{-}$ or AsO_4^{3-}), of which the first form, As(III) is more noxious than As(V) [6]. In oxidizing conditions, arsenite converts to arsenate, and vice versa under reducing conditions. Inorganic arsenic compounds are more harmful and toxic, compared to organic arsenic compounds [7]. Inorganic and organic arsenic compounds are mainly used to preserve wood and as pesticides [8,9]. It also finds applications in many industries such as pharmaceuticals, paints, pesticide production, leather, textiles, etc. Several food supplements and care products contain trace amounts of arsenic and it is also used in medical products [10]. The maximum permissible limit for As in drinking water is 10 μg/L, as defined by the World Health Organization [11].

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A simple spectrophotometric study of adsorption of Hg(II) on glycine functionalised magnetic nanoparticle entrapped alginate beads

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ABSTRACT

In this study, a simple spectrophotometric method has been applied to investigate the adsorption of Hg(II) from aqueous solution on glycine functionalised magnetic nanoparticles entrapped calcium alginate beads (GFMNPECABs) from aqueous solution. The adsorbent was characterised by Fourier Transform Infrared (FT-IR) spectroscopy, Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD) and Brunauer-Emmett-Teller (BET) analysis. The influence of pH, contact time, temperature, adsorbent dose etc. were studied and optimised. The results of batch adsorption experiment showed that maximum adsorption capacity of 3.59 mg g^{-1} was obtained at pH 5 and 65 minutes of contact time.The adsorption behaviour of Hg(II) was evaluated using Langmuir, Freundlich and Temkin isotherm and it was found that the data best fitted with the Freundlich model. The kinetic study revealed that the adsorption follows pseudo-second-order kinetics with a high correlation coefficient of $R^2 = 0.9998$. The thermodynamic investigation verified the endothermic and spontaneous nature of the adsorption process with an enthalpy change (ΔH) and entropy change (ΔS) of 20.25 kJ mol^{-1} and 79.88 J mol^{-1} K, respectively. The adsorption studies were monitored based on the reaction of Hg(II) with iodine and leucocrystal violet. This study shows that GFMNPECABs is a promising adsorbent for removal of Hg(II) from aqueous solution and the above spectrophotometric method could be satisfactorily applied for adsorption studies.

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KEYWORDS
Mercury; adsorption; magnetic nanoparticles; glycine functionalised; calcium alginate; spectrophotometric method

1. Introduction

Mercury(II) (Hg^{2+}) is one of the most dangerous pollutants because of its toxic or carcinogenic properties. It's occurrence is rare in the Earth's crust (0.1–1.0 mg L^{-1}) [1]. Some inorganic and organic mercury compounds are extremely toxic and cause serious threat to human beings and to natural environment. The maximum acceptable content of Hg(II) for human beings as recommended by World Health Organization (WHO) in drinking water is 1 µg L^{-1} [2]. Hg(II) finds its wide applications in industries, that produce electrical equipment, paints, pesticides, pulp and paper, domestic thermometers, and medicines. The main sources of Hg(II) emission to land, water, and air are by the process of mining of

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Article

Ga-doped ZnO coating – a suitable tool for tuning the electrode properties in the CdS/ZnS core-shell quantum dots based solar cells

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Abstract: Bi-layer coatings from sputtered indium tin oxide (ITO) and gallium doped zinc oxide (Ga:ZnO) were investigated for transparency in the visible range of the electromagnetic spectrum, optical rejection ability in the near infrared spectrum and conductivity for the novel quantum dot based solar cells. The multilayer stack produced at optimal oxygen partial pressure with optimized films thickness and surface roughness exhibit improved optical properties without to worsen the electrical ones, even after additional oxidation during the reactive sputtering of the metal-oxides. With an average optical transmittance of 91.3%in the visible region, average reflection and resistivity lower than $0.4x10^{-2}$ Ω.cm, these coatings are good candidate for front panel electrode in the solar cells. The obtained results reveal that multilayered stacks of transparent ITO/Ga-doped ZnO coatings possess relatively low surface roughness (7-9 nm) and appropriate refractive index. The additional oxidation of GZO films induces modification of the film thickness and respectively of their optical performances.

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Keywords: ZnO doped by gallium; optical coatings; transmittance; CdS/ZnS core-shell quantum dots; transparent conductive oxide

1. Introduction

Transparent conductive films are important part of any optoelectronic device. Especially in the solar cell fabrication, the efficiency of the cell is strongly dependent on the quality of the transparent conductive electrode (TCE) [1,2]. It usually consists of oxide film (transparent conductive oxide (TCO)) or a system of few TCOs involving few interfaces. This electrode serves not only as an electrical conductor, but also as an optical filter. It is preferable if the TCE can transmit more than 82-85% of the visible light with broad band of the transmission characteristic (for efficiently absorption of all wavelengths of the visible light from blue to red) and if it can reject the infrared (IR) and ultraviolet (UV) components [3]. UV light causes materials degradation, shortening the solar cells' life and the IR heating component affect the charge carriers' mobility in the films, which results in a throughput decrease.

According to available studies, approximately 30 % of the total losses in the photoconductors are optical ones [4,5]. Therefore, these losses must be suppressed to minimum, although no exact criterion exists about satisfactory minimum. Optical losses reduction is especially crucial for the non-silicon, thin film perovskites cells, where the efficiency is naturally low and each percent of loss decrease is significant for the normal

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Adsorption of cationic dyes, drugs and metal from aqueous solutions using a polymer composite of magnetic/β-cyclodextrin/activated charcoal/Na alginate: Isotherm, kinetics and regeneration studies

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ABSTRACT

In this work, we successfully synthesized novel polymer gel beads based on functionalized iron oxide (Fe_3O_4), activated charcoal (AC) particles with β-cyclodextrin (CD) and sodium alginate (SA) polymer (Fe_3O_4/CD/AC/SA), by a simple, reproducible and inexpensive method. These beads proved to be versatile and strong adsorbents with magnetic properties and high adsorption capacity. The composites were characterized by Fourier transform infrared spectroscopy, scanning electron microscopy, energy dispersive X-ray spectroscopy, vibrating sample magnetometry, adsorption at −196 °C, high resolution transmission electron microscopy, thermogravimetric analysis and point of zero charge measurements. Two dyes, two drugs and one metal were used to test the adsorption capability of the prepared polymer nanocomposite. The adsorbent showed good removal efficiencies for the studied pollutants, especially the cationic dyes and the metal, when compared to other low-cost adsorbents. The saturated adsorption capacity of Fe_3O_4/CD/AC/SA reached 5.882 mg g−1 for methyl violet (MV), 2.283 mg g−1 for brilliant green (BG), 2.551 mg g−1 for norfloxacin (NOX), 3.125 mg g−1 for ciprofloxacin (CPX), 10.10 mg g−1 for copper metal ion (Cu(II)). The adsorption isotherm studies showed that data fitted well with Langmuir and Temkin isotherms models. The kinetic data showed good correlation coefficient with low error function for the pseudo-second order kinetic model. The data analysis was carried out using error and regression coefficient functions for the estimation of best-fitting isotherm and kinetic models, namely: chi-square test ($\chi 2$) and sum of the squares of errors (SSE). The activation energy was found to be 47.68 kJ mol−1 for BG, 29.09 kJ mol−1 for MV, 28.93 kJ mol−1 for NOX, 4.53 kJ mol−1 for CPX and 17.08 kJ mol−1 for Cu(II), which represent chemisorption and physisorption behavior of sorbent molecules. The polymer composites can be regenerated and easily separated from aqueous solution without any weight loss. After regeneration, the Fe_3O_4/CD/AC/SA beads still have good adsorption capacities up to four cycles of desorption and adsorption. The results indicate that the polymer gel beads are promising adsorbents for the removal of different categories of toxicants (like dyes, drugs and metal) in single adsorbate aqueous systems. Thus, the novel Fe_3O_4/CD/AC/SA beads can be effectively employed for a large-scale applications as environmentally compatible materials for the adsorption of different categories of pollutants.

1. Introduction

Several organic and inorganic contaminants, like drugs, domestic wastewater, (acid, basic or azo) dyes, heavy metals, among others, are continuously discharged into water bodies. This causes serious environmental problems and contamination (Moussavi et al., 2013; Homem and Santos, 2011; Bafana et al., 2011; Monier et al., 2012). Many pharmaceutical compounds (like antibiotics) are not completely metabolized by living bodies and are excreted as parent substances or in the form of metabolites. Often, these are not fully treated by wastewater

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Article

Methionine-Functionalized Graphene Oxide/Sodium Alginate Bio-Polymer Nanocomposite Hydrogel Beads: Synthesis, Isotherm and Kinetic Studies for an Adsorptive Removal of Fluoroquinolone Antibiotics

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Abstract: In spite of the growing demand for new antibiotics, in the recent years, the occurrence of fluoroquinolone antibiotics (as a curative agent for urinary tract disorders and respiratory problems) in wastewater have drawn immense attention. Traces of antibiotic left-overs are present in the water system, causing noxious impact on human health and ecological environments, being a global concern. Our present work aims at tackling the major challenge of toxicity caused by antibiotics. This study deals with the efficient adsorption of two commonly used fluoroquinolone (FQ) antibiotics, i.e., Ofloxacin (OFX) and Moxifloxacin (MOX) on spherical hydrogel beads generated from methionine–functionalized graphene oxide/ sodium alginate polymer (abbreviated Met-GO/SA) from aqueous solutions. The composition, morphology and crystal phase of prepared adsorbents were characterized by X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM), Fourier transform infrared spectroscopy (FTIR), high-resolution transmission electron microscopy (HR-TEM) and thermogravimetric analysis/differential thermogravimetry (TGA/DTG). Batch adsorption tests are followed to optimize the conditions required for adsorption process. Both functionalized and non-functionalized adsorbents were compared to understand the influence of several experimental parameters, such as, the solution pH, contact time, adsorbent dosage, temperature and initial concentration of OFX and MOX on adsorption. The obtained results indicated that the functionalized adsorbent (Met-GO/SA) showed a better adsorption efficiency when compared to non-functionalized (GO/SA) adsorbent. Further, the Langmuir isotherm was validated as the best fitting model to describe adsorption equilibrium and pseudo second-order-kinetic model fitted well for both types of adsorbate. The maximum adsorption capacities of Met-GO/SA were 4.11 mg/g for MOX and 3.43 mg/g for OFX. Thermodynamic parameters, i.e., $\Delta G°$, $\Delta H°$ and $\Delta S°$ were also calculated. It was shown that the overall adsorption process was thermodynamically favorable, spontaneous and exothermic in nature. The adsorbents were successfully regenerated up to four cycles with 0.005 M NaCl solutions. Overall, our work showed that the novel Met-GO/SA nanocomposite could better contribute to the removal of MOX and OFX from the liquid media. The gel beads prepared have adequate features, such as simple handling, eco-friendliness and easy recovery. Hence, polymer gel beads are promising candidates as adsorbents for large-scale water remediation.

Keywords: methionine functionalized; graphene oxide; polymer nanocomposite; hydrogel beads; fluoroquinolones antibiotics; adsorption; isotherms; kinetics; thermodynamics

Facile Synthesis of Bismuth-Based Perovskite and Solvent Engineering for Improving the Crystallinity of Lead-Free Perovskite Material: A Microstructural Exploration

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***Abstract*—In this work, bismuth based perovskite thin film has been synthesized and the different solvent precursor in lead-free methyl ammonium bismuth bromide ($MABiBr_3$) perovskite thin film was investigated. Initially, we have focused on the bismuth based material for the synthesis of lead-free perovskite thin film, because this material is non-toxic elements and fulfil requirements of being environmentally friendly. Moreover, bismuth is relatively stable as compared to other metal halides and has a variety of uses in the commercial application field. There were three precursor solvents used i.e., N,N-dimethylformamide (DMF), dimethyl sulfoxide (DMSO) and gamma-butyrolactone (GBL) for improving the crystallinity of the synthesized perovskite thin film and also increasing the efficiency of the synthesized material. Thus, the present work compared the effect of five different combinations of $MABiBr_3$ with various solvents, i.e. only $MABiBr_3$, $MABiBr_3$/DMSO, $MABiBr_3$/DMF, $MABiBr_3$/GBL and $MABiBr_3$ with all three DMSO, DMF and GBL. The synthesized $MABiBr_3$ perovskite thin film was characterized by X-Ray diffraction (XRD) analysis for structural investigation and the lattice strain was estimated by the Williamson−hall plot. The results showed ordinary grain size, average interlayer spacing, dislocation density, and micro strain of $MABiBr_3$ perovskite film. $MABiBr_3$/DMF/DMSO/GBL showed a good average particle size. The stress of the synthesized perovskite thin film with different solvent precursor was compressive to tensile stress as the solvent variation. The combined use of all three solvent precursors show a good response to induce crystallinity of perovskite thin film.**

Keywords—Perovskite, bismuth bromide, solvent engineering, XRD analysis

I. INTRODUCTION

Nowadays, in developing perovskite technologies, organic-inorganic metal halide perovskite and inorganic quantum dots deal with high competiveness. Additionally, for reducing the cost and promising future inventions they can be merged with abundant elements [1,2]. In the past five years, organolead based perovskites have played an important role such as a good absorber material used for future generation perovskite solar cells (PSCs). Lead (Pb) has been also used in their compositions like PbS, or $CsPbI_3$ in the quantum dot solar cells [3,4], or else $APbI_3$ (A = methylammonium or formamidinium) in PSCs [5]. However, the major concern with the lead is its toxicity. Therefore, the World Health Organization (WHO) has listed it as among 10 toxic chemicals to be restricted under some legislature's universal [6]. From that perspective, bismuth-based materials are the best substitution for replacing lead-having conglomerate. Bismuth is a pentavalent post-transition metal, it has a relatively low cost, good stability as compared to the other compounds and has more noteworthy commercial applications [2,3,7]. Furthermore, bismuth is not considered a toxic metal and less possesses hazard to the environment. It has a variety of uses, including fire extinguishers, cosmetics as well as used in common medicine named Pepto-Bismol for the relief of stomach aches [8]. Besides, Bi^{3+} has good optoelectronic properties and is the best candidate for defect tolerant compounds. Bismuth has active ns^2 lone pairs and has a tendency to create a maximum number of antibonding interactions at the valence band, consequently, defects are very low at the edges of the band [9,10]. For reciting charge transport in perovskite films, lattice uniformity and grain structure both play an important role because prominent grains with fault-free crystallinity are very important for energy-efficient devices [11-13].

There are several methods like vapor assisted [14] and solution-processed [15] techniques used for achieving the crystalline planar perovskite films. In a present effort in solvent engineering, it is found that the coordination strength of $BiBr_3$ varies with the solvent precursor, which is beneficial to give a good degree of crystallization in deposited perovskite films. For formulating $MABiBr_3$ perovskite film, GBL and DMF are commonly adapted like host solvents [16], whereas DMSO is used as an additive solvent for improving the efficiency of PSCs [17]. DMSO also improves the crystallization and enlarged grain size of $MABiBr_3$. After thermal annealing, DMSO can be completely removed from the prepared perovskite film.

In the present study, it was successfully synthesized bismuth based perovskite thin film and solvent engineering was used for various solvents like DMF, DMSO and GBL for improving the crystallization and efficiency of perovskite thin film. The effect of five different combinations of

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Solochrome Dark Blue Azo Dye Removal by Sonophotocatalysis Using Mn^{2+} Doped ZnS Quantum Dots

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Abstract: This work investigates the degradation of the azo dye solochrome dark blue (SDB) by measurement of the photocatalytic, sonocatalytic and sonophotocatalytic activities, under low ultrasonic frequency (40 kHz) and UV-C (254 nm) light, using Mn-doped ZnS semiconductor quantum dots (Mn^{2+}:ZnS Qds) as catalysts, prepared by a simple chemical precipitation procedure. In order to study the different morphological and optical crystal properties, various characterization techniques were used, such as high resolution transmission electron microscopy, scanning electron microscopy, energy dispersive X-ray analysis, X-ray diffraction, N_2 adsorption-desorption at −196 °C and ultraviolet-visible spectroscopy. The average particle size of the semiconductor Qds was in the range of 3–4 nm. The optimal parameters affecting dye degradation, such as the catalyst loading, solution pH, time of irradiation, initial concentration of dye, dopant concentration, ultrasonic power and frequency effect were evaluated. The synthesized catalytic material exhibited a high activity for sonophotocatalytic degradation of SDB (89%), larger than that observed for sonocatalysis (69.7%) or photocatalysis (55.2%) alone, which was due to the improved electron-holes separation, formation of more reactive radicals and enhancement of the active surface area. Qds showed good stability and reusability after five repeated cycles. Finally, the degradation products were identified by liquid chromatography-mass spectrometry (LC-MS).

Keywords: semiconductors; quantum dots; doping; optical properties; sonocatalysis; photocatalysis

Citation: Patel, J.; Singh, A.K.; Jain, B.; Yadav, S.; Carabineiro, S.A.C.; Susan, M.A.B.H. Solochrome Dark Blue Azo Dye Removal by Sonophotocatalysis Using Mn^{2+} Doped ZnS Quantum Dots. *Catalysts* **2021**, *11*, 1025. https://doi.org/10.3390/catal11091025

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1. Introduction

From the viewpoint of environmental sustainability, textile processing and production release a huge quantity of polluted wastewaters, which enter the environment with unknown effects on health. Those wastewaters contain various synthetic dyes used in coloring of textile fabrics [1]. These textile dyes are a matter of concern, due to their high stability and low degradation capacity in wastewater treatment plants. A variety of techniques can be used for the degradation of such dyes [2].

Solochrome dark blue (SDB) is an essential azo dye used for dyeing nylon, wool, silk and other fibers. Solochrome dark blue (SDB) is mainly used as an indicator in complexometric titrations for the determination of total hardness of water due to elements such as calcium, zinc, magnesium, and to a lesser extent for other metal ions, including manganese. These metal ions readily undergo oxidation in alkaline media to form products of uncertain stoichiometry. It is a hazardous dye, and its degradation intermediates may be carcinogenic. Therefore, it is highly desirable to develop an effective method for removal of such dye pollutants from wastewater effluents, even at trace levels.

3.4.3.1 Number of research papers in the Journal notified on UGC website during last five years-

Title of papers	**Name of Authors**	**Department of the Teacher**	**Name of Journal**	**Year of Publication**	**ISSN Number**	**Link to the recognition in UGC enlistment of the Journal**		
						Link to website of the Journal	**Link to article/paper/ abstract to the article**	**Is it listed in UGC Care list/ Scopus/ Web of Science/ other, mention**
On Approximation of Fixed Point in Busemann Space via Generalized Picard Normal S-iteration Process	Dr. Padmavati, Dr. Samir Dashputre, Kavita Sakure	Mathematics	Malaya Journal of Matematik 8(3) (2020), 1055-1062.	2020	ISSN (Print) : 2319 - 3786 ISSN (Online) : 2321 – 5666	http://www.malayajournal.org	https://doi.org/10.26637/MJM0803/0056	UGC Care list
Strong and\(\Delta\)-Convergence Results for Generalized Nonexpansive Mapping in Hyperbolic Space	Dr. Padmavati, Dr. Samir Dashputre, Kavita Sakure	Mathematics	Communications in Mathematics and Applications, 11(3) (2020), 389-401.	2020	ISSN (Print) : 0976-5905 ISSN (Online) : 0975-8607	https://www.rgnpublications.com/journals/index.php/cma	https://www.rgnpublications.com/journals/index.php/cma/article/view/1357	Web of Science
Fixed Point Approximation of Countably Infinite Family of Nonexpansive Mappings	Dr. Padmavati, Dr. Samir Dashputre, Kavita Sakure	Mathematics	South East Asian Journal of Mathematics and	2021	ISSN (Print) : 0972-7752 ISSN (Online) : 2582-0850	http://rsmams.org/journals/seajmams/home	http://rsmams.org/journals/articleinfo.php?articleid=545&tag=seajma	UGC Care list

			Mathematical Sciences, 17(1) (2021), 361-382				ms	
Convergence Results for Proximal Point Algorithm in Complete CAT(0) Space for Multivalued Mappings	Dr. Padmavati, Dr. Samir Dashputre, Kavita Sakure	Mathematics	Journal of the Indonesian Mathematical Society, 27(1) (2021), 29-47	2021	ISSN (Print) : 2086-8952 ISSN (Online) : 2460-0245	https://jims-a.org/index.php/jimsa	http://dx.doi.org/10.22342/jims.27.1.899.29-47	Web of Science
Convergence Results for Generalized Nonexpansive Mappings in hyperbolic Spaces via SP iteration Process	Dr. J.K.Kim, Dr. Padmavati, Dr. Samir Dashputre, Kavita Sakure	Mathematics	Journal of Nonlinear and Convex Analyis, 22(2), 2021, 839-854	2021	ISSN (Print) : 1345-4773 ISSN (Online) : 1880-5221	http://www.ybook.co.jp/jnca.html	http://www.yokohamapublishers.jp/online2/jncav22-4.html	Scopus
Fixed point theorem on fuzzy metric spaces with rational inequality and its applications	Rakesh Tiwari, , Sudhir Kumar Srivastava and Shraddha Rajput	Mathematics	Interna-tional Journal of Research in Engineering and Science (IJRES),	2020	ISSN (Online): 2320-9364; ISSN (Print):2320-9356	www.ijres.org	https://www.researchgate.net/publication/343541485_Fixed_point_theorem_on_fuzzy_metric_spaces_with_rational_inequality_and_its_applications	Other
Fixed point results for ($\propto -\beta_k, \psi$)integral type contraction mappings in fuzzy metric spaces	Rakesh Tiwari and ShraddhaRajput	Mathematics	Communications in Math-ematics and Applications	2021	ISSN 0975-8607 (online); 0976-5905 (print)	http://www.rgnpublications.com	DOI: 10.26713/cma.v12i1.1476	Web of science
Convergence of new Bernstein type operators	Narendra kumar kurre, Mohammed Feroz Khan	mathematics	IOSR	Nov-Dec 2020	e- 2278- 5728 p- 2319-765X	www.iosrjournals.org	-	No
Pointwise Approximation by q- Bernstein type operators	Narendra kumar kurre,	mathematics	IJMTT	Dec-2020	2231-5373	www.ijnttjournal.org	-	yes

	Mohammed Feroz Khan							
On the convergence of generalized Beta-Kantorovich type operators	Mohammed Feroz Khan, Narendra kumar kurre	mathematics	IOSR	Mar-Apr2021	e- 2278- 5728 p- 2319-765X	www.iosrjournals.org	-	No

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INERTIAL PICARD NORMAL S-ITERATION PROCESS

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Abstract. Many iterative algorithms like that Picard, Mann, Ishikawa and S-iteration are very useful to elucidate the fixed point problems of a nonlinear operators in various topological spaces. The recent trend for elucidate the fixed point via inertial iterative algorithm, in which next iterative depends on more than one previous terms. The purpose of the paper is to establish convergence theorems of new inertial Picard normal S-iteration algorithm for nonexpansive mapping in Hilbert spaces. The comparison of convergence of InrrNSP and InrrPNSP is done with InrrSP (introduced by Phuengrattana et al. [25]) and MSP (introduced by Suparatulatorn et al. [27]) via numerical example.

1. Introduction

Fixed point theory plays very crucial role in the fields of pure and applied mathematics as well as in many other branches of science (see [14, 15, 19, 29, 30] and references therein). One of the most fundamental problems in the operator theory is to find fixed points of nonlinear operators (see [8–10]). Many

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[3]Keywords: Picard normal S-iteration process, normal S-iteration process, inertial extrapolation, weak convergence, strong convergence.
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FIXED POINT APPROXIMATION OF COUNTABLY INFINITE FAMILY OF NONEXPANSIVE MAPPINGS

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Abstract: In this paper, we propose an iterative algorithm and then prove the strong convergence of proposed algorithm in framework of CAT(0) space and Hilbert space for approximating the common fixed point of countably infinite family of nonexpansive mappings and minimizer of proper, convex, lower semicontinuous function. Then we implement the proposed algorithm to solve constrained minimization problem and system of linear equations. Our results genaralize the results of Phuengrattana *et al.* [36] and Suparatulatorn *et al.* [43].

Keywords and Phrases: Proximal point algorithm, CAT(0) spaces, nonexpansive mappings, constrained convex minimization problems, system of linear equations.

2020 Mathematics Subject Classification: 47H09, 47H10.

1. Introduction

Let (X, d) be a metric space. A geodesic path joining $x \in X$ to $y \in X$ (or, more briefly, a geodesic from x to y in X) is a map c from a closed interval $[0, l] \subset \mathbb{R}$ to X such that $c(0) = x, c(l) = y$, and $d(c(t), c(t')) = |t - t'|$ for all $t, t' \in [0, l]$. In particular, c is an isometry and $d(x, y) = l$ The image of c is called a geodesic (or metric) segment joining x and y. In case this geodesic segment is unique, it is denoted by $[x, y]$. The space (X, d) is said to be geodesic space if every two points of X are joined by a geodesic, and X is said to be uniquely geodesic if there is exactly one geodesic joining x and y for each $x, y \in X$. A subset $Y \subseteq X$ is said to be convex if Y includes every geodesic segment joining any two of its points.

A geodesic triangle $\Delta(x_1, x_2, x_3)$ in a geodesic metric space (X, d) consists of three points x_1, x_2, x_3 in X (referred as the vertices of Δ) and a geodesic segment between each pair of vertices (referred as the edges of Δ). A comparison triangle for the geodesic triangle $\Delta(x_1, x_2, x_3)$ in (X, d) is a triangle $\overline{\Delta}(x_1, x_2, x_3) := \Delta(\overline{x_1}, \overline{x_2}, \overline{x_3},)$ in the Euclidean plane $\mathbb{R}^2$ such that $d_{\mathbb{R}^2}(\overline{x_i}, \overline{x_j}) = d(x_i, x_j)$ for $i, j \in \{1, 2, 3\}$.

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Research Article

Strong and Δ-Convergence Results for Generalized Nonexpansive Mapping in Hyperbolic Space

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Abstract. In this paper, we propose a new iteration process which is faster than Picard Normal S-iteration process, Normal S-iteration process, Mann iteration process and Picard iteration process in hyperbolic space for generalized nonexpansive mapping. We also present strong and Δ−convergence results for proposed iteration process. An illustrative example with different set of parameters is also given in this paper.

Keywords. Hyperbolic space; Generalized nonexpansive mappings; Picard normal S-iteration process; Normal S-iteration process

MSC. 47H10; 47H09

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1. Introduction

Let X be a normed space and C be a nonempty subset of X. The mapping $T : C \to C$ is said to be

(1) *nonexpansive*, if $\|Tx - Ty\| \leq \|x - y\|$ for all $x, y \in C$.

(2) *quasi-nonexpansive*, if $\|Tx - p\| \leq \|x - p\|$ for all $x \in C$ and $p \in F(T)$, where $F(T)$ denotes the set of all fixed point of T, i.e.,

$$F(T) = \{x : Tx = x, x \in C\}.$$

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On The Degree of Approximation by Modified Beta-Bernstein Type Operators

Mohammed Feroz Khan[1], Narendra Kumar Kurre[2], M. A. Siddiqui[3]

ABSTRACT: *In this article,we define the modified form of Bernstein type operators based on Beta function developed by Dhawal.J. Bhatt et al. recently.We have proved these operators uniform convergence on the basis of Korovkin's theorem and rate of convergence through modulus of continuity and asymptotic behaviour is shown as Vorovnoskaja type theorem.*

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I. Preliminaries

Most celebrated Weierstrass approximation theorem is the milestone in the development of Approximation theory which is currently understood as the given form :

If $f:[a,b] \to R$ continuous and for any $s > 0$, $\exists$ an algebraic polynomial p such that

$$|f(x) - p(x)| \leq s, \qquad \forall x \in [a,b]$$

Bernstein [1] gave a very sound proof of this theorem and introduced Bern- stein polynomial of degree n of the function f defined as

$$B_n f(x) = \sum_{k=0}^{n} f\left(\frac{k}{n}\right) p_{n,k}(x), \qquad (1)$$

where $p_{n,k}(x) = \binom{n}{k} x^k (1-x)^{n-k}$, and $0 \leq k \leq n$.

Lots of generalisation and improvements [2, 3, 4, 5, 6, 7, 8, 9, 10, 11] of (1) are studied by many researchers.

Recently Dhawal J. Bhatt et al. [12] defined the following Beta-Bernstein operator

B_n :
For $f \in C[0, 1]$, $B_n : C[0, 1] \to C[0, 1]$

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On approximation of fixed point in Busemann space via generalized Picard normal s-iteration process

Samir Dashputre[1], Padmavati[2] and Kavita Sakure [3]*

Abstract
This paper deals with strong as well as Δ−convergence results for SKC map in Busemann space via generalized Picard normal s-iteration process. We design an example for the Suzuki-Karapinar conditioned mapping in this paper. Also we discuss generalized Picard normal s-iteration process is faster than some famous iteration processes. An numerical example is presented in this paper to support our result.

Keywords
Busemann Space, Δ−convergence, strong convergence, SKC map, iteration method.

AMS Subject Classification
47H09, 47H10.

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1. Introduction

Busemann [3] developed the theory of non-positive curvature for pathmetric space. Then the class of geodesic for curvature non-positivity in convex space introduced by Gromov [10]. The term "Busemann" first time used by Bowditch [2]. Foertsch et al. [5] proved that if CAT(0) spaces satisfies Ptolemy condition, then CAT(0) is Busemann space. The examples of Busemann space are uniformly convex Banach space such as l_p, l_p and W_p^m for $1 < p < \infty$ and Minkowski space and strictly convex Banach spaces and simply connected Riemannian manifolds of nonpositive sectional curvature are examples of the Busemann space. The hyperbolic space appeared for denoting Busemann convex space in [23].

On the other hand, many researchers designed iterative process for approximating fixed point of nonexpansive map and for some class of nonexpansive map (see [1, 12, 16, 19, 20, 25]) in last fifty years and compare which iteration process is faster.

Let Y be a normed space and M be a nonempty subset of Y. The mapping $S : M \to M$ is said to be
(1) **nonexpansive**, if $\|Sl - Su\| \leq \|l - u\|$ for all $l, u \in M$.
(2) **quasi-nonexpansive**, if $\|Sl - p\| \leq \|l - p\|$ for all $l \in M$ and $p \in F(S)$, where $F(S)$ denotes the set of all fixed point of S, i.e.,

$$F(S) = \{t : St = t, t \in M\}.$$

Many nonlinear problem can be written as fixed point problem

$$t = St,$$

where fixed point map S may be nonlinear. The solution of such problem is called a fixed point of the map S.

The fixed point iteration can be defined by

$$t_{n+1} = St_n \quad \forall n \in N. \tag{1.1}$$

The iterative process (1.1) is known as Picard iteration, method of successive substitution or Richardson iteration. Picard iteration for Banach contraction mapping converges to

unique fixed point of S, but this iteration fails for approximating fixed point for nonexpansive map. On the other hand, this iteration method enable us to identify existence of fixed point of S.

In 1953, Mann [19] introduced an iteration process : Assume that $t_0 \in M$ is arbitrary. The $\{t_n\}$ as follows

$$t_{n+1} = \alpha_n t_n + (1 - \alpha_n)St_n, \quad n \geq 0, \tag{1.2}$$

where $\{\alpha_n\}$ is real sequence in the interval $(0, 1)$. The iteration $\{t_n\}$ is known as Mann iteration process.

Assume that M is convex subset of normed nonlinear space Y and $S : M \to M$ is a map. Assume that $t_0 \in M$ is arbitrary. The following sequence $\{t_n\}$ in M defined as follows

$$\begin{cases} t_{n+1} = Su_n, \\ u_n = (1 - \alpha_n)t_n + \alpha_n St_n, \quad n \in N. \end{cases} \tag{1.3}$$

$$\begin{cases} t_{n+1} = Su_n, \\ u_n = (1 - \alpha_n)v_n + \alpha_n Sv_n, \\ v_n = (1 - \beta_n)t_n + \beta_n St_n, \quad n \in N. \end{cases} \tag{1.4}$$

$$\begin{cases} t_{n+1} = Tu_n, \\ u_n = (1 - \alpha_n)v_n + \alpha_n Sv_n, \\ v_n = (1 - \beta_n)w_n + \beta_n Sw_n, \\ w_n = (1 - \gamma_n)t_n + \gamma_n St_n, \quad n \in N. \end{cases} \tag{1.5}$$

where $\{\alpha_n\}$, $\{\beta_n\}$ and $\{\gamma_n\}$ are real sequence in $(0, 1)$.

isometry if $d(l, u) = l$. The image of c is said to be geodesic (or metric) segment joining the t and u. When it is unique, then this geodesic segment is represented by $[t, u]$. A space (Y, d) is called geodesic space, if every two points of Y can be joined by a geodesic and Y is called uniquely geodesic, if there is only one geodesic joining t and u for each $t, u \in Y$. A subset $X \subseteq Y$ is called convex, if X includes every geodesic segment joining any two of its points. The geodesic triangle $\Delta(t_1, t_2, t_3)$ in the geodesic metric space (Y, d) consists of three points t_1, t_2, t_3 in Y (vertices of Δ) and a geodesic segment between each pair of vertices (the edges of Δ).

Assume that $c : [t, u] \longrightarrow Y$ is path in a metric space Y. The path c is called an affinely reparameterized geodesic, if either c is the constant path or there is a geodesic path $c' : [s, v] \longrightarrow Y$ such that $c = c' o \psi$, where $\psi : [t, u] \longrightarrow [s, v]$ is unique affine homeomorphism between the intervals $[t, u]$ and $[s, v]$ which preserves ratio of distances and collinearity.

Assume that Y is uniquely geodesic space. If $c([t, u])$ is geodesic segment joining a and b and $\eta \in [a, b]$, then $z := c((1 - \eta)t + \eta u)$ is unique point in $c([t, u])$ satisfying $d(z, a) = \eta d(a, b)$ and $d(z, b) = (1 - \eta)d(a, b)$. Here $[a, v]$ represents geodesic segment $c[t, u]$ and z represents $(1 - \eta)t + \eta u$. The subset $M \subseteq Y$ is called geodesically convex, if M contains every geodesic segment joining any two of its point.

Assume that Y is geodesic metric space and $f : Y \longrightarrow \mathbb{R}$ mapping. If f is convex (strictly convex), if for every geodesic path $c : [t, u] \longrightarrow Y$, $fo c : [t, u] \longrightarrow \mathbb{R}$ is convex (strictly convex). If $g : f(X) \longrightarrow \mathbb{R}$ is an increasing convex (strictly convex) and $f : X \longrightarrow \mathbb{R}$ is a convex function, then

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Convergence of New Bernstein Type Operators

NARENDRA KUMAR KURRE, MOHAMMED FEROZ KHAN, AND M.A.SIDDQUI

ABSTRACT. We concern in this paper new Bernstein type operator with parameter $\lambda \in [-1, 1 - 1/n]$. We discuss the Rate of Convergence of Bernstein operator, prove that Bernstein approximation theorem with that new parameter and also prove that Voronovskaja type theorem using by exponential operators.

Mathematics subject classification:41A36
Keywords:Bernstein Operator,Bezier basis function,λ-Bernstein operator,Exponential operator, Voronovskaja theorem , Rate of convergence

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I. Introduction

In 1912 Given by S.N.Bernstein. A function f on $[0, 1]$ they define the polynomial

$$B_n f(x) = \sum_{k=0}^{n} \binom{n}{k} x^k (1 - x)^{n-k} f(\frac{k}{n}). \tag{1}$$

for each positive integer n. Known as Bernstein polynomials.We will discuss in this paper, if f is continuous on $[0, 1]$, its sequence of Bernstein polynomials converges uniformly to f on $[0, 1]$, thus giving constructive proof of Weierstrass theorem. There are several proof of this fundamental theorem beginning with that given by K.Weierstrass after Bernstein gave its constructive proof in 1912. We introduce by using Exponential operator rate of convergence of Bernstein operator and proof the Bernstein approximation theorem with new parameter $\lambda \in [-1, 1-1/n]$ and also prove that Voronovskaja type theorem by exponential operator with new parameter.Now this new operator known as λ-Bernstein operator such that

$$B_n f(x) = \sum_{k=0}^{n} f(k/n)\tilde{b}_{n,\lambda}(x) \tag{2}$$

where $x \in [0, 1]$, and $n = 1, 2, \ldots$ where the function $b_{n,\lambda}(x)$ are defined as in the paper by Ye.Z. Long [10] new Bezier bases with parameter λ

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Pointwise Approximation By Q- Bernstein Type Operators

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ABSTRACT *: We concern in this paper a new study of Pointwise approximation by q - Bernstein operators in the mobile interval $x \in [-1, 1 - 1/n]$ with use of exponential operators and obtain the Direct theorem and Weighted approximation theorem for that operators with Rate of convergence.*

Subject-class: 41A10 , 41A17, 41A25, 41A36

Keywords: *q - Bernstein operators, Pointwise approximation, Exponential operators, Rate of convergence.*

I. INTRODUCTION AND AUXILIARY RESULTS

In the year 1912 S.N.Bernstein introduced famous proof of the Weierstrass approximation theorem and the defined operators called Bernstein operators.

Definition: Bernstein [12] : If $f : [0, 1] \longrightarrow \mathbf{R}$. Then the Bernstein operators of f is

$B_n f(x) = \sum_{i=0}^{n} f(i/n) \binom{n}{i} x^i(1-x)^{n-i}$ .....(1)

For each positive integer n = 1,2,3,.....

Bernstein proved that if $f \in C[0,1]$ then the sequence $B_n f(x)$ converges uniformly on [0,1].

Definition: Phillips [5] : If $f : [0, 1] \longrightarrow \mathbf{C}$. , $q > 0$ then q - Bernstein operators of f is

$B_{n,q}(f;x) = \sum_{i=0}^{n} f(\frac{[i]q}{[n]q}) \prod_{s=0}^{n-1-i}(1 - q^s x) \binom{n}{i}_q$ ..... (2)

Where n = 1,2,3,.....

Here if $q = 1$ the polynomials $B_{n,1}(f;x)$ are classical Bernstein polynomials.

Theorem 1.0.1. (Bernstein): If $f \epsilon C[0, 1]$ then $B_{n,1}(f; x) \Rightarrow f(x)$ for $x \epsilon [0, 1]$ as $n \longrightarrow \infty$ for $q \epsilon (0, 1)$ convergence of the sequence $B_{n,q}(f; x)$ was introduced by A.Illinskii. It follows directly from the definition of q - Bernstein polynomials possess the end point interpolation property i.e.

$Bn, q(f; 0) = f(0)$

$Bn, q(f; 1) = f(1)$ .....(3)

for all $q > 0$. and here n= 1,2,3,.....

In 2019 Adrian Holhas gave the general exponential operators let $I \subset \mathbf{R}$ be an open interval and let $\alpha \geq 0$ be a real numbers consider a continuous function $\Theta : (0, \infty) \longrightarrow \mathbf{R}$ and we denote by $\mathbf{C}_{\theta,\alpha}$ the space of continuous functions $f \in \mathbf{C}(I)$ with the property that exist $M > 0$ such that $|f(x)| \leq Me^{\alpha|x|}$, for every $x \in I$. Because of the symmetry and to simplify the notation we consider in the following that $I \subset (0,\infty)$.

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On The Convergence of Generalized Beta-Kantorovich Type Operators

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Abstract: *In the presented article, we generalize the positive linear operator which is Kantorovich type with beta bases given by Dhawal. J. Bhatt et al. recently. We introduce the real positive parameters to generalize the operator, then prove uniform convergence for the sequence of this newly defined operators with the help of Korovkin's theorem. We estimate central and pointwise moments and also the rate of convergence through modulus of continuity. We have shown its asymptotic behaviors in terms of Voronovskaya type asymptotic formula.*

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Keywords: Kantorovich operator, Beta bases, rate of convergence, Voronovskaya type asymptotic formula, modulus of continuity.

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I. Introduction

Most celebrated Weierstrass theorem states that if f is a continuous function on [0.1] then for $\varepsilon > 0$, ☐ a polynomial $P(x)$ such that

$$|f(x) - P(x)| < \varepsilon \ , x \in [0,1]$$

S.N. Bernstein [1] gave a constructive proof of the above theorem using the sequence of positive linear operators (Bernstein operators). His polynomial operator $B_n(f; x)$ is defined by

$$B_n(f;x) = \sum_{k=0}^{n} \binom{n}{k} x^k (1-x)^{n-k} f\left(\frac{k}{n}\right)$$

There were some drawbacks associated with the operators one of which was slow rate of convergence and the other one, Bernstein operator was not suitable for approximating functions which were integrable in the sense of lebesgue or Riemann.
In those contexts, in 1930, Kantorovich [2] introduced an operator $K_n(f; x)$ defined by

$$K_n(f;x) = (n+1)\sum_{k=0}^{n+1} \binom{n}{k} x^k (1-x)^{n-k} \int_{\frac{k}{n+1}}^{\frac{k+1}{n+1}} f(t)dt$$

Where f(x) is an integrable function on [0,1]
A lots of generalizations and modifications of Kantorovich operator have been introduced by many researchers [4-10] with different basis and parameters.
Recently Dhawal J. Bhatt et al. [11] defined Kantorovich type operator with Beta basis function as follows :
For $f \in R[0,1], x \in [0,1]$

$$B_n^* : R[0,1] \to R[0,1]$$

Then $$B_n^*(f;x) = (n+1)\sum_{r=0}^{n} P_{n,r}(x) \int_{\frac{r}{n+1}}^{\frac{r+1}{n+1}} f(t)dt \qquad (1)$$

where $$P_{n,r}(x) = \binom{n}{r} \frac{B(nx+r+1, 2n-r-nx+1)}{B(nx+1, n-nx+1)}$$

Where B (a b) is the Beta function defined by

$$B(a,b) = \int_0^1 t^{a-1}(1-t)^{b-1}dt \quad (a,b>0)$$

Now we generalize the operator (1) with associating real parameters $(0 \leq \alpha \leq \beta)$ consequencing the above and defined generalized form as

$$\bar{B}_n : R[0,1] \to R[0,1] \text{ such that}$$

$$\bar{B}_n(f;x) = (n+\beta+1)\sum_{r=0}^{n} P_{n,r}(x) \int_{\frac{r+\alpha}{n+\beta+1}}^{\frac{r+\alpha+1}{n+\beta+1}} f(t)dt$$

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CONVERGENCE RESULTS FOR PROXIMAL POINT ALGORITHM IN COMPLETE CAT(0) SPACE FOR MULTIVALUED MAPPINGS

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Abstract. In this paper, we propose the modified proximal point algorithm with the process for three nearly Lipschitzian asymptotically nonexpansive mappings and multivalued mappings in CAT(0) space under certain conditions. We prove some convergence theorems for the algorithm which was introduced by Shamshad Hussain *et al.* [22]. A numerical example is given to illustrate the efficiency of proximal point algorithm for supporting our result.

Key words and Phrases. CAT(0) spaces, Nearly Lipschitzian mappings, Proximal point algorithm, $\Delta-$convergence.

1. Introduction

The proximal point algorithm (PPA) is a method for finding a minimizers of convex lower semicontinuous (lsc) function defined on Hilbert spaces was initiated by Martinet [29] in 1970. The PPA has since become extremely popular among the various researchers inclination in the theory of optimization and also exposed many challenging mathematical problems. The rich literature on this subject has become too extensive (see e.g. [7–9,12,13,17,18,21,24,25,36–38]). In particular, the PPA was studied in the framework of Riemannian manifold [10,20], in Hadamard manifold [4–6,11,27,41] and in CAT(0) space [8,14–16,34,40].

On the otherhand, Markin [28] and Nadler [31] introduced the study of fixed points for multivalued contractions and nonexpansive mappings using the Hausdorff

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metric. Shimizu *et al.* [39] proved the existence of fixed points for multivalued nonexpansive mappings in convex metric space was established by Shimizu *et al.* [39], i.e. he proved that *every multivalued mapping $T : Y \to C(Y)$ has a fixed point in a*

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CONVERGENCE RESULTS FOR GENERALIZED NONEXPANSIVE MULTIVALUED MAPPING IN HYPERBOLIC SPACES VIA SP ITERATION PROCESS

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Abstract. In this paper, we establish some $\Delta-$convergence and strong convergence theorems for the iterative scheme proposed by Phuengrattana and Suantai [33] for generalized nonexpansive multivalued mappings in the frame work of hyperbolic spaces. Our results are generalizations and improvements of several relevant results in the current literature.

1. Introduction

The study of fixed points for multivalued contractions and nonexpansive mappings using the Hausdorff metric was initiated by Markin [26] and Nadler [27]. In 1996, Shimizu and Takahashi [36] established the existence of fixed points for multivalued nonexpansive mappings in convex metric spaces. Later on, an attractive and amusing fixed point theory for such maps was established which has plentiful applications for example in control theory, convex optimization, differential inclusion and economies (see [12] and references cited therein). The theory of multivalued nonexpansive maps is harder than the corresponding theory of single valued nonexpansive maps.

Banach is the first who used the iteration process well-known as Picard iteration ($x_{n+1} = Tx_n$, where T is a mapping from a nonempty subset of underlying space) and approximate fixed point a contraction mapping in a complete metric space, but it fails to approximate the fixed point for nonexpansive mappings. It is challenge to researcher developed new iteration processes for various classes of nonlinear mapping for approximating fixed points of single valued mappings as well as multivalued mappings and it is very dynamic research area since last few decades. The iterative process for approximating fixed points have been investigated by various researchers as follows, where C be nonempty closed convex subset of a Banach space X.

Mann iteration process [25]: For an arbitrary $x_0 \in C$, we construct sequence $\{x_n\}$ as follows

$$x_{n+1} = \alpha_n x_n + (1 - \alpha_n)Tx_n, \quad n \geq 0, \tag{1.1}$$

where $\{\alpha_n\}$ is real sequence in the interval $(0, 1)$.

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Key words and phrases. Generalized nonexpansive multivalued mappings, SP iteration process, strong and $\Delta-$convergence theorems, hyperbolic spaces.
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Diversity of forest herbs during rainy season in the reserve forest of Bhupdeopur of district Raigarh, Chhattisgarh

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Abstract
In the given study the stress is given on the study of herb layer vegetation in Bhupdeopur reserve forest of Raigarh district of Chhattisgarh because any detailed studies on herb layer in forest ecosystems was not done so far. An in depth survey has been conducted in rainy season to search out the assorted forms of forest herbs. Ninety herb species were recorded in season, their native names and numerous uses by the native inhabitants as well as healthful values were recorded throughout the survey. The parameters like frequency, density and abundance were conjointly undertaken.

Keywords: forest herbs, Bhupdeopur reserve forest, Chhattisgarh, frequency, density, and abundance

Introduction

India is recognized as a country rich in all aspects of Biodiversity and Ecosystem. For any one country in the world, it has perhaps the largest array of environmental stipulations by virtue of its tropical location. Forests are one of the most important recognized ecosystems in the biosphere and India is rich in all aspects of Biodiversity and Ecosystems. These plant strata square measure integral part of organic phenomenon for mammals and birds and management of microclimate of the location. The herb layer biomass typically plays a very important role within the utilization of nutrients. In forest system underneath level studies haven't been given a correct weightage like the tree constituents.

Hence solely a number of studies on the role of underneath level vegetation in numerous forms of plantation ecosystems is noted. Phytosociological analysis of a plant community is a very important facet of ecological study of any piece of vegetation. Species composition is one of the necessary characters of plant community. Analytical character *viz.* Frequency, density and abundance square measure terribly helpful within the composition of 2 completely different plant communities. The current study was conducted in Bhupdeopur reserve forest of district Raigarh Chhattisgarh. (Table 1)

Aim/Purpose

1. Identification of herb species of Bhupdeopur reserve forest.
2. to review the herb diversity of Bhupdeopur reserve forest.
3. Identification of vulnerable herb species that is of promising worth.
4. to review the floristic composition of Bhupdeopur reserve forest.
5. To enlist ethnobotanical uses of herbs specifically of health and sustenance security.

Materials and strategies

1. Choice of study sites: The present study was conducted in Bhupdeopur Reserve forest of district Raigarh, Chhattisgarh. The study space was divided into four circles named as Naharpali, Kerajhar, Delari and Khairpur, every circle was divided into beats and a complete of twenty beats in sixteen villages were thought for the study. The study site is in twenty five km of North West of Raigarh town. The quadrates comes underneath Raigarh forest area of Raigarh forest division in Raigarh and Kharsia body block.
2. Technique of sampling with in the given study Phytosociological diversity analysis was administrated by quadrate technique. Sampling of study space was done by Quadrat technique following Oosting, (1958) [6]. 1mtr sq. circular quadrates were used for the sampling of herb layer. On the idea of the information obtained from the quadrate samples the structural distribution of forest herbs in the season were analyzed. The parameters like proportion frequency, density, abundance were obtained and were calculated from the information as follows.

$$\%\, F = \frac{\textit{Number of sampling units in which plant species occured}}{\textit{Total number of sampling units studied}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individuals of a plant species in all sampling units}}{\text{Total Number of sampling units studied}}$$

$$\text{Abundance} = \frac{\text{Total number of individual plant species in all the sampling units}}{\text{Total number of sampling units of occurrence}}$$

Result and Discussion

A total of 44 species of herbs belonging to 38 genera of 16 families were recorded out of them 33 plant species belonged to dicotylodonae, 9 belonged to monocotyledonae and 1 belonged to pteridophyte. Fabaceae was found the dominant family Poaceae, 03 of Asteraceae and Cyperaceae, 02 each for Oxalidaceae, Apiaceae, Euphorbiaceae, Convolvulaceae and

Lamiaceae were recorded. The Minimum number of species (01) was recorded for 06 of the families like Periplocaceae, Onagraceae, Schizaecaceae, Polygonaceae, Malvaceae and Scrophulariaceae. Out of 44 herbs species recorded during summer season 42 species were wild and 02 were wild/ cultivated.(Table) 90 Herb species of 76 genera of 33 families and 60 species belonged to 52 genera of 22 families were 72 observed during the summer, rainy and winter season respectively. 33 plant species belonged to dicotylodonae, 9 belonged to monocotyledonae and 1 belonged to pteridophyte in summer, 60 plant species belonged to dicotyledonae, 28 to monocotyledonae and 02 plant speices of pteridophyta in rainy season and 40 plant species of dicotyledonae, 19 of monocotyledonae and 01 plant species of pteridophyte in winter season were recorded. In summer season, Fabaceae was found the dominant family recorded 08 species, while, 07 species each of Acanthaceae and Poaceae, 03 of Asteraceae and Cyperaceae, 02 each for Oxalidaceae, Apiaceae, Euphorbiaceae, Convolvulaceae and Lamiaceae were recorded. The Minimum number of species (01) was recorded for 06 of the families like Periplocaceae, Onagraceae, Schizaecaceae, Polygonaceae, Malvaceae and Scrophulariaceae.

Out of 44 herbs species recorded during summer season 42 species were wild and 02 were wild/ cultivated (Table-10). In rainy season, the maximum number of Herb species (12) was recorded of family Asteraceae, (11) of family Poaceae, 8 of Fabaceae, 7 each of Cyperaceae and Acanthaceae, 4 each of Lamiaceae and Euphorbiaceae, 3 each of Zingiberaceae and Solanaceae, 2 each of Lilliaceae, Amaranthaceae, Oxalidaceae, Vitaceae, Chenopodiaceae, Convolvulaceae and Malvaceae, 1 each of Dioscoreaceae, Araceae, Apiaceae, Cleomaceae, Hypoxidaceae, Commelinaceae, Onagraceae, Schizaecaceae, Sterculiaceae, Tiliaceae, Periplocaceae, Rubiaceae, Scrophulariaceae, Ophioglossaceae, Nyctaginaceae, Acoraceae and Polygonaceae. Out of 90 herb recorded during rainy season 83 were found wild and 07 were noted as wild/ cultivated (Table-11). In winter season, Poaceae and Fabaceae were found to be the dominant families. The maximum number of Herb species (08) was noted for the family Poaceae and Fabaceae while, (07) of family Cyperaceae, (06) of family Asteraceae, Acanthaceae (05) of family Malvaceae, (02) each of family Lamiaceae, Oxalidaceae, Euphorbiaceae,and Convolvulaceae. The minimum number of species (01) was recorded for (12) of the families like Apiaceae, Vitaceae, Zingiberaceae, Hypoxidaceae, Commelinaceae, Periplocaceae, Onagraceae, Schizaecaceae, Rubiaceae, Scrophulariaceae, Cleomaceae and Colchicaceae. Out of 60 herb recorded during winter season 57 species were wild and 03 were noted as wild / cultivated).

1. **% Frequency of herbs:** In rainy season,% frequency of 88 plant species in the range of 1% to 20%, 01 plant species in the range of 21% to 40%, 01 plant species in the range of 41% to 60% and none of the plant species was in the range of 61% to 80% and 81% to 100%.The maximum % frequency 41% was estimated for the plant species *Hyptis suaveolens* (L.) poit and the minimum (3%) for 03 plant species like *Aloe vera* (L.) Burm. f. and *Heteropogon contortus* (L.) Beauv. Ex Roem & Schult. *Oxalis corniculata* Linn.
2. **Density of herbs:** In rainy season, density was calculated for 81 plant species in the range of 0.00 to 1.60, while none of the plant species was in the range of 1.61 to 3.00 and 4.6 to 6.00 and 01 plant species was in the range of 3.10 to 4.50.The maximum density 4.49 was calculated for the plant species *Hyptis suaveolens* (L.) Poit and the minimum density 0.07for *Andrographis echoides* Nees.
3. **Abundance of Herbs:** In rainy season, abundance of 87 plant species was calculated under the range of 0.00 to 2.00, 02 plant species in the range of 2.01 to 4.00, where as none of the plant species was in the range of 4.10 to 6.00 and 01 plant species in the range of 6.10 to 8.10. The maximum abundance 7.15 was estimated for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum (0.08) for the 02 plant species *Amaranthus virdis* Hook.and*Amaranthus spinosus* Linn.
4. **Relative frequency of herbs:** In rainy season**,** relative frequency was determined for 78 plant species in the range of 0.00 to 1.5, 06 plant species in the range of 1.6 to 3.00, none of the plant species was in the range of 3.1 to 4.5 and 01 plant species in the range of 4.6 to 6.0.The maximum relative frequency 5.50 was determined for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum 0.40 for the plant species. *Heteropogon contortrs* (L.) Beauv.ex Roem & Schult. and *Oxalis corniculata* Linn.
5. **Relative density of herbs:** In rainy season, Relative density was determined for 79 plant species in the range of 0.00 to 1.50, 10 plant species in the range of 1.60 to 3.00, where as none of the plant species in the range of 3.10 to 4.50 and 01 plant species in the range of 4.60 to 6.00. The maximum Relative density 5.59 was recorded for the plant species *Chlorophytum tuberosum* (Roxb.) baker and *Hyptis suaveolens* (L.) Poit. and the minimum relative density 0.08 for *Andrographis echoides* Nees.
6. **Relative Abundance of herbs:** In rainy season, Relative abundance was determined for 87 plant species in the range of 0.00 to 4.50, 02 plant species in the range of 4.51 to 9.00, where as none of the plant species in the range of 9.01 to 13.50 and 01 plant species in the range of 13.51 to 18.00. The maximum Relative abundance was 17.49 was recorded for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum 0.19 for *Amaranthus viridis* Hook. and *Amaranthus spinosus* Linn.
7. **Important value index of herbs:** In rainy season, important value index was determined for 57 plant species in the range of 0.00 to 10.75, none of the plant species in the range of 10.76 to 21.50, 02 plant species in the range of 21.51 to 32.25, 01 plant species in the range of 32.26 to 43.00. The maximum important value index 42.17 was recorded for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum 1.28 for the *Euphorbia hirta* Linn.

Table 1: Phytosociological study of Herbs in Bhupdeopur Reserve forest area of district Raigarh during Rainy season investigatged during the year 2009-2011.

S. no.	Botanical Name	Local / Vernacular Name	Family	Habitat	% Frequency	Density	Abundance	Relative Frequency	Relative Density	Relative Abundance	Important Value Index
1	*Acanthospermum hispidum* DC.	Cabi	Asteraceae	Wild	10	1.09	0.30	1.34	1.35	0.73	3.42
2	*Acorus calamus* L.	Bach	Acoraceae	Wild / Cultivated	4	0.43	0.10	0.53	0.53	0.24	1.30
3	*Ageratum conyzoides* Linn.	Lango	Asteraceae	Wild	11	1.20	0.50	1.47	1.49	1.22	4.18
4	*Alloteropsis cimicina* (L.) Stapf.	Cockatoo	Poaceae	Wild	20	2.19	2.35	2.68	2.72	5.75	11.15
5	*Aloe vera* (L.) Burm. f.	Ghrit kumari	Liliaceae	Wild / Cultivated	3	0.32	0.10	0.40	0.39	0.24	1.03
6	*Alysicarpus vaginalis* DC.	Latkana	Fabaceae	Wild	8	0.87	0.24	1.07	1.08	0.58	2.73
7	*Amaranthus spinosus* Linn.	Kanta Bhaji	Amaranthaceae	Wild / Cultivated	6	0.65	0.08	0.80	0.81	0.19	2.52
8	*Amaranthus viridis* Hook.	Chaulai Bhaji	Amaranthaceae	Wild / Cultivated	5	0.54	0.08	0.67	0.67	0.19	1.53
9	*Amorphophallus paeonifolius* (Dennst.) Nicolson	Jungli Suran	Araceae	Wild	4	0.43	0.10	0.53	0.53	0.24	1.30
10	*Anacyclus pyrethrum* (L.) Link	Akarkara	Asteraceae	Wild	5	0.54	0.12	0.67	0.67	0.29	1.63
11	*Andrographis paniculata* (Burm. f.) Wall. ex Nees	Bhui Neem	Acanthaceae	Wild	9	0.98	0.27	1.20	1.22	0.66	3.08
12	*Andrograhis echoides* Nees.	Kala Bhuineem	Acanthaceae	Wild	8	0.07	0.21	1.07	0.08	0.51	1.66
13	*Anisomeles indica* (Linn.) Kuntze	Van Tulsa	Lamiaceae	Wild	8	0.87	0.16	1.07	1.08	0.39	2.54
14	*Aristida adscensionis* L.	Buch Ghass	Poaceae	Wild	8	0.87	0.16	1.07	1.08	0.39	2.54
15	*Aristida depressa* Retz. Non Hook. F. & Thoms.	Kantabaheri	Poaceae	Wild	9	0.98	0.29	1.20	1.22	0.70	3.12
16	*Biophytum sensitivum* (Linn.) DC edgow & Hook. F.	Laxmana	Oxalidaceae	Wild	9	0.98	0.36	1.20	1.22	0.88	3.30
17	*Boerhavia diffusa* (L.) nom. Con F.	Punarva	Nyctaginaceae	Wild	7	0.76	0.14	0.93	0.94	0.34	2.21
18	*Cassia tora* Linn.	Charota	Fabaceae	Wild	15	1.64	0.85	2.01	2.04	2.08	6.13
19	*Cayratia carnosa* (Wall.) Gagnep.	Ram chana	Vitaceae	Wild	8	0.87	0.14	1.07	1.08	0.34	2.49
20	*Cenchrus setigerus* Vah.	Ghass	Poaceae	Wild	7	0.76	0.16	0.93	0.94	0.39	2.26
21	*Centella asiatica* (L.) Urban	Brahmi	Apiaceae	Wild	4	0.43	0.50	0.53	0.53	1.22	2.28
22	*Chenopodium album* L.	Bathuwa	Chenopodiacee	Wild	8	0.87	0.18	1.07	1.08	0.44	2.59
23	*Chenopodium murale* Linn.	Bada Bathuwa	Chenopodiacee	Wild	9	0.98	0.19	1.20	1.22	0.46	2.88
24	*Chlorophytum tuberosum* (Roxb.) Baker	Khonjhiri	Liliaceae	Wild	19	2.08	1.40	2.55	5.59	3.42	8.56
25	*Chloris virgata* (L.)Sw.	Bara Ghass	Poaceae	Wild	6	0.65	0.19	0.80	0.81	0.46	2.07
26	*Cleome viscosa* L.	Hur hur	Cleomaceae	Wild	15	1.64	1.36	2.01	2.04	3.32	7.37
27	*Corchorus acutangulus* Lam.	Nalta	Tiliaceae	Wild	5	0.54	0.33	0.67	0.67	0.80	2.14
28	*Costus speciosus*(Koenig) Sm.	Keokand	Zingiberaceae	Wild / Cultivated	7	0.76	0.15	0.93	0.94	0.36	2.23
29	*Crotalaria burhia* Buch. Ham.	Jungali san	Fabaceae	Wild	6	0.65	0.10	0.80	0.81	0.24	1.85
30	*Curculigo orchioides* Gaertn.	Kali musli	Hypoxidaceae	Wild	13	1.42	0.69	1.74	1.76	1.68	5.18
31	*Curcuma angustifolia* Roxb.	Tikhur	Zingiberaceae	Wild	7	0.76	0.12	0.93	0.94	0.29	2.16
32	*Curcuma amada* Roxb.	Jungali Haldi	Zingiberaceae	Wild	6	0.65	0.12	0.80	0.81	0.29	1.90
33	*Cyanotis axillaris* Roemschult.	Baghanulla	Commelinaceae	Wild	10	1.09	0.68	1.34	1.35	1.66	4.35
34	*Cynodon dactylon* Pers.	Dub Ghass	Poaceae	Wild	14	1.53	1.29	1.87	1.40	3.15	6.92

35	*Cyperus compressus* Linn.	Ghass	Cyperaceae	Wild	9	0.98	0.54	1.20	1.22	1.32	3.74
36	*Cyperus pilosus* vahl.	Ghass	Cyperaceae	Wild	9	0.98	0.75	1.20	1.22	1.83	4.25
37	*Cyperus bulbosus* Vahl.	Ghass	Cyperaceae	Wild	8	0.87	0.83	1.07	1.08	2.03	4.18
38	*Cyperus rotundus* L.	Nagar motha	Cyperaceae	Wild	7	0.76	0.65	0.93	0.94	1.59	3.46
39	*Cyperus scariosus* R.Br.	Nagaranustaka	Cyperaceae	Wild	9	0.98	0.75	1.20	1.22	1.83	4.25
40	*Cyperus triceps* (Roxb.) Endl. DC.	Nirbisi	Cyperaceae	Wild	4	0.43	0.37	0.53	0.53	0.90	1.96
41	*Cyperus iria* Linn.	Taraju ghass	Cyperaceae	Wild	8	0.87	0.57	1.07	1.08	1.39	3.54
42	*Desmodium triflorum* DC.	Kudaliya	Fabaceae	Wild	16	1.75	1.40	2.14	2.18	3.42	7.74
43	*Dioscoria alata* Linn.	Barakand	Dioscoreaceae	Wild	7	0.76	0.20	0.93	0.94	0.48	2.35
44	*Eclipta alba* (L.) Hassk.	Shring raj	Asteraceae	Wild	9	0.98	0.18	1.20	1.22	0.44	2.86
45	*Elephantopus scaber* Linn.	Mayor chundi	Asteraceae	Wild	8	0.87	0.20	1.07	1.08	0.48	2.63
46	*Elytraria acaulis* (L.f.)	Dasmori	Acanthaceae	Wild	5	0.54	0.15	0.67	0.67	0.36	1.70
47	*Eragrostris spicata* Vasey	Ghass	Poaceae	Wild	6	0.65	0.49	0.80	0.81	1.19	2.80
48	*Eremopogon fovelotus* (Delile) Stapf.	Pirichit	Poaceae	Wild	8	0.87	0.20	1.07	1.08	0.48	2.63
49	*Euphorbia dracunculoides* Lam. Boiss.	Banburi	Euphorbiaceae	Wild	4	0.43	0.15	0.53	0.53	0.36	1.42
50	*Euphorbia thymifolia* Linn.	Choti Dudhi	Euphorbiaceae	Wild	7	0.76	0.18	0.93	0.94	0.44	2.31
51	*Euphorbia hirta* Linn.	Dudhi	Euphorbiaceae	Wild	5	0.54	0.22	0.67	0.67	0.53	1.87
52	*Evolvulus alsinoides* Linn.	Shankha Pushpi	Convolvulaceae	Wild	12	1.31	0.21	1.61	1.63	0.51	3.75
53	*Glycirrhiza glabra* L.	Mulethi	Fabaceae	Wild	15	1.64	1.36	2.04	2.04	3.32	7.37
54	*Hemidesmus indicus* (L.) R. Br.	Anantmool	Periplocaceae	Wild	22	2.41	0.49	2.95	3.00	1.19	7.14
55	*Heteropogon contortus* (Linn.) Beauv. Ex Roem. Schult.	Shuklakanta	Poaceae	Wild	3	0.32	0.27	0.40	0.39	0.66	1.45
56	*Hyptis suaveolens* (L.) Poit.	Ban Tulsa	Lamiaceae	Wild	41	4.49	7.15	5.50	5.59	17.49	28.58
57	*Justicia procumbens* Linn.	Pit papara	Acanthaceae	Wild	9	0.98	0.24	1.20	1.22	0.58	3.00
58	*Ludwigia perennis* Linn.	Jal Dhawai	Onagraceae	Wild	7	0.76	0.21	0.93	0.94	0.51	2.38
59	*Lygodicun flexuosum* (Linn.) Sw.	Indraraj	Schizaecaceae	Wild	5	0.54	0.11	0.67	0.67	0.26	1.60
60	*Malva parviflora* Linn.	Panirak	Malvaceae	Wild	9	0.98	0.27	1.20	1.22	0.66	3.08
61	*Melochia corchorifolia* Linn.	Gobi	Sterculiaceae	Wild	6	0.65	0.28	0.80	0.81	0.68	2.29
62	*Mentha viridis* Linn.	Pudina	Lamiaceae	Wild / Cultivated	5	0.54	0.12	0.67	0.67	0.29	1.63
63	*Merremia emarginata* (Burm. F.)	Musakani	Convolvulaceae	Wild	18	1.97	1.85	2.41	2.45	4.52	9.38
64	*Microtyloma uniflorum* (Lam.) Verde.	Kulthi	Fabaceae	Wild	6	0.65	0.16	0.80	0.81	0.39	2.00
65	*Mimosa pudica* Linn.	Lajwanti	Fabaceae	Wild	4	0.43	0.14	0.53	0.53	0.34	1.40
66	*Ocimum basilicum* Linn.	Tulsi	Lamiaceae	Wild / Cultivated	7	0.76	0.18	0.93	0.94	0.44	2.31
67	*Oldenlandia corymbosa* Linn.	Pitpapara	Rubiaceae	Wild	6	0.65	0.13	0.80	0.81	0.31	1.92
68	*Ophioglossum reticulatum* L.	Jibhi	Ophioglossaceae	Wild	7	0.76	0.39	0.93	0.94	0.95	2.82
69	*Oxalis corniculata* Linn.	Khatti booti	Oxalidaceae	Wild	3	0.32	0.27	0.40	0.39	0.66	1.45
70	*Peristrophe bicalyculata* Nees.	Atrila	Acanthaceae	Wild	7	0.76	0.14	0.93	0.94	0.34	2.21
71	*Phyllanthus niruri* Hook. F.	Bhui amla	Euphorbiaceae	Wild	11	1.20	0.44	1.47	1.49	1.07	4.03
72	*Pluchea lanceolata* (DC.) Oliv & Hiem.	Rasna	Asteraceae	Wild	6	0.65	0.15	0.80	0.81	0.36	1.97
73	*Rumex dentatus* L.	Ambavati	Polygonaceae	Wild	6	0.65	0.16	0.80	0.81	0.39	2.00
74	*Rungia pectinata* (L.) Nees.	Kanghi	Acanthaceae	Wild	4	0.43	0.21	0.53	0.53	0.51	1.57
75	*Rungia repens* Nees.	Kharmar	Acanthaceae	Wild	10	1.09	0.45	1.34	1.35	1.10	3.79
76	*Scoparia dulcis* Linn.	Ghoda Tulsi	Scrophulariaceae	Wild	8	0.87	0.18	1.07	1.08	0.44	2.59
77	*Setaria glauca* Beavu.	Green Fox Tail	Poaceae	Wild	4	0.43	0.20	0.53	0.53	0.48	1.54

78	*Sida rhombifolia* Linn.	Lal Barela	Malvaceae	Wild	5	0.54	0.33	0.67	0.67	0.80	2.14
79	*Solanum xanthocarpum* Schrad. & H. Wendl.	Kantaki	Solanaceae	Wild	7	0.76	0.30	0.93	0.94	0.73	2.60
80	*Sphaeranthus indica* Linn.	Mundi	Asteraceae	Wild	4	0.43	0.10	0.53	0.53	0.24	1.30
81	*Spilanthes paniculata* Wall. ex DC.	Akarkara	Asteraceae	Wild	7	0.76	0.28	0.93	0.94	0.68	2.55
82	*Tridax procumbens* Linn.	Khargos ghass	Asteraceae	Wild	7	0.76	0.30	0.93	0.94	0.73	2.60
83	*Vernonia cinerea* Nees.	Sahdevi	Asteraceae	Wild	10	1.09	0.29	1.34	4.35	0.70	3.39
84	*Vetiveria zizanioides* Linn.	Birni	Poaceae	Wild	7	0.76	0.16	0.93	0.94	0.39	2.26
85	*Vicoa vestita* Benth. Ex Hook. F.	Pila Rasna	Asteraceae	Wild	5	0.54	0.22	0.67	0.67	0.53	1.87
86	*Vitis quadrangularis* Linn.	Hadjod.	Vitaceae	Wild	4	0.43	0.12	0.53	0.53	0.29	1.35
87	*Wendlendia exerta* DC.	Khel Papara	Solanaceae	Wild	8	0.87	0.38	1.07	1.08	0.93	3.08
88	*Withania somnifera* (Linn.) Dunal	Ashwagandha	Solanaceae	Wild	6	0.65	0.26	0.80	0.81	0.63	2.24
89	*Xanthium strumonium* Linn.	Chota gokharu	Asteraceae	Wild	4	0.43	0.10	0.53	0.53	0.24	1.30
90	*Zornia gibbosa* Spanoghe	Samarpari	Fabaceae	Wild	8	0.87	0.42	1.07	1.08	1.02	3.17

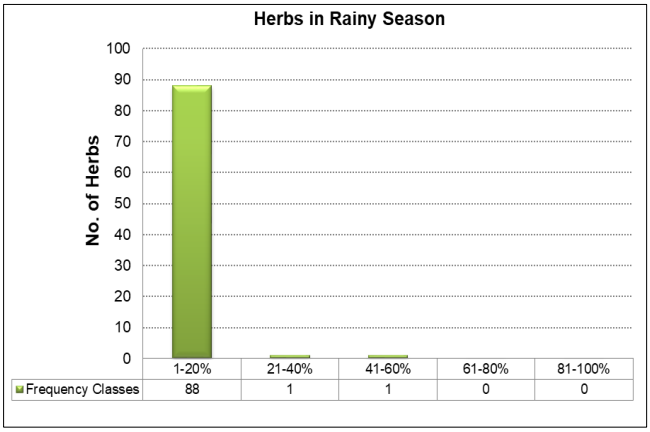


Fig 1: Seasonal Frequency of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

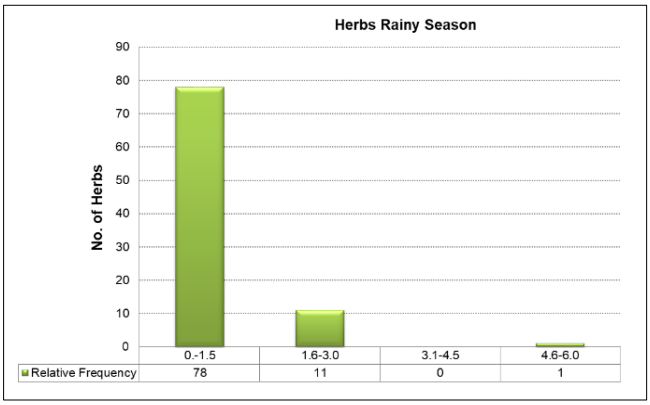


Fig 2: Seasonal Relative Frequency of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

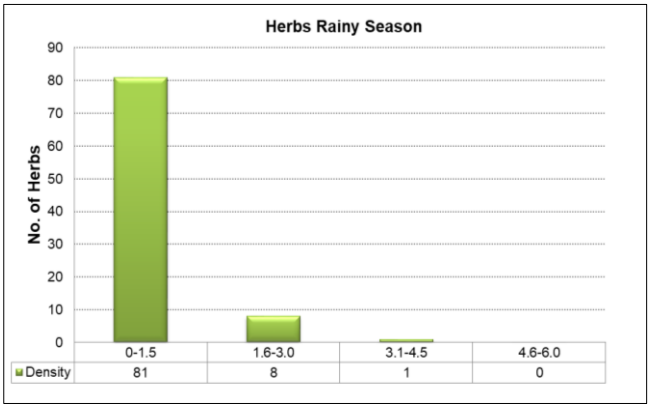


Fig 3: Seasonal Density of herbs recorded in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

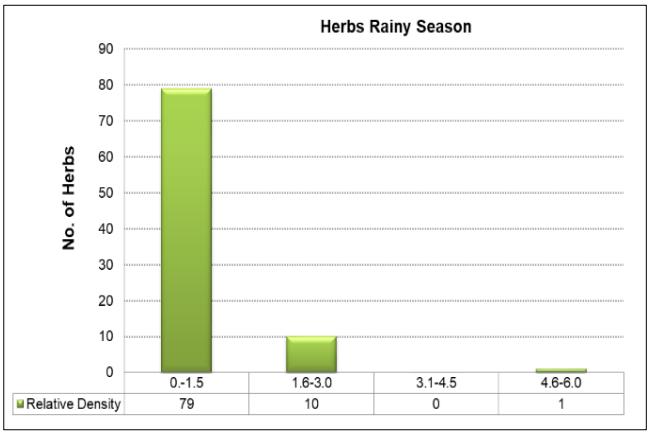


Fig 4: Seasonal Relative Density of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

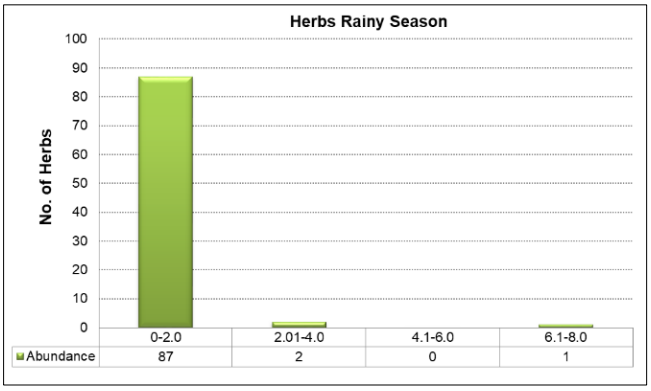


Fig 5: Seasonal Abundance of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

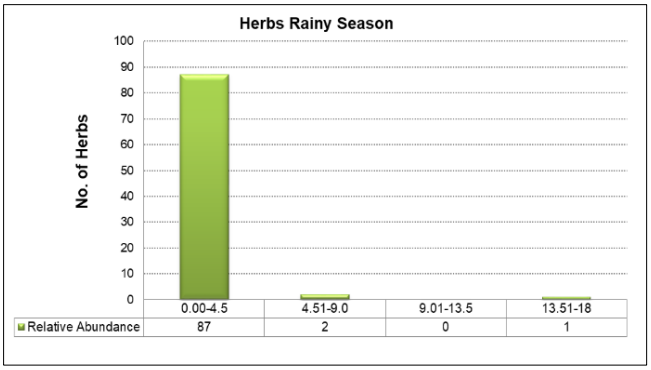


Fig 6: Seasonal relative Abundance of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

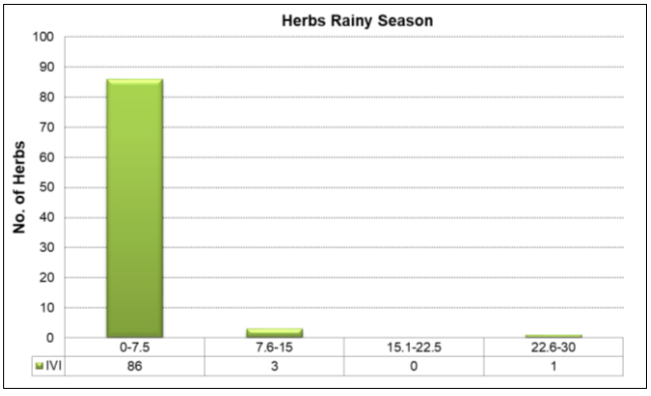


Fig 7: Seasonal Important Value Index (IVI) of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

Conclusion

The Phytosociological diversity analysis of herb layer vegetation throughout time of year clearly indicates that Bhupdeopur Reserve Forest is an especially necessary system by the virtue to richness of forest health and variety of herb species. The species that square measure vulnerable would like a lot of attention and care.

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Addition of *Butea monosperma* var. *Lutea* (Fabaceae) in the flora of district Rajnandgaon, Chhattisgarh, India

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Abstract
Golden yellow flowering *Butea monosperma* was recorded for the first time in district Rajnandgaon near Ambagarh Chowki. The plant is identified as *Butea monosperma* (Lam) Taub. Syn *B. Frondosa* Koenig Ex. Roxb.var. *lutea* (Witt) Maheshwari. The location of the plant is 20° 49' 19.1"N; 80° 44' 45.8"E. On-site observation and morphological characteristics were examined. Counseling with local peoples was done to gather its socio-economic importance.

Keywords: Chhattisgarh, golden yellow, new species, palash, taxonomy

Introduction

Butea monosperma has a place with the family Fabaceae and is commonly known as the Flame of forest. It has various local names like palas, palash, chichra, dhak, bastard teak, bijasneha, bengal kino, khakara, mutthuga (Firdaus and Mazumder, 2012) [1]. *B. monosperma* is a very slow developing deciduous tree distinguished by the trifoliolate pinnate leaves. It is naturally grown in the tropical and subtropical climate of India, Sri Lanka, Thailand, Laos, Bangladesh, Nepal, Myanmar, and Cambodia (Kandasamy & al., 2013) [2].

The different parts of plant and extract have been utilizing in Unani, homeopathy, and traditional system medicine since a long year ago. It is useful in hepatic disorder, diarrhea, ulcer, diabetes, improving memory, and abnormal menstruation. Antihelminthic, antibacterial, anti-inflammatory activities, free radical scavenging activities are likewise such properties of *B. monosperma* (Yadav & al., 2020) [3].

Flavonoids are very important naturally occurring polyphenol and are active biomolecules with medicinal values. The flower and bark of *B. monosperma* contain flavonoids such as butin, butrin, isobutrin, and butein (Chauhan and Mahish, 2020) [4].

The finding of new plant species is always excited and uncovers the magnificence of nature. Likewise gives additional way to track down its morphological, anatomical characteristics, bioactive compound, pharmacological properties, and genetic relationship among species, and so on. *Butea monosperma* var. *lutea* was reported from places around Pune, Aurangabad in Maharashtra, Jillella block of Sirsilla forests of Karimnagar, Peddagutta of Nizamabad and Kummarigudem and Mallakpally of Warangal district of Andhra Pradesh and Gujarat (Naqvi, 2001 [5]; Reddy *et al*. 2001 [6]; Patil and Mahajan, 2018 [7]). Therefore, by the present study, golden butea, *Butea monosperma* (Lam) Taub. Syn *B. Frondosa* Koenig Ex. Roxb.var. *Lutea* (Witt) Maheshwari is added in the flora of district Rajnandgaon, Chhattisgarh, India. It is very rare, declared as globally endangered medicinal plant by Conservation Assessment Management Planning Workshop for Medicinal Plants of Andhra Pradesh (Jadhav *et al*. 2001) [8].

Materials and Methods

Study area: Bandha bazaar is a small village located in the block of Ambagarh Chowki, district Rajnandgaon, Chhattisgarh state.

It is 08 km from Ambagarh Chowki and 48 km from the district headquarter.

Bandha bazaar is located 315 meters above sea level. During sampling, the temperature was 38.5°C, humidity 5%, wind 5.50 m/sec towards NW.

The study area belongs to the tropical wet and dry climate. The major population is tribal with the dominance of Gond. The residence can communicate in Hindi and Chhattisgarhi. The location of the study area is presented in Fig. 1.

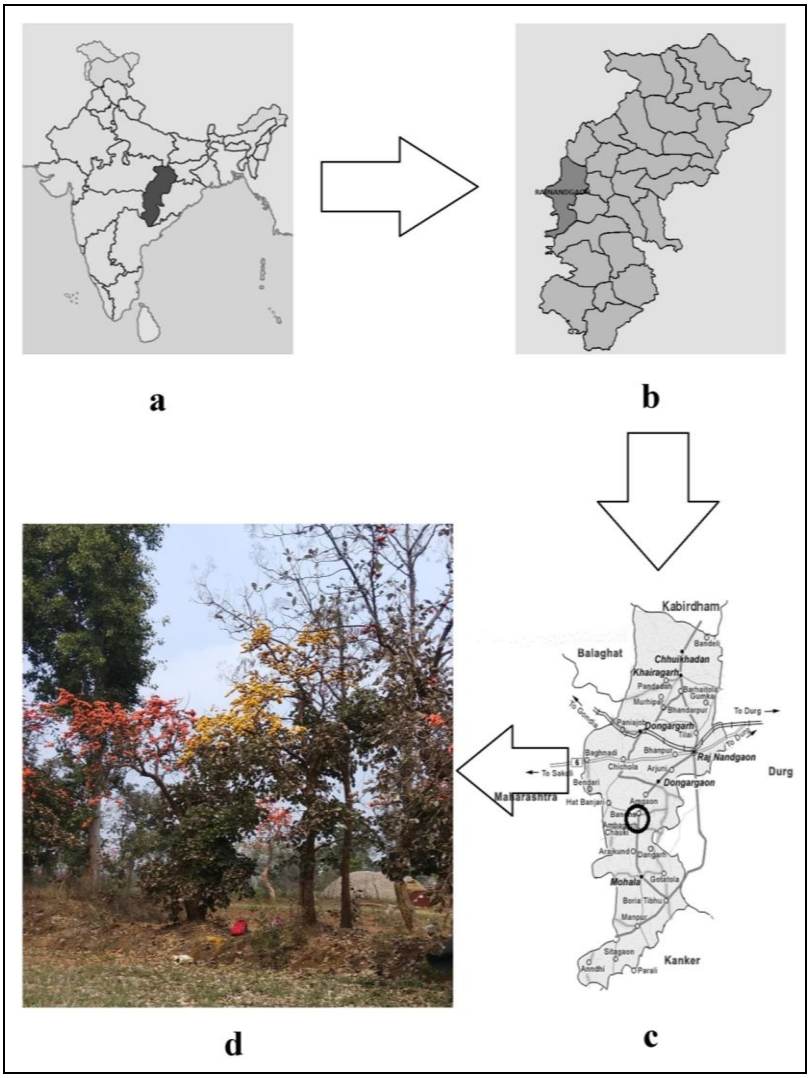


Fig 1: Location of Plant: a. Position of Chhattisgarh state in India; b. Position of district Rajnandgaon in Chhattisgarh state; c. Location of the study area in the circle; d. The Golden yellow *Butea monosperma* (Lam) Taub. Syn *B. Frondosa* Koenig Ex. Roxb.var. *lutea* (Witt) Maheshwari at 20° 49' 19.1" N; 80° 44' 45.8" E

Sample collection and identification: Plant related information was gathered from the local residents. Tree height, leave status, bark, and flower were examined at the spot. Leaves and dropped fresh yellow flowers were collected and placed in the sterile polythene bag and transported to the laboratory within 02 hours. After transport flower components were separated and its measurement was taken.

Results

A rare golden yellow *Butea monosperma* (Lam) Taub. Syn *B. Frondosa* Koenig Ex. Roxb.var. *lutea* (Witt) Maheshwari was recorded from Bandha Bazar, Block Ambagarh Chowki district Rajnandgaon, Chhattisgarh. The geographical location of the plant is 20° 49' 19.1"N; 80° 44' 45.8" E. The plant is not incorporated in the literature of flora found in Rajnandgaon district and Chhattisgarh state (Verma *et al*., 1985 [9]; Verma *et al*.1993 [10]; Mudgal *et al*. 1997 [11]; Khanna *et al*. 2001 [12]; Khanna & al., 2005 [13]). Therefore, the present collection is a new distribution and record for the flora of Rajnandgaon district, Chhattisgarh.

Taxonomic treatment

Butea monosperma (Lam) Taub. Syn *B. Frondosa* Koenig Ex. Roxb.var. *lutea* (Witt) Maheshwari. Descrip. List, N. et Ber. For. Circ. C. P. 75, 1916. Butea *lutea* Sagreiya, Indian for. 65: 560, 1939, Maheshwari, Bul. Bot. Surv. India 3(1): 91-94, 1961[14]. Figs. 2,3.

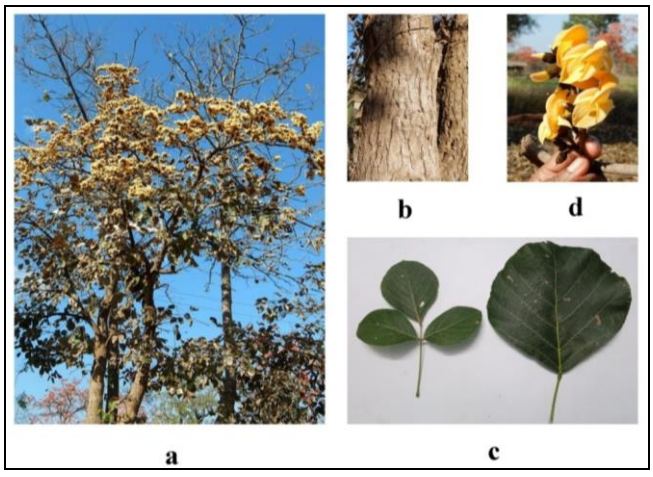


Fig 2: Plant description: **a**. The plant *Butea monosperma* (Lam.) var. *lutea* (Witt) Maheshwari; **b**. Bark of the plant; **c.** Leaflet; **d**. Inflorescence

The plant is a deciduous, erect medium-sized tree of about 24 feet long naturally grown. Stem: Usually crooked and

sometimes twisted with irregular branches and rough grey bark, rough, thick, fibrous, wound with gum, reddish exudates. Leaves: The leaves are pinnately compound with the long petiole (10-14 cm) with stipules, pulvinus leaf base; tripinnate unequal leaflets, each leaflet 15-20cm long; broadly ovate to rhomboid, glabrous; coriaceous leaflet, texture smooth in young and rough in mature; leafless while flowering; arrangement – alternate, base – cuneate; shape – rhomboid or ovate, margin – entire. Inflorescences: racemes, big and rigid 12-15 cm. Flowers: Golden yellow, bisexual, terminal or axillary; bracts small, pedicels 3cm long. Calyx: Black velvety cup shaped 1.5-1.8 cm long. Corolla: Standard ovate 5.3-6.4 x2.6-3.2 cm glabrous, acute apex, entire margin; wing petals lanceolate, 6.4-7 x 1.4-1.6 cm pubscent, base oblique, apex aucte; keel petals elliptical 6.3-7.3x 1.10-2.6 cm, base oblique, apex acute, margin entire, vexillary aestivation. Stamens: Diadelphous (9+1), filaments 5.8-7.0 cm long; anther elliptical to oblong. Ovary: Stalked oblong densely tomentose; style 5.8-6.2 cm long sparely pubescent, curved. Pod: single seeded inside a pod; pod thin stalked and oblong, green in color; silky tomentose, size 15-18 cm in length, and 3 to 4.8 cm broad. Fruit: ellipsoid, flattened, 2.5 to 3.0 cm long.

Flowering: March - April.

Fruiting: April - June.

Flowering fruiting Period: The flowering, fruiting time of *B. monosperma* (Lam.) var. *lutea* (Witt) Maheshwari is presented in Fig. 4.

Distribution*:* In India: Pune, Aurangabad in Maharashtra; Karimnagar, Peddagutta of Nizamabad and Kummarigudem and Mallakpally in Andhra Pradesh; Gujarat and Chhattisgarh.

Vernacular: Parsa (Chhattisgarhi), Palas, Palash, Chichra, dhak, Bastard Teak, Bijasneha, Bengal Kino, Khakara, Mutthuga.

Specimens examined: India, Chhattisgarh, Bandha Bazar, district of Rajnandgaon, 20° 49' 19.1 "N; 80° 44' 45.8" E.

Field note: Noted single plant from the area.

Key to the species of Butea

1. Trees, lowest flower 4-6 cm long orange red, calyx-tooth much shorter than the side ones……*B. monosperma*
2. Flowers golden yellow; pod oblong, brownish, 1 seeded….*B. monosperma* var. *lutea*
3. Woody climbers; lowest calyx-tooth equal to the side one, flowers orange scarlet……*B. superba*

Socio-economic use of Plant

According to the conversation with local peoples, the plant is socio-economically important. It acts as a host for lac insects and produces shellac. The plant is a source of earning for local peoples. Leaves are utilized for making plates, cups, native umbrellas (Khumri), and wrapping mud houses. Roots are used as small ropes for bundling of Tendu Patta (*Diospyros melanoxylon* leaves).

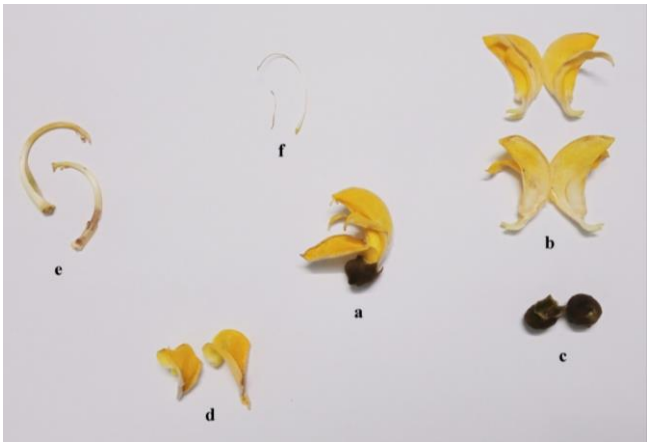


Fig 3 Flower description: a. Whole flower; b.&d. V.S. of flower; c. Calyx; e. Stamens; f. Pistil

Discussion

Leaf shape, leaf arrangement, flower color, seed shapes are some common variations found in plant species. New additions of *B. monosperma* in the flora of different locations have been previously done worldwide. These additions are based on the flower color, foliolate of the leaves, and flowering or nonflowering of the plant. Patel and Patel (2015) [15] reported a golden *B. monosperma* (Lam.) var. *lutea* from the Sabarkantha District of Gujarat State, India. A unifoliolate *B. monosperma* was observed by Rana and Nagar (2019) [16]. This plant has some other properties like it do not produce flower and fruit but gives small bracts and bracteoles only. The plant is located on agricultural land at Meghpar village, Jamnagar district, Gujarat State India. Patil and Mahajan (2018) [7] also reported golden yellow *B. monosperma* (Lam.) var. *lutea* from Bombay Pune highway at Pune. Based on the flower color, marker-related genetic diversity was studied by Vashishtha *et al*. (2013) [17]. The study notice similarity in the RAPD, SRAP markers but differences were observed in ISSR. ISSR was also used by Kandasamy *et al*. (2013) [2] for the molecular diversity among Golden yellow, Yellow, Mustard, Chrome yellow, White and Scarlet Flowering *B. monosperma* and found these plants are moderately similar.

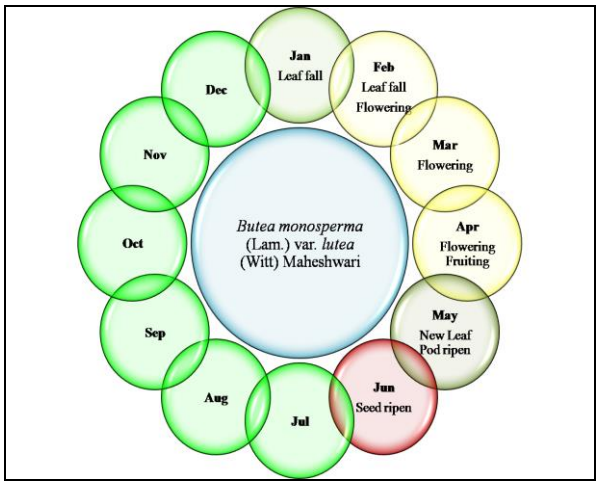


Fig 4: Cyclicity of *Butea monosperma* (Lam.) var. *lutea* (Witt) Maheshwari

Conclusion

Butea monosperma is a very essential medicinal and socio-economic important plant of local living. Variation in the same species of the plant allows contemplating it and comparing its morphological, physiological, chemical, and genetic characteristics. The plant identified in the present study is showing the variation in flower color. A similar plant was also recorded from the Gujarat and Maharashtra state of India yet not recorded in the district Rajnandgaon, Chhattisgarh.

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AEROMYCOFLORA OF PHYTOPATHOGENIC FUNGAL SPORES AT THE PERIPHERY OF RAIPUR CITY

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A Study of Aeromycoflora of phytopathogenic fungal spores at the periphery of Raipur city was conducted for one year during March 2018 to February 2019. The aeromycoflora was isolated by using gravity petriplates method. The atmosphere was rich in propagule of different fungal species. Fungal spores are widely distributed over the area, which constitute the major bioparticle component of the air. The qualitative and quantitative assessment of pathogenic fungal spores would be useful for diseases forecasting system. Survey was carried out in six outdoor sites situated at rural and semi urban areas at the periphery of Raipur city.

A total of 48 species belonging to 20 fungal genera in addition to two sterile types were isolated and identified on the basis of colony morphology, mycelia and spore structure. *Alternaria alternata*, *Aspergillus niger*, *Acremonium strictum*, *Cladosporium cladoporioides*, *Curvularia lunata*, *C. oryzae*, *Fusarium oxysporum* and *Penicillium* species were found in all the sites throughout the year which were known to be the major airborne fungi causing various disease in plant (crop and vegetables) like *Fusarium* wilt, collar rot, *Alternaria* blight, *Colletotrichum* blight, downy mildew, powdery mildew, *Phoma* blight, sheath and collar rot in winter season and blast and brown spot in rainy season. Major fungal diseases harm the crops and vegetables, which also effect the production of crops (5% - 8%) and in vegetable (7% to 10%) in study area.

Keywords: Aeromycoflora, phytopathogenic fungal spores, Crop plant, Raipur city.

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INTRODUCTION

Dispersal in air is one of many mechanisms by which plant pathogens can spread to reach new susceptible plants either within the same field or even in a completely different continent[1-3]. Gregory (1973)[2] predicted that most spores of plant pathogens do not disperse beyond the field in which they were produced. Although this short-distance dispersal can be important for disease epidemics by infection of new plants in the same field or adjacent fields around inoculum sources, longer distance dispersal is also of great significance in allowing spores to reach new locations.

The composition of airborne fungal spores in outdoor environments is influenced by local weather which affects the biology of the fungi and the dispersion of their reproductive propagules. An intensive study and established the relationship between aerobiology and plant diseases and emphasized its role in forecasting the disease[4-5]. It is now the time that, people think and plan to utilize all resources, for aerobiological monitoring prediction and warning into a scheme of optimum value of human and plant population. Studies on fungal components of periphery of Raipur city are useful in understanding plant pathogen and in establishing the forecasting system for diseases control and the survey of aeromycoflora has assumed a great significance. The study of aeromycoflora of a particular region provides the clear view about interaction of fungal spores in the form of disease on plants as well as occurrence of allergy in human being.

Raipur is the capital of Chhattisgarh state. The major occupation of the rural area of Chhattisgarh is farming, where the major crops are rice and chickpea. The study of aeromycology is essential in plant pathology and in disease forecasting of plant diseases. The bio component occurring in aeromycoflora of rural area adjoining to Raipur needs to be analyzed qualitatively and quantitatively as they are the main cause of diseases in plants. Seasonal variation affects aeromycoflora of the area

Keeping this in view, the present investigation deals with the study of aeromycoflora occurrence at the periphery of Raipur city, its correlation with the diseases in plant for better understanding of the deposition and dissemination patterns of fungal spores.

MATERIALS AND METHODS

Study sites

The study sites of present studies are Chandanidih, Zora, Boriakala, Dhaneli, Baronda and Dumartarai. All the sites are a rural agricultural village, located 10 to 20 km away from periphery of Raipur city. The village occupies 1.0-1.5 km^2 area with a population of 4000-4500 people. The village economy is mostly (75%) dependent on agriculture and cattle farming. Many food crops viz, paddy, wheat, sugarcane, ground nut, maize, along with seasonal crops are cultivated. However, during recent years, the cropland has been decreasing due to urbanization.

Sampling Method

In the present study, six different outdoor sites were selected for sampling Aeromycoflora *i.e.* Chandanidih, Zora, Boriakala and Dhaneli, Baronda and Dumartarai. The study was carried out during March 2018 to February 2019. The culture plate exposure method was adopted for trapping the mycoflora. Potato dextrose agar (PDA) was used as culture medium.

10 ml of sterilized PDA medium was aseptically poured in petriplates and allowed to solidify. Five petriplates containing PDA medium were exposed in the air for 5-10 minutes at 1 meter above the ground level at the sampling sites. The study was conducted in intervals of 15 days in every month. The exposed petridishes were sealed with the help of cello tape and brought to the laboratory and incubated for 3-6 days at 26 ± 1ºC. After incubation fungal colonies were counted, isolated and identified with the help of standard literature[6-7]. For identification at species level, microscopic slides were prepared using glycerin gel as mounting media and lacto phenol and cotton blue stain[8].

A questionnaire survey along with interview was conducted in a population of 300 farmers and 4 agriculture officers to get an overall idea about the fungal diseases on crop vegetation in the study area. Season of crop growing, crop production, crop loss, disease prevalence, precautions taken and treatment process are noted during the survey.

RESULTS AND DISCUSSION

The fungal concentration and its variation in the air of the periphery of Raipur city are represented in Table 1. A total of 48 species belonging to 20 fungal genera in addition to two sterile types were recorded from all six sites. Out of six study sites, highest of 199 fungal species were recorded from Baronda and Dumartarai (118 fungal species) followed by Zora (94 fungal species), Dhaneli (94 fungal species), Chandanidih (87 fungal species) and Broiakala (81 fungal species) during the present study periods (Figure 1). A majority of fungi were members of anamorphic fungi (35 fungal species), while seven fungal species from Ascomycotina, four fungal species from Zygomycotina and two species of mycelia sterilia was recorded in all the site (Figure 2). Seasonal variation of aeromycoflora was also observed. *Aspergillus, Cladosporium, Alternaria, Curvularia, Fusarium, Acremonium and Penicillium* species found dominant throughout the season in every month. *Phoma pomorum* and *Thielavia terricola* was found as least frequent fungi. In summer, 44 fungal species belonging to 17 fungal genera were recorded. In rainy season, 44 fungal species belonging to 17 fungal genera and in winter, 45 fungal species belonging to 18 fungal genera were recorded. The genera recorded mainly comprised with *Cladosporium*, *Aspergillus*, *Curvularia* and *Alternaria* as dominating types in all the sites. In winter, the number of airborne fungal spores increased and climatic condition was favourable to cause disease in some plants. The probable reason for the severity and spread of the diseases was because of continuous rainfall, alternate cloudy weather, humidity and slow wind, soil condition, etc. Such meteorological condi-

tions favour the pathogen attack in plants. The air-borne spore load and infection was reported to have inverse correlation with the mean annual rain-fall[9].

Table 1: Aeromycoflora of phytopathogenic fungi at the periphery of Raipur city

SN.	Name of Aeromycoflora	Name of the study sites																	
		Chandanidih			Zora			Boriakala			Dhaneli			Baronda			Dumartarai		
		Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter
	Zygomycotina																		
1.	*Absidia spinosa*	-	+	+	-	-	-	-	+	+	-	-	-	+	-	-	+	+	+
2.	*Mucor cymosus*	-	+	+	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+
3.	*Mucor* sp.	+	+	+	+	+	-	+	+	+	+	+	-	+	+	-	+	+	+
4.	*Gongronella butleri*	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+
	Ascomycotina																		
1.	*Emericella nidulans*	-	-	-	-	+	-	-	+	+	-	+	+	+	+	+	+	+	+
2.	*Khuskia oryzae*	-	-	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
3.	*Phoma destructive*	-	+	+	+	-	-	-	-	-	-	+	+	+	+	+	-	-	+
4.	*Phoma glomerate*	+	-	+	-	-	-	-	+	-	-	-	-	-	+	+	+	+	+
5.	*P. pomorum*	-	-	+	-	+	+	+	-	-	+	+	-	-	+	+	+	-	-
6.	*Phomosis vexans*	-	-	+	-	+	+	-	+	+	-	-	+	+	+	+	-	+	-
7.	*Thielavia terricola*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-
	Anamorphic fungi																		
1.	*Alternaria alternate*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2.	*A. tenuissime*	+	-	-	-	+	+	-	+	-	-	-	+	+	+	+	+	+	-
3.	*A. crassa*	+	+	+	+	-	+	+	-	+	+	+	+	-	+	+	+	+	+
4.	*A. redicina*	-	-	+	-	-	+	+	+	+	-	-	+	+	+	+	+	+	+
5.	*A. citri*	+	+	+	+	+	+	-	-	+	+	+	+	-	+	+	-	+	+
6.	*Aspergillus niger*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
7.	*A. flavus*	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	-	+	+
8.	*A. oryzae*	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
9.	*A. fumigates*	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	-	+	+
10.	*A. nidulans*	-	-	+	-	+	-	+	+	-	-	+	+	+	-	+	+	+	+

11.	*A. sclerotiorum*	-	-	+	-	+	+	-	+	+	-	-	-	-	+	+	+	+	+
12.	*A. stellatus*	+	-	-	+	-	-	-	-	-	-	-	-	+	-	-	+	-	-
13.	*A. terreus*	-	-	+	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+
14.	*A. versicolor*	-	-	+	+	+	+	-	-	+	+	+	-	+	+	+	+	+	+
15.	*Acremonium strictum*	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+
16.	*A. implicatium*	-	-	+	-	+	-	-	-	-	+	+	-	+	-	+	+	+	+
17.	*A. terricola*	-	-	+	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+
18.	*Cladosporium* sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
19.	*C. cladosporiodes*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
20.	*C. oxysporum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
21.	*Curvularia lunata*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
22.	*C. clavate*	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	-	+	+
23.	*C. tritici*	-	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+
24.	*C. oryzae*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
25.	*Drechslera tetramera*	-	-	+	-	-	+	-	-	+	-	+	+	+	+	+	-	-	+
26.	*D. australiensis*	-	-	+	-	-	+	-	-	-	-	+	+	-	-	+	-	-	+
27.	*Fusarium* sp.	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+
28.	*F. oxysporum*	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
29.	*F. pallidoroseum*	+	+	+	+	+	+	+	-	+	-	-	-	+	+	+	+	+	+
30.	*F. moniliformis*	+	+	+	+	+	+	-	-	-	-	+	-	-	+	+	+	+	+
31.	*Monilia fructigena*	+	-	-	+	-	-	+	-	-	+	+	+	+	+	+	+	+	+
32.	*Penicillium* sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
33.	*P. purpurogenum*	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+	+
34.	*Nigrospora oryzae*	-	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+
35.	*Tricoderma* sp.	-	-	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+
	Mycelia sterilia																		
1.	*Mycelia sterilia white*	-	-	+	-	-	-	+	-	+	-	-	-	-	-	+	-	-	-
2.	*Mycelia sterilia black*	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	+
Total		**22**	**25**	**40**	**28**	**33**	**34**	**21**	**30**	**30**	**25**	**36**	**33**	**36**	**39**	**34**	**37**	**40**	**41**
Grand total		**87**			**95**			**81**			**94**			**199**			**118**		

(+) indicates presence of fungal species, (-) indicates absence of fungal species.

In winter, *Fusarium* wilt, collar rot, downy mildew, powdery mildew, *Alternaria* blight, *Colletotrichum* blight, *Phoma* blight, sheath and collar rot were recorded as plant (crops and vegetables) diseases. However, blast and brown spot diseases were recorded in rainy season and summer in the present survey. The impact of vegetation and crop field on saprophytic microflora in air was well emphasized[10] and application of this knowledge would be one of the best strategies of plant disease control[11].

In this study, *Aspergillus* was observed as most frequent and dominant species. Similar result was

found by earlier researchers in the air at Raipur[12-15] and different places like Aurangabad[16], Kanpur[17] and Nagpur[18]. Similarly, *Cladosporium* were reported as predominant and most frequent fungi at Raipur[19] and different places like Nagpur[18] and Rohtak[20]. Similarly, *Curvularia* was most frequent species observed by earlier workers. Bhatt *et al,* (2009)[21] reported *Curvularia lunata* as dominant causal agent of glume discoloration of rice in Kashmir valley. Sreeramulu and Ramalingam (1966)[22] and Ahire *et.al*. (2007)[23] recorded *Cladosporium* sp as "universal dominant". Khailare and Chitnavis (2002)[24] reported that *Aspergillus niger, Alternaria and Cladosporium* sp. were also the most frequent fungal species of slum and descent area of Kolhapur. Uddin (2004)[25] reported that *Penicillium* and *Aspergillus* were most frequent in airspora, along with *Aspergillus niger, Cladosporium oxysporum* and *Alternaria alternata.* In this way, it is evident that the seasonal variation as well as meteorological conditions affects the fungal flora of the environment both qualitatively and quantitatively. The present study provides the qualitative and quantitative feature on aeromycoflora at the periphery of Raipur city.

CONCLUSION

Through questionnaire survey along with interview of farmers and field agriculture officers, it was found that fungal spores cause disease in crop plants and vegetables in the study area. *Fusarium* wilt, collar rot, downy mildew, powdery mildew, *Alternaria* blight, *Colletotrichum* blight, *Phoma* blight, sheath and collar rot were the common plant diseases in winter, whereas blast and brown spot disease were common in rainy season and summer.

Pathogenic infection by *Fusarium, Alternaria, Cladosporium, Phoma, Aspergillus* etc. has been recorded in the present study. The spores of anamorphic fungi were the large contributors of the total air borne fungal spores. Thus *Aspergillus, Cladosporium, Alternaria,* and *Curvularia,* which were dominant in all the sites also recorded in higher concentrations the air. Monitoring of air borne fungi can be helpful in prevention of fungal diseases. Experimental survey proves that higher concentration of pathogenic fungal spores in the atmosphere can initiate diseases in plant. The systemic characters will help to develop diagnostic keys supplemented with information on symptoms of diseases, its extent of damage and distribution and management strategies. Present survey showed Carbendazim, Propiconozol and Hexaconozol to be most effective antifungal agents used by farmers in different crop plants. For precaution measure, proper treatment of seed, bund cleaning and use resistant variety, before sowing the seed will be helpful. Moreover, extensive studies should be undertaken to find out the allergenic fungi over such crop field which are implicated in causing different hypersensitive reactions among agriculture workers.

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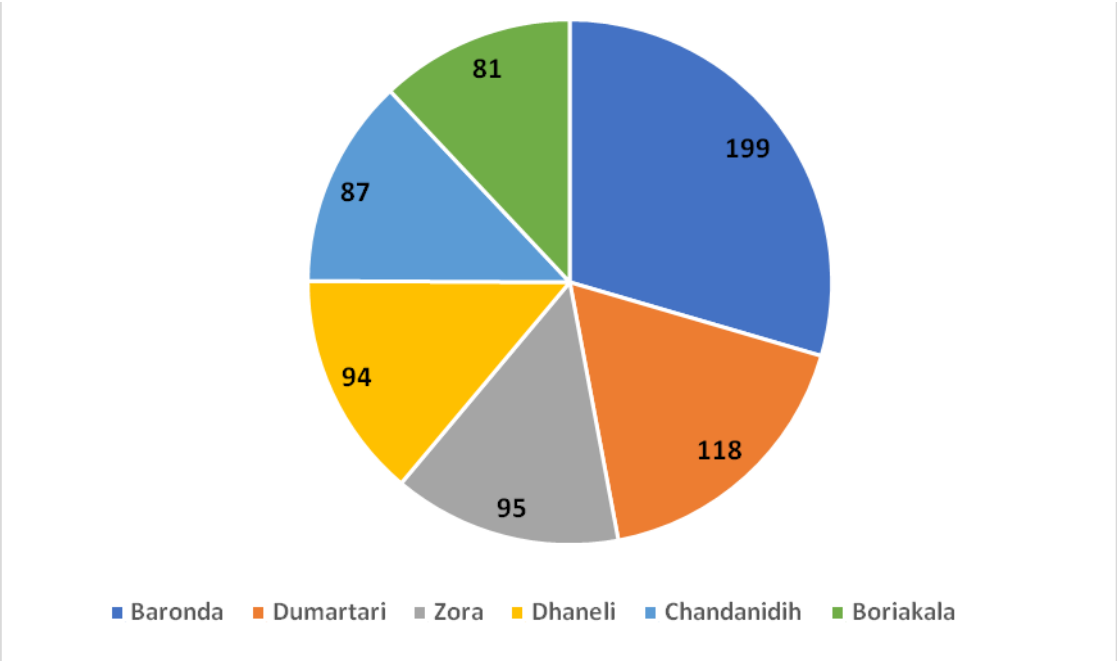


Fig. 1: Occurrence of fungal species in Raipur city

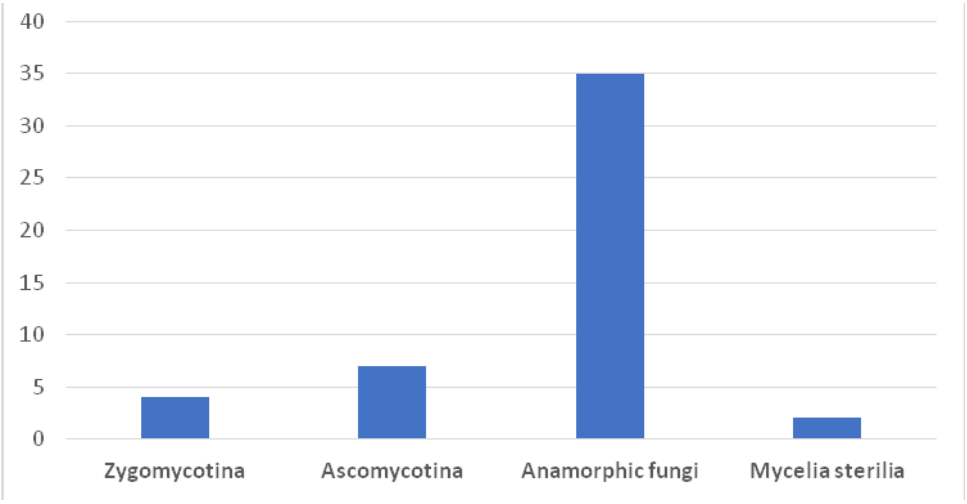


Fig. 2. Classwise distribution of fungal species in Raipur city

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Allelopathic potential of *Parthenium hysterophorus* on wheat, *Triticum aestivum*. rice, *Oryza sativa*, soybean, *Glycine max* and pigeonpea, *Cajanus cajan*

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ABSTRACT

Allelopathic effects of *Parthenium hysterophorus* were studied on seed germination and seedling growth of *Triticum aestivum*, *Oryza sativa*, *Glycine max* and *Cajanus cajan*. The shade dried leaves of *Parthenium hysterophorus* were soaked in distilled water for 24 hours at room temperature to obtain aqueous extract and sterilized seeds were treated with 2%, 4%, 6%, 8% and 10% concentration of *P. hysterophorus* leaves aqueous extract. The germinated seeds were counted every day to observe mean germination time. It has been found that significant time is taken to germinate with increasing concentration. It has been also observed that germination percentage, root length, shoot length and seedling vigour value were reduced at >2% as compared to control. The 10 % aqueous extract showed the maximum inhibitory effect on seedling growth. In the present investigation, the leaves aqueous extract of *P. hysterophorus* had strong inhibiting effects on seed germination and seedling growth. It is necessary to keep this weed under check at the emerging stage at agro crop field so that crop growth constraint may be avoided.

Figures : 07 References : 19 Tables : 04
KEY WORDS : Allelopathy, Aqueous extract, Mean germination time, *Parthenium hysterophorus* L., Seed germination, Seedling growth.

Introduction

The term allelopathy, from the Greek-derived compounds allelo- and -pathy (meaning “mutual harm” or “suffering”), was first coined and defined the term allelopathy in 1937 by Hans Molisch. Allelopathy is a phenomenon involving either direct or indirect and either beneficial or adverse effects of a plant (including microorganisms) on another plant through the release of chemicals in the environment[16]. Allelochemicals are the secondary metabolites produced by plants and are products of primary metabolic processes. Allelopathic substances released by the plants accumulate in the soil to physiologically active levels. *Parthenium hysterophorus* L. (Family - Asteraceae) is an alien annual herbaceous weed; allelopathic properties cause suppression of natural vegetation and severely affect the crop plants posing a strong threat crop production and bio-diversity. Aqueous extract[10,15] of *Parthenium hysterophorus* shows the inhibitory effect on of plant growth different species. The plant releases the number of allelochemicals to surround such as phenolic acids, sesquiterpene, lactones especially Parthenin[10,18]. Plants release phytochemicals from dead tissues and their incorporation to the soil could be accelerated by leaching thus facilitating their harmful effects in the agro crop. *Parthenium hysterophorus* L. produce allelochemicals that suppress the production of crops[9]. *Triticum aestivum* L, *Oryza sativa* L., *Glycine max* L. and *Cajanus cajan* L. are the most widely consumed agro crop in India. The weed infestation is recognized is a serious biological suppression to total crop production. Therefore the allelopathic potential of leaf aqueous extracts of abnoxious *Parthenium hysterophorus* L. on the germination and early growth of above mentioned agro crop plants were investigated in the laboratory.

Materials and Methods

Sample Collection and Preparation of Plant Extracts

Fresh *P. hysterophorus* plants were collected from the agriculture field of Durg district of Chhattisgarh and was brought to the laboratory. Thenafter washed thoroughly with water and it was kept to dry in shade for ten days. Leaf samples were separated, powdered and stored in plastic bottles at room temperature (average

ACKNOWLEDGEMENTS : We would like to thank UGC CRO, Bhopal for financial assistance and also thanks to Principal of our Institute and Head of Department for providing lab facilities.

TABLE-1 : Effect of Leaf aqueous extract of *Parthenium hysterophorus* on germination & seedling growth of Wheat

Conc. %	Germination %	GI	MGT	Root Length (cm)	Shoot Length (cm)	SVI	Biomass
Control	100	6.72	1.9	19.15	12.05	1915	0.35
2%	63.33	4.08	1.88	11.45	8.51	528.23	0.21
4%	50	2.22	2.95	10.76	6.77	534.66	0.27
6%	36.67	2.52	2.27	8.93	4.44	306.4	0.2
8%	30	1.74	3.33	6.97	2.21	256.63	0.11
10%	NG	NG	NG	NG	NG	NG	NG
F Value	21.18	17.64	11.34	198	169.2	33.11	66.16
LSD 0.05%	15.95	0.287	0.52	2.36	0.73	257.04	1.25

GI= Germination Index, MGT = Germination Mean Time, SVI = Seedling Vigour Index.

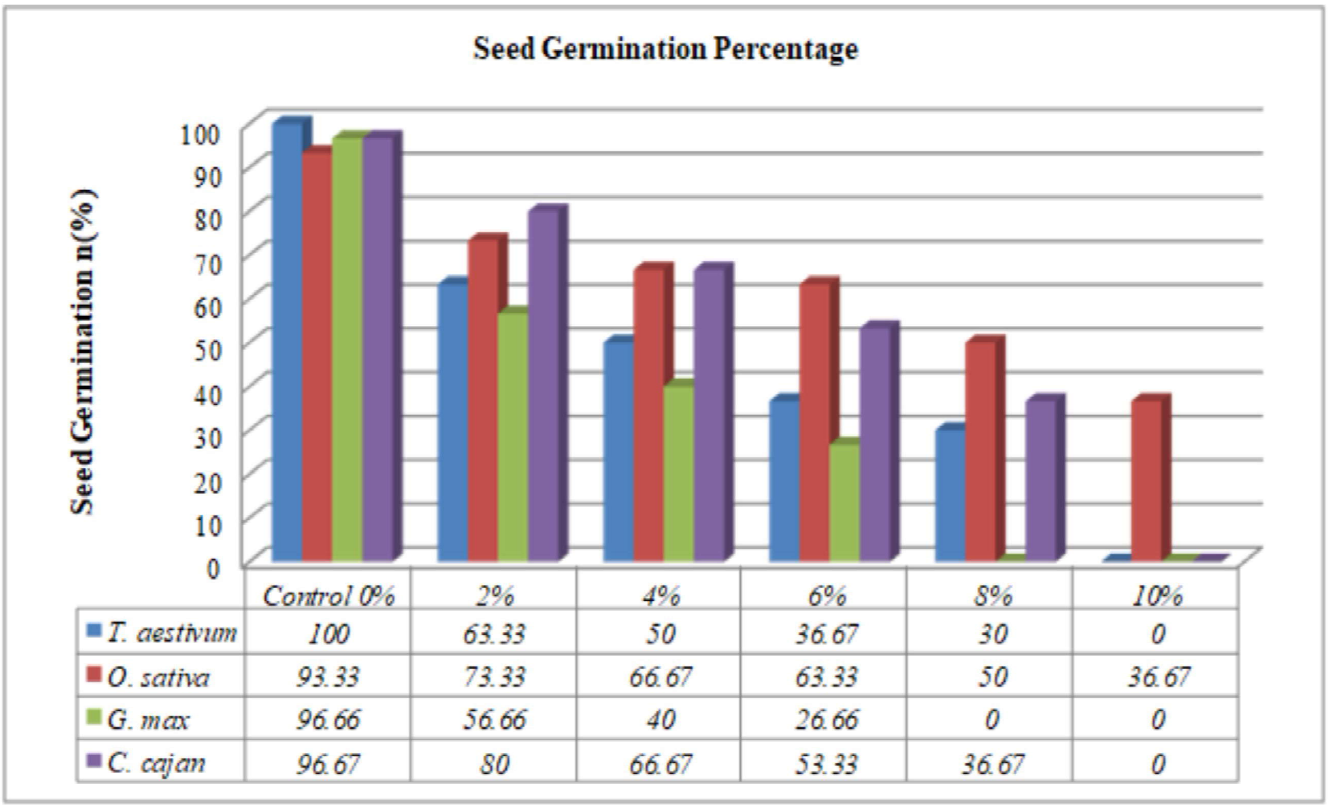


Fig. 1: Effect of leaf aqueous extract of *Parthenium hysterophorus* on seed germination percentage of test plant species

TABLE-2 : Effect of Leaf aqueous extract of *Parthenium hysterophrus* on germination & seedling growth of Rice

Conc. %	Germination %	GI	MGT	Root Length (cm)	Shoot Length (cm)	SVI	Biomass
Control	93.33	2.49	3.85	7.3	6.16	680	0.596
2%	73.33	1.91	4	7.53	5.19	553	0.396
4%	66.67	1.7	4.14	6.82	5.82	455	0.28
6%	63.33	1.52	4.28	6.28	4.71	399.16	0.173
8%	50	1.26	4.08	5.24	4.28	262.53	0.136
10%	36.67	0.89	4.22	4.7	4.13	175.1	0.083
F Value	18.63	17.6	1.13	38.5	30.8	35.41	186.18
LSD 0.05%	9.83	0.29	NS	0.39	0.32	67.79	0.039

GI= Germination Index, MGT = Germination Mean Time, SVI = Seedling vigour Index. NS =Not Significant

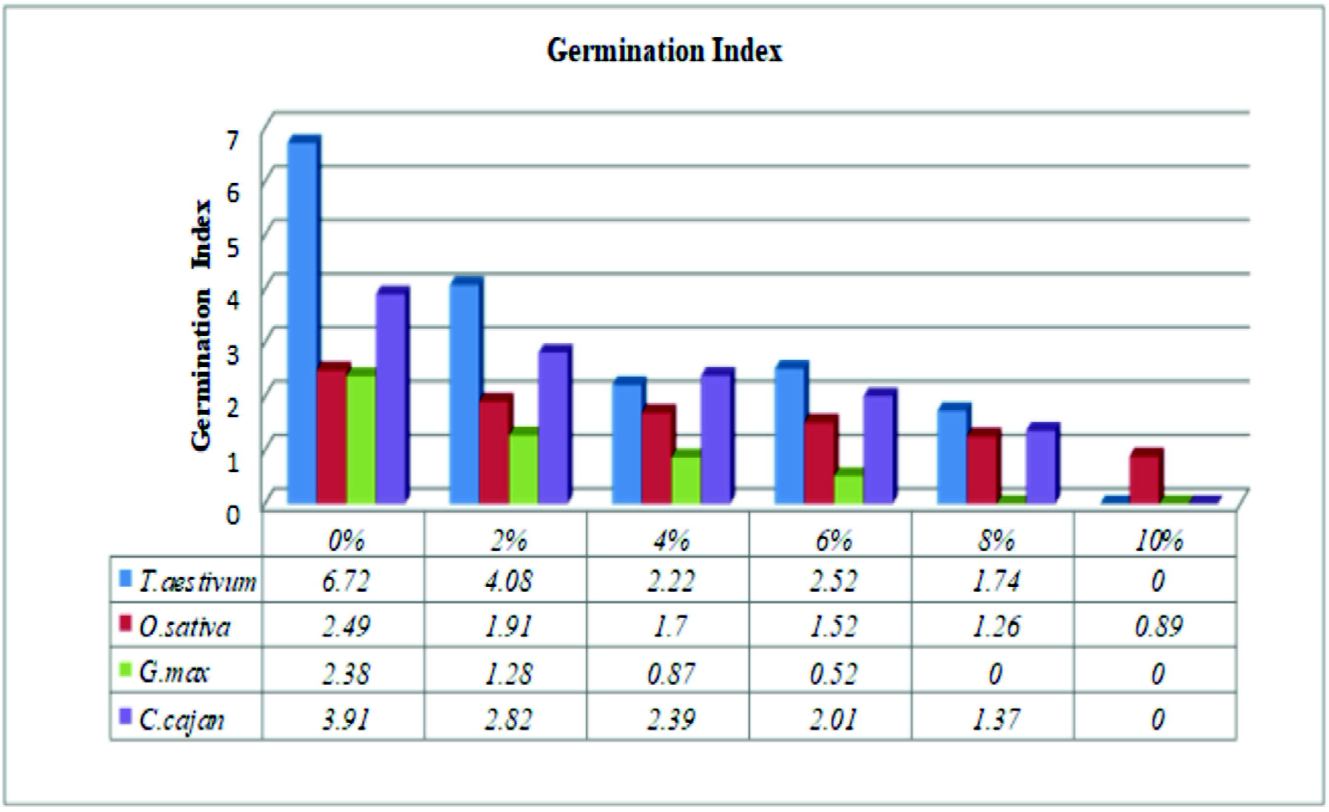


Fig. 2: Effect of leaf aqueous extract of *Parthenium hysterophorus* on germination index of test plant species

TABLE-3 : Effect of Leaf aqueous extract of *Parthenium hysterophorus* on germination & seedling growth of Soybean

Conc. %	Germination %	GI	MGT	Root Length (cm)	Shoot Length (cm)	SVI	Biomass
Control	96.67	2.38	3.89	8.66	7.13	835.66	0.57
2%	56.67	1.28	4.6	2	0.63	113.33	0.41
4%	40	0.87	4.89	0.7	0.46	28.33	0.35
6%	26.67	0.52	5.21	0.43	0.36	12	0.2
8%	NG	NG	NG	NG	NG	NG	NG
10%	NG	NG	NG	NG	NG	NG	NG
F Value	81	58.38	75.6	488	558	3040	243.3
LSD 0.05%	8.89	0.25	0.61	0.33	0.26	0.148	0.039

GI= Germination Index, MGT = Germination Mean Time, SVI = Seedling Vigour Index.

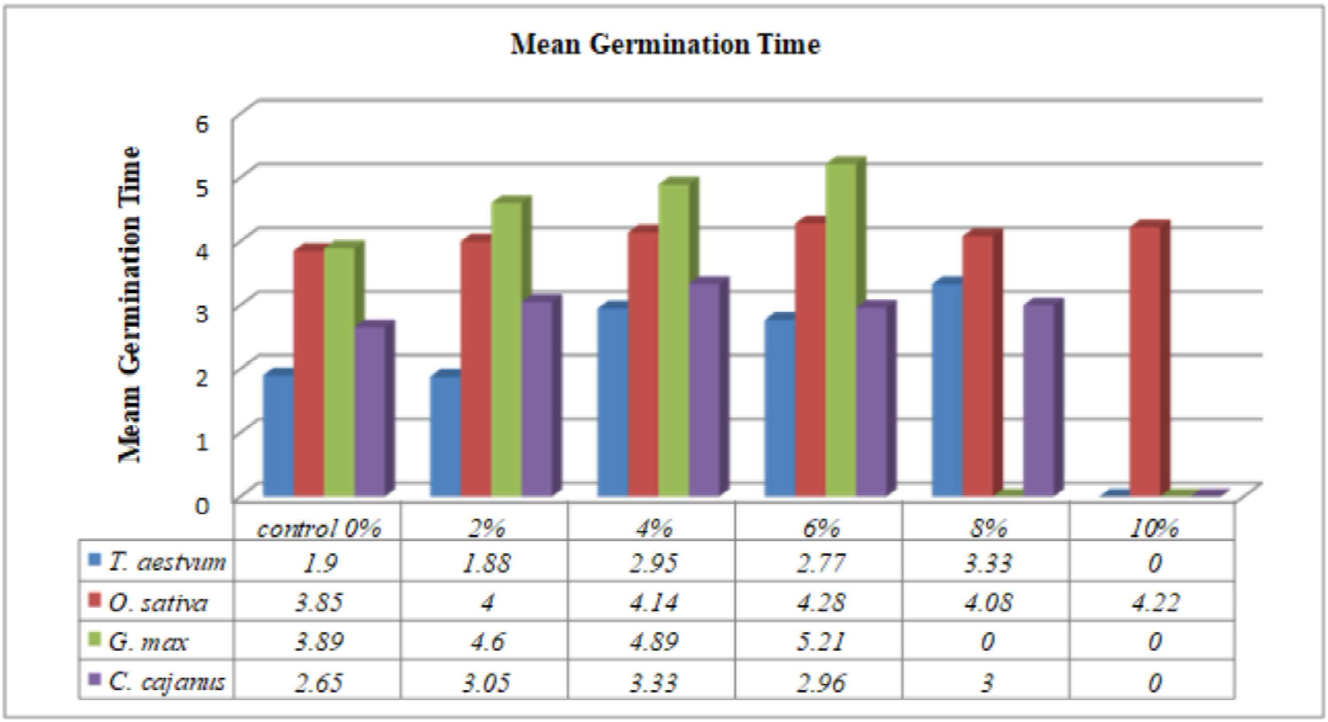


Fig. 3: Effect of leaf aqueous extract of *Parthenium hysterophorus* on mean germination time of test plant species

TABLE-4 : Effect of Leaf aqueous extract of *Parthenium hysterophrus* on germination & seedling growth of pigeon pea

Conc. %	Germination %	GI	MGT	Root Length (cm)	Shoot Length (cm)	SVI	Biomass
Control	96.67	3.91	2.65	4.28	3.1	412	0.8
2%	80	2.82	3.05	3.58	2.68	285	0.61
4%	66.67	2.39	3.33	3	2.47	198	0.52
6%	53.33	2.01	2.96	2.57	1.8	136.33	0.44
8%	36.67	1.34	3	1.67	1.29	60.33	0.32
10%	NG	NG	NG	NG	NG	NG	NG
F Value	48.67	13.93	10.38	214.42	39.22	103	304.9
LSD 0.05%	10.69	0.77	0.84	0.22	0.39	32.33	0.04

GI= Germination Index, MGT = Germination Mean Time, SVI = Seedling Vigour Index.

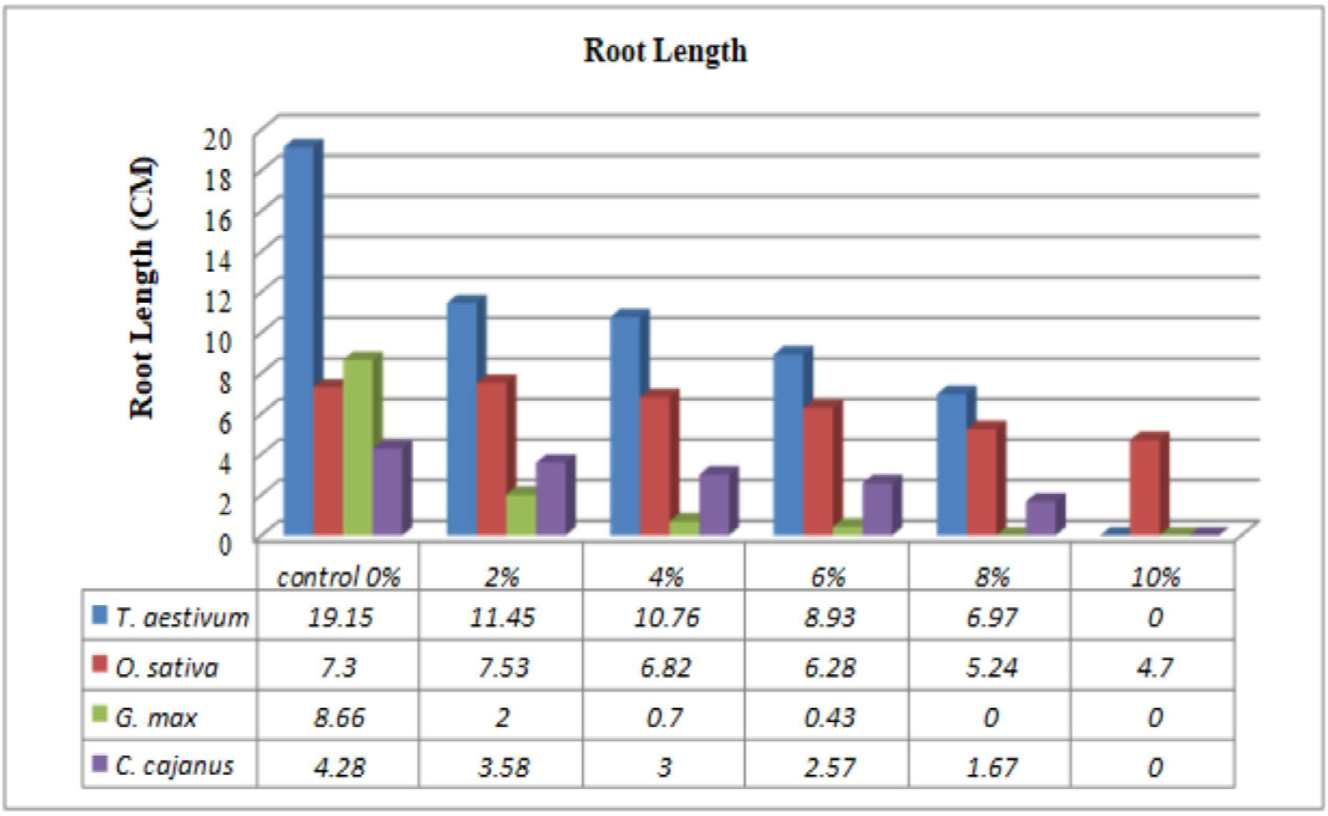
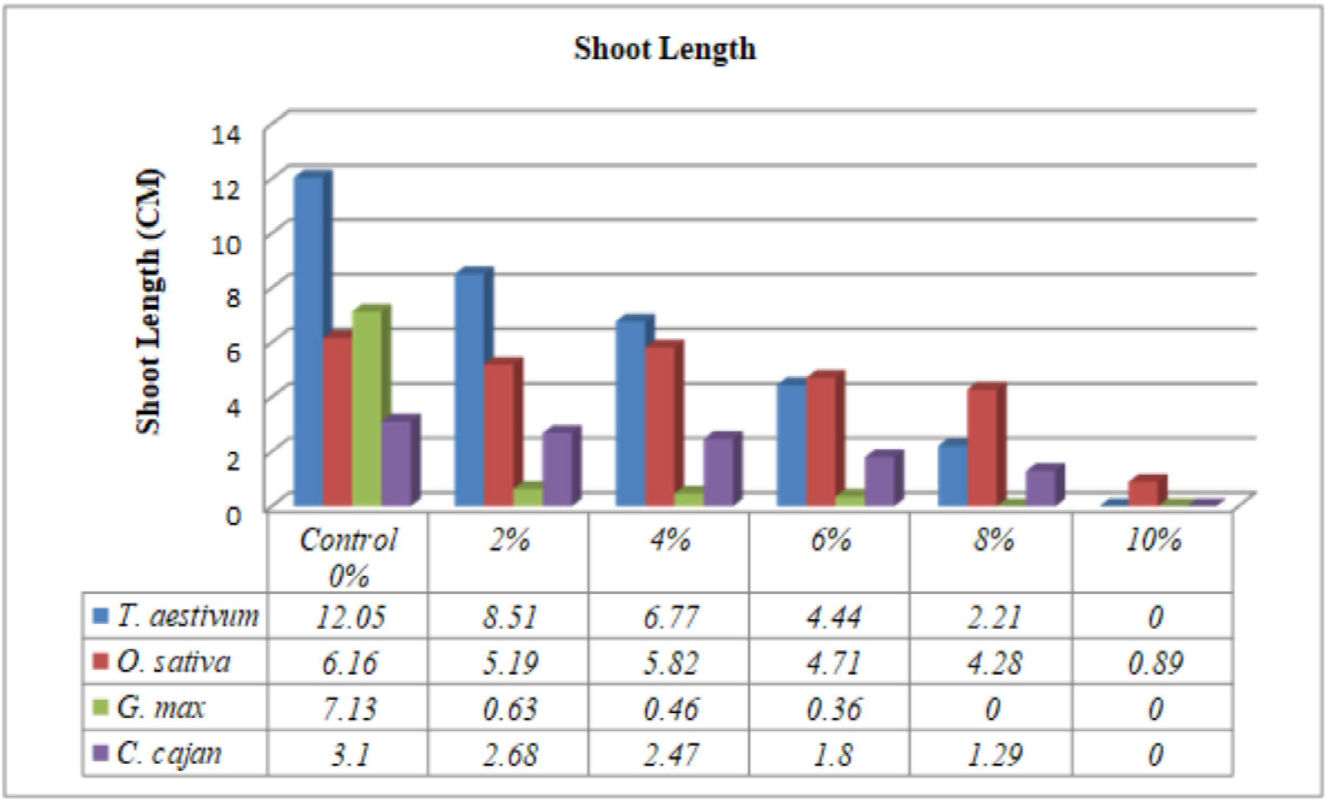
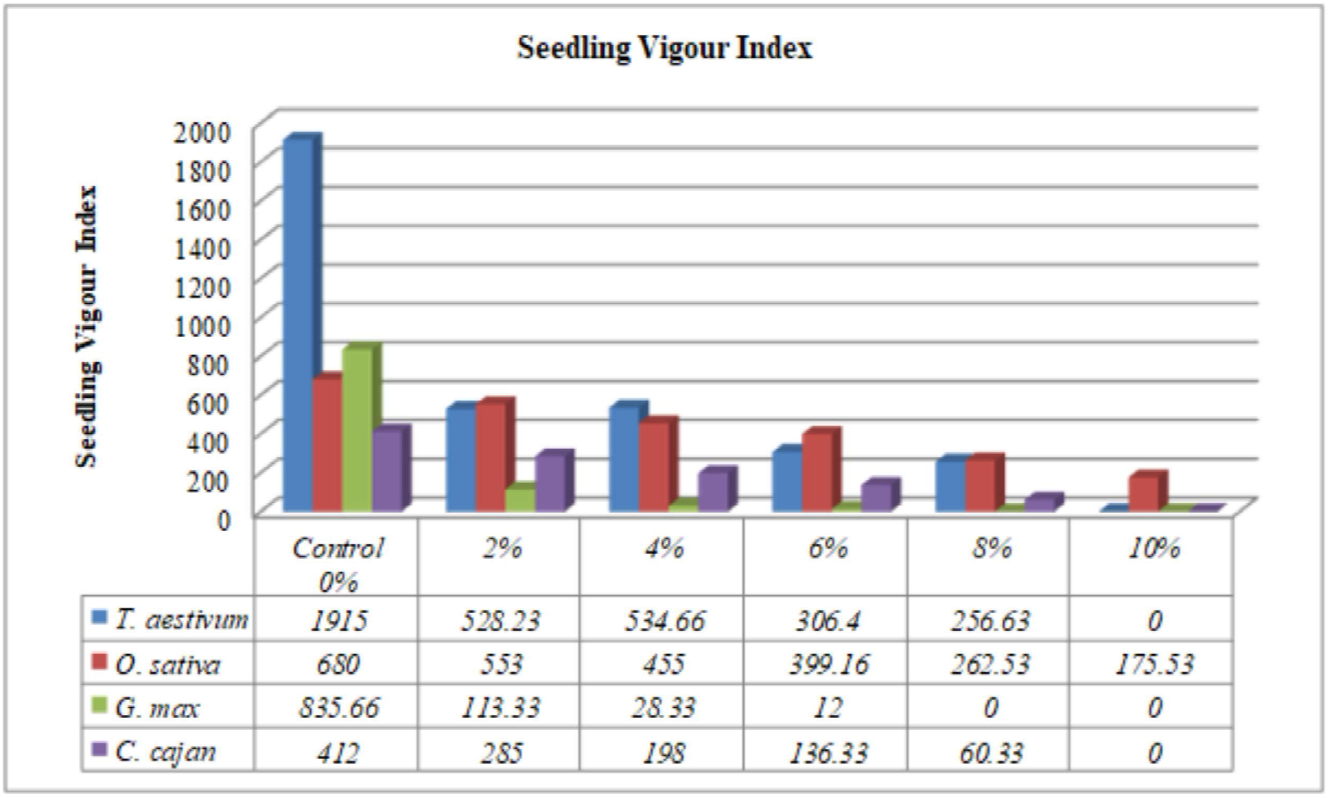


Fig. 4: Effect of leaf aqueous extract of *Parthenium hysterophorus* L. on root length of test plant species.



	Control 0%	2%	4%	6%	8%	10%
T. aestivum	12.05	8.51	6.77	4.44	2.21	0
O. sativa	6.16	5.19	5.82	4.71	4.28	0.89
G. max	7.13	0.63	0.46	0.36	0	0
C. cajan	3.1	2.68	2.47	1.8	1.29	0

Fig. 5: Effect of leaf aqueous extract of *Parthenium hysterophorus* on shoot length of test plant species.



	Control 0%	2%	4%	6%	8%	10%
T. aestivum	1915	528.23	534.66	306.4	256.63	0
O. sativa	680	553	455	399.16	262.53	175.53
G. max	835.66	113.33	28.33	12	0	0
C. cajan	412	285	198	136.33	60.33	0

Fig. 6: Effect of leaf aqueous extract of *Parthenium hysterophorus* on seedling vigour index of test plant species

25°C). Ten grams of powdered leaves were soaked in 100 ml distilled water for 24 hr at room temperature. The aqueous extract was filtrated through Whatman No. 1 filter paper and final volumes were adjusted to 100 ml; this gives 10% aqueous extract. The extracts were considered as stock solution and a series of the solution with different dilution strengths (2, 4, 6, 8, & 10.) were prepared. Each of ten healthy selected seeds was surface sterilized by 2% sodium hypochloride for 15 min, then it was kept for germination in sterilized petridishes on 2-folds of blotting paper and moister with 10 ml of different concentration of aqueous extracts (2%, 4%, 6%, 8%, & 10%). Each treatment was setup in 3 replicates with 10 seeds. A separate series of control was setup using distilled water. The petridishes were maintained under laboratory conditions at average 25°C temperature for ten days. Equal volumes of distilled water were added to petridishes for maintaining the moisture content of the blotting paper.

Germinated seeds were counted daily according to the seedling evaluation procedure[2]. The numbers of germinated seeds were recorded every 24 hours. Ten days sowing and germination, the percentage were calculated using the formula (Germinated seed\Total seed × 100) for each replication of the treatment.

Mean Germination Time: Mean germination times (MGT) were calculated according to the equation[8].

$$MGT = \frac{\Sigma(Dn)}{\Sigma n}$$

Where **n** is a number of seeds that emerged on day, and **D** is the number of days counted from the beginning of germination. The germination indexes (GI) were calculated by using the following formula[2]:

$$GI = \frac{\text{No. of germinated seeds}}{\text{Days of first count}} + \frac{}{} + \frac{\text{No. of germinated seeds}}{\text{Days of final count}}$$

All the emerged seedlings from each replication were counted and the percentage of emergence were calculated by using the following formula:

$$\text{Emergence \%} = \frac{\text{Emerged seed}}{\text{Total seed}} \times 100$$

The length of roots and shoots were measured in centimeters from the point where the root and shoot join together at the end of the root and to the top of the shoot.

Seedling Vigour Index: Seedling Vigour Index (SVI) was calculated according to the following formula[1].

SVI = Germination/Emergence % × Radical length (cm)

Biomass

Roots and shoots of the entire seedling were separated, oven dried at 70° C for 48 hr until they reached a constant weight and then they were weighed.

Statistical Analysis

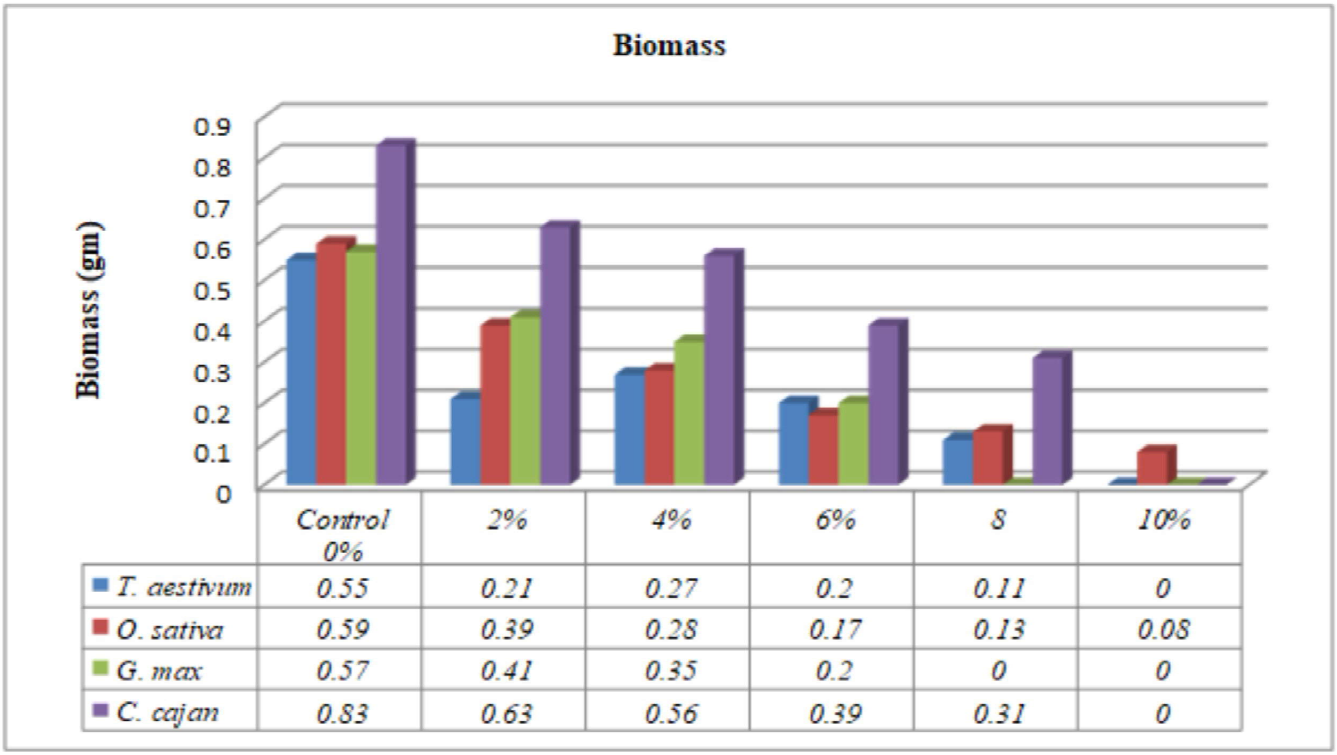
The data were analyzed statistically using Fisher's analysis of variance using SPSS 16.0 software and treatment means were compared using the Least Significance Difference (LSD) at a probability level of 0.05%.

Results and Discussion

Effect of aqueous leaves extract of *Parthenium hysterophorus* on seed germination and seedling growth behaviour of four agro crop plants *Triticum aestivum*, *Oryza sativa*, *Glycine max* and *Cajanus cajan* were studied and results are summarized (Tables 1 - 4 & Figs. 1-7).

Germination Percentage

Germination percentages are summarized in Fig. 1. ANOVA showed a significant difference ($p<0.05$) between treatments in all tested plant (Tables 1, 2, 3 and 4). The highest seed germination percentage was recorded in control (range from 93.33 to 100%) and lowest seed germination in 8 and 10 % (range from 30 to 36.67%) extract of *Parthenium hysterophorus.* There was complete seed germination inhibition in *Triticum aestivum*, *Glycine max* and *Cajanus cajan* at 10% extract. It is highly interesting that there is a significant reduction in seed germination percentage with increasing concentration of <2%. This showed that leaf extract contains inhibiting chemicals resulting in the reduced germination of all agro crops. Plants exhibit allelopathy by releasing water soluble phytotoxin from leaves, stem, root, fruit and seeds, such metabolites play an inhibitory role in delay or completely inhibition of seed germination[16]. Seed germination was



	Control 0%	2%	4%	6%	8	10%
T. aestivum	0.55	0.21	0.27	0.2	0.11	0
O. sativa	0.59	0.39	0.28	0.17	0.13	0.08
G. max	0.57	0.41	0.35	0.2	0	0
C. cajan	0.83	0.63	0.56	0.39	0.31	0

Fig. 7: Effect of leaf aqueous extract of *Parthenium hysterophorus* on biomass (g) of test plant species.

inhibited completely in *Glycine max* at 10% extract of *Parthenium hysterophorus* L., this result is supported by earlier works[5,14,19].

Germination Index (GI)

Germination index were recorded separately of each crop in Table-1 to 4 and F value also recorded at 5% level of significance and data of all crops are summarized in Fig. 2. Germination index of all treatment crops showing significantly reduced with increasing concentration of extract. It is completely inhibited at 8 and 10 % concentration extract in *Glycine max* L. This result is supported by previous findings[5,6], whereas in *Triticum aestivum* L. and *Cajanus cajan* L. GI were completely inhibited at 10%.

Mean Germination Time (MGT)

There were significant reductions of germination mean time at 2 to 10 % concentration over control. Maximum MGT taken is recorded in *Glycine max* 5.21 at 6% and minimum in *Triticum aestivum* 1.9 at control. MGT is delayed in all experiment with increasing concentration. The maximum MGT indicates that there might be an inhibitory compound in aqueous of *Parthenium hysterophorus* which delayed the germination process of crop seeds. Results are supported by earlier finding[3] which stated that Chickpea seeds soaked in the root extract of *Asphodilus tenuifolus* took more time for germination.

Root and Shoot Length

The root and shoot length of test crop plants were studied and results were recorded in Figures 4 & 5. Among all the plants, the concentration of extract increases the root and shoot length reduced as compared to control. The control showing maximum root length 19.15 cm in *Triticum aestivum* and minimum was recorded in *Cajanus cajan. Triticum aestivum* and *Cajanus cajan* were showing inhibitory action at <2% and there was no result at 10% aqueous extract whereas in *Glycine max* completely inhibited at 8 and 10% aqueous extract in a same experimental condition. *Triticum aestivum* showed maximum shoot length followed by *Glycine max*, *Oryza sativa* and *Cajanus cajan* in control. The minimum root and shoot length were recorded in *Glycine max* having a range from 2 to 0.43 cm of root length and 0.63 to 0.36 cm of shoot length at the concentration of 2 to 6%. Earlier works have also reported that foliar leachates of *Parthenium hysterophorus* reduces root and shoot elongation of *Oryza sativa* and *Triticum aestivum*[17] *Zea mays and Glycine max*[4]. *Parthenium hysterophorus* in the form of extract or residue or growing weed effect the germination, growth and productivity of *Zea mays*[13]. This indicates the availability of the inhibitory chemicals in

higher concentration in leaves[11].

Seedling Vigour Index (SVI)

Seedling Vigour Index (SVI) is summarized in Fig. 6. ANOVA showed significant difference ($p<0.05$) between treatments in all tested plants. Results showed that SVI reduces with increasing concentration of aqueous leaves extract of *Parthenium hysterophorus* as compared to control. The maximum SVI recorded in wheat (SVI-1950) followed by soybean (SVI- 835), rice (SVI- 680) and pigeon pea (SVI- 412) on control. The results are supported by the earlier finding[13] which revealed that *Parthenium hysterophorus* in the form of extract affect the germination and growth of *Zea mays.*

Biomass

A dry weight of seedling (root & shoot) completely inhibited in wheat and soybean, at 10% extract. The result showed that leaves extract had strong allelopathy property that reduced the biomass of test crop plants with increasing concentration (Fig. 7). Biomass of wheat, maize and soybean inhibit with increasing concentration of aqueous extract of *Parthenium hysterophorus*.[5]

Conclusion

The result of this study showed that *Parthenium hysterophorus* has allelopathic potential. It exhibited significant inhibitory effect on seed germination, seedling emergence, mean germination time, seedling vigour index and dry weight of root and shoot in all selected agro crops. Inhibitory effect increased with increasing concentration of the allelochemicals. Therefore it is necessary to keep this weed under check at the emergence stage at agro crop field so that its allelopathic based crop growth suppression may be avoided. Further studies on the interaction between allelochemicals and crop species are essential to interpret the mechanism of such allelopathic effects.

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Diversity of forest herbs during rainy season in the reserve forest of Bhupdeopur of district Raigarh, Chhattisgarh

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Abstract
In the given study the stress is given on the study of herb layer vegetation in Bhupdeopur reserve forest of Raigarh district of Chhattisgarh because any detailed studies on herb layer in forest ecosystems was not done so far. An in depth survey has been conducted in rainy season to search out the assorted forms of forest herbs. Ninety herb species were recorded in season, their native names and numerous uses by the native inhabitants as well as healthful values were recorded throughout the survey. The parameters like frequency, density and abundance were conjointly undertaken.

Keywords: forest herbs, Bhupdeopur reserve forest, Chhattisgarh, frequency, density, and abundance

Introduction

India is recognized as a country rich in all aspects of Biodiversity and Ecosystem. For any one country in the world, it has perhaps the largest array of environmental stipulations by virtue of its tropical location. Forests are one of the most important recognized ecosystems in the biosphere and India is rich in all aspects of Biodiversity and Ecosystems. These plant strata square measure integral part of organic phenomenon for mammals and birds and management of microclimate of the location. The herb layer biomass typically plays a very important role within the utilization of nutrients. In forest system underneath level studies haven't been given a correct weightage like the tree constituents.

Hence solely a number of studies on the role of underneath level vegetation in numerous forms of plantation ecosystems is noted. Phytosociological analysis of a plant community is a very important facet of ecological study of any piece of vegetation. Species composition is one of the necessary characters of plant community. Analytical character *viz.* Frequency, density and abundance square measure terribly helpful within the composition of 2 completely different plant communities. The current study was conducted in Bhupdeopur reserve forest of district Raigarh Chhattisgarh. (Table 1)

Aim/Purpose

1. Identification of herb species of Bhupdeopur reserve forest.
2. to review the herb diversity of Bhupdeopur reserve forest.
3. Identification of vulnerable herb species that is of promising worth.
4. to review the floristic composition of Bhupdeopur reserve forest.
5. To enlist ethnobotanical uses of herbs specifically of health and sustenance security.

Materials and strategies

1. Choice of study sites: The present study was conducted in Bhupdeopur Reserve forest of district Raigarh, Chhattisgarh. The study space was divided into four circles named as Naharpali, Kerajhar, Delari and Khairpur, every circle was divided into beats and a complete of twenty beats in sixteen villages were thought for the study. The study site is in twenty five km of North West of Raigarh town. The quadrates comes underneath Raigarh forest area of Raigarh forest division in Raigarh and Kharsia body block.
2. Technique of sampling with in the given study Phytosociological diversity analysis was administrated by quadrate technique. Sampling of study space was done by Quadrat technique following Oosting, (1958) [6]. 1mtr sq. circular quadrates were used for the sampling of herb layer. On the idea of the information obtained from the quadrate samples the structural distribution of forest herbs in the season were analyzed. The parameters like proportion frequency, density, abundance were obtained and were calculated from the information as follows.

$$\%\, F = \frac{\textit{Number of sampling units in which plant species occured}}{\textit{Total number of sampling units studied}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individuals of a plant species in all sampling units}}{\text{Total Number of sampling units studied}}$$

$$\text{Abundance} = \frac{\text{Total number of individual plant species in all the sampling units}}{\text{Total number of sampling units of occurrence}}$$

Result and Discussion

A total of 44 species of herbs belonging to 38 genera of 16 families were recorded out of them 33 plant species belonged to dicotylodonae, 9 belonged to monocotyledonae and 1 belonged to pteridophyte. Fabaceae was found the dominant family Poaceae, 03 of Asteraceae and Cyperaceae, 02 each for Oxalidaceae, Apiaceae, Euphorbiaceae, Convolvulaceae and

Lamiaceae were recorded. The Minimum number of species (01) was recorded for 06 of the families like Periplocaceae, Onagraceae, Schizaecaceae, Polygonaceae, Malvaceae and Scrophulariaceae. Out of 44 herbs species recorded during summer season 42 species were wild and 02 were wild/ cultivated.(Table) 90 Herb species of 76 genera of 33 families and 60 species belonged to 52 genera of 22 families were 72 observed during the summer, rainy and winter season respectively. 33 plant species belonged to dicotylodonae, 9 belonged to monocotyledonae and 1 belonged to pteridophyte in summer, 60 plant species belonged to dicotyledonae, 28 to monocotyledonae and 02 plant speices of pteridophyta in rainy season and 40 plant species of dicotyledonae, 19 of monocotyledonae and 01 plant species of pteridophyte in winter season were recorded. In summer season, Fabaceae was found the dominant family recorded 08 species, while, 07 species each of Acanthaceae and Poaceae, 03 of Asteraceae and Cyperaceae, 02 each for Oxalidaceae, Apiaceae, Euphorbiaceae, Convolvulaceae and Lamiaceae were recorded. The Minimum number of species (01) was recorded for 06 of the families like Periplocaceae, Onagraceae, Schizaecaceae, Polygonaceae, Malvaceae and Scrophulariaceae.

Out of 44 herbs species recorded during summer season 42 species were wild and 02 were wild/ cultivated (Table-10). In rainy season, the maximum number of Herb species (12) was recorded of family Asteraceae, (11) of family Poaceae, 8 of Fabaceae, 7 each of Cyperaceae and Acanthaceae, 4 each of Lamiaceae and Euphorbiaceae, 3 each of Zingiberaceae and Solanaceae, 2 each of Lilliaceae, Amaranthaceae, Oxalidaceae, Vitaceae, Chenopodiaceae, Convolvulaceae and Malvaceae, 1 each of Dioscoreaceae, Araceae, Apiaceae, Cleomaceae, Hypoxidaceae, Commelinaceae, Onagraceae, Schizaecaceae, Sterculiaceae, Tiliaceae, Periplocaceae, Rubiaceae, Scrophulariaceae, Ophioglossaceae, Nyctaginaceae, Acoraceae and Polygonaceae. Out of 90 herb recorded during rainy season 83 were found wild and 07 were noted as wild/ cultivated (Table-11). In winter season, Poaceae and Fabaceae were found to be the dominant families. The maximum number of Herb species (08) was noted for the family Poaceae and Fabaceae while, (07) of family Cyperaceae, (06) of family Asteraceae, Acanthaceae (05) of family Malvaceae, (02) each of family Lamiaceae, Oxalidaceae, Euphorbiaceae,and Convolvulaceae. The minimum number of species (01) was recorded for (12) of the families like Apiaceae, Vitaceae, Zingiberaceae, Hypoxidaceae, Commelinaceae, Periplocaceae, Onagraceae, Schizaecaceae, Rubiaceae, Scrophulariaceae, Cleomaceae and Colchicaceae. Out of 60 herb recorded during winter season 57 species were wild and 03 were noted as wild / cultivated).

1. **% Frequency of herbs:** In rainy season,% frequency of 88 plant species in the range of 1% to 20%, 01 plant species in the range of 21% to 40%, 01 plant species in the range of 41% to 60% and none of the plant species was in the range of 61% to 80% and 81% to 100%.The maximum % frequency 41% was estimated for the plant species *Hyptis suaveolens* (L.) poit and the minimum (3%) for 03 plant species like *Aloe vera* (L.) Burm. f. and *Heteropogon contortus* (L.) Beauv. Ex Roem & Schult. *Oxalis corniculata* Linn.
2. **Density of herbs:** In rainy season, density was calculated for 81 plant species in the range of 0.00 to 1.60, while none of the plant species was in the range of 1.61 to 3.00 and 4.6 to 6.00 and 01 plant species was in the range of 3.10 to 4.50.The maximum density 4.49 was calculated for the plant species *Hyptis suaveolens* (L.) Poit and the minimum density 0.07for *Andrographis echoides* Nees.
3. **Abundance of Herbs:** In rainy season, abundance of 87 plant species was calculated under the range of 0.00 to 2.00, 02 plant species in the range of 2.01 to 4.00, where as none of the plant species was in the range of 4.10 to 6.00 and 01 plant species in the range of 6.10 to 8.10. The maximum abundance 7.15 was estimated for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum (0.08) for the 02 plant species *Amaranthus virdis* Hook.and*Amaranthus spinosus* Linn.
4. **Relative frequency of herbs:** In rainy season**,** relative frequency was determined for 78 plant species in the range of 0.00 to 1.5, 06 plant species in the range of 1.6 to 3.00, none of the plant species was in the range of 3.1 to 4.5 and 01 plant species in the range of 4.6 to 6.0.The maximum relative frequency 5.50 was determined for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum 0.40 for the plant species. *Heteropogon contortrs* (L.) Beauv.ex Roem & Schult. and *Oxalis corniculata* Linn.
5. **Relative density of herbs:** In rainy season, Relative density was determined for 79 plant species in the range of 0.00 to 1.50, 10 plant species in the range of 1.60 to 3.00, where as none of the plant species in the range of 3.10 to 4.50 and 01 plant species in the range of 4.60 to 6.00. The maximum Relative density 5.59 was recorded for the plant species *Chlorophytum tuberosum* (Roxb.) baker and *Hyptis suaveolens* (L.) Poit. and the minimum relative density 0.08 for *Andrographis echoides* Nees.
6. **Relative Abundance of herbs:** In rainy season, Relative abundance was determined for 87 plant species in the range of 0.00 to 4.50, 02 plant species in the range of 4.51 to 9.00, where as none of the plant species in the range of 9.01 to 13.50 and 01 plant species in the range of 13.51 to 18.00. The maximum Relative abundance was 17.49 was recorded for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum 0.19 for *Amaranthus viridis* Hook. and *Amaranthus spinosus* Linn.
7. **Important value index of herbs:** In rainy season, important value index was determined for 57 plant species in the range of 0.00 to 10.75, none of the plant species in the range of 10.76 to 21.50, 02 plant species in the range of 21.51 to 32.25, 01 plant species in the range of 32.26 to 43.00. The maximum important value index 42.17 was recorded for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum 1.28 for the *Euphorbia hirta* Linn.

Table 1: Phytosociological study of Herbs in Bhupdeopur Reserve forest area of district Raigarh during Rainy season investigatged during the year 2009-2011.

S. no.	Botanical Name	Local / Vernacular Name	Family	Habitat	% Frequency	Density	Abundance	Relative Frequency	Relative Density	Relative Abundance	Important Value Index
1	*Acanthospermum hispidum* DC.	Cabi	Asteraceae	Wild	10	1.09	0.30	1.34	1.35	0.73	3.42
2	*Acorus calamus* L.	Bach	Acoraceae	Wild / Cultivated	4	0.43	0.10	0.53	0.53	0.24	1.30
3	*Ageratum conyzoides* Linn.	Lango	Asteraceae	Wild	11	1.20	0.50	1.47	1.49	1.22	4.18
4	*Alloteropsis cimicina* (L.) Stapf.	Cockatoo	Poaceae	Wild	20	2.19	2.35	2.68	2.72	5.75	11.15
5	*Aloe vera* (L.) Burm. f.	Ghrit kumari	Liliaceae	Wild / Cultivated	3	0.32	0.10	0.40	0.39	0.24	1.03
6	*Alysicarpus vaginalis* DC.	Latkana	Fabaceae	Wild	8	0.87	0.24	1.07	1.08	0.58	2.73
7	*Amaranthus spinosus* Linn.	Kanta Bhaji	Amaranthaceae	Wild / Cultivated	6	0.65	0.08	0.80	0.81	0.19	2.52
8	*Amaranthus viridis* Hook.	Chaulai Bhaji	Amaranthaceae	Wild / Cultivated	5	0.54	0.08	0.67	0.67	0.19	1.53
9	*Amorphophallus paeonifolius* (Dennst.) Nicolson	Jungli Suran	Araceae	Wild	4	0.43	0.10	0.53	0.53	0.24	1.30
10	*Anacyclus pyrethrum* (L.) Link	Akarkara	Asteraceae	Wild	5	0.54	0.12	0.67	0.67	0.29	1.63
11	*Andrographis paniculata* (Burm. f.) Wall. ex Nees	Bhui Neem	Acanthaceae	Wild	9	0.98	0.27	1.20	1.22	0.66	3.08
12	*Andrograhis echoides* Nees.	Kala Bhuineem	Acanthaceae	Wild	8	0.07	0.21	1.07	0.08	0.51	1.66
13	*Anisomeles indica* (Linn.) Kuntze	Van Tulsa	Lamiaceae	Wild	8	0.87	0.16	1.07	1.08	0.39	2.54
14	*Aristida adscensionis* L.	Buch Ghass	Poaceae	Wild	8	0.87	0.16	1.07	1.08	0.39	2.54
15	*Aristida depressa* Retz. Non Hook. F. & Thoms.	Kantabaheri	Poaceae	Wild	9	0.98	0.29	1.20	1.22	0.70	3.12
16	*Biophytum sensitivum* (Linn.) DC edgow & Hook. F.	Laxmana	Oxalidaceae	Wild	9	0.98	0.36	1.20	1.22	0.88	3.30
17	*Boerhavia diffusa* (L.) nom. Con F.	Punarva	Nyctaginaceae	Wild	7	0.76	0.14	0.93	0.94	0.34	2.21
18	*Cassia tora* Linn.	Charota	Fabaceae	Wild	15	1.64	0.85	2.01	2.04	2.08	6.13
19	*Cayratia carnosa* (Wall.) Gagnep.	Ram chana	Vitaceae	Wild	8	0.87	0.14	1.07	1.08	0.34	2.49
20	*Cenchrus setigerus* Vah.	Ghass	Poaceae	Wild	7	0.76	0.16	0.93	0.94	0.39	2.26
21	*Centella asiatica* (L.) Urban	Brahmi	Apiaceae	Wild	4	0.43	0.50	0.53	0.53	1.22	2.28
22	*Chenopodium album* L.	Bathuwa	Chenopodiacee	Wild	8	0.87	0.18	1.07	1.08	0.44	2.59
23	*Chenopodium murale* Linn.	Bada Bathuwa	Chenopodiacee	Wild	9	0.98	0.19	1.20	1.22	0.46	2.88
24	*Chlorophytum tuberosum* (Roxb.) Baker	Khonjhiri	Liliaceae	Wild	19	2.08	1.40	2.55	5.59	3.42	8.56
25	*Chloris virgata* (L.)Sw.	Bara Ghass	Poaceae	Wild	6	0.65	0.19	0.80	0.81	0.46	2.07
26	*Cleome viscosa* L.	Hur hur	Cleomaceae	Wild	15	1.64	1.36	2.01	2.04	3.32	7.37
27	*Corchorus acutangulus* Lam.	Nalta	Tiliaceae	Wild	5	0.54	0.33	0.67	0.67	0.80	2.14
28	*Costus speciosus*(Koenig) Sm.	Keokand	Zingiberaceae	Wild / Cultivated	7	0.76	0.15	0.93	0.94	0.36	2.23
29	*Crotalaria burhia* Buch. Ham.	Jungali san	Fabaceae	Wild	6	0.65	0.10	0.80	0.81	0.24	1.85
30	*Curculigo orchioides* Gaertn.	Kali musli	Hypoxidaceae	Wild	13	1.42	0.69	1.74	1.76	1.68	5.18
31	*Curcuma angustifolia* Roxb.	Tikhur	Zingiberaceae	Wild	7	0.76	0.12	0.93	0.94	0.29	2.16
32	*Curcuma amada* Roxb.	Jungali Haldi	Zingiberaceae	Wild	6	0.65	0.12	0.80	0.81	0.29	1.90
33	*Cyanotis axillaris* Roemschult.	Baghanulla	Commelinaceae	Wild	10	1.09	0.68	1.34	1.35	1.66	4.35
34	*Cynodon dactylon* Pers.	Dub Ghass	Poaceae	Wild	14	1.53	1.29	1.87	1.40	3.15	6.92

35	*Cyperus compressus* Linn.	Ghass	Cyperaceae	Wild	9	0.98	0.54	1.20	1.22	1.32	3.74
36	*Cyperus pilosus* vahl.	Ghass	Cyperaceae	Wild	9	0.98	0.75	1.20	1.22	1.83	4.25
37	*Cyperus bulbosus* Vahl.	Ghass	Cyperaceae	Wild	8	0.87	0.83	1.07	1.08	2.03	4.18
38	*Cyperus rotundus* L.	Nagar motha	Cyperaceae	Wild	7	0.76	0.65	0.93	0.94	1.59	3.46
39	*Cyperus scariosus* R.Br.	Nagaranustaka	Cyperaceae	Wild	9	0.98	0.75	1.20	1.22	1.83	4.25
40	*Cyperus triceps* (Roxb.) Endl. DC.	Nirbisi	Cyperaceae	Wild	4	0.43	0.37	0.53	0.53	0.90	1.96
41	*Cyperus iria* Linn.	Taraju ghass	Cyperaceae	Wild	8	0.87	0.57	1.07	1.08	1.39	3.54
42	*Desmodium triflorum* DC.	Kudaliya	Fabaceae	Wild	16	1.75	1.40	2.14	2.18	3.42	7.74
43	*Dioscoria alata* Linn.	Barakand	Dioscoreaceae	Wild	7	0.76	0.20	0.93	0.94	0.48	2.35
44	*Eclipta alba* (L.) Hassk.	Shring raj	Asteraceae	Wild	9	0.98	0.18	1.20	1.22	0.44	2.86
45	*Elephantopus scaber* Linn.	Mayor chundi	Asteraceae	Wild	8	0.87	0.20	1.07	1.08	0.48	2.63
46	*Elytraria acaulis* (L.f.)	Dasmori	Acanthaceae	Wild	5	0.54	0.15	0.67	0.67	0.36	1.70
47	*Eragrostris spicata* Vasey	Ghass	Poaceae	Wild	6	0.65	0.49	0.80	0.81	1.19	2.80
48	*Eremopogon fovelotus* (Delile) Stapf.	Pirichit	Poaceae	Wild	8	0.87	0.20	1.07	1.08	0.48	2.63
49	*Euphorbia dracunculoides* Lam. Boiss.	Banburi	Euphorbiaceae	Wild	4	0.43	0.15	0.53	0.53	0.36	1.42
50	*Euphorbia thymifolia* Linn.	Choti Dudhi	Euphorbiaceae	Wild	7	0.76	0.18	0.93	0.94	0.44	2.31
51	*Euphorbia hirta* Linn.	Dudhi	Euphorbiaceae	Wild	5	0.54	0.22	0.67	0.67	0.53	1.87
52	*Evolvulus alsinoides* Linn.	Shankha Pushpi	Convolvulaceae	Wild	12	1.31	0.21	1.61	1.63	0.51	3.75
53	*Glycirrhiza glabra* L.	Mulethi	Fabaceae	Wild	15	1.64	1.36	2.04	2.04	3.32	7.37
54	*Hemidesmus indicus* (L.) R. Br.	Anantmool	Periplocaceae	Wild	22	2.41	0.49	2.95	3.00	1.19	7.14
55	*Heteropogon contortus* (Linn.) Beauv. Ex Roem. Schult.	Shuklakanta	Poaceae	Wild	3	0.32	0.27	0.40	0.39	0.66	1.45
56	*Hyptis suaveolens* (L.) Poit.	Ban Tulsa	Lamiaceae	Wild	41	4.49	7.15	5.50	5.59	17.49	28.58
57	*Justicia procumbens* Linn.	Pit papara	Acanthaceae	Wild	9	0.98	0.24	1.20	1.22	0.58	3.00
58	*Ludwigia perennis* Linn.	Jal Dhawai	Onagraceae	Wild	7	0.76	0.21	0.93	0.94	0.51	2.38
59	*Lygodicun flexuosum* (Linn.) Sw.	Indraraj	Schizaecaceae	Wild	5	0.54	0.11	0.67	0.67	0.26	1.60
60	*Malva parviflora* Linn.	Panirak	Malvaceae	Wild	9	0.98	0.27	1.20	1.22	0.66	3.08
61	*Melochia corchorifolia* Linn.	Gobi	Sterculiaceae	Wild	6	0.65	0.28	0.80	0.81	0.68	2.29
62	*Mentha viridis* Linn.	Pudina	Lamiaceae	Wild / Cultivated	5	0.54	0.12	0.67	0.67	0.29	1.63
63	*Merremia emarginata* (Burm. F.)	Musakani	Convolvulaceae	Wild	18	1.97	1.85	2.41	2.45	4.52	9.38
64	*Microtyloma uniflorum* (Lam.) Verde.	Kulthi	Fabaceae	Wild	6	0.65	0.16	0.80	0.81	0.39	2.00
65	*Mimosa pudica* Linn.	Lajwanti	Fabaceae	Wild	4	0.43	0.14	0.53	0.53	0.34	1.40
66	*Ocimum basilicum* Linn.	Tulsi	Lamiaceae	Wild / Cultivated	7	0.76	0.18	0.93	0.94	0.44	2.31
67	*Oldenlandia corymbosa* Linn.	Pitpapara	Rubiaceae	Wild	6	0.65	0.13	0.80	0.81	0.31	1.92
68	*Ophioglossum reticulatum* L.	Jibhi	Ophioglossaceae	Wild	7	0.76	0.39	0.93	0.94	0.95	2.82
69	*Oxalis corniculata* Linn.	Khatti booti	Oxalidaceae	Wild	3	0.32	0.27	0.40	0.39	0.66	1.45
70	*Peristrophe bicalyculata* Nees.	Atrila	Acanthaceae	Wild	7	0.76	0.14	0.93	0.94	0.34	2.21
71	*Phyllanthus niruri* Hook. F.	Bhui amla	Euphorbiaceae	Wild	11	1.20	0.44	1.47	1.49	1.07	4.03
72	*Pluchea lanceolata* (DC.) Oliv & Hiem.	Rasna	Asteraceae	Wild	6	0.65	0.15	0.80	0.81	0.36	1.97
73	*Rumex dentatus* L.	Ambavati	Polygonaceae	Wild	6	0.65	0.16	0.80	0.81	0.39	2.00
74	*Rungia pectinata* (L.) Nees.	Kanghi	Acanthaceae	Wild	4	0.43	0.21	0.53	0.53	0.51	1.57
75	*Rungia repens* Nees.	Kharmar	Acanthaceae	Wild	10	1.09	0.45	1.34	1.35	1.10	3.79
76	*Scoparia dulcis* Linn.	Ghoda Tulsi	Scrophulariaceae	Wild	8	0.87	0.18	1.07	1.08	0.44	2.59
77	*Setaria glauca* Beavu.	Green Fox Tail	Poaceae	Wild	4	0.43	0.20	0.53	0.53	0.48	1.54

78	*Sida rhombifolia* Linn.	Lal Barela	Malvaceae	Wild	5	0.54	0.33	0.67	0.67	0.80	2.14
79	*Solanum xanthocarpum* Schrad. & H. Wendl.	Kantaki	Solanaceae	Wild	7	0.76	0.30	0.93	0.94	0.73	2.60
80	*Sphaeranthus indica* Linn.	Mundi	Asteraceae	Wild	4	0.43	0.10	0.53	0.53	0.24	1.30
81	*Spilanthes paniculata* Wall. ex DC.	Akarkara	Asteraceae	Wild	7	0.76	0.28	0.93	0.94	0.68	2.55
82	*Tridax procumbens* Linn.	Khargos ghass	Asteraceae	Wild	7	0.76	0.30	0.93	0.94	0.73	2.60
83	*Vernonia cinerea* Nees.	Sahdevi	Asteraceae	Wild	10	1.09	0.29	1.34	4.35	0.70	3.39
84	*Vetiveria zizanioides* Linn.	Birni	Poaceae	Wild	7	0.76	0.16	0.93	0.94	0.39	2.26
85	*Vicoa vestita* Benth. Ex Hook. F.	Pila Rasna	Asteraceae	Wild	5	0.54	0.22	0.67	0.67	0.53	1.87
86	*Vitis quadrangularis* Linn.	Hadjod.	Vitaceae	Wild	4	0.43	0.12	0.53	0.53	0.29	1.35
87	*Wendlendia exerta* DC.	Khel Papara	Solanaceae	Wild	8	0.87	0.38	1.07	1.08	0.93	3.08
88	*Withania somnifera* (Linn.) Dunal	Ashwagandha	Solanaceae	Wild	6	0.65	0.26	0.80	0.81	0.63	2.24
89	*Xanthium strumonium* Linn.	Chota gokharu	Asteraceae	Wild	4	0.43	0.10	0.53	0.53	0.24	1.30
90	*Zornia gibbosa* Spanoghe	Samarpari	Fabaceae	Wild	8	0.87	0.42	1.07	1.08	1.02	3.17

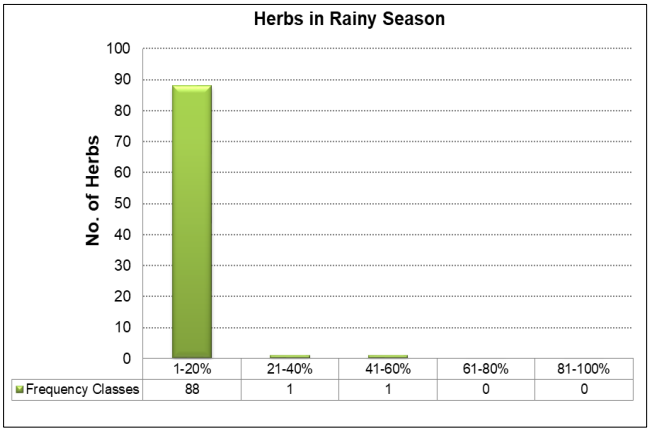


Fig 1: Seasonal Frequency of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

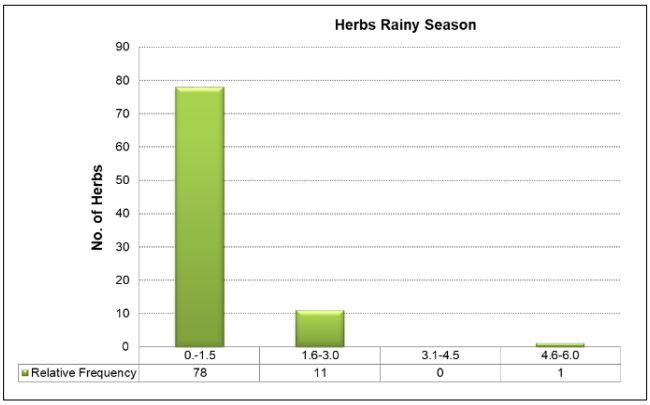


Fig 2: Seasonal Relative Frequency of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

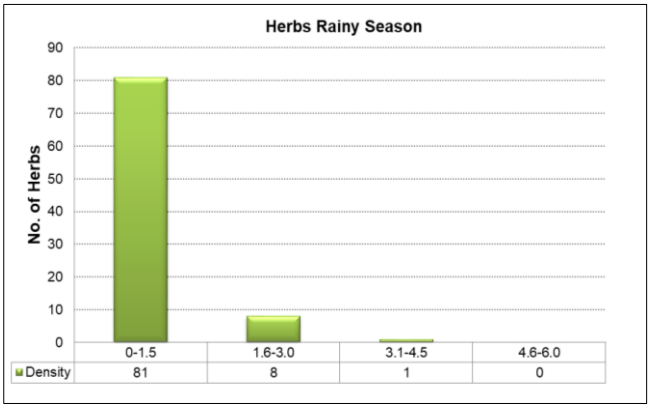


Fig 3: Seasonal Density of herbs recorded in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

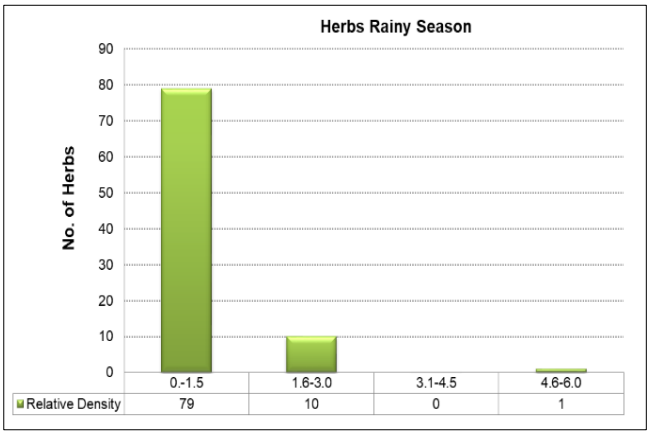


Fig 4: Seasonal Relative Density of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

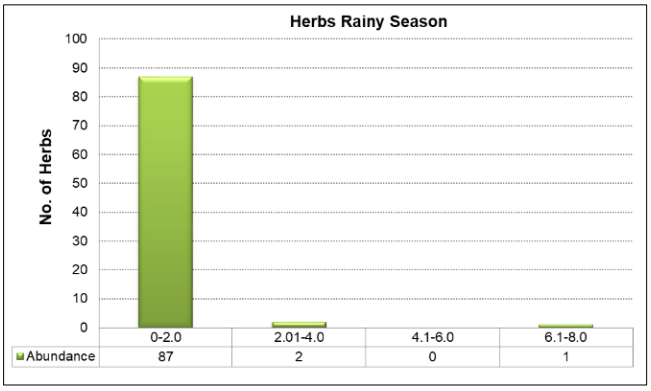


Fig 5: Seasonal Abundance of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

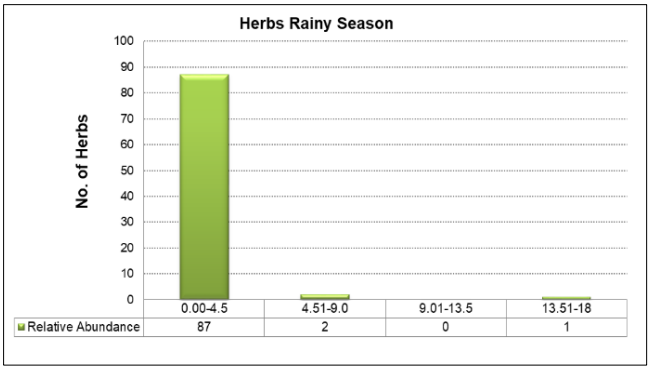


Fig 6: Seasonal relative Abundance of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

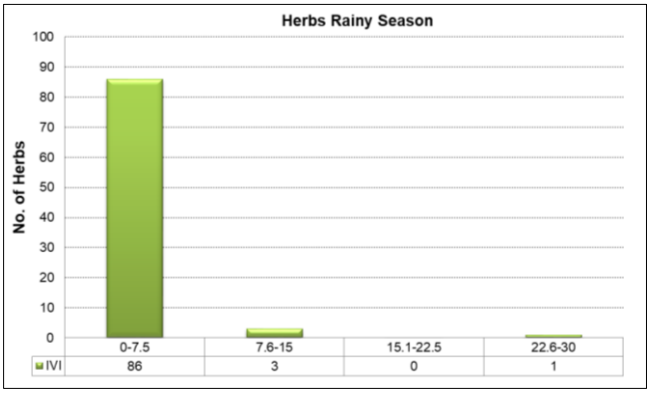


Fig 7: Seasonal Important Value Index (IVI) of herbs determined in Bhupdeopur Reserve forest area of district Raigarh, Investigated during the year 2009-2011.

Conclusion

The Phytosociological diversity analysis of herb layer vegetation throughout time of year clearly indicates that Bhupdeopur Reserve Forest is an especially necessary system by the virtue to richness of forest health and variety of herb species. The species that square measure vulnerable would like a lot of attention and care.

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Diversity of Forest Herbs during Winters in the Reserve Forest of Bhupdeopur of District Raigarh Chhattisgarh

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Abstract: ***The present work is concerned with the study of herb layer vegetation during winter season in Bhupdeopur reserve forest of Raigarh district of Chhattisgarh as the exclusive studies on herb layer vegetation in different seasons in forest ecosystems are the need of present ecological time. An extensive survey has been conducted to find out the various steps of forest flora. 60 herb species belonging to 22 families, their local names and various uses by the local inhabitants including medicinal values were recorded during survey, took place in winter season. The parameters such as frequency, density and abundance were also undertaken.***

Keywords: Bhupdeopur reserve forest, Raigarh district, Chhattisgarh, Frequency, Density, Abundance, Forest herbs

1. Introduction

India is recognized as a country rich in all aspects of Biodiversity and Ecosystem. For any one country in the world, it has perhaps the largest array of environmental stipulations by virtue of its tropical location. Forests are one of the most important recognized ecosystems in the biosphere and India is rich in all aspects of Biodiversity and Ecosystems . Forests are generally considered as assemblage of trees but in actual sense it is a multistoried vegetation system in which vegetation can be classified into three main storeys , tree storey , shrub storey and herb storey.

The herb storey or under storey vegetation considered an important component of forest ecosystem. These plant strata are integral part of food chain for mammals and birds and control microclimate of the site. The herb layer biomass generally plays an important role in the recycling of nutrients. In forest ecosystem under storey studies have not been given a proper weightage like the tree constituents. No systematic documentation have been made so far to know the floristic composition and ethnobotanical knowledge of the area, that how many types of herb species are found in winter season and how many of them are endangered and at the verge of extinction. In light of the above information present study was planned to study the floristic composition with reference to plant diversity in the forest of Bhupdeopur and ethnobotanical study of the area.

Phytosociological analysis of a plant community is an important aspect of ecological study of any piece of vegetation. Species composition is one of the important characters of plant community .Analytical character viz. Frequency ,density and abundance are very useful in the composition of two different plant communities. The present study was conducted in Bhupdeopur reserve forest of district Raigarh Chhattisgarh. (Table 1)

Aim/ Purpose

1) Identification of herb species of Bhupdeopur reserve forest, during winter season .
2) To study the winter season herb diversity of Bhupdeopur reserve forest.
3) Identification of endangered herb species which is of promising value.
4) To study the floristic composition of Bhupdeopur reserve forest.
5) To enlist ethnobotanical uses of herbs specifically of health and livelihood security.

2. Materials and Methods

1) Selection of study sites

The present study was conducted in Bhupdeopur Reserve forest of district Raigarh, Chhattisgarh. The study area was divided into 4 circles named as Naharpali, Kerajhar, Delari and Khairpur, each circle was further divided into beats and a total of 20 beats in 16 villages were considered for the study. The study site is spread over in 25 km of North West of Raigarh city. The area comes under Raigarh forest range of Raigarh forest division in Raigarh and Kharsia administrative block.

2) Method of sampling

In the present study Phytosociological diversity analysis was carried out by quadrate method. Random sampling of study area was done by Quadrat method following Oosting, (1958). 1mtr sq. circular quadrates were used for the sampling of herb layer. On the basis of the data obtained from the quadrate samples the structural distribution of forest herbs (in the winter season were analysed. The parameters such as percentage frequency , density , abundance were obtained and were calculated from the data as follows.

$$\%F = \frac{Number\ of\ sampling\ units\ in\ which\ plant\ species\ occured}{Total\ number\ of\ sampling\ units\ studied} \times 100$$

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$$Density = \frac{Total\ number\ of\ individuals\ of\ a\ plant\ species\ in\ all\ sampling\ units}{Total\ Number\ of\ sampling\ units\ studied}$$

$$Abundance = \frac{Total\ number\ of\ individual\ plant\ species\ in\ all\ the\ sampling\ units}{Total\ number\ of\ sampling\ units\ of\ occurrence}$$

3. Result and Discussion

40 herb species of dicotyledonae, 19 of monocotyledonae and 01 plant species of pteridophyte in winter season were recorded. In winter season, Poaceae was found to be the dominant family. The maximum number of Herb species (09) was noted for family Poaceae, while, (08) of family Fabaceae, (06) each of family Asteraceae, Acanthaceae and Cyperaceae, 04 of Malvaceae, (02) each of Lamiaceae, Oxalidaceae, Euphorbiaceae, Convolvulaceae, and Rhamnaceae. The minimum number of species (01) was recorded for 13 of the families like Apiaceae, Vitaceae, Zingiberaceae, Amaryllidaceae, Commelinaceae, Asclepiadaceae, Onagraceae, Schizaecaceae, Rubiaceae, Scrophulariaceae, Tiliaceae, Cleomaceae and Colchicaceae. Out of 60 herb recorded during winter season 57 species were wild and 03 were noted as wild / cultivated. (Table-1).

Seasonal distribution of Herbs

1) **% Frequency of herbs:** In winter season, 55 plant species were under the frequency range of 1% to 20% 02 plant species belonging to the range of 21% to 40% 03 plant species belonging to the range of 41% to 60% and none of plant species recorded in the range of 61% to 80% and 81% to 100%. The maximum % frequency (57%) was recorded for the plant species *Merremia emarginata* Burm. H. Hallier F. and the minimum frequency (3%) was recorded for 5 plant species like *Crotalaria burhia* Buch-Ham., *Cyanotis oxillaris* (L.) D. Donex sweet, *Euphorbiahirta* Linn., *Lygodium flexuosum* (L.), and *Oxalis corniculata* Linn. (Fig-1).
2) **Density of herbs:** In winter, the study of the density showed that total 57 plant species belonging to the density range 0.00 – 0.28, 02 plant species belonging to the range of 2.81 – 5.6, while none of the plant species were recorded in the range of 5.7 – 8.4 and 01 plant species belonged to the rang of 8.5 – 11.2. The maximum density (11.2) was calculated for the plant speices *Hyptis suaveolens* (L.) poit. And the minimum density (0.05) was observed for *Euphorbia hirta* Linn. (Fig.-1).
3) **Abundance of Herbs:** In winter season, abundance of 54 plant species was in the range of 0.00 – 2.50, 04 plant species in the range of 2.51 – 5.00, 01 plant species in the range of 5.01 – 7.50 and 01 in the range of 7.51 to 10.00. The maximum abundance 20.64 was calculated for the plant species *Hyptis suaveolens* (L.) and the minimum 0.16 for the *Fimbristylis miliacea* (L.) Vahl. (Fig-1).
4) **Relative frequency of herbs:** In winter season relative frequency was determined for 52 plant species in the range of 0.00 to 2.25, 05 plant species in the range of 2.26–6.75 and 03 plant species in the range of 6.76–9.00. The maximum relative frequency was calculated 8.24 for *Meremmia emarginata* Burn. F. Hallier F. and minimum 0.43 for 5 plant species like *Crotalaria pallida*, Aiton., *Cyanotis oxillaris* (L.) D Don ex. Sweet, *Euphorbia hirta* Linn., *Lygodium flexuosum* (L.) Sw. and *Oxalis cuniculata* L. (Table-1, Fig2).
5) **Relative density of herbs:** In winter season, relative density was determined for 54 plant species in the range of 0.00 to 5.25, 04 plant species in the range of 5.26 to 10.50, 01 plant species in the range of 10.51 to 15.75 and 01 plant species in the range of 15.76 to 21.00.The maximum relative density was calculated 25.10 for *Hyptis suaveolens* (L.) Poit. and the minimum relative density 0.17 was obtained for *Oxalis corniculata* Linn. (Table-1, Fig-2).
6) **Relative Abundance of herbs:** In winter season, Relative abundance was determined for 54 plant species in the range of 0.00 to 2.50, 04 plant species in the range of 2.51 to 5.00, 01 plant species in the range of 5.01 to 7.50 and 01 plant species in the range of 7.51 to 10.00. The maximum Relative abundance 9.26 was calculated for the plant species *Hyptis suaveolens* (L.) Poit and the minimum 0.11 for the *Fimbristylis monostachya*. (Table-1, Fig-2).
7) **Important value index of herbs:** In winter season, important value index was calculated for 57 plant species in the range of 0.00 to 10.75, none of the plant species in the range of 10.76 to 21.50, 02 plant species in the range of 21.51 to 32.25, 01 plant species in the range of 32.26 to 43.00. The maximum important value index 42.17 was recorded for the plant species *Hyptis suaveolens* (L.) Poit. and the minimum 1.28 for the *Euphorbia hirta* Linn. (Table-1, Fig-3).

Table 1: Phytosociological study of Herbs in Bhupdeopur Reserve forest area of district Raigarh during Winter season investigated during the year 2009-2011.

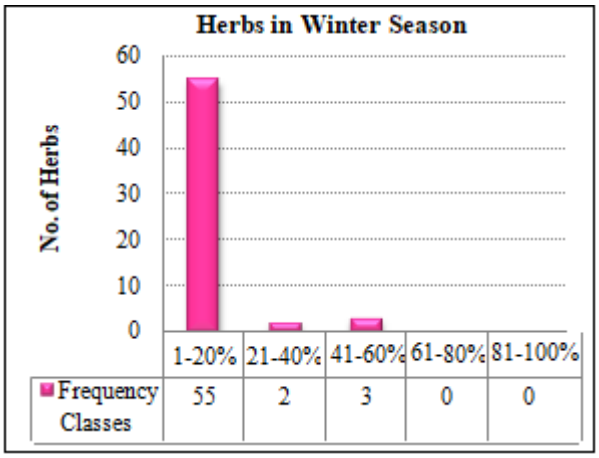
S. No.	Botanical Name	Local / Vernacular Name	Family	Habitat	% Frequency	Density	Abundance	Relative Frequency	Relative Density	Relative Abundance	Important Value Index
1	*Abutilon indicum* (Link.) Sweet.	Atibala	Malvaceae	Wild	7	0.14	2.00	1.01	0.31	0.89	2.21
2	*Aeschynomene indica* Linn.	Langaun	Fabaceae	Wild	5	0.32	6.40	0.72	0.71	2.87	4.30
3	*Ageratum conyzoides* Linn.	Lango	Asteraceae	Wild	11	0.33	3.00	1.59	0.73	1.34	3.60
4	*Alloteropsis cimicina* (L.) Stapf	Ghass	Poaceae	Wild	11	0.42	3.81	1.59	0.94	1.71	4.24

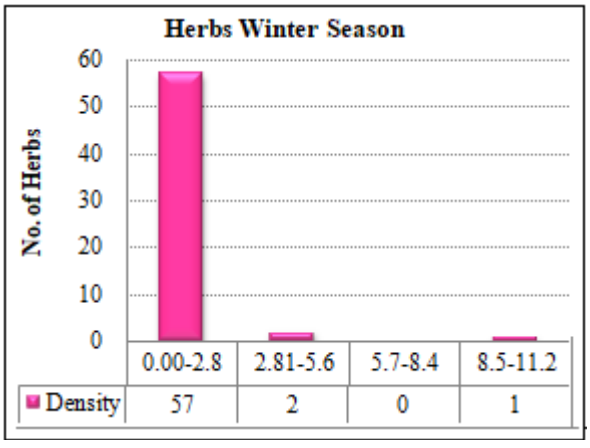
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5	*Alysicarpus vaginalis* DC.	Latkana	Fabaceae	Wild	11	0.51	4.63	1.59	1.14	2.07	4.80
6	*Andrographis echoides* (L.) Nees.	Kala Bhui Neem	Acanthaceae	Wild	5	0.13	2.60	0.72	0.29	1.16	2.17
7	*Andrographis paniculata* (Burm. f.) Wall. ex Nees	Bhui Neem	Acanthaceae	Wild	12	0.60	5.00	1.73	1.34	2.24	5.31
8	*Anisomeles indica* (L.) Auntze.	Van Tulsa	Lamiaceae	Wild	4	0.14	3.50	0.57	0.31	1.57	2.45
9	*Biophytum sensitivum* (Linn.) DC. Edgew & Hook F.	Laxmana	Oxalidaceae	Wild	6	0.14	2.33	0.86	0.31	1.04	2.21
10	*Cayratia carnosa* (Lam) Gagnep	Ram chana	Vitaceae	Wild	5	0.08	1.6	0.72	0.17	0.71	1.60
11	*Centella asiatica* (L.) Urban	Brahmi	Apiaceae	Wild	6	0.26	4.33	0.86	0.58	1.94	3.38
12	*Chloris dolichostachya* Lag.	Vengoli	Poaceae	Wild	7	0.21	3.00	1.01	0.47	1.34	2.82
13	*Corchorus acutangulus* Lag.	Nalta	Malvaceae	Wild	5	0.54	0.33	0.72	1.21	0.14	2.07
14	*Cleome viscosa* L.	Hurhur	Cleomaceae	Wild	8	0.87	0.20	1.15	1.94	0.08	3.17
15	*Clitoria ternatea* L.	Aparajita	Fabaceae	Wild / Cultivated	5	0.10	2.00	0.72	0.22	0.89	1.83
16	*Cenchrus setigerus* Vahl.	Dhaman Ghass	Poaceae	Wild	7	0.19	2.71	1.01	0.42	1.21	2.64
17	*Costus speciosus* (Koenig) Sm.	Keokand	Zingiberaceae	Wild	10	0.36	3.60	1.44	0.80	1.61	3.85
18	*Crotalaria pallida* Aiton	Junglisan	Fabaceae	Wild	3	0.14	4.66	0.43	0.31	2.09	2.83
19	*Curculigo orchioides* Gaertn	Kalimusli	Amaryllidaceae	Wild / Cultivated	18	1.40	7.77	2.60	3.13	3.48	9.21
20	*Cyanotis oxillaris* (L.) D. Don ex sweet	Baghanulla	Commelinaceae	Wild	3	0.07	2.33	0.43	0.15	1.04	1.62
21	*Cynodon dactylon* Pers.	Dub ghass	Poaceae	Wild	8	0.42	5.25	1.15	0.94	2.35	4.44
22	*Cyperus bulbosus* Vahl.	Junglipyaz	Cyperaceae	Wild	12	0.42	3.50	1.73	0.94	1.57	4.24
23	*Cyperus compressus* (L.)	Ghass	Cyperaceae	Wild	9	0.35	3.88	1.30	0.78	1.74	3.82
24	*Cyperus iria* Linn.	Tarajughass	Cyperaceae	Wild	5	0.25	5.00	0.72	0.56	2.24	3.52
25	*Cyperus rotundus* L.	Nagarmotha	Cyperaceae	Wild	11	0.53	4.81	1.59	1.18	2.15	4.92
26	*Cyperus scariosus* R.Br.	Motha	Cyperaceae	Wild	9	0.98	0.75	1.30	2.19	0.33	3.82
27	*Cyperus triceps* (Roxb.) Endl.	Nirbisi	Cyperaceae	Wild	10	0.52	5.20	1.44	1.16	2.33	4.93
28	*Desmodium triflorum* DC.	Kaldali	Fabaceae	Wild	48	5.55	11.56	6.94	12.43	5.18	24.55
29	*Desmodium gangeticum* DC.	Salparni	Fabaceae	Wild	14	0.32	2.28	2.02	0.71	1.02	3.75
30	*Elephantopus scaber* L.	Mayur chundi	Asteraceae	Wild	10	0.22	2.20	1.44	0.49	0.98	2.91
31	*Elytraria acaulis* (L.f.) Lindau	Dasmori	Acanthaceae	Wild	6	0.14	2.33	0.86	0.31	1.04	2.21
32	*Eragrostis ciliaris* Linn.	Grass	Poaceae	Wild	6	0.24	4.00	0.86	0.53	1.79	3.18
33	*Euphorbia hirta* Linn.	Dudhi	Euphorbiaceae	Wild	3	0.05	1.66	0.43	0.11	0.74	1.28
34	*Evolvulus alsinoides* Linn.	Shankha Pushpi	Convolvulaceae	Wild	14	0.50	3.57	2.02	0.71	1.60	4.33
35	*Fimbristylis miliacea* (L.) Vahl	Mutha	Cyperaceae	Wild	8	0.87	0.16	1.15	1.94	0.11	3.20
36	*Gloriosa superba* Linn.	Kalihari	Colchicaceae	Wild	9	0.24	2.66	1.30	0.53	1.19	3.02
37	*Hemidesmus indicus* (L.) R. Br.	Anantmool	Asclepiadaceae	Wild	29	0.65	2.24	4.19	1.45	1.00	6.64
38	*Heteropogon contortus*(Linn.) Beaun. Ex Roem & Schwt.	Shupla kanta	Poaceae	Wild	17	1.40	8.23	2.46	3.13	3.69	9.28
39	*Hyptis svaveolens* (L.) Poit.	Ban Tulsa	Lamiaceae	Wild	54	11.2	20.64	7.81	25.10	9.26	42.17

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40	*Ludwigia perennis* Linn.	Jal Dhawai	Onagraceae	Wild	5	0.14	2.80	0.72	0.86	1.25	2.83
41	*Lygodium flexuosum* (L.) Sw.	Indra raj	Schizaecaceae	Wild	3	0.08	2.66	0.43	0.17	1.19	1.79
42	*Malva parviflora* Linn.	Panirak	Malvaceae	Wild	10	0.22	2.20	1.44	0.49	0.98	2.91
43	*Malvestrum coromendelianum* (L.) Garcke	Jhadu Ghass	Malvaceae	Wild	15	0.28	1.86	2.17	0.62	0.83	3.62
44	*Meremmia emarginata* Burm. F.	Musakani	Convolvulaceae	Wild	57	5.60	9.82	8.24	12.55	4.40	25.19
45	*Oldenlandia corymbosa* Linn.	Pit Papara	Rubiaceae	Wild	7	0.17	2.42	1.01	0.38	1.08	2.47
46	*Oxalis corniculata* Linn.	Chuka tripati	Oxalidaceae	Wild	3	0.08	2.66	0.43	0.17	1.19	1.79
47	*Peristrophe bicalyculata* (Rete.) Nees.	Atrilal	Acanthaceae	Wild	7	0.19	2.71	1.01	0.42	1.21	2.64
48	*Phyllanthus niruri* Hook. F.	Bhui Amla	Euphorbiaceae	Wild	8	0.38	4.75	1.15	0.85	2.13	4.13
49	*Rungia pectinata* (L.) Nees.	Tavashu	Acanthaceae	Wild	15	0.38	2.53	2.17	0.85	1.13	4.15
50	*Rungia repens* Nees.	Kharmar	Acanthaceae	Wild	10	0.28	2.80	1.44	0.62	1.25	3.31
51	*Scoparia dulcis* Linn.	Ghoda Tulsi	Scrophulariaceae	Wild	8	0.30	3.75	1.15	0.67	1.68	3.50
52	*Setaria glauca* (L.) Beauv.	Lapetra	Poaceae	Wild	13	0.24	1.84	1.88	0.53	0.82	3.23
53	*Sida rhombifolia* Linn.	Lal Barela	Malvaceae	Wild	8	0.36	4.50	1.15	0.80	2.01	3.96
54	*Tephrosia purpurea* (L.) Pers.	Sarponkh	Fabaceae	Wild	15	1.64	1.36	2.17	3.67	0.61	6.45
55	*Thysanolaena maxima* (Roxb.)	Phool Baheri	Poaceae	Wild	23	1.00	4.34	3.32	2.24	1.94	.7.50
56	*Tridax procumbens* Linn.	Khargosh ghass/ Pok sunala	Asteraceae	Wild	15	0.56	3.73	2.17	1.25	1.67	5.09
57	*Vernonia cinerea* Nees.	Sahdevi	Asteraceae	Wild	20	0.45	2.25	2.89	1.00	1.00	4.89
58	*Vicoa vestita* Benth. (Wall. ex DC.)	Pila Rasna	Asteraceae	Wild	8	0.12	1.50	1.15	0.26	0.67	2.08
59	*Youngia japonica* (Linn.) DC.	Mauli	Asteraceae	Wild	4	0.09	2.25	0.57	0.20	1.00	1.77
60	*Zornia gibbosa* Spanoghe	Samarpani	Fabaceae	Wild	6	0.26	4.33	0.86	0.58	1.94	3.38





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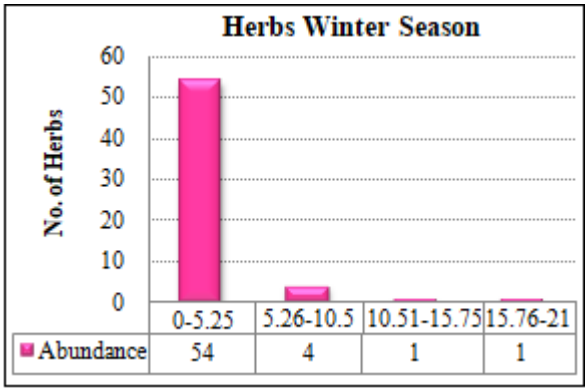
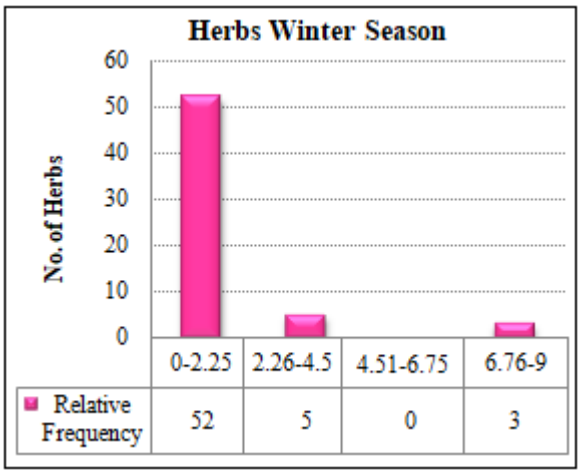
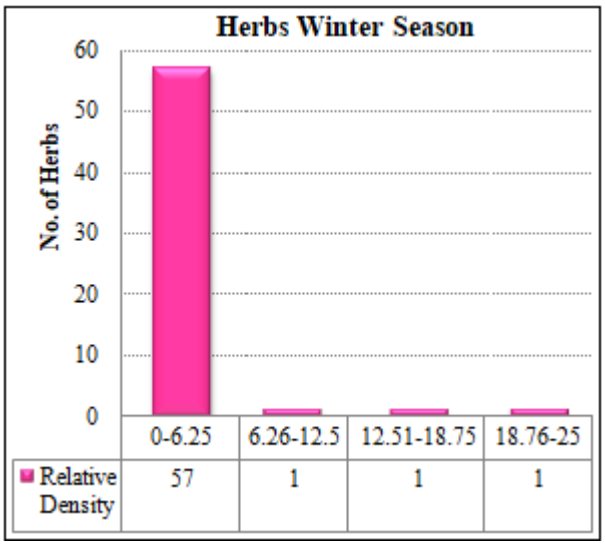


Figure 1: Frequency, density and abundance of Herbs in winter determined in Bhupdeopur Reserve forest area of district Raigarh





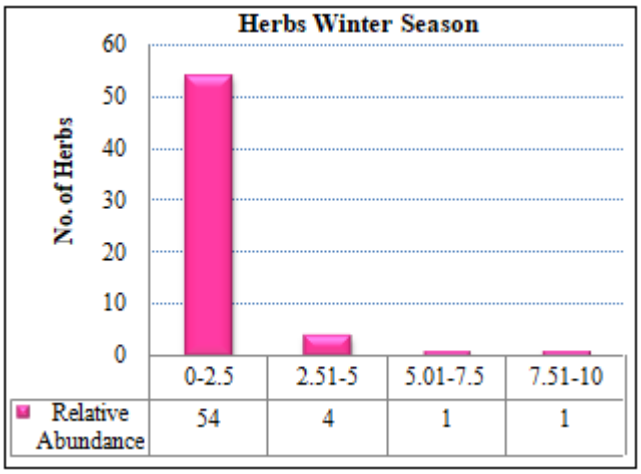


Figure 2: Relative Frequency, Relative density, Relative Abundance of Herbs determined in Bhupdeopur Reserve forest area of district Raigarh

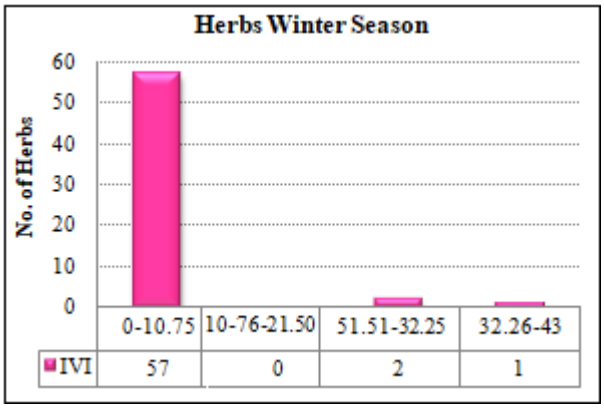


Figure 3: Important Value Index (IVI) of Herbs determined in Bhupdeopur Reserve forest area of district Raigarh

4. Conclusion

The Phytosociological diversity analysis of herb layer vegetation during winter season clearly indicates that Bhupdeopur Reserve Forest is an extremely important ecosystem by the virtue to richness of forest health and diversity of herb species. The species which are threatened need more attention and care.

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DIVERSITY OF SOIL AND LEAF SURFACE MYCOFLORA: A SOURCE OF AEROMYCOFLORA

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Microorganisms are introduced into the air from various sources. The important sources of these microorganisms are soil and vegetation of that area. Microorganisms, which are found on plants' surface either as pathogens or as saprophytes, also get suspended in the air. Man-made actions like digging or ploughing the soil may also release soil-borne microbes into the air. The surrounding atmosphere

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No...3758/9...

Durg, Date: 06/12/2021

SANCTION LETTER OF RESEARCH PROJECT

Project No. – MN/RP/12/BOT, Date – 06/12/2021

The minor Research Project Submitted by **Dr. Shriram Kunjam**, entitled – **"Evaluation of in silico anti arthritic potential of medicinal plant *Croton roxburghii* Balak (Euphorbiaceae)"** has been evaluated and accepted by the committee and so the proposal is being sanctioned for investigation in subject Botany.

The allocation of the project is as below mentioned –

S. No.	Investigators	Components	Allocation	Remark
6.	**Dr. Shriram Kunjam**	Chemical, Glassware's	20,000=00	
		Hiring Service	20.000=00	
		Contingency	10,000=00	
		Travel	Nil	
		Miscellaneous	Nil	
			50,000=00 Fifty Thousand Only	

1. The tenure of above Minor Research Project will be 2 Years (till 5 Dec. 2023).
2. The Principal Investigator will be responsible for lawful expenditure as per finance rule of Government of Chhattisgarh and submission of audited report of all justified lawful expenditure to the College Office will be responsibility of Principal Investigator.
3. Any unlawful expenditure will be recovered from salary of the employee.
4. Any alteration in grants component shall not be admissible without prior approval from Research Council of the College.

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Ethnobotanical Survey of Medicinal Plant Species used by Tribal Communities Around Katghora Tehsil of Korba District

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The traditional knowledge about plants and their uses in India is disappearing in recent years because the new generations of villagers migrate to cities for better life and jobs. Katghora tehsil is located at 22.50 N 82.550 E and has an average elevation of 293 meters above the sea levels in Korba district of Chhattisgarh State, India. The ethnobotanical information was obtained through interviews using semi-structured questionnaires of 32 traditional healers of 14 villages. Details of plant species, part(s) used and remedy formulations were also collected for the treatment of different health problems.

A total 52 species in 35 families and 51 genera were reported in the treatment of various health conditions. Family Fabaceae was dominant of the plant species documented. Roots (38%) were the most frequently used parts in preparing herbal remedies. Decoction and oral administration were commonly used method of herbal medicine preparation. 26 health conditions were treated using medicinal plants.

This study highlighted the closed relationship between people of the area and plant species especially when faced with frequent diseases. Many plant species are used as remedies for multiple ailments. However, most of the species used were collected in the surrounding of the villages.

Keywords : Ethnobotany, Tribal community, Katghora, Medicinal plants.

INTRODUCTION

Medicinal plants have been used by humans from time immemorial. Many drugs have plant origin, and several plants are currently undergoing investigation to ascertain their therapeutic efficacies (Balunas, 2005, Vickers *et. al.* 2001). People who live in rural areas of the Asia-Pacific are familiar with the medicinal properties of plants, growing close to their homes, in the open fields, water margins, waste lands, both inside and outside the nearby forest areas and under different growth conditions. Most of the plant materials collected is used fresh either to obtain the extract from the whole plant or parts thereof, whether they are leaves, roots, flowers or fruits. In case of woody forms, mostly the bark, roots and other parts are used. Though dried plant parts are frequently used, often the easy availability of fresh material is a critical point and the herbal doctor in the village is well familiar with various plants he/she needs, their growth patterns, seasonality, habitat and other details. Such details were usually passed on in the past from parent to offspring in the family and uses of plants and the various combinations or mixes made were kept as a family secret. According to World Health Organization (WHO) - "Any plant and its organs containing any substance that can be used therapeutically, or can be used as raw material for chemical /pharmaceutical synthesis" is classified as drugs. Tribal people are people who live in harmony with nature and maintain a close relationship between human and environment. The World Health Organization estimates that up to 80% of the people in developing countries still depend on local medicinal plants to fulfill their primary health care needs (WHO,2002). In certain African countries, up to 90% of the population still relies exclusively on plants as sources of medicines (Hostettmann *et al* 2002). An estimated 25% of prescribed drugs and 11% of drugs considered essential by WHO are derived from plants, and a large number of synthetic drugs are obtained from precursor compounds originating from plants (Rates, 2001). The Indian subcontinent is being inhabited by more than 53.8 million tribal people in 5,000 forest dominated villages of tribal community and comprising 15% of the total geographical area of Indian landmasses, representing one of the greatest emporia of ethno-botanical wealth (Chowdhuri, 2000). The traditional knowledge about plants and their uses in India is disappearing in recent years because the new generations of villagers migrate to cities for better life and jobs. The present study provides that medicinal plants continue to play an important role in the healthcare system of this tribal community of Chhattisgarh, India.

MATERIALS AND METHODS

STUDY AREA

Katghora tehsil is located at 22.50 N 82.550 E and has an average elevation of 293 meters above the sea levels in Korba district of Chhattisgarh State, India. The inhabitant's people of Korba comes under different religious, social and cultural backgrounds. The main inhabitants are tribal that constitute the majority (51.67%) of the total population. The main scheduled tribes belong in Korba district are Pahadi Korwa, Gond, Raj Gond, Kawar, Bhaiyana, Binjhwar are Scheduled tribe and Dhanuhar, Satnami, Ganda and Panka etc are comes under the scheduled caste.

DATA COLLECTION

Intensive as well as extensive periodic field trips were conducted in the Katghora forest ranges. An organized questionnaire was used to record information concerning the name, age, sex, address, level of education of the interviewees, place of the collection of the plant and date of the meeting. Details of plant species, part(s) used and remedy formulations were also collected for the treatment of different health problems. In the present study, 14 villages of 32 traditional healers of Katghora Tehsil of Korba district of Chhattisgarh State were surveyed to gather information of plans and plant products used by different communities.

Table 1: Age and Gender Characteristics of Traditional Healers Interviewed in Katghora tehsil

	Age (Year)						
Gender	21-30	31-40	41-50	51-60	61-70	71-80	Total
Male	3	2	5	5	4	4	23
Female	-	2	1	3	2	1	09

Data analysis

The majority of the data collected during the study were descriptive in nature and explained directly. The collected data were recorded in a spreadsheet and treated in the form of percentage and proportion of the number of the plants per family in the study area, plants reported with the medicinal formulation and other ethnobotanical uses, method of preparation of herbal formulations, their mode of administration and the type of the ailments cured by herbal remedies are listed.

RESULTS

Medicinal Plant Diversity : A total 52 species in 35 families and 51 genera were reported in the treatment of various health conditions (Table -01). According to result, the percentage of species in families are Fabaceae (33%), Rubiaceae (19%), Asclepiadaceae (11%), Amaranthaceae, Solanaceae and Euphorbiaceae (07%) and rest of the families sharing (04%) (Figure-02).

Uses of Traditional Medicines in the local people : Traditional healers in the study area play an important role in primary health care of the local community as the majority of their clients came from poor families who cannot afford the modern health care services. According to traditional healers, the local people are reliant on wild plants for primary health care due to the widespread belief in its effectiveness over modern health care.

Plant Parts Used : The Katghora forest range forest constituted the largest number of trees, climbers, and herbs followed by shrubs, epiphytes and parasitic plants. This could be due to the fact that these growth forms are available in almost all seasons as they are relatively drought resistant and are not affected by seasonal variations. In the preparation of recipes, either the entire plant or plant parts including bark, stem, leaves, flowers, fruits, seeds, roots/rhizomes/tubers and latex are used. Roots (38%) were the most frequently used parts in preparing herbal remedies followed by whole plants (16%), bark (15%), tuber, stem and leaves (Aprox. 08%) by the different communities of the area. (Figure-03.)

A wide variety of health problems were treated using herbal remedies. According Interviews with traditional healers revealed different methods of diagnosis and treatment of ailments. The data obtained from the traditional healers, the majority of plant species were used to treat snake bite (17%), followed by scorpion sting and jaundice (09%), headache, cancer, cuts & wounds, booster tonic and hydrophobia (05%), diabetes and menstrual disorder (03%) (Figure-01). The most common health problem in the study area is snake bite, scorpion sting and jaundice. Recipes using single plant or plant parts were more common, although polyherbal recipes for a number of ailments were also used. The most common method of preparation was extracts in hot cold water, and mode of administration was oral rather than topical or other form. Decoction and oral administration were commonly used method of herbal medicine preparation. 26 health conditions were treated using medicinal plants.

The recommended dosage of a particular recipe differs not only from healer to healer but also on the severity of the ailment and the patient age: adults (>12 yr) and children (<12 yr). The doses for liquid preparations were prescribed through estimation in terms of a full, half- or one- fourth of a cup, depending on the age and physical condition of the patient as well as the severity of the ailment.

DISCUSSION

As the results of this study similar to earlier findings on the use of traditional medicine in Meghalaya that reported widespread use of indigenous remedies by both rural and urban communities (Ahmed and Borthakur 2005, Jaiswal 2010, Kharkonger and Joseh 1997, Mao *et al.* 2009, Rao and Shanpur 1981, Singh and Debnath 2008, Singh and Shanpur 2010, Singh *et al.* 2013, Singh and Singh 2002, Upadhaya *et al.*, 2005). Traditional NBR Garo healers believed that roots and barks are more effective than other plant parts, which is also similar to reports that indicated that the roots and other

Table 1 : List of medicinal plants and their uses of treatment of different diseases by different communities of Katghora Tehsil.

S.N.	Local Name	Botanical Name	Habit	Family	Plant Part Used	Name of Disease	Mode of preparation
1	Annatmul	*Hemidesmus indicus*	C H	Asclapiadaceae	Root	Snake bite	Root extract is boiled with drinking water and given orally twice a day
2	Khadhar	*Gardenia turgida*	S	Rubiaceae	Root		Aqueous extract of root is prepared in water and given orally, two or three times a day
3	Mithi Veriyari	*Scoparis dulcis* Linn	H	Scrophulariaceae	Whole Plant		Decoction of whole plants is given orally three times a day
4	Lajwanti	Mimosa pudica Linn	H	Fabaceae	Whole Plant		whole plants are made extract in 250 ml of drinking water and shaken well and filtered. Extract of whole plant is given twice a day in one day only
5	Kewanch	*Mucuna pruriens* Linn	C H	Fabaceae	Root		Decoction of root is given twice a day
6	Rohina	*Soymida ferifuga* (Roxb) Adr. Juss	T	Meliaceae	Root and bark		50 g fresh bark of this plant together with 50 g root of Holarrhena pubescens are made into paste, and mixed with 200 ml of drinking water and given orally three times a day for three days
7	Haldu	*Haldia cordifolia* (Roxb)	T	Rubiaceae	Bark and Leaf		Fresh juice of bark and leaf is given orally twice a day in two days
8	Bada Chakoda	*Senna obtusifolia* L. Irwin & Barneby	H	Fabaceae	Seed		Decoction of seed powder is given orally twice a day
9	Apamarg	*Achyranthus aspera* L.	H	Amaranthaceae	Root		Root of both plant is boiled and make extract and given orally once a day
10	Sarphonk	*Tephrosia purpurea* (L) Pers	H	Fabaceae	Root		
11	Ber	Ziziphus mauritiana (Lamk.)	T	Rhamnaceae	Root	Scorpion sting	Fresh root is eaten
12	Saliha	*Boswellia serrata* (Trihana & Planc)	T	Burseraceae	Bark		Paste of the fresh stem bark is applied externally on to scorpion sting
13	Apamarg	*Achyranthus aspera* L.	H	Amaranthaceae	Root		Paste of fresh roots along with 200 ml of drinking water is made into aqueous extract and given one time a day.
14	Bhatkataiya (Kantkari)	*Solanum xanthocarpum* Schardt & Wendl	H	Solanaceae	Root		Paste of fresh root is applied on to the scorpion sting
15	Arand	*Ricinus communis*	S	Euphorbiaceae	Root		Paste of root is used externally on the scorpion sting
16	Marorphalli	*Helicteres isora*	S	Sterculiaceae	Root	Jaundice	

17	Dronpuspi	*Leucas cephalotes* (Roth) Spreng	H	Lamiaceae	Whole Plant		Decoction of whole plants is given orally twice a day
18	Bhui Aonla	*Phyllanthus niruri* L.	H	Euphorbiaceae	Whole Plant		
19	Bada Chakoda	*Senna obtusifolia* L. Irwin & Barneby	H	Fabaceae	Seed		Seed powder with water is used
20	Safed Punarnava	*Boerhavia procumbens*	H	Nyctaginaceae	Whole Plant		Whole plants are boiled with water and given a day
21	Guruch, Gilo	*Tinospora cordifolia* Willd.	C H	Menispermaceae	Root and Stem	Diabetes	Fresh juice is given daily
22	Gudmar	*Gynema sylvestry*	H	Asclapiadaceae	Leaf and Stem		Infusion of leaf and stem is used in diabetes
23	Bhui Neem	*Andrographis paniculata* ()	H	Acanthaceae	Whole Plant	Fever	Decoction of whole plant parts is given twice a day in fever
24	Hadjod	*Cissus quadrangularis* L.	C H	Vitaceae	Whole Plant	Bone Fracture	Pest of whole part applied in the fracture
25	Teak	*Tectona grandis* L.f.	T	Lamiaceae	Young Leaf	Bladder Stone	Decoction of young leaf is used
26	Haldu	*Haldia cordifolia* (Roxb)	T	Rubiaceae	Leaf	Headache	Pest of leaf and root is applied in the pain
27	Bhatkataiya (Kantkari)	*Solanum xanthocarpum Schardt & Wendl*	H	Solanaceae	Root		
28	Ban Tulsi	*Ocimum gratissimum* L.	H	Labiateae	Leaf		
29	Semal	*Bombax ceiba*	T	Bombacaceae	Gum	Menstrual Disorder	Root and gum of both the plants with milk given twice a day
30	Sarphonk	*Tephrosia purpurea* (L) Pers	H	Fabaceae	Root		
31	Sarai	*Shorea robusta* Roth	T	Dipterocarpaceae	Bark	Cancer	Mixture of bark and root of three plants of decoction is given twice a day
32	Dhawai	*Woodfordia fructicosa* L. Kurz	S	Lytharaceae	Root		
33	Mahua	*Madhuca latifolia*	T	Sapotaceae	Bark		
34	Bhui Champa	*Premna herbacea*	T	Verbinaceae	Root	Arthritis	Pest of root is applied in the joint pain
35	Gilo	*Tinospora cordifolia* Willd.	C H	Fabaceae	Stem		Stem is boiled with water and given twice a day
36	Ban Pyaj	*Curculigo capitulata*	H	Liliaceae	Tuber	Tuberculosis	Decoction of tuber is used
37	Ban Semi	*Dolichos gladiatus*	C H	Fabaceae	Root	Booster Tonic	Decoction of root used as booster tonic
38	Safed Musli	*Chlorophytum borivilanum* L.	H	Liliaceae	Tuber		Powder of tuber with milk is given twice a day
39	Satawar	*Asparagus racemosus* Willd.	H	Liliaceae	Tuber		Decoction of root is given twice a day
40	Ban Kosum	*Schleichera oleosa* (Lour.) Merr.	T	Sapindaceae	Root	Syphilis	
41	Tendu	*Diospyros melanoxylon* Roxb.	T	Ebenaceae	Root and Bark	Wounds	Pest of root and bark is used in wounds
42	Gunja	*Lannea coromandelica* (Houtt.) Merr	T	Anacardiaceae	Bark Juice	Cuts	Bark juice used in cut part
43	Bhringraj	*Eclipta alba* Linn.	H	Asteraceae	Whole Plant		Pest of whole part of plants applied in the cut

44	Mehndi, Heena	*Lawsonia inermis* Linn.	S	Lytharaceae	Root	Epilepsy	Juice taken fresh to cure stomach
45	malkangni	Celastrus paniculata willd	T	Celastraceae	Root		disorder whereas dried root in epilepsy
46	Punarnava	*Boerhavia diffusa* L.	H	Nyctaginaceae	Whole Plant	Piles	Decoction of whole plant is given twice a day and paste is also applied in piles
47	Saja	*Terminalia tomentosa* Willd.	T	Combratacea	Bark	Stomachache	Infusion of bark is given
48	Kalihari	*Gloriosa superba* L.	C H	Liliaceae	Root	Swelling	Paste of root is applied in swelling
49	Amaltas	*Cassia fistula* L.	T	Fabaceae	Root and Bark	Hydrophobia	Decoction of root, bark and fruit is given
50	Kumhi	*Careya arborea* Roxb.	T	Lecythidaceae	Bark and Fruit		
51	Madar	*Calotropis procera*	S	Asclapiadaceae	Root		
52	Keo Kand	*Costus speciosus*	H	Costaceae	Tuber	Gastric	Tuber is boiled with drinking water and given orally twice a day
53	Ban Sarson	*Brassica napus* L.	H	Brassicaceae	Whole Plant	Leucorrhea	Decoction of whole plants is given twice a day in three days
54	Chitrak	*Plumbago zeylanica* Linn.	H	Plumbaginaceae	Root and Leaf	Skin disorder	Paste of root and leaf is applied in skin disorder
55	Gorakhmundi	*Sphaeranthus indica* Linn.	H	Asteraceae	Whole Plant	Goiter	Paste of whole plants is applied in the goiter
56	Gudsukari	*Grewia hirsuta* Linn.	S	Tilliaceae	Root	Dysentery	Roots are used to treat amoebic dysentery
57	Anar	*Punica granatum* L.	S	Punicaceae	Young Fruit		Fresh juice of unripe fruit is given twice a day
58	Patal Kumhada	*Pueraria tuberosa* Willd. DC.	H	Fabaceae	Tuber	Kidney disorder	Tuber is boiled with drinking water and given orally once a day in three days

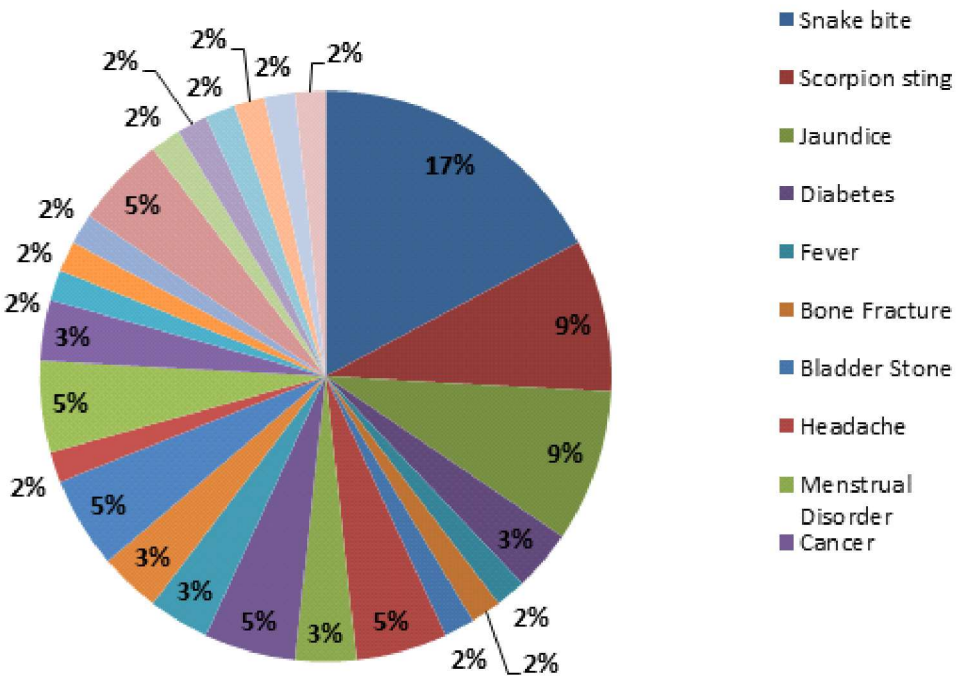


Fig.-01 The use aim and usage percentages of the plants in the study area

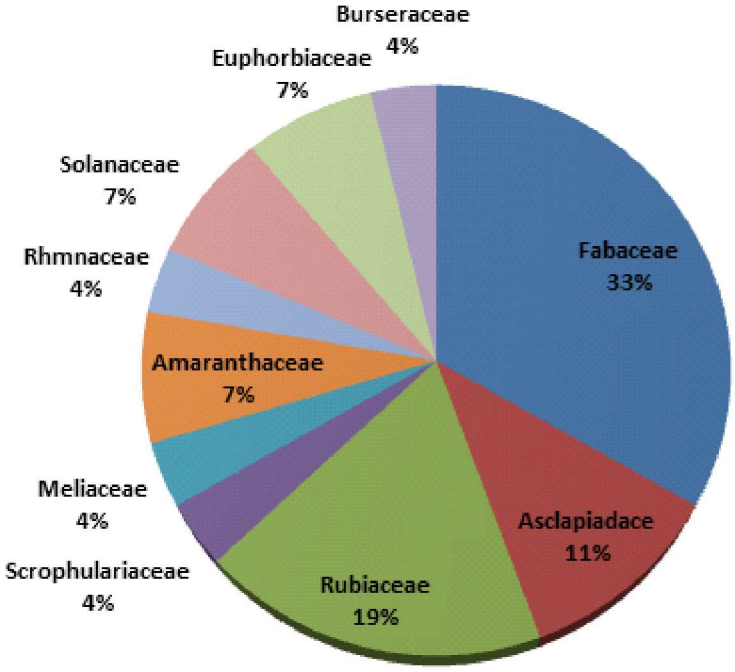


Fig.-02 Family wise distribution of plants

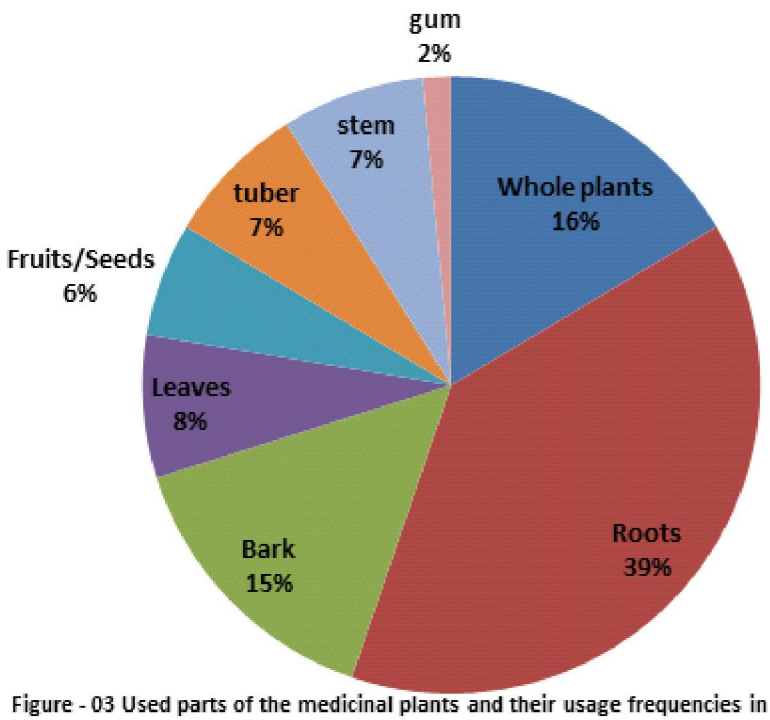


Figure - 03 Used parts of the medicinal plants and their usage frequencies in the study area

underground parts had high concentrations of bioactive compounds (Kunwar *et al.* 2006). The uses of mixtures of plant species in treatment of particular diseases are common in the other part of country (Jaiswal 2010 and Kayang 2007). Snake bites in rural areas are commonly treated with plant extracts (Kumar *et al.* 1987 and Kunwar *et al.,* 2006). In general, the plant families Compositae, Fabaceae and Solanaceae are well represented in East African compendia. The frequent uses of leaves and roots are antivenin preparation is noted by Watt *et al.* and Bennett *et al.* (Bennet and Prance 2000, Watt and Breyer-Brandwijik 1962.).

CONCLUSIONS

This study highlighted the closed relationship between people of the area and plant species especially when faced with frequent diseases. Many plant species are used as remedies for multiple ailments. Villagers are generally migrating to big cities and benefiting from the facilities of modern medicine, the heritage of traditional ethnobotanical knowledge's is decreasing dramatically. Traditional knowledge of medicinal properties of plants was vibrant in the area due to continued reliance on plant resources for primary health care needs. Although the traditional healers of Katghora forest ranges claimed a high level of efficacy from their herbal remedies, there is a need to standardize the preparation techniques of recipes, dose regimens, methods of administration, and diagnosis of ailments. The findings of the present study asserted the need for scientific validation of the reported species for their efficacy against the disease concerned through further phytochemical and other studies.

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Extremophiles
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REVIEW

Molecular strategies to enhance stability and catalysis of extremophile-derived α-amylase using computational biology

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Abstract

α-Amylase is the most significant glycoside hydrolase having applications in various industries. It cleaves the α,1–4 glucosidic linkages of polysaccharides like starch, glycogen to yield a small polymer of glucose in α-anomeric configuration. α-Amylase is produced by all the three domains of life but microorganisms are preferred sources for industrial-scale production due to several advantages. Enormous studies and research have been done in this field in the past few decades. Still, it is requisite to work on enzyme stability and catalysis, as it loses its functionality in extreme. As the enzyme loses its structural and catalytic property under extreme environmental conditions, it is mandatory to confer some potential strategies for enhancing enzyme behaviour in such conditions. This limitation of an enzyme can be overcome up to some extent by extremophiles. They serve as an excellent source of α-amylase with outstanding features. This review is an attempt to encapsulate some structure-based strategies for improving enzyme behaviour thereby enabling researchers to selectively amend any of the strategies as per requirement during upstream and downstream processing for higher enzyme yield and stability. Thus, it will provide some cutting-edge strategies for tailoring α-amylase producing organism and enzyme with the help of several computational biology tools.

Keywords α-Amylase · Computational biology · Extremophiles · Glycoside hydrolase · Structural insights

Introduction

Enzymes are the most vital bio-product needed for sustaining life on earth. In recent years, α-amylase has significantly replaced the chemical hydrolysis of starch in industries. α-Amylase (α-1,4-glucan 4-glucanohydrolase, EC 3.2.1.1) is an endo-acting hydrolyzing enzyme responsible for the breakdown of α,1–4 glucosidic linkages of starch and other related polysaccharides to yield maltooligosaccharides, glucose, and limit dextrin in an α-anomeric form (Machius et al. 1995; Yadav 2012; Al-Dhabi et al. 2020; Abd-Elaziz et al 2020; Janeček and Zámocká 2020). The total contribution of α-amylases in the enzyme market is about 30% and hence occupies the second position after proteases (Wu et al. 2018; Allala et al. 2019; Wang et al. 2019a; Abd-Elaziz et al. 2020). It is synthesized by microorganisms, plants, and animals. But for large-scale production, microorganisms are generally selected. Microorganisms are preferred because they offer cheaper large-scale production, ease of genetic engineering approaches, enormous strain availability etc. (Abdel-Fattah et al. 2013; Abd-Elhalem et al. 2015; Afrisham et al. 2016). It is extensively used in several industries and plays a substantial role in them (Table 1).

Despite having lots of industrial applications there are certain shortcomings related to the use of α-amylase. They tend to drop their structural conformations, stability, and catalysis when allowed to work in extreme conditions (Ahmed et al. 2020). To overcome this sensitivity of α-amylase towards harsh conditions, researchers are seeking sources living in extreme environmental conditions. Extremophiles are the organism inhabiting such harsh environment

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Table 1 Role of α-amylase in various industries

S. no	Industries	Role	References
1	Sugar	Starch gelatinisation, saccharification, liquefaction, high fructose corn syrup synthesis	Gupta et al. (2003), Kikani and Singh (2012), Mehta and Satyanarayana (2016)
2	Detergent	Act as an additive in laundry for removal of starchy food stains like (potato, chocolates, sweets etc.), blood stains. Potential uses in the detergent formulation because α-amylase can also tolerate alkaline condition	Roy et al. (2012), Roy et al. (2013), Jagadeeswari and Santhi (2016)
3	Bakery (food)	As an anti-staling agent, dough softening agent, quality enhancer of bakery products like bread, It is used to make noodles with high porosity, Fruit juice synthesis Additive in animal feed for proper digestion	Gomes-Ruffi et al. (2012), Haghighat-Kharazi et al. (2018), Li et al. (2019), Trabelsi et al. (2019), Wang et al. (2020)
4	Pharmaceuticals (clinical)	Widely used in drug delivery in the form of ECDR (enzymatically-controlled drug release) and CLA tablet (cross-linked amylose) to accelerate controlled drug release, used in digestive aids	Dumoulin et al. (1999), Rahmouni et al. (2001)
5	Textile	Widely used for textile biofinishing in the form of a bio-desizing agent for the removal of starch, denim washing	Chinnammal and ArunKumar (2013), Colomera and Kuilderd (2015)
6	Biofuels & Breweries	Hydrolyse sugar and lignocellulosic biomass for the synthesis of beer, bioethanol	Kikani and Singh (2012)
7	Paper	For the hydrolysis of starch coating of paper to make it smooth for writing	Gupta et al. (2003), de Souza and e Magalhães (2010)
8	Leather	Used in the dehairing and fibre opening of leather	Gupta et al. (2003), Choudharyet al. (2004)
9	Waste management/ Bioremediation	Widely used for the biodegradation of hydrocarbons like n-alkanes in association with starch, also used for food waste degradation, treatment of effluent rich in starch-based wastes	Kikani and Singh (2012), Karimi and Biria (2016), Msarah et al. (2020), Pinto et al. (2020)
10	Others	Biofilm inhibitor of *Staphylococcus aureus, Pseudomonas aueroginosa* related biofilms, biodemulsifier	Craigen et al. (2011), Jiang et al. (2018), Vaikundamoorthy et al. (2018)

like hot springs or geysers, hydrothermal vents, geothermal areas, geographical poles, Antarctica sea ice etc. (Cipolla et al. 2012; Moshfegh et al. 2013; Allala et al. 2019; Wang et al. 2019a; Ottoni et al. 2020). They can serve to be the potential source of α-amylase having tremendous potential and remarkable metabolic features to bear similar conditions in industries without losing its stability and efficiency. Thus, the presented review aims to put stress on the various strategic upstream and downstream approaches by the help of various bioinformatics tools. These approaches will help to obtain α-amylase from sources like extremophiles which might be beneficial for the researcher for tailoring it as per the requirement to make the best version of it.

Structural features of α-amylase

α-Amylase belongs to the family of glycoside hydrolases 13, 57, 119 and 126. Furthermore, it is also present in the subfamilies of GH13 i.e., GH13_1, 5, 6, 7, 10, 14, 15, 19, 24, 27, 28, 32, 36, 37, 39, 41, 42 (Janeček et al. 2014). The details regarding the GHs family, its subfamilies is available on CAZy database (http://www.cazy.org/) and is updated regularly with latest information regarding its number. The main representative family of α-amylase is GH13 with a total of about ~ 112,268 sequences currently available (as on January 29th, 2021). The structure of α-amylase is characterized by three domains (A, B, and C) (Fig. 1). The A domain is known as the catalytic domain which comprises a central scaffold of $(\beta/\alpha)_8$ TIM (triosephosphate isomerase) barrel and regarded as the N-terminal of the enzyme (Janecek et al. 1997; Yadav 2012). As the $(\beta/\alpha)_8$ barrel fold was firstly seen in chicken muscle triosephosphate isomerase, it was named as TIM barrel. The domain B which varies in size and structure in different species appears as a long loop originating from strand β3 and helix α3 of the $(\beta/\alpha)_8$ barrel. Being a metalloenzyme, there is a calcium (Ca^{2+}) binding site at the interface of domain A and B and hence serving as a connecting link for both the domains. The C domain consists of eight antiparallel β sheets (Greek key motif) and regarded as the C-terminal end of the enzyme (Yadav 2012; Janeček et al. 2014). There are certain features which are conserved

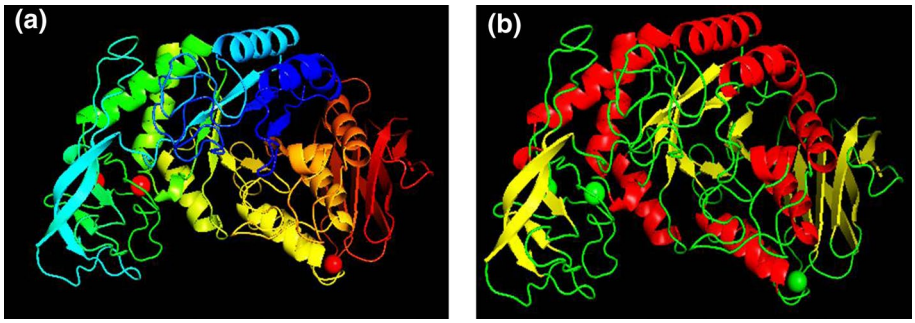


Fig. 1 Predicted molecular structure of α-amylase obtained from *Bacillus subtilis* WB600 (UNIPROTKB ENTRY: C0LZX2_BACLI). The α-amylase encoding gene sequences was harvested from NCBI (https://www.ncbi.nlm.nih.gov/) and the structure was prepared by homology modelling using SWISS-MODEL (https://swissmodel.expasy.org/) in which PDB ID 1BLI (Machius et al. 1998) was taken as a template in which 98.96% sequence identity was there. **a** The A, B, and C domains are shown in blue, green and red respectively and the three calcium ions are shown by red spheres **b** the helix, sheet and loop were shown in red, yellow and green respectively

in the GH13 family like (1) the 4–7 conserved regions (sequence fingerprint), out of which the first four regions (I, II, III and IV) are located near the β3, β4, β5, β7 of the central $(\beta/\alpha)_8$ TIM barrel. The rest of the conserved domains (V, VI, VII) are situated at the C-terminus of domain B or the β2 and β8 of the barrel-fold, (2) The three catalytic residues are regarded as catalytic triad comprises of aspartic acid at β4 (act as a nucleophile), glutamic acid at β5 (proton donor) and aspartic acid (stabilizes the transition state) at β7 (Janecek et al. 1997; Janeček et al. 2014).

Factors responsible for α-amylase stability and catalytic efficiency

The functionality of α-amylase in industries is mainly dependent on its stability. There are so many intrinsic and extrinsic factors which account for α-amylase stability and catalytic behaviour (Yadav 2012; Dey et al. 2016).

Intrinsic factor

The amino acid residues composition and its type, charge, flexibility is the most critical intrinsic factor responsible for the adaptability of α-amylase in life-threatening environmental conditions (Table 2). There are variations in the total amino acid residues composition and their alignment in organisms inhabiting colder region (psychrophiles), hotter region (thermophiles), and high salinity (halophiles) and pH fluctuations (acidophiles and alkalophiles) etc. (Table 3 and Fig. 2).

For analyzing the influence of intrinsic factors like amino acid sequence on physiological adaptations, four different α-amylase genes (as an illustrative example) from various organisms were selected and aligned for comparative study. α-Amylase gene from *Pseudoalteromonas* sp. 2–3 (UNIPROTKB ENTRY: W8SKF6_9GAMM) as a psychrophilic α-amylase, *Bacillus licheniformis* NH1 (UNIPROTKB ENTRY: A1YR25_BACLI) as a thermotolerant α-amylase, *Bacillus subtilis* WB600 (UNIPROTKB ENTRY: C0LZX2_BACLI) as an acidic α-amylase, *Luteimonas abyssi* (UNIPROTKB ENTRY: A0A1B1HY00_9GAMM) as an alkali-stable α-amylase.

Extrinsic factors

The external factors such as pH of the surrounding medium, chelators, and metal ions also affect the enzyme stability (Yadav 2012). The protein stability is fairly dependent on the type of weak interactions like the electrostatic interactions, hydrogen bonding, and van der Waal's forces etc.

Physiological adaptations in α-amylase inhabiting extreme environmental conditions

It is worth wondering how some organisms like the extremophiles are capable in withstanding such harsh environmental conditions. They make necessary changes in their intrinsic and extrinsic factors to attain homeostasis for surviving in those regions.

Structural features of cold-active α-amylase

The α-amylases which are active even at low temperature are advantageous because they cut-off the energy expenditure required for sustaining high temperature. There are extremely low-temperature regions like the Alpine region, deep-sea water, North and South Pole which are inhabited by psychrophiles (Smalås et al. 2000). Psychrophilic or cold-active α-amylase is active even in a temperature range

Table 2 The compositional analysis of amino acid residues and other modifications in α-amylases from different sources which are adapted in various harsh conditions

S. no	Adaptation	Amino acid residues		Any other modifications	References
		Decreased	Increased		
1	High temperature	Asp, Gln	Charge and polar amino acid residues Lys, Arg, Glu	Increased number of salt bridges	Tomazic and Klibanov (1988), Cambillau and Claverie (2000), Siddiqui et al. (2010)
2	Low temperature	Pro, Arg/Arg + Lys ratio	Met, acidic and hydrophobic residues	Reduced number of disulphide bond and aromatic interaction, lower binding affinity to Ca^{2+}	Smalås et al. (2000), Feller (2003), Siddiqui et al. (2006)
3	Strong oxidizing agent	Met, Cys	Ala, Ser, Leu, Ile, Thr	–	Yang et al. (2012), Ozturk et al. (2013), Sindhu et al. (2017)
4	Acidic	His	Asp, Arg	Membrane impermeability to H^+ ions, developed secondary transporters for eliminating intracellular protons, tetraether lipid instead of ester linkages to reduce acid attack	Yang et al. (2013), Sharma et al. (2016), Liu et al. (2017)
5	Alkaline	Lys	Arg	-	Song et al. (2016)
6	High salinity	Basic amino acid residue like Lys, Arg, bulky hydrophobic residues (Phe, Ile, Leu)	Acidic amino acid residues like Asp, Glu	Biosynthesis or accumulation of various osmolyte in bacteria, archaea and eukaryotes to neutralize the salt stress, increased salt bridges	Roberts (2005), Karan et al. (2012), DasSarma and DasSarma (2015), Pan et al. (2020)

Table 3 The compositional analysis of amino acid residues of α-amylase genes obtained from various extremophiles

S. no	α-Amylase from	Total AAR	Amino acid residues composition			
			Lys (K)	Arg (R)	Basic amino acid residues	Acidic amino acid residues
1	*Pseudoalteromonas* sp. 2–3	596	(34) 5.7%	(17) 2.9%	Arg + Lys: 51	Asp + Glu: 63
2	*Bacillus subtilis* AS01a	659	(34) 5.2%	(22) 3.3%	Arg + Lys: 56	Asp + Glu: 68
3	*Bacillus subtilis* WB600	512	(30) 5.9%	(23) 4.5%	Arg + Lys: 53	Asp + Glu: 62
4	*Luteimonas abyssi*	475	(4) 0.8%	(37) 7.8%	Arg + Lys: 41	Asp + Glu: 47
5	*Bacillus licheniformis* NH1	512	(29) 5.7%	(24) 4.7%	Arg + Lys: 53	Asp + Glu: 62

The composition analysis was done through ExPASy ProtParam tool (https://web.expasy.org/cgi-bin/protparam/protparam). The number in parenthesis indicates the total number of that residue present in the whole gene sequence. (1) α-Amylase from *Pseudoalteromonas* sp. 2–3 (UNIPROTKB ENTRY: W8SKF6_9GAMM) is an psychrophilic α-amylase hence it has a low number of basic residues (Arg < Lys); (2) α-Amylase from *Bacillus subtilis* AS01a is thermophilic and as a result it has increased number of acidic amino acid; (3) α-Amylase from *Bacillus subtilis* WB600 (UNIPROTKB ENTRY: C0LZX2_BACLI) is acidic and thus it possess enhanced amount of acidic residues; (4) *Luteimonas abyssi* (UNIPROTKB ENTRY: A0A1B1HY00_9GAMM) is an alkalophilic α-amylase and hence it has high amount of Arg residues; (5) α-Amylase from *Bacillus licheniformis* NH1(UNIPROTKB ENTRY: A1YR25_BACLI) is thermostable and hence possess high amount of acidic residues

of 0–10 °C or even lower. The cold-adapted α-amylase is enriched with molecular flexibility to compensate for the low-temperature difficulties (Fig. 3a). The psychrophilic α-amylase has increased turnover number and catalytic efficiency and decreased thermal stability (Smalås et al. 2000). The variation in amino acid residues in cold-adapted α-amylase is described in Table 2. For stabilizing the α-amylase there is a significant reduction in the Pro residues to confer secondary structure flexibility (Feller 2003). Some of the psychrophiles secretes polyhydroxyalkanoates as a cryoprotectant for coping up with such low temperature (Irwin 2020).

Structural features of thermophilic α-amylase

Thermostability of α-amylase is the mandatory property to be applicable in industries. The thermophilic enzyme has so many benefits like they have decreased risk of contamination, do not require any cooling equipment installation and thereby cut-off the manufacturing cost. Various studies have revealed that the thermostability provided by domain B is also attached to domain A in the $(\beta/\alpha)_8$-barrel (Declerck et al. 2000). The type of adaption in the amino acid residues of a thermophilic amylase is shown in Table 2 and Fig. 3a. Most of the α-amylases are dependent on calcium ion (Ca^{2+}) for structural integrity and catalysis. It is also involved in the thermophilic adaptation of enzyme (Yadav et al. 2012). However, there are certain α-amylases which are independent of Ca^{2+} for their enzyme activity (Kikani and Singh 2012).

Structural features of low pH active α-amylase

The conversion of starch into glucose requires calcium-independent and low pH active α-amylases. Acid stability of α-amylases is one such property which is obligatory to be applicable in the starch industry. The stability of a protein is fundamentally reliant on its primary structure (the sequence of the amino acid residues) (Yadav and Prakash 2011). The pH of the surrounding medium is the influencing factor responsible for the protonation and deprotonation of amino acid. Proteins tend to drop their primary structure and start unfolding when exposed to exceptionally low and high pH. This is because of the repulsion between the same charges of the functional groups of amino acid residues. A molten globule state formed while protein unfolding causing a decrease in tertiary structure and an increase in the secondary structure (Yadav and Prakash 2011). The acid stability in α-amylases is conferred by (1) The decrease in the cell membrane permeability to protons, (2) secondary transport system for the efflux of protons, (3) well developed DNA as well as protein repair machinery and (4) occurrence of tetraether lipids in the archaeal membrane which are less prone to acid degradation (5) presence of acidic amino acid residues like Asp and Glu which confer high negative charge for the stabilization of protein at tremendously low pH (Tables 2 and 3; Fig. 3b) (Sharma et al. 2016; Parashar and Satyanarayana 2018).

Liu et al. (2017) enhanced the acid-tolerant capacity of α-amylase obtained from *Bacillus licheniformis* by employing site-directed mutagenesis. They replaced the His residues from position 281, 289, 293, 316, and 327 by Arg and Asp residues, created ten mutants consisting of 5 Arg residues and 5 Asp residues. They also created a triple mutant (H293R/H316R/H327R) after analyzing the 3-D structure of α-amylase. Out of all those mutants produced the most acid stable α-amylase by the H293R, H316R, H327R, and H293R/H316R/H327R. The increase in acid resistance of α-amylase is probably due to an increased negative charge on the protein surface. One more similar

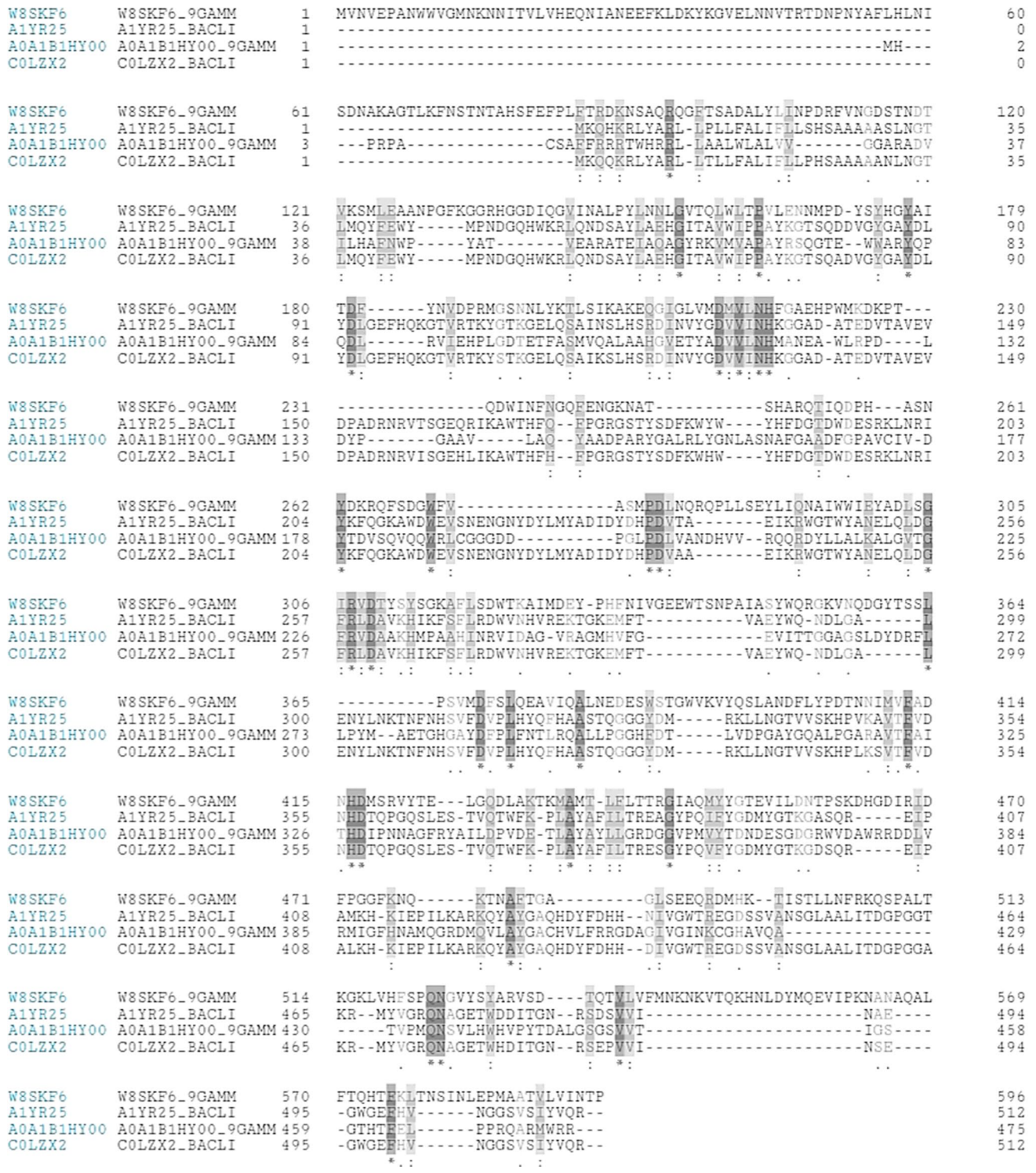


Fig. 2 Multiple sequence alignment of four α-amylase genes obtained from (1) α-Amylase from *Pseudoalteromonas* sp. 2–3 (UNIPROTKB ENTRY: W8SKF6_9GAMM) is an psychrophilic α-amylase; (2) α-Amylase from *Bacillus licheniformis* NH1 (UNIPROTKB ENTRY: A1YR25_BACLI) is thermostable α-amylase; (4) *Luteimonas abyssi* (UNIPROTKB ENTRY: A0A1B1HY00_9GAMM) is an alkalophilic α-amylase; (4) α-Amylase from *Bacillus subtilis* WB600 (UNIPROTKB ENTRY: C0LZX2_BACLI) is acidic α-amylase. The alignment was done through UniProt align tool (https://www.uniprot.org/align/). The similar residues are highlighted in grey colour, (*) represents the highly conserved residues

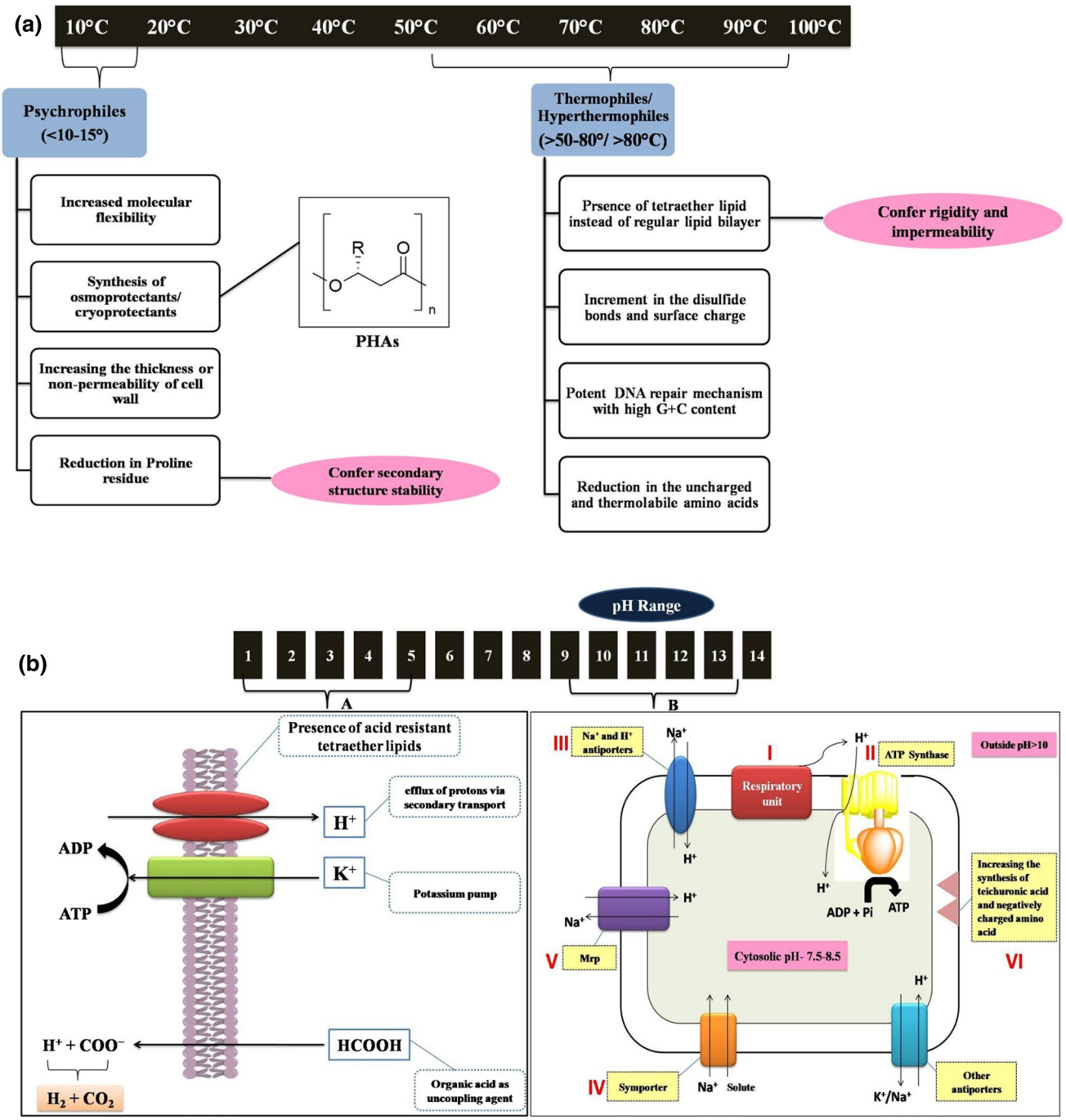


Fig. 3 a Physiological adaptations in psychrophiles and thermophiles/ hyperthermophiles. **b** Mechanismof pH homeostasis in **a** acidophiles and **b** alkalophiles. The pH homeostasis in alkaliphiles is obtained via different mechanism i.e., (I) the H^+ released via respiratory unit is coupled with (II) ATPases along with various antiporters: (III) solute symporters (IV), Multiple resistance and pH antiporter (V), and presence of acidic content (VI)

study was conducted on α-amylase obtained from *Bacillus subtilis* by Yang et al. (2013). They replaced the His residue from position 222, 275, 293, 310 with acidic residue (Asp). They found an increase of 45–92% enzyme activity when incubated at pH 4.5 and a temperature of 25° C for 24 h which is higher than the enzyme activity of wild type α-amylase (39.5%). There is a significant increase in the catalytic efficiency (k_{cat}/K_m) values of the mutant type as compare to that of wild-type.

Structural features of high pH active α-amylase

The detergent factory requires an alkali-stable α-amylase capable of withstanding high pH during washing with detergents. Alkaliphiles are the organism capable of surviving and continuing their metabolism at pH > 9 and are even active in the pH range 10–13 (Horikoshi 1999). They are found in certain areas such as Soda Lakes, alkaline hydrothermal vents (Kulkarni et al. 2019). The alkaliphiles serve an important function in the laundry and detergent industry by secreting enzymes like alkali stable α-amylase. The bacteria confer stability at such extreme pH by attaining various physiological adaptations (Fig. 3b). The most common adaptation is changes in their cell wall content i.e., enhancing the acidic content of the cell wall by increasing the synthesis of teichuronic acid (teichuronopeptide) or negatively charged amino acid (poly-γ-D-glutamic acid) (Kulkarni et al. 2019; Irwin 2020). The above statement is in agreement with the amino acid data provided in Table 3. The alkali stable α-amylase produced by *Luteimonas abyssi* has an increased amount of basic amino acid residues as well as an increased amount of aspartic acid and glutamic acid residues (as calculated through ExPASy ProtParam tool; https://web.expasy.org/cgi-bin/protparam/protparam). The second most important physiological adaptation observed is in the increased expression of various transporters as seen in *Bacillus halodurans* C-125 (alkalophile). The mentioned bacteria use Na^+/K^+antiporter along with H^+ ATPases to expel H^+ out of the cytoplasm (Irwin 2020).

Structural features of halophilic α-amylase

The α-amylase produced by halophiles is of great industrial significance. Halophilic α-amylases can tolerate high salinity (> 20–30% NaCl). So, they were employed in bioremediation of hazardous compounds and food processing (Lanyi 1974; Bayley et al. 1978; DasSarma and DasSarma 2015; Pan et al. 2020). The halophiles thrive in high salinity by strategies like 'salt-in' and 'salt out'. In 'salt-in' method of adaptation, the halophiles pump KCl in their cytoplasm from the external environment at a concentration equals to that of extracellular NaCl. On the other hand, in 'salt out' strategy, halophiles biosynthesize or accumulate osmolyte from the surrounding medium to respond towards high osmotic pressure. The bacteria and eukaryotes primarily accumulate neutral solutes whereas archaea prefer to gather negatively charged osmolyte (Roberts 2005; DasSarma and DasSarma 2015). Interestingly, the high salt concentration favours the structural stability in halophiles rather than disrupting it. This fact was checked by analyzing the behaviour of halobacteria in low salt concentration. The halobacterium showed cell envelope disintegration and inactivation of membrane-embedded enzyme (Larsen 1967; Lanyi 1974). It indicates that salt concentration is mandatory to maintain structural harmony, folding, kinetics conformation (Karan et al. 2012).

The factors which are primarily responsible for macromolecular stability are the various non-ionic interactions and the amino acid residues. Among the non-ionic interactions, long-range electrostatic interaction, hydrophobic bond, and the intracellular, as well as the intercellular hydrogen bonding, plays a crucial role (Lanyi 1974; DasSarma and DasSarma 2015). Halophiles tend to possess an increased amount of salt bridges and acidic amino acid residues like Asp and Glu as compared to that of basic residues (Lys and Arg). It has reduced the number of bulky aromatic residues (Phe, Iso, Leu) for better flexibility, reduced surface hydrophobicity, and high surface hydration (Larsen 1967; Lanyi 1974; Karan et al. 2012; DasSarma and DasSarma 2015) Table 2. The acidic residues are involved in binding with the water molecules and salt ions to enhance the structural flexibility through electrostatic repulsion.

Role of computational biology in tailoring α-amylase for enhanced stability

Computational biology or more specifically bioinformatics tools have enabled the researchers to elucidate structural and conformation-related aspects of macromolecules. It comprises various software and tools for the detailed analysis of data generated in genomics, proteomics, and transcriptomics studies (Priyadarshini and Singh 2019). Detailed structural insights can be predicted by using these tools. Bioinformatics has certainly provided an opportunity to customize the enzyme as per our need. It has so many handy tools for various purposes. Various bioinformatic tools have been used in this review to represent various data in an easy and readable form. The SWISS-MODEL (https://swissmodel.expasy.org/) was used to predict the molecular structure of α-amylase whose gene sequence (FASTA) was isolated from NCBI (https://www.ncbi.nlm.nih.gov/). Another tool used to analyze the amino acid composition of α-amylase from different physiological adaptations was done through ExPASy ProtParam tool (https://web.expasy.org/cgi-bin/protparam/protparam). For multiple sequence alignment of α-amylase gene sequence from different was performed through UniProt align tool (https://www.uniprot.org/align/).

Strategies for producing stable α-amylase

α-Amylase plays a significant role in several industries (Table 1). Industries demands an α-amylase which can withstand extreme conditions like pH stress, temperature, salinity, presence of different chemicals etc. Various

strategies can be obtained to achieve the desired target of industrial-grade α-amylase (Fig. 4).

Approaches at upstream level

The foremost strategy to get the desired result is the changes that can be adapted at the microbe level with the help of recombinant DNA technology (rDNA). The α-amylase coding gene or the open reading frames (ORFs) can be identified, modified suitably, and then re-inserted in a suitable host for heterologous expression. The assorted bioinformatics tools have made this process so handy. This approach will enhance industrial enzyme production and its quality. Furthermore, this technique will directly yield the desired result and will not demand downstream processing. A published report by Sanchez et al. (2019) describe a psycrophilic α-amylase from a *Pseudoalteromonas* sp. 2–3 (psychrophile) inhabiting Antarctica. The α-amylase encoding gene was isolated by them from *Pseudoalteromonas* sp. 2–3 and then expressed the ORF of the same in *Escherichia coli* BL21 (DE3) for recombinant protein (α-amylase) production. The produced α-amylase is exceptionally active in the range of 10–35 °C with maximum activity at 20 °C. Several other potential findings regarding the heterologous expression of α-amylase genes are summarized in Table 4.

Metagenomics—an ideal tool for exploring Extremozymes

The major hindrance in working with the extremophiles in the research laboratory is the lack of their natural habitat in which they live. Their harsh environmental condition is challenging to refabricate in laboratories. To overcome this hurdle, researchers are concentrating on alternative technique, the metagenomics. This approach is only possible because of the availability of accessible bioinformatics tools. It is a culture-independent technique to explore the genomic profile of various extremophiles from their environment and hence obtaining novel α-amylase with excellent metabolic properties (Ngara and Zhang 2018; Nair and Bhat 2020). The Metagenomics along with next-generation high throughput sequencing (NGS) technology is used for the sequence-based screening of α-amylase with peculiar metabolic capabilities (Bilal et al. 2018; Ngara and Zhang 2018). Software is available for performing the sequence-based screening of novel gene producing exceptional enzymes like NGS QC toolkit (http://www.nipgr.res.in/ngsqctoolkit.html), PRINSEQ (http://prinseq.sourceforge.net/), QIIME (http://qiime.org/), CARMA (http://omictools.com/carma-s1021.html) etc. Another efficient approach in this field is function-based screening by creating the recombinant metagenome in vitro (Ngara and Zhang 2018). The recombinants created were then screened by various assay techniques for the presence of desirable properties.

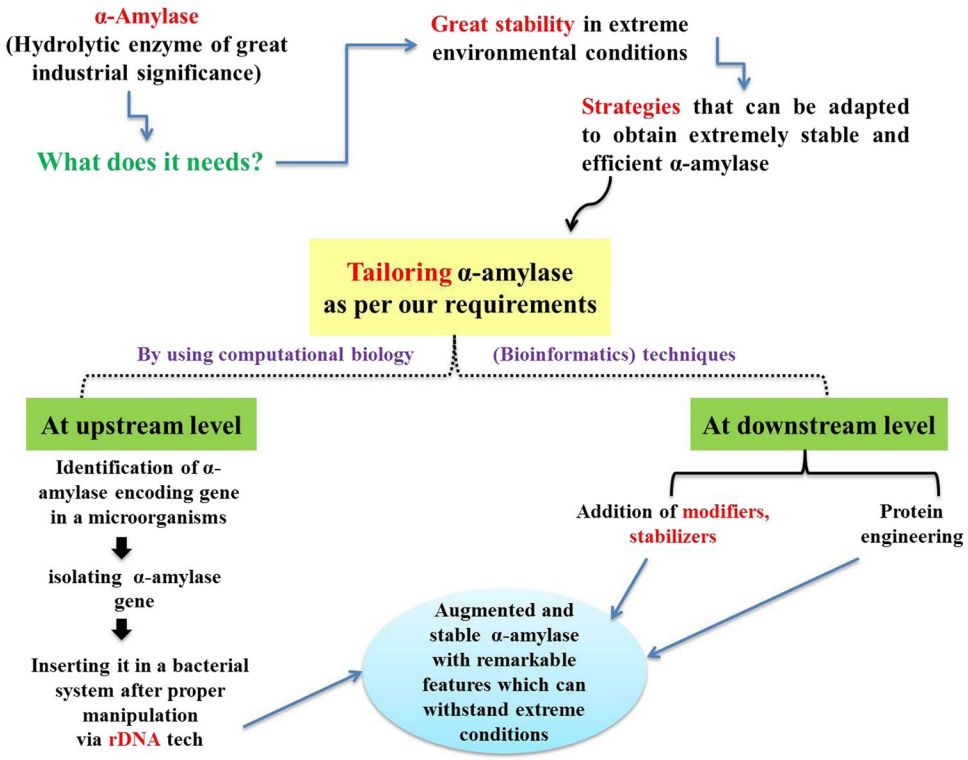


Fig. 4 Various approaches at upstream and downstream processing of α-amylase to improve its catalysis and stability

Table 4 Heterologous expression while upstream processing of α-amylase gene for improved production and stability in extreme conditions

S. no	α-Amylase obtained from	α-Amylase producing gene	Expressed in host	Molecular mass (in kDa)	Exceptional features	References
1	*Bacillus licheniformis* NH1	*amyN*	*Escherichia coli*	58	Increase in the half-life at 85 °C	Hmidet et al. (2008)
2	*Bacillus subtilis* AS01a	*AmyBS-I*	*Escherichia coli*	72.3	Activity even at 70 °C, dough rheological properties	Roy et al. (2013)
3	*Bacillus subtilis* WB800	*amy1*	*Escherichia coli*		Augmented production	Chen et al. (2015)
4	*Geobacillus* sp. *4j*	*Gs4j-amyA*	*Escherichia coli*	62	Augmented α-amylase production (22-folds higher than wild type), $t_{1/2}$ of 4.25 h at 80 °C	Jiang et al. (2015)
5	*Geomyces pannorum*	*GpA2*	*Aspergillus oryzae*	54	Cold adaptation in the range 0–20 °C	Mao et al. (2015)
6	*Staphylothermus marinus*	SMMA	*Escherichia coli*		Extreme temperature tolerant up to 100° C as well as mild acid stable (pH 4.0–6.0)	Li et al. (2018)
7	*Aspergillus niger* CSA35	*CDF_Amyl*	–		–	Avwioroko et al. (2018)
8	*Pseudoalteromonas* sp. 2–3	–	*Escherichia coli*	68.8	Active in the range between 10–35 °C having maximum activity at 20 °C	Sanchez et al. (2019)
9	*Thermomyces dupontii* L18	*Td*AmyA	*Pichia pastoris*	61.2[a], 59.2[b]	Thermostable at 60 °C	Wang et al. (2019b)

[a]By SDS-PAGE

[b]by gel filtration

There are only a few literature available regarding the applicability of metagenomic approaches for obtaining α-amylase with most promising features. Function based metagenomic approach yielded a psychrophilic α-amylase (AmyI3C6) as reported by Vester et al. 2015. Nair and Bhat (2020) employed the similar function-based metagenomic strategy and reported novel α-amylase P109 from the Arabian Sea sediment metagenome clone BTM109. The α-amylase obtained is applicable by several biotechnological firms. Published report by Sharma et al. (2010) concluded *pAMY* (a novel α-amylase gene) extracted from the metagenomic library construct of soil metagenome from Northwestern Himalaya. The isolated α-amylase was active even at low temperature and is devoid of calcium ion in its domain organization.

Approaches at downstream level

Another strategy that can be adapted is at the enzyme level. Various techniques can be applied like protein engineering, the addition of certain stabilizers as well as modifiers to get the enzyme with exceptional features. Catalytic attributes of an enzyme include thermostability, psychrophilic nature, solvent tolerant, substrate selection, and binding efficiency. Nowadays, all these attributes are amended by various protein engineering approaches. Thermostability of α-amylase isolated from *Bacillus licheniformis* was improved by Declerck et al. (2000) by replacement of Asp with Phe. This modification has resulted in a six-fold increase in $t_{1/2}$ at 80 °C.

Conclusion

The market of starch and starch-related products is growing day by day and raising the demand for novel α-amylase with excellent characteristics and high stability. Moreover, α-amylase is the most valuable enzyme possessing numerous biotechnological applications. Applications are principally based on structural stability as well as catalytic efficiency. Thus efforts are required to produce α-amylase with tremendous catalysis and high stability under adverse conditions. The structure-based tailoring offers the opportunity to obtain industrial-grade α-amylase with the most promising features. The present manuscript encapsulates various amendments that can be easily done through computational tools and recombinant DNA technology.

The manuscript has conveyed various molecular approaches based on computational biology for obtaining superior quality α-amylase. The large pool of data related to several aspects of a gene is accessible in software related to bioinformatics and thereby helps in understanding the structural and catalytic features of α-amylase. The detailed structural assessment has enabled the researcher to create mutants based on the functionality of the amino acid residues. There are some reports available regarding the structural alteration in α-amylase to enhance its features in recent decades. Still,

some more efforts are obligatory in the structure–function relationship of α-amylase to recognize what kind of modification it needs to improve its properties.

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Author contributions The idea for writing the review and concept: SKJ, JSP; literature search, analysis and study: JSP, NG, EB, SK, ST; Drafting of review: JSP, NG; Editing: SKJ, JSP, EB; critically revised the work: JSP, NG.

Declarations

Conflict of interest All authors declare that they have no conflicts of interest in any part of this study.

Ethical approval This article does not contain any studies with human and animal participants performed by any of the authors.

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Energy: Crises, Challenges and Solutions

Chapter 11

Opportunities in the Living Lights

Special Reference to Bioluminescent Fungi

Pramod Kumar Mahish, Nagendra Kumar Chandrawanshi, Shriram Kunjam, S.K. Jadhav

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Summary

Bioluminescence is the emission of of perceptible cold light from organisms; therefore, they are recognized as living lights. Bioluminescent organisms are present everywhere on the earth predominately in the ocean. The terrestrial bioluminescent organism includes very well-known Fireflies; microorganisms like bacteria; insects like flies and springtails. Mushrooms, earthworms, snail, centipedes, millipedes and beetles are some other terrestrial bioluminescent organisms. Attracting prey, intraspecies visual communication and escape from a predator are some major significance of bioluminescence in living organisms. Bioluminescent organisms produce light by the chemical reaction; therefore, it is known as chemiluminescence. Luciferase catalyzes the chemical oxidation of the substrate (luciferin) which leads to the emission of light. About 40 bioluminescence systems have been reported on the earth in which D-luciferin, coelenterazine and Cypridina luciferin-based systems are well studied. About 81 known species of bioluminescent fungi are recorded worldwide. These fungi belong to four dissimilar lineages – Omphalotus, Armillaria, mycenoid and Lucentipes. Lightening, monitoring biological process, clinical diagnosis, drug discovery, cancer research, biosensor development and immunoassays are the future scope of bioluminescence technology. Future lighting is the most exciting scope of bioluminescence technology. Recently, eukaryotic yeast cell autonomously glowed after the transfer of a genetically encoded system of bioluminescent fungus *Neonothopanus nambi* . The bioluminescence system of the same fungus was used to produce an engineered tobacco plant that also has the self glowing property. The fungal bioluminescence system was also successfully used as a biosensor for the environmental monitoring of mercury, copper and zinc. The virulence and growth of some fungi like *Candida albicans, Aspergillus fumigatus* and *Cryptococcus neoformans* were real-time monitored using bioluminescence-based non-invasive method in vivo. It is known as bioluminescence imaging (BLI) that allows the temporal and spatial progression of disease in living beings. So, the present chapter aims to give insights about bioluminescence in fungi, its mechanism and future scope.

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Petrography and Mineral Chemistry of Mafic Metavolcanics of Baghmara Formation (Sonakhan Group), Raipur District, Chhattisgarh

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Abstract The Sonakhan Greenstone Belt (SGB) is a late Archaean Greenstone Belt covering an area of about 1200 Sq. km. along the north-eastern part of Raipur district of Chhattisgarh state. It comprises metavolcanic and metasedimentary sequences which have undergone greenschist to amphibolite facies of metamorphism. The supracrustals around Sonakhan and adjoining area are classified into relatively older Baghmara Formation dominated by mafic metavolcanics and felsic metavolcanics and a younger Arjuni Formation dominated by sandstone and polymictic conglomerate, the later includes clasts derived from Baghmara Formation. The two formations together constitute the Sonakhan Group.

The present paper presents an account of the petrography and mineral chemistry of Baghmara Formation. Petrographaic studies indicate that Baghmara Formation is a suite of bimodal metavolcanics. The pillow lavas of Baghmara Formation display characteristic features of metabasalts exhibiting low grade metamorphism (greenschist facies) represented by the mineral assemblage chlorite, actinolite and plagioclase minerals. The mineral chemistry of this assemblage has been studied by microprobe analysis. The presence of spinifex texture in these has been reported from the Sonakhan Greenstone Belt. The presence of spinifex texture suggests a komatiitic affinity for these metabasalts.

Keywords Sonakhan Greenstone Belt, petrography, mineral chemistry

1. Introduction

The Sonakhan Greenstone Belt, covering an area of about 1200 sq. km in north-eastern part of Raipur District, falls in S.O.I. toposheet Nos.64K/10 and 64K/11. It is bounded by 81^0 37' and 82^0 45' East longitudes and 21^0 17' and 21^0 37' North latitudes. It is situated at about 173 km. NE of Durg. One can approach the study area via Pithora which is located at about 100 km. from Raipur on NH-6. The study area includes Baghmara, Rajadeori, Sonakhan, Devgaon, Devpur, Nawagaon, Jungle Pahar, Amarua, Golajhar, Thelkadabri localities which are within a range of 35 to 45 km. to the North of Pithora.

The Sonakhan Greenstone Belt represents a late Archaean volcanosedimentary sequence which includes mafic and felsic metavolcanics with Banded Iron Formation and chert (Baghmara Formation) and the sedimentary sequence of conglomerate, greywacke, argillite along with B.I.F. and ferruginous chert (Arjuni Formation). The metavolcanics of Baghmara Formation have undergone greenschist to amphibolite facies of metamorphism. The Sonakhan Group rests unconformably over Baya Gneissic Complex. Structurally, it is a broad synformal basin with moderate plunge to the North- Northwest and closure to the South near Baya .

The Baghmara Formation forms the most prominent metavolcanic component of the Sonakhan Greenstone Belt and exhibits spectacular pillow structure formed by submarine emplacement of basaltic lavas. The level of

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Morphometric Analysis of Santra watershed Using G.I.S. and Remote Sensing, Santra Village, Block Patan, District-Durg, Chhattisgarh

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ABSTRACT: Morphometric analysis of Santra Nala watershed was carried out using Google Earth imagery, Survey of India Toposheet and QGIS 2.6.1 open-source software. Using QGIS 2.6.1 georeferencing, digitization and measurements were done. Measurements of Morphometric parameters of Santra Nala Watershed in three aspects these are linear, areal and relief. The results of computation were correlated with Google Earth Imagery and the synthesis of interpretation was translated to meaningful conclusions.

KEYWORDS: Watershed, Morphometric analysis, QGIS, Google Earth Imagery.

I. INTRODUCTION

Watershed may be defined as a naturally occurring hydrologic unit bounded by natural boundaries and characterized by the similar physical, topographical, and climatic conditions. It is a land area from which water drains under gravity to a common drainage channel. Thus, a watershed is delineated area with well-defined topographic boundary and one water outlet. The soil and water conservation measures carried out on a watershed basis can play a prominent role in the strategy of comprehensive land and water management. Watershed management involves proper use of land and water resources of a watershed for optimum production with minimum hazards to natural resources (Biswas et al,1998).

The study of drainage network characteristic of a particular watershed may be carried out in two ways viz genetic approach and descriptive approach. The genetic approach involves the study of evolution of stream of a region of tectonics, lithology and structures. While the descriptive approach involves the study of forms characteristics and stream pattern (Singh, 1998). The drainage system refers to the origin and development of stream through time, while drainage pattern means spatial arrangements and forms of drainage system. The evolution of drainage system and development of related landforms in a region depends on the bedrock lithology and associated geological structures (Astra and SoulanKillis, 1992).Morphometric analysis of various watershed has been carried out using satellite data and arial photographs (Nautiyal, 1994: Agrawal,1998; Biswas et al,1998; Arun et al,2005; Thakkar and Dhiman,2007; Javed et al ,2009).

II. STUDY AREA

The study area is confined between latitude21°00'02"N to 21°05'02"N and longitude 81°25'01"E to 81°30'46"E. Santra watershed is situated in and around the Santra village in the PatanBlock of Durgdistrict, Chhattisgarh and covers an area of 43.107 km^2.The maximum and minimum elevations in the study area deduced from Google Earth imagery are 315m and 296m above Mean Sea Level, respectively. The general slope of the watershed is from Northwest to Southeast. Main stream of the Santra watershed joins the Shivnath river along downstream side. The average annual rainfall of the area is 1047mm (CGWB Annual Report, 2019). There are some small water ponds and one check dam in the area, which primarily serve as a source of irrigation locally. Apart from these water tanks, there is a canal passing through the study area.

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Significance of Geological Events in the Kangerdhara area with Special Reference to the Development of Kotamsar and Dandak Cave

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ABSTRACT: In the present study Kanger Dhara area of Bastar region has been taken into consideration with a view to study that does the Kanger Dhara area have any implication on the Development of Kotamsar and Dandak cave? To find out the significance of geological events which took place in the Kanger Dhara Area, detailed field investigation carried out in the area. Structural signatures responsible for the development of exotic caves in the nearby surroundings were also collected.There are thick carbonate rocks present near the surface. Intrusive bodies, fold, faults and joints are also observed in the area. The study area is mainly occupied by Meso Neo Proterozoic plate of Indravati Basin.

Presence of sandstone pieces inside the Kotamsar and Dandak cave indicates that provenance was uplifted and weathering and erosional activities took place and Tirathgarh sandstone which is the lowest member of the Indravati basin moved in the downstream direction, where subterranean flow was taking place in the Kotamsar and Dandak caves and these broken pieces were deposited.

KEYWORDS: Karst topography , Speleotherms, Palaeo geography

I. INTRODUCTION

There are thick carbonate rocks at or near the surface, in the study area. Presence of joints, movement of surface water upon the surface of exposed carbonate rocks and migration of surface water along the planes of weaknesses to the subsurface and pronounced solution activity is observed. All of these ultimately lead to sub terranean turbulent flow and formation of gigantic chambers and exotic structures. In the later stages shifting of underground stream to close by region and tickling down of ground water through joints and formation of exotic speleotherms is very well preserved in this region. Isolated hillocks of carbonate rocks i.e., Hums indicate the earlier extension of lime stone rocks in the entire region. Apart from that, it has also been noticed intrusive bodies, folds, faults and joints. Indravati Basin usually does not show these kinds of structural peculiarities in most parts of the basin. Tirathgarh Sand stone, Cherakur shale and sandstone, Kanger lime stone and Jagdalpur shale and dolomite members are usually undisturbed and undeformed and very gently dipping, but in this region these members are highly disturbed. Study area covers the toposheet No. 65 I/4 of the Kanker Dhara region. The coordinates of Kanger Dhara regionare N 18°52.449', E081°55.415 and it lies at altitude of 475 m. above sea level. Geological features which played important role in the development of Karst topography in the region are: 1. Igneous intrusive activity near Kanger Dhara, 2. Kanger Dhara fault, 3. Folds near Kanger Dhara, 4. Joint near Kanger Dhara. (Jha, A.S,2015)

II. METHODOLOGY

Detailed geological mapping at the Kanger Dhara and adjoining areas was done because this region has very peculiar geological structures. In our opinion these structures have significant role in the development of the topographical features in this Kanger valley region. To accomplish this objective, we have done very detailed geological mapping in the 1:200scale. During field work, we have identified indication of intrusive activities which are responsible for the evolution of very interesting and exclusive topography of this area. We have identified several folds, joints, fault and intrusive bodies. We also mapped several joints and tried to establish their relationship with the stress prevailed during the geological past. We have also made an effort to prepare palaeogeographical reconstruction of the area.

For the proper information of the ancient land form and processes involved our team has collected some valuable information, these findings may help to know much about the palaeogeography and developmental processes of the past.(Paul, W., 2008)

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Application of QGIS in Identification of Igneous Rocks Using Digital Image Histogram

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Abstract:
The spectral signatures of various igneous rocks were studied using histograms of satellite images and digital photographs of hand specimen of rocks. Comparison of histogram of digital image of hand specimen of a known rock was done with satellite image of a terrain of known geographical location and the igneous rocks were identified on the basis of similarity of image histograms. It was found on the basis of study of histograms of gabbro, granite, basalt and rhyolite that the shape of histogram of images cropped from Google Earth and those from images of hand specimens of known rocks and photographs of glazed rocks taken from internet were showing high degree of resemblance.

Key words: *Image histogram, Digital image histogram, Igneous rock, Identification of Rocks*

Date of Submission: 10-11-2021 Date of Acceptance: 26-11-2021

I. Introduction

The categorization and identification of rocks are indispensable in geological research work. The traditional recognition methods are based on the physical, petrographical and chemical properties of rocks, which are used to identify rocks at macro- and micro-scales.

Freely available, high-resolution satellite imagery in Google Earth not only allows identification of research questions but is also critical in pre–field work mapping, targeting sites for field work. We used high resolution images in Google Earth to identify igneous rocks by comparing the image histograms of outcrops of igneous rocks extracted from Google Earth images with the images of rocks downloaded from internet.

A digital image/imagery of igneous rocks taken by remotely sensed special camera was used for classifying or trying to identifying by reflection of particular histograms. It has been having another way to uncover rock petrography or petrogenesis by remote sensing and GIS. The traditional recognition methods are based on the physical, petrographical and chemical properties of rocks as well as of each property has some sub-properties which are used to identify rocks at macro- and micro-scales. This method is not a method based on identification using single property to identifying perfectly but it has one of them like texture, structure or any other physical, petrological or chemical properties, which assist to researchers "to sense" things about the Earth surface.

The image processing techniques allow to extract from an image a set of numerical features, expressed as coded characteristics of the selected object, and used to differentiate one class of objects from another. The unit of information in a digitized image is the pixel and each pixel has properties of position and value; however, by itself, the knowledge of the position and value of a particular pixel generally does not convey any geological information, but it can be used to compare with the attributes of pixel values of a known object in order to identify an unknown object.

A digital image can be described as a two-dimensional array of integer values. Each value, referred to as a picture element or pixel, represents the average brightness inthe image at one location. The horizontal rows of pixels are referred to as lines, and the vertical columns as samples.

A digital imaging system measures the detected radiation within a specified spectral range (band) from each of many small areas collected in a predetermined pixel array format. Each pixel is assigned an integer value, termed a DN (digital number) that is related to the brightness of that area within the image. The integers fall within a discrete range. For instance, recorded in eight-bit format, the data range from 0 to 255, or 2 8 levels (0 = black or absence of radiation, 255 = white or saturation when dealing with black and white images).

The image processing techniques allow to extract from an image a set of numerical features, expressed as coded characteristics of the selected object, and used to differentiate one class of objects from another. The image processing techniques allow to extract from an image a set of numerical features, expressed as coded characteristics of the selected object, and used to differentiate one class of objects from another

Colour and texture are two different but complementary visual stimuli. Colour is related to the spectral content of the image, whereas texture refers to the variation of the intensity in a neighbourhood of pixels. As

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Standardization Of Bioprocess Parameters For Optimization Of Xylanase Production By Aspergillus Niger Soil Isolate

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ABSTRACT

In-vitro studies were carried out on *Aspergillus niger*, an indigenous strain, to determine the most optimize conditions for high xylanase production. The selected strain was boosted for xylanase enzyme production in czapek's dox broth medium using different carbon and nitrogen sources. Maximum enzyme activity was detected when xylan was used as carbon source and yeast extract was used as nitrogen source. Shake culture conditions, 1.0% NaCl, higher inoculums dose and 06 days of incubation were observed with high xylanase production. Submerged condition was found superior over solid-state condition; however, wheat bran substrate yielded more xylanase over others. Optimum pH and temperature for xylanase activity were found to be 7.0 and 28^{o}C. The enzyme was produced and extracted under optimized conditions and compared with values of before optimization. It was then purified and characterized for stability at different temperatures and pH. A high amount of xylanase was formed under optimized conditions and was found stable up to 45^{o}C temperature and at pH 8.0.

Key words: Bioprocess parameters, Optimization, *Aspergillus niger*, Xylanase

I. INTRODUCTION

Microorganisms are rich sources of xylanase enzymes, which are produced by diverse genera and species of bacteria, actinomycetes and fungi (Chandra *et al*., 2012 and Malhotra and Chapadgaonkar, 2018). Applications of xylanases can be found in the food and beverage industries (bakery goods, coffee, starch, plant oil and juice manufacture), feedstock improvement (increasing animal feed digestibility), and the quality improvement of lignocellulosic residues. The use of xylanases to allow such manufacturing processes to be run with less elements, further down less harsh conditions and also with less troubling side reactions. The cost of any enzyme production is one of the key factors, require optimization of conditions and parameters to achieve cost -benefit ratio.

Filamentous fungi are predominantly producers of xylanases. They excrete the enzymes into their surrounding and the enzyme levels are much higher than those of yeast and bacteria (Steiner *et al*., 1987). In addition to xylanase, fungi

typically produce several accessory xylanolytic enzymes, which are necessary for debranching substituted xylans (Jaafaru, 2013). An important factor for efficient xylanase production is the choice of an appropriate inducing substrate and bioprocess parameters that can affect activities and productivities of xylanase (Dietmar *et al*., 1996). Similarly, the activity of crude enzyme is also very important particularly when it is to be used in its crude form.

Considering these, a preliminary study had been done on 32 indigenous fungal isolates of social forest area of Bhilai Township to screen out the best xylanase producer among all and out of them *A.niger* was found the best xylanse producing strain among all (Kulkarni and Gupta, 2013). The main objective of present study is to standardize the parameters for xylanase production by *A. niger* under experimental conditions.

II. MATERIALS AND METHODS

Identification of isolate *Aspergillus niger* the potential producer of xylanase – Fungal identification was carried out based on the colony morphologies and structural characteristics as observed under the light microscope. The fungal characteristics were described and identified based on the description given in the manual of soil fungi (Gilman, 1959), Dematiaceous Hyphomycetes (Ellis, 1971) and illustrated genera of Imperfect fungi (Barnett *et al*., 1972). The ability to produce xylanase was primarily confirmed by Congo red test by rising on Oat spelt xylan agar plates (Kheng and Omar, 2005).

Xylanase assay – Xylanase activity was further assessed by using Oat spelt xylan (Sigma) as enzyme substrate. The enzyme substrate was prepared by 0.25 g of xylan wetted with 2ml 95% ethanol and 22.5ml of distilled water in a beaker and covered with aluminum foil and boiled to dissolve on hot plate at 100^{o}C for 10 min and made up the volume to 25ml with distilled water. The reaction mixture was prepared by adding 5.0ml of substrate, 1.0 ml of the culture filtered supernatant (crude enzyme) and 1.0 ml of sodium acetate buffer (pH 6.0). The mixture was incubated at 40^{o}C in water bath with shaking for 15 min. Released reducing sugar was measured using 3, 5-dinitrosalicylic acid and xylose as standard. Colour was developed by boiling in water bath for 5 min and read at 540 nm. One unit of enzyme activity was defined as amount of enzyme required to liberate 1µmol of xylose per minute under the assay conditions.

Optimization of cultural conditions for xylanase production – The optimization was carried out based on stepwise amendment of the main parameters for xylanase production. The growth was carried out keeping the temperature (28^{o}C) for 7 days.

A) **Effect of various carbon sources:** lactose, sucrose, maltose, dextrose, xylan, cellulose, and mannitol were examined using czapek's dox broth.
B) **Effect of various Nitrogen sources:** peptone, yeast extract, sodium nitrate, ammonium sulphate, ammonium nitrate, meat extract and beef extract were used.
C) **Optimization of salt concentration:** Using NaCl and KCl at different concentrations, varying from 1 to 6%.
D) **Effect of agitation:** The effect was examined by using regular incubator for non agitating flasks and shaker incubator for agitating flasks.
E) **Effect of incubation period:** Evaluated at 24 h interval over a period for 7days.
F) **Effect of pH:** Observed by changing the pH of growth medium by 05 to 10.

G) Effect of cultivation temperature: The enzyme production was examined by incubating the growing culture at different temperatures starting from 28ºC, 32ºC, 37ºC, 40ºC.

H) Optimization of inoculum size: Approximately 100 to 150 spores of *A.niger* were transferred to 9 ml of sterile water blank. This suspension was serially diluted to 10^{-1} to 10^{-6} and each dilution was transferred to sterile media and incubated at 28ºC for 7 days.

I) Xylanase production under solid state fermentation: The fungi were cultured in Erlenmeyer flasks (250 ml) containing 10.0 g of paddy straw, paddy husk, rice bran and wheat straw (particle size 300 - 500 mm) moistened with 10 ml of mineral salts solution. The composition of the mineral salts solution was (g./L): NaCl, 1.0; $MgSO_4.7H_2O$, 0.5; $(NH_4)_2HPO_4$, 2.5; NaH_2PO_4, 0.5; $CaCl_2.2H_2O$, 0.01; $FeSO_4.7H_2O$, 0.01; $ZnSO_4.7H_2O$, 0.002. The pH was adjusted and the medium was then autoclaved. The flasks were inoculated with 1 ml of spore suspension containing $1x10^6$ spores/ ml obtained from 7-day-old pure cultures. The flasks were incubated at 28ºC under shaking conditions (100 rpm) for 7 days. The enzyme was harvested in sodium acetate buffer (50 mM, pH 7.0). The fermented slurry was filtered through cheese cloth and centrifuged at 10000 x g for 20 min at 4°C. The supernatant was used for further enzyme study.

J) Xylanase production under submerged fermentation: It was carried out with Birch wood xylan as the carbon source along with mineral salts medium. The pH of the medium was adjusted to 7.0 and 50 ml of the medium was transferred into a 250 ml Erlenmeyer flask and inoculated with 1 ml of spore suspension containing $1x10^6$ spores/ ml. The flasks were incubated at 28ºC on a shaking incubator (100 rpm) for 7 days. After incubation, the medium was filtered through Whatman No.1 filter paper and the filtrate was centrifuged at 10000 x g for 15 min at 4ºC. The supernatant was used as enzyme for further evaluation.

Enzyme characterization –

A) Partial purification of xylanase: It was done by adding chilled Ethanol drop wise to the culture filtrate (100 ml) at 4 °C with continuous stirring and left at –20°C for 24 h. The precipitate was collected by centrifugation and was then dissolved in 30 ml of a sodium acetate buffer (50 mM, pH 6.0).

B) Stability of xylanase activity on different temperature and pH range – The temperature stability/ tolerance of purified enzyme was determined by the incubation of the reaction mixture from 15 to 70ºC and at pH 7.0. Enzyme activity was measured at 45ºC in different pH values by the use of sodium acetate buffer from 3.0 to 8.0.

SDS-PAGE and xylanases detection by zymography – Sodium dodecyl sulfate–polyacrilamide gel electrophoresis (SDS-PAGE) was carried out using a 10% gel and low molecular weight standards from 14 to 66 kDa. After the electrophoresis, the xylanase polypeptide was detected using oat spelt xylan (Sigma) as substrate.

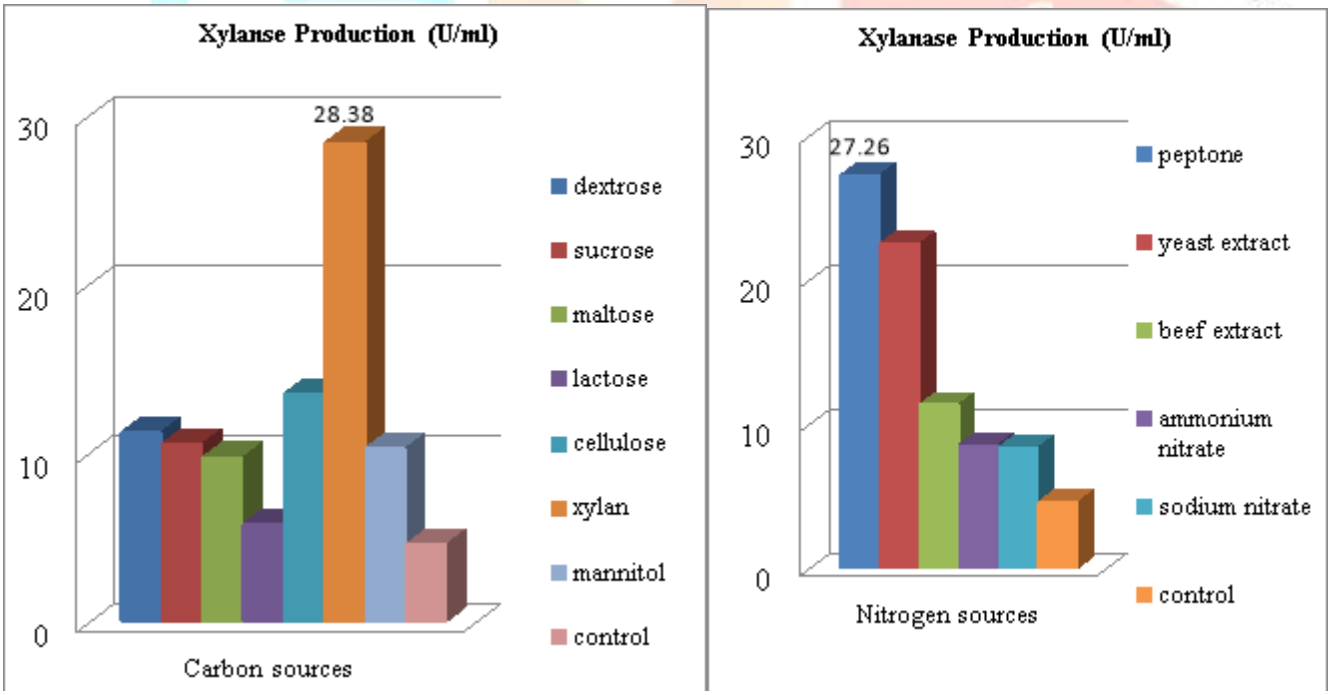
Statistical Analysis – All the above experiments were carried out maintaining 05 replicates and obtained values were subjected to find out standard error of mean.

III. RESULT AND DISCUSSION

Soil fungi are gaining considerable importance as good producers of xylanase over others from the industrial point of view. Their non-pathogenic nature, easy cultivation and capability of producing high levels of extracellular enzymes attract researchers to work on parameter optimization procedures. and to study the factors responsible for increasing enzyme activity in its crude form (Simoes *et al*., 2009; Sridevi and Charya, 2011 and Parihar and Rai, 2015). In the present study, different bioprocess parameters were investigated for indigenous soil fungal isolate *Aspergillus niger*.

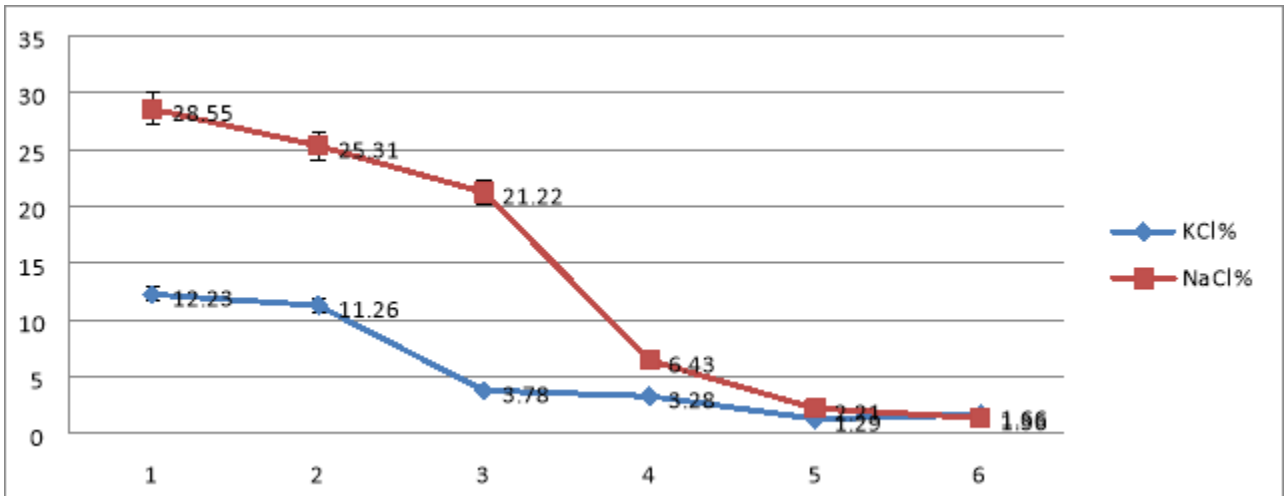
The effect of additional carbon and nitrogen sources in the growth medium affected positively. Kheng and Omar (2005) also reported that supplementation of additional carbon and nitrogen sources in the growth medium could enhance enzyme productivity. The enzyme production was found significantly higher when supplemented with xylan (28.38U/ml) as carbon source (Fig.-1). The results showed that xylan served as a superior carbon source and seems to be efficient inducers of xylanase activity by *A. niger*. Okafor *et al.* (2005) suggested the initiation of xylanase production through low molecular weight degradation products of xylan. Peptone as nitrogen source was found best over others (27.26U/ml). This result however, was in contrast to that reported by Naby *et al.* (2005). On the other hand, Tallapragada *et al*. (2011) reported organic nitrogen sources (meat extract, peptone and yeast extract) relatively suitable for xylanase production.

Fig. 1 Effect of different carbon and nitrogen sources on xylanase production



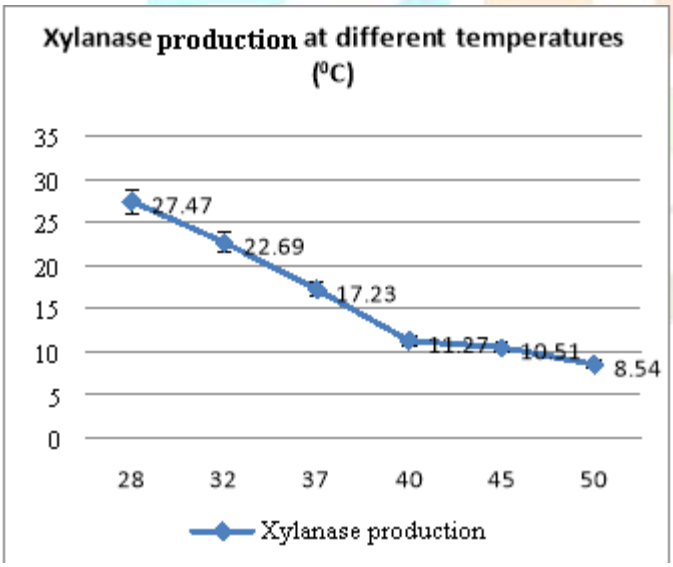
Lower concentrations of salts were affected positively. However, NaCl (1%) was found superior over the KCl (1%) and produced significantly high (28.55U/ml) xylanase (Fig.-2).

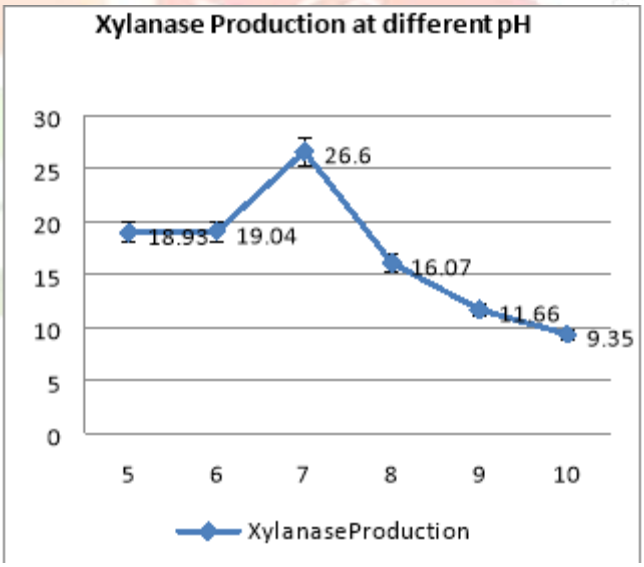
Fig. – 2 Effect of NaCl and KCl at different concentrations on xylanase production



Aspergillus niger grew well at 28ºC, pH 7.0 and produced significantly more enzyme (27.47U/ml; 26.6U/ml respectively (Fig. -3). The net temperature and pH influenced not only by the environment, but also the changes generated from the metabolic activities of the growing fungi. The results revealed that the enzyme production linked closely to the growth of the fungus. The xylanase production correlated to the growth and availability of fungal biomass. This observation was in agreement with those reported by Kheng and Omar (2005) and Simoes *et al*. (2009).

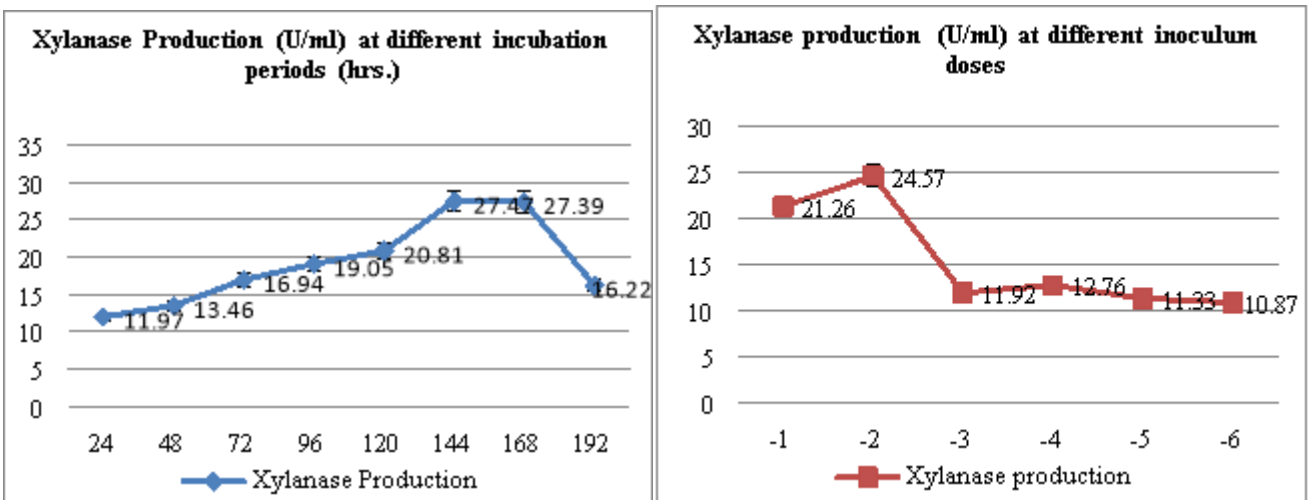
Fig. - 3 Effect of incubation temperature and pH on xylanase production





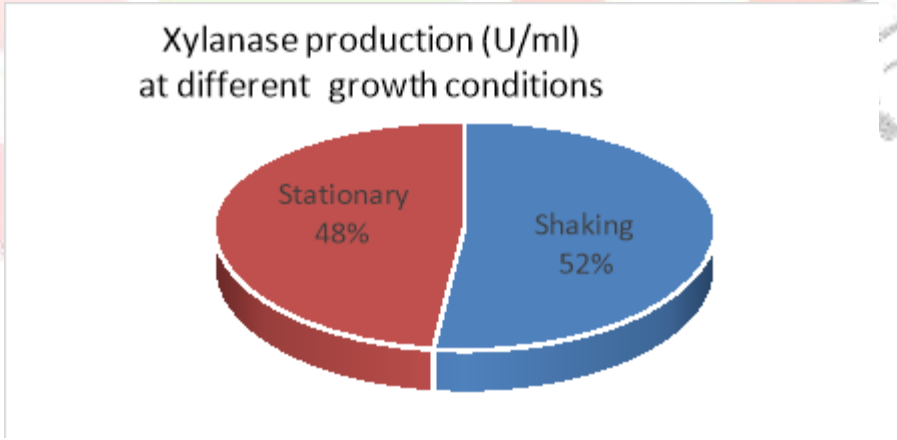
The effect of incubation period and inoculam dose on xylanase production is depicted in Fig.-4. It is clear from the figure that the fungus attains its maturity after 6-7 days and produced maximum enzyme (27.4U/ml). This is due to exhaustion of growth the substrate from the medium after 6-7 days and thus not available to trigger the extracellular enzyme production. High spore contents during inoculation caused faster growth and prompt enzyme production (24.57U/ml), supporting the fact that the time taken to achieve maximum growth or enzyme productivity was much longer at lower inoculum sizes. Tallapragada and Venkatesh (2011) also reported higher degradation of the substrates and increase availability of the nutrients for higher enzyme production during their studies.

Fig. – 4 Effect of incubation period and inoculums dose on xylanase production



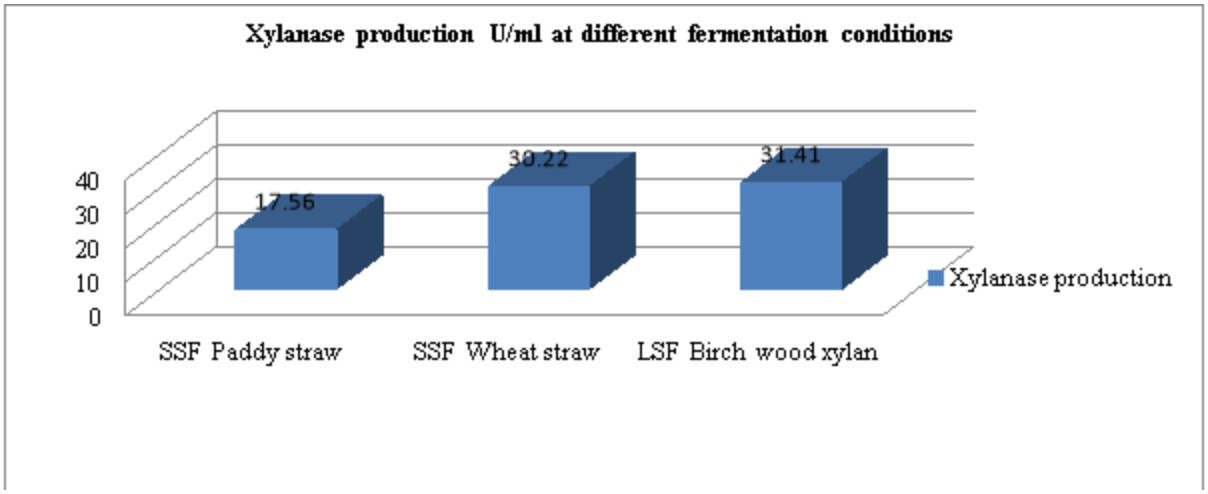
The effect of agitation was found important to ensures aeration, supply of oxygen for aerobic metabolism, and also for removal of CO_2, heat, water vapor, and volatile components produced during the growth. It also has very important effects on hydration properties. The effect of shaking on xylanase production was studied under above optimized growth conditions. It was observed that shaking conditions supported the enzyme production over the stationary condition (Fig.–5). However, the difference was not significant. Several studies have reported different results regarding agitation during fermentation and stated that some organisms require more air for growth as compared to others.

Fig. – 5 Effect of agitation on xylanase production



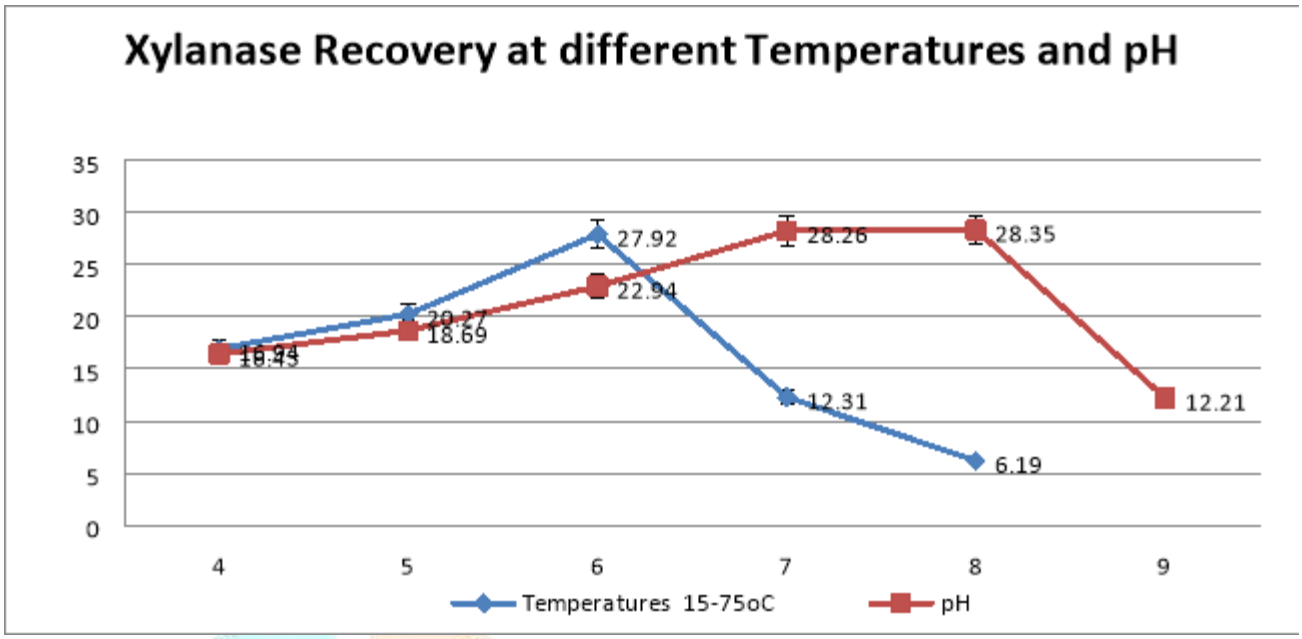
The media types are one of the most responsible factors for the higher value of crude enzyme activity obtained from fungal strains. Solid-state fermentation (SSF) has significant economical in producing the food, feed, pharmaceutical and agricultural industrial products. Due to the rough nature of the substrates, strong agitation is not required during the fermentation. The products thus obtained are more concentrated and need less purification procedures. Additionally, the countries with abundance of biomass and agro-industrial residues, these can be used as cheap raw materials. Xylanase initiation by lignocelluloses substrates have been shown by several reports. The major substrates used in their studies were wheat bran, rice straw, corncobs, saw dust, sugarcane bagasse, palm kernel cake and soybean meal (Reis *et al*., 2003; Okafor *et al.*, 2007 and Simoes *et al*., 2009). In the present study, wheat straw under SSF condition and birch wood xylan under LSF condition yielded better xylanase (30.22U/ml and 31.41U/ml respectively).

Fig. – 6 Effect of fermentation condition on xylanase production



Temperature during growth plays a critical role in enzyme productivity. The enzyme activity was investigated at different reaction temperatures ranging from 25-60°C (Fig. -7). The *Aspergillus niger* contributed promising results, with maximum activity of xylanase, when incubated at 45°C (16.00 Unit/ml) and minimum was observed at 25°C (7.33 Unit/ml). The enzyme activity was found to increased or decreased below and above from 45°C temperature. This was attributed to denaturation and conformation changes of enzymatic proteins. Optimum pH not only provides suitable condition for growth and enzyme production, but will also determine the enzymatic action on the substrates and enhance the enzyme stability. In the present study, the enzyme exhibited activity up to pH 7.0 and stability up to pH 8.0. Reis *et al*. (2003) reported high stability of fungal xylanase under alkaline conditions and temperature up to 55°C. Shah and Madamwar (2005) and Jin *et al.* (2012) also reported maximum recovery of partial purified xylanase at 50 -55°C and pH 5.0.

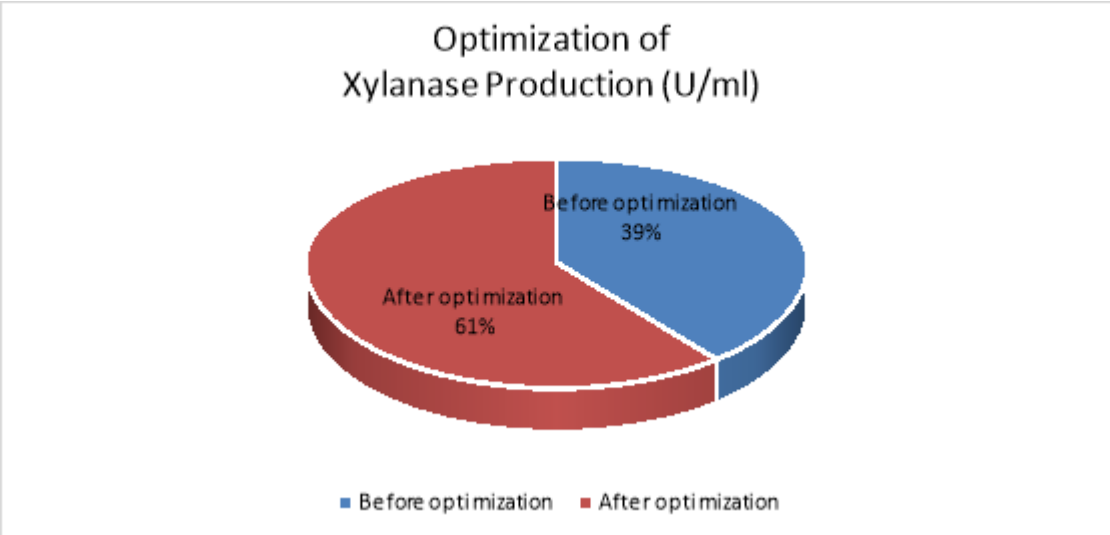
Fig. -7 Effect of reaction temperature and pH on Xylanase recovery



Important factor for effective enzyme production is the choice of an appropriate inducing substrate, either insoluble or soluble, as well as optimization of the medium composition. Bioprocess parameters, that can affect activities and productivities of xylanase attained in a fermentation process, include the pH, temperature, or agitation (Haltrich *et al.*, 1996 and Venkatesh and Tallapragada, 2009). Garapati *et al*. (2009) reported that moisture content, Incubation time and inculation concentration were major influential parameters for xylanase production by *Aspergillus terreus*.

It was noticed that all factors and interactions considered in the experimental design were statistically significant at 95% confidence limit (Fig. – 8) indicating that nearly all the variability of experimental data can be explained in terms of significant effects. Statistical analysis of the xylanase production data in above experimental designs revealed that among all selected factors type of carbon and nitrogen source, salt concentration, growth temperature and pH, incubation time and inoculums dose contributed the maximum impact on the overall enzyme production followed by temperature and pH of reaction mixture. Effect of agitation and fermentation under SSF or LSF condition did not affected significantly in this study. Naby *et al.* (1992) reported 5.7fold increased xylanase activity after optimization of culture medium.

Fig. – 8 Comparison of Xylanase production before and after Optimization



Zymogram analysis through SDS PAGE gel showed two different polypeptides at 32 and 38 kDA position. Coral *et al.* (2002) reported one xylanase band to be around 36 k DA in their isolate *A.niger* Z1 wild strain. Presence of multiple xylanases has been reported in a number of fungal and bacterial isolates from terrestrial sources (Ghatora *et al.*, 2006). Raghukumar *et al.* (2003) identified Endo-β-1,4-xylanases (1,4-β-D-xylan xylanohydrolase; EC3.2.1.8) belong to the class of glycosyl hydrolases, with a molecular mass over 30 k Da and an acidic pH in their studies.

Sakthiselvan *et al.* (2014) isolated xylanase from *Hypocrea lixii* SS1 by utilizing sunflower oil sludge (waste from the oil industry) as the sole carbon source for xylanase production and the enzyme was further affirmed by SDS-PAGE with their standard molecular weight (29 k Da).

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3.4.3 Details of research papers per teacher in CARE Journals notified on UGC website during the year.

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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

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RESEARCH ARTICLE

BIOREMEDIATION OF CRUDE OIL CONTAMINATED SOIL BY HYDROCARBON DEGRADING BACTERIA

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Key words:-
Biodegradation, Crude Oil, Streptomycin, Hydrocarbon, Contamination

Abstract

Proficiency of hydrocarbon-degrading bacteria useful for eradicating soil pollution stimulated by seepage of petroleum and their derivative substances, therefore, sequestered different bacterial isolates were bear significant merits for utilizing hydrocarbons as an uncommon source of their growth and development. A colorimetric assay was performed at 595 nm wavelength which was subjected to the mineral salt broth with 1% oil (petrol, diesel, and burned out engine oil). This broth having minimum nutrients used by inoculated bacteria in which some isolates were adopted for taking a sufficient amount of either petrol, diesel, or burned-out engine oil as carbon source hence increases its turbidity that was measured in two days time interval up to twelve days of observation. We found that selected isolates were able to degrade burned out engine oil efficiently in contrast to petrol and diesel. At optical density 0.21± 0.13, 0.19±0.08, 0.18±0.09, 0.17±0.12 the result showed by isolatesBI-7, BI-2, BI-4, BI-6goodcompetency to degrade burned out engine oil. On the other hand, maximum diesel and petrol utilized by BI-2 & BI-1 isolate at O.D. 0.09±0.02, 0.05±0.02 was recorded. Most of the bacterial isolates resulted in a positive biochemical test. BI-1 & BI-7 resulted in positive starch hydrolysis test, whereas, all isolates resulted in positive urease test, simultaneously negative results for all isolates obtained when catalase and antibiotic sensitivity test against streptomycin were performed.

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Original Research Article

FTIR Based Pharmacological Validation of *Bridelia retusa*

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Department of Biotechnology, Govt. V.Y.T. PG. Autonomous College, Durg, Chhattisgarh, 491001, India

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***Corresponding author:** Anil Kumar

Abstract

Bridelia retusa commonly known as Khaja or Kasai in India, belonging to the family Euphorbiaceae, is a tropical small-sized tree found throughout warmer parts of India. Entire parts of *Bridelia retusa* has been traditionally used for healing of several ailments such as rheumatism, diabetes, diarrhea, dysentery, removal of urinary concretions, and the bark of the plant is used by tribal people to develop sterility as a contraceptive. The present investigation was planned to evaluate and explore potential bioactive phytocompounds in the bark, fruit, and leaf extract of *Bridelia retusa* using phytochemical profiling and an infra-red spectrophotometer. The phytochemical evaluation of bark, fruit, and leaf extracts of *Bridelia retusa* revealed the presence of alkaloids, cardiac glycosides, flavonoids, saponins, steroids, tannins, and terpenoids in extracts. All seven phytocompounds were found in both aqueous leaf and methanolic bark extracts. Alkaloid was detected in all except for ethyl acetate extract. Cardiac glycosides were found in extracts of aqueous and petroleum ether. Steroid and terpenoids were detected from all aqueous and methanol extracts whereas saponin was found in all aqueous extracts. FTIR spectrophotometric analysis exhibited the presence of primary & secondary alcohols, alkenes, aldehyde, primary & secondary amines, aliphatic bromo compounds, aliphatic ether, aromatic amines, acid halides, ester, halo compounds, vinyl ether, and aromatic compounds. The presence of these phytocompounds suggests better possibilities for the plant as a source of significant phytomedicines in pharmaceutical industries and research institutes for the discovery of lead compounds for a competent drug.

Keywords: *Bridelia retusa*, Phytocompounds, FTIR.

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Original Research Article

Evaluation of Pharmacological Features and Nanoparticle Formation by *Urena lobata*

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***Corresponding author:** Anil Kumar

Abstract

Urena lobata commonly known as Congo jute or hibiscus burr is a shrub belonging to the family Malvaceae widely distributed throughout India. The plant is utilized by the traditional healers for various ailments such as arthritis, diabetes, cough and malaria. In the present study, phytochemical constituents and antioxidant property of *Urena lobata* was studies in both normal extract and silver nanoparticle form. The antioxidant property of leaf of the plant was also evaluated. We have reported alkaloid, saponin, steroid, terpenoid, tannin, flavonoid and carbohydrate and significant antioxidant activity by DPPH method from this plant. For the first time, silver nanoparticle was successfully synthesized using *Urena lobata* leaf extract in the current investigation and characterized by UV–VIS spectrophotometer and the characteristic surface plasmon resonance peak was identified to be 424 nm. X-ray diffraction (XRD) was employed to ascertain the crystalline nature and purity of the silver nanoparticles which implied the presence of 111, 002, 022, 113, and 222 lattice planes of the cubic structure of metallic silver and Fourier transform infrared spectroscopy (FTIR) was used to determine specific functional groups in silver nanoparticles and the capping agents present in the leaf extract.

Keywords: *Urena lobata,* diabetes, saponin, Fourier transform infrared spectroscopy (FTIR).

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RESEARCH ARTICLE

PHARMACOLOGICAL AND NANOBIOTECHNOLOGICAL ASPECTS OF *GYMNEMA SYLVESTRE*

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Gymnemasylvestre, Phytocompounds, Nanoparticles, FTIR, XRD

Abstract

*Gymnemasylvestre*commonly knownGurmar orsugar destroyer, belonging to the family Asclepiadaceae, is a slow-growing,woody climberdistributed throughout India, traditionally used in Ayurvedic system of medicine forthe treatment of several diseases such diabetes, jaundice,urinary complaints, chronic cough, stomach problems, breathing troubles, malaria and snakebites. The present work was planned to investigate phytochemical profiling and green synthesis of silver nanoparticles using*Gymnemasylvestre*.The phytochemical assessment of stem and leaf extracts of *Gymnemasylvestre* revealed the presence of important phytocompounds such as alkaloids, carbohydrates, cardiac glycosides,flavonoids, phenols, proteins, saponins,steroids,tannins and terpenoids.Saponin was found in all the sample extract.Aqueous stem extractof *Gymnemasylvestre*was utilized for the synthesis of silver nanoparticles. UV-Vis spectrophotometric studyexhibited absorbance peak at 419 nm that measures the reduction ofsilver nitrate tosilver nanoparticles based on optical properties called surface plasmon resonance. FT-IR study of silver nanoparticles showed the presence of specific molecular functional groups such as alkenes, amines, amides, alcohols, phenols, aromatic and halo compounds that acts as capping and stabilizing agents for the synthesis of silver nanoparticles.XRD pattern analysis suggested that the crystalline nature of silver ions and crystalline size of silver nanoparticles of39.5 nm by Scherrer's formula. The presence of this phytoconstituent suggested vital medicinal featuresof theplant and their importancein synthesizing and stabilizing silver nanoparticles.

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Original Research Article

Phytochemical Screening and Antioxidant Activity of *Neolamarckia cadamba* and *Cymbopogon citrates* from Durg District of Chhattisgarh, India

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***Corresponding author:** Anil Kumar

Abstract

Medicinal plants have attracted a great deal of scientific interest due to their potential as a source of natural biologically active compounds especially the antioxidant properties of medicinal plants that have created its wider applications including pharmaceuticals, alternate medicine, and natural therapies. The present study was to evaluate the qualitative estimation of phytochemicals and antioxidant properties from leaves, stem, and root of *Neolamarckia cadamba* and *Cymbopogon citratus*. In our study, we found the presence of steroids, flavonoids, alkaloids, tannins, saponins, and cardiac glycosides and antioxidant features in both plants and found suitable for the therapy of oxidative damages. In the present study, free radical scavenging percentage activity was found maximum in aqueous stem extract of *Neolamarckia cadamba* (81% with 1.5 ml extract) and least in aqueous stem and leaf extract of *Cymbopogon citrates* (1.67% and 1.67% with 0.5 ml respectively). From the present work, it becomes possible to conclude that these plants could be a promising source of bioactive compounds and warrant further study.

Keywords: Antioxidant, Pharmaceuticals, *Neolamarckia cadamba*, *Cymbopogon citratus*.

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A Search for Impact of SARS-CoV-2 on the Reproductive System

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Abstract

The feature of SARS-CoV-2 is yet not fully known but its impact o human society is historical. It has not only crippled the health but has adversely damaged all economic and infrastructural development of the world. Previously it was supposed that the virus is mainly responsible for the respiratory system but now it becomes clear that besides the respiratory system it is damaging several organs viz. cardiovascular, renal, neural, and reproductive systems of the body. In the present study,the author has tried to summarize the knowledge experienced during the epidemic regarding reproductive damage tothe population. We found that due to the high presence of ACE2 receptor in male genital organ there is evidence of an adverse effect of SARS-CoV-2 on the male reproductive system but its impact on the female reproductive system is inconclusive, however much more study is required.

Keywords *: 1.SARS-CoV-2, 2.ACE2 receptor, 3.Male Reproductive System, 4.Orchitis.*

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RAPD BASED RELATIONSHIP STUDY IN FUNGAL ISOLATES OF FOOD SAMPLES FROM DURG, INDIA

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ABSTRACT

Fungi are commonly found in the environment of which some are useful, and some are pathogenic to both animal and plant. The fungal diversity has compelled us to think about the rearrangement of its biosystematics. For the present study fungus, contaminated foods (Onion, Coconut, Groundnut, Sweet) were collected from the local market of Durg (21.1623^{0}N, 81.4279^{0}E) India and cultured in PDA and CDA medium. Two genus *Penicillium & Aspergillus* were successfully cultured in both mediums but quickly in PDA. Both were isolated and used for DNA separation using CTAB in extraction buffer. For the study of phylogenetic relationship, RAPD analysis was carried out for both *Penicillium* (Group-I) and *Aspergillus* (Group-II). Genomic DNA of both groups was subjected to PCR amplification using random Primer (OPC-04, OPC-05 & OPC-08). Phylogenetic relationship was established based on banding pattern followed by the dendrogram. The result showed that among Group-I, *Penicillium* (R_1, R_2) having a close relationship, similarly among Group-II. *Aspergillus* (R_3, R_4, R_5, R_6, R_7) also showed a close relationship, but marked differences found between Group-I (R_1, R_2, *Penicillium*) and Group-II (R_3, R_4, R_5, R_6, R_7, *Aspergillus*). This data may be useful to analyze the impact and importance of the related genes in secondary infections, mycotoxin production as well as in biosystematics.

KEY WORDS: *Aspergillus, Penicillium*, RAPD, Dendrogram

Annals of Nutritional Disorders & Therapy

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Special Article - Anemia

Prevalence of Sickle Cell Anemia in Association of *Plasmodium falciparum* from Rajnandgaon, India

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Abstract

Sickle cell anemia is a blood disorder resulting from the inheritance of abnormal genes from parents. It is caused due to mutation in the β-globulin gene. Sickle cell anemia is widespread across the world and in Central India. The present study was undertaken to study the prevalence of the disorder in the Rajnandgaon district of Central India. A random sampling of 6088 people was done to test the sickle cell anemia problem by slide test method and a total of 249 (4.09%) people were found sickled positive. Further electrophoresis test was performed for all 249 of which 67 were found homozygous (HbSS) and 182 were found heterozygous (HbAS) positive.

Besides the above analysis, chloroquine prophylaxis associated with a high prevalence of *Plasmodium falciparum Pfcrt* K76T mutation in people (n=26) with sickle cell anemia was also analyzed. The genotype of the subject was screened using the hemoglobin electrophoresis system and the *P. falciparum Pfcrt* genotyping was carried out using PCR-Restriction Fragment Length Polymorphism (RFLP). The prevalence rate of *Pfcrt* K76T mutant gene was proportionately found higher in the hemoglobin SS (n=40, m=32, r=0.67) genotype individuals than the hemoglobin AS (n=52, m= 27, r=0.519) and AA (n=182, m= 68, r= 0.37).

Keywords: Sickle cell anemia; *P. falciparum*; Chloroquine; *Pfcrt* K76T, PCR-RFLP

A stability analysis on a smoking model with stochastic perturbation

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Revised 25 March 2021
Accepted 9 April 2021

Abstract

Purpose – The purpose of this paper is to investigate the effects of irregular unsettling on the smoking model in form of the stochastic model as in the deterministic model these effects are neglected for simplicity.

Design/methodology/approach – In this research, the authors investigate a stochastic smoking system in which the contact rate is perturbed by Lévy noise to control the trend of smoking. First, present the formulation of the stochastic model and study the dynamics of the deterministic model. Then the global positive solution of the stochastic system is discussed. Further, extinction and the persistence of the proposed system are presented on the base of the reproductive number.

Findings – The authors discuss the dynamics of the deterministic smoking model form and further present the existence and uniqueness of non-negative global solutions for the stochastic system. Some previous study's mentioned in the Introduction can be improved with the help of obtaining results, graphically present in this manuscript. In this regard, the authors present the sufficient conditions for the extinction of smoking for reproductive number is less than 1.

Research limitations/implications – In this work, the authors investigated the dynamic stochastic smoking model with non-Gaussian noise. The authors discussed the dynamics of the deterministic smoking model form and further showed for the stochastic system the existence and uniqueness of the non-negative global solution. Some previous study's mentioned in the Introduction can be improved with the help of obtained results, clearly shown graphically in this manuscript. In this regard, the authors presented the sufficient conditions for the extinction of smoking, if <1, which can help in the control of smoking. Motivated from this research soon, the authors will extent the results to propose new mathematical models for the smoking epidemic in the form of fractional stochastic modeling. Especially, will investigate the effective strategies for control smoking throughout the world.

Originality/value – This study is helpful in the control of smoking throughout the world.

Keywords Simulations, Levy process, Stochastic smoking model, Extinction, Persistence

Paper type Research paper

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PHARMACOLOGICAL APPROACH OF *Terminalia arjuna*: A REVIEW

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Review Article

ABSTRACT

Terminalia arjuna **is an evergreen tree that belongs to the family** ***Combretaceae*** **and has widespread traditional medicinal uses. Although the whole plant part has some medicinal properties owing to the presence of specific bioactive compounds, but the bark part of the plant prominently being used to treat various ailments by ethnic traditional healers (cardiovascular, skin, asthama, hypertension, unrinary tract disorders) . The main bioactive constituent of the plant is glycosides (cardiac glucoside), flavonoids (arjunone and arjunolone), and triterpenoids (arjunolic acid) that are responsible for its cardioprotective, antioxidant, wound healing (tannin and saponin found in bark part), antitumour (especially against human hepatoma), anti-inflammatory, anti-diabetic, antimicrobial (broad spectrum effect against many gram negative bacteria) activities. Various pharmacological studies indicated its protective action against toxicities induced by certain heavy metals (As) and toxic compounds (NaF and Acetaminophen) owing to the potent antioxidant properties of one of the bioactive agent Arunolic acid. The plant has many more potential in terms of its therapeutic uses that can be explored by referring to the traditional ethnomedicinal experts and literature and thereby can be scientifically validated so that its toxicity side effects and dosage can be measured and quantified. The present review encompases morphological features, distribution, a few traditional and ethnomedicinal formulations and uses, scientific studies on phytochemical constituents and pharmacological significance of** ***Terminalia arjuna*** **and can be refered for further scientific investigations on the bioactive secondsary metabolites of the plant.**

Keywords: *Terminalia arjuna; combretaceae;* bark; cardioprotective; antitumour; antioxidant; antiinflamatory.

Research Square

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They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Arsenic Induced Free Radicals Mediated Genotoxicity and Protective Features of *Ocimum Gratissium L.*

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Research Article

Keywords: Arsenic, Comet assay, Lymphocytes, Oxidative Stress, Phytochemicals, Oryctolagus cuniculus L. Ocimum gratissium L.

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Abstract

Arsenic toxicity is a worldwide geogenic problem for large number of populations. The major problem of arsenicosis is generation of free radicals and related genotoxicity, In the present study three plants species *Ocimum gratissimum* L., *Ocimum sanctum*, *Ocimum basilicum*, were examined by both *in vivo* and *in vitro* methods in *Oryctolagus cuniculus L* to know the free radical scavenging property in Sodium Arsenite induced oxidative stress and related genotoxicity. Oxidative stress was evaluated considering MDA, GSH, SOD, CAT & GPx, and genotoxicity was examined by comet assay and RAPD test. In the present study, Na_3AsO_3 was found to generate free radicals in lymphocytes of *O. cuniculus* and best recovery was reported (MDA-4.78 ± 0.05; GSH-2.87 ± 0.50;SOD-1.78 ± 0.03;CAT-2.72 ± 0.02;GPx-7.43 ± 0.01) under exposure of ethanolic leaf extract of *O. gratissimum*. Na_3AsO_3 was also found to cause polymorphic bands and increased comet tail in lymphocytes which was found significantly recovered by exposure of ethanolic leaf extract of *O. gratissimum.*

Research Square

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They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Arsenic Contamination of Groundwater and Its Clinical Impact on Inhabitants in Central East India

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Research Article

Keywords: Arsenic contamination, Keratosis, Leucomelanosis, Haematological parameters, Biochemical Parameters

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Abstract

We have worked on the As concentrations present in the groundwater samples in the Rajnandgaon region of India, as well as the clinical assessment of the impact of Arsenicosis on the human population. Out of twenty groundwater samples from eight villages, arsenic was found to be above the permissible limit in eighteen samples. The people in the affected area were found suffering from diffused and spotted melanosis, diffused and nodular keratosis, leucomelanosis, hepatomegaly, and splenomegaly. The hematological parameters, viz. low Hemoglobin, high ESR, and low PCV, with RBC, WBC, and Platelet counts adversely altered and increased Prothrombin time. The change in biochemical parameters reflects the toxic effect of prolonged exposure to arsenic viz. – low Serum Glucose, high LDL, HDL, and TG, decreased Total Protein, Albumin, and Globulin. Total Bilirubin, Creatinine, Urea, and SGPT were at higher levels, but the activity of Alkaline phosphatase was found lower. The study reveals the severe health impact on humans, especially on the liver, kidney, and skin caused by arsenic toxicity in Kaurikasa village and adjoining area.



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A New Genetic Insight for Orphan Renal Disorder, Fabry: A Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Fabry is the rare X-linked genetic disorder caused due to mutation in Alpha –Galactosidase encoding GLA gene mutation in chromosome number 22. It has wide diversification in prevalence due to clinical heterozygosity. There are some potential biomarkers for the evaluation of normal or altered genes responsible for Fabry. Advances in the research of biomarkers over the years have made significant development for several clinical indicators, viz. urine-derived cells, oxidative stress, DNA methylation, etc. At present days the recommended therapies for the disease are Enzyme Replacement Therapy (ERT), Chaperone therapy (CT), and mRNA-based therapy, besides, some second-generation therapies which are still under clinical trials.

Keywords: Rare inherited disease; genomic variants fabry; biomarker; diagnostics; treatment.

SHODH SAMAGAM

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छत्तीसगढ़ में सार्वजनिक वितरण की वर्तमान प्रणाली का मूल्यांकन

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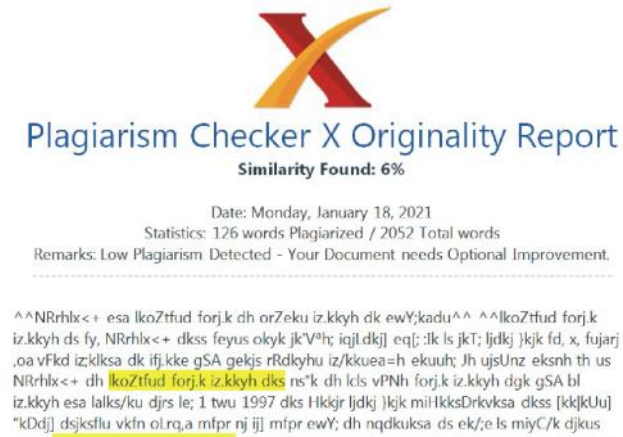
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शोध सार

''सार्वजनिक वितरण प्रणाली के लिए छत्तीसगढ़ को मिलने वाला राष्ट्रीय पुरस्कार, मुख्य रूप से राज्य सरकार द्वारा किए गए निरंतर एवं अथक प्रयासों का परिणाम है। हमारे तत्कालीन प्रधानमंत्री माननीय श्री नरेन्द्र मोदी जी ने छत्तीसगढ़ की सार्वजनिक वितरण प्रणाली को देश की सबसे अच्छी वितरण प्रणाली कहा है। इस प्रणाली में संसोधन करते समय 1 जून 1997 को भारत सरकार द्वारा उपभोक्ताओं को खाद्यान्न, शक्कर, केरोसिन आदि वस्तुएं उचित दर पर, उचित मूल्य की दुकानों के माध्यम से उपलब्ध कराने हेतु, लक्षित सार्वजनिक वितरण प्रणाली लागू की गयी और इसी उद्देश्य को तेजी से पूरा करने के लिए छत्तीसगढ़ राज्य शासन द्वारा 23 सितंबर 2004 को प्रदेश में छत्तीसगढ़ सार्वजनिक वितरण प्रणाली नियोजन आदेश 2004 लागू किया गया। समय के साथ इस प्रणाली में पारदर्शिता और उपभोक्ताओं को अधिक सुविधा प्रदान करने के लिए उचित मूल्य की दुकानों में ऑनलाइन सेवाएं वर्ष 2007 से शुरू कर दी गयी। इस प्रकार छत्तीसगढ़ सरकार लगातार वितरण प्रणाली में सुधार करती रही और यही प्रयास राज्य सरकार को अभी तक 7 राष्ट्रीय स्तर के पुरस्कार दिला चुकी है, जिसमें प्रधानमंत्री अवार्ड 2008–09 सहित अन्य अवार्ड भी शामिल है। आज पुरे देश में प्रथम स्थान पर आरूढ़ छत्तीसगढ़ की वितरण प्रणाली सर्वश्रेष्ठ मानी जाती है।''

मुख्य शब्द

सार्वजनिक वितरण प्रणाली।

प्रस्तावना

देश 15 अगस्त 1947 को अंग्रेजी सत्ता से तो

राजनीतिक रूप से आजाद हो गया किंतु गुलामी की मानसिकता से मुक्त होने की शायद अब भी जरूरत थी। स्वतंत्रता के समय से हमें दो बड़ी चुनौतियां गरीबी और खाद्य सुरक्षा विरासत में मिली। एक नजर से देखा जाए तो इन समस्याओं को हल करना विकास का पहला लक्ष्य बन गया था। सरकार ने अनाज की खरीद और वितरण व्यवस्था को संतुलित करने का पूरा प्रयास किया और आज तक करती आ रही है। इसी खाद्य भंडारण की नीति को क्रियान्वित करने के लिए एक व्यवस्था का जन्म हुआ जिसे सार्वजनिक वितरण प्रणाली के नाम से जाना गया।

विश्व के हर देश की सरकार यह चाहती है कि उनके देश की जनता स्वस्थ रहें, उनको अच्छा भोजन मिले लेकिन बढ़ती हुई जनसंख्या के कारण लोगों में गरीबी, भुखमरी बढ़ती जा रही है। इस समस्या को देखते हुए सरकार ने न्यूनतम वर्ग, मध्यम वर्ग के लोगों को भोजन देने का निर्णय लिया। जिससे उनका जीविकोपार्जन हो सके। सार्वजनिक वितरण प्रणाली खाद्यान्नों की कमी को दूर करने तथा उचित मूल्य पर खाद्यानों की पूर्ति करने के लिए बनाई गई है। शुरूवात में इसका लाभ समाज के हर तबके, हर व्यक्ति को मिलता था। ऐसा कोई मापदंड़ आधारित भेद नहीं था कि केवल गरीबों को ही सार्वजनिक वितरण प्रणाली का लाभ मिलेगा, परन्तु बढ़ती हुई जनसंख्या के बीच न्यूनतम वर्ग एवं मध्यम वर्ग की पहचान करके उनको निम्न दरों पर राशन उपलब्ध कराने की चुनौती को पूरा करने इस प्रणाली में संशोधन करके इसका नाम लक्षित सार्वजनिक वितरण प्रणाली कर दिया गया।

पूरे देश में अनाज और अन्य सामाग्रियों का वितरण करने के लिए सरकारी उचित मूल्य की दुकानों का जाल बिछाया गया। इन सरकारी दुकानों से गेहूं, चावल, शक्कर, मिट्टी का तेल, सूती कपड़े, बच्चों की स्कूल सामग्री, साबुन जैसी जरूरी सामाग्रियां मिला करती थी। इस व्यवस्था का मकसद लोगों की न्यूनतम जरूरतों को उचित मूल्य पर पूरा कराना था। सरकार इस व्यवस्था को रियायत देती रही है, रियायत के मायने यह है कि सरकार ज्यादा मूल्य पर बाजार से सामान खरीद कर कम मूल्य पर लोगों को उपलब्ध कराती है। कई सालो पहले ही सार्वजनिक वितरण प्रणाली, देश में खाद्य अर्थव्यवस्था के मैनेजमेंट के लिए सरकार की नीति का महत्वपूर्ण अंग बन चुकी है। सार्वजनिक वितरण प्रणाली प्रत्यक्ष रूप से एक महतवपूर्ण कदम है जिससे गरीब वर्ग को ऊपर उठाने का एक सराहनीय प्रयास किया जा रहा है क्योंकि सरकार चाहती है गरीबी को खत्म किया जाए। सभी व्यक्ति को तन ढकने के लिए वस्त्र, सिर के लिए छत तथा भुख मिटाने के लिए भोजन की आवश्यकता होती है। कम वस्त्र के बिना व्यक्ति का जीवन संभव है, परन्तु भोजन के बिना जीवन असंभव है। इसलिए व्यक्ति रोटी के लिए कठिन मेहनत करता है साथ ही सरकार पर भी लोगों को खाद्य मुहैया कराने का दायित्व होता है।

सरकार यह जो कल्याणकारी योजना उपलब्ध करा रही है, उससे निम्न वर्ग के लोगों तथा मध्यम वर्ग के लोगों का जीविकोपार्जन हो रहा है। यह प्रणाली केन्द्र और राज्य सरकार द्वारा संयुक्त रूप से चलायी जा रही है। केन्द्र सरकार ने भारतीय खाद्य निगम के द्वारा खाद्यानों की खरीद, भंडारण, ढुलाई और आवंटन करने की जिम्मेदारी ली है तथा राज्य सरकार, राज्य के अंदर आबंटन, गरीबी रेखा के नीचे परिवार की पहचान जैसे कार्य करती है। इसमे गरीब परिवारो को बीपीएल राशन कार्डधारी के नाम से चिन्हित किया जाता है। राज्य सरकार के माध्यम से राशन कार्ड जारी किया जाता है। उचित समय पर दुकानों का पर्यवेक्षण करने की भी जिम्मेदारी राज्य सरकार की होती है। जनता की सुविधा का ध्यान रखते हुए हितग्राहियों को खाद्य सामग्री उचित मूल्य की दुकानों पर, उचित मूल्य पर एवं उचित समय पर उपलब्ध कराना सरकार का दायित्त होता है। छत्तीसगढ़ राज्य खाद्य निगम किसानों से न्यूनतम समर्थन मूल्य पर धान खरीदी की सुविधा देकर उनको अनाज का समर्थन मूल्य प्रदान कर, वितरण प्रणाली को सरल बनाने का प्रयास कर रही है।

इस प्रणाली को सरकार का प्राथमिक समाज कल्याण और गरीबी उन्मूलन कार्यक्रम के अंर्तगत माना जाता है। इसे खाद्यान्न बाजार में मूल्यों में स्थिरता लाने की व्यवस्था के तौर पर शुरू किया गया था। परन्तु अब खाद्य सामग्री जैसे गेहूं, चीनी, चावल, केरोसीन की आपूर्ति कराना, गरीबों की दशा तथा उसके पोषण की स्थिति में सुधार और बाजार मूल्यों पर नियंत्रण करना इसका उद्देश्य बन गया है।

शोध साहित्य का पुनरावलोकन

मिश्रा चंद्रशेखर ने वर्ष 1991 दिसम्बर में अपने लेख ''सार्वजनिक वितरण प्रणाली प्रबंधन में सुधार आवश्यक'' में लिखा है कि ग्रामीण समुदाय को विशेषकर सुदूर, दुर्गम एवं पहाड़ी क्षेत्रों में रहने वाले लोगों को अनिवार्य वस्तुओं विशेषकर खाद्यान्न, चीनी, मिट्टी तेल, खाद्य तेल, नमक तथा कपड़े की आपूर्ति की आवश्यकता को नजर अंदाज नहीं किया जा सकता। प्रधान मंत्री जी ने इस वर्ष स्वतंत्रता दिवस के अवसर पर अन्य महत्वपूर्ण विषयों के साथ सार्वजनिक वितरण प्रणाली पर अपने विचार रखे।

डॉ. जगदीप सक्सेना ने फरवरी वर्ष 2017 में अपने लेख ''भारत में खाद्य सुरक्षा दशा दिशा और भावी परिदृश्य'' में लिखा है कि आज हमारे देश के अन्न भंडारों में लगातार बढ़ती आबादी को पर्याप्त भोजन उपलब्ध कराने की और किसी अकास्मिता से निपटने के लिए पर्याप्त अन्न मौजूद हैं। हरे भरे खेतों में उपजे अनाज को देश के कोने–कोने तक पहूंचाने और आर्थिक रूप से कमजोर परिवारों को कम कीमत पर अनाज उपलब्ध कराने की एक मजबूत प्रणाली भी काम कर रही है।

ए. एन. अग्रवाल ने वर्ष 2018 में अपने लेख ''खाद्य समस्या और सार्वजनिक वितरण प्रणाली'' में लिखा है कि देश में ऐसे लोगों की संख्या बहुत अधिक हैं जिन्हे पर्याप्त भोजन नहीं मिल पाता, यही नहीं बल्कि जो भोजन उन्हे मिलता है उसमें भी पोषक तत्वों का प्रायः अभाव रहता है। खाद्यान्न की यह समस्या गरीबी के लिए बहुत गंभीर बनी हुई है। इस समस्या के समाधान हेतु उचित दर पर दुकानों के द्वारा गरीब लोगों को सस्ते भाव में अनाज सुलभ कराया जाता है।

शोध अध्ययन का उद्देश्य

1. सार्वजनिक वितरण प्रणाली में गरीबों का जीवन स्तर में हुए परिवर्तनों का अध्ययन करना।
2. सार्वजनिक वितरण प्रणाली का रोजगार एवं पोषण पर पड़ने वाले प्रभाव का अध्ययन करना।
3. सार्वजनिक वितरण प्रणाली की सार्थकता का अध्ययन करना।
4. सार्वजनिक वितरण प्रणाली की समस्याओं का सार्थक सुझाव प्रस्तुत करना।

शोध परिकल्पना

1. नियोजित विकास के काल में खाद्यान्न उत्पादन में पर्याप्त वृद्धि हुई है।
2. पर्याप्त खाद्यान्न के उत्पादन के बावजूद भी खाद्यान्न समस्या बनी हुई है।
3. खाद्य वितरण हेतु बनाई गई सार्वजनिक वितरण प्रणाली की व्यवस्था कारगर है।
4. सार्वजनिक वितरण की वर्तमान प्रणाली आवश्यक अपेक्षा में अनुकूल हैं।

शोध प्रविधि

प्रस्तुत अध्ययन को दो उपभागों में बांटा गया है।

1. अध्ययन क्षेत्र का परिचय
2. आंकड़ों का संकलन

1. **अध्ययन क्षेत्र का परिचय :** भारत के हृदय में बसा छत्तीसगढ़ जिसे धान का कटोरा कहा जाता है। यह उसकी समृद्धि का परिचायक है। प्राकृतिक सुंदरता, सरलता तथा उदारता से ओतप्रोत, नैसर्गिक सौंदर्य संजोए हुए कल–कल संगीत सुनाती नदियां एवं जलप्रपात, लोक संगीत और लोकधुन, जनजाति सभ्यता का ये संगम छत्तीसगढ़ की धरोहर है। मध्यप्रदेश पुनर्गठन अधिनियम 2000 के अंतर्गत भारत के हृदय प्रदेश मध्यप्रदेश से पृथक होकर 1 नवम्बर 2000 को छत्तीसगढ़, भारतीय संघ का 26 वां राज्य बन गया। समुद्री घोड़े की आकृति लिए हुए छत्तीसगढ़ इस क्षेत्र को ऐतिहासिक गौरव गाथा कह रहा है। प्राकृतिक ऐतिहासिक काल से आधुनिक काल तक, दक्षिण कौशल से छत्तीसगढ़ तक का सफर अपनी एक विशिष्ट पहचान लिए हुए हैं। छत्तीसगढ़ आज 20 वां वर्ष की युवावस्था को प्राप्त करते हुए वर्तमान में ना केवल राष्ट्रीय अपितु

अंतरराष्ट्रीय स्तर पर भी अपनी गरिमा बिखेर रहा है।

2. **अध्ययन क्षेत्र का परिचय :** प्रस्तुत अध्ययन का शीर्षक छत्तीसगढ़ में सार्वजनिक वितरण प्रणाली की वर्तमान प्रणाली का मूल्यांकन है। यह शोध अध्ययन द्वितीयक समंको पर आधारित हैं। द्वितीयक समंको के स्त्रोत छत्तीसगढ़ राज्य सरकार के विभिन्न प्रकाशन एवं विभागों के माध्यम से लिया गया हैं।

तालिका क्रमांक 1 : छत्तीसगढ़ में जारी राशनकार्ड की जानकारी

क्रमांक	राशन कार्ड के प्रकार	राशन कार्ड की संख्या
1.	अंत्योदय कार्ड	1395289
2.	निराश्रित कार्ड	38282
3.	अन्नापूर्णा कार्ड	6168
4.	प्राथमिकता कार्ड	4202536
5.	निःशक्तजन कार्ड	9767
6.	(एपीएल) सामान्य कार्ड	877958
कुल योग		**6530000**

(स्त्रोत : छत्तीसगढ़ खाद्य विभाग)

उपर्युक्त तालिका से स्पष्ट होता है कि छत्तीसगढ़ में राशन कार्ड की कुल संख्या 6530000 है अंत्योदय कार्ड की संख्या 1395289, निराश्रित कार्ड की संख्या 38282 है, अन्नपूर्णा कार्ड की संख्या सबसे कम 6168 है। उसी प्रकार निःशक्तजन कार्ड की संख्या भी कम है, लेकिन अन्नपूर्णा कार्ड से अधिक है इसकी संख्या 9767 है। प्राथमिकता कार्ड की संख्या सबसे अधिक 4202536 है। एपीएल सामान्य परिवार की राशनकार्ड की संख्या 877958 है।

तालिका क्रमांक 2 : छत्तीसगढ़ में जातिवार राशनकार्ड की जानकारी

क्रमांक	राशन कार्ड	ग्रामीण	शहरी	कुल योग
1.	अनुसूचित जाति	736067	174123	910190
2.	अनुसूचित जनजाति	1847030	124653	1971683
3.	अन्य पिछड़ा वर्ग	2442045	653353	3095398
4.	सामान्य	189815	362915	552730

(स्त्रोत : छत्तीसगढ़ खाद्य विभाग)

उपर्युक्त तालिका से स्पष्ट होता है कि अनुसूचित जाति की ग्रामीण राशनकार्ड की संख्या 736067 तथा शहरी राशनकार्ड की संख्या 174123 तथा कुल योग 910910 है। इसी तरह अनुसूचित जनजाति की ग्रामीण संख्या 1847030 तथा शहरी संख्या 124653 तथा योग 1971683 है। अन्य पिछड़ा वर्ग की ग्रामीण संख्या 2442045 तथा शहरी संख्या 653353 तथा योग 3095398 है, तथा सामान्य वर्ग की ग्रामीण संख्या 189815 शहरी संख्या 362915 तथा योग 552730 है।

तालिका क्रमांक 3 : छत्तीसगढ़ में शहरी एवं ग्रामीण दुकानों की संख्या

क्र.	शहरी दुकानों की संख्या	ग्रामीण दुकानों की संख्या	कुल दुकानों की संख्या
1.	1262	11047	12309

निष्कर्ष

संपूर्ण आंकड़ों का अध्ययन करने के पश्चात् यह निष्कर्ष निकलता है कि सार्वजनिक वितरण प्रणाली गरीब, असहाय लोगों के लिए वरदान साबित हुई हैं। जो कि राज्य तथा देश की सबसे बड़ी समस्या गरीबी तथा भुखमरी को समाप्त करने में काफी कारगर भूमिका निभा रही हैं। आज पी.डी.एस. का इतना व्यापक रूप गरीबी और भुखमरी

को जड़ से उखाड़ फेकने हेतु सरकार के प्रयासो को दर्शा रही है। ''सार्वजानिक वितरण प्रणाली के लिए छत्तीसगढ़ को मिलने वाला राष्ट्रीय पुरस्कार, मुख्य रूप से राज्य सरकार द्वारा किए गए निरंतर एवं अथक प्रयासों का परिणाम है। हमारे तत्कालीन प्रधानमंत्री माननीय श्री नरेन्द्र मोदी जी ने छत्तीसगढ़ की सार्वजनिक वितरण प्रणाली को देश की सबसे अच्छी वितरण प्रणाली कहा है। इस प्रणाली में संशोधन करते समय 01 जून 1997 को भारत सरकार द्वारा उपभोक्ताओं को खाद्यान्न, शक्कर, केरोसिन आदि वस्तुएं उचित दर पर, उचित मूल्य के दुकानों के माध्यम से उपलब्ध कराने हेतु, लक्षित सार्वजनिक वितरण प्रणाली लागू की गयी और इसी उद्देश्य को तेजी से पूरा करने के लिए छत्तीसगढ़ राज्य शासन द्वारा 23 सितम्बर 2004 को प्रदेश में छत्तीसगढ़ सार्वजनिक वितरण प्रणाली नियोजन आदेश 2004 लागू किया गया। समय के साथ प्रणाली में पारदर्शिता और उपभोक्ताओं को अधिक सुविधा प्रदान करने के लिए उचित मूल्य की दुकानों में ऑनलाइन सेवाएं वर्ष 2007 से शुरू कर दी गयी। इस प्रकार छत्तीसगढ़ सरकार लगातार वितरण प्रणाली में सुधार करती रही है और यही प्रयास राज्य सरकार को अभी तक 7 राष्ट्रीय स्तर के पुरस्कार दिला चुकी है जिसमें पी.एम. अवार्ड 2008–09 सहित अन्य अवार्ड शामिल है। आज पूरे देश में प्रथम स्थान पर आरूढ़ छत्तीसगढ़ की वितरण प्रणाली सर्वश्रेष्ठ मानी जाती है''। इसी के साथ महिला सशक्तिकरण एवं महिलाओं को आगे लाने के लिए सरकार ने बहुत अधिक योजनाएं लागू की जिसमें से सार्वजनिक वितरण प्रणाली के तहत महिला हितग्राहियों के नाम से ही राशनकार्ड बनाना अति सराहनीय प्रयास रहा है।

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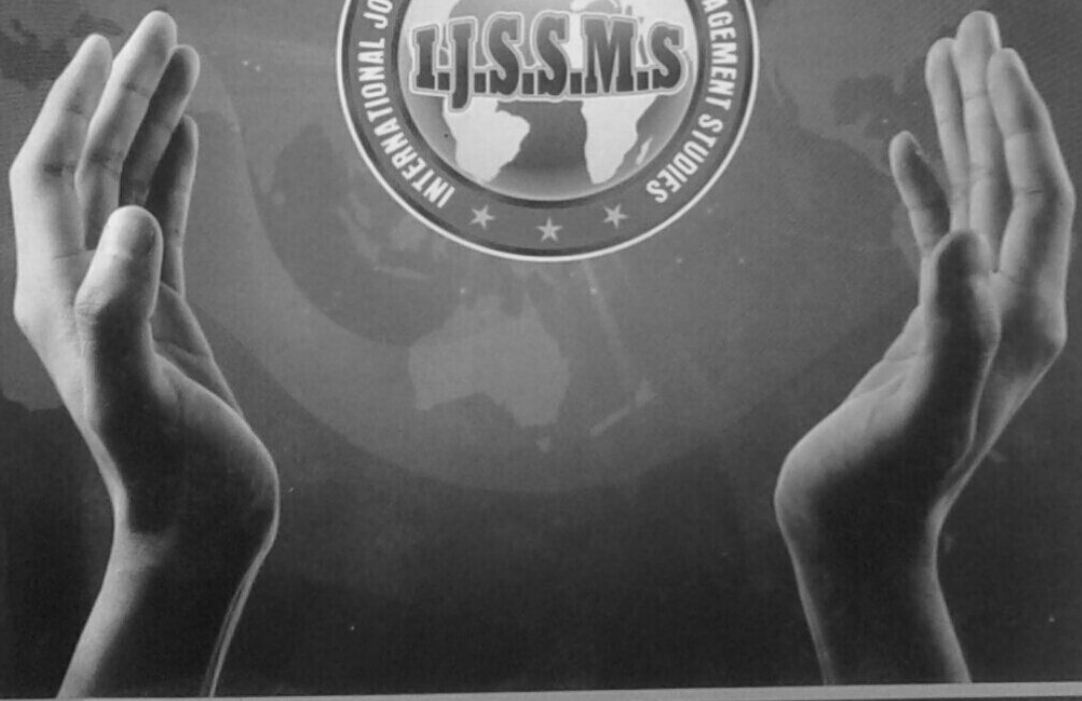
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महिला विकास एवं सशक्तिकरण के भुमिका का अध्ययन – (छत्तीसगढ़ राज्य के अन्तर्गत बेमेतरा जिले के विशेष संदर्भ में)

प्रेमलता पटेल (शोधार्थी)
डॉ. आर.एन. सिंह (प्राचार्य) शोध निर्देशक
महाविद्यालय शासकीय विश्वनाथ यादव तामस्कर, स्नाकोत्तर स्वशासी महाविद्यालय दुर्ग

साराशं :– छत्तीसगढ़ राज्य के अन्तर्गत बेमेतरा जिले के नवागढ विकासखण्ड का अध्ययन करने पर यह निष्कर्ष समाने आया हैं कि स्व–सहायता समूह महिला विकास एवं सशक्तिकरण मे महत्वपुर्ण भुमिका हैं यह गग्रामीण महिलाओं के विकास के लिए सशक्तिकरण एक माध्यम बन गया है जिसके आधार पर नवागढ़ विकास खण्ड निर्धन महिलाओं को रोजगार प्राप्त हुए जिससे महिलाओं के आय, बचत, में वृद्धि हुए तथा महिलाओं में जागरूकता की भावना आये वह समाजिक, आर्थिक, तथा राजनितिक क्षेत्र में स्वयं निर्णय लेने लगे हैं तथा समाज में आत्मसम्मान तथा प्रतिष्ठा प्राप्त कर रहे हैं।

Key word :– महिला विकास, सशक्तिकरण, स्व–सहायता समूह, आय बचत।

प्रस्तावना :– जिस राष्ट्र के अतित में ''यत्र नार्यस्तु पुज्यन्ते तत्र रमन्ते देवता'' का उद्घघोष हुआ हो वह आज के सन्दर्भ में केवल इतिहास के पन्नो में ही सिमट कर रह गया हैं उत्तर वैदिक काल से लेकर 19 सदी तक नारी डरावस्था में ही रही और लंबे समय से उत्प्रेरित, अपमानित, शोषित रही जिसके परिणाम स्वरूप समस्त समाज को हानि हुई। नारी की प्रतिभा एवं उसकी सृजनात्मक शक्ति का राष्ट्र निर्माण में उपयोग नही हो पाया।

अपने यहॉ मैथलीशरण गुप्त की पंक्तियॉ तो बार – बार दोहराई जाती रही हैं –

अबला जीवन हाय, तुम्हारी यही कहानी भारत में विभिन्न प्रयत्नो के बावजुद महिलाओ की स्थिति अभी भी पुरूद्ध प्रधान समाज की स्थिति हैं महिलाओं को वह स्थिति अभी भी प्राप्त नही है जिसके हकदार हैं भारतीय समाज कके वर्तमान परिप्रेक्ष्य में महिलाओ के स्थिति को देखे तो समाज, राज्य, देश का विकास करने के लिए पुरूषों के साथ – साथ महिलाओं की भागीदार भी अत्यंत आवश्यक है क्योकि समाज रूपी गाड़ी को न तो अकेला पुरूष चला सकता हैं न ही अकेली महिला, महिला और पुरूष की समान भागीदारी होना चाहिए महिलाओं के समाजिक, राजनैतिक, आर्थिक विकास करने के लिए महिला सशक्तिकरण आवश्यक है महिलाओं की विकास एवं सशक्तिकरण करने के लिए सर्व प्रथम महिलाओ को एकत्र कर समूह बनाकर महिलाओं मेकं आत्मविश्वास और जागरूकता की भावना लाना होगा जिसे Human help group का नाम दिया गया है स्व सहायता समूह के माध्यम से महिलाऐं सशक्त हो कर अपने आर्थिक स्थिति, समाजिक स्थिति, राजनितिक स्थिति को सुधार सकते है तथा अपने अधिकारों को पहचान सकते है स्व–सहायता समुह द्वारा गरीब महिलाओं को एकत्रित कर तथा बैंको के माध्यम से कम ब्याज में ऋण उपलब्ध करा कर महिलाओं में जागरूकता पैदा करना तथा महिलाओं के विभिन्न आकास्मिक समास्याओं क समाधान करना तथा जागरूकता का भावना पैदा करना छत्तीसगढ़ के पंडवानी गायिका को फुलवासन बाई जिनको तमान पद्यमश्री से पुरूस्कृत किया हैं यह विभिन्न गरीब महिलाओं को एकत्रित कर तथा महिलाओं को विभिन्न समस्याओं को हल करने में सक्षम बनाया।

इस प्रकार महिला विकास और सशक्तिकरण के माध्यम से महिलाओं में एक कांतिकारी स्थिति पैदा कर दिया है उन्हे शिक्षा, स्वास्थ्य, कौशल विकास और निर्णय लेने कके अवसर के साथ कानुनी अधिकार भी प्रदान करने होंगे ताकि वह सही अर्थो में सशक्त और समर्थ बन सके।

शोध का उद्देश्य :– शोध प्रबंध का उद्देश्य निम्न प्रकार हैं –

1. महिलाओं में जागरूकता कील भावनाओं का पता लगाना।
2. महिलाओं के समाजिक आर्थिक स्थिति में सुधार होना।

परिकल्पनाऍं :– मेरे शोध प्रबंध के लिए निम्न परिकल्पनाऍं परिकल्पित किये गये हैं –

1. महिलाओं की जागरूकता की भावना में वृद्धि हुए हैं।
2. महिलाओं के समाजिक आर्थिक स्थिति में सुधार हुआ हैं।

शोध प्रविधि :– "महिलाओं के विकास में सशक्तिकरण के भुमिका का अध्ययन" छत्तीसगढ़ राज्य के अन्तर्गत बेमेतरा जिले के विशेष सन्दर्भ में –
शोध प्रविधि को दो भागों में विभक्त किया गया हैं।
1. आंकड़ो का संकलन –
2. आकड़ो का विश्लेष्ण –

1. आकड़ो का संकलन :– बेमेतरा जिले के विशेष अन्तर्गत बेमेतरा जिले का शोध प्रबंध में अध्ययन के चयनित किये गये हैं आकड़ो का संकलन के लिए द्वितीयक आकड़ो का प्रभोज किया गया हैं।
2. आकड़ो का विश्लेङ्गण :– आकड़ो को सुगम बनाने के लिए विश्लेषण करने तथ्यात्मक बनाने के लिए द्वितीयक आकड़ो का प्रयोग किया गया हैं।
अध्ययन क्षेत्र का परिचय :– बेमेतरा जिला छत्तीसगढ़ राज्य में एक जिला हैं बेमेतरा जिले की स्थापना 1 जनवरी 2012 को किया गया हैं यह दुर्ग संभाग में सम्मिलित हैं जिले में 5 तहसील हैं 4 विकासखण्ड हैं बेमेतरा, बेरला, नवागढ़, एवं साजा भौगौलिक क्षेत्रफल 2854.81 वर्ग कि.मी.

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1. नवागढ़
2. नांदघाट

शोध साहित्य का पुनरावलोकन :–

1. सिंह धनवीर, जुन (2018)[1] :– शोध प्रबंध "महिला सशक्तिकरण मुद्दे एवं चुनौतिया (जनपद मेरा का एक भौगौलिक अध्ययन) प्रस्तुत शोध प्रबंध में देश के सतत एवं संतुलित विकास के लिए महिला सशक्तिकरण आवश्यक हैं समानता का संवैधानिक अधिकार होने के बावजुद की की महिलाओं का समाजिक एवं आर्थिक विकास उस अनुपात में नही हो पाया जिस अनुपात में होना चाहिए था।

2. खींजी राजेन्द्र सिंह (2012)[2] :– प्रस्तुत अध्ययन "ग्रामीण महिलाऐ एवं विकास कार्यक्रम (विशेष जोधपुर जिले की ग्रामीण महिलाओं का समाजिशास्त्रीय अध्ययन) से निष्कर्ष यह प्राप्त होता हैं कि महिला विकास समाज के एक विकास का एक महत्वपुर्ण अध्याय हैं जब तक समाज महिलाओ को उनका यथोचित स्थान प्रदान नही किया जाता हैं तब तक समाज में महिलाओं को उचित स्थान प्राप्त नही हो पाएगा।

3. ड्रा इन्दु शर्मा :– "महिला सशक्तिकरण की दिशा में आने वाले चुनौतियो का अध्ययन" में यह निष्कर्ष निकलता हैं महिलाऐ अपने साहस और योग्यता के बल पर उसने अनेक सफलता प्राप्त की हैं पर मंजिल अभी दुर हैं उसे प्राप्त करने के लिए अनेक प्रयास करने पड़ेंगे।

4. पाण्डेय शशि, (2016)[4] :– स्व–सहायता समूह लघु ऋण एवं महिला सशक्तिकरण एक अध्ययन (इलाबाद के चीव गावों के सन्दर्भ में) शोध प्रबंध से यह निष्कर्ष निकलता हैं ग्रामीण महिलाओं को स्वावलबी और आत्मनिर्भर बनाने में स्वयं सहायता समूह महत्वपुर्ण भुमिका निभा रहे हैं अतः स्व–सहायता समूह महिलाओं कासे विकास की मुख्य धारा से जोडकर आर्थिक, समाजिक, राजनितिक जीवन में कांतिकारी परिवर्तन हुए, कर सशक्तिकरण की दिशा की ओर उन्मुख किया हैं।

5. उमरे श्रीमति निर्मला, (2013)[5] :– शोध प्रबंध ग्रामीण महिलाओं के आर्थिक समाजिक सुदृढ़ीकरण में महिला स्व–सहायता समूहों की भुमिका का अध्ययन (विशेष छत्तीसगढ़ के राजनांदगॉव के सन्दर्भ में) अध्ययन क्षेत्र में स्व–सहायता समूह महिला सशक्तिकरण में नील का साबित हुआ।

सशक्तिकरण का अर्थ :– आत्मविश्वास, आत्मनिर्भरता, सुयोग्यता, सबलता सशक्तिकरण हैं –

महिला सशक्तिकरण – महिलाओं को विकास के समान अवसर उपलब्ध कराना, मनचाही शिक्षा प्राप्त करने का अधिकार देना घर परिवार समाज के बारे में स्वतंत्र निर्णय करने का अधिकार देना सशक्तिकरण हैं।

महिलाऐ विकास के आर्थिक व समाजिक, राजनितिक होना चाहिए इसमें से किसी एक का परिवर्तन को विकास नही कहा जा सकता हैं महिलाओं

के विकास के लिए स्व–सहायता समुह की अवश्यकता हैं ताकि गरीब महिलाओं को एकत्रित कर समूह बनाकर कम ब्याज पर बैंको से ऋण उपलब्ध कराकर महिलाओं में जागरूकता के भवना लाना इस प्रकार स्व–सहायता समूह सशक्तिकरण के सलिए आवश्यक हैं –

तालिका 1.1

परियोजना का नाम	गठित समूह	सदस्य संख्या
नवागढ़	130	1470
नांदघाट	130	1329
योग	260	2799

स्त्रोत – महिला बाल विकास केन्द्र 2018–19

तालिका से स्पष्ट होता हैं कि नवागढ़ परियोजना में 130 स्व–सहायता समूह सदस्य संख्या 1470, नांदघाट पहरयोजना में गठित 130 सदस्य संख्या 2799 हैं।

तालिका 1.2

समूह में बचत राशि संबंध विवरण –

परियोजना का नाम	खेले गये बैंक खाते	कुल बचत राशि
नवागढ़	225	2262215
नांदघाट	130	384120
योग	355	2646335

स्त्रोत – महिला बाल विकास केन्द्र 2018–19

तालिका से स्पष्ट होता हैं कि नवागढ़ में खोले गये बैंक खते 225 बचत राशि 2262215 तथा नांदघाट परियोजना 130 खोले गये बैंक खाते तथा कुल बचत राशि 384120 इस प्रकार स्व–सहायता समूह के द्वारा महिलाऐ आर्थिक रूप से सशक्त हो रही हैं।

तालिका 1.3

आर्थिक गतिविधियों से जुड़े स्व–सहायता समूह –

परियोजना का नाम

गतिविधियाँ	नवागढ़		नांदघाट	
	समूह	सदस्य संख्या	समूह	सदस्य संख्या
मछली पालन	12	131	0	0
पशुपालन	2	20	0	0
कृषि	30	312	0	0
होटल, दुकान	0	0	2	20
बड़ी, पापड़, मसाला	11	112	0	0
कुल	55	575	2	20

स्त्रोत महिला बाल विकास केन्द्र 2018–19

तालिका से स्पष्ट होता हैं कि नवागढ़ में मछली पालन करने वाले समूह 12 सदस्य संख्या 131 पशुपालन उरने वाले समुह 2 सदस्य संख्या 20 कृषि करने वाले समूह 30 सदस्य संख्या 312 होटल,दुकान समूह 0 सदस्य 0 बड़ी,मसाला,पापड़ गठित समूह 11 सदस्य संख्या 112, नांदघाट मे मछली पालन करने वाले समूह 0 सदस्य संख्या 0 पशुपालन करने वाले समुह 0 सदस्य संख्या 0 कृषि करने वाले समूह 0 सदस्य संख्या 0, होटल,दुकान समूह 2 सदस्य 20 बड़ी, मसाला, पापड़ गठित समूह 0 सदस्य संख्या 0, इस प्रकार स्व–सहायता समूह के माध्यम से महिलाओं के विकास में सशक्तिकरण करने में सहायता प्रदान करते हैं।

निष्कर्ष :– निष्कर्ष रूप से यह कहा जा सकता है कि ग्रामीण विकास और सशक्तिकरण के प्रस्तुत अध्ययन पर यह निष्कर्ष निकलता हैं कि स्व–सहायता समूह महिला सशक्तिकरण का एक माध्यम हैं स्व–सहायता समूह के माध्यम से महिलाओं में जागरूकता की भावना, आय में वृद्धि तथा बचत में वृद्धि हुआ हैं महिलाओं द्वारा स्व निर्णय लिया जाने लगा इस प्रकार के महिलाओं के सामाजिक, आर्थिक हस्थिति में सुधार हुआ तथा महिलाओं में आत्मविश्वास, आत्मसम्मान की भावना में वृद्धि हुआ हैं इस प्रकार महिला सशक्तिकरण महिला के विकास का एक आयाम ही नही बल्कि कांतिकारी परिवर्तन हैं।

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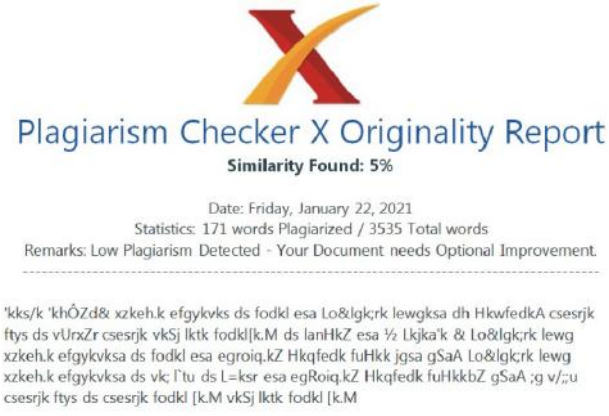
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शोध सार

स्व–सहायता समूह ग्रामीण महिलाओं के विकास में महत्वपुर्ण भुमिका निभा रहें हैं। स्व–सहायता समूहो ने ग्रामीण महिलाओं के आय सृजन के स्त्रोत में महत्वपुर्ण भुमिका निभाई हैं। यह अध्ययन बेमेतरा जिले के बेमेतरा विकास खण्ड और साजा विकास खण्ड के संदर्भ में हैं। बेमेतरा विकसित तथा साजा विकासखण्ड अविकसित क्षेत्र का चयनित किये गये हैं। इस शोध का प्रमुख उद्देश्य बेमेतरा विकास खण्ड और साजा विकास खण्ड के ग्रामीण महिलाओं के आय एवं बचत में वृद्धि सामाजिक व आर्थिक स्थिति में सुधार हुई हैं यह ज्ञात करना हैं। प्रस्तुत शोध में यह निष्कर्ष निकलता हैं कि ग्रामीण महिलाओं के विकास में स्व–सहायता समूह का अद्वितीय भूमिका रही हैं। स्व–सहायता व सुक्ष्म वित्त के माध्यम से बेमेतरा विकास खण्ड व साजा विकास खण्ड में महिलाओं के द्वारा उनकी कार्य कलापों संबंधी आर्थिक, सामाजिक और राजनितिक गतिविधियो में वृद्धि हुई हैं। बेमेतरा विकास खण्ड विकसित होने के करण स्व–सहायता समूह संगठनों पर उतने ध्यान नही दे पायी हैं। साजा विकास खण्ड अनुसुचित जनजाति होने के कारण समुहों के गठन में महत्वपुर्ण भुमिका निभायी हैं, इस प्रकार समूह के माध्यम से महिलाओं के सामाजिक, आर्थिक, राजनितिक क्षेत्र में सुदृढ़ हुई हैं।

मुख्य शब्द

महिला, सशक्तिकरण, स्व–सहायता समूह, सामाजिक, आर्थिक स्थिति।

प्रस्तावना

भारतीय अर्थव्यवस्था पुर्णतः कृषि प्रधान देश हैं। देश के सर्वागीण विकास के लिए ग्रामीण विकास बहुत

ही महत्वपुर्ण हैं। भारत में आधे से अधिक जनसंख्या महिलाओं को प्रतिनिधित्व करता हैं और यहाँ की महिलाऐं कृषि आदि कार्यो में संलग्न रहती हैं इसके बावजुद भी महिलाओं की स्थिति संतोषजनक नही कही जा सकती हैं। छत्तीसगढ़ में महिलाओं का प्रतिशत कम हैं, छत्तीसगढ़ राज्य भी एक पुरूष प्रधान देश हैं।

अतः चाहे हम छत्तीसगढ़ राज्य की बात करे या भारत देश की बात करें महिलाओं का विकास अत्याधिक महत्वपुर्ण हैं। अध्ययन क्षेत्र बेमेतरा जिला पुरूष प्रधान जिला हैं, व गाँवो से घिरा हुआ हैं, यहाँ भी पुरूषों की अपेक्षा महिलाओं की जनसंख्या कम हैं। कुल कार्यशील जनसंख्या, कुल जनसंख्या का 49.97 प्रतिशत हैं जिससे कुल कार्यशील महिलाओं का भागीदारी 22 प्रतिशत हैं। महिलाओं का विकास होना अत्यंत आवश्यक हैं और महिलाओं के विकास करने के लिए महिलाओं कों विभिन्न प्रकार के समास्याओं से मुक्ति दिलाने की जरूरत हैं (जैसेः शोषण, साहूकार, रूढ़िया) तभी महिलाओं के सामाजिक, आर्थिक, राजनितिक और शैक्षणिक स्थिति में सुधार हो पायेंगे। इसके लिए शासकीय और अशासकीय दोनों प्रयास हुए, लेकिन इन प्रयासों में व्यक्तिगत प्रयास अधिक हुए। इसके लिए सर्वप्रथम सन् 1974 में भारत के गुजरात राज्य में सुश्री इला भट्ट ने महिलाओं को इकत्रित कर स्व–सहायता समूह का गठन किया हैं।

छत्तीसगढ़ के संदर्भ मे स्व–सहायता समूह को अधिक सफल बनाने वाले प्रसिद्ध तीजन बाई और श्रीमति फुलवासन बाई जिन्होने महिलाओ को संगठित कर विभिन्न प्रकार से सहायता प्रदान कर महिलाओं में आत्मसम्मान, आत्मनिर्भरता, निर्णय लेने की क्षमता की विकास किया है।

इस प्रकार स्व–सहायता समूह के माध्यम से महिलाओं के विभिन्न प्रकार के समस्याओं का समाधान, लघु उद्योग में सहयोग स्व–सहायता समूह गाँवो में बेहतर विकल्प साबित हुआ। स्व–सहायता समूहों से महिलाओं में जागरूकता की भावना तथा आर्थिक एवं समाजिक स्थिति में सुधार, आत्मसम्मान, आत्मनिर्भरता की भावना बढ़ गयी। अतः स्व–सहायता समूह एक क्रांतिकारी एवं अद्भुत परिवर्तन हैं, यह महिलाओं के विकास का अभिन्न अंग हैं।

स्व–सहायता समूह का अर्थ

स्व–सहायता समूह का शाब्दिक अर्थ ऐसे लोगो के समूह से आर्थिक रूप से एक दुसरे की सहायता करते हुए एकजुट हुए हो। स्व–सहायता समूह आर्थिक और सामाजिक स्तर एवं समान विचारधारी वाले व्यक्तियों का वह समूह हैं, जिसमें सदस्य स्वैक्षिक आधार पर नियमित बचत करते हैं तथा अपने विचारों का अदान–प्रदान कर एक–दुसरे का सहयोग करते हैं। स्व–सहायता समुह की संख्या 10–20 हो सकते हैं, समान वर्ग पृष्ठभुमि के होते हैं।

स्व–सहायता समूह की परिभाषा

स्व–सहायता समूह को निम्न से परिभाषित किया हैं, ***युनीसेफ*** *के अनुसार, स्व–सहायता समूह अपनी आवश्यकता पुर्ति तथा समस्या सामाधान के लिए सामूहिक प्रयास करने का एक साधान हैं।*

राकेश मल्होत्रा के अनुसार, *एक ऐसा गठबंधन हैं जिसमें 5–20 सदस्य स्वेच्छा से एक–दुसरे की मदद करने के उद्देश्य से संगठित होते हैं।* सामान्यतः स्व–सहायता समूह के सदस्य एक–दुसरे से भली–भॉति परिचित होते हैं, एक ही गाँव के सामाजिक व आर्थिक परिस्थितियों और व्यवसाय के होते हैं, अर्थात् वह समरूप होते हैं।

स्व–सहायता समुह का अर्थ कुछ निश्चित उद्देश्यों के लिए अथवा लक्ष्यों के प्राप्ति के लिए कई व्यक्ति के द्वारा परस्पर मिलकर विकसित किये गये संगठन को समूह कहते हैं, स्व–सहायता समुह की सर्वप्रथम अवधारणा बांग्लादेश में, श्री मोहम्मद युनुस ने 1976 से सुक्ष्म वित को आधार मानकर अनेक स्व–सहायता समूहों का सृजन किया गया। बांग्लादेश में गरीबी उन्मुलन हेतु प्रो. युनूस ने पड़े भीषण अकाल के मध्य मोहम्मद युनूस द्वारा 42 परिवारों को 27 डॉलर का चिन्तामुक्त ऋण प्राप्त किया गया, जो अल्प प्रयोग का प्रयोग मात्र था जो सफल रही हैं। ऋण प्रदान करने के लिए ग्रामीण बैंक की स्थापना की, ग्रामीण बैंको द्वारा अल्प मात्रा में निर्धनों के समूह को जिसे स्वयं सहायता समूह कहते हैं।

सबसे पहले भारत के गुजरात राज्य में सुश्री इला भट्ट के नेतृत्व में 1974 में महिलाओं द्वारा संगठित स्वयं सहायता समुहों को सुक्ष्म वित प्रदान कर उन्हे उत्पादन गतिविधियों का प्रशिक्षण दिया। नाबार्ड संभवतः भारत वर्ष का पहली संस्था हैं, जिसने सर्वप्रथम स्व–सहायता समूह व उनके प्रोत्साहन एक महत्वपुर्ण पहल की।

छत्तीसगढ़ के प्रसिद्ध पंडवानी गायक तीजन बाई और पुलवासन बाई अपने आपको सशक्त कर तथा उँचाईयों के पदो पर आगे बढ़े तथा उन्होनें ग्रामीण समाज के अन्य गरीब महिलाओं का समूह बनाकर अन्य लोगो को सशक्त बनाये। इस प्रकार स्व–सहायता समूह सुक्ष्म ऋण के माध्यम से महिलाओं के विकास एवं सशक्तिकरण में अपने सार्थकता को सिद्ध किये हैं।

शोध का उद्देश्य

शोध का उद्देश्य निम्न प्रकार से हैः

1. महिला स्व–सहायता समूह के द्वारा महिलाओं के आय एवं बचत में वृद्धि होना।
2. महिला स्व–सहायता समूहों द्वारा सामाजिक व आर्थिक स्थिति में सुधार।
3. महिला स्व–सहायता समूह में जागरूकता का पता लगाना।

परिकल्पना

शोध प्रबंध के लिए निम्न परिकल्पनाएँ परिकल्पित किए गये हैंः

1. महिला स्व–सहायता समूह के द्वारा महिलाओं के आय में एवं बचत में वृद्धि हुई।
2. स्व–सहायता समूहों के द्वारा महिलाओ में जागरूकता में वृद्धि हुई हैं।

शोध प्रविधि

दो भागों में विभक्त हैंः

1. आंकड़ो का संकलन 2. आंकड़ो का विश्लेषण

1. आंकड़ो संकलन

ग्रामीण महिलाओं के विकास में स्व–सहायता समूहों की भूमिका बेमेतरा जिले के बेमेतरा एवं साजा विकासखण्ड के विशेष संदर्भ में हैं। जिसमें बेमेतरा विकासखण्ड जो विकसित तथा साजा विकासखण्ड अविकसित क्षेत्र का प्रतिनिधित्व कर रहा है, का मेरे द्वारा शोध प्रबंध में न्यादर्श के लिए चयनित किये गये है।

प्रत्येक अध्ययन में संमको का समान रूप से प्रतिनिधित्व हो सके इसके लिए भौगौलिक एवं आर्थिक स्थिति को ध्यान में रखते हुए प्रत्येक विकासखण्ड में स्थिति स्व–सहायता समूहो एक सारणी बनाकर दैव निदर्शन पद्धति के आधार पर प्रत्येक विकासखण्ड 5–5 स्व–सहायता समूह लभन किया जावेगा दैव निदर्शन पद्धति के आधार चयनित स्व–सहायता समूहो के 5–5 सदस्यों 10X5=50 इस तरह 50 सदस्यो का चयन कर अध्ययन किये हैं।

2. आंकड़ो का विश्लेषण

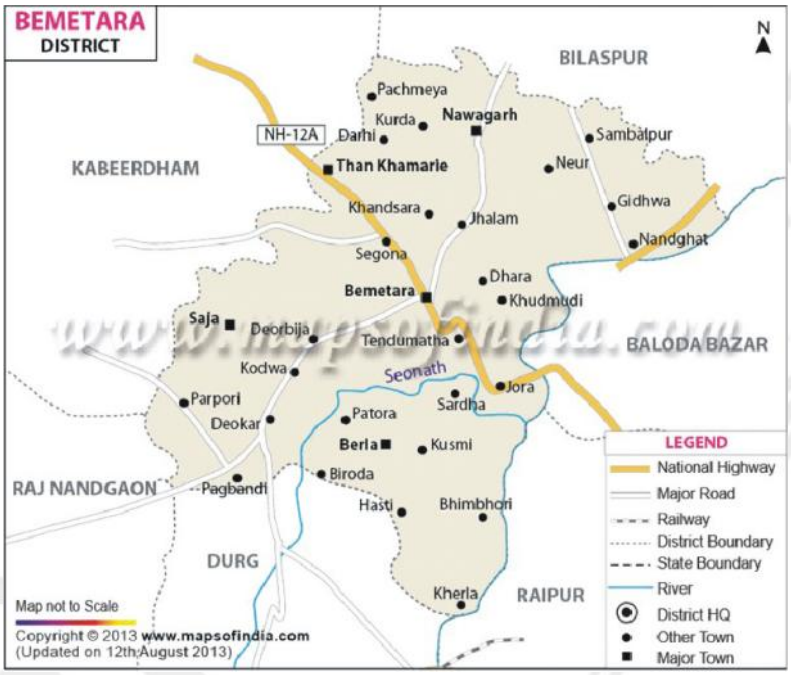
आंकड़ो के विश्लेषण को रोचक एवं तत्थ्यात्मक बनाने के लिए ग्राफ, तालिका, प्रतिशत आदि विधियो के साथ–साथ आंकड़ो को सुगम बनाने हेतु मानचित्र विधि का प्रयोग किया गया हैं। अध्ययन को तत्थ्यात्मक एवं तुलनात्मक बनाने के लिए द्वितीयक आंकड़ो और प्राथमिक समंको का प्रयोग किया गया है।

तालिका 1.1 : शोध प्रविधि को निम्न तालिका के रूप में दर्शाया गया है

क्रमांक	विकासखण्ड	महिला स्व-सहायता समूह का अध्ययन हेतु चयन	महिला प्रति स्व-सहायता समुह के सदस्यों हेतु चयन	महिला स्व-सहायता समूहो कुल सदस्यों का अध्ययन हेतु चयन
1.	बेमेतरा विकसित	5	5	25
2.	साजा अविकसित	5	5	23
योग		**10**	**10**	**50 न्यादर्श**

अध्ययन का क्षेत्र

बेमेतरा जिला छत्तीसगढ़ का एक जिला हैं इसकी स्थापना 1 जनवरी 2012 को हुई हैं। यह जिला दुर्ग संभाग में सम्मिलित हैं। जिले में 5 तहसीले – बेमेतरा, साजा, नवागढ़, बेरला व थानखम्हरिया हैं। यहाँ गावों की संख्या 700 हैं, ग्राम पंचायते 7, नगर पालिका 1, जनपद पंचायत 4, जिले का भौगौलिक क्षेत्रफल 2854081 वर्ग कि.मी. 21090 उत्तरी अक्षांश, 81031 पुर्व देशांत पर स्थित हैं। बेमेतरा जिला में 2011 के अनुसार जनसंख्या 795759, जनसंख्या घनत्व 278 वर्ग कि.मी. लिंगानुपात प्रतिहजार स्त्रियों पर 100 प्रतिशत, अनुसुचित जाति की संख्या 144022, अनुसुचित जन जाति की संख्या 37185, साक्षरता प्रतिशत 69.87 हैं विकासखण्ड 4, बेमेतरा, साजा, बेरला, नवागढ़ विकासखण्ड हैं।



चयनित न्यादर्श विकासखण्ड का परिचय

1. बेमेतरा विकासखण्ड का परिचय

बेमेतरा जिला के विकासखण्डो में बेमेतरा एक विकासखण्ड है, इसका भौगौलिक क्षेत्रफल 729.79 वर्ग कि. मी. कुल ग्राम 187, आबाद ग्राम 187, ग्राम पंचायत 103 जनपद पंचायत 1, नगर पालिका 1 हैं। बेमेतरा विकासखण्ड का अक्षांश 21070 उत्तरीय और देशांस 81.30 पूर्व पर स्थित हैं। 2011 के जनगणना के अनुसार कुल जनसंख्या 21,5624, स्त्री–पुरूष अनुपात 997, अनुसुचित जाति की संख्या 38,300, अनुसुचित जनजाति की संख्या 9841, साक्षरता का प्रतिशत 70.72 हैं।

2. साजा विकासखण्ड का परिचय

बेमेतरा जिला विकासखण्डो में से साजा एक विकासखण्ड हैं। इसका भौगौलिक क्षेत्रफल 451 वर्ग कि.मी. 21066, उत्तर अक्षांश 81053 देशांस पुर्व पर स्थित हैं। कुल ग्राम 109 आबाद ग्राम 108, ग्राम पंचायत 97, जनपद पंचायत 1 हैं। 2011 के जनगणना के अनुसार 117486, स्त्री–पुरूष अनुपात 1004, अनुसुचित जाति की संख्या 14063, अनुसुचित जनजाति की संख्या 8522, कुल साक्षरता 71854 हैं।

शोध साहित्य का पुनरावलोकन

शोध कार्य को समझने व विशिष्टता लाने हेतु शोध का अध्ययन करना आवश्यक हैं। अतः निम्न शोध ग्रंथो का अध्ययन किया गया हैं:

1. **यु चेरीनबी, 2010** ''माइक्रो क्रेडिट मैंनेजमेंट वाय वुमेन्स सेल्फ हेल्प ग्रुप्स'' स्व–सहायता समूहों के गुणात्मक एवं संख्यात्मक आयामों पर पड़ने वाले प्रभाव का अध्ययन किया।
2. **कौशिक प्रो. आशा** प्रस्तुत शोध प्रबंध में अपने लेख ''भारत में महिला सशक्तिकरण दशा एवं दिशा में बटमा की नारी उत्थान के लिए किये गये प्रयास उसके समय के स्थित चुनौतियों के संदर्भ में पौन नजर आते हैं। महिला सशक्तिकरण का अर्थ यह हैं कि सामाजिक, आर्थिक, राजनीतिक, व्यक्तिक सभी स्तरों पर महिला की प्रबल भुमिका एवं निर्णय प्रक्रिया में प्रभावी सहभागिता हो।
3. **बानीस महू, 2012** प्रस्तुत शोध में ''स्व–सहायता समुह का भारतीय अर्थव्यवस्था पर प्रभाव'' प्रस्तुत अध्ययन से यह निष्कर्ष निकलता हैं कि अनुसुचित जाति व सामान्य जाति की महिलाओ की आर्थिक स्थिति में सुधार 100 प्रतिशत पाया। महिलाऐ इस बात की पक्ष में पाया गया कि उनके आर्थिक स्थिति में सुधार हुआ आर्थिक स्थिति में सुधार के लिए क्रेडिट पावरफुल दल है जो यह सुक्ष्म ऋण गरीब महिलाओं को योजना से जोड़ती हैं। गरीब महिलाओं को स्व–सहायता समूह के माध्यम से सुक्ष्म ऋण उपलब्ध कराती है ताकि गरीब महिलाओं के आर्थिक, सामाजिक स्थिति में सुधार हो सके।
4. **मिश्र कान्तेश्वर कुमार, 2014** प्रस्तुत अध्ययन ''महिलाओं के सामाजिक एवं राजनीतिक सशक्तिकरण में स्व–सहायता समुह की भुमिका का विश्लेषात्मक अध्ययन राजनांदगाँव जिले के विशेष संदर्भ में'' इस शोध निष्कर्ष यह निकलता हैं कि दैव निदर्शन पद्धति का उपयोग करते हुए 300 न्यादर्श 6 विकासखण्ड को शामिल किया गया हैं। इस शोध का प्रमुख उद्देश्य स्व–सहायता समूह के माध्यम से गरीबी रेखा से नीचे जीवन यापन करने वाले लोगो को लाभ हो रहा हैं महिलाओं के सामाजिक, आर्थिक स्थिति में सुधार हो रहे हैं। अतः इस शोध का यह निष्कर्ष निकलता हैं कि राजनांदगाँव जिले के महिलाओं तथा स्व–सहायता समूह कार्यक्रम से तमाम ग्रामीण महिलाओं को लाभ हुआ हैं, इसके साथ ही भारत विकास योजनाओं के माध्यम से सामाजिक, आर्थिक, सशक्तिकरण तथा साथ में महिलाओं की स्थिति में सुधार हुआ।
5. **डॉ. पाण्डेय शशि, जुन 2016** प्रस्तुत शोध प्रबंध ''स्व–सहायता समूह लघु एवं महिला सशक्तिकरण निष्कर्ष के रूप से यह कहा जा सकता हैं कि समूह की क्रियाओं में भाग लेकर महिलाऐं विभिन्न कार्यो में जुड़कर विकास के नये आयाम से जुड़ गयी हैं तथा समूह के स्तर पर नेतृत्व करने की क्षमता भी उभरी हैं। महिला सशक्तिकरण का प्राथमिक उद्देश्य ही यह हैं कि उनको अपने अधिकारो के प्रति सशक्त किया जाये इस प्रकार ग्रामीण महिलाओं को स्वावलम्बी, आत्मनिर्भर बनाने में स्व–सहायता समुह महत्वपुर्ण भुमिका निभा रहे हैं।
6. **उमरे श्रीमती निर्मला, 2013** शोध शीर्षक ''ग्रामीण महिलाओ के आर्थिक – सामाजिक सुदृढ़ीकरण में महिला स्व–सहायता समूह की भुमिका का अध्ययन ''छत्तीसगढ़ के राजनांदगाँव के विशेष संदर्भ में'' के अन्तर्गत 3 विकासखण्डो का अध्ययन किया गया था प्रत्येक विकासखण्ड 200 सदस्यों के अध्ययन हेतु चयन किया गया हैं। शोध का प्रमुख उद्देश्य – सामाजिक, आर्थिक स्थिति का पता लगाना, बजट स्व–सहायता समूहों की स्थिति का अध्ययन करना इस प्रकार शोध प्रबंध से यह निष्कर्ष निकलता हैं कि स्व–सहायता समुहों की उपयोगिता ग्रामीण परिवारों में गरीबी दुर करने में तथा अधिक से अधिक महिलाओं के सशक्तिकरण में सहायक सिद्ध हुआ हैं। स्व–सहायता समुहों के माध्यम से अपनी छोटी–छोटी बचत तथा लघु ऋण के द्वारा महिलाओं के विभिन्न प्रकार के समास्याओं समाधान महिलाओं में जागरूकता आया महिला स्व–सहायता समुह महिलाओं के विकास में पत्थर का मील साबित हुआ है। ग्रामीण क्षेत्र में सुक्ष्म वृत्त एवं स्व–सहायता समुहों का सशक्तिकरण की क्रिया में एक क्रांतिकारी कदम साबित हुआ हैं।
7. **त्यागी डॉ. निशा, 2018** शोध शीर्षक''भारत में महिला सशक्तिकरण उभरते आयाम प्रस्ततु शोध अध्ययन'' से यह निष्कर्ष प्राप्त होते हैं कि महिलाओं के जागरूकता के लिए सरकार ने विभिन प्रकार के योजनाऐं लागु

किया ताकि महिलाऐ सशक्त हो सके। महिला सशक्तिकरण 2001 महिलाओं कों आर्थिक उत्थान के लिए प्रयास किये गये हैं जिसके तहत महिलाओं के स्थिति में सुधार हो सके हैं। जैसे कि बेटी बचाव बेटी बढ़ाव, सुकन्या योजना ये सभी योजना महिलाओं के विकास के लिए है, परिणाम स्वरूप महिलाऐं पंचायत में भाग लेकर अपने सामाजिक एवं आर्थिक कार्यो को उजागर कर रही हैं।

8. **बाफना डॉ. 2018** शोध प्रबंध में स्व–सहायता समूहों की प्रभावी विकास में बैंको के ऋण नीति का योगदान विशेष उज्जैन जिले के सन्दर्भ में प्रस्तुत शोध प्रबंध से यह निष्कर्ष निकलता हैं कि स्व–सहायता समूह और गैर सरकारी संस्थाओं बैंको के प्रयास से महिलाओं में आत्मनिर्भरता, स्वयं के व्यवसाय संचालित करने की भावना तथा समाज में महिलाओं की प्रतिष्ठा में वृद्धि हुई हैं। स्व–सहायता समूह और बैंक लिंकेज कार्य के द्वारा महिलाओं ने स्वयं के व्यवसाय का संचालन किया हैं, जिससे महिलाओं में बचत की प्रवृत्ति में बढ़ोत्तरी हुई हैं। गरीबी जैसे समास्याओं को हल कर महिलाओं में आर्थिक सम्पन्नता आयी हैं, इस प्रकार महिलाओ में आत्मसम्मान की वृद्धि हुई हैं।

स्व–सहायता समुह का उद्देश्य

स्व–सहायता समूह का उद्देश्य आपसी बचत एवं ऋण के माध्यम से गरीब लोंगो का सहयोग करना, आकस्मिक सहायता प्रदान करना, लघु एवं कुटीर उद्योग का विकास करना, महिलाओं के आर्थिक एवं सामाजिक स्थिति में सुधार करना तथा महिलाओं में जागरूकता की भावना लाना हैं।

स्व–सहायता समुह की आवश्यकता

स्व–सहायता समूह के माध्यम से ग्रामीण महिलाओं के सशक्तिकरण को एक महत्वपुर्ण इकाई के रूप में अपनाया गया। स्व–सहायता समूह जो अधिक ऋण एवं बचत से शुरू किये जाते हैं। स्व–सहायता समुह विकास का एक आधार स्तंभ हैं, ग्रामीण महिलाऐं स्व–सहायता समूहों के जरिए सामाजिक व आर्थिक बदलाव ला रही हैं। स्व–सहायता समुहों के माध्यम से महिलाओं ने मेहनत व लगन के बल पर एक नया मुकाम हासिल किये। स्व–सहायता समूहों में स्वैच्छिक संगठन से हमेशा सहयोग प्राप्त होता हैं। स्व–सहायता समुह के आपसी सहयोग तथा बैंको के माध्यम से कम ब्याज दर पर ऋण, उपलब्ध कराकर रोजगार के अवसर में वृद्धि हुए तथा महिलाओं में सशक्त एवं जागरूकता की भावनाा में वृद्धि हो सके तथा महिलाओं के आर्थिक एवं सामाजिक स्थिति में सुधार हो सके। इस प्रकार महिलाओं के विकास के लिए स्व–सहायता समूह की आवश्यकता हुई।

समूह की सदस्यता

समूह की सदस्य संख्या 10 से 20 हो सकती हैं, कोई भी सदस्य स्त्री या पुरूष जो 18 वर्ष का हो चुका है सदस्यता प्राप्त कर सकता हैं। खाता खोला जाता हैं, प्रत्येक सदस्य के पास बैंक खाते होना चाहिए समूह की बैंक होती हैं, सप्ताह में एक बार बुलावे में जाते हैं। समूह की महत्वपुर्ण अभिलेख सदस्यता रजिस्टर, उपस्थिति रजिस्टर, नगदी रजिस्टर, बचत संबंधी रजिस्टर, ऋण संबंधी रजिस्टर होते हैं।

चयनित न्यादर्श स्व–सहायता संबंधी जानकारी

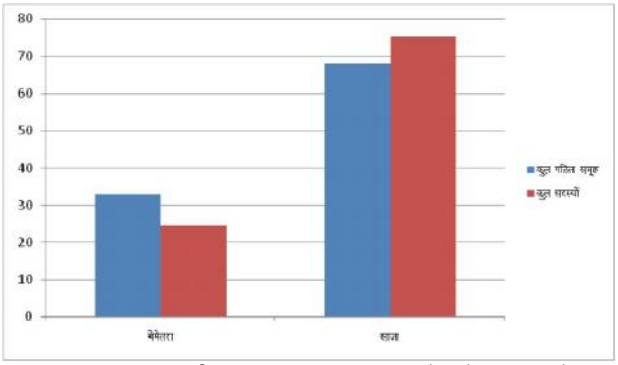
तालिका 1.2 : स्व–सहायता समूह का सदस्य जानकारी

क्रमांक	विकासखण्ड	कुल प्राप्ति समूह		कुल सदस्यों	
		समूह	प्रतिशत	सदस्य	प्रतिशत
1	बेमेतरा	254	32.81	02540	24.51
2	साजा	520	67.18	07820	75.42
योग		**774**	**100.00**	**10360**	**100.00**

(स्त्रोत : महिला–बाल विकास केन्द्र मार्च 2018)

तालिका 1.2 से स्पष्ट होता हैं कि बेमेतरा विकासखण्ड जो विकसित क्षेत्र हैं, जहाँ पर स्व–सहायता समूह की संख्या 254 हैं तथा साजा विकासखण्ड जो विकसित क्षेत्र जो महिला स्व–सहायता समूह की संख्या सबसे अधिक 520 हैं। इस प्रकार स्पष्ट होता हैं कि साजा क्षेत्र महिला स्व–सहायता समूह महिलाओं के विकास में सहायता

प्रदान कर रहे हैं।



तालिका 1.3 : 2. चयनित न्यादर्श स्व–सहायता समूहो के सदस्यों का वर्गवार विवरण

क्रमांक	विकासखण्ड	अनुसुचित जाति	अनुसुचित जनजाति	अन्य पिछड़ा वर्ग	समान्य	योग	प्रतिशत
1	बेमेतरा	720	192	1280	348	2540	24.56
2	साजा	1200	1569	3150	1881	7.800	75.43
योग		1920	1761	4430	2229	10340	100.00
प्रतिशत		18.56	17.03	42.84	21.55	100	

(स्त्रोत : महिला बाल विकास केन्द्र 2018 मार्च)

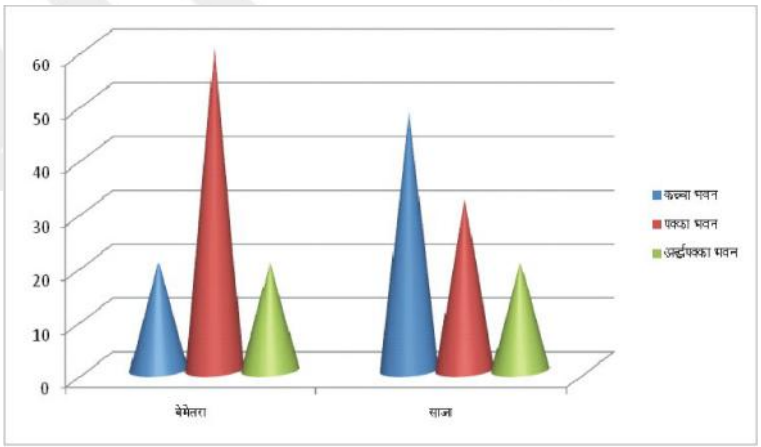
तालिका 1.3 स्पष्ट होता हैं कि बेमेतरा विकासखण्ड महिला स्वयं सहायता समुहों में सर्वाधिक अन्य पिछड़ा वर्ग 1280 हिन्दु हैं, अनुसुचित जनजाति न्युनतम 192 हैं। साजा विकासखण्ड में अनुसुचित जनजाति 1569 हैं तथा सामान्य 1881 सबसे कम हैं।

तालिका 1.4 : चयनित न्यादर्श में महिला स्व–सहायता समूहो के सदस्यों के निवासित भवन के प्रकार

भवन के प्रकार	विकासखण्ड				योग	
	बेमेतरा		साजा			
	सवस्य	प्रतिशत	सवस्य	प्रतिशत	सवस्य	प्रतिशत
कच्चा	5	20	12	48	17	34
पक्का	15	60	8	32	23	46
अर्द्धपक्का	5	20	5	20	10	20
योग	25	100	25	100	50	100

(स्त्रोत : प्राथमिक समंक)

तलिका 1.4 से स्पष्ट होता हैं कि बेमेतरा विकासखण्ड के अन्तर्गत भवन के प्रकार में पक्का भवन सबसे अधिक 60 प्रतिशत, सबसे कम अर्धपक्का एवं पक्का भवन बेमेतरा में पाये गये हैं। इसी प्रकार साजा विकासखण्ड के अन्तर्गत सबसे अधिक कच्चा भवन 48 प्रतिशत सबसे कम अर्धपक्का भवन 20 प्रतिशत पाये गये हैं।

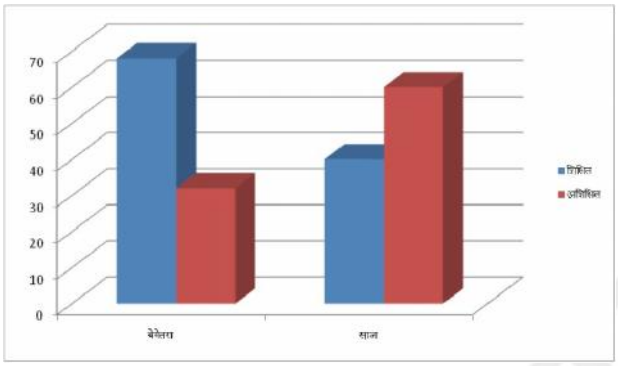


तालिका 1.5 : चयनित न्यादर्श क्षेत्र महिला स्व–सहायता समूह शैक्षणिक संबंधी जानकारी

शिक्षा	विकासखण्ड				योग	
	बेमेतरा		साजा			
	सदस्य	प्रतिशत	सदस्य	प्रतिशत	सदस्य	प्रतिशत
शिक्षित	17	68	10	40	27	54
अशिक्षित	8	32	15	60	23	46
योग	25	100	25	100	50	100

(स्त्रोत : प्राथमिक संमक)

1.5 तालिका में बेमेतरा विकासखण्ड के अन्तर्गत शिक्षित सदस्य न्यादर्श में 68 प्रतिशत तथा अशिक्षित सदस्यों का 32 प्रतिशत पाये गये हैं। ठीक इसी प्रकार साजा विकासखण्ड के अन्तर्गत 40 शिक्षित सदस्य हैं तथा 60 प्रतिशत अशिक्षित लोग हैं।

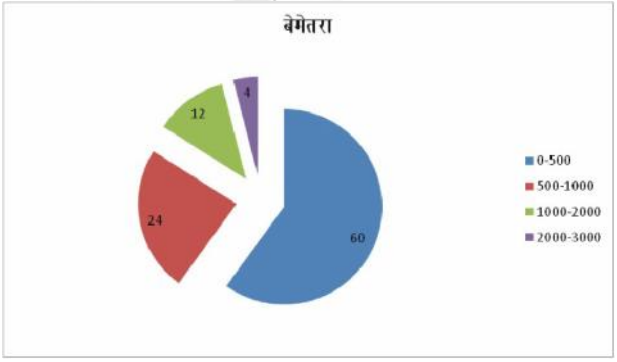


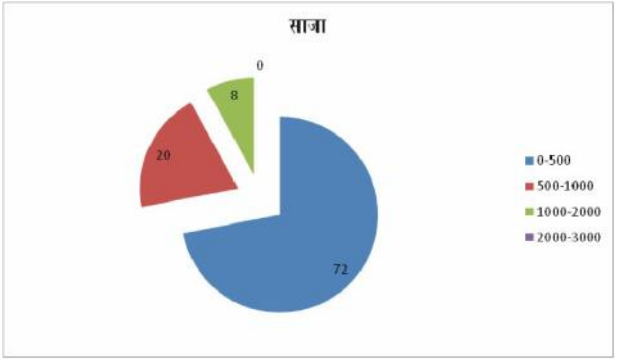
तालिका 1.6 : न्यादर्शक्षेत्र में महिला स्व–सहायता समूहो की मासिक आय संबंधी विवरण

मासिक आय	विकासखण्ड				योग	
	बेमेतरा		साजा			
	सदस्य	प्रतिशत	सदस्य	प्रतिशत	सदस्य	प्रतिशत
0-500	15	60	18	72	33	66
500-1000	6	24	5	20	11	22
1000-2000	3	12	2	8	5	10
2000-3000	1	4	0	0	1	2
योग	**25**	**100**	**25**	**100**	**50**	**100**

(स्त्रोत : प्राथमिक समंक)

तलिका 1.6 में बेमेतरा विकासखण्ड के अन्तर्गत मासिक आय सबसे अधिक वाले सदस्य 0–500 के अन्तर्गत 60 प्रतिशत हैं तथा सबसे कम सदस्य 2000–3000 के अन्तर्गत हैं। इसी प्रकार साजा विकासखण्ड के अन्तर्गत मासिक आय सर्वाधिक 0–500 के अन्तर्गत 72 प्रतिशत सदस्य हैं तथा 2000–3000 के अन्तर्गत एक भी सदस्य नहीं हैं। इस प्रकार कहा जा सकता है कि स्व–सहायता समूह में महिलाओं के जुड़ने से मासिक आय में वृद्धि हुई है जो आर्थिक स्थिति में सुधार का स्त्रोत हैं।



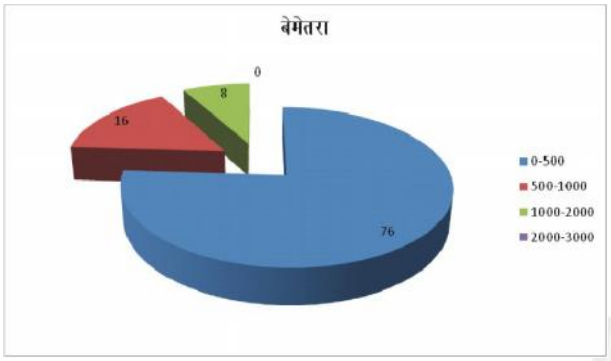


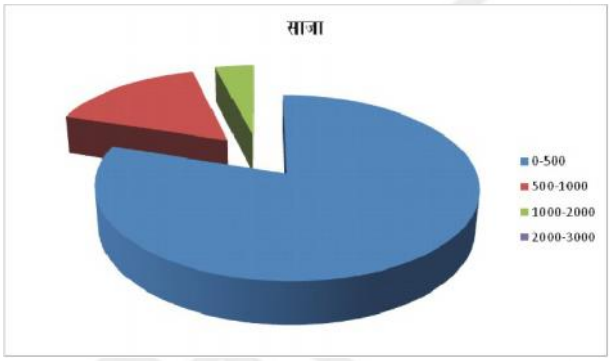
तालिका 1.7 : न्यादर्श क्षेत्र महिला स्व–सहायता समूह के मासिक बचत संबंधी राशि

मसिक आय	विकासखण्ड				योग	
	बेमेतरा		साजा			
	सदस्य	प्रतिशत	सदस्य	प्रतिशत	सदस्य	प्रतिशत
0-500	19	76	20	80	39	78
500-1000	4	16	4	16	8	16
1000-2000	2	8	1	4	3	6
2000-3000	0	0	0	0	0	0
योग	**25**	**100**	**25**	**100**	**50**	**100**

(स्त्रोत : प्राथमिक समंक)

तलिका 1.7 में बेमेतरा विकासखण्ड के अन्तर्गत 0–500 के अन्तर्गत मासिक बचत वाले सदस्य 76 प्रतिशत सबसे अधिक हैं, तथा 2000–3000 के अन्तर्गत 0 सदस्य हैं ठीक इसी प्रकार साजा विकासखण्ड के अन्तर्गत 0–500 के मासिक बचत वाले 39 प्रतिशत सदस्य हैं तथा सबसे कम 2000–3000 के अन्तर्गत 0 प्रतिशत हैं। इस प्रकार स्व–सहायता समुह के माध्यम से दोनो विकसित क्षेत्र तथा अविकसित क्षेत्र में योगदान प्रदान कर रहे हैं।





तालिका क्र. 1.8 : अध्ययन क्षेत्र में महिलाओं के जागरूकता संबंधी विवरण

शासकीय योजनाऐं	विकासखण्ड								योग	
	बेमेतरा				साजा					
	जानकारी		लाभनित		जानकारी		लाभनित		जानकारी	लाभनित
	हाँ	नहीं	हाँ	नहीं	हाँ	नहीं	हाँ	नहीं		
कौशल उन्नयन	20	5	05	20	22	3	15	10	50	50
छत्तीसगढ़ महिला कोश	18	7	10	15	24	1	17	08	50	50
महिला जागृति शिविर	22	3	20	05	24	1	22	03	50	50
सक्षम योजना	16	9	03	22	19	6	10	15	50	50

(स्त्रोत : प्राथमिक समंक)

सर्वेक्षण में यहा पाया गया की बेमेतरा विकासखण्ड विकसित क्षेत्र की अपेक्षा साजा विकास खण्ड में स्व–सहायता समुह के द्वारा महिलाओं में अधिक जागरूकता पायी गयी हैं, क्योकि बेमेतरा जिला विकसित होने के कारण वहाँ की महिलाऐं ध्यान नही दे पाती हैं और साजा विकासखण्ड में अनुसुचित जाति एवं जनजाति क्षेत्र होने के कारण समूह गठन में महत्वपुर्ण भागीदारी निभाती हैं।

तालिका क्र. 1.9 : अध्ययन क्षेत्र में महिलाओं के स्व–सहायता समूह का कार्य संबंधित विवरण

कार्य	विकासखण्ड				योग	
	बेमेतरा		साजा			
	समूह संख्या	प्रतिशत	समूह संख्या	प्रतिशत	समूह संख्या	प्रतिशत
कृषि	10	40.0	09	36	19	38.00
पशुपालन	05	20.9	02	08	07	55.33
उचित मुल्य की दुकान	20	20.3	07	28	12	24.00
कुटीर उद्योग	02	08.0	03	12	05	10.00
लघु उद्योग	03	12.0	04	16	07	14.00
योग -	25	100.0	25	100	50	100.00

(स्त्रोत : प्राथमिक समंक)

सर्वेक्षण से यह स्पष्ट होता हैं कि स्व–सहायता समूह के माध्यत से महिलाओं को काम मिलने के कारण महिलाओं के अर्थिक स्थिति में सुधार हुई हैं।

सुझाव

महिला स्व–सहायता समूह के लिए सुझाव निम्न प्रकार से हैं:

1. स्व–सहायता समूह के महिलाओं के लिए प्रशिक्षण की व्यवस्था किया जाए।
2. महिला स्व–सहायता समूह के लिए बैंको की व्यवस्था लचीली होनी चाहिए।
3. महिलाओं को महिला विकास कार्यक्रम योजनाओं और नीतियों की जानकारी होनी चाहिए।
4. पंचायत स्तर पर उत्पादन सहप्रशिक्षण केन्द्र की स्थापना की जाए।
5. ऋण की राशि की मात्रा को वर्तमान में 4 गुणा के स्थान पर 10 गुणा कर देना चाहिये।
6. समय–समय पर शासन की ऋण माफी की नीतियाँ समूहों के लिए उचित नही हैं क्योंकि जो समूह ऋण समय–समय पर देते रहते हैं, वह भी बेईमान समूहों की श्रेणी में चले जाते हैं।
7. समूह के द्वारा निर्मित उत्पादकों के विक्रय हेतु शासन द्वारा मेलों एवं प्रदर्शनों का आयोजन करना चाहिए।

सारांश एवं निष्कर्ष

इस प्रकार निष्कर्ष रूप में यह कहा जा सकता हैं कि स्व–सहायता समूह महिलाओं को आत्मनिर्भरता प्राप्त करने में सार्थक सिद्ध हुए हैं। महिला स्व–सहायता समुह महिलाओं के आय एवं रोजगार का एक माध्यम बन गया हैं। स्व–सहायता समूह लघु बचत एवं लघु ऋण के द्वारा ग्रामीण महिलाओं के विभिन्न समस्याओं का समाधान कर रहे हैं, तथा महिलाओ की जागरूकता तथा प्रतिष्ठा की भावना बढ़ गया हैं। इस प्रकार महिलाओं की आर्थिक व सामाजिक स्थिति में भी सुधार हुआ हैं। अतः कहा जा सकता हैं कि महिलाओं के लिए स्व–सहायता समूह एक क्रांतिकारी परिवर्तन हैं तथा महिलाओं के विकास में स्व–सहायता समुह मील का पत्थर साबित हुए हैं।

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प्रजातंत्र की नींव ग्राम पंचायतो का ग्रामीणों के कायाकल्प में अद्वितीय भूमिका (दुर्ग जिले के विकास खंड–धमधा के विशेष संदर्भ में)

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शोधार्थी, अर्थशास्त्र अध्ययनशाला, हेमचंद यादव विश्वविद्यालय, दुर्ग (छ.ग.)

"आज ग्रामों में इतना विकास हो चुका है कि जहाँ भी देखें पक्के मकान और पक्की सड़कें 24 घंटे बिजली और पानी सहित आधुनिक सुविधायें व्याप्त है। ग्राम पंचायत आज भारत का ऐसा अद्भुत परिचायक बन गया है जैसे कि मानव शरीर की संरचनात्मक एवं क्रियात्मक इकाई के बारे में जानना हो तो कोशिका की संरचना को देख कर समझा जा सकता है। ठीक उसी प्रकार भारत देश के विकासात्मक, राजनैतिक पहलू, धार्मिक सौहार्द्र की भावना, एकता और जीवन प्रत्याशा को समझना है तो ग्राम पंचायत का अध्ययन करके इसे आसानी से समझा जा सकता है। ग्राम पंचायत को भारत का लघु दर्पण कहना बिलकुल अतिश्योक्ति नहीं होगी"।

प्रस्तावना :– भारतीय समाज विश्व में अपनी अलग पहचान लिये हुए अपनी प्राचीनतम परम्पराओं को साथ लेकर नया आयाम रचता आया है। भारत ऐसा देश है जिसकी 70 प्रतिशत आबादी गाँवों में निवास करती है और यही गाँवों की एकता, एक संगठन का निर्माण करती है जो जनसमूह के विकास एवं समृद्धि के लिए निरंतर प्रयासरत् रहती है इसी समूह को नाम मिला ग्राम पंचायत।

राष्ट्रपिता महात्मा गांधी ने ऐसे भारत का सपना देखा था जिसमें सभी गाँव के पास ऐसे अधिकार हो जिससे गाँव अपने पैरो पर खड़ा हो सके और अपनी जरूरतों की पूर्ति स्वयं कर सकें। स्वायत शासन का अधिकार रखते हुए ग्राम पंचायत ग्रामीण सशक्तिकरण की अवधारणा को साकार कर रहा है। आज महात्मा गांधी के सपनों की झलक धरातल पर साफ देखी जा रही है।

जब छत्तीसगढ़ अपने अस्तित्व में नहीं था तब मध्यप्रदेश देश का सबसे बड़ा राज्य और किसानों का हितैशी माना जाता था आज छत्तीसगढ़ राज्य का अपना अस्तित्व है। धान का कटोरा कहा जाने वाला किसानों का राज्य छत्तीसगढ़ जिसमें ग्राम पंचायत की भूमिका इतनी सराहनीय है कि छत्तीसगढ़ के विभिन्न जिलों सहित विकास खंडों में ग्राम पंचायत अपना स्वायत शासन चलाकर केन्द्र सरकार एवं राज्य सरकार की योजनाओं को ग्रामीणों तक पहुंचाकर ग्रामीण विकास में अहम योगदान दे रही है।

शोध के लिये चयनित क्षेत्रों में इन्ही आयामों का अवलोकन करते हुए इस शोध अध्ययन के माध्यम से ग्राम पंचायत का ग्रामीणों के लिए यर्थाथता के अपेक्षित परिणामों सहित विवेचना करना शोध पत्र में प्रस्तावित है।

ऐतिहासिक पृष्ठ भूमि :– पुरातन काल से पंचायत की व्यवस्था विभिन्न नामों से अपने अस्तित्व को दर्शाते आया है। जैसे ऋग्वेद में सभा, महाकाव्यों में पंचों का उल्लेख, मनुस्मृति में मनुग्राम तथा कौटिल्य ने भी गाँव का उल्लेख किया है। इतिहास के पन्नों में चोल के स्थानीय प्रशासन, ब्रिटिश काल में लार्ड रिपन के स्थानीय स्वायत्त शासन का प्रयास उल्लेख है। राष्ट्रपिता महात्मा गांधी का ग्रामीण सशक्तिकरण की अवधारणा जिसे भारतीय संविधान ने विशेष महत्व दिया साथ ही पंचायतों की अवस्था एवं स्थितियों के अवलोकन हेतु साही आयोग, बलवंत राय मेहता समिति, अशोक मेहता समिति, राव समिति, सिंघवी समिति एवं पी0के0 थुगंन समिति के सिफारिशों ने ग्राम पंचायतों को नया आयाम दिया।

आजादी के बाद पं0 जवाहर लाल नेहरू ने 1959 में पंचायत व्यवस्था लागू की तथा 1993 में संविधान में 73 वें संशोधन ने पंचायतों को संवैधानिक दर्जा दिलाया। आज ग्राम पंचायत के पास ऐसी शक्तियाँ और अधिकारें है जिनके माध्यम से ग्राम का सर्वागीण विकास करते हुए स्वायत शासन की इकाई के रूप में सक्षम नजर आता है।

ग्रामीणों की आश ग्राम पंचायत :– भारतीय अर्थव्यवस्था की नींव कृषि और किसान इसके पायदान है। भारत की कई राज्यों में कृषि की जाती है परन्तु छत्तीसगढ़ जिसकी महानता का गुणगान करते लोग थकते नही ऐसे राज्य में भी किसानों की स्थिति बेहाल रही है। आजादी के कई वर्षो बाद घोर गरीबी, अशिक्षा, भूखमरी, बाढ़–सूखा, महामारी जैसी अनेक बीमारियाँ

ग्रामीणों के नस–नस में बस चुकी थी, महिलाओं और बच्चों की स्थिति अति दयनीय रही जिसका वर्णन करना कठिन है। इसी तरह अनेक परेशानियों से गाँव लंबे समय तक जुझता रहा है। ऐसे हालात में पंचायत की व्यवस्था ग्रामीणों के लिए ऐसी उम्मीद की किरण बनकर आई जिसके सहारे उन्हें अपना भविष्य उज्जवल महसूस होने लगा। आज ग्राम पंचायतों के माध्यम से किसान, मजदूर, युवा, महिलाओं एवं बच्चों को नया जीवन मिला है।

शोध साहित्य का पुनरावलोकन :– शोध साहित्य के पुनरावलोकन से स्पष्ट होगा कि ग्राम पंचायत के कारण गाँवों का सर्वांगीण विकास हो रहा है।

1. डॉ0 सीमा रानी (2018)– अपने अध्ययन ''ग्राम पंचायतों में ग्रामीण महिलाओं की भूमिका'' में लिखा है कि भारत की अधिकांश आबादी गाँवों में रहती है। भारत के गाँवों की पंचायती राज प्रणाली जमीनी स्तर पर लोकतंत्र का अनोखा और नायाब उदाहरण है। इसके बावजूद ग्रामीण महिलाओं को उनकी वास्तविक भागीदारी आज भी प्राप्त नही हो पायी है।
2. सिद्धार्थ झॉ (2016) – अपने अध्ययन '' गावों की बुनियादी विकास में पंचायतों की भूमिका'' में लिखा है कि जब कभी आप गाँवों की चमकती सड़को, 24 घंटे बिजली–पानी की सुविधा, गॉव के पक्के मकान ये सब देखकर चौक जाये तो समझ लीजिये गाँव का सर्वांगीण विकास हो रहा है।

शोध अध्ययन का उद्देश्य :– प्रस्तुत शोधपत्र के प्रमुख उद्देश्य निम्नानुसार है:–

1. ग्राम पंचायत व्यवस्था से ग्रामीण परिवेश में परिवर्तन का अध्ययन।
2. पंचायतों के माध्यम से ग्रामीणों को मिलने वाली मुलभूत सुविधाओं का मूल्यांकन करना।
3. सरकार द्वारा विभिन्न योजनाओं के माध्यम से ग्राम पंचायतों को दी जाने वाली मानव विकासात्मक कार्यक्रम के क्रियान्वयन का विश्लेषण करना।

शोध परिकल्पना :–

1. ग्राम पंचायत ग्रामीणों की समस्याओं के समाधान में तथा ग्रामीण विकास में सकारात्मक भूमिका निभा रही है।
2. ग्राम पंचायत ग्रामीणों में राजनैतिक चेतना का स्तर बढ़ाने तथा शासन द्वारा दी जाने वाली व्यवस्था का समुचित लाभ पहुंचाने में सक्षम है।
3. ग्राम पंचायत विशेष कर किसानो के लिए कृषि संबंधित सम्पूर्ण जानकारी तथा ग्रामीणों के रोजगार के साधन विकसित करने में सक्षम है।

अध्ययन पद्धति :– प्रस्तावित शोध अध्ययन को दो उप भागों में बाँटा गया है–

1. अध्ययन क्षेत्र का परिचय
2. आकंडों का संकलन

1. अध्ययन क्षेत्र का परिचय :– छत्तीसगढ़ राज्य के हृदय स्थल पर शिवनाथ नदी के पूर्व में स्थित है जिला दुर्ग। दुर्ग जिला छत्तीसगढ़ में औधोगिक विकास का अग्रदूत है, जहाँ भिलाई स्पॉत संयंत्र की स्थापना के साथ न सिर्फ जिले बल्कि संपूर्ण प्रदेश का चौतरफा औद्योगिक विकास हुआ है, इसके साथ ही दुर्ग जिला सांस्कृतिक विविधता सामाजिक सामंजस्य, संसाधनों के अर्थपूर्ण उपयोग एवं विभिन्न जाति धर्म के लोगो के बीच आपसी सौहार्द्र के लिए भी जाना जाता है। जिले के बीचों–बीच से राष्ट्रीय राजमार्ग क्रमांक 6 मुंबई–नागपुर–कोलकाता राजमार्ग गुजरता है। रेलवें की दक्षिण–पूर्व रेल सेवा यहाँ उपलब्ध है। दुर्ग छत्तीसगढ़ प्रांत के 27 जिलों में तीसरा सबसे बड़ा जिला है। जिसमें 3 तहसील, 3 विकास खंड, 3 जनपद पंचायत, 8 जिला पंचायत, 3 नगर पालिका, 01 लोक सभा क्षेत्र , विधान सभा क्षेत्र 07, ग्राम पंचायत 297, पटवारी हल्का 156, प्राथमिक स्वास्थ्य केन्द्र 21, उपस्वास्थ्य केन्द्र 128 तथा 28 पुलिस थानों के साथ ही पड़ोसी जिले राजनांदगाँव, रायपुर, बेमेतरा, बालोद, धमतरी की सीमाओं को स्पर्श करती है।

दुर्ग जिले के तीन विकास खंड दुर्ग, धमधा तथा पाटन इनमे से सबसे अधिक ग्राम पंचायतों की संख्या 116 धमधा विकास खंड के अंतर्गत आता है। जिसमें 116 पंचायतों में 162 ग्राम का प्रतिनिधित्व करते 116 सरपंच तथा औसतन ग्राम पंचायतों में 10 से 15 वार्ड है जिसमें पंचगण कार्यरत् है। धमधा विकास खंड की कुल जनसंख्या 204491 है जिसमें 102361 पुरूष, 102130 महिलाएँ है। प्रत्येक पंचायत में पंचायत सचिव, रोजगार सहायक सचिव सहित कम्प्यूटर ऑपरेटर अपनी सेवा दे रहे है।

2. आंकड़ो का संकलन :– प्रस्तुत अध्ययन में प्राथमिक तथा द्वितीयक दोनो प्रकार के आंकड़ो का संकलन किया गया है। प्राथमिक आकंडे हेतु विकास खंड धमधा के 20 से 60 वर्ष के 150 लोगों का चयन दैव निदर्शन प्रविधि के अंतर्गत लॉटरी प्रणाली के माध्यम से किया गया तथा चयनित उत्तरदाताओं से साक्षात्कार अनुसूची एवं अवलोकन प्रविधि द्वारा आंकड़ा एकत्र किया गया, जिसमें साक्षात्कार निर्देशिका का

प्रयोग किया गया है। साथ ही आवश्यकतानुसार संग्रहित किये गये है।
द्वितीयक आंकड़ो के संदर्भ में संबंधित ग्रंथो से आंकड़े

तालिका कमांक 01

ग्राम पंचायत के संदर्भ में ग्रामीणों के वस्तु स्थिति से संबंधित तालिका

स0 क्र.	ग्राम पंचायत का ज्ञान	आवृत्ति	प्रतिशत
1	हॉ	129	86
2	नहीं	21	14
	योग	150	100

स्त्रोत – प्राथमिक समंक संकलन

सर्वप्रथम उत्तरदाताओं से यह जानने का प्रयास किया गया कि क्या वे ग्राम पंचायत के बारे में जानकारी रखते है, तो 86 प्रतिशत उत्तरदाताओं को पंचायत का ज्ञान है।

तालिका कमांक 02

पंचायतो द्वारा किये गये कार्यो के संबंध में तालिका

स0 क्र.	कार्य का प्रकार	हॉ		नहीं		योग	
		आवृत्ति	प्राति	आवृत्ति	प्रति	कुल	प्रतिशत
1	गलियों का सीमेंटीकरण	90	60	60	40	150	100
2	बंद नालियों का निर्माण	60	40	90	60	150	100
3	खंभो में लाईट की व्यवस्था	30	20	120	80	150	100
4	पेयजल की सुविधा	114	76	36	24	150	100
5	घरो में बिजली प्रदाय	141	94	09	06	150	100
7	पंचायत में डिजिटल सुविधायें	99	66	51	34	150	100

स्त्रोत – प्राथमिक समंक संकलन

उपर्युक्त तालिका से स्पष्ट होता है कि 60 प्रतिशत उत्तरदाताओं के पंचायतों में गलियों का सीमेंटीकरण, 40 प्रतिशत ग्राम पंचायतों में बंद नालियों का निर्माण तथा खंभों में लाइट की व्यवस्था मात्र 20 प्रतिशत उत्तरदाताओं के पंचायत में है। इसके साथ ही बिजली की पहुँच सर्वाधिक 94 प्रतिशत तथा पेयजल की व्यवस्था 76 प्रतिशत लोगों के पंचायतों में उपलब्ध है। आज डिजिटल इंडिया के समय में भी 34 प्रतिशत उत्तरदाताओं के ग्राम पंचायतों में डिजिटल सुविधाएं नहीं पहुँच पायी है।

तालिका कमांक 03

पंचायत द्वारा सरकारी योजनाओं के क्रियान्वयन से ग्रामीण को लाभ तालिकाः–

स क्र.	योजनाएं	हॉ	प्रति	नहीं	प्रति	कुल	प्रतिशत
1	सार्वजनिक वितरण प्रणाली	117	78	33	22	156	100
2	प्रधानमंत्री उज्जवला योजना	60	40	90	60	150	100
3	प्रधानमंत्री आवास योजना	48	32	102	68	150	100
4	मनरेगा के तहत कार्य	108	72	42	28	150	100
5	स्वच्छ भारत मिशन के तहत शौचालय निर्माण	144	96	06	04	150	100

स्त्रोत – प्राथमिक समंक संकलन

तालिका के अवलोकन से ज्ञात होता है कि उत्तरदाताओं में से सार्वजनिक वितरण प्रणाली में लाभ 78 प्रतिशत, मनरेगा के तहत कार्य 72 प्रतिशत, उज्जवला योजना के तहत गैस चूल्हे की पहुँच 40 प्रतिशत लोगों तक तथा सबसे न्यूनतम 32 प्रतिशत लोगों को प्रधानमंत्री आवास का लाभ मिला है, परन्तु इनमें सर्वाधिक महत्वपूर्ण स्वच्छ भारत मिशन हर – घर में शौचालय निर्माण का कार्य 96 प्रतिशत का आंकड़ा पार कर चुका है।

इस प्रकार तालिकाओं के माध्यम से आंकड़ों का एकत्रीकरण पूर्णतः उत्तरदाताओं द्वारा दिये गये जवाबों के आधार पर किया गया है।

निष्कर्ष :– उपर्युक्त विश्लेषण के आधार पर यह निष्कर्ष निकाला जा सकता है कि ग्रामीणों को ग्राम पंचायत का ज्ञान ही नहीं अपतु ग्राम पंचायत से मिलने वाली मूलभूत सुविधाओं तथा सरकार की योंजनाओं का अधिकतम लाभ मिल रहा है। आज ग्रामों में इतना विकास हो चुका है कि जहॉ भी देखे पक्के मकान, पक्की सड़के, 24 घंटे बिजली–पानी सहित आधुनिक सुविधाएँ व्याप्त है। ग्राम पंचायत का स्वरूप आज भारत देश का ऐसा अद्भुत परिचायक बन गया है जैसे कि मानव शरीर की संरचनात्मक एवं क्रियात्मक इकाई के बारे में जानना हो तो कोशिका की संरचना को देख कर समझा जा सकता है। ठीक उसी प्रकार भारत देश के विकासात्मक, राजनैतिक पहलू, धार्मिक सौहाद्र की भावना, एकता और जीवन प्रत्याशा को समझना है तो ग्राम पंचायत का अध्ययन करके इसे आसानी से समझा जा सकता है। ग्राम पंचायत को भारत का लघु दर्पण कहना बिलकुल अतिश्योक्ति नही होगी। लेकिन अभी इसे लंबा सफर तय करना है। ग्राम विकास, ग्रामीण युवाओं के लिए रोजगार उच्च शिक्षा का अवसर, किसानों को अत्याधुनिक सुविधाएँ सब्सीडी, न्यूनतम समर्थन मूल्य, सिंचाई का पर्याप्त प्रबंध, और सरकार की योजनाओं को गॉव के अंतिम छोर पर खडे मजदूर तक पहुंचाना है। शत – प्रतिशत सफलता तभी हासिल हो पायेगी जब ग्रामीणों का पलायन शहर की ओर पूर्णतः बंद हो जायेगा।

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An Argument of Universal Basic Income and Its Fiscal Feasibility in India

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Abstract – In 21st century developing as well as developed economies faces the problem of income inequality. Many researches show that in developing countries like India problem of income inequality is widening very dangerously, though proportion of poverty decline but still very large number of people lives in miserable condition. The concept of basic income becomes very popular among economist as remedies of poverty. In this paper we examine some literatures which reveal its benefit and shortcomings. We also examine the possibility of its implementation in context of India.

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India is one of the largest democratic country of the world. Currently we are in fever of general election 2019. According to experts they assuming that alliance government may be formed. Regional political parties may play a significance role in this election. One of the India's oldest national party congress recently announced in his manifesto that if congress will be in power they introduced the quasi universal basic income. This announcement heated the most debatable topic of 21st century, the universal basic income. As we seen there are various arguments in favors and oppose of the scheme among the economist of the world. In this paper we start our discussion from its history to current fiscal soundness of the scheme in context of Indian economy.

Under the Congress party's Nyuntam Aay Yojana (NYAY) or minimum income scheme) announced on March 25, 2019, the poorest 20% of Indian families (which are estimated to number 50 million families or 250 million people) would given a cash transfer of up to Rs 6,000 a month to ensure they have a monthly income of Rs 12,000 (or Rs 72,000 a year). Though it is not a universal income bur it is a quasi universal basic income. If we see at global level, recently next American election 2020, the Democratic presidential candidate Andrew Yang said that government will put $1000 in pocket of every American. Now universal basic income becomes very hot debate among the economist of the world.

HISTORY AND PHILOSOPHY OF UBI

First we should understand what exactly the concept of UBI is. Universal Basic Income is an unconditional periodic cash payment that the government makes to everyone. It is a floor below which no one's cash income can fall.

The history of intellectual thinking of UBI is half a decade old but its gain popularity in last two decades very rapidly. G.D.H. Cole a political economist at Oxford University first to use the phrase "Basic Income" in 1953. He advocated that concept as a social dividend. Sir James Tobin a famous American economist who support the Keynesian idea of government to overcome the recession wrote in 1966 that a guaranteed minimum income to be paid to male heads of household.

UBI, POVERTY & UNEMPLOYMENT: AN ARGUMENT

In very simple manner if we disuses the general people about UBI, many of them favors it because ultimately its ensure basic right of human being to live in this planet with dignity and be able to access the basics like food ,education and medical to survive life with a meaningful way. And many of them argues that its make people lazy and they chose leisure rather than working. Despite going to any conclusions we should first study the expert's views and examines the studies done in that field in very rational and honest manner.

First we study the criticism of the UBI. In 2014 a working paper publish in research division of Federal reserve bank of St. Louis, Titled "Universal Basic Income versus Unemployment Insurance", The author concludes that voluntary unemployment would rise rapidly as a basic incomes amount rose. However author also argues that a basic income of $ 2000 (2001) or so is clearly sustainable. Apart

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rom that study many developed economy may threaten about falling of jobs due to mechanization. Robot starting replace the humans and it's a big threat all of us. A 2013 paper by oxford university the author Carl Frey and Michase Osborne found that 47% of US employment at a risk of computerization. In that scenario we must need to think about a basic income of every citizen. One can say we should increase our output double so that we can maintain employment at sustainable level but it put environment of planet in a blanket of carbon intensive growth. According to IMF projection advanced economies grow at 1.91% in 2017 and will grown 2.0% in 2018 that leads to carbon intensive global economy.

"It is not people resist work, people resist meaningless work, people resist stupid work and people resist humiliating work".

- David Graeber (Anthropologist)

An article published 28th march 2019 in The Hindu newspaper; Rathin Roy (Member of Prime ministers Economic Advisory Council) opposed the basic income idea. He argued that when economy grown at above 7% and the growth is inclusive then UBI is Unnecessary.

Next level we seen many of studies and experiment supported the concept of basic income. Many thinker and philosopher like Tom Paine to John Rawls argue that "the society that fails to guarantee a decent minimum income to all citizens will fail the test of justice". In 2011 a study done by Evelyn L. forget from university of Manitoba found that Famous experiment called The Manitoba Experiment (In this experiment two group of Manitoba resident received a guaranteed minimum income from 1974 to 1974) reveals a positive impact of minimum income program.

Bolsa familia Program, In 2014 Brazil government has made modest cash grant to poor families who so they able to send their children to school and the doctor. Due to that program the countries poverty rate fell from 26.1% in 2003 to 14.1 % in 2009. The program is estimated to be responsible for 59% of the reduction in poverty and 140% of the reduction in extreme poverty. Due to Bolsa Familia program Income inequality in Brazil fall significantly.

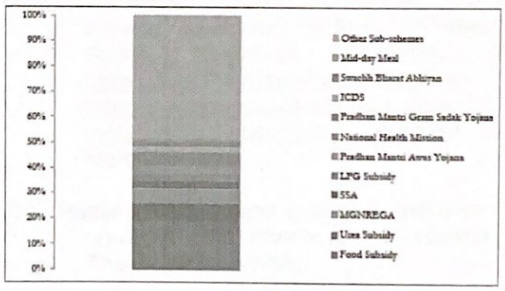
Year	Gini Coefficient (value)
2003	0.580
2009	0.538

Source: IPEA (Brazilian Govt.)

BASIC INCOME & FISCAL PRUDENT: IN CONTEXT OF INDIA

Before going to fiscal arithmetic of Indian economy we stress on a study done by Daniele Fabbri in 2019. International labor organization published a document. In this document one chapter name ILO Social Protection Floor Recommendation (No.202). In this recommendation there is a point suggested by ILO is Sustainable and equitable financing for UBI. Daniel Fabbri suggested in his paper regarding ILO recommendation. In his paper he recommended following points. 1. The reallocation of Public expenditure. 2. Increasing tax revenue 3. Lobbying for aid and transfer for revenue generation. 4. Eliminating illicit financial flow. 5. Using fiscal and central bank foreign reserve. 6. Restructuring existing debt.

If we see the trend of central government expenditure on central sponsored welfare scheme its approx. 5.2% of GDP which allocated by central government in 2016-17 budget. In 2016-17 budget provision there was above 950 schemed sponsored by the central government. In figure below there is top scheme which consist large part of expenditure.



Source: Economic survey 2016-17

A large majority of these are small in terms of allocation with the top 11 schemes accounting for about 50 percent of total budgetary allocation. As is seen in Figure, Food Subsidy or Public Distribution System (PDS) is the largest programme followed by Urea Subsidy and the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). The other programs include Crop Insurance, Student Scholarships, and National Handloom Development Programme etc.

In next table we try to identify the tax revenue from various sources (direct &indirect). We know indirect tax put more burdens on the poor people compare to rich one and widen the income inequality significantly. If government source more funds through direct taxes then we can raise our revenue, now question is how. We talk in details in later.

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irst we should check the revenue pattern in below tables.

(Rs. Crore)

Estimation of Indirect tax			
	2016-17	2017-18(BE)	2017-18(RE)
Customs	2,25,370	2,45,000	1,35,242
Union Excise duty	3,82,094	4,06,900	2,76,99
Service Tax	2,54,499	2,75,000	79,507
GST	-	-	4,44,631
UNGST	4,146	4,679	4,744
Gross Indirect tax	8,66,109	9,31,579	9,41,119

Source: Union Budget 2018-19

Estimation of Direct tax			
	2016-17	2017-18(BE)	2017-18(RE)
Corporation Tax	4,84,924	5,67,949	5,63,745
Personal Income Tax	3,49,591	4,08,956	4,41,255
Total Direct Tax	8,34,515	9,76,905	1,005,000

Source: Union Budget 2018-19

In simple manner if found in above table that there is no significant difference between revenue from direct taxes and indirect taxes. Government can raise direct taxes from richest persons through implementing wealth and property taxes. OXFOM report reveals wealth of only top 10 wealthiest Individuals of India is equals to approximately wealth of half of Indian population. Why this difference. Why not we make some provision for alternate direct taxes for wealthy persons? In light of this idea an article authored by shreehari Paliath suggested very interesting approach to raise direct tax revenue.

According to him, under simple assumptions, we find that a 2% tax on total wealth on households owning more than Rs 2.5 Crore of wealth (that is the top 0.1% of households), would yield Rs 2.3 trillion or 1.1% of GDP," the report says, adding, "99.9% of households would not be concerned by such a tax."

An alternative 2% tax on land and buildings above Rs 2 Crore would yield Rs 2.6 trillion (1.2% of GDP), impacting only the top 1% of the households.

This could nearly offset the 1.3% of GDP expenditure that the Congress's minimum income guarantee of Rs 72,000 a year would cost, as per the report's estimates.

CONCLUSION

In this paper we analyses various argument regarding UBI. We found that the concept of basic income is effective for poverty elimination but we must make sure that the guaranteed income should be implemented in a rational ways otherwise its leads more voluntary unemployment and its consequence at macro level will very negative for economic development. Other problem is financing the scheme, on that issue we can say there is a various ways we raise revnue through rational ways.

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छत्तीसगढ़ के बालोद विकासखंड में सार्वजनिक वितरण प्रणाली : एक अध्ययन

• ईश्वर लाल
•• के. पद्मावती

सारांश– *प्रस्तुत शोध पत्र छत्तीसगढ़ के बालोद जिले के ग्रामीण क्षेत्रो में सार्वजनिक वितरण प्रणाली को केन्द्र में रखकर लिखा गया हैं। सार्वजनिक वितरण प्रणाली का क्रियान्वयन उचित मूल्यों के दुकानों द्वारा किया जाता है, जिसके द्वारा उपभोक्ताओं को प्रतिमाह नियमित रूप खाद्यान्न जैसे शक्कर, गेंहूँ, नमक एवं केरोसीन आदि उचित मात्रा में उचित मूल्य की दुकान के माध्यम वितरित किया जाता है तथा उचित मूल्य की दुकानों का संचालन एवं क्रियान्वयन सभी राशन कार्ड धारियोके हितो को ध्यान में रखते हुए ग्राम पंचायत, महिला समूह मंडली ,उचित एंजेसी के माध्यम से किया जा रहा है। साथ ही साथ शासन द्वारा समय-समय पर उचित योजनाओ का निर्माण किया जाता है। इन योजनाओं को सभी वर्गो को ध्यान में रखकर निष्पक्ष रूप चलाया जा रहा है, जिससे समाज के गरीब एवं कमजोर वर्ग को इसका भरपूर लाभ प्राप्त हो।*

मुख्य शब्द– सार्वजनिक वितरण प्रणाली, उपभोक्ता, मूल्य

प्रस्तावना– सार्वजनिक वितरण प्रणाली भारत सरकार के उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय के द्वारा भारतीय खाद्य सुरक्षा अधिनियम के अंतर्गत चलायी जाने वाली एक महत्वपूर्ण योजना है। सार्वजनिक वितरण प्रणाली आदेश 2001 में लागू किया गया। जब छत्तीसगढ़ राज्य का गठन हुआ तब सार्वजनिक वितरण प्रणाली का उतना विकास नहीं हुआ था। जैसे-जैसे सार्वजनिक वितरण प्रणाली विकास हुआ इस पर सरकार ने ज्यादा ध्यान दिया। छत्तीसगढ़ सार्वजनिक वितरण प्रणाली नियत्रंण आदेश सन् 2004 में भारत सरकार द्वारा लाया गया। जब छत्तीसगढ़ मे 2004 में नई सरकार बनी तो उसने गरीबी रेखा से नीचे रहने वाले श्रमिक, गरीब, मजदूर सभी के हित को देखते हुए इस योजना को अधिक जोर देते हुए छत्तीसगढ़ शासन द्वारा प्रत्येक गरीब को 3 रूपये किलो चावल प्रदान किया गया। साथ ही इसे संपूर्ण भारत में एक।मॉडल के रूप में देखा गया यह वास्तव में सभी के हित से संबधित योजना थी इस योजना को छत्तीसगढ़ के बाहर के राज्यों ने भी देखा एवं सराहा है। साथ ही विदेशों में भी इस योजना की काफी तारीफ की गई जो संपूर्ण भारत में राज्य शासन एवं केन्द्र शासन के सहयोग से चलायी जा रही है। इस प्रणाली के अंतर्गत सार्वजनिक वितरण प्रणाली की दुकानों, जिसे राशन दुकान कहते

• शोधार्थी (पी-एच.डी.) अर्थशास्त्र शासकीय वि.या.ता.स्व.स्नातकोत्तर महाविद्यालय दुर्ग (छ.ग.)
•• सहायक प्राध्यापक अर्थशास्त्र शासकीय वि.या.ता.स्व.स्नातकोत्तर महाविद्यालय दुर्ग (छ.ग.)

है, के माध्यम से गरीब एवं कमजोर वर्ग के लोगो को गेहू, शक्कर,केरासीन, नमक, इत्यादि आवश्यकता की वस्तुएं कम कीमत पर उपलब्ध करवायी जाती है। छत्तीसगढ़ राज्य प्रारम्भ से ही सार्वजनिक वितरण प्रणाली की कई समस्याओं से जूझ रहा था जैसे मासिक आंवटन में देरी, परिवहन की समस्या, बड़ी संख्या में फर्जी राशन कार्ड बनाना एवं पारदर्शिता की कमी होनें के कारण खाद्यन्न हितग्राहियों तक नहीं पहुंच पाता था।

सार्वजनिक वितरण प्रणाली के अंतर्गत उचित मूल्य दुकानो के आंवटन, राशन सामग्री का समय पर उठाव, उचित मूल्य की उपलब्धता बनाएं रखने के साथ संपूर्ण वितरण व्यवस्था पर निगरानी रखने के लिए निरीक्षक टीम द्वारा समय समय पर उचित कार्यवाही एवं सुरक्षा प्रदान करना आदि कार्य किए जा रहे है। राज्य शासन द्वारा सबसे महत्वपूर्ण कार्य 23 दिसम्बर 2004 को पूरे प्रदेश में छत्तीसगढ़ सार्वजनिक वितरण प्रणाली नियंत्रण आदेश 2004 लागू किया गया जिसके माध्यम से आज छत्तीसगढ़ में सार्वजनिक वितरण प्रणाली अपने आप में एक मिसाल कायम की है।

छत्तीसगढ़ राज्य में वर्तमान सार्वजनिक वितरण प्रणाली मे लगभग 90 प्रतिशत जनसंख्या ग्राम पंचायत, ग्राम सभा, राशन दुकानों के माध्यम से खाद्यान्न प्राप्त कर रहे है। छत्तीसगढ़ खाद्य सुरक्षा अधिनियम 2012 (क्रमांक 5 सन् 2013) दिनांक 18 जनवरी 2013 से प्रभावशील है।

बालोद जिले में सार्वजनिक वितरण प्रणाली का क्रियान्वयन एक नजर में– सार्वजनिक वितरण प्रणाली के अंतर्गत बालोद जिले में योजनाओ का क्रियान्वयन ग्रामीण क्षेत्रो में उचित मूल्यों के दुकानो की सहायता से किया जा रहा है। साथ ही शासन द्वारा उचित रूप से अन्य माध्यमो से, जैसे दो या तीन गांव मिलकर एक ही वितरण केन्द खाद्यान्न उपलब्ध कराते है। साथ ही हितग्राहियो के राशन कार्ड का बीच-बीच में निरीक्षण किया जाता है और शासन स्तर पर खाद्य निरीक्षक एवं सहायक निरीक्षक अधिकारी नियुक्ति किए जाते है। जनता की समस्या को ध्यान में रखते हुए गांव में वितरण केन्द खोल दिया गया है और इस वितरण प्रणाली को अन्य समूहो द्वारा संयुक्त रूप से नया आयाम दिया जा रहा है।

दिनांक 1 नवम्बर 2012 को दुर्ग जिले में कोर पीडीएस स्कीम का प्रारंभ किया गया है। वर्तमान में दुर्ग जिले से बालोद नया जिले के रूप में स्थापित हुआ है। बालोद विकासखंड में 57 ग्राम पंचायत है। इस वितरण प्रणाली के अधिक व्यवस्थित एवं सूचारू रूप से क्रियान्वयन के लिए पीडीएस को ऑनलाइन कर दिया गया है। अब ऑनलाइन के माध्यम से टेबलेट द्वारा कार्डधारी के परिवार के एक सदस्य की फोटो ली जाती है, जिसके माध्यम से परिवार के सदस्य को खाद्यान्न दिया जाता है। छत्तीसगढ़ शासन द्वारा पीडीएस को 2007 से कम्प्यूटरीकृत कर दिया गया है। साथ ही सार्वजनिक वितरण प्रणाली के कम्प्यूटरीकरण के पश्चात् सभी वितरण केन्द एवं सभी खाद्य कार्यालय को इंटरनेट के माध्यम से जोड़ दिया गया हैं। इससे किसी भी प्रकार के भ्रष्टाचार की संभावना खत्म हो गई है।

सार्वजनिक वितरण प्रणाली का आर्थिक महत्व– छत्तीसगढ़ राज्य अविभाजित मध्यप्रदेश का हिस्सा है। जब छत्तीसगढ़ बना उस समय वह खाद्यान्न के क्षेत्र में बहुत पीछे था। छत्तीसगढ़ राज्य के अलग होने के बाद विकास को नया आयाम मिला है। सन् 2001

में भारत सरकार द्वारा सार्वजनिक वितरण प्रणाली (नियंत्रण) आदेश 2004 में लागू हुआ। छत्तीसगढ़ में राष्ट्रीय खाद्य सुरक्षा अधिनियम जनवरी 2014 से लागू है, के तहत राज्य में 2.01 करोड़ लाभार्थियो को 3 रूपये प्रति किलो की दर से चावल प्राप्त करने का कानूनी अधिकार है साथ ही शासन द्वारा इस प्रणाली को सुदृढ़ बनाये रखने एवं भ्रष्टाचार को रोकने के लिए आवश्यक कदम उठाए गए है। वर्तमान में इस वितरण प्रणाली का शासन द्वारा क्रियान्वयन नहीं किया जा रहा है।उचित मूल्यो के दुकानों के बजाए स्थानीय समुदाय के माध्यम से इसका क्रियान्वयन किया जा रहा है जैसे वन सेवा समिति, सेवा सहकारी समिति, आदिम जाति सहकारी समिति एवं विपणन सहकारी समिति इत्यादि। इसका लाभ यह हुआ कि इसमें स्थानीय लोगो की भागीदारी बढ़ेगी और दुकान का अपने हिसाब से संचालन हो पाएगा साथ ही प्रतिदिन ज्यादा समय तक खुली रहेगी। सभी का सहयोग एवं भागीदारी रहेगी। यह कहा जा सकता है कि इस योजना में गरीब एवं मजदूर वर्ग के आर्थिक विकास को केन्द्र बिन्दु में रखा गया है।

अध्ययन का उद्देश्य–

1. सार्वजनिक वितरण प्रणाली की सहायता से लोगो के जीवन स्तर में पड़ने वाले आर्थिक प्रभावो का अध्ययन करना।
2. ग्रामीण विकास हेतु सार्वजनिक वितरण प्रणाली एवं खाद्य सुरक्षा की भूमिका का अध्ययन करना।
3. सार्वजनिक वितरण प्रणाली द्वारा आम जनता को मिलने वाले लाभ का अध्ययन करना।

परिकल्पना–

1. सार्वजनिक वितरण प्रणाली से खाद्य सुरक्षा में वृध्दि में हुई एवं लोगो के जीवन स्तर में सुधार हो रहा है।
2. सार्वजनिक वितरण प्रणाली ग्रामीण विकास में सहायक है और खाद्य सुरक्षा अधिनियम आ जाने से इसका समाज या गरीब वर्ग के कल्याण में सकारात्मक प्रभाव पड़ रहा है।
3. इस प्रणाली के सफल क्रियान्वयन से जनता को प्रत्यक्ष लाभ मिल रहा है।

अध्ययन पद्धति–

प्रस्तुत अध्ययन बालोद विकासखंड के सार्वजनिक वितरण प्रणाली के वर्तमान स्थिति का एक अध्ययन है। इस शोध पत्र को तैयार करने में प्राथमिक एवं द्वितीयक स्त्रोत का प्रयोग किया गया। बालोद विकासखंड के चयनित 20 ग्राम पंचायतों के अंतर्गत 336 अलग-अलग ग्राम पंचायत के अंतर्गत 336 परिवार के उत्तरदाताओं का चयन उद्देश्यपूर्ण निदर्शन के द्वारा किया गया है। साथ इस संबंध में अभिमत प्राप्त किया गया है। और इसका विश्लेषण किया गया है इस प्रकार उत्तरदाताओं से साक्षात्कार व प्रश्नावली भरवाकर इसकी राय जानकर सार्वजनिक वितरण प्रणाली से सबंधी अनेक प्रश्न पूछे गए और इस प्रणाली के पक्ष में विश्वास व्यक्त करते हुए यहा माना गया है कि यह योजना बालोद विकासखंडमें रहने वाले गरीब वर्ग के लिए जीवन रेखा है।

तथ्यों का संकलन–

प्रस्तुत अध्ययन हेतु बालोद विकासखंड के ग्राम पंचायत के अंतर्गत उत्तरदाताओं की

प्रकृति को ध्यान में रखकर किया गया है। तथ्यों के संकलन हेतु साक्षात्कार एवं अनुसूची का प्रयोग किया गया। साथ ही हमनें समूह वार्ता के साथ-साथ अवलोकन विधि का उपयोग किया है। इस अध्ययन पद्धति में अपने पूर्व में किए गयें शोध अध्ययन, पत्र पत्रिकाओं, समाचार पत्र, इकोनामिक विकली, कुरूक्षेत्र,शासकीय अधिसूचना व इंटरनेट को उपयोग में लाया गया है।

तथ्यों का विश्लेषण–

प्रस्तुत शोध पत्र में अपने मौलिक शोध को विश्लेषण पर आधारित किया हैं। साथ विभिन्न विधियों के माध्यम से अपने शोध को आगे बढ़ाया है, जिसमें प्रमुख रूप से काई वर्ग परीक्षण, प्रतिशत एवं माध्य विधि का उपयोग किया गया है। इसमें तथ्यों का विश्लेषण की आवश्कता के अनुरूप प्रयोग हुआ है।

निष्कर्ष–

अध्ययन में हमने पाया है कि बालोद विकासखंड के अंतर्गत ग्रामीण क्षेत्रो में रहने वाले गरीब एवं मजदूरों वर्ग को ध्यान में रखतें हुए उचित मूल्य की दुकाने की सहायता से इसका क्रियान्वयन किया जा रहा है, जिसके माध्यम से आम हितग्राहियो को उचित मात्रा में गेहू, चावल, केरोसीन, व शक्कर नियमित रूप से प्रतिमाह उपलब्ध हो जाती हैं। छत्तीसगढ़ शासन द्वारा समय-समय पर वितरण व्यवस्था के सुचारू क्रियान्वयन हेतु नवीन टेक्नालॉजी का प्रयोग कर रही है। सार्वजनिक वितरण प्रणाली में लगातार बढ़ रही पारदर्शिता एवं सक्षम कानूनी प्रतिबंधो को देखकर यह आशा की जा सकती है कि छत्तीसगढ़ राज्य की सार्वजनिक वितरण प्रणाली हितग्राहियों की आशा के अनुरूप कार्य करने में समर्थ होगी।

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शोधपत्र–अर्थशास्त्र

छत्तीसगढ़ में सार्वजनिक वितरण प्रणाली एवं खाद्य सुरक्षा

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प्रस्तुत शोधपत्र छत्तीसगढ के सार्वजनिक वितरण प्रणाली एवं खाद्य सुरक्षा को केन्द्र में रखकर तैयार किया गया है। देश का पहला राज्य छत्तीसगढ जिसने वर्ष 2012 में खाद्य सुरक्षा एवं पोषण सुरक्षा कानून बनाकर अपने यहाँ के लाखो गरीब परिवारों को दिया भरपेट भोजन का अधिकार. मुख्यमंत्री खाद्यान्न सहायता योजना में लगभग 58 लाख से ज्यादा राशन कार्ड धारक परिवारों को सिर्फ 1 रूपये किलो में प्रति राशन कार्ड 1 किलो और अनुसूचित क्षेत्रों में 2 किलो आयोडिन नमक मुत। इसके साथ ही अनुसूचित क्षेत्रों में प्रत्येक राशन कार्ड धारक परिवार को सिर्फ 5 रूपये किलो में 2 किलो चना दिया जा रहा है। मुख्यमंत्री खाद्यान्न योजना और छत्तीसगढ खाद्य एवं पोषण सुरक्षा अधिनियम लागू होने के बाद पीडीएस का कवरेज 45 प्रतिशत से बढ़कर 82 प्रतिशत हुआ।

शब्द कुंजी: सार्वजनिक वितरण प्रणाली, गरीबी, खाद्य सुरक्षा

प्रस्तावना :

खाद्य व कृषि संगठन के अनुसार एक परिवार के लिए खाद्य सुरक्षा सुनिश्चित करने के लिए चार तत्व आवश्यक होते हैं। खाद्य उपलब्धता, खाद्य पदार्थो तक पहुंच, खाद्य का उपयोग एवं स्थायित्व। छत्तीसगढ में वर्तमान में खाद्यान्न एवं अन्य खाद्य पदार्थों का उत्पादन उसकी उपलब्धता को इंगित करता है। खाद्य सुरक्षा और पोषण सुरक्षा कानून बनाने वाला छत्तीसगढ देश का पहला राज्य है। 2013 से लागू इस कानून से राज्य की 91प्रतिशत जनसंख्या लाभान्वित हो रही है। खाद्य सुरक्षा के लिए भौतिक पहुंच तथा आर्थिक पहुंच दोनों जरूरी है, जिसके लिए कुशल सार्वजनिक वितरण प्रणाली एवं खाद्य पदार्थों की उच्च रियायती कीमतें बहुत जरूरी है। छत्तीसगढ की सार्वजनिक वितरण प्रणाली पूरे देश के लिए एक मॉडल के रूप स्थापित हो गई है जो अन्य राज्यों के लिए भी एक आदर्श है। गरीबी रेखा से नीचे के परिवार अपने एक सदस्य की दिनभर की मजदूरी से भुखमरी से सुरक्षा प्राप्त कर सकते हैं।

राज्य सरकारी स्कूलों में मध्यान्ह भोजन योजना व बच्चो व गर्भवती महिलाओं के लिए आईसीडीएस योजना के मुस्तैदी से क्रियान्वयन किए जाने से खाद्य सुरक्षा की पहुंच हितग्राहियों तक बढ़ी है। निराश्रित श्रेणी के एकल सदस्य वाले राशन कार्ड धारको को जून 2014 से हर महीने 10 किलो निःशुल्क अनाज उपलब्ध करवाया जा रहा है।

छत्तीसगढ में सार्वजनिक वितरण प्रणाली का क्रियान्वयन का एक नजर :

छत्तीसगढ अविभाजित मध्यप्रदेश का हिस्सा था। छत्तीसगढ का गठन 2000 में हुआ है। छत्तीसगढ राज्य गठन के पूर्व छत्तीसगढ की आर्थिक स्थिति उतनी मजबूत नहीं थी । लेकिन राज्य का धीरे धीरे विकास हो रहा हैं। इस अनवरत विकास के माध्यम से आज छत्तीसगढ़ की सार्वजनिक वितरण प्रणाली का विश्व में एक मॉडल के रूप पहचान है। छत्तीसगढ सरकार ने 12 दिसम्बर 2012 को छत्तीसगढ खाद्य एवं पोषण सुरक्षा अधिनियम पारित किया है। यह देश का पहला राज्य है जिसने भारत सरकार के राष्ट्रीय खाद्य सुरक्षा अधिनियम 2013 को सबसे पहले लागू किया है। छत्तीसगढ राज्य के गठन के समय प्रदेश में 6501 उचित मूल्य की दुकाने संचालित थी किन्तु राज्य गठन के पश्चात् इसके विस्तार हेतु 4544 नयी दुकानें स्थापित की गई है। वर्तमान समय में पीडीएस दुकानों की संख्या 8637 से बढ़कर 12298 हो गयी है। छत्तीसगढ की लगभग 40 प्रतिशत आबादी गरीबी रेखा के नीचे जीवन यापन करने को मजबूर है। इसके मासिक बजट का बड़ा हिस्सा भोजन सामग्री पर व्यय होता है। प्रदेश में सार्वजनिक वितरण प्रणाली की व्यवस्था से इन्हें खाद्य सुरक्षा उपलब्ध हुई हैं। राज्य के दूरस्थ क्षेत्रों मे भी सार्वजनिक वितरण प्रणाली की स्थापना की गई है। छत्तीसगढ राज्य अपार संभावनाओं के साथ समृद्ध की ओर अग्रसर है। खाद्य सुरक्षा के लिये हमारे पास पर्याप्त संसाधन और योजनाएं उपलब्ध हैं। जरूरत इस बात की हैं। कि हम अपने संसाधनों का उपयोग उचित एवं बेहतर प्रबंधन के साथ करें।

सार्वजनिक वितरण प्रणाली का आर्थिक महत्व :

आज छत्तीसगढ़ राज्य अपार संभावनाओं के साथ समृद्ध राज्य बनने की ओर अग्रसर है। राज्य ने पहले की तुलना में कृषि क्षेत्र में उत्तरोत्तर वृद्धि की हैं। साथ ही भारतीय खाद्य निगम ने अपनी भूमिका का निर्वहन बखूबी किया हैं। सरकार किसानों से न्यूनतम् समर्थन मूल्य पर धान खरीदी की सुविधा देकर उन्हें उनके अनाज का उचित मूल्य प्रदान कर रही है, तथा उपभोक्ताओं को सार्वजनिक वितरण प्रणाली के माध्यम से सेवा प्रदान कर रही है। सार्वजनिक वितरण प्रणाली को सरकार का प्राथमिक समाज कल्याण और गरीबी उन्मूलन कार्यक्रम माना जाता है। इसको खाद्यान्न बाजारों में मूल्यो में स्थिरता लाने की व्यवस्था के तौर पर शुरू किया गया है। दूरस्थ अदिवासी क्षेत्रों में भी सार्वजनिक वितरण प्रणाली की सुविधाये उपलब्ध हो रही है। राज्य सरकार गरीबी रेखा से नीचे रहने वाले परिवारों को पीडीएस के माध्यम से खाद्यान्न उपलब्ध कराने का पूर्ण प्रयास

कर रही है। फिर भी विरोधाभास की स्थिति हैं। हमें व्यवस्था ऐसी बनानी होगी कि राज्य में खाद्य सुरक्षा के साथ पोषण, रोजगार और स्वास्थ्य में सुधार हो। प्रसिद्ध अर्थशास्त्री डॉ. के. एन. राव ने भी कहा है कि देश में अन्न की वास्तविक कमी नहीं है बल्कि सरकार की अदूरदर्शिता और प्रशासन व्यवस्था के कारण अभाव प्रतीत होता है। इससे स्पष्ट होता है कि सार्वजनिक वितरण प्रणाली का सशक्तिकरण किया जाना अति आवश्यक है। गरीब कौन है? सरकार को इनकी वास्तविक संख्या ज्ञात करना ही होगा। राशन दूकानों से काला बाजारी रोकने के लिए नियमों को कठोर किया जाये अन्यथा सार्वजनिक वितरण प्रणाली द्वारा गरीबी भूखमरी के बीच जो विरोधाभास है उसे कभी भी समाप्त नहीं किया जा सकता।

पीडीएस की सफलता मुख्य रूप से राज्य सरकार द्वारा किये गये प्रयासों का ही परिणाम हैं। छत्तीसगढ़ की कोर पीडीएस परियोजना को राष्ट्रीय पुरस्कार प्राप्त हुआ है। केन्द्र सरकार ने छत्तीसगढ़ की सार्वजनिक वितरण प्रणाली को देश के लिए एक आदर्श सार्वजनिक वितरण प्रणाली बताया है। साथ ही देश के 18 राज्यों ने छत्तीसगढ़ के पीडीएस को देखा और सराहा है। छत्तीसगढ़ की पीडीएस योजना अपने आप में एक मिसाल है। प्रदेश के गरीबों को खाद्य सुरक्षा देने के लिए कानून बनाने वाला देश का पहला राज्य छत्तीसगढ़ है।

अध्ययन का उद्देश्य :

1 गेहूँ, चावल, चीनी, मिट्टी तेल का उचित एवं नियमित आपूर्ति का अध्ययन करना।
2 गरीबों की सुरक्षा उनके पोषण की स्थिति में सुधार और बाजार मूल्यों पर नियंत्रण आदि का नियंत्रण करना।
3 खाद्य सुरक्षा एवं सार्वजनिक वितरण प्रणाली के विषय में लोगों को जागरूक करना।

परिकल्पना :

1 खाद्य सुरक्षा की लोगो तक पहुंच सुविधापूर्ण एवं सरल हुई हैं।
2 सार्वजनिक वितरण प्रणाली द्वारा लोगों के जीवन स्तर ऊपर उठ रहा है।
3 सार्वजनिक वितरण प्रणाली द्वारा मिलने वाले खाद्यान्न सामग्री के वितरण में पारदर्षिता एवं गुणवक्ता रखी जा रही है।

अध्ययन पद्धति :

प्रस्तुत अध्ययन छत्तीसगढ़ सार्वजनिक वितरण प्रणाली एवं खाद्य सुरक्षा स्थिति का एक अध्ययन है। यह अध्ययन क्षेत्र संपूर्ण छत्तीसगढ़ पर आधारित है। यह द्वितीयक संमको पर आधारित अध्ययन है।

उपर्युक्त तालिका 01 के अध्ययन से ज्ञात होता है कि योजना के अंतर्गत उपलब्ध होनेवाली प्रमुख सामग्री निम्न है जिसमें मुख्य रूप से चावल, शक्कर, नमक, एवं केरोसीन इत्यादिं। चावल सभी प्रकार के कार्डधारियों को उपलब्ध होता होता है। शक्कर मुख्य रूप से नीला राशनकार्ड को प्रदान किया जाता है शक्कर प्रति कार्ड 1 प्रति किलो और 13.50 रूपये की दर से प्राप्त होती है गुलाबी, हरा राशनकार्ड को शक्कर प्रदान नहीं किया जाता है। इसी प्रकार केरोसीन नगरीय क्षेत्रों मे 02 लीटर ग्रामीण क्षेत्रों में गैर अनुसूचित क्षेत्रों में अधिकतम 3 लीटर उपलब्ध होती है और अन्त्योदय (गुलाबी) परिवार को केरोसीन नहीं दी जाती और निःशक्तजन (हरा) राशनकार्ड धारियों को न्यूनतम 15 रू. एवं अधिकतम 17.20 रू. प्रति लीटर की दर से प्रति राशन कार्ड प्रतिमाह प्राप्त होती है।

उपर्युक्त तालिका 2 के अध्ययन से निष्कर्ष निकलता है कि अन्त्योदय गुलाबी राशन कार्ड की संख्या सबसे अधिक है।

तालिका क्रमांक–1 योजनान्तर्गत खाद्यान्न की पात्रता एवं दर

क्र. सं.	योजना का नाम	खाद्यान	भाक्कर	अमृत नमक	केरोसीन	चना
1	प्राथमिकता (नीला) राशनकार्ड	7 किलो प्रति , 1रूपये प्रति किला की दर से प्रतिमाह	प्रति राशनकार्ड 1 किलोग्राम 13.50 रू. प्रतिकिलो की दर से	अनुसूचित क्षेत्र में 2 किग्रा प्रति परिवार गैर अनुसूचित क्षेत्र में किग्रा प्रति परिवार निःशुल्क	नगरीय क्षेत्र में अधिकतम 02 ली. ग्रामीण क्षेत्र में गैर अनुसूचित क्षेत्रो मे अनुसूचित अधिकतम 02 ली. तथा अनुसूचित क्षेत्रों में अधिकतम 3 ली.	अनुसूचित विकासखंड के हितग्राहितयों को प्रतिमाह 02 किग्रा 5 रू. प्रतिकिलो की दर से
2	अन्त्योदय (गुलाबी) राशनकार्ड	35 किलो 1 रूपये प्रति किलो की दर से प्रतिमाह प्रति राशनकार्ड				
3	निःशक्तजन (हरा) राशनकार्ड	10 किलो 1 रूपये प्रति किलो की दर से प्रतिमाह प्रति राशनकार्ड	निरंक	निरंक	न्यूनतम 15 रू. एवं अधिकतम 17.20 रू. प्रति ली. की दर से प्रति राशनकार्ड प्रतिमाह	निरंक

स्त्रोतः आर्थिक एवं सांख्यिकी संचालनालय, छ.ग, रायपुर

तालिका क्रमांक–2 राशन कार्ड की स्थिति

क्र.	प्रकार	संख्या
1	अन्त्योदय योजना (गुलाबी कार्ड)	1519362
2	अन्त्योदय योजना निःशक्तजन	55485
3	स्पेशल गुलाबी कार्ड	7606
4	प्राथमिक निला कार्ड	4357398
5	निःशक्त ज़न (हरा)	8303
	कुल	5948154

स्त्रोत–आर्थिक एवं सांख्यिकी संचालनालय, छ.ग, रायपुर (2015–16)

प्राथमिक नीला कार्ड की सबसे कम राशन कार्ड हितग्राही, निःशक्तजन हरा है। कुल छत्तीसगढ़ में 31 जनवरी 2016 की स्थिति में 5148154 राशनकार्ड है।

उपर्युक्त तालिका 3 से ज्ञात होता हैं कि वर्गवार राशनकार्ड धारियों में अन्य पिछड़ा वर्ग का 47.6: हैं जो सबसे अधिक है।

तालिका क्रमांक–3 वर्गवार छत्तीसगढ़ के आधार पर राशन कार्ड

क्र.	जाति	प्रतिशत
1	अनुसूचित जाति	14.7%
2	अनुसूचित जनजाति	32.3%
3	अन्य पिछड़ा वर्ग	47.6%
4	सामान्य वर्ग	5.4%
कुल		100%

स्त्रोत–आर्थिक एवं सांख्यिकी संचालनालय, छ.ग, रायपुर (2015–16)

वहीं सामान्य वर्ग सबसे कम 5.4: है अन्य जैसे अनुसूचित जनजाति 32.3: व अनुसूचित जाति का 14.7: है। वर्गवार राशन कार्ड में अन्य पिछड़ा वर्ग शीर्ष स्थान पर है।

तथ्यों का संकलन :

प्रस्तुत अध्ययन हेतु प्राथमिक संमक का प्रयोग नहीं किया गया, इस अध्ययन में द्वितीयक सामग्री के रूप में पूर्व में किए गए शोध अध्ययन, पत्र पत्रिकाओं, समाचार पत्र, शासकीय अधिसूचना प्रतिवेदन एवं इंटरनेट का प्रयोग किया गया है।

निष्कर्ष :

छत्तीसगढ़ में सार्वजनिक वितरण प्रणाली अन्य राज्यों की तुलना में बेहतर है। यहाँ गरीबों को उचित मूल्य पर खाद्यान्न शक्कर, केरोसीन, आदि वस्तुएँ उपलब्ध करवाने सार्वजनिक वितरण प्रणाली संचालित की जा रही है। इस कार्य हेतु राशन सामग्री के वितरण में पारदर्शिता लाने तथा प्रभावी प्रणाली नियंत्रण हेतु सार्वजनिक वितरण प्रणाली के कम्प्यूटरीकरण का कार्य वर्ष 2007 में प्रारंभ किया गया है। इस कार्य कें लिये सभी जिला खाद्य कार्यालयो को इंटरनेट के माध्यम से राज्य मुख्यालय से जोड़ा गया है। फरवरी 2008 से राशन सामग्री के वितरण की नियमित निगरानी हेतु चावल उत्सव प्रारंभ किया गया इस प्रकार छत्तीसगढ़ में गरीबी निवारण के लिये सार्वजनिक वितरण प्रणाली का कार्य एक महत्वपूर्ण कदम हैं। भोजन मनुष्य की मूलभूत आवष्यकता है। मानव बिना कुछ खाए ज्यादा दिनों तक जिंदा नहीं रह सकता। इसी वजह से सरकार का यह दायित्व है कि वह किसी देश की सीमाओं के भीतर निवास कर रहे लोगों को खाद्य सुरक्षा मुहैया कराए। लेकिन छत्तीसगढ़ की सार्वजनिक वितरण प्रणाली अपने आप में एक मिसाल हैं। यह योजना गरीब एवं मजदूर वर्ग के लिए जीवन आधार हैं।

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मुस्लिम महिला शिक्षा और सशक्तिकरण

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शोध सार – शिक्षा प्रत्येक नागरिक को प्रत्येक क्षेत्र में समान अवसर देने का प्रयास करती है । परन्तु इसके बावजुद भी समाज में कुछ सांस्कृतिक विभिन्नता के कारण महिलाएं समान रूप से शिक्षित नहीं है । हमारे इस शोध मे मुस्लिम महिलाओं के शिक्षा एवं सशक्तिकरण को महत्व दिया गया हैं ।

शब्द कुंजी – शिक्षा, विकास

प्रस्तावना –

सम्पूर्ण राष्ट्र एक शरीर के समान है, तथा उसमें निवास करने वाले विभिन्न वर्ग तथा जातियॉ इस राष्ट्र रूपी शरीर के अलग–अलग अंग है। यदि शरीर का कोई अंग कार्य न करे तो उसका प्रभाव शरीर पर पड़ना स्वाभाविक है। वैसे तो हर समुदाय में भेदभाव और किसी न किसी किस्म के अन्याय की महिलाएं शिकार है। मुस्लिम महिलाओं के बारे मे भी यही हकीकत है, मुस्लिम महिलाएं अल्पसंख्यकों में अल्पसंख्यक है। गरीब मुस्लिम महिलाओं की हालत तो और भी बदत्तर है । सरकार की विकास और कल्याण की बहुत कम योजनाओं का लाभ उन तक पहूंच पाता है। पुरूष प्रधान मर्यादाएं और जबरदस्ती मजहबी आदेशों ने पिछड़ेपन की जंजीरो से छुटकारा पाने के उनके अवसर पर और भी पावंदियॉ डाल दी हैं।

शिक्षा,स्वास्थ्य,रोजगार,स्वतंत्रता सभी दृष्टिकोण से मुस्लिम महिलाएं देश की सर्वाधिक पिछड़ी हुई महिलाए मानी गई है । पर्दा प्रथा, तीन तलाक, बाल विवाह, बहु विवाह इत्यादि चीजो ने मुस्लिम महिलाओं का जीवन दूभर कर दिया है एक तरफ जहां वे गरीबी, बेरोजगारी, अशिक्षा की मार से त्रस्त है वहीं धार्मिक कानूनों की मनमानी व्याख्या स्त्री विरोधी साबित हो रही है । भारतीय मुसलमान शिक्षा के क्षेत्र में अन्य समुदायो के पीछे है इस समुदाय मे बड़े पैमाने पर फैली गरीबी, बेरोगारी इसके लिए जिम्मेदार है ।

शिक्षा किसी भी समाज के विकास और उत्थान का आधार होती है शिक्षा से दुर रहने पर ही कोई भी समाज हर प्रकार के विकास के साथ–साथ मानव विकास के मामले में भी पिछड़ जाता है। शिक्षा की कमी के कारण ही कई समाज अजीविका के हिसाब से पिछड़ता है, जिसका असर उसके रहन–सहन पर पड़ता है। यह अशिक्षा ही है जिसके चलते वह बेरोजगारी निम्न आय आर्थिक संसाधनो कि कमी और आखिर मे गरीबी जैसी समस्याओं से भी जूझता रहता है ।

अध्ययन का महत्व एवं आवश्यकता :–

सफलता का सर्वश्रेष्ठ माध्ययम शिक्षा है । शिक्षा द्वारा ही हम जीवन की कठिनाइयों को दूर करते हुये उन्नति के शिखर पर पहुंच सकते है। यहां केवल एक समुदाय या वर्ग को शिक्षित होने से सफलता नहीं मिलेगी, वरन् सम्पूर्ण देश को शिक्षित् होने की आवश्यकता है। जहां महिलाओं और पुरूषों का बराबरी से शिक्षित होना जरूरी है ।

भारत की मुस्लिम बेटियां समाज का सबसे अशिक्षित वर्ग है। सम्मानित रोजगार में उनकी तादाद सबसे कम है, अपने ही समाज मे दहेज के कारण ठुकराई जा रही है, गरीबी बेरोजगारी और असंगठित क्षेत्र की शोषणकारी व्यवस्था की मजदूरी मे पिस रही है। इसलिए मुस्लिम महिलाओं को शिक्षित करने की आवश्यकता है।

उद्देश्य :– भारत कि मुस्लिम महिलाओं मे शैक्षिक स्थिति का अध्ययन करना।

परिकल्पना :– मुस्लिम महिलाओं के शिक्षा और सशक्तिकरण मे धनात्मक सम्बन्ध हैं।

आकड़ो की प्रस्तुतिकरण :– आज आवश्यक है सामान्य उच्च एवं तकनीकी शिक्षा की प्रगति की । समग्र विकास के लिए यह आवश्यक है कि शिक्षा का लाभ सभी जातियों और वर्गों के महिलाओं को समान रूप से प्राप्त हो। एसे मे भारतीय मुस्लिम वर्ग मे महिलाओं का साक्षरता प्रतिशत एक विचारणीय तथ्य है। यहां पर आवश्यकता है कि मुस्लिम समुदाय की महिलाओं के शिक्षा के क्षेत्र में आने वाली समस्याओ का समाधान कर मुस्लिम समुदाय को समाज की मुख्य धारा के साथ जोड़कर राष्ट्र का विकास करना ।

उपरोक्त तालिका से स्पष्ट है कि सन् 2011 में भारत की साक्षरता दर मुस्लिम समुदाय के महिलाओं मे अन्य समुदायों से पीछे हैं । आधुनिक सोच और शिक्षा से वंचित मुस्लिम महिलाओं का एक बड़ा तबका जीवन के हर क्षेत्र में पिछड़ा हुआ हैं। इस समुदाय में बड़े पैमाने पर फैली गरीबी और बेरोजगारी इसके लिए जिम्मेदार है ।

2011 जनगणना रिपोर्ट के अनुसार धार्मानुसार साक्षरता दर :–

क्र.	समुदाय	आबादी की प्रतिशतता	साक्षरता की प्रतिशतता	महिलाओं की प्रतिशतता	शिक्षित महिलाओं की प्रतिशतता
1	हिन्दु	79.79	63.60	48.82	27.10
2	मुस्लिम	14.22	57.27	48.75	31.98
3	इसाई	2.29	74.34	50.57	36.39
4	सिक्ख	1.72	73.26	47.44	39'62
5	बौद्ध	0.69	71.83	49.11	39.21
6	जैन	0.36	86.42	49.22	41.46
7	अन्य	0.62	50.34	50.21	20.77

स्त्रोंत :– भारत जनगणना 2011

शिक्षा मे कमी का सामाजिक – आर्थिक स्तर पर तथा समाजिक – आर्थिक स्तर का शिक्षा पर प्रभाव पड़ता है यह दोनो परस्पर एक दूसरे पर निर्भर होते है । सच्चर कमेटी रिपोर्ट भी यह बताती है कि भारतीय मुसलमान शिक्षा के मामले मे लगभग हर स्तर पर पिछड़े हैं। उनकी साक्षरता दर राष्ट्रीय औसत से बहुत कम है । प्राथमिक शिक्षा के बाद स्कूल छोड़ देने वाले मुस्लिम बच्चों की संख्या सबसे ज्यादा पायी गई है, इसी कारण स्नातक तथा स्नातकोत्तर करने वाले भारतीय मुस्लिम महिला विद्यार्थियों की संख्या उनकी आबादी के अनुपात में काफी कम है ।

मुस्लिम महिलाओं मे शिक्षा का स्तर हिन्दु व अन्य धर्म की महिलाओं की तुलना मे अपेक्षाकृत कम है । इसका प्रमुख कारण परिवार की निम्न आय और मुस्लिम बालिकाओं का घरेलु कामकाज मे अधिक संलग्न रहना है स्कुल मे मुस्लिम बालिकाओं की उपस्थिति आधी के करीब है । बालिका शिक्षा के प्रति मुस्लिम परिवारों मे एक स्वस्थ दृष्टिकोण भी नही है जिसके कारण मुस्लिम बालिकाएं उच्च शिक्षा की ओर उन्मुख नहीं हो पा रही हैं।

सुझाव :–

शिक्षा प्रत्येक समुदाय व वर्ग का सशक्त बनाने का सबसे शक्तिशाली और प्रभावी उपकरण है शिक्षा के इस प्रभावी उपकरण से ही मुस्लिम समुदाय के लोगो मे सकारात्मक बदलाव लाया जा सकता है । भारतीय मुस्लिम महिलाओ को बड़े पैमाने पर शिक्षित व प्रशिक्षित किया जाये ताकि वे अर्थव्यवस्था मे उत्पन्न होने वाले आर्थिक सुयोंगो मे सहभागी बन सकें ।

निष्कर्ष :–

उपर्युक्त विवेचन से स्पष्ट होता है कि महिला शिक्षा और सशक्तिकरण एक दुसरे के पूरक है । अतः निष्कर्ष के रूप मे हम यह कह सकते है कि शिक्षा एकमात्र साधन है जो महिलाओ के व्यक्तित्व मे अपेक्षित विकास ला सकता है । भारत के मुस्लिम महिलाओ मे अन्य समुदायो के अपेक्षा शिक्षा के स्तर में और भी ज्यादा कमी पायी गई है अतः अध्ययन की परिकल्पना सार्थक सिद्ध होता है ।

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Decoding Industry 4.0 for Inclusive and Sustainable Growth



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Home Loan Customer Perception towards Public and Private Sector Banks- A Comparative Study

K. Padmawati[1], Avichal Sharma[2]

ABSTRACT

The Home loan sector in India is the pivotal role player in the growth of the real estate scenario in India. With tax incentives given to the housing finance sector, transactions related to buying and selling of residential properties have increased considerably. Since, the new class of buyers are relatively younger set of customers who are more aware about legal documentation and approvals, buyers are now more 'end-users' rather than investors. The property market in India undergoes transformation to align itself with global standards with an increased emphasis on quality and cost control and documentation methods. The present study has analyzed the key decision and influencing factors of home loan from the perspective of home loan customers of public and private sector banks. Findings of the study revealed that significant difference is observed in perception of home loan customer of Public and Private sector banks as the government economic policies affect the interest rates of home loan. Similarly, effect of home loan on standard of living, on savings and investment planning, future purchase planning, planning for early repayment, for home loan transfer to other banks, on referral to friends and relatives for home loan from the same bank were perceived significantly different by home loan customers of Public and Private sector banks.

Keywords: Home Loan, Banks, Housing Finance, Customer Perception.

INTRODUCTION

There has been a phenomenal growth in the demand for housing in the country in recent years both in quantitative and qualitative terms due to increase in population, expansion of industrial and commercial activities, large scale immigration into urban area etc. House building has become the most vibrant activity among the middle-class of the 21st century India. Ample tax-breaks with access to cheap bank loans, minimum pre-conditions and paper work, have laid the foundation. Since then, there has been no

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looking back for the housing boom. The last decade saw the emergence of a strong Indian middle-class with rising disposable incomes, seeking constructive avenues for investment. The interest rate plunging from their historical highs and reining in of inflationary spiral resulted in a huge demand for housing loans. As returns outweighed risks, banks vied with one another to offer the cheapest rates, reduce paper work and extend top-quality service. The typical middle-class Indian is building a fresh asset- his house from his salary. The bank's contribution in creating the asset is often far higher than the contribution of the customer.

The new class of buyers are relatively younger set of customers and more aware about legal documentation and approvals, buyers are now more 'end-users' rather than investors. The property market in India is undergoing transformation to align itself with global standards with an increased emphasis on quality and cost control and documentation methods. In the current economy of India, the real estate sector has the maximum propensity to generate income and demand for materials, equipment and services. It can be said that housing finance companies were formed for co-existing with buyer's requirements of housing loans for investing in properties. The Home loan sector in India is the pivotal role player in the growth of the real estate scenario in India. With tax incentives given to the housing finance sector, transactions related to buying and selling of residential properties increased considerably and was much higher as compared to previous years.

Earlier, the home loan sector in India was solely dependent on nationalized and public sector banks, but the entry of public sector banks into the housing finance business marked the beginning of the first round of interest rate cuts. And this reduction in interest rates has enhanced the borrowing power of customers. Most of the financial institutions offer home loans to both Indian and NRI customers at floating and fixed rate of interest or blended ones and have customized packages for the purposes of constructing/ buying a new house, vacant plot or extension and even home improvement. Loans for non-residential premises, home equity and top-up/personal loans are also available. Moreover, a person looking for a housing loan can avail himself of life insurance covers, home protection insurance, and other privileges related to banking facilities.

REVIEW OF LITERATURE

Lee and Marlowe (2003) revealed that convenience was considered as an important criterion by most of the home loan customers followed by low fee and personal relationships. Customers have also considered location, hours of operation, online

banking as convenience features. However, decision making criteria may vary across the experiences with service quality of banking services, socioeconomic and demographic characteristics of the customers. Sangwan and Bhan (2012) observed that home loan customers get attracted to lower interest rate and low processing cost. Majority of home loan customers prefer loan for construction of new house. Findings of the study also emphasized that private sector bank employees were found to be more cooperative than public sector bank employees.

Patel (1996) shared the genesis of home loan financing by banks and how it became the priority sector over the time for banking system. Moreover the study also emphasized the importance of housing loan for weaker section of society. The increased importance of housing finance underlined the importance and scope for establishing housing finance subsidiaries by the banks. With the host of Real Estate Funds from Financial Institutions, financial support from the Banks and Housing Finance Companies (HFCs) that have access to low cost retail funds and refinance given by National Housing Board at competitive rates, more investors are willing to pledge their assets to the realty sector. Banks and HFCs are entering or seeking to enter into tie-ups with builders/development authorities/ private developers in order to improve the credit delivery system and devise competitive pricing and aggressive strategy. Foreign banks are also able to woo retail customers by fine-tuning their housing loans (Yates and Whitehead, 2001)

Interest Rates for Home Loans are undoubtedly the most important parameter to factor into your calculations. And in most cases is the decisive factor for an investor to narrow down on a certain Housing Finance Company's home loan offer. The interest on housing loans in India is usually calculated either on monthly reducing or yearly reducing balance basis

HYPOTHESES

Following Hypotheses were framed for the study and tested at 5% significance level.

H_{01} – Interest rate charges for housing finance is not perceived significantly different by home loan customers of Public and Private sector banks.

H_{02} – Increase in interest rate due to changes in economic conditions is not perceived significantly different by home loan customers of Public and Private sector banks.

H_{03} – Effect of Government economic policies on Interest rate is not perceived significantly different by home loan customers of Public and Private sector banks.

H_{04} – Satisfaction towards housing loan is not perceived significantly different by home loan customers of Public and Private sector banks.

H_{05} – Effect of home loan on standard of living is not perceived significantly different by home loan customers of Public and Private sector banks.

H_{06} – Effect of home loan on savings and investment planning is not perceived significantly different by home loan customers of Public and Private sector banks. .

H_{07} – Effect of home loan on future purchase planning is not perceived significantly different by home loan customers of Public and Private sector banks.

H_{08} – Planning for early repayment is not perceived significantly different by home loan customers of Public and Private sector banks. .

H_{09} – Planning for home loan transfer to other banks is not perceived significantly different by home loan customers of Public and Private sector banks.

H_{010} – Referral to friends and relatives for home loan from the same bank is not perceived significantly different by home loan customers of Public and Private sector banks.

OBJECTIVE OF THE STUDY

The study was primarily aimed to measure the perception of home loan customers. The specific objective was:

- To gauge and compare the perception of home loan customers of public sector and private sector banks.

RESEARCH METHOD

For the proposed research, a self-structured set of items were framed comprising ten statements. The questionnaire was set on the basis of three points Likert scale; in which respondents were asked to rate the statements on the basis three points scale. The relative weightages were mentioned from agree (3) to disagree (1).The instrument was distributed to 200 home loan customers randomly, irrespective of their lending banks in the month of September 2019. The scope of the study was the Durg city of Chhattisgarh

(India).The gathered 200 samples of home loan customers were stratified on the basis of private sector and public sector banks.

RESULTS AND DISCUSSION

Significant difference observed in the perception of home loan customers of public and private sector banks that government economic policies affect the interest rates of home loan. Similarly, effect of home loan on standard of living, savings and investment planning, future purchase planning, planning for early repayment, planning for home loan transfer to other banks, referral to friends and relatives for home loan from the same bank were perceived significantly different by home loan customers of public and private sector banks. So, hypotheses $H_{0(3)}$, $H_{0(5)}$, $H_{0(6)}$, $H_{(7)}$, $H_{(8)}$, $H_{(9)}$, and $H_{0(10)}$were rejected. However, Interest rate charges for housing finance, Increase in interest rate due to changes in economic conditions, and overall satisfaction towards housing loan were not perceived significantly different by home loan customers of Public and Private sector banks. So, hypotheses $H_{0(1)}$, $H_{0(2)}$and $H_{0(4)}$were accepted (Table 1).

Home loan customers of Public sector banks were found to be more concerned that government economic policy affects the interest rates of home loan. Home loans have significant effect on their standard of living, their savings and investment planning, and on their future purchase planning. Whereas home loan customers of private sector banks were found to be more concerned about their planning for early repayment of home loan, some customers were planning for home loan transfer to other banks, and some were agreed that they would refer their friends and relatives for home loan from their existing home loan bankers (Table 2).

CONCLUSION

It has been observed that fluctuation in interest rate on home loans directly affects the amount of equally monthly installment and subsequently the purchasing behavior of home loan customers. It has affected home loan customers in many ways; such as increase in Equated Monthly Installment (EMI), increased tenure of repayment etc. Fluctuating rate of interest on home loan has affected different category of home loan customers in different manner. The degree of effect may be higher on customers who have high amount of loan than those who have lower amount of loan. The present study has further analyzed the key decision and influencing factors of home loan from perspective of home loan customers of public and private sector banks. Findings of the study have identified significant difference in perception of home loan customers of private and public sector banks for dome of the key factors.

Findings of the study could provide a measure of understanding the behavior of home loan customers for formulating marketing and promotional strategies. It is a time to understand that the property market is also turning into a buyer's market, with price cuts resorted to by some realtors, and their willingness to negotiate prices. Lower interest rates, on top of this trend, may help tilt the balance in favor of a home buyer, especially from the lower- and middle-income group. Accordingly, housing finance companies and banks have to develop lending strategies to the home loan customers on the basis of their segments.

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TABLE 1: Gender-wise T test

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2-tailed)
Higher charges	Equal variances assumed	1.943	.166	-.133	123	.895
	Equal variances not assumed			-.132	119.039	.895
Inflation	Equal variances assumed	6.928	.010	-1.560	123	.121
	Equal variances not assumed			-1.542	112.786	.126
Govt support	Equal variances assumed	323.086	.000	4.977	123	.000
	Equal variances not assumed			5.292	78.631	.000
Interest rate charges	Equal variances assumed	3.606	.060	-.236	123	.814
	Equal variances not assumed			-.235	118.573	.815
Standard of Living	Equal variances assumed	1.494	.224	3.112	123	.002
	Equal variances not assumed			3.104	119.055	.002
Affected saving	Equal variances assumed	1.952	.165	3.283	123	.001

plans	Equal variances not assumed			3.292	121.551	.001
Purchase power	Equal variances assumed	1.952	.165	3.283	123	.001
	Equal variances not assumed			3.292	121.551	.001
Prepayment	Equal variances assumed	51.514	.000	-3.732	123	.000
	Equal variances not assumed			-3.653	103.572	.000
Shifting of loan	Equal variances assumed	17.054	.000	-3.142	123	.002
	Equal variances not assumed			-3.189	122.492	.002
Like to Suggest	Equal variances assumed	100.349	.000	-4.846	123	.000
	Equal variances not assumed			-4.605	73.989	.000

TABLE 2: Gender-wise Mean and Standard Deviation

	Bank	N	Mean	Std. Deviation
Higher Charges	Public Sector Banks	58	1.8276	.99363
	Private Sector Banks	67	1.8507	.95749
Inflation	Public Sector Banks	58	2.6724	.63212
	Private Sector Banks	67	2.8358	.53928
Govt. Support	Public Sector Banks	58	2.9138	.28312
	Private Sector Banks	67	2.2537	.97458
Interest Rate Charges	Public Sector Banks	58	2.1379	.99909
	Private Sector Banks	67	2.1791	.95228
Standard of Living	Public Sector Banks	58	2.1207	.95656
	Private Sector Banks	67	1.5970	.92211
Saving	Public Sector Banks	58	2.3448	.94686

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Status of Industrial Development in Chhattisgarh with Special Reference to Micro, Small and Medium Scale Enterprises

Anshumala Chandangar

INTRODUCTION

There is an immense potential for industrial development in the state because the state is generously bestowed with natural resources. A number of large cement plants by groups like ACC, Grasim, Ambuja, Jaypee and Lafarge are in the state. Over 100 steel(sponge/pig) projects are on different stages of implementation. Major investors in this sector are Tata, Jindal, Essar etc. According to a report of Chhattisgarh government there are approximately 130 steel re-rolling mills, 17 ferro units, large number of agro-based and food processing enterprises, chemical and forest-based units etc. are there in Chhattisgarh. The industrial areas of state are not confined to developed cities of Chhattisgarh but they are located in even the remotest areas of the state like the Bastar region and the tribal belt of north Chhattisgarh so that there is equal development in all the areas. With the purpose to develop and create more opportunities for industrial development 8 Integrated Infrastructure Development. Centres have been established in Mahasamund, Kabirdham, Sarguja, Janjgir, Champa, Bilaspur, Dantewada and Raipur. Government of Chhattisgarh has started many schemes to promote industrial development for both large scale industries and MSMEs. Micro, Small and Medium enterprises are the backbone for the people living in remote, tribal regions with very few resources available at their end. There were total 22402 micro,356 small and 10 medium enterprises post fourth census in Chhattisgarh, according to the MSME Report 2016-17.

Table 1
Main Industrial Products and their Contribution in National Production

Product	*Production(in core sector)*	*% of the national production*
Steel	15 million ton	30%
Cement	18 million ton	15%
Aluminium	35 lakh million ton	30%
Sponge ron	100 lakh million ton	-

Source: Report, Industrial profile of Chhattisgarh,2016-17

The main industrial products of Chhattisgarh can be seen in the table 1. steel and Aluminium contribute 30 percent of the national production, contribution in cement production is 15 per

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cent. Chattisgarh even exports few products mainly Steel, Handicraft, Handloom, Blended Yarn, agro products, Cement, Aluminim, Minerals and Engineering products etc.,nearly 75 per cent of steel is from Bhilai and rest from Raipur and Bilaspur. The export was Rs.1675 crore in 2009-10 which increased to Rs.7701 crores in the year 2013-14 which shows a robust increase in the exports in Chattisgarh.

OBJECTIVES OF THE STUDY

- To analyse the growth of industrial sector in Chhattisgarh.
- To analyse the status of Micro, small and medium enterprises in Chhattisgarh.

REVIEW OF LITERATURE

Dr Anuradha, J. (2014) in her study revealed that except marginal increase in growth rate in employment generation by MSMEs, the growth rate in other parameters is not encouraging during liberalization period. The paper critically analysed the definitional aspect of MSMEs and explored the opportunities enjoyed and constraints faced by MSMEs. Subrahmaniam and Azeez traced the trends in industrial growth of Kerela and found the growth of industry has been low compared to the general growth of Kerela. Manisha and Renu concluded in their paper that the industrial growth in Haryana had been remarkable. In his Study Tulus Tambunan on MSMEs in Indonesia, concluded that poverty seems to be the main force behind the growth of MSMEs.

RESEARCH METHODOLOGY

The study is based on secondary data which has been collected from the publications and reports of government of Chhattisgarh, Government of India. Publications like Annual Report of MSME, Industrial profile of Chhattisgarh 2016-17, Economic Survey of Chhattisgarh, Government websites has been surfed during the study for different data. Sectoral Growth is calculated by percentage method.

ANALYSIS

Table 2

Sector-wise distribution of Gross State Domestic Product of Chhattisgarh state (at 2011-12 prices) in Rupees Lakhs

Industry of origin/Year	*2012-13*	*2013-14*	*2014-15*	*2015-16*	*2016-17*	*2017-18*	*2018-19*
Primary Sector	4773536	4999953	5231237	5100649	5844721	5974670	6201320
Agriculture only	2850360	2927578	3121630	3092063	3639707	3615045	3759177
Secondary -Sector	5403268	6396455	6227808	6490689	7137082	7421006	7862841
Industry	7326445	8468830	8337415	8499275	9342096	9780631	10304984
service sector	5380078	5859043	6064311	6466758	6673618	7279069	7783788
GSDP	1555688	1725545	1752335	1805809	1965542	2067474	21847949

Source: Economic survey of Chattisgarh,2018-19)

Table 2 shows the sector wise distribution of Gross state Domestic product of Chhattisgarh, the gross state domestic product is estimated to increase from Rs.1555688 lakhs in 2012-

13 to Rs.21847949 lakhs in 2018-19. The income from industry including mining was Rs. 7326445 lakhs in 2012-13 which is estimated to increase to Rs.10304984 in the year 2018-19, which shows a robust increase in the income from this sector. Also, the income from the industrial sector was the highest among the three sectors.

Table 3 shows the percentage growth of gross state domestic product and its sectors over different years. we can see that the growth for the secondary sector was 18.38 per cent in the year 2013-14 which is estimated to decrease to 5.95 per cent showing a very sharp decrease in the growth of secondary sector.

Table 3
Percentage Growth of Gross State Domestic Product of Chhattisgarh over the previous year (in percent)

Industry of origin/Year	*2013-14*	*2014-15*	*2015-16*	*2016-17*	*2017-18*	*2018-19*
Primary Sector	4.74	4.63	-2.5	14.59	2.22	3.79
Agriculture only	2.71	6,63	-0.95	17-71	-0.68	3.99
Sec-Sector	18.38	-2.64	4.22	9.96	3.98	5.95
Industry	15.59	-1.55	1.94	9.92	4.69	5.36
service sector	8.90	3.5	6.64	3.20	9.07	6.93
GSDP	10.92	1.55	3.05	8.85	5.19	5.67

Source: Economic Survey of Chhattisgarh 2018-19

When the mining sector is included in the secondary sector the industry shows a decrease of 2.79 points which means there is a low growth in the mining sector. The year 2014-15 shows a negative growth of -1.55 per cent, the negative growth was due to the low performance in the iron and steel sector. Th low growth continued in the year 2015-16 which increased to robust growth of 9.92 in 2016-17. Clearly, the low growth of the industrial sector is the reason for low growth of GSDP in Chhattisgarh. Table 4 shows the contribution of the different sectors in the Gross State Domestic Product of Chhattisgarh. The share of primary sector was 30.68 per cent in the year 2012-13 which decreased to 17.21 per cent in the year 2017-18.

Table 4
Percentage share of different sectors in the GSDP of Chhattisgarh (in percent)

Industry of origin/Year	*2012-13*	*2013-14*	*2014-15*	*2015-16*	*2016-17*	*2017-18*	*2018-19*
Primary Sector	30.68	28.98	29.85	28.25	29.74	28.90	28.38
Agriculture only	18.32	16.97	17.81	17.12	18.5217.49	17.21	
Secondary -Sector	34.73	37.07	35.54	35.94	36.31	35.89	35.99
Industry	47.09	49.08	47.58	47.07	47.53	47.31	47.17
service sector	34.58	33.95	34.61	35.81	33.95	35.21	35.63
GSDP	100	100	100	100	100	100	100

Source: Economic Survey of Chhattisgarh 2018-19

The share of industrial sector was 47.09 per cent in the year 2012-13 which increased to 47.31 per cent in 2017-18 which shows there is not much increase in the share of industrial

sector during these years. The table also shows that the share of industrial sector is the highest in the GSDP, which implies rapid industrialization after the emergence of the state and Chhattisgarh has transformed from an agrarian economy to an industrial economy. Manufacturing sector is the back bone of the industrial sector for the state, table 5 shows the growth and share of manufacturing sector.

Table 5
Growth and share of manufacturing sector in the GSDP

Item / Year	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Contribution in lakhs	2660179	3588922	3313429	3402519	3660171	3841141	4040133
Growth in percent	9.25	34.91	-7.68	2.69	7.57	4.94	5.18
Share(in GSDP) in per cent	17.10	20.80	18.91	18.84	18.62	18.58	18.49

Source: Economic Survey of Chhattisgarh 2018-19

The growth of the sector is not impressive and shows a decreasing trend with -7.68 per cent growth in the year 2014-15. Its share in the GSDP was 17.10 per cent which increased to 8.58 per cent that is only increased by 1.48 percentage points which is not a significant change.

MICRO, SMALL AND MEDIUM ENTERPRISES (MSMES)

Micro, small and medium enterprises play an important role in the state's economy, it provides employment opportunities to local people of the region, contributes to the industrial production and hence contribution to the state income, it contributes in the export of different products, it has low capital cost, producing wide range of products and services to meet the domestic as well as global demands. MSMEs are more significant because of inclusion of people with few resources, people from weaker section of the society, people in the remote areas of the state. Government of Chhattisgarh is providing support to the existing micro, small and medium scale enterprises as well as to new enterprises for producing more and new products. The government runs various schemes for financial aid, technology assistance, for skill development and training etc. to make MSMEs more competitive. Table 5 shows the number of micro, small and medium enterprises at the district level in Chhattisgarh. The southern tribal region of Chhattisgarh consists of Sukuma, Bastar, Bijapur, Narayanpur, Kondagaon and Dantewada which are very backward regions of the state. There are 15 registered units in Sukuma which provides employment to 200 people in the region where employment opportunities are very few. In Bastar district the number of registered units are 436, where 2572 people are employed, producing agro products, wood products, metal products and mineral products etc. The northern region of Chhattisgarh consists of district Balarampur, Jashpur, Sarguja and Surajpur, in which Sarguja has 11950 units of micro, small and medium scale enterprises which is giving employment to 22812 people in the district. The major produce is agro products, readymade garments, servicing and repairing sector and others. Jashpur produces leather products, agro and wooden products etc.

Table 5
Number of Micro, small and medium enterprises at district level in Chhattisgarh

S.No.	Districts	No. of Registered Industrial units	Employment in small/medium enterprises	Type of Industries
1	Sukuma	15	100	Agro,wood,metal,mineral
2	Bastar	436	2572	Agro,wood,meta, mineral,servicing
3	Bijapur	3	127	Metal , servicing,others
4	Narayanpur	18	122	Agro,metal,wood
5	Kondagaon	4	486	Agro,metal.mineral,readymade garment,thread,woollen
6	Dantewada	180	771	Agro,wood,servicing,leather, paper,readymade garments
7	Raipur	6701	34483	Agro,metal work,wood,leather,woollen,thread,readymade,paper
8	Durg	18878	-	Metal,agro,servicing,other,leather
9	Bilaspur	19068	44481	Agro,metal,mineral,leather,wood,others
10	Balrampur	30	284	Agro,mineral,metal,servicing
11	Jashpur	1829	4735	Leather,agro,wood,mineral,readymade garments
12	Sarguja	11950	22812	Agro,readymade,servicing,others
13	Surajpur	283	1963	Agro,metal,mineral
14	Korba	671	2812	Agro,servicing,woodetc.
15	Janjgir-champa	1296	5637	Agro,mineral,metal,wood etc
16	Raigarh	9699	15351	Wood,servicing and repairing,agro etc

Source: MSME Development Institute, Raipur, ministry of MSME, Govt. of India

The big cities of Chhattisgarh consist of many MSME units. Raipur City has 6701 registered units and a total of 10649 units working in the district where 3483 people are employed in these units, whereas 86400 people are working on daily wages basis, 23906 people are employed in the large and medium scale industries and the major export items from these micro, small and medium enterprises are spun silk yarn,, herbal medicine food items, steel structures, cement etc. The Durg district of Chhattisgarh has deposits of limestone, floor stone and clay, the presence of Bhilai steel plant helps many MSME units to come up through both forward and backward linkages. There are 1878 enterprises registered where 55210 people are employed in medium and large-scale industries and 62206 employed on daily wage basis. The district produces all kind of products like agro products, wood, metal, leather products and readymade garments. District Bilaspur with 19068 units employees 3811 and 45642 people in medium and large-scale industry and on daily wages basis respectively. The districts of Korba, Janjgir-Chapa, Raigarh have 671, 1296 and 9699 registered units, respectively, which are producing vast varieties of products.

SCHEMES OF GOVERNMENT OF CHHATTISGARH TO SUPPORT THE EXISTING MSMES AND TO PROMOTE THE ESTABLISHMENT OF NEW MSMES

Primary responsibility of promotion and development of MSMEs is of the state Government which is supported by the Government of India by different initiatives. some of these programs and scheme include MSE-CDP, IIDC, industrial parks and NMC Programme, Micro and Small Enterprises Cluster Development scheme is considered to increase the competitiveness in the industry by ensuring inter firm cooperation based on networking and trust. Due to geographical proximity and similarity of products, cluster of large number of units can be made leading to higher output at lower cost of implementation, it helps to overcome the disadvantages of economics of scale and low capital base increases competitiveness and better cost effectiveness.

Integrated infrastructure development centre(IIDC) for small scale industries at Kabirdham, Birkoni (Mahasamund), Nayanpur (sarguja), (Bilaspur), kapan of janjgir Champa, tekann (Dantewada) has been established to meet increasing requirement of land for industrial units the Government of Chhattisgarh September setting up 3 mega industrial areas in Bilaspur,Raigarh and Raipur for the development of Metal Park, Engineering Park, Electronic manufacturing cluster and Mega food Park.

Another program is National Manufacturing Competitiveness Programme, the national manufacturing competitiveness council has drawn 10 schemes including schemes for promotion of ICT, mini tool room, design techniques and marketing support for small and medium enterprises

INDUSTRIAL POLICY 2014-19 OF CHHATTISGARH STATE

The state is well equipped with basic amenities for development likes roads, railways, sufficient power supply etc. which makes it a preferred destination for the investors. To utilize its natural resources, human resources and energy resources properly, the government has implemented the industrial policy 2009-14. One of the important ambitious projects under the policy is the establishment of three Railway Corridor which is expected to change the face of railway mobility and we have a revolution impact on the industrial development on the state.

The objectives of the industrial policy 2014-19 include promotion of the manufacturing sector with "Make in Chhattisgarh" design to make the state more competitive and to encourage youth of the state for entrepreneurship. To Promote export and encouraging the establishment of SEZs, balanced industrial growth and providing benefit to the Weaker section of the society in which naxalism affected families are included to bring them into the main stream of development. For achieving above mentioned objectives Chhattisgarh State Industrial Development Corporation (CSIDC) will be the nodal agency. Multi-storeyed building for MSMEs will be constructed, in the acquisition of private and transfer of government land for land banks 20% will be reserved for MSMEs. Chhattisgarh consultancy organisation (CHON) is formed for industrial surveys, preparing of reports etc. For increasing export establishment of export facilitation cum convention centre in Naya Raipur concept of 'Udyog Mitra' is included for the industrial projects of more than 10 cr. "Mitaan" a single window system under the Chhattisgarh industrial investment promotion act ,2002 to ease the process related to the establishment of industries.

CONCLUSION

Chhattisgarh, whose 44% area is covered with forest, with more than 88 species of rich valuable medicinal plants, a state blessed with minerals like coal, iron ore, bauxite, zinc and tin, a state rich in water resources has the potential to become an industrially developed state. If these resources are utilised properly than the state will become free from poverty, unemployment. Government of Chhattisgarh has taken many initiatives to bring investors from Indian and all over the world so as to boost industrial development in the state. The need is to develop both the large scale and MSMEs to bring a rapid change in the development process. According to Tambunan Tulus, (2019), capacity building in small and medium scale enterprises should be given high priority by the policy makers in their economic development policies, specially at the regional level Government should conduct training programs and focus on online marketing, entrepreneurship, management and the improvement of product quality and business efficiency.

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GROSS ENVIRONMENT PRODUCT (GEP): THINKING BEYOND GROSS DOMESTIC PRODUCT (GDP)

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Abstract
The economic growth at the cost of ecological imbalance is an extremely important issue for all the economies around the world. In India, according to A Report on Environmental Accounts, 11 states showed negative change in the natural capital whereas 14 states showed slight increase between 0-5 percent during 2005-2015 as compared to the average growth rate of GSDP between 7 to 8 percent during 2005-2015 for almost all the states which shows that the growth of capital is insignificant (Envi stats India, 2018). Fast depletion of the natural capital which includes water, minerals, forests, land, air, biodiversity etc poses a challenge to achieving poverty reduction and sustainable development objectives (Cantrell, J.2020). Therefore, it is very necessary to monitor and measure natural capital for sustainable development. Gross Domestic Product (GDP) measures only the Income of the Nation but it is also important to know the level of change of natural capital in a year which is measured by Gross Environmental Product (GEP). Uttarakhand is set to become the first state in India to measure GEP.

Keywords: Gross Environment Product, Natural Capital, Ecological Growth, Gross Domestic Product, Sustainable Development.

Introduction
Natural capital which refers to a class of natural goods comprising of ecosystems, land, water, sub-soil resources and the like, is essential for economic growth, employment and prosperity of the people. All kinds of benefits whether it is the use of natural resources for production process or enjoying nature, everything comes from environment. Do we talk about environmental growth when we talk about economic growth? Policymakers need to understand the interdependence and interplay of environment and economy so that natural resources can be used sustainably for the economic growth or sustainable development. GDP is the measure of the growth of the economy where as the Gross Environmental product is the measure of the quality and quantity of the natural resources of any country, it measures the monetary value of the natural capital of any country. Uttarakhand has taken the first step towards measuring the growth of its natural capital and is set to become first state in India to assign monetary value to its natural resources- water, air, forest and soil.

Objectives
- To analyse the level of change in natural capital in India.
- To understand the concept and need of Gross Environmental Product.

Research Methodology
This paper is based on secondary data and information that has been collected from various research articles, e-journals, government reports, newspapers and different government official websites.

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Natural capital in India

The continuous economic activities for the growth of economy have resulted in ecological recuperation, not only destruction or depletion. Since these natural resources are in non-renewable and its quantity is decreasing and secondly it is also impacting the quality aspects like polluted air and diminished biodiversity. The level of change in natural capital between 2005 and 2015 as per the Envi stats India 2018 report, few states like Madhya Pradesh Maharashtra Manipur Rajasthan, there is slight increase in the natural capital stock by more than 5% where as in the states like Chhattisgarh, Arunachal Pradesh, Himachal Pradesh, Uttar Pradesh, West Bengal showed very less increase in the capital stock between 0 to 5 percent ,states of Kerala, Gujarat, Jharkhand, Tamilnadu, Uttarakhand showed a decrease in the natural capital. If we see the growth of Gross Domestic Product of the states between 2005 to 2015, the growth rate was 7-8 percent which is much higher than the growth of natural capital in the states.

Change in the level of natural capital in India

Forests: The stock of the evergreen forests in India has decreased by 1 percent whereas the deciduous forest showed a slight increase in its stock, Grass grazing land stock has also decreased, the snow and glacier stock has decreased by 5.61 percent in these years. According to Ministry of Environment statistics total growing stock of forest has decreased from 1122.12 million cum in 2006-07 to 958.34 million cum in 2015-16 which is a major concern for India, from 2006-07 to 2010-11 almost in all the states, the growing stock has reduced except for Goa and Sikkim, whereas on Madhya Pradesh, Jharkhand and Maharashtra the stock has increased. The carbon stock has increased by 419 million tonnes in a span of 9 years by 2015-16.

Land: According to the report of ministry of environment, in India 50 percent of topsoil has been almost lost since independence and we are eating chemicals due to which the rising number of Cancer cases in India can be seen. Land degradation is the loss of biodiversity and productivity and since independence it has increased from 38951 ha in 2005 to 51125 ha in 2015.

Water: Water resources are of major concern at present especially the decreasing level of underground water. There are so many rivers like Ganga, Brahmaputra, Indus, Godavari, Kaveri, Mahanadi, Narmada which had been good source of water in the places where it is flowing but now the water resources are being increasingly stressed by over-by-over abstraction, pollution and climate change that has affected both quality and quantity of water and the data shows that the per capita availability of water has decreased over the decades in India. The per capita availability of water was 5178 cubic metre per year in 1951 which has been estimated to reduce 21421 cubic metre per year in 2021 and will be 1174 cubic metre per year by 2051.The gap between supply and demand of water is increasing which will make water availability difficult for a sustainable development in the future. Rivers like Cauvery, Penner, Sabarmati are facing acute scarcity, similarly Luni and West flowing rivers are facing acute scarcity. If we talk about groundwater depletion, the depth of water is from 10 to 40 m bgl in North Western states of India whereas in western part the depth is more than 40 m bgl. This depletion of water is affecting the farming of the states and reducing the growth of agriculture sector and giving a warning about the sustainable agriculture. According to Central Ground Water Board of India, over exploitation of water is there in Delhi, Haryana, Himachal Pradesh, Tamilnadu, Uttar Pradesh, Punjab and Rajasthan in which Delhi, Punjab and Rajasthan are facing acute water scarcity because of over exploitation of water.

Minerals: are the building blocks of an economy these are non-renewable and limited resource which are vital for the basic industries in any economy. India is endowed with huge mineral resources like

coal, iron ore, manganese ore, bauxite etc. but the over exploitation of these minerals is an issue of major concern for the sustainable development. There has been an increase in the total resources of few important minerals like coal, diamond, graphite, etc. in last few decades, similarly new reserves of few minerals have been discovered like iron ore in Chhattisgarh, manganese in Gujarat, dolomite in Uttarakhand etc. Reserves of some minerals have exhausted due to over exploitation, bauxite reserves in Andhra Pradesh has reduced, iron ore stock in Jharkhand has reduced etc. Similarly, total crude oil reserves have reduced from 786.04 mmt in year 2005 to 635.59 mmt in 2015, but the natural gas reserves have increased from 1102.99 BCM in 2005 to 1251.99 BCM in 2015 year. The need is of proper assessment of these stocks for policy makers for the sustainable growth.

Air: According to a report by WHO, quality of air has deteriorated in last few decades and 90 percent people across the globe have some or the other respiratory problems because of the polluted air. According to a UN report how to 30 cities in the world the top polluted cities 20 hour in India on the quality of air we are breathing in According to a study in 2019, 70 lakh people in India died of polluted air. Deteriorating quality of air in India is a major concern for it is not only affecting the health but also the economy. As per the Global Burden of Disease Comparative Risk Assessment for 2015, air pollution exposure contributes to approximately 1.8 million premature deaths and 49 million disability adjusted life years lost, ranking it among the top risk factors for ill health in India. Also, in a study conducted by World Bank and Institute of Health Metrics and Evaluation on the cost of air pollution, 8.5 percent of India's GDP was lost due to air pollution in the terms of welfare cost and lost labour incomes (Centre for Environmental Health Report, 2017)

Gross Environment Product

Due to the depletion of natural resources, it is high time to think seriously about the natural capital and protection of ecosystem to ensure sustainable development along with ecological growth. Gross Environment Product will help in asserting ecosystem support for an aggressive economy growth. The fact is that we are surviving because of air, water, soil, forest biodiversity etc. but the growth of natural capital is not estimated and is not included in the GDP calculation. We never thought of augmenting resources but bought its alternative, for example, in form of water bottle, in the form of air purifier or in the form of fertilizers, we never thought of harvesting water or organic fertilizer for long. We don't have any data of these natural capital that how much we are left with these natural resources for our future generations. Prosperity lies in the augmentation of these resources and Gross Environment Product is another growth measure that is parallel to GDP. We need to know how much forests have been added or reduced in a given year in a country. We need to know that how much soil has been enriched in a given year, that how much water has been harvested in a given year, the quality of air has improved or adulterated in a year in a given country.

According to environmentalist Anil Joshi, GDP is considered the most impressive growth indicator of any given country globally, but this measure does not take into account the status of forest, air, water, and soil, this is the basic reason that we don't have awareness of ecological growth and reciprocating impact on the environment. Therefore, Gross Environment Product is an indicator to measure growth of ecosystem (Joshi A, 2021). Uttarakhand is set to become first state in India to assign monetary value to the natural resources -air water, forest and soil, evaluating both the quality and quantity of these natural resources, Uttarakhand has 71 percent of forest cover and a place of great importance for biodiversity so, it is very important for policy makers to know the degradation or addition of these natural resources for the economic and ecological growth in the future.

Conclusion

The level of change in natural capital in India shows that the depletion of natural resources is at faster pace than its growth which is a big challenge in front of the government to its poverty reduction and sustainable development objectives. The need is the measurement of the natural capital i.e., to calculate GEP, the states must adapt the GEP measurement like Uttarakhand to attain economic growth along with the natural capital growth. Aftermath of Covid, government needs to deploy more stimulus packages for economic recovery along with environmental policy changes for conserving our biodiversity and protecting the ecosystem.

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Research Publication from 2017 to 2021

Name -Dr. K. Padmawati

[A] Details of Research Paper

S.N.	Title of Paper	Title of Journal	ISSN No.	Volume & Year of Publication
1	मुस्लिम महिलाओं के सामाजिक आर्थिक स्थिति का विश्लेषणात्मक अध्ययन (दुर्ग भिलाई के मुस्लिम बाहुल्य क्षेत्रों के सन्दर्भ में)	Research Journal of Social and Life Sciences (Peer Reviewed)	ISSN 0973-3914	Vol.- XXX-XXXI, Year-15, Dec. 2019- March 2020
2	A Description of Public Expenditure on Agriculture and Output Growth	Research Journal of Social and Life Sciences (Peer Reviewed)	ISSN 0973-3914	Vol.- XXX-XXXI, Year-15, Dec. 2019- March 2020
3	महिलाओं के विकास में महिला एवं बाल विकास विभाग की प्रमुख योजनाओं के प्रमुख उपलब्धियों का अध्ययन (छत्तीसगढ़ के धमतरी जिले के कुरुद ब्लॉक के विशेष सन्दर्भ में)	Research Journal of Social and Life Sciences (Peer Reviewed)	ISSN 0973-3914	Vol.- XXX-XXXI, Year-15, Dec. 2019- March 2020
4	An Argument of Universal Basic Income and Its Fiscal Feasibility in India	Journal of Advances & Scholarly Researches in Allied Education (Peer Reviewed)	ISSN: 2230-7540	VOL- 16, ISSUE-6, 2019
5	छत्तीसगढ़ के बालोद विकासखंड में सार्वजनिक वितरण प्रणाली: एक अध्ययन	Research Journal of Arts , Management & Social Science(Peer Reviewed)	ISSN: 0975-4083	अंक- XVIII-I, Page - 154
6	छत्तीसगढ़ में सार्वजनिक वितरण प्रणाली एवं खाद्य सुरक्षा	Research Analysis and Evaluation (Peer Reviewed)	ISSN 0975-3486(Print), E-ISSN- 2320-5448	Issue – 102-103 (Combined) ,March -April 2018)
7	मुस्लिम महिला शिक्षा और सशक्तिकरण	Research Analysis and Evaluation (Peer Reviewed)	ISSN 0975-3486(Print), E-ISSN- 2320-5448	Issue – 89-93, June 2017

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मुस्लिम महिलाओं की सामाजिक आर्थिक स्थिति का विश्लेषणात्मक अध्ययन

(दुर्ग एवं भिलाई शहर के मुस्लिम बाहुल्य क्षेत्रों के संदर्भ में)

* शबनम
** के.पद्मावती

सारांश- प्रस्तुत शोध पत्र मुस्लिम जाति की महिलाओं की सामाजिक-आर्थिक स्थिति का विश्लेषण, दुर्ग एवं भिलाई शहर के मुस्लिम बाहुल्य क्षेत्रों के सन्दर्भ मे किया गया है। भारतीय मुस्लिम महिलाओं की सामाजिक-आर्थिक स्थिति का अवलोकन करने से ज्ञात होता है कि प्राचीनकाल से ही मुस्लिम महिलाओं की स्थिति दयनीय है। सदियों से सभ्यता और संस्कृति के नाम पर महिलाओं की इच्छाओं और महत्वाकांक्षाओ को बांधा गया है, इसी वजह से मुस्लिम महिलाओं में शिक्षा का स्तर कम है तथा अधिकतर महिलाएं शिक्षा से वंचित भी रही हैं।

मुख्य शब्द- महिला, स्थिति, सभ्यता, संस्कृति

प्रस्तावना- भारत मे मुस्लिम धर्मावलम्बियों की संख्या लगभग 17 करोड़ 22 लाख़ है जो कि भारत की कुल आबादी का 14.23 प्रतिशत है, जो विश्व का सबसे बड़ा लोकतांत्रिक राष्ट्र है। विश्व के देशो में सबसे ज्यादा मुस्लिम आबादी इण्डोनेशिया में है। इण्डोनेशिया और भारत के अलावा पाकिस्तान, बांग्लादेश, इजिप्ट, नाइजीरिया, ईरान आदि देश मुस्लिम बाहुल्य आबादी वाले देश है।

भारत के राज्यो और केन्द शासित प्रदेशों में सबसे ज्यादा मुस्लिम आबादी का प्रतिशत जम्मू एवं काश्मीर में 68 प्रतिशत और लक्ष्यद्वीप में 96 प्रतिशत है। भारत विश्व का सबसे बड़ा मुस्लिम अल्पसंख्यक आबादी वाला देश है। अल्पसंख्यक मुस्लिम समुदाय की अपनी ही कई समस्याएँ हैं। जैसे आर्थिक रूप से पिछड़े होने के साथ-साथ सामाजिक तथा राजनीतिक रूप से पिछड़ापन भी इस वर्ग मे विद्यमान है, शिक्षा के अभाव के कारण येवर्ग अपनी राष्ट्रीय पहचान को लेकर संघर्षरत् है। आजादी के इतने दशक बीत जाने के बाद भी यह वर्ग राजनीतिक, चिकित्सा तथा शिक्षा आदि क्षेत्रों मे अपर्याप्त प्रतिनिधित्व रखता है इस अल्पसंख्यक समुदाय की महिलाओं की स्थिति अन्य अल्पसंख्यक समुदाय की महिलाओं से निम्न है तथा विचारणीय तथ्य यह है कि इस पर अब तक

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* शोधार्थी, अर्थशास्त्र अध्ययनशाला, प. रविशंकर शुक्ल विश्वविद्यालय, रायपुर (छ.ग.)
** सहायक प्राध्यापक, अर्थशास्त्र विभाग, शासकीय विश्वनाथ तामस्कर स्नातकोत्तर महाविद्यालय, दुर्ग (छ.ग.)

चिन्तन और मनन पूरी तरह से नही हुआ है। मुस्लिम महिलाओं को मुस्लिम समाज ने अनेक अधिकारो से वंचित किया गया है तथा समाजिक, आर्थिक क्षेत्र में भी मुस्लिम महिलाए पिछड़ी है उनकी स्थिति असंतोषजनक है। जिसके वजह से राष्ट्र के अनेक स्थानों पर गंभीर समस्याऐं उत्पन्न हो रही है, जो किसी भी समाज तथा राज्य दोनो के लिए घातक है।

अध्ययन का उद्देश्य-

1. मुस्लिम महिलाओं की सामाजिक स्थिति को ज्ञात करना।
2. मुस्लिम महिलाओं की आर्थिक स्थिति को ज्ञात करना।

अध्ययन पद्धति- प्रस्तावित अध्ययन के लिए दुर्ग एंव भिलाई क्षेत्रों का चुनाव किया गया है।

उत्तरदाताओं का चुनाव- अध्ययन हेतु 110 मुस्लिम महिलाओं का चयन दैव निदर्शन पद्धति से किया गया है तथा अध्ययन के द्वारा उनकी सामाजिक एंव आर्थिक स्थिति का पता लगाया गया है।

तथ्यों का संकलन हेतु प्रयुक्त उपकरण एंव प्रविधि- अध्ययन के लिए तथ्यों का संकलन हेतु साक्षात्कार अनुसूची उपकरण एंव अवलोकन प्रविधि का प्रयोग किया गया है।

प्राप्त तथ्यों का वर्गीकरण, सारणीयन, विश्लेषण एंव प्रस्तुतिकरण-

अध्ययन से प्राप्त तथ्यों का वर्गीकरण सारणीयन, विश्लेषण एंव प्रस्तुतिकरण, किया गया है। उत्तरदाताओं की सामाजिक स्थिति किसी भी व्यक्ति की सामाजिक स्थिति का मूल्यांकन निम्न आधार पर आंका जाता है।

1. **पड़ोसी से संबंध-** वर्तमान स्थिति मे शहरों मे निवासरत् सामाजिक परिवेश मे पडोसियों का अध्ययन अत्यन्त जरूरी है, क्योंकि पड़ोसी ही वह पहला रिश्तेदार होता है। जो व्यक्ति के सुख-दुःख मे सबसे पहले सहभागी होता है। एक पड़ोसी का दूसरे पडोसी से संबंध कैसा है। यह एक-दूसरे के व्यवहार एवं संबंधो पर निर्भर करता है। ऐसा कहा जाता है कि जब जरूरत होती है रिश्तेदार से ज्यादा पड़ोसी पहले काम मे आते है परन्तु इसके लिए जरूरी है कि आपके पड़ोसी अच्छे हो, अध्ययन किये गये समूह मे पड़ोसियों के संबंध को ज्ञात करने का प्रयास किया गया है।
2. **कठिनाइयों मे पड़ोसियों द्वारा मदद-** किसी भी व्यक्ति के लिए उनका परिवार पड़ोसी और उनके मित्रों की बहुत अहमियत होती है। ये सभी कारक व्यक्ति को प्रत्यक्ष व अप्रत्यक्ष रूप से भावनात्मक सहायता प्रदान करती है। इन सभी कारकों के बिना किसी भी व्यक्ति का जीना दूर्भर हो जाता है। पड़ोस या आस-पास रहने वाले लोग एक-दूसरे के सहायक होते है। खुशी का अवसर हो या दुख का अवसर हो पड़ोसी जितने काम आते है उतने दूर रहने वाले रिश्तेदार व सगे-सम्बन्धी नही। हमे पड़ोसीयों के साथ अच्छे व मधुर संबंध व व्यवहार रखना चाहिए तथा आवश्यकता पड़ने पर पड़ोसियो को एक-दूसरे की मदद के लिए हमेशा आगे आना चाहिए। उत्तरदाताओ द्वारा यह जानने का प्रयत्न किया गया है कि कठिनाइयों और परेशानी मे पड़ोसियों द्वारा मदद मिलती है या नही।
3. **सामाजिक कार्यक्रमों में सहभागिता-** हर मनुष्य एक सामाजिक-सांस्कृतिक प्राणी होता है। जन्म से लेकर मृत्यु तक वह समाज मे ही रहता है सामाजिक कार्यक्रम या समारोह के माध्यम से ही हर मनुष्य एक-दूसरे से मिलकर अपनी समस्त आवश्यकताओं को पूरा कर सकता है सामाजिक

कार्यक्रमों के माध्यम से किसी भी स्त्री की मिलनसार प्रवृत्ति तथा उसकी समाजिक स्वतंत्रता को प्रदर्शित करता है। भारतीय महिलाओं की स्थिति एक समान नही रही है, इसमे समय के अनुसार महिलाओं की स्थिति मे भी परिवर्तन हुआ है। समाज मे महिलाओं की स्थिति, सम्मान एवं उनको बराबरी का हक प्राप्त हुआ है। उत्तरदाताओ द्वारा उनकी सामाजिक कार्यक्रमो मे सहभागिता को जानने का प्रयत्न किया गया है।

4. **सामाजिक बैठको में हिस्सा लेना**– सामान्यतः यह देखा गया है कि शहरो में रहने वाली महिलाएं सामाजिक बैठको में पुरूषों के साथ हिस्सा लेकर अपनी सहभागिता दर्ज कराती है तथा सामाजिक निर्णयों पर अपने विचारों को खुलकर भी रखती है इन सभी विचारों पर ही समाज का मुखिया अपने निर्णय पर पहुँच पाता है तथा अपने निर्णय से समाज को प्रभावित कर पाता है। उत्तरदाताओ द्वारा यह जानने का प्रयास किया गया है कि उनकी सामाजिक बैठको मे हिस्सेदारी है या नहीं

5. **शैक्षणिक स्थिति का विश्लेषण**– शिक्षा मानव को एक अच्छा इंसान बनाती है। शिक्षा से उचित आचरण, कौशल, तकनीकी दक्षता, नैतिकता तथा मानसिक रूप से मजबूती प्रदान करती है। शिक्षा प्रत्येक मनुष्य का पहला और सबसे आवश्यक अधिकार है। शिक्षा व्यक्ति के जीवन में एक लक्ष्य निर्धारित करने और आगें बढ़ने के लिए प्रेरित करती है। शिक्षा किसी भी व्यक्ति के ज्ञान, कुशलता, आत्मविश्वास और व्यक्तित्व में सुधार करता है तथा सामाजिक विकास, आर्थिक वृद्धि और तकनीकी उन्नति का रास्ता प्रशस्त करती है।

तथ्यों का विश्लेषण-

तालिका क्रमांक – 1
पड़ोसियो के साथ संबंध का विवरण

क्र.	पड़ोसी से संबंध	आवृत्ति	प्रतिशत
1.	मधुर संबंध	104	94.'55
2.	तनावपूर्ण संबंध	06	5.45
योग		110	100

तालिका क्रमांक – 2
पड़ोसी द्वारा मदद का विवरण

क्र.	पड़ोसी द्वारा मदद	आवृति	प्रतिशत
1.	हॉ	97	88.18
2.	न्ही	13	11.82
योग		110	100

तालिका क्रमांक – 3
सामाजिक बैठको मे हिस्सा लेने के विषय मे विवरण

क्र.	समाजिक बैठको मे हिस्सा लेना	आवृति	प्रतिशत
1.	हॉ	17	15.45
2.	नही	91	84.55
योग		110	100

तलिका क्रमांक– 4
समाजिक कार्यक्रमो मे हिस्सा लेने का स्वरूप का विवरण

क्र.	समाजिक कार्यक्रमों मे हिस्सा लेने का स्वरूप	आवृति	प्रतिशत
1.	अध्यक्ष	2	11.76
2.	आम नागरीक	15	88.24
योग		17	100

तालिका क्रमांक – 5
शिक्षा संबंधी विवरण

क्र.	शिक्षा संबंधी विवरण	आवृति	प्रतिशत
1	शिक्षित	48	43.64
2	अशिक्षित	62	56.36
योग		110	100

तलिका क्रमांक 1 के अध्ययन से स्पष्ट होता है कि उत्तरदाताओं का 94.55 प्रतिशत पड़ोसियो का संबंध अच्छा और मधुर है। तथा 5.45 प्रतिशत उत्तरदाताओ का संबंध पड़ोसियों से तनावपूर्ण है। अतः यह कहा जा सकता है जिन उत्तरदाताओं का अपने पड़ोसियो से झगड़ा हुआ है उन उत्तरदाताओ का पड़ोसियो से संबंध खराब तथा जिन उत्तरदाताओ का संबंध अच्छा है उनका सामाजिक स्थिति अच्छी है

तलिका क्रमांक 2 के अध्ययन से यह स्पष्ट होता है कि 88.18 प्रतिशत उत्तरदाताओ का पड़ोसियो द्वारा कठिनाइयो मे मदद प्राप्त होती है तथा 11.82 प्रतिशत उत्तरदाताओ को जिनकी पड़ोसियो से किसी भी बात पर तनाव है या किसी भी प्रकार से मदद प्राप्त नही होती है।

तलिका क्रमांक 3 के अध्ययन से यह स्पष्ट होता है कि सामाजिक बैठको में हिस्सा लेने से संबंधित अधिकतर 84.55 प्रतिशत उत्तरदाता सामाजिक बैठको मे हिस्सा नही लेती तथा 15.45 प्रतिशत उत्तरदाता सामाजिक बैठको में हिस्सा लेती है। अर्थात् अधिकतम मुस्लिम महिलाए सामाजिक बैठको में हिस्सा नहीं लेती है जिससे उनके समाज मे होने वाले किसी भी गतिविधियों अथवा सामाजिक व सरकारी योजनाओं का भी फायदा नही ले पाती है।

तालिका क्रमांक 4 के अध्ययन के अनुसार यह स्पष्ट है की 11.76 प्रतिशत मुस्लिम महिलाए सामाजिक कार्यक्रमें मे अध्यक्ष पद के रूप मे हिस्सा लेती है तथा अधिकतम 88.24 प्रतिशत मुस्लिम महिलाएं सामाजिक कार्यक्रमों मे आम नागरीक के रूप मे हिस्सा ली है। अतः यह कहा जा सकता है की मुस्लिम महिलाएं चार दिवारी से बाहर निकलकर सामाजिक कार्यक्रमों मे आम नागरिक के रूप मे हिस्सा ले रही है।

तालिका क्रमांक 5 के अध्ययन के अनुसार यह स्पष्ट होता है की 56.36 प्रतिशत अधिकतम मुस्लिम महिलाएं अशिक्षित है तथा 43.63 प्रतिशत मुस्लिम महिलाएं ही शिक्षित है। अर्थात अधिकतम मुस्लिम महिलाएं अशिक्षित है जिससे वे सामाजिक व आर्थिक दोनो रूप से पिछड़ी हुई है। अशिक्षा ही उनके सोचने समझने व आगे बढ़ने से रोकती है।

उत्तरदाताओं की आर्थिक स्थिति का विवरण– आर्थिक स्थिति का

मूल्यांकन निम्न आधारों पर किया जा सकता है।

1. **मकान**– किसी भी मकान का मुख्यतः दो प्रकार के हो सकते है। पहला किराये का और दूसरा स्वयं का मकान। आवास एक मनुष्य की मौलिक आवश्यकताओं मे से एक है जिसका प्रभाव स्वास्थ्य, शांति कुशलता तथा जीवन के सभी प्रहलुओं पर पड़ता है।

2. **मकान का स्वरूप**– मुस्लिम बाहुल्य क्षेत्रों मे घनत्व तथा स्थानात्मक भिन्नता है। प्रत्येक मनुष्य अपनी आय तथा आवश्यकता के आधार पर है इसलिए उनके मकान के स्वरूप की जानाकरी ली गई है।

3. **आय का स्त्रोत**– महिलाओं में आर्थिक आत्मनिर्भरता स्वंतत्रता समानता ही यह निर्धारित करती है किवह कितने सशक्त है जब परिवार व समाज की सहयोग तथा असहयोग की स्थिति में होते है। ऐसे समय मे मुस्लिम महिलाए को चाहिए की अपनी अस्मिता एंव स्वयत्तता की रक्षा कर सके तथा कार्यशील होना भी स्वालम्बन की एक दिशा है। उत्तरदाताओ की आर्थिक स्थिति ज्ञात करने के लिए निम्नलिखित तालिका प्रस्तुत किया गया है।

तालिका क्रमांक 6
उत्तरदाताओं का मकान का विवरण

क्र.	उत्तरदाताओ का मकान	आवृत्ति	प्रतिशत
1.	स्वयं का मकान	47	42.73
2.	किराये का मकान	63	57.27
	योग	110	100

तालिका क्रमांक 7
उत्तरदाताओं के मकान का स्वरूप का विवरण

क्र.	उत्तरदाताओं के मकान का स्वरूप	आवृत्ति	प्रतिशत
1.	कच्चा मकान	67	60.91
2.	पक्का मकान	12	10.91
3.	अर्धपक्का मकान	31	28.18
	योग	110	100

तालिका क्रमांक 8
उत्तरदाताओं के कार्य संबधी विवरण

क्र.	कार्य संबंधी विवरण	आवृत्ति	प्रतिशत
1.	कार्यरत्	52	47.27
2.	अकार्यरत्	58	52.73
योग		110	100

तालिका क्रमांक 9
कार्य का स्वरूप/आय का स्त्रोत संबंधी विवरण

क्र.	कार्य का स्वरूप/आय का स्त्रोत	आवृत्ति	प्रतिशत
1.	सिलाई कढ़ाई	24	46.15
2.	काम वाली बाई	15	28.85
3.	नौकरी	2	3.85
4.	व्यवसाय	4	7.69
5.	मजदूरी	7	13.46
	योग	52	100

प्रस्तुत की गई तालिका क्रमांक 6 के अध्ययन से उत्तरदाताओ के आवास सम्बंधी

जानकारी प्राप्त की गई है कुल उत्तरदाताओ के अध्ययन से यह पाया गया है कि 57.27 प्रतिशत किराये के आवास मे निवासरत् है तथा 42.73 प्रतिशत उत्तरदाताओ के पास आज भी उनका स्वमं का मकान नही है। जो उनके कमजोर आर्थिक स्थिति को बताता है।

तालिका क्रमांक 7 के अध्ययनगत समूह के सभी उत्तरदाताओ के मकान के स्वरूप का विश्लेषण करने पर ज्ञात होता है कि अधिकांश 60.91 प्रतिशत उत्तरदाता कच्चे मकानो मे निवासरत है तथा 28.18 प्रतिशत उत्तरदाता अधपक्के मकानो मे निवासरत् है तथा 10.91 प्रतिशत ही उत्तरदाताओ के पास पक्के मकान की सुविधा है। अर्थात् मुस्लिम महिलाओ के पास निवास के लिए पक्के मकान की उपलब्धता भी नही है जो उनको आर्थिक रूप से कमजोर करती है। अत: कहा जा सकता है कि आर्थिक स्थिति ठीक न होने के कारण अधिकांश कच्चे आवासो मे निवासरत है।

तालिका क्रमांक 8 के अनुसार यह स्पष्ट होता है कि अध्ययनगत समुह की अधिकांश महिलाएं अकार्यश्त् है अर्थात 52.73 प्रतिशत महिला उत्तरदाता कार्यरत है अत: यह कहा जा सकता है कि इस समुह मे बेरोजगारी विद्यमान है जो उनकी आर्थिक स्थिति के लिए धातक है।

तालिका क्रमांक 9 से स्पष्ट होता की मुस्लिम महिला उत्तरदाता जो कार्यरत् है उनकी कार्य की प्रकृति किस प्रकार की है। तालिका से स्पष्ट होता है 46.15 प्रतिशत उत्तरदाता धर बैठे कार्य करती है। 28.85 प्रतिशत उत्तरदाता दूसरो के घरो मे काम करती अर्थात् कामवाली बाई के रूप मे कार्यरत है, जो उनके कमजोर आर्थिक स्थिति की जानकारी देता है। 3.85 प्रतिशत नौकरी, 7.69 प्रतिशत व्यवसाय तथा 13.46 प्रतिशत मजदूर अर्थात् अधिकतर महिलाओ का आय का स्त्रोत उनका धर बैठे काम जैसे सिलाई, कढाई का कार्य करके अपना जीवनयापन करती है अत: यह कहा जा सकता है कि मुस्लिम महिलाएं आर्थिक रूप से कमजोर है।

निष्कर्ष–

दुर्ग-भिलाई शहर के मुस्लिम बाहुल्य क्षेत्रों मे इन महिलाओं की सामाजिक-आर्थिक स्थिति अच्छी नहीं पाई गई। शिक्षा के स्तर में कमी इसका एक प्रमुख कारण रहा। मुस्लिम समाज की संस्कृति एवं सभ्यता उन्हे समाज में आगे आने से रोकती है। इन महिलाओं को समाज मे अनेक अधिकारों से वंचित रखा गया जिसकी वजह से इन महिलाओं में असंतोष की भावना है तथा शिक्षा की कमी ने आगे बढ़ने की इच्छा खत्म कर रही है। जो कि समाज व राष्ट्र दोनो के लिए सही नही है।

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महिलाओं के विकास में महिला एवं बाल विकास विभाग की प्रमुख योजनाओं के उपलब्धियों का अध्ययन

(छत्तीसगढ़ धमतरी जिले के कुरूद ब्लॉक के विशेष संदर्भ में)

* वेणु साहू
** के. पद्मावती

सारांश- *प्रस्तुत शोध-पत्र में छत्तीसगढ़ के धमतरी जिले के कुरूद ब्लॉक के अंतर्गत महिला एवं बाल विकास विभाग द्वारा चलाई जा रही विभिन्न योजनाओं का अध्ययन किया गया है, जिसके अंतर्गत वर्तमान में यह योजनाएँ चलायी जा रही है - (1) पूरक पोषण आहार योजना, (2) महतारी जतन योजना, (3) बाल संदर्भ योजना,(4) मुख्यमंत्री कन्यादान योजना, (5) अमृत दुग्ध योजना, (6) किशोरी शक्ति योजना, (7) प्रधानमंत्री मातृ वंदना योजना, (8) सुकन्या समृद्धि योजना, (9) गैर सबला योजना, (10) दत्तक पुत्री योजना, (11) स्वाधार योजना, (12) उज्ज्वला योजना, (13) प्रधानमंत्री स्वच्छ भारत योजना। इन योजनाओं से कुरूद ब्लॉक प्रभावित हो रहा है या नही यह ज्ञात करने के लिये अध्ययन क्षेत्र के रूप में चुना गया है। महिला एवं बाल विकास विभाग द्वारा चलायी जा रही योजनाओं के अंतर्गत महिलाओं की आर्थिक, सामाजिक स्थिति में वृद्धि हुई है एवं बच्चों के कुपोषण स्तर में कमी आयी है।*

मुख्य शब्द- पोषण, आहार, किशोरी, दत्तक

प्रस्तावना:- मानव संसाधन विकास मंत्रालय (भारत सरकार) के अंतर्गत महिला एवं बाल विकास विभाग की स्थापना सन् 1985 में हुई है, भारतवर्ष में महिलाओं से संबंधित 27 से अधिक योजनाएँ चलायी जा रही है। इसका मुख्य उद्देश्य महिलाओं एवं बच्चो के समग्र विकास को बढ़ावा देना है। महिलाओं के विकास का अर्थ महिलाओं का सम्पूर्ण विकास करना अर्थात् शारीरिक, मानसिक, आर्थिक, सामाजिक एवं सांस्कृतिक कार्यक्रमों में महिलाओं की भागीदारी को सुदृढ़ करना है। बौद्धिक विकास तथा स्वास्थ्य से जुड़ी समस्याओं का निवारण करना तथा सम्पूर्ण पोषण आहार देकर कुपोषित एवं एनीमिया से बचाना, जिससे की देश में सशक्त और स्वस्थ्य महिलाएँ तथा बच्चे जो राष्ट्र निर्माण के विकास में सहयोग प्रदान करें।

आर्थिक गतिविधियों में मुख्य कामगारों के रूप में एक बड़ी संख्या महिला कामगारों की है, ग्रामीण महिलाओं में कार्यभागीदारिता की दर 18.40 प्रतिशत, वही

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* शोधार्थी (पी.एच.डी.) अर्थशास्त्र शासकीय वि.या.ता.स्व.स्नातकोत्तर महाविद्यालय दुर्ग, छ.ग.
** सहायक प्राध्यापक अर्थशास्त्र शासकीय वि.या.ता.स्व.स्नातकोत्तर महाविद्यालय दुर्ग, छ.ग.

शहरी महिलाओं की दर 8.6 प्रतिशत है। फिर भी महिलाओं के कार्यों को कोई महत्व नही दिया जाता है और न ही राष्ट्र के आर्थिक विकास में भी गिना जाता है।

बच्चों के समग्र विकास के लिए महिला एवं बाल विकास विभाग द्वारा समेकित बाल विकास सेवाओं (ICDS) का क्रियांवयन किया जाता है, जिसके अंतर्गत पूरक पोषण, टीकाकरण, स्वास्थ्य जांच और रेफरल सेवाएँ, स्कूल जाने से पहले अनौपचारिक शिक्षा भी दी जाती है। महिला एवं बाल विकास के अंतर्गत आंगनबाड़ियों से यह ज्ञात हुआ है कि आंगनबाड़ी में पढ़ने वाले बच्चों की देखरेख आंगनबाड़ी कार्यकर्ता एवं आंगनबाड़ी सहायिका के द्वारा किया जाता है। बच्चो का शारीरिक, मानसिक एवं बौद्धिक विकास का दायित्व इन्ही के ऊपर रहता है साथ ही शिशुवती महिलाएँ, गर्भवती महिलाएँ एवं किशोरी बालिकाओं के लिए ताजा गर्म भोजन आंगनबाड़ियों में उपलब्ध रहता है। जिसके अंतर्गत चावल, मिक्स दाल, हरी सब्जी, आचार, पापड़, फोर्टिफाइल तेल, सलाद, दो रोटी, गुड़ एवं रेडी टू ईट फूड (सम्पूर्ण पोषण आहार) हितग्राहियों को ताजा गर्म पका हुआ भोजन प्रत्येक दिन दिया जाता है तथा रेडी टू ईट फूड प्रत्येक सप्ताह में मंगलवार को दिया जाता है। हितग्राहियों के पोषण आहार को ध्यान में रखते हुए महिला एवं बाल विकास विभाग में अधिकारी एवं सुपरवाईजर द्वारा समय-समय पर निरीक्षण किया जाता है।

कुरूद ब्लॉक के अंतर्गत रेडी टू ईट फूड बनाने के लिए महिला समूह संगठन को सौंपा गया है, जिससे की महिलाओं को रोजगार मिला है और उसकी आर्थिक स्थिति में सुधार आया है। महिलाओं को जो राशि मिलती है, उससे बचत करके अपने घर की खर्चे तथा छोटे-छोटे कुटीर एवं लघु उद्योग भी चला रही हैं। जिसके अंतर्गत रेडी टू ईट फूड, फल दुकान, सब्जी उत्पादन, कृषि कार्य, पशुपालन, मत्स्य पालन, फूलों की खेती, वाशिंग पाउडर, साबून, फिनाइल, सेनेटरी नेपकीन एवं अन्य व्यवसाय कर रही है।

महिला एवं बाल विकास विभाग योजना महिलाओं एवं बच्चो का सम्पूर्ण विकास का क्रियांवयन करना है तथा येाजनाओं के बारे में जानकारी देना एवं योजनाओं का लाभ दिलाना इनका मुख्य उद्देश्य रहा है।

शोध साहित्य का पुनरावलोकन-

किसी भी अध्ययन के पूर्व किए गए शोध साहित्य अत्यंत उपयोगी होता है, अध्ययन से प्राप्त निष्कर्ष शोध कार्य के लिए अत्यंत ही उपयोगी होता है -

(1) कहोल उषा, जैन कामिनी, शांडिल्य दुर्गेश (2009) ''महिला विकास और सरकारी प्रयास''- इसमे महिलाओं की शिक्षा को विशेष रूप से ध्यान मे रखकर महिलाओं की विकास के बारे में बताया गया है। सुदृढ़ महिलाएँ ही अपने परिवार एवं समाज को विकास की ओर ले जा सकती है। सरकार द्वारा चलाये जा रहे योजनाओं के अंतर्गत महिलाएँ अपनी आर्थिक स्थिति सुधार सकती है। पिछले कुछ दशकों के अंतर्गत महिलाओं की स्थिति अत्यन्त ही दयनीय थी, जो कि अब कुछ हद तक महिलाओं की स्थिति में सुधार आयी है, ग्रामीण क्षेत्रों मे अभी महिलाओं की शिक्षा का स्तर निम्न है। जबकि शहरी क्षेत्रों में महिला साक्षरता दर में वृद्धि हुई है। मध्यप्रदेश मे महिला साक्षरता दर को बढ़ाने के लिए सरकार द्वारा कुछ योजनाएँ चलायी जा रही है, जो लाड़ली लक्ष्मी योजना, विक्रमादित्य छात्रवृत्ति प्रदान, गणवेश एवं पाठ्य- पुस्तक योजना, राज-राजेश्वरी,

राष्ट्रीय मातृत्व योजना है, इसके अलावा जननी सुरक्षा योजना, लाभ योजना, किशोरी बालिका योजना यह सरकार द्वारा महिलाओं को आर्थिक रूप से सक्षम बनाने के लिए चलायी जा रही है तथा महिलाओं को रोजगार के अवसर उपलब्ध कराकर आर्थिक रूप से स्वावलंबी बनाने के उद्देश्य से चलायी जाती है यह इसका निष्कर्ष है।

(2) चौधरी आशा (2013) ''निम्न वर्ग के सामान्य एवं एकीकृत बाल विकास योजना से पोषित 3 से 5 वर्ष के बच्चों के पोषण स्तर का तुलनात्मक अध्ययन ''- इसमें भारतीय बच्चों की पोषण आहार के बारे में बताया गया है, कि 1-3 वर्ष तथा 3-5 वर्ष तक के बच्चों के शारीरिक विकास के लिए कितना पोषण आहार देना चाहिए एवं कुपोषण से बचाया जा सके।

एकीकृत बाल विकास सेवा योजना द्वारा 6 वर्ष तक की आयु के बच्चों, गर्भवती एवं स्तनपान करवाने वाली माताओं को एक सम्पूरक पोषण सेवा दी जाती है, जिसके अन्तर्गत 6 वर्ष से कम आयु के बच्चों को 30 कैलोरी एवं 10 ग्राम प्रोटीन वाला आहार देना एवं अत्यधिक कुपोषित बच्चों को 600 कैलोरी एवं 20 ग्राम प्रोटीन वाला आहार देने की व्यवस्था रहती है। इसके अलावा शारीरिक विकास होते जाता है, वैसे ही पोषण स्तर को बढ़ा दिया जाता है, प्रोटीन, कैलोरी, विटामिन एवं कैल्शियम के साथ बाल विकास एकीकृत द्वारा अन्य योजनाओं से भी बच्चों को लाभान्वित किया जाता है तथा निष्कर्ष रूप में यह होगा कि एकीकृत बाल विकास योजनाओं का लाभ बच्चों को अधिक लाभ प्राप्त होगा एवं समान्य बच्चों को पोषण आहार का लाभ अधिक मिल सकेगा।

(3) सरवटे नंदिनी तोमर संगीता (2013) '' गर्भवती महिला का आहार- एक अध्ययन ''- सरवटे एवं तोमर ने माँ के गर्भ मे भ्रूण की विकास के बारे मे तथा आहार, पोषक, विटामिन कितनी मात्रा मे गर्भवती माता को लेना विशेष जोर दिया गया है। गर्भवती स्त्रियाँ अपने आहार के प्रति जागरूक हो तथा कुपोषण के कारण देश मे मृत्यु-दर तथा बाल मृत्यु तक की संख्या अधिक होता है। इस पर रोक लगाया जा सके।

अध्ययन का उद्देश्य-

(1) न्यादर्श परिवार की आर्थिक एवं सामाजिक संरचना का अध्ययन करना।

(2) छत्तीसगढ़ शासन की महिला एवं बाल विकास विभाग की प्रमुख योजनाओं का अध्ययन करना।

(3) महिला एवं बाल विकास की प्रमुख योजनाओं को जानना एवं विश्लेषण कर सुझाव प्रदान करना।

अध्ययन का क्षेत्र-

प्रस्तुत शोध का अध्ययन क्षेत्र धमतरी जिले के कुरूद ब्लॉक को लिया गया है। जिनके अंतर्गत ब्लॉक के चारों दिशाओं को न्यादर्श के रूप में दूरस्थ एवं निकटतम ग्राम के अतंर्गत 20 ग्राम पंचायतों एवं संलग्न गाँवों से 375 परिवारों का चयन करके शोध कार्य के रूप में चुना गया है। कुरूद ब्लॉक की भौगोलिक स्थिति 20^0-49-58'' उत्तरी अक्षांश से 81^0-42-57'' पूर्व देशांश तक है। भौगोलिक क्षेत्रफल 592S42 वर्ग कि. मी. तक फैला हुआ है। कुल जनसंख्या 2001 में 296137 तथा 2011 में कुल जनसंख्या 219013 है। कुरूद ब्लॉक में कुल आंगनबाड़ियों की संख्या 273 तथा

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A Description of Public Expenditure on Agriculture and Output Growth

* Rishi Kant Chaudhary
** K. Padmawati

Abstract- *Agriculture generates only 18 percent of the gross domestic product but sustains 600 million people almost half of India's population. Nearly 69%, or 833 million Indians, most of them poor live in rural areas. These numbers highlight the importance of this sector in terms of policymaking and expenditure decision. since the first five-year plan agricultural sector had to rely heavily on government finance. last few years economist questioning the government weak budget push to the rural sector and persistence agricultural crisis demonstrate the poor performance of the government to handle the crisis. This paper looks at the trend of government expenditure on agriculture in five years between the period 2014-15 to 2018-19. Paper also examines the pattern of agricultural output growth in the same period.*

Key Words- Agriculture, Expenditure, Agricultural output.

Introduction:

In most developing economies agriculture is the core sector, provide the livelihood of a significant proportion of the population. Recent years the agrarian crisis deepens and government fails to address the problem of farmers. Identifying the root-causes of farmers distress is challenging for policymakers. Chand et al (2015), who suggests that "growth in farm income after 2011–12 has plummeted to around 1%, and this is an important reason for the sudden rise in agrarian distress inrecent years." The income of farmers directly associated with the price of their output, in India and minimum support price (MSP) remained very controversial in the last many years and one can say its affected the level of income of farmers.

In contemporary literature, growing agriculture and allied sector help the overall growth of the economy and poverty alleviation in developing economies. However, due to inadequate attention and budgetary support is given to the agricultural sector, this sector has been underproductive and unviable as an occupation of millions of people. In India, the per capita gross domestic product

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(GDP) of workers in agriculture comprises only about one-fifth of those in the non-agricultural occupation and it continues declining (Bhalla, 2007). Since 2004-05, the agriculture is seen improvised but much of recent growth has been spurred by price growth rather than productivity induced (Chand and Shinoj 2012, Birthal et al 2014).

Now the primary problems as we saw in our agriculture sector is the productivity and level of income of farmers. For enhancing productivity in agriculture much research suggested an increase in investment in infrastructure needed. Enhance investment in the rural public good help agriculture growth and output productivity. In agriculture, expenditure on infrastructure and R&D is the most desirable way to increasing firm productivity (Fan et al. 2007). In this paper, we examine the trend of public expenditure on the agricultural sector.

Fiscal Situation and GDP growth in recent years

Farm distress increasing in recent years very rapid manner and before going to examine the pattern of expenditure on this sector we first look at the indicators of fiscal movement and performance of our overall GDP numbers.

Table-1

Year / Indicators	2014-15*	2015-16*	2016-17*	2017-18*	2018-19**	2019-20***
Revenue Receipts	1101472	1195025	1374203	1435233	1729682	1962761
Capital Receipts	562201	595748	600991	706740	727553	823588
Fiscal deficit	510725 (4.1)	532791 (3.9)	535618 (3.5)	591062 (3.5)	634398 (3.4)	703760 (3.3)

Source- Union Budget of India (Various years)

Figures in crore
Revenue receipts -Tax revenue (Net to centre) + Non tax revenue
Capital receipts - Recovery of loans + Other receipts + Borrowing and other liabilities
* Actual
**Revised estimate
***Budget estimate

In 2014-15, the total revenue receipt of the government of India was 11.01 lakh crore and its reached the 17.29 lakh crore in 2018-19, the total increase is revenue receipts is 57.08% in five years. On another side, the government slightly reduced the fiscal deficit year over year but at the time of distress rural economy, the policy of reducing fiscal deficit raise the question against the macroeconomic policy of the government. The Fiscal Responsibility and Budget Management (FRBM) Act was enacted in 2003 which set targets for the government to reduce fiscal deficits. In May 2016, the government set up a committee under NK Singh to review the FRBM Act,the committee recommended that the government should target a fiscal deficit of 3 percent of the GDP in years up to March 31, 2020, cut it to 2.8 percent in 2020-21 and to 2.5 percent by 2023. In Budget 2017, Finance Minister Arun Jaitley deferred the fiscal deficit target of 3% of the GDP and chose a target of 3.2%, citing the NK Singh committee report.

Now on GDP number, after demonetization and tax reform, the growth rate declined in the last two years. Recently CSO published the 2019-20 first-quarter GDP data and its growth rate is 5%. The GDP performance reveals the slowdown in our economy and if the government will not manage the next upcoming quarter's performance then India will be trapped in a severe economic crisis.

Table-2

Year / Indicators	2014-15	2015-16	2016-17	2017-18	2018-19*
GDP (at constant market price)	10536984	11381002	12298327	13179857	14077586
GDP Growth Rate	7.5%	8.0%	8.2%	7.2%	6.8%
Food Grain Production (Million tonnes)	252.0	251.6	275.1	285.0	283.4**

Source- CSO

*Provisional estimate

**Third advanced estimate

At the same five-year period, the production of the food grain increased in a very inconsistent manner. Last year from 2017-18 to 2018-19 the production of food grain grows negatively, although India's farms are producing enough food grain for its people. India produced 252 million tonnes by 2015-'16, and by 2017-'18, food grain output is likely to reach 285 million tonnes, according to the fourth advance estimates of crop production, released in August 2018. India's food grain requirement for 2025 should be 300 million tonnes according to a March 2017 report from Delhi-headquartered think tank PRS Legislative Research.

Despite these high levels of production, agricultural yield – the quantity of a crop produced on a unit of land – in India is lower than many other countries. India is the second-largest producer of paddy in the world after China, but even though India's paddy yield increased 2.5 times over 56 years to 2017, its yield (3.8 tonnes/ha) was almost 18% lower than China's in 2017. Brazil (6.2 tonnes/ha) and the USA (8.4 tonnes/ha) too had higher yields.

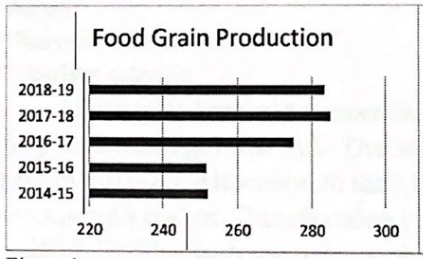


Figure 1.

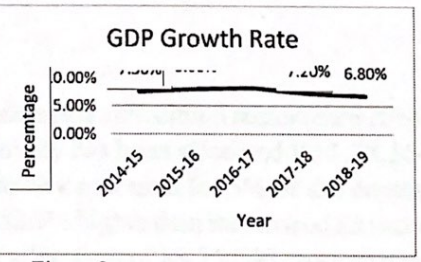


Figure 2.

Trends of public expenditure on agriculture

For many developing countries, agriculture is the largest sector in terms of its sharein GDP and employment. In India, it is the largest sector which

provided a livelihood to the people. More importantly, the majority of the world's poor live inrural areas and depend upon agriculture for their livelihood. Agriculture is thereforecritical both for economic development and poverty reduction. It follows that indeveloping countries spending on agriculture is one of the most important governmentinstruments for promoting economic growth and alleviating poverty in rural areas(Fan and Saurkar, 2006).There have been many studies of the relationship between government expenditureand economic growth. Some of these studies have looked specifically at the linkbetween government spending and agricultural growth and poverty reduction (Elias1985; Fan, Hazell, and Thorat 2000). These studies show positive growth and poverty reductioneffects from public spending in agriculture. Yet, in the majority of developing countries aid andpublic expenditure to agriculture is stagnant or declining. To study the expenditure pattern onagriculture we split the expenditure into three departments, one is the expenditure on thedepartment of agriculture, cooperation and farmers welfare and second is the department ofagricultural research and education and third is a department of Animal Husbandry, Dairying,and Fisheries.It is worthy to note that till July 2019 Department of Animal Husbandry,Dairying and Fisheries comes under The Ministry of Agriculture and Farmers but is now created as a new department and renamed as a Department of Animal Husbandry, Dairying & Fisheries (DADF) the area comes under the department of agriculture & farmers welfare.Agriculture is a state subject and the Union Budget allocation under the Ministry is largely focused on subsidies and transfers to states for centrally sponsored schemes.

Table-3. Allocation across department (Rs. In crore)

Year / Department	2014-15*	2015-16*	2016-17*	2017-18*	2018-19**	2019-20***
Agriculture & Co-operation	19255.10	15296.04	36912.48	37396.72	67800	130485.21
Agricultural Research and Education	4840.01	5386.26	5792.25	6942.92	7952.73	8078.76
Animal Husbandry, Dairying, and Fisheries	1822.10	1410.12	1857.98	2022.10	3273.01	3737
Total	25,917.21	22,092.42	44562.71	46,361.74	79025.74	1,42,300.97

Source: Expenditure Budget, Union Budget of India (Various years)

* Actual

**Revised estimate

***Budget estimate

Above table detailed the expenditure on the agricultural sector since 2014-15 by the central government. The Ministry has been allocated Rs 1,38,564 crore in 2019-20. Allocation to the Ministry accounts for 5% of the central government's budget. This allocation is 82.9% higher than the revised estimate for 2018-19. This increase is due to the allocation of Rs 75,000 crore to PM-KISAN (income support scheme for farmers), which was announced in the 2019-20 interim budget. The scheme (being implemented from December 2018) also received an allocation of Rs 20,000 crore for the year 2018-19. In this case, if we compare the growth in agriculture expenditure on the last five years

then we have seen a high jump due to PM-KISAN scheme. The allocation of agricultural research and education in 2015-16 government reduced the amount compared to the preceding year. although budget allocation agriculture research and education from 2014-15 to 2019-20 its show 66.91% jump and numbers look quite impressive but expert say that Agricultural R&D is the main source of innovation, which is needed to sustain agricultural productivity growth in the long-term and more R&D needed. Expenditure on Animal Husbandry, Dairying, and Fisheries was frozen from 2014-15 to 2016-17 and the percentage increase was only 1.96% during this period but in 2018-19 government pushed the expenditure and expenditure has increased from Rs. 1822.10 crore in 2014-15 to Rs.3737 (BE) crore during 2019-20.

Table-4. Growth rate of Expenditure on agriculture

Year/ Department	2015-16	2016-17	2017-18	2018-19	2019-20
Agriculture &Cooperation	-20.56%	141.32%	1.31%	81.30%	92.46%
Agriculture Research & Education	11.29%	7.54%	19.87%	14.54%	1.58%
Animal Husbandry, Dairying & Fisheries	-22.61	31.76%	8.83%	61.86%	14.18
Total Expenditure on agriculture	14.76	101.76	4.04	70.45	80.07

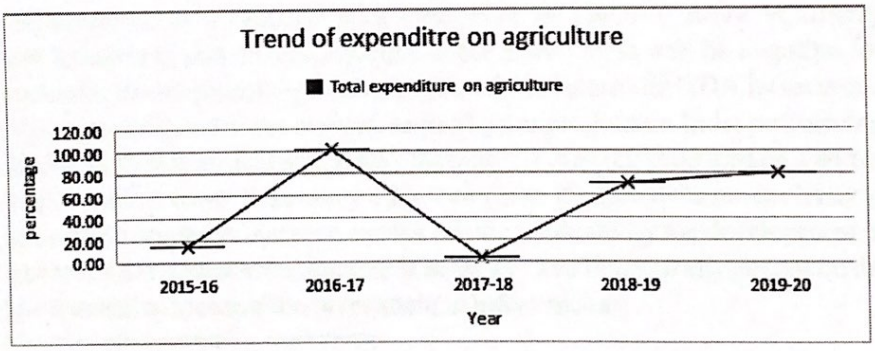


Figure 3.

Growth of GVA in agriculture and allied sector

The agriculture sector in India typically goes through cyclical movement in terms of its growth. The Gross Value Added (GVA) in agriculture improved from a negative 0.2 percent in 2014-15 to 6.3 percent in 2016-17 only to decelerate to 2.9 percent in 2018-19. While the crops, livestock and forestry sector showed fluctuating growth rates over the period from 2014-15 to 2017-18, the fisheries sector has shown rapid growth from 4.9 percent in 2012-13 to 11.9 percent in 2017-18.

Table 5

Growth of GVA in Agriculture & Allied Sectors at 2011-12 prices

Item	2014-15	2015-16*	2016-17**	2017-18***	2018-19****
Agriculture & Allied Sectors	7.2	8.0	7.9	6.9	6.6

Source: Central Statistics Office, Ministry of Statistics & Programme Implementation (MoSPI)

Note-* Third Revised Estimate, **Second Revised Estimate, *** First Revised Estimate ****As per the press note on Provisional Estimates of Annual National Income 2018-19 and Quarterly Estimates of Gross Domestic Product for the Fourth Quarter (Q4) of 2018-19 released by CSO on 31st May 2019

Conclusion:

In this paper, we study the trends of Central government budget numbers and its allocation on agriculture & allied sector, we also study the GVA growth of agriculture and allied sector and food grain production in India last five years. The main problem with the current economic scenario of India is falling overall GDP numbers, for this government needs to take big reforms to stabilize the GDP growth. Second, the fiscal policy of the Indian government looks very rigid in reaching the FRBM act target, the current situation required to increase the expenditure and loosen up the fiscal deficit target. Allocation to agriculture is seemed very inconsistent in staring years of NDA government but later its increase the amount allocated significantly, the jump in allocation due to PM-KISAN Scheme. The scheme is followed the principle of basic income by nature but many studiesfound that the concept of basic income is effective for poverty elimination but we must make sure that the guaranteed income should be implemented in a rational way otherwise its leads to more voluntary unemployment and its consequence at the macro level will be negative for economic development.Agriculture research is neglectedin NDA Ist term and must be prioritized in the budget. In food grain production India performing satisfactorily but, agricultural yield – the quantity of a crop produced on a unit of land in India is lower than many other countries. It's meant the productivity in agriculture needed to increase and for raising productivity the development of agricultural and rural infrastructure is necessary and finally,it all depends on the government to increase the investment in infrastructure.

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An Economic Analysis of Recent Trend of India's GDP

-Dr. Anshumala Chandangar

Assistant Professor

Department of Economics, Govt. V.Y.T. PG Autonomous College, Durg (Chhattisgarh)

ABSTRACT :-

India's GDP was growing very fast after 2004-05, with its annual growth rate touching 9 percent until the global crisis of 2008,which also affected the Indian economy but the effect was very mild, reason being firstly, we have largeclosed and domestic markets and secondly because of strict financial regulations, but the year 2020 saw once in a century crisis, in the year 2020 there was a choice between lives and livelihoods and gave an economic shock that has triggered both supply and demand side shopping India and across the world. This paper attempts to analyse the trend of economic growth of the GDP(at 2011-12 prices) of India and its three sectors.The growth rate of GDP at 2011-12 prices have shown a decreasing trend since 2016-17. The financial year 2020-21 witnessed an unprecedented fall in the growth rate of GDP by -7.7 % due to outbreak of pandemic, covid-19. The Gross Value Added at constant prices for 20-21 has been estimated to be -7.2 percent. The per capita income at 2011-12 prices have also shown a negative estimated growth of -8.2 percent in the year 2020-21. The present study also aims at analysing and comparing the data in regard to the contribution of three sectors in the overall GDP of India during the period 2011-12 to 2020-21. The service sector being the driver of the economy has been hit badly due to the pandemic. The study also tries to analyse the components of GDP like Gross Fixed Capital Formation (GFCF), Private Final Consumption Expenditure (PFCE), Govt. Final Consumption Expenditure (CFCE), Gross Domestic Savings etc.

Keywords: Economic Growth, Components of GDP, covid-19, trend of GDP, per capita Income.

1.1 INTRODUCTION

The year 2020 was the year of economic shock not only for India but for the whole world. A

GEOGRAPHICAL SUBCONSCIOUSNESS
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Dedicated to...

My Lovey Son



"Arnik"

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models of climate change impacts on health can provide useful insights into these interactions between non-climate factors and climate change effects.

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7

Climate Change and Its Impact on Human Health

Dr. Anshumala Chandangar

Abstract:

Climate change has adverse impacts on human health and it is the most challenging issue for the entire world at present. The climate change impacts our health by affecting our food, water, air we breathe, weather etc. With climate change, the frequency, severity, duration and location of weather and climate phenomena – like rising temperatures, heavy rain and drought, and other kinds of severe weather are changing and more people are exposed to these conditions. U.S. Global Change Research Program Report, 2016). The climate change result in regional weather changes, heat waves, extreme weather, temperature rise, and precipitation gives rise to different health effects like asthma and respiratory problems, cardiovascular diseases, water-borne diseases, vector-borne diseases, mental illness, etc. Climate change has a number of short-term and long-term impacts on human health. The Report Assessment of Climate Change over the Indian region forecast that unless robust steps are taken, between

Dr. Anshumala Chandangar: Assistant Professor, Dept. of Economics, Govt. V.Y.T. PG Autonomous College, Durg (Chhattisgarh) India.

2070 and 2099 average temperatures in India will rise by approximately 4.4 degrees Celsius relative to the recent past (Gupta. J, 2020). According to the IPCC, Third Assessment Report people of almost all the continents of the world are suffering due to climate-sensitive diseases like malaria, cholera, thermal stress, air pollution-related illness, the direct effect of heat is an important health issue in many continents. Australia and New Zealand are hit mostly by heat waves and also by tropical cyclones and floods, in European countries the people suffer from thermal stress, vector and food borne diseases, and water-related diseases.

Keywords: Climate change, Human health, Temperature, Precipitation, Climate sensitive diseases.

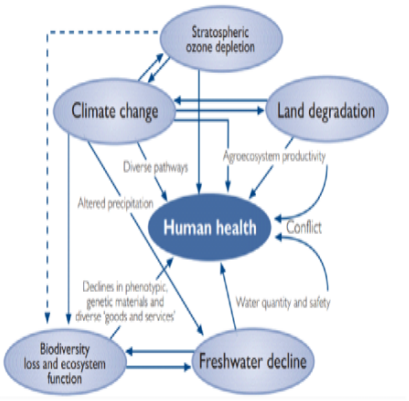
Introduction:

Climate change is the most challenging issue at present, climate change affects the social and environmental dimensions of health and it is a threat to human health worldwide.

The increase in the greenhouse gases in the last few decades has increased the temperature of the earth resulting in the melting of glaciers, increase in sea levels, extreme change in the weather, and most importantly it has affected our food, water, and air that we intake giving rise to major health issues. According to NOAA's 2020 AnnualClimate Report the combined land and ocean temperature has increased at an average rate of 0.13 degrees Fahrenheit (0.08 degrees Celsius) per decade since 1880 (Lindsey. R, Dahlman. L, 2021). According to World Health Organisation Report 2018, between 2030 and 2050 climate change is expected to cause approximately 95000 additional deaths per year from malnutrition

malaria, diarrhea, and heat stress. Climate change has a number of short terms and long-term impacts on human health. The Report on Assessment of Climate Change over the Indian region forecasted that unless robust steps are taken to mitigate greenhouse emissions, between 2070 and 2099 average temperature in India will rise by approximately 4.4 degrees Celsius relative to the recent past (Gupta. J, 2020). Climate change has resulted in heat-related illnesses and deaths, water-borne diseases like malaria, and affected mental health of the people, and disease patterns are changing all around the world.

Figure 1: Global Environmental Change. Climate Change and Human Health



Source: World Health Organization, climate change and human health, 2003.

Figure 1, shows the impact of all environmental changes including climate change on human health. Global warming, environmental degradation of land, depletion of ozone layer etc. cause climate change in such a way that it causes biodiversity loss, freshwater

decline, deteriorating air quality, which further has an adverse effect on human health. Global climate change affects health along with other factors like social-economic factors affect the human health of that place, people with the pre-existing problem are more exposed to health issues due to the climatic changes, also the poor people, children, and the old people are vulnerable to the climate change. Climate change affects human health in two ways firstly, worsening the health of the people where a health issue is pre-existing, and secondly by creating health issues where it was not existing beforehand.

Factors that Affect Human Health Due to Climate Change:

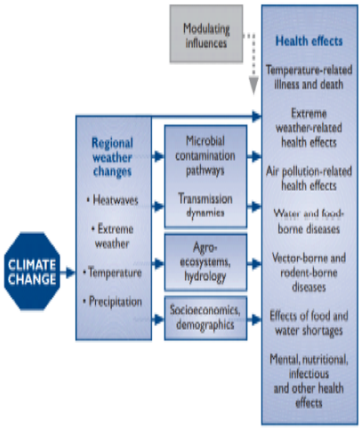
Basically, the drivers of the climate change are increased temperature levels, precipitation, rise in the sea level and extreme weather events like heat events and other disasters like winter storms and drought. Let us see that what are the impact of climate change on human health. **Figure 2**, shows the pathway by which climate change effect human health. Regional weather changes like heat waves, extreme weather like winter storms, temperature and precipitation cause the different health effects in humans and other species.

Extreme Heat: Frequent heat events has resulted in the elevated temperature which has Caused illness and deaths in old age people in different parts of the world, for example, in 2013 heat waves during summer caused more than 70000 excess deaths. Extreme heat causes a higher temperature which in turn raises ozone level and other pollutants in the air which further increase respiratory and cardiovascular diseases. High air temperature has more pollens which cause asthma in people around

the world. In 2017, US recorded thousands of more deaths because of summer waves. A study in America concluded that the older adults and children are at higher risk of illness and dying because of extreme heat.

Quality of Air we Breathe: Change in climate has worse effect on the weather of the place climate change has resulted in increase in the preserver of pollens and other pollutants and aeroallergens (which are released by plants) raising the level of ozone in the in air, this polluted air we breathe increase allergy problems, asthma and respiratory illness and also cardiovascular diseases. The ozone will cause premature death and severe lungs infection or reduce lung function. The presence of very small particles which are called particulate of matter wildfire smoke in the air can cause lung cancer POCD etc.

Figure 2: Pathway by which Climate Change Affect Human Health



Source: World Health Organization, climate change and human health, 2003.

Extreme Events: Events like floods, hurricanes, drought, wildfires and winter storms are the result of climate change which has shattered the life of the

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Dr. Anshumala Chandangar

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Biophysical Foundations of Production and Consumption of Human Economy Sources and Sink Functions of the Ecosystem

Dr. Anshumala Chandangar

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ABSTRACT

Three major problems associated with our management of the world's ecosystems are already causing significant harm to some people, particularly the poor, and unless addressed will substantially diminish the long-term benefits we obtain from ecosystems: First, approximately 60% (15 out of 24) of the ecosystem services examined during the Millennium Ecosystem Assessment are being degraded or used unsustainably, including fresh water, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests. The full costs of the loss and degradation of these ecosystem services are difficult to measure, but the available evidence demonstrates that they are substantial and growing. Many ecosystem services have been degraded as a consequence of actions taken to increase the supply of other services, such as food. These trade-offs often shift the costs of degradation from one group of people to another or defer costs to future generations. Second, there is established but incomplete evidence that changes being made in ecosystems are increasing the likelihood of nonlinear changes in ecosystems (including accelerating, abrupt, and potentially irreversible changes) that have important consequences for human well-being.

KEY WORDS: *production, consumption, human, economy, ecosystem, sustainable, management*

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Examples of such changes include disease emergence, abrupt alterations in water quality, the creation of "dead zones" in coastal waters, the collapse of fisheries, and shifts in regional climate. Third, the harmful effects of the degradation of ecosystem services (the persistent decrease in the capacity of an ecosystem to deliver services) are being borne disproportionately by the poor, are contributing to growing inequities and disparities across groups of people, and are sometimes the principal factor causing poverty and social conflict. This is not to say that ecosystem changes such as increased food production have not also helped to lift many people out of poverty or hunger, but these changes have harmed other individuals and communities, and their plight has been largely overlooked. In all regions, and particularly in sub-Saharan Africa, the condition and management of ecosystem services is a dominant factor influencing prospects for reducing poverty. The degradation of ecosystem services is already a significant barrier to achieving the Millennium Development Goals agreed to by the international community in September 2000 and the harmful consequences of this degradation could grow significantly worse in the next 50 years. The consumption of ecosystem services, which is unsustainable in many cases, will continue to grow as a consequence of a likely three- to sixfold increase in global GDP by 2050 even while global population growth is expected to slow and level off in mid-century. Most of the important direct drivers of ecosystem change are unlikely to diminish in the first half of the century and two drivers— climate change and excessive nutrient loading—will become more severe. Already, many of the regions facing the greatest challenges in achieving the MDGs coincide with those facing significant problems of ecosystem degradation. Rural poor people, a primary target of the MDGs, tend to be most directly reliant on ecosystem services and most vulnerable to changes in those services. More generally, any progress achieved in addressing the MDGs of poverty and hunger eradication, improved health, and environmental sustainability is unlikely to be sustained if most of the

ecosystem services on which humanity relies continue to be degraded. In contrast, the sound management of ecosystem services provides cost-effective opportunities for addressing multiple development goals in a synergistic manner. There is no simple fix to these problems since they arise from the interaction of many recognized challenges, including climate change, biodiversity loss, and land degradation, each of which is complex to address in its own right. Past actions to slow or reverse the degradation of ecosystems have yielded significant benefits, but these improvements have generally not kept pace with growing pressures and demands. Nevertheless, there is tremendous scope for action to reduce the severity of these problems in the coming decades.

INTRODUCTION

Ecosystems and the biological diversity contained within them provide a stream of goods and services, the continued delivery of which remains essential to our economic prosperity and other aspects of our welfare. In a broad sense, ecosystem services refer to the range of conditions and processes through which natural ecosystems, and the species that they contain, help sustain and fulfil human life (1). These services regulate the production of ecosystem goods, the natural products harvested or used by humans such as wild fruit and nuts, forage, timber, game, natural fibres, medicines and so on. More importantly, particularly for those in less developed economies, ecosystem services support life by regulating essential processes, such as purification of air and water, pollination of crops, nutrient cycling, decomposition of wastes, and generation and renewal of soils, as well as by moderating environmental conditions by stabilising climate, reducing the risk of extreme weather events, mitigating droughts and floods, and protecting soils from erosion. For the purposes of this report, ecosystem services have been grouped into six categories broadly based on both their ecological and economic function.

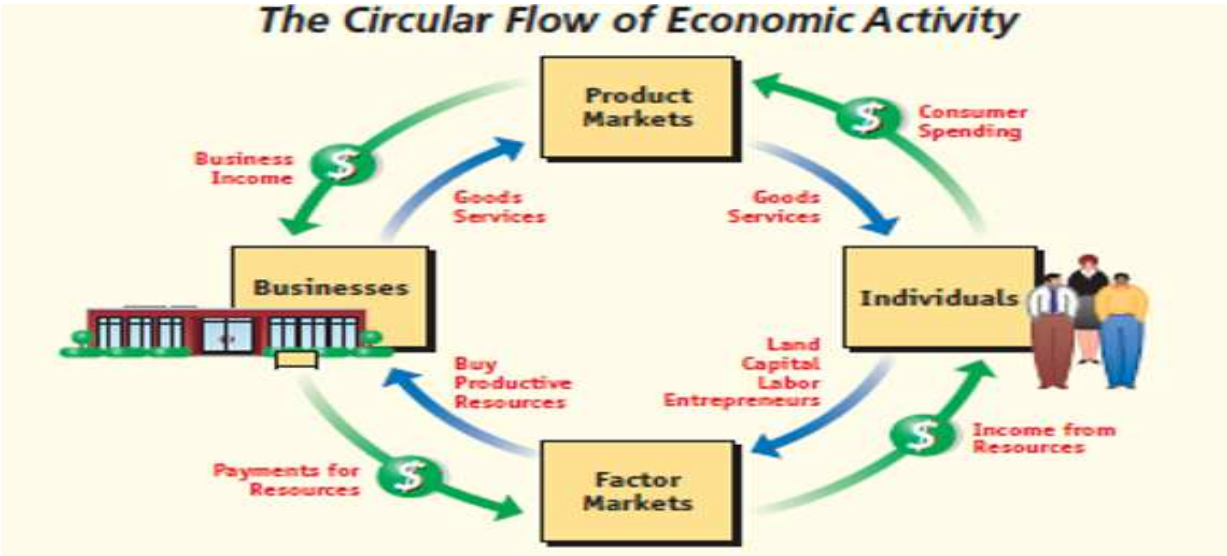


These are:

- Purification and Detoxification: filtration, purification and detoxification of air, water and soils;
- Cycling Processes: nutrient cycling, nitrogen fixation, carbon sequestration, soil formation;
- Regulation and Stabilisation: pest and disease control, climate regulation, mitigation of storms and floods, erosion control, regulation of rainfall and water supply
- Habitat Provision: refuge for animals and plants, storehouse for genetic material;
- Regeneration and Production: production of biomass providing raw materials and food, pollination and seed dispersal; and
- Information/Life-fulfilling: aesthetic, recreational, cultural and spiritual role, education and research.

The causes of biodiversity loss and ecosystem function damage due to unsustainable production and consumption patterns are almost too numerous to mention. The drivers can be interdependent, driven by local, national or global factors and include:

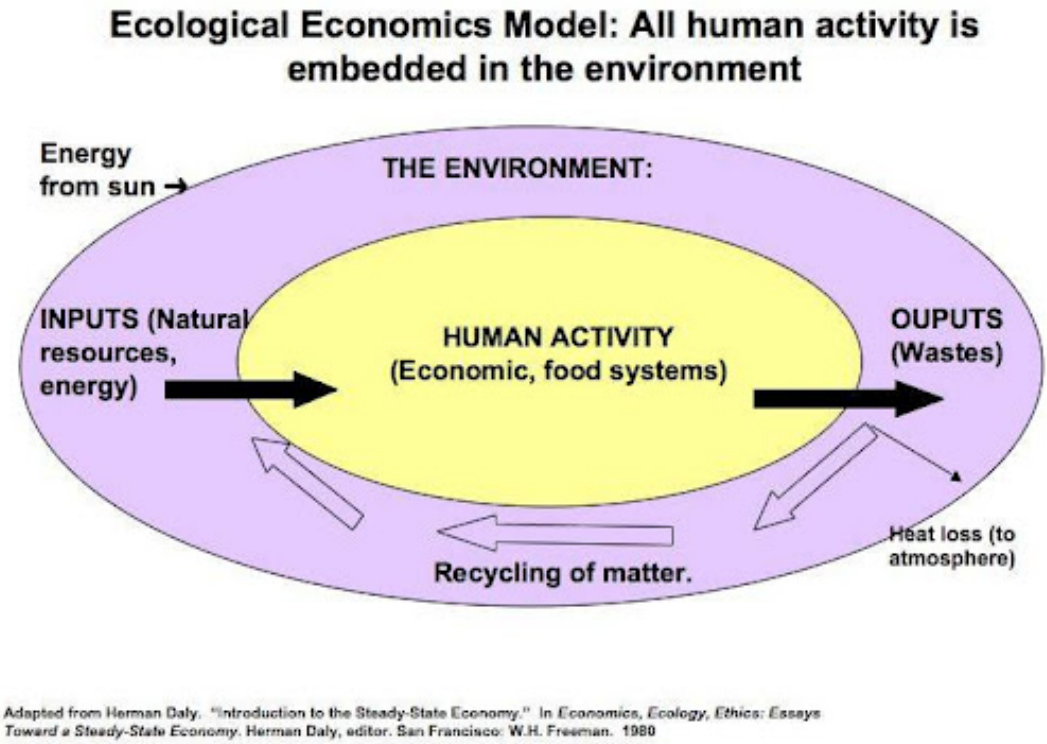
- Market and economic policy failures, such as perverse subsidies, absence of markets for ecosystem goods and services, and inadequate or non-existent information about the value of goods and services; • Issues of governance, such as absence of clearly defined and secure property rights, clear environmental policies and policy goals, poor enforcement of existing regulation, corruption, lack of political will, lack of capacity and inadequate information and knowledge; and
- Global demographic and other factors, such as human population growth, poverty, wars and unrest.



Information on the economic value of ecosystem services will not on its own provide a solution to ecosystem degradation. The real challenge is to use this information to redress market and policy failures. This can be done by removing perverse incentives such as subsidies that encourage degradation and creating positive incentives for achieving sustainable outcomes through payments for ecosystem services, creation of markets for services, or other incentives for sustainable resource management. This is the 'demonstration - capture' paradigm in environmental economics where demonstration of economic value should lead to their 'capture' through market or other mechanisms (where 'capture' infers turning at least some of the economic value into cash).

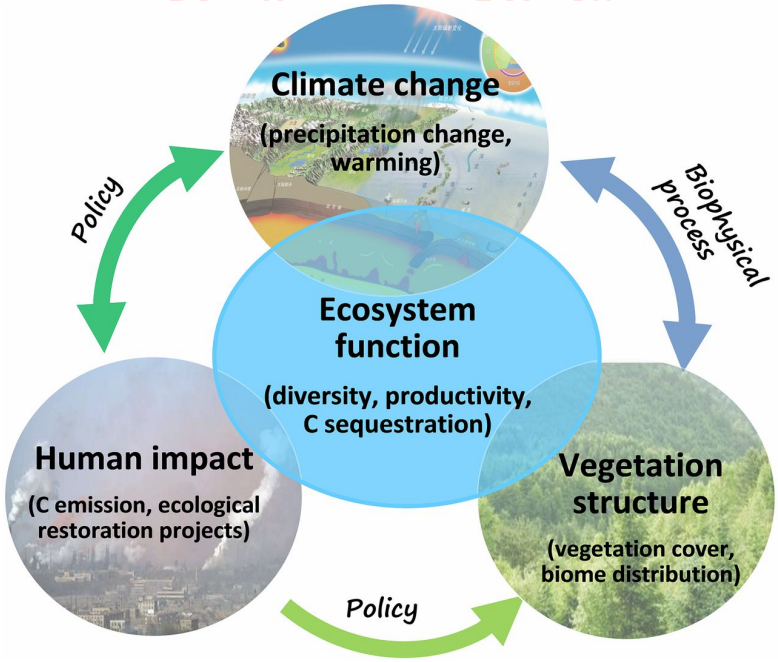
OBSERVATIONS

The distribution of benefits of ecosystem goods and services among different beneficiary groups at different time periods is a crucial factor when considering the value of ecosystem goods and services. In terms of beneficiaries, we can think of individuals (the basic unit in estimating the total economic value), commercial entities and the public sector as forming broad categories. Often when decisions are made about resource use, the inclusion of the interests of the global community can tip the balance. This is especially the case when it comes to nonuse and option values and even more so when mechanisms to capture these values for the local communities can be put in place. Another scale at which the conflicts between users, or trade-offs between uses, become evident is that of temporal variation of ecosystem goods and services. Benefits and beneficiaries vary between short vs. long term, and this variation is clearest when exploitation of ecosystem goods in the short term leads to a decline in ecosystem services in the long term. One of the most striking examples of this is logging in the short term, which may lead to decline or loss of watershed and other services of forests.



Adapted from Herman Daly, "Introduction to the Steady-State Economy." In *Economics, Ecology, Ethics: Essays Toward a Steady-State Economy*. Herman Daly, editor. San Francisco: W.H. Freeman. 1980

The Food and Agricultural Organisation (FAO) defines forests as an area with (a) an existing or expected tree canopy of more than 10%; and (b) a total area of more 0.5 hectares where trees reach at least 5 metres in size (FAO, 2000). This definition extends to natural forests, forest plantations and land from which forest has been cleared but that will be reforested in the foreseeable future. However, stands of trees established primarily for agricultural production, such as fruit tree plantations are excluded from this definition (2). Defined as such, forests are among the world's most important biomes in terms of the area of land surface they cover (approximately 30% of all land - over 3.8 billion hectares (3)), the goods and services they provide, and the biodiversity they contain (approximately 90% of terrestrial biodiversity). The World Bank (2001) highlights that more than 1 billion people depend on forests for their livelihoods to varying degrees. Sixty million indigenous people are almost wholly dependent on forests, while around 350 million people living within or adjacent to dense forests depend on them to a high degree for subsistence and income. In developing countries, agro-forestry farming schemes support 1.2 billion people and help sustain agricultural productivity and the generation of income. Forest industries provide employment for some 60 million people worldwide. The medical needs of approximately one billion people depend on drugs derived from forest plants, many of which have been long been used in traditional medicine In recognition of the importance of forest ecosystems and the services provided, the proportion of forest cover to total land area (excluding inland waters) has been adopted as an indicator measure for monitoring progress towards achieving the Millennium Development Goals (MDGs) adopted by the member states of the United Nations under the 2000/2002 Millennium Declaration (United Nations, 2001). Forest cover is monitored in relation to the target of 'integrating the principles of sustainable development into country policies and programmes and reversing the loss of environmental resources' under the goal of 'ensuring environmental sustainability'. Monitoring forest cover reveals the relative importance of forest land within countries, while changes in forest cover reflect the demand for land from other competing uses (4).

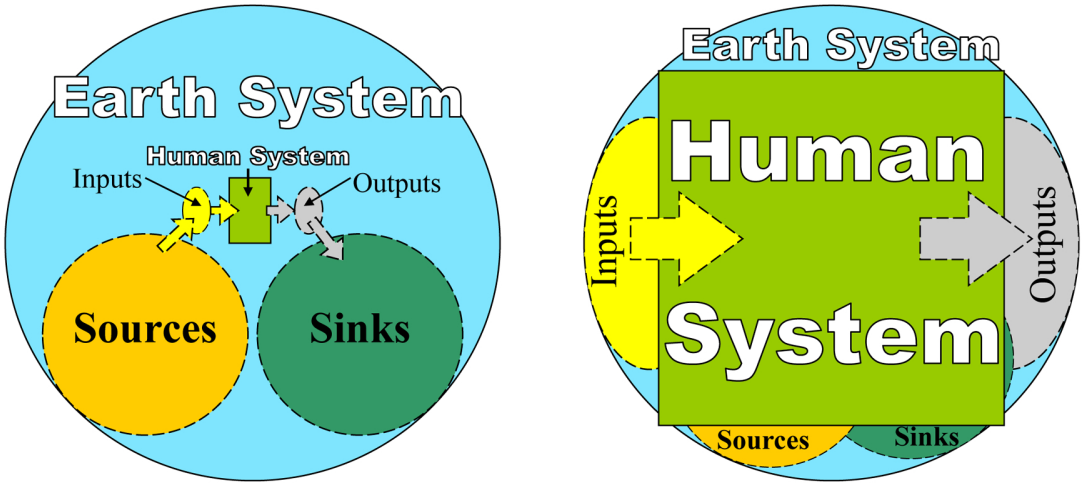


Agro-ecosystems are estimated to cover between 28 and 37% of total land area, though this includes some overlap with forests and grasslands, given ecosystem fragmentation. About 69% are permanent pasture while the remainder are crops, of which 91% are annual and 9% perennial (5). These human dominated landscapes range from highly intensive and mechanised agricultural systems to more extensive subsistence systems. Agriculture is a critical economic sector, especially in the developing world. It is most important to the economies of low-income countries, accounting for approximately 31% of GDP overall and 50% of GDP in SubSaharan Africa. In the middle and high income countries, by contrast, it accounts for 12% and 1-3% of GDP, respectively. Yet conventional measures of GDP greatly understate agriculture's contribution to the economy, which should also include upstream and downstream manufacturing and services. Agriculture also provides many jobs, in the order of 56% to 65% of the total labour force in Asia and Sub-Saharan Africa (6). The case of agriculture and ecosystem services is thus a particularly pertinent one, as agriculture is essentially a man-made ecosystem. At the same time as natural cycles (e.g. carbon and nutrient cycles) affect agriculture, they are altered by farming activities. Therefore, this section, in contrast to the previous two, highlights the role of biodiversity and ecosystem services in providing for agriculture, and examines the fragile relationship between certain farming practices and sustaining ecosystem services.

The Past: "Empty World" → The Present: "Full World"

When the Human System was small relative to the Earth System, the two could be modeled separately.

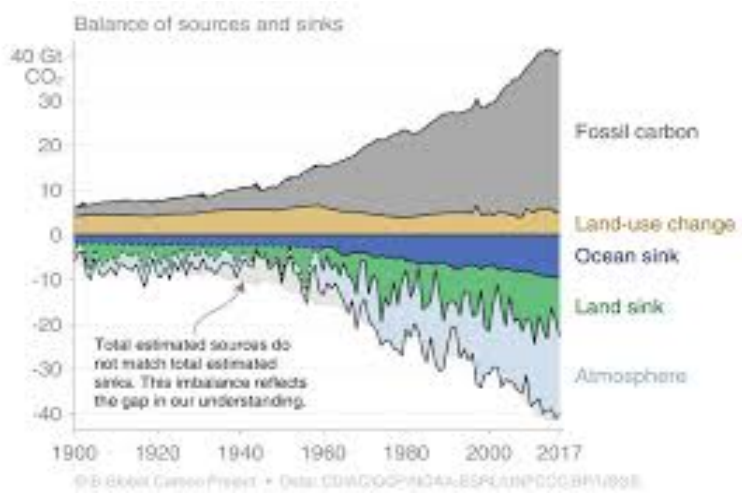
The Human System has grown so large that both must now be modeled coupled to each other.



Capacity of ES sources was large relative to HS inputs. HS outputs were small relative to absorption of ES sinks.

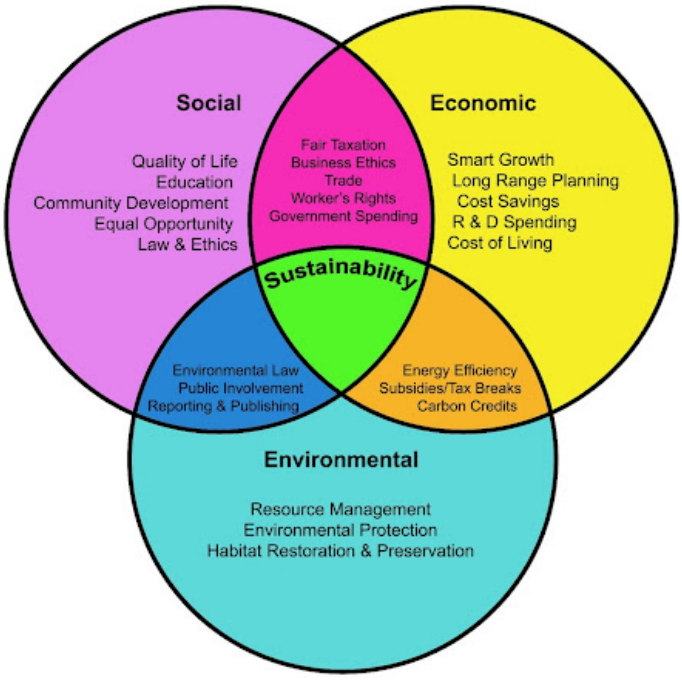
Now, HS inputs and outputs are so large relative to the ES, they threaten to deplete its sources and overwhelm its sinks.

All ecosystems deliver goods and services to humankind and therefore have economic value, where economic value is defined as all contributions to human welfare (financial, social, environmental and health). These ecosystem services include the purification of air and water, the pollination of crops, nutrient cycling and decomposition of wastes, the generation and renewal of soils, stabilisation of climate, mitigation of droughts and floods, and protecting soils from erosion. This review of the ecological and economic literature for a subset of ecosystems, namely, forests, wetlands and agro-ecosystems, describes the value of ecosystem goods and services from a multi-disciplinary perspective, and uses examples to demonstrate key issues. Evidence from the ecological literature demonstrates the complexity of ecosystem functioning, and the unpredictability of ecosystem responses to the multitude of human pressures. In general, land management decisions tend to emphasise only a subset of these ecosystem consequences, and usually only at local scales, and the full range of ecosystem services is rarely recognised let alone explicitly considered. While ecological science has repeatedly highlighted the general pattern of ecosystem responses to human-imposed stress, including the existence of response discontinuities characterised by sudden and often catastrophic environmental change, quantifying these patterns and predicting the location of thresholds continue to elude us. Evidence from the economic literature of the value of ecosystem services, differentiates between the value of goods which are used directly (e.g. timber, fish, etc) and those services which indirectly support and contribute to production systems and human welfare (e.g. watershed services and nutrient cycling). Ecosystem services are also valuable for reasons not related to their use (non-use value), for example because we believe they should exist for others now or in future and for their own sake. Use and non-use values combine to give the total economic value (TEV) of a resource. Through analysing the changes in the TEV, economics provides a framework that recognises the distribution of economic benefits between (or economic values held by) different stakeholders, there are gaps in the quantitative evidence base, which are discussed below. Individual economic studies have generally been undertaken to inform a particular land-use decision at a local level, in most cases seeking to monetise the loss of total economic value due to degradation of ecosystem services. These studies have examined opportunity costs, replacement costs, contributions to local livelihoods (income), non-use values and so on. Evidence of large scale benefits from ecosystem services is demonstrated in this literature through high aggregate willingness to pay of affected populations for those services. Economic analysis also shows that maintaining ecosystems in an unused/undeveloped state is economically viable, i.e. generates higher welfare than use or development, generally only when all components of TEV are taken into account showing the importance of indirect use and non-use values.(21)



DISCUSSIONS

In the face of the uncertainties about the impact of human activities on ecosystems, the greatest challenge for ecologists is to parameterise existing models of ecosystem response allowing for an informed and economically optimal decision making environment. Finally, ecological science provides a conceptual framework by which the responses of different ecosystem services may be recognised at appropriate scales. Assessing the outcome of land use decisions requires explicit recognition of several spatial and temporal scales of analysis. Integrating our knowledge of ecosystem properties and dynamics into economic assessments of land use is essential to determine the full costs of alternative land-use options. Most of the economic studies reviewed for this report concentrate on a single use of a single good or service of a given ecosystem. This assessment of the literature is also made by (7). The difficulties in understanding the ecosystem dynamics and reflecting these in decision-making, however, lie in the interactions of multiple goods and services of ecosystems and how these affect the benefits received from these ecosystems. Therefore, future economic research in this area should consider a range of interdependent ecological functions, uses and economic benefits at a given site; or track changes in site values across different states of ecological disturbance. (20) The information from this will not only help decision makers with the complex trade-offs between conservation, sustainable use and development but also trade-offs between local, national / regional and global beneficiaries. The measures that can capture more of the economic value and increase the incentives for conservation are touched upon only briefly here due to the scope of the current study. Future research should investigate the necessary conditions for such measures and their relative merits. For example, the research could (i) examine the success of a particular incentive mechanism across locations (e.g. countries); (ii) consider the appropriateness of mechanisms for different ecosystems or types of ecosystem stress; or (iii) study the relative effectiveness of different mechanisms in a particular location. A starting point for this research would be a review of the literature on finance for ecosystem services, which is continually being updated.(19)

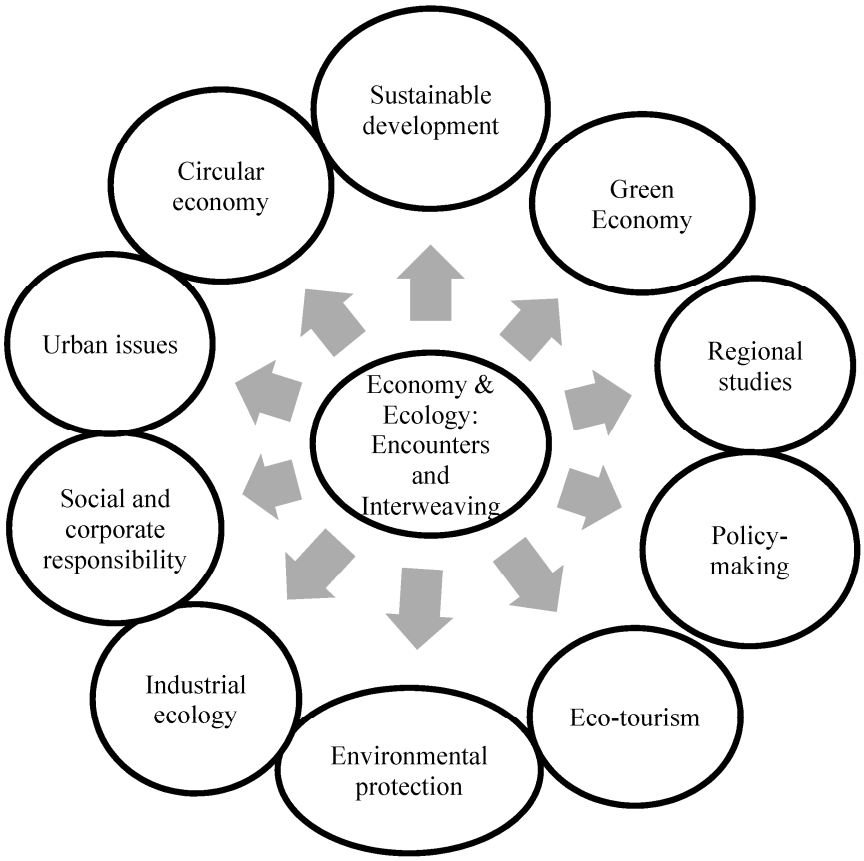


Proper valuation and accounting of natural resources are necessary for robust development planning. Just as necessary are transparent institutions and good governance. Decision-making that is inclusive helps provide not only legitimacy for resource management policies, but ensures that the range of knowledge and social interests and values are considered in policy-making. Managing natural resources generally entails also managing competing demands and multiple resources and values as well as providing for environmental protection, which requires an integrated approach. High-quality institutions that promote economic growth are at the heart of good governance. This includes regulatory authorities that are reliable and free of corruption, transparent and accountable; reliable property rights and functioning markets; the absence of harmful subsidies that interfere with sustainable resource use; the rule of law and adequate legal recourse.(18)

The wealth embodied in natural resources makes up a significant proportion of the wealth of most nations, often more than the wealth embodied in produced capital, therefore making natural resources management a key aspect of economic development (8). Many countries have seen significant rises in revenues from natural resources due to the rise in commodity prices. Natural resources such as oil, gas, minerals and timber are expected to continue to play a significant role in resource abundant economies, as demand from rapidly growing economies increases, and as supplies of non-renewable resources decline and renewable resource harvests approach maximum sustained yield levels. Not surprisingly, countries richly endowed with natural capital have the potential to derive significant current income from resources.

RESULTS

Payments for ecosystem services (PES) provide incentives for owners of natural resources such as farmers and forest owners to manage resources in order to provide ecological services. PES are defined as voluntary transactions in which a well defined environmental service is bought and sold by at least one buyer and one seller, provided that the seller actually ensures that the ecosystem service is provided (9). Key environmental services such as carbon sequestration, biodiversity protection, watershed protection, and landscape beauty may be targeted in a PES scheme (10). In order to be effective, then, PES systems must target a well-defined ecosystem service and ensure that payments add to the ecosystem service that would be provided under a business as usual scenario. Moreover, they must be able to monitor the provision of the ecosystem service. PES policies would in most instances complement other policies. The voluntary nature of PES means that they enjoy high legitimacy among participants. Payments are typically calculated on the basis of foregone revenue from resource use as well as costs incurred in providing the ecosystem service. PES systems are thus intended to maintain livelihoods while valuing, and paying for, the wider social benefits derived from ecosystem services. PES schemes are not particularly easy to design and implement and require a substantial amount of initial effort. Baselines for ecosystem services must be established in order to determine if PES provide additional value.(17) PES schemes also depend upon social capital embodies in the trust between buyers and sellers, and may require an intermediary such as an NGO to develop (11). Moreover, transaction costs may be high. Incorporating a PES scheme into the policy mix therefore necessitates a careful weighing of the costs and benefits of such a scheme in relation to other policy instrument options. However, PES schemes are increasing in number around the world, sometimes with the strategic support of the NGO and international communities. For instance, WWF has worked in Moldova, Romania, and Ukraine to identify land uses and environmental services that could trigger payments from the European Union and national agencies, thereby supporting rural residents and protecting the environment (12). Based on WWF‘s initiative, the Global Environment Facility has continued funding work in the Lower Danube Basin to mainstream PES schemes in an integrated river basin management context. The first PES project in Central Asia was launched in 2008 (16) by the Central Asia Regional Environmental Centre in Kyrgyzstan in cooperation with the Swiss government, the US Forest Service and the Global Environment Facility, and working with local stakeholders, including national and local authorities, the water user and pasture user associations, local experts and the local population. The project aims to improve the ecological health of alpine and sub-alpine ecosystems by making grazing practices more sustainable. The ecosystem services to be paid for are water supplies to the watershed, water quality, biodiversity and forest conservation, with upstream grazing farmers and national forest districts identified as sellers and irrigated agriculture farmers and tourists identified as buyers. Although this PES scheme has run into obstacles in the form of a low ability and willingness to pay for the environmental services and a limited understanding of the relationship between upstream grazing practices and downstream water quality, the project is providing a unique learning environment and is serving as a springboard for further PES schemes in the region (13).



CONCLUSION

Natural resources decision-making is often a source of debate and conflicting values. While there may never be complete consensus within a given country on exactly how to put the principles of sustainable resources management into practice in the case of renewable resources, or on how optimally to exploit non-renewable resources and how to invest the revenues, depending on how they are approached, decision making processes can help or hinder sustainability and social and economic development.(15) Natural resources policy is inherently complex, involving scientific uncertainties, complex natural systems, technical considerations and long time frames. At the same time, social and political developments throughout the world, in developed, developing and transition countries alike, have ushered in an era in which public participation and multi-stakeholder participation processes are demanded, expected and required under freedom of information and participation laws such as those implementing the Aarhus Convention. While it is understood that a diversity of decision making processes is necessary across national contexts as well as policy-specific contexts, some basic principles of decision making, consistent with the principles for good governance in general and for natural resources in particular, will apply to all decision making processes in the context of sustainable development, including: (14)

- Credible mechanisms for reporting outcomes of policy decisions and for fostering accountability of results;
- Coherence across government departments and levels of government; and
- A transparent and inclusive approach to decision-making, so as to confront conflicting interest and points of view and to address policy trade-offs when these arise (OECD, 2001).

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Biophysical Foundations of Production and Consumption of Human Economy Sources and Sink Functions of the Ecosystem

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ABSTRACT

Three major problems associated with our management of the world's ecosystems are already causing significant harm to some people, particularly the poor, and unless addressed will substantially diminish the long-term benefits we obtain from ecosystems: First, approximately 60% (15 out of 24) of the ecosystem services examined during the Millennium Ecosystem Assessment are being degraded or used unsustainably, including fresh water, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests. The full costs of the loss and degradation of these ecosystem services are difficult to measure, but the available evidence demonstrates that they are substantial and growing. Many ecosystem services have been degraded as a consequence of actions taken to increase the supply of other services, such as food. These trade-offs often shift the costs of degradation from one group of people to another or defer costs to future generations. Second, there is established but incomplete evidence that changes being made in ecosystems are increasing the likelihood of nonlinear changes in ecosystems (including accelerating, abrupt, and potentially irreversible changes) that have important consequences for human well-being.

KEY WORDS: *production, consumption, human, economy, ecosystem, sustainable, management*

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Examples of such changes include disease emergence, abrupt alterations in water quality, the creation of "dead zones" in coastal waters, the collapse of fisheries, and shifts in regional climate. Third, the harmful effects of the degradation of ecosystem services (the persistent decrease in the capacity of an ecosystem to deliver services) are being borne disproportionately by the poor, are contributing to growing inequities and disparities across groups of people, and are sometimes the principal factor causing poverty and social conflict. This is not to say that ecosystem changes such as increased food production have not also helped to lift many people out of poverty or hunger, but these changes have harmed other individuals and communities, and their plight has been largely overlooked. In all regions, and particularly in sub-Saharan Africa, the condition and management of ecosystem services is a dominant factor influencing prospects for reducing poverty. The degradation of ecosystem services is already a significant barrier to achieving the Millennium Development Goals agreed to by the international community in September 2000 and the harmful consequences of this degradation could grow significantly worse in the next 50 years. The consumption of ecosystem services, which is unsustainable in many cases, will continue to grow as a consequence of a likely three- to sixfold increase in global GDP by 2050 even while global population growth is expected to slow and level off in mid-century. Most of the important direct drivers of ecosystem change are unlikely to diminish in the first half of the century and two drivers— climate change and excessive nutrient loading—will become more severe. Already, many of the regions facing the greatest challenges in achieving the MDGs coincide with those facing significant problems of ecosystem degradation. Rural poor people, a primary target of the MDGs, tend to be most directly reliant on ecosystem services and most vulnerable to changes in those services. More generally, any progress achieved in addressing the MDGs of poverty and hunger eradication, improved health, and environmental sustainability is unlikely to be sustained if most of the

ecosystem services on which humanity relies continue to be degraded. In contrast, the sound management of ecosystem services provides cost-effective opportunities for addressing multiple development goals in a synergistic manner. There is no simple fix to these problems since they arise from the interaction of many recognized challenges, including climate change, biodiversity loss, and land degradation, each of which is complex to address in its own right. Past actions to slow or reverse the degradation of ecosystems have yielded significant benefits, but these improvements have generally not kept pace with growing pressures and demands. Nevertheless, there is tremendous scope for action to reduce the severity of these problems in the coming decades.

INTRODUCTION

Ecosystems and the biological diversity contained within them provide a stream of goods and services, the continued delivery of which remains essential to our economic prosperity and other aspects of our welfare. In a broad sense, ecosystem services refer to the range of conditions and processes through which natural ecosystems, and the species that they contain, help sustain and fulfil human life (1). These services regulate the production of ecosystem goods, the natural products harvested or used by humans such as wild fruit and nuts, forage, timber, game, natural fibres, medicines and so on. More importantly, particularly for those in less developed economies, ecosystem services support life by regulating essential processes, such as purification of air and water, pollination of crops, nutrient cycling, decomposition of wastes, and generation and renewal of soils, as well as by moderating environmental conditions by stabilising climate, reducing the risk of extreme weather events, mitigating droughts and floods, and protecting soils from erosion. For the purposes of this report, ecosystem services have been grouped into six categories broadly based on both their ecological and economic function.

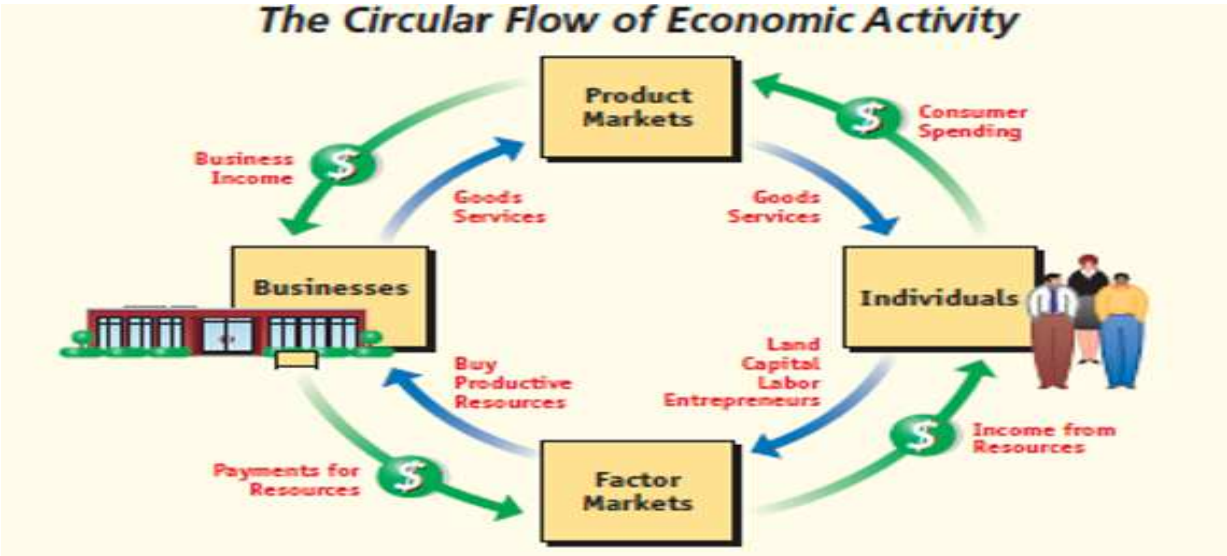


These are:

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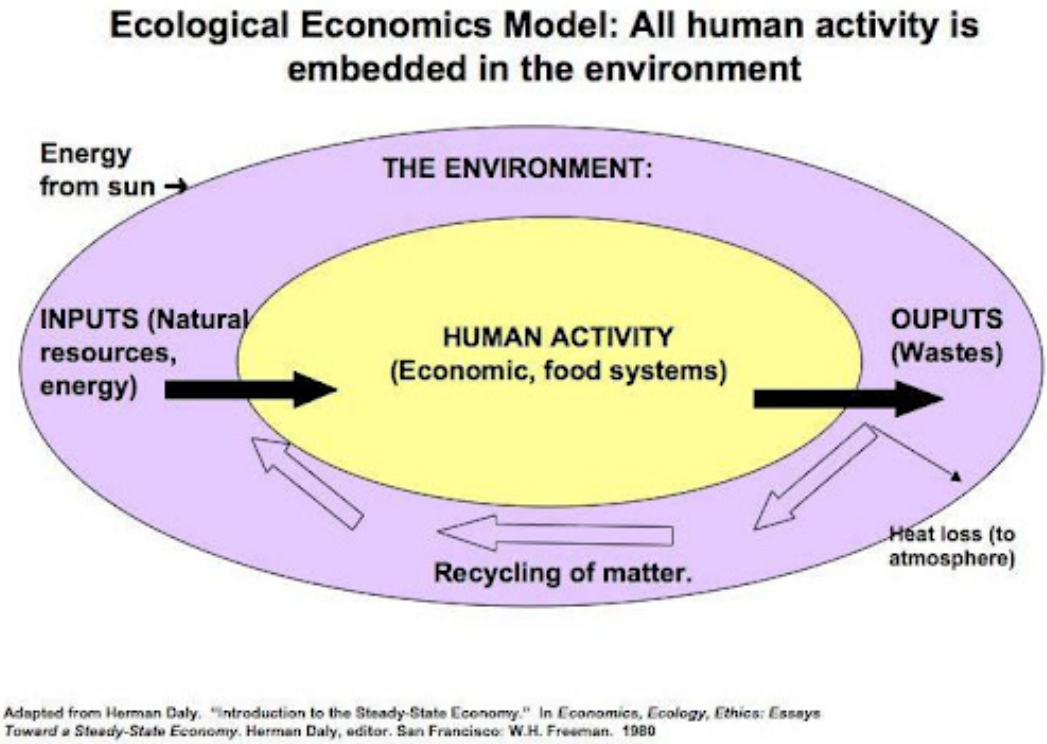
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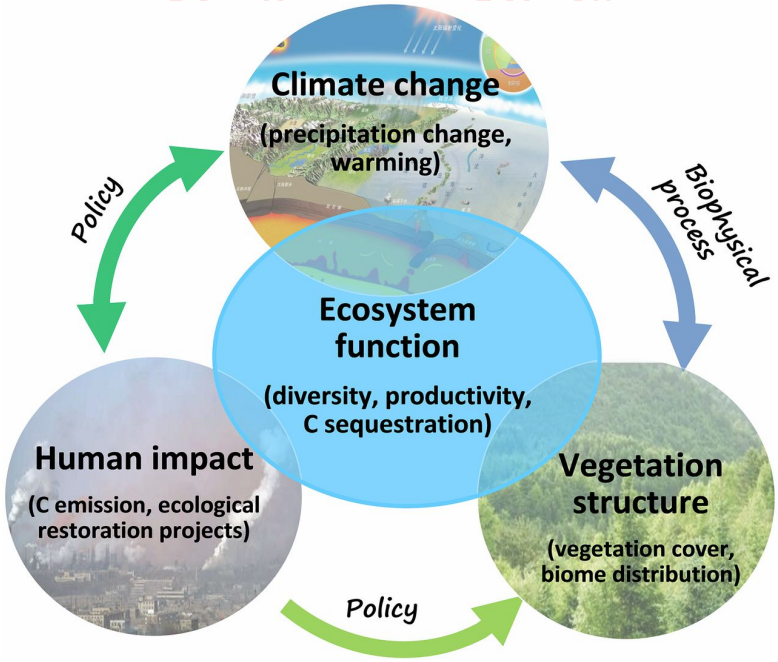
OBSERVATIONS

The distribution of benefits of ecosystem goods and services among different beneficiary groups at different time periods is a crucial factor when considering the value of ecosystem goods and services. In terms of beneficiaries, we can think of individuals (the basic unit in estimating the total economic value), commercial entities and the public sector as forming broad categories. Often when decisions are made about resource use, the inclusion of the interests of the global community can tip the balance. This is especially the case when it comes to nonuse and option values and even more so when mechanisms to capture these values for the local communities can be put in place. Another scale at which the conflicts between users, or trade-offs between uses, become evident is that of temporal variation of ecosystem goods and services. Benefits and beneficiaries vary between short vs. long term, and this variation is clearest when exploitation of ecosystem goods in the short term leads to a decline in ecosystem services in the long term. One of the most striking examples of this is logging in the short term, which may lead to decline or loss of watershed and other services of forests.



Adapted from Herman Daly, "Introduction to the Steady-State Economy." In *Economics, Ecology, Ethics: Essays Toward a Steady-State Economy*. Herman Daly, editor. San Francisco: W.H. Freeman. 1980

The Food and Agricultural Organisation (FAO) defines forests as an area with (a) an existing or expected tree canopy of more than 10%; and (b) a total area of more 0.5 hectares where trees reach at least 5 metres in size (FAO, 2000). This definition extends to natural forests, forest plantations and land from which forest has been cleared but that will be reforested in the foreseeable future. However, stands of trees established primarily for agricultural production, such as fruit tree plantations are excluded from this definition (2). Defined as such, forests are among the world's most important biomes in terms of the area of land surface they cover (approximately 30% of all land - over 3.8 billion hectares (3)), the goods and services they provide, and the biodiversity they contain (approximately 90% of terrestrial biodiversity). The World Bank (2001) highlights that more than 1 billion people depend on forests for their livelihoods to varying degrees. Sixty million indigenous people are almost wholly dependent on forests, while around 350 million people living within or adjacent to dense forests depend on them to a high degree for subsistence and income. In developing countries, agro-forestry farming schemes support 1.2 billion people and help sustain agricultural productivity and the generation of income. Forest industries provide employment for some 60 million people worldwide. The medical needs of approximately one billion people depend on drugs derived from forest plants, many of which have been long been used in traditional medicine In recognition of the importance of forest ecosystems and the services provided, the proportion of forest cover to total land area (excluding inland waters) has been adopted as an indicator measure for monitoring progress towards achieving the Millennium Development Goals (MDGs) adopted by the member states of the United Nations under the 2000/2002 Millennium Declaration (United Nations, 2001). Forest cover is monitored in relation to the target of 'integrating the principles of sustainable development into country policies and programmes and reversing the loss of environmental resources' under the goal of 'ensuring environmental sustainability'. Monitoring forest cover reveals the relative importance of forest land within countries, while changes in forest cover reflect the demand for land from other competing uses (4).

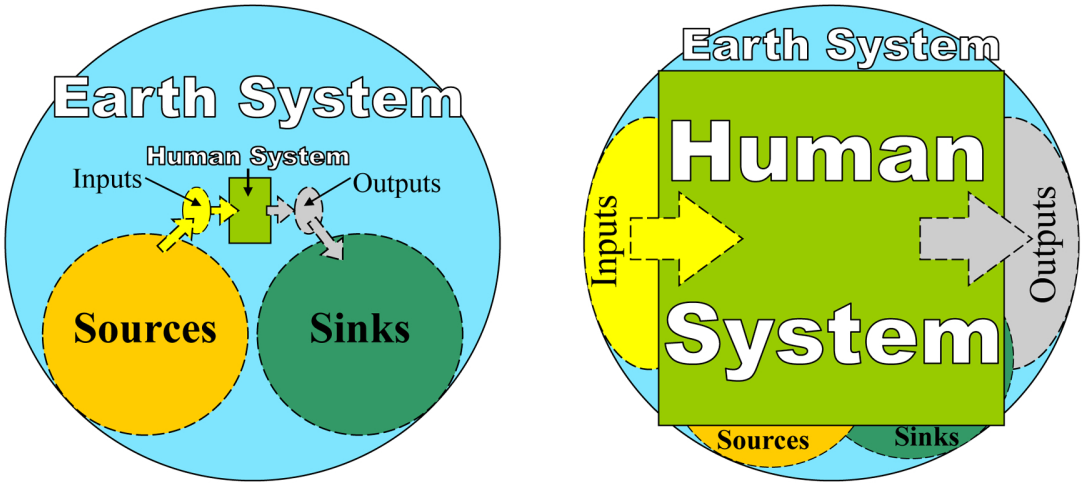


Agro-ecosystems are estimated to cover between 28 and 37% of total land area, though this includes some overlap with forests and grasslands, given ecosystem fragmentation. About 69% are permanent pasture while the remainder are crops, of which 91% are annual and 9% perennial (5). These human dominated landscapes range from highly intensive and mechanised agricultural systems to more extensive subsistence systems. Agriculture is a critical economic sector, especially in the developing world. It is most important to the economies of low-income countries, accounting for approximately 31% of GDP overall and 50% of GDP in SubSaharan Africa. In the middle and high income countries, by contrast, it accounts for 12% and 1-3% of GDP, respectively. Yet conventional measures of GDP greatly understate agriculture's contribution to the economy, which should also include upstream and downstream manufacturing and services. Agriculture also provides many jobs, in the order of 56% to 65% of the total labour force in Asia and Sub-Saharan Africa (6). The case of agriculture and ecosystem services is thus a particularly pertinent one, as agriculture is essentially a man-made ecosystem. At the same time as natural cycles (e.g. carbon and nutrient cycles) affect agriculture, they are altered by farming activities. Therefore, this section, in contrast to the previous two, highlights the role of biodiversity and ecosystem services in providing for agriculture, and examines the fragile relationship between certain farming practices and sustaining ecosystem services.

The Past: "Empty World" → The Present: "Full World"

When the Human System was small relative to the Earth System, the two could be modeled separately.

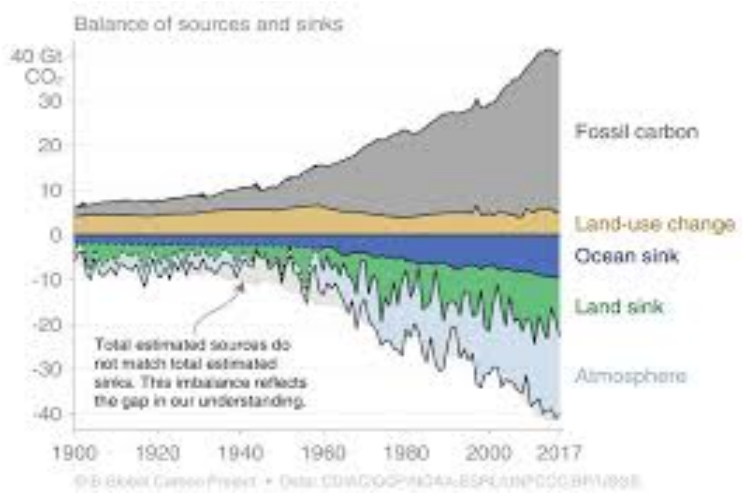
The Human System has grown so large that both must now be modeled coupled to each other.



Capacity of ES sources was large relative to HS inputs. HS outputs were small relative to absorption of ES sinks.

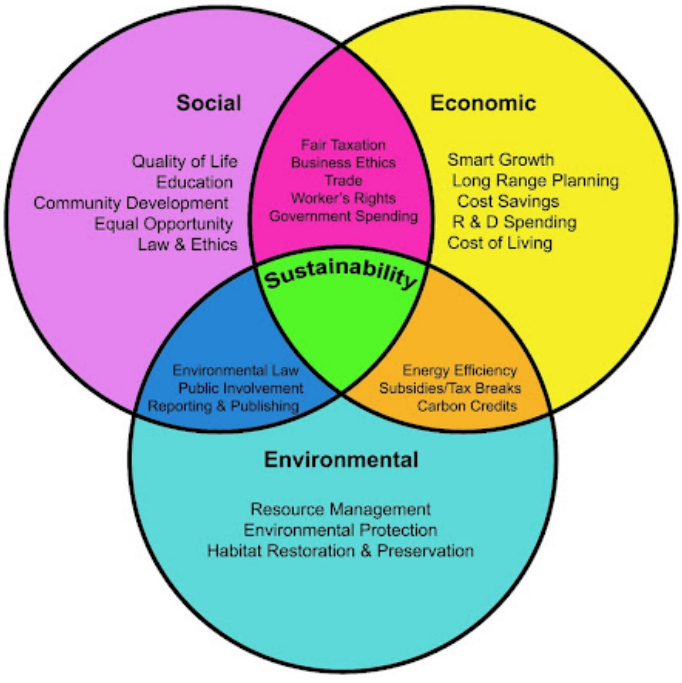
Now, HS inputs and outputs are so large relative to the ES, they threaten to deplete its sources and overwhelm its sinks.

All ecosystems deliver goods and services to humankind and therefore have economic value, where economic value is defined as all contributions to human welfare (financial, social, environmental and health). These ecosystem services include the purification of air and water, the pollination of crops, nutrient cycling and decomposition of wastes, the generation and renewal of soils, stabilisation of climate, mitigation of droughts and floods, and protecting soils from erosion. This review of the ecological and economic literature for a subset of ecosystems, namely, forests, wetlands and agro-ecosystems, describes the value of ecosystem goods and services from a multi-disciplinary perspective, and uses examples to demonstrate key issues. Evidence from the ecological literature demonstrates the complexity of ecosystem functioning, and the unpredictability of ecosystem responses to the multitude of human pressures. In general, land management decisions tend to emphasise only a subset of these ecosystem consequences, and usually only at local scales, and the full range of ecosystem services is rarely recognised let alone explicitly considered. While ecological science has repeatedly highlighted the general pattern of ecosystem responses to human-imposed stress, including the existence of response discontinuities characterised by sudden and often catastrophic environmental change, quantifying these patterns and predicting the location of thresholds continue to elude us. Evidence from the economic literature of the value of ecosystem services, differentiates between the value of goods which are used directly (e.g. timber, fish, etc) and those services which indirectly support and contribute to production systems and human welfare (e.g. watershed services and nutrient cycling). Ecosystem services are also valuable for reasons not related to their use (non-use value), for example because we believe they should exist for others now or in future and for their own sake. Use and non-use values combine to give the total economic value (TEV) of a resource. Through analysing the changes in the TEV, economics provides a framework that recognises the distribution of economic benefits between (or economic values held by) different stakeholders, there are gaps in the quantitative evidence base, which are discussed below. Individual economic studies have generally been undertaken to inform a particular land-use decision at a local level, in most cases seeking to monetise the loss of total economic value due to degradation of ecosystem services. These studies have examined opportunity costs, replacement costs, contributions to local livelihoods (income), non-use values and so on. Evidence of large scale benefits from ecosystem services is demonstrated in this literature through high aggregate willingness to pay of affected populations for those services. Economic analysis also shows that maintaining ecosystems in an unused/undeveloped state is economically viable, i.e. generates higher welfare than use or development, generally only when all components of TEV are taken into account showing the importance of indirect use and non-use values.(21)



DISCUSSIONS

In the face of the uncertainties about the impact of human activities on ecosystems, the greatest challenge for ecologists is to parameterise existing models of ecosystem response allowing for an informed and economically optimal decision making environment. Finally, ecological science provides a conceptual framework by which the responses of different ecosystem services may be recognised at appropriate scales. Assessing the outcome of land use decisions requires explicit recognition of several spatial and temporal scales of analysis. Integrating our knowledge of ecosystem properties and dynamics into economic assessments of land use is essential to determine the full costs of alternative land-use options. Most of the economic studies reviewed for this report concentrate on a single use of a single good or service of a given ecosystem. This assessment of the literature is also made by (7). The difficulties in understanding the ecosystem dynamics and reflecting these in decision-making, however, lie in the interactions of multiple goods and services of ecosystems and how these affect the benefits received from these ecosystems. Therefore, future economic research in this area should consider a range of interdependent ecological functions, uses and economic benefits at a given site; or track changes in site values across different states of ecological disturbance. (20) The information from this will not only help decision makers with the complex trade-offs between conservation, sustainable use and development but also trade-offs between local, national / regional and global beneficiaries. The measures that can capture more of the economic value and increase the incentives for conservation are touched upon only briefly here due to the scope of the current study. Future research should investigate the necessary conditions for such measures and their relative merits. For example, the research could (i) examine the success of a particular incentive mechanism across locations (e.g. countries); (ii) consider the appropriateness of mechanisms for different ecosystems or types of ecosystem stress; or (iii) study the relative effectiveness of different mechanisms in a particular location. A starting point for this research would be a review of the literature on finance for ecosystem services, which is continually being updated.(19)

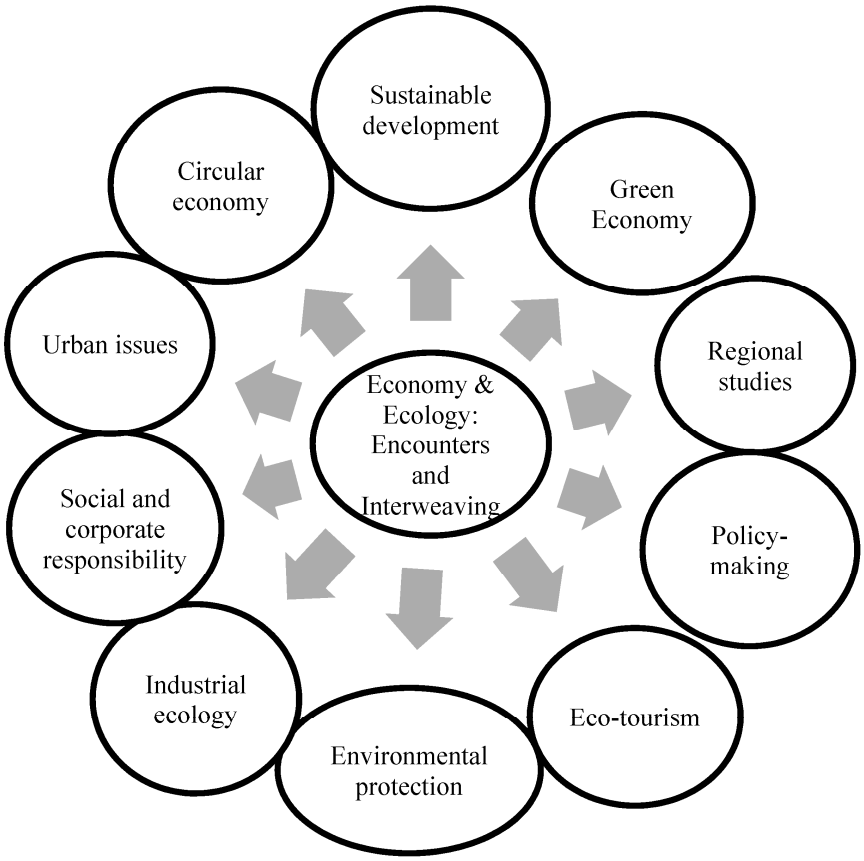


Proper valuation and accounting of natural resources are necessary for robust development planning. Just as necessary are transparent institutions and good governance. Decision-making that is inclusive helps provide not only legitimacy for resource management policies, but ensures that the range of knowledge and social interests and values are considered in policy-making. Managing natural resources generally entails also managing competing demands and multiple resources and values as well as providing for environmental protection, which requires an integrated approach. High-quality institutions that promote economic growth are at the heart of good governance. This includes regulatory authorities that are reliable and free of corruption, transparent and accountable; reliable property rights and functioning markets; the absence of harmful subsidies that interfere with sustainable resource use; the rule of law and adequate legal recourse.(18)

The wealth embodied in natural resources makes up a significant proportion of the wealth of most nations, often more than the wealth embodied in produced capital, therefore making natural resources management a key aspect of economic development (8). Many countries have seen significant rises in revenues from natural resources due to the rise in commodity prices. Natural resources such as oil, gas, minerals and timber are expected to continue to play a significant role in resource abundant economies, as demand from rapidly growing economies increases, and as supplies of non-renewable resources decline and renewable resource harvests approach maximum sustained yield levels. Not surprisingly, countries richly endowed with natural capital have the potential to derive significant current income from resources.

RESULTS

Payments for ecosystem services (PES) provide incentives for owners of natural resources such as farmers and forest owners to manage resources in order to provide ecological services. PES are defined as voluntary transactions in which a well defined environmental service is bought and sold by at least one buyer and one seller, provided that the seller actually ensures that the ecosystem service is provided (9). Key environmental services such as carbon sequestration, biodiversity protection, watershed protection, and landscape beauty may be targeted in a PES scheme (10). In order to be effective, then, PES systems must target a well-defined ecosystem service and ensure that payments add to the ecosystem service that would be provided under a business as usual scenario. Moreover, they must be able to monitor the provision of the ecosystem service. PES policies would in most instances complement other policies. The voluntary nature of PES means that they enjoy high legitimacy among participants. Payments are typically calculated on the basis of foregone revenue from resource use as well as costs incurred in providing the ecosystem service. PES systems are thus intended to maintain livelihoods while valuing, and paying for, the wider social benefits derived from ecosystem services. PES schemes are not particularly easy to design and implement and require a substantial amount of initial effort. Baselines for ecosystem services must be established in order to determine if PES provide additional value.(17) PES schemes also depend upon social capital embodies in the trust between buyers and sellers, and may require an intermediary such as an NGO to develop (11). Moreover, transaction costs may be high. Incorporating a PES scheme into the policy mix therefore necessitates a careful weighing of the costs and benefits of such a scheme in relation to other policy instrument options. However, PES schemes are increasing in number around the world, sometimes with the strategic support of the NGO and international communities. For instance, WWF has worked in Moldova, Romania, and Ukraine to identify land uses and environmental services that could trigger payments from the European Union and national agencies, thereby supporting rural residents and protecting the environment (12). Based on WWF‘s initiative, the Global Environment Facility has continued funding work in the Lower Danube Basin to mainstream PES schemes in an integrated river basin management context. The first PES project in Central Asia was launched in 2008 (16) by the Central Asia Regional Environmental Centre in Kyrgyzstan in cooperation with the Swiss government, the US Forest Service and the Global Environment Facility, and working with local stakeholders, including national and local authorities, the water user and pasture user associations, local experts and the local population. The project aims to improve the ecological health of alpine and sub-alpine ecosystems by making grazing practices more sustainable. The ecosystem services to be paid for are water supplies to the watershed, water quality, biodiversity and forest conservation, with upstream grazing farmers and national forest districts identified as sellers and irrigated agriculture farmers and tourists identified as buyers. Although this PES scheme has run into obstacles in the form of a low ability and willingness to pay for the environmental services and a limited understanding of the relationship between upstream grazing practices and downstream water quality, the project is providing a unique learning environment and is serving as a springboard for further PES schemes in the region (13).



CONCLUSION

Natural resources decision-making is often a source of debate and conflicting values. While there may never be complete consensus within a given country on exactly how to put the principles of sustainable resources management into practice in the case of renewable resources, or on how optimally to exploit non-renewable resources and how to invest the revenues, depending on how they are approached, decision making processes can help or hinder sustainability and social and economic development.(15) Natural resources policy is inherently complex, involving scientific uncertainties, complex natural systems, technical considerations and long time frames. At the same time, social and political developments throughout the world, in developed, developing and transition countries alike, have ushered in an era in which public participation and multi-stakeholder participation processes are demanded, expected and required under freedom of information and participation laws such as those implementing the Aarhus Convention. While it is understood that a diversity of decision making processes is necessary across national contexts as well as policy-specific contexts, some basic principles of decision making, consistent with the principles for good governance in general and for natural resources in particular, will apply to all decision making processes in the context of sustainable development, including: (14)

- Credible mechanisms for reporting outcomes of policy decisions and for fostering accountability of results;
- Coherence across government departments and levels of government; and
- A transparent and inclusive approach to decision-making, so as to confront conflicting interest and points of view and to address policy trade-offs when these arise (OECD, 2001).

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COVID-19 Has Devastated Indian Economy (2021)

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ABSTRACT: From April to June 2020, India's GDP dropped by a massive 24.4%. According to the latest national income estimates, in the second quarter of the 2020-'21 financial year (July-September 2020), the economy contracted by a further 7.4%, with the third and fourth quarters (October 2020-March 2021) seeing only a weak recovery, with GDP rising 0.5% and 1.6%, respectively. This means that overall rate of contraction in India was (in real terms, adjusted for inflation) 7.3% for the whole 2020-'21 financial year.

From April to June 2020, India's GDP dropped by a massive 24.4%. According to the latest national income estimates, in the second quarter of the 2020/21 financial year (July to September 2020), the economy contracted by a further 7.4%. The recovery in the third and fourth quarters (October 2020 to March 2021) was still weak, with GDP rising 0.5% and 1.6%, respectively. This means that the overall rate of contraction in India was (in real terms) 7.3% for the whole 2020/21 financial year.In the post-independence period, India's national income has declined only four times before 2020 – in 1958, 1966, 1973 and 1980 – with the largest drop being in 1980 (5.2%). This means that 2020/21 is the worst year in terms of economic contraction in the country's history, and much worse than the overall contraction in the world.The decline is solely responsible for reversing the trend in global inequality, which had been falling but has now started to rise again after three decades.While the macroeconomic statistics provide a snapshot of India's economic position, they hide the large and unequal effects on households and workers within the country.

Both wealth and income inequality has been on the rise in India . Estimates suggest that in 2020, the top 1% of the population held 42.5% of the total wealth, while the bottom 50% had only 2.5% of the total wealth . Post-pandemic, the number of poor in India is projected to have more than doubled and the number of people in the middle class to have fallen by a third .

During India's first stringent national lockdown between April and May 2020, individual income dropped by approximately 40%. The bottom decile of households lost three months' worth of income .

Microdata from the largest private survey in India, CMIE's 'Consumer Pyramids Household Survey' (CPHS), show that per capita consumption spending dropped by more than GDP, and did not return to pre-lockdown levels during periods of reduced social distancing. Average per capita consumption spending continued to be over 20% lower after the first lockdown (in August 2020 compared with August 2019), and remained 15% lower year-on-year by the end of 2020.

Official poverty data are unavailable, and the CPHS data come with a caveat of 'top' and 'bottom exclusions'. For example, official statistics show a rural headcount ratio of 35% in 2017/18 . But the CPHS data estimate it at 25%, which suggests exclusions at the lower end of the consumption distribution .Despite these statistical concerns, the CPHS does provide consumption numbers for a large sample of individuals, which can provide insights into changes in consumption levels arising from the pandemic.

I. INTRODUCTION

India, according to the 'Economic and Social Survey of Asia and the Pacific 2021: Towards post-COVID-19 resilient economies', is estimated to record an economic growth of 7 per cent in 2021-22, over a contraction of 7.7 per cent witnessed in the previous fiscal on account of the pandemic's impact on normal business activity.Observing that India entered the pandemic with subdued GDP growth and investment, the report said, "Following one of the most stringent lockdowns in the world, the economic disruptions that the country experienced mounted in the second quarter of 2020."[1]

It added that a subsequent change in lockdown policies and success in reducing infection rates supported an impressive economic turnaround in the third quarter."However, the pace of recovery moderated in the fourth quarter with estimated year-on-year growth still close to zero."Despite a robust reduction in new COVID-19 cases and the start of vaccine roll-out, India's 2021 economic output is expected to remain below the 2019 level," it added.[2]

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Figure 1:
Age distribution of COVID-19 patients in India



India is expected to grow at 7.2 per cent in 2021 but economic growth could decelerate next year, according to a United Nations report which said the recovery in the country is constrained by the ongoing human and economic cost of the COVID-19 pandemic and the negative impact of food price inflation on private consumption.[3]

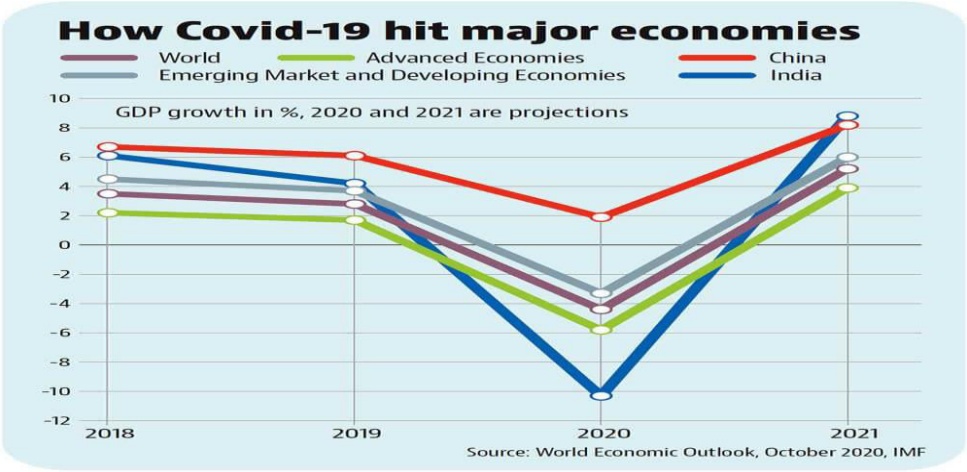


Fig.1b. The Economy fared

The UNCTAD Trade and Development Report 2021, released here on Wednesday, sounded a cautiously optimistic note to say that the global economy is set for a strong recovery in 2021, albeit with a good deal of uncertainty clouding the details at the regional and country levels over the second half of the year.After a 3.5 per cent fall in 2020, the United Nations Conference on Trade and Development (UNCTAD) expects world output to grow 5.3 per cent this year, partially recovering the ground lost in 2020.[4] The report said that India suffered a contraction of 7 per cent in 2020 and is expected to grow 7.2 per cent in 2021.The recovery in India is constrained by the ongoing human and economic cost of COVID-19, and the negative impact of food price inflation on private consumption, the UNCTAD report said.The report projects that India will clock an economic growth of 6.7 per cent in 2022, slower than the country's expected 2021 growth rate.However, even with a slower growth rate of 6.7 per cent, India will still be the fastest-growing major economy in the world next year.[5] India, which experienced a contraction of 7.0 per cent in 2020, showed a strong quarterly growth of 1.9 per cent growth in the first quarter 2021, on the back of the momentum of the

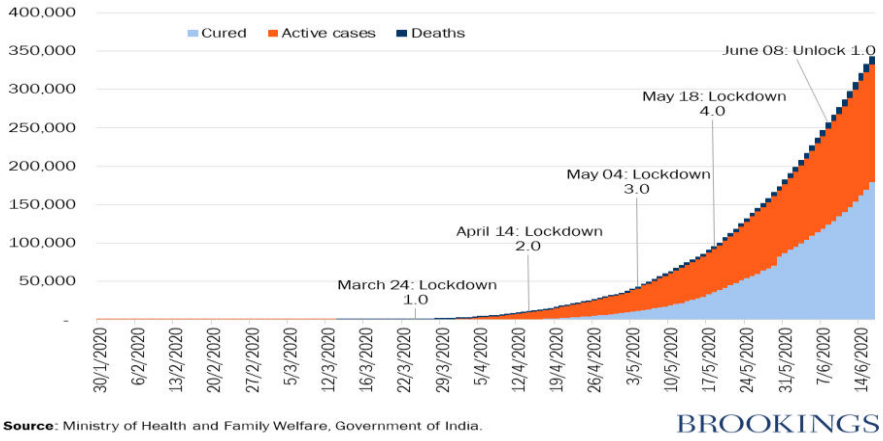
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second half of 2020 and supported by government spending in goods and services," the report said."Meanwhile, a severe and broadly unanticipated second wave of the pandemic, compounded by bottlenecks in the vaccine roll out, hit the country in the second quarter, on top of rising food and general price inflation, forcing widespread lockdowns and drastic consumption and investment adjustments, it said.It noted that income and wealth inequalities in the country have widened, and social unrest has increased.The Central Bank [6] estimates another sharp contraction (quarter-on-quarter) in the second quarter followed by a rebound afterwards.[7]

Figure 1. Total (cumulative) number of cases of COVID-19 in India



Source: Ministry of Health and Family Welfare, Government of India. BROOKINGS

Given the inherent fragilities in coping with the pandemic and restoring employment and incomes, growth in 2021 as a whole is estimated at 7.2 per cent, insufficient to regain the pre-COVID-19 income level," the report said."Going forward, assuming away a resurgence of the pandemic to the degree experienced in the second wave, a revitalisation of private sector activity, subject still to a slow recovery of jobs, is likely to be matched with a more adverse policy environment, especially on the fiscal front, and with continuing pressures on the trade balance. On these conditions, the economy is expected to decelerate to 6.7 per cent growth in 2022, the report said.Further, it said that in India, consumer inflation was already at 6 per cent before the pandemic. The COVID-19 shock caused a temporary dip in prices, but as the economy recovered and food prices accelerated, the country returned to a 6 per cent inflation rate in mid-2021.[8]
The UNCTAD said that global growth is expected to hit 5.3 per cent this year, the fastest in almost half a century, with some countries restoring - or even surpassing - their output level of 2019 by the end of 2021."The global picture beyond 2021, however, remains shrouded in uncertainty, it said, adding that looking ahead, the UNCTAD expects world output to grow 3.6 per cent in 2022.South Asia [9] suffered a sharp contraction of 5.6 per cent in 2020, with the region's economic activity brought to a halt thanks to widespread restrictions.Deficient public healthcare systems and high levels of informality magnified the impact of the pandemic in terms of both health and economic outcomes,[10] which was reflected in a stark rise in poverty rates, the report said. The UNCTAD expects the region to expand by 5.8 per cent in 2021, with the more vigorous recovery signalled at the beginning of the year muted by a rapid surge in infections during the second quarter of 2021.Moreover, the limited progress made in terms of vaccine rollouts continues to leave the countries of the region susceptible to future outbreaks. For 2022, the UNCTAD expects the region's growth rate to moderate to 5.7 per cent.The US is projected to grow at 5.7 per cent in 2021 followed by a three per cent GDP growth next year.[11]

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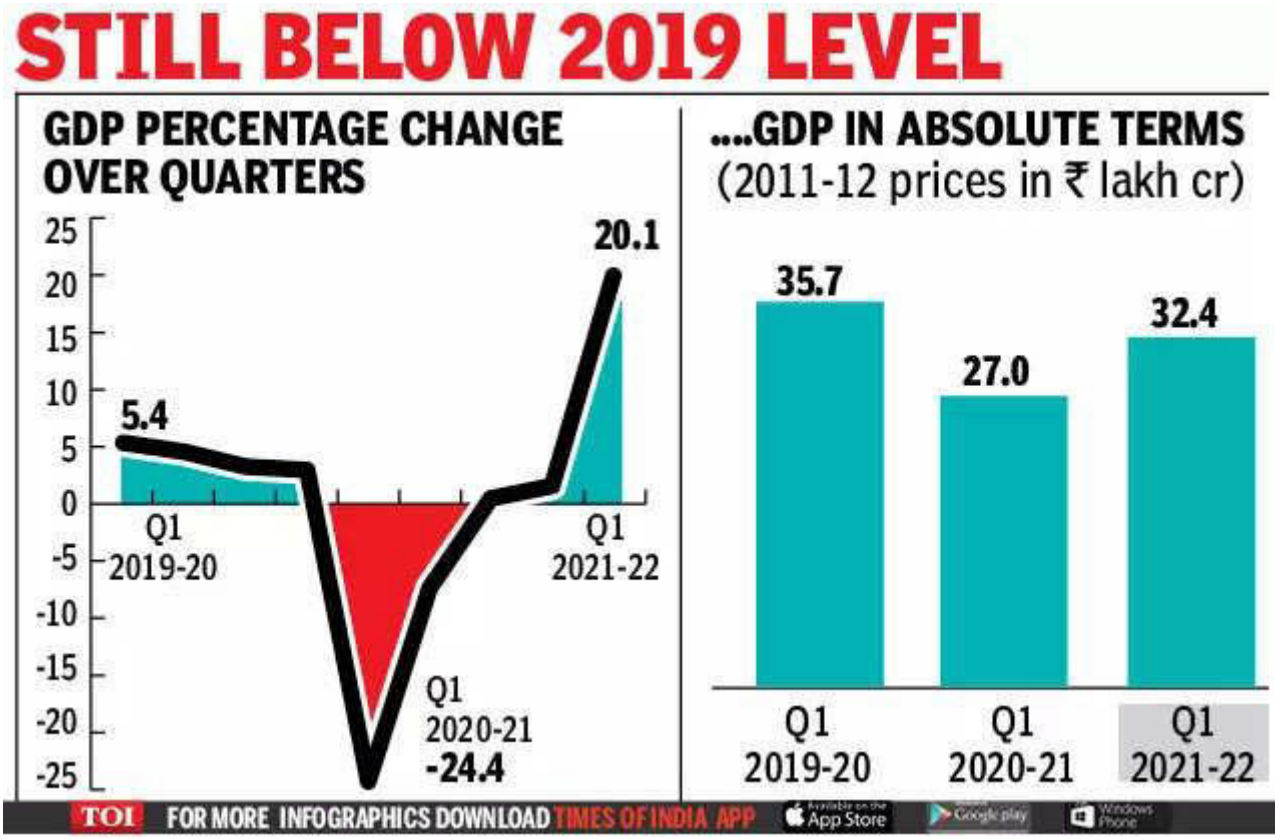


Fig.2. India GDP growth

II. OBSERVATIONS

The last financial year (2020-21) started with the whole country being under one of the strictest (and, grossly ill-planned) lockdowns anywhere in the world. But at that time few would have thought that April 2021 would be worse in terms of Covid cases than April 2020. Indeed, initial government estimates last year suggested that there won't be any new Covid cases after 16th May 2020.However, as the chart below shows, Covid cases have registered a "V-shaped" recovery . At the last count, India had 1.75 times more daily cases now than the past peak, which was in September 2020.[12]

The spread of COVID-19 in India was initially characterized by fewer cases and lower case fatality rates compared with numbers in many developed countries, primarily due to a stringent lockdown and a demographic dividend. However, economic constraints forced a staggered lockdown exit strategy, resulting in a spike in COVID-19 cases. This factor, coupled with low spending on health as a percentage of gross domestic product (GDP), created mayhem because of inadequate numbers of hospital beds and ventilators and a lack of medical personnel, especially in the public health sector. Nevertheless, technological advances, supported by a strong research base, helped contain the damage resulting from the pandemic.[13]

The day Prime Minister Narendra Modi first declared the 21 days of lockdown he also warned that this lockdown will have a negative economic impact and we have to pay the price for it. The All India Association of Industries (AIAI) estimated loss for Indian economy slated to be $640 million with growth slated to be between 5 and 5.6% till 2022 [15] After the first lockdown phase, within 7 days, electricity demand reduced to 30%, traffic in port became 5% less, oil demand lessened by 70%, and Indian rail activity was below 36% compared to last year The unemployment rate increased to 19% after a month of lockdown and overall unemployment was 26% across India by 24th April. Hence, the lockdown has a havoc impact on small, medium, and large enterprises of the country, which led to no job and economic downturn condition [14]

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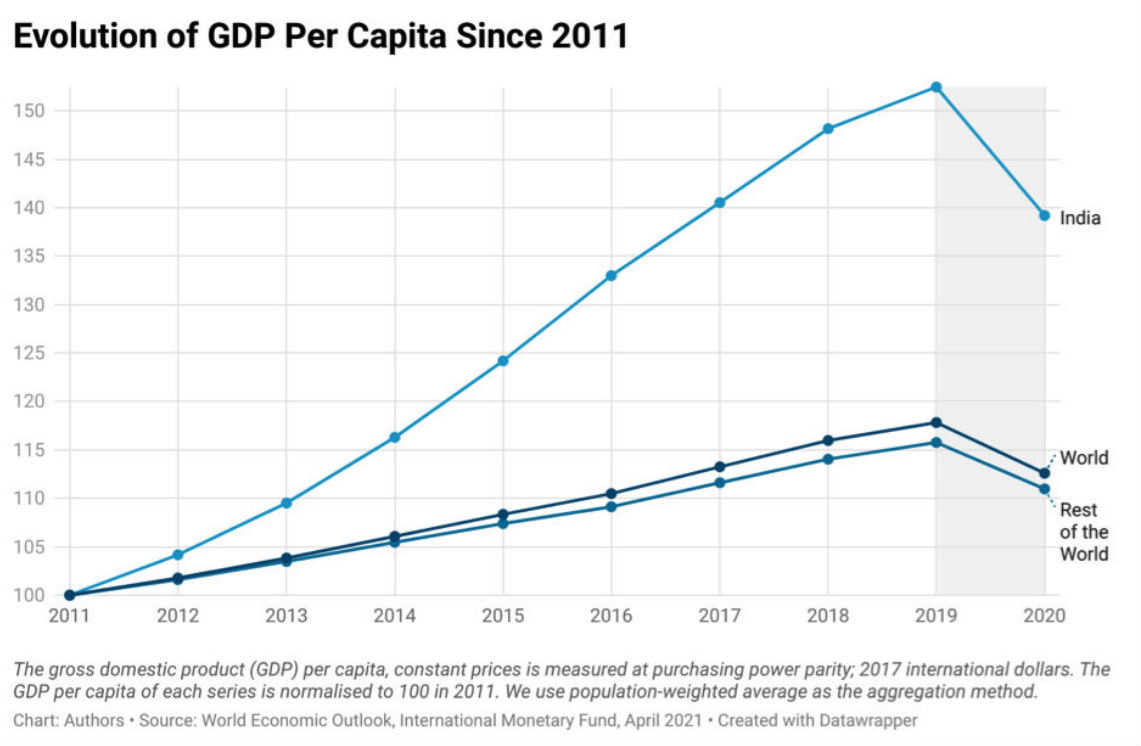


Fig.3. Devastation of Indian economy

III. DISCUSSION

After a harrowing Q1 and Q2 data in the view of Covid 19, the Indian economy has started to ghain momentum. [44] In a good news for the economy of the country, the Ministry of Statistics and Programme Implementation on Friday stated that the GDP in the third quarter of 2020-21 shows growth at 0.4 per cent. With this, the country's economy is now out of a technical recession after two consecutive quarters of degrowth. [16]

"Sectors witnessing positive GVA growths during Q3 2020-21 over Q3 2019-20 are: Agriculture, Forestry & Fishing (3.9%); Manufacturing (1.6%); Electricity, Gas, Water Supply & Other Utility Services. Construction (6.2%); and, Financial, Real Estate & Professional Services (6.6%)," said Ministry of Statistics and Programme Implementation[17]

According to the Asian Development Outlook (ADO) 2020, the Asian Development Bank's (ADB) annual flagship economic publication, [43] the regional economic growth in developing Asia will decline sharply in 2020 due to the effects of the COVID-19 pandemic.[18]

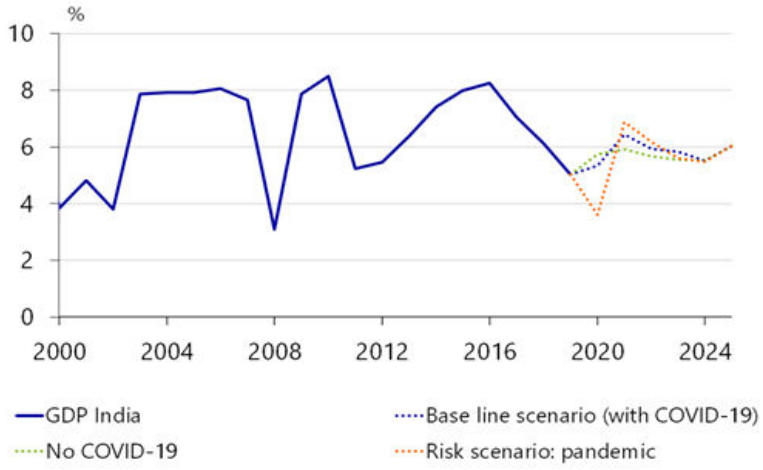


Fig.4. COVID-19 Impact

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The Bank's five largest stakeholders are the US (15.6 percent), Japan (15.6 percent), China (6.4 percent), India (6.3 percent), and Australia (5.8 percent).[42]

The report forecasts regional growth of 2.2 percent in 2020, a downward revision of 3.3 percentage points relative to the 5.5 percent ADB had forecast in September 2019. Growth is expected to rebound to 6.2 percent in 2021, assuming that the COVID-19 outbreak ends. Excluding the newly industrialized economies of Hong Kong, China, South Korea, Singapore, and Taiwan, developing Asia is forecasted to grow 2.4 percent this year, compared to 5.7 percent in 2019, before rebounding to 6.7 percent in 2021.[19]

Concerning India, the ADB stated that "Growth in India will remain subdued after a disappointing 2019.[40] India suffered a sharp slowdown last year, from 6.1% in fiscal 2018 to 5.0%, as a credit crunch that originated in the non-banking financial sector severely hampered bank lending. COVID-19 has not yet spread extensively in India, but measures to contain the virus and a weaker global environment will whip up headwinds, [41]offsetting support from corporate and personal income tax cuts as well as financial sector reforms which are meant to revive credit flows. GDP growth in India is forecast to slow further to 4.0% this year before strengthening to 6.2% in fiscal 2021. Inflation in the subregion will soften to 4.1% in 2020 as food inflation eases in India with improved agriculture." [20]

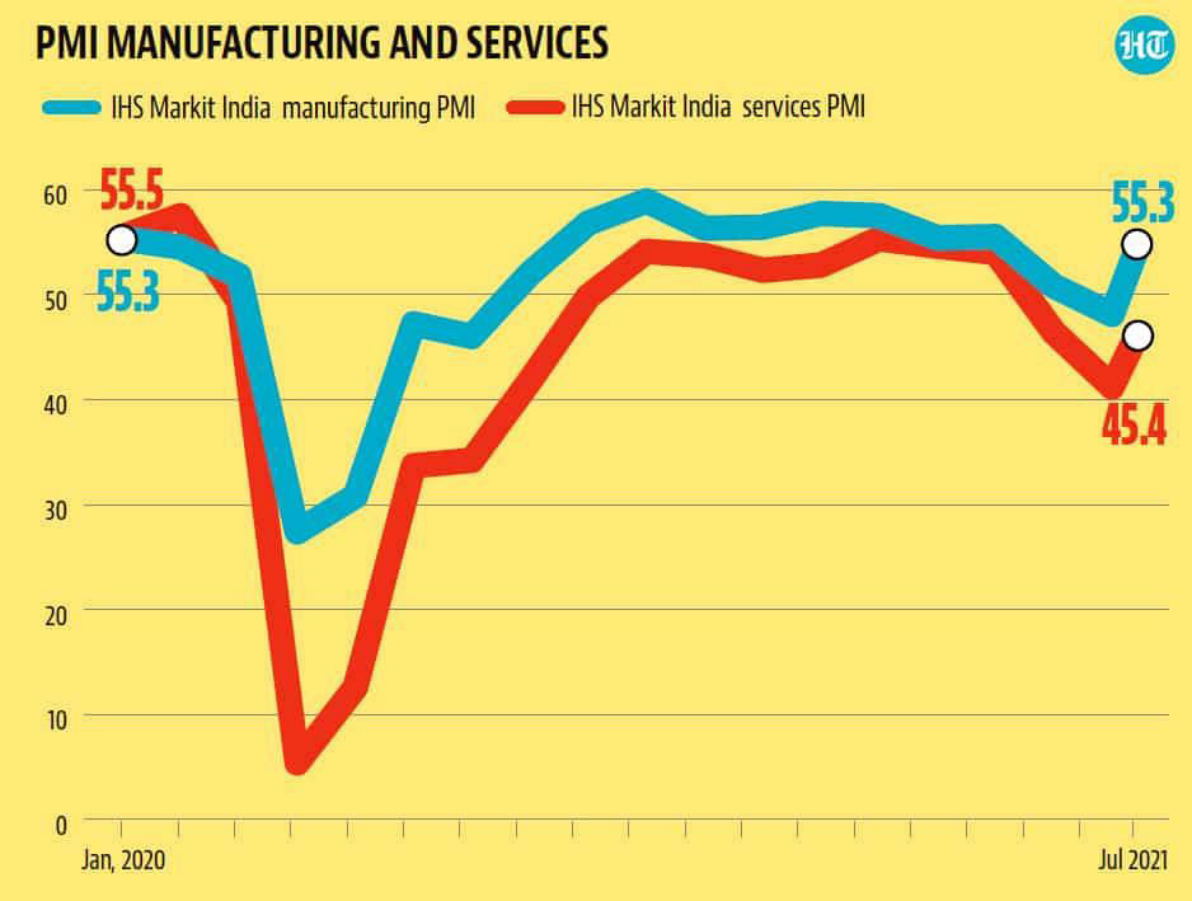


Fig.5. COVID-19 held back Indian economy

V. RESULTS

Union Finance Minister Nirmala Sitharaman said India has not only faced the COVID-19 crisis with great resilience and fortitude but has also played a major role and "walked the talk" on the global fight against it.Pointing out the fast recovery of India's economy, Sitharaman in her address to the Development Committee [39] of the World Bank said the Modi Government, besides taking economic relief measures, has also undertaken significant structural reforms to turn the crisis into an opportunity and emerge stronger.The measures undertaken by the government have set a strong foundation for India's sustained economic growth," she said.[21]

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According to the International Monetary Fund's World Economic Outlook, India is estimated to be the fastest-growing major economy in 2021, projected to grow at 9.5 per cent in 2021 and 8.5 per cent in 2022.[22]
Observing that despite the pandemic, India received its highest ever FDI inflows of USD82.0 billion in fiscal 2020-21, the finance minister said this trend in India"s FDI is an endorsement of its status as a preferred investment destination amongst global investors.Addressing the Development Committee meeting, Sitharaman said India has faced the COVID-19 crisis with great resilience and fortitude.[23]

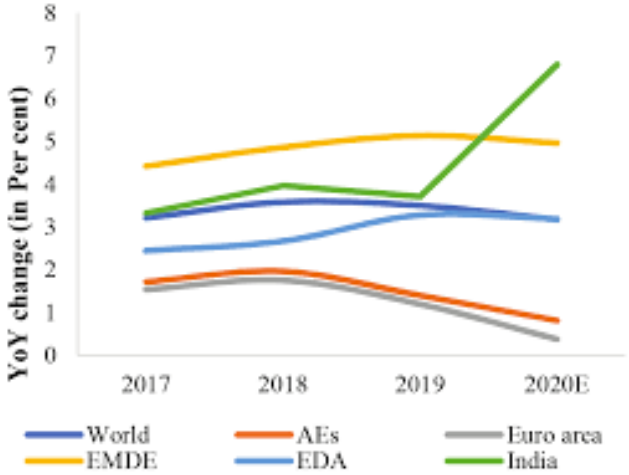


Fig.6. State of economy

The country's pandemic response has focused on the twin goals of saving both the lives and livelihoods, she said."When faced with the second wave of infections, India again mounted a carefully calibrated and dynamic response to the evolving situation. Given that the second wave was asynchronous in its onset across states and wider in its spread, only localised lockdowns were imposed during the second wave," she said.[24]
This approach aided reduction in cases in the COVID-19 hotspots without dampening economic activity in regions with fewer cases, she said.
"Despite a more brutal second wave, India's GDP grew at 20.1 per cent YoY during April-June quarter of 2021, recovering more than 90 per cent of the corresponding pre-pandemic output levels of 2019," she added.[25]
The broad-based and swift recovery of both the demand and supply-side components reaffirms India's resilient recovery and strong macroeconomic fundamentals.[38]
"With the easing of the COVID-19 restrictions, GST collections for July, August and September 2021 have crossed the INR 1 trillion mark, which testifies to the fact that the economy is recovering at a fast pace. The robust GST revenues are expected to continue in the coming months too as the economic recovery gathers momentum," the finance minister said.
India, she said, is one of the frontrunners in the global vaccine deployment race with the second-highest total number of COVID-19 vaccines administered all over the world.[26]
As of September 30, India has administered 951.35 million doses, covering 72.8 per cent of the 18 years (as on August 10, 2021) and above population with at least one dose of COVID-19 vaccine.[37]
"India has also played a major role and truly 'walked the talk' on the global COVID-19 effort. India's massive Vaccine Maitri programme, under which more than 66.3 million doses of COVID-19 vaccines were exported to 95 countries worldwide bears special mention. India is all set to resume vaccine export in October 2021," she said.[27]
India also made its digital platform for COVID-19 vaccination, CoWIN, an open-source for all countries to access, adapt and use. India is also at the forefront of multilateral efforts, including the Quad plan for the production of one billion vaccines to be offered to South-East Asian countries, she added.
Sitharaman said in addition to economic relief measures, India has undertaken significant structural reforms to turn the crisis into an opportunity and emerge stronger.These reforms across diverse areas include agriculture and food processing, commercial coal mining, financial support to MSMEs and change in definition with increased thresholds, production linked incentive schemes to boost manufacturing, privatisation of PSUs and asset monetisation, increased FDI limit in defence and insurance are amongst the most notable reforms and have set a strong foundation for India's post-COVID economic growth, she said.Production Linked Incentive (PLI) schemes have been introduced across key

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sectors [36] to create national manufacturing champions and generate employment opportunities for the country's youth. [28] "The objective is to make India a bigger and more important part of the global economy by pursuing policies that are efficient, competitive and resilient," she said.Observing that Infrastructure development has assumed a major focus in strengthening India's economic recovery, the finance minister said India has a robust National Infrastructure Pipeline (NIP) which is a first-of-its-kind, whole-of-government exercise to provide world-class infrastructure."Measures have been undertaken to promote ease of doing business with rational tax systems, simple and clear laws, reducing compliance burden and leveraging technology for better compliance," she said.[29]

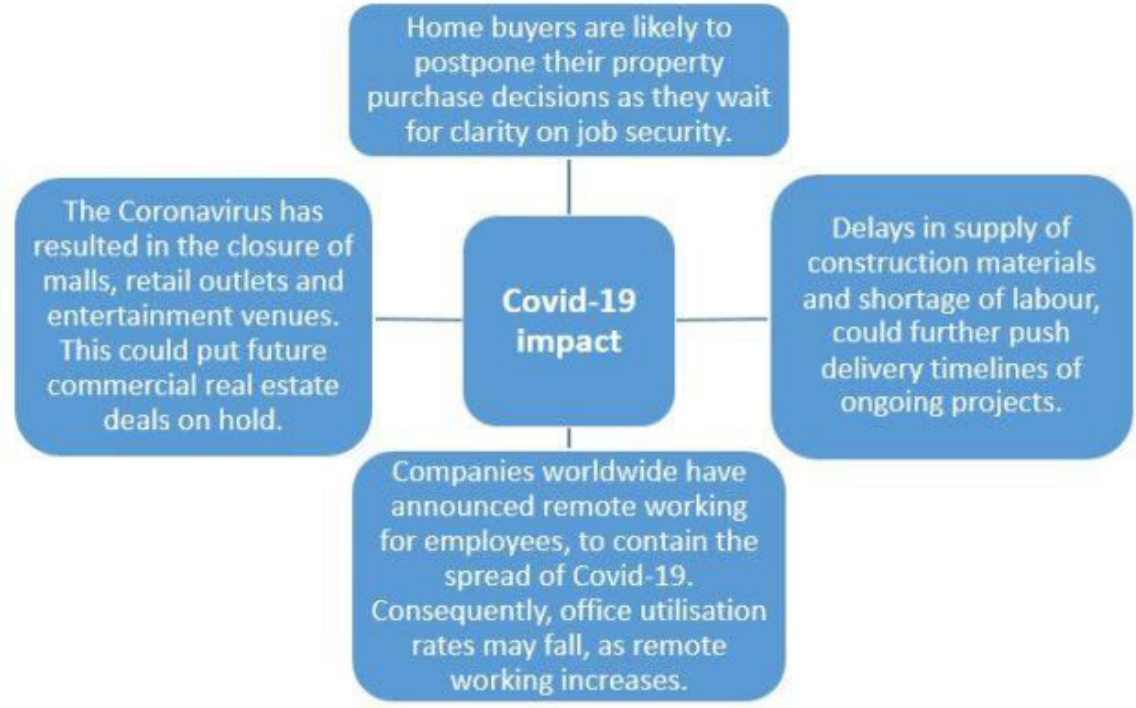


Fig.7. Impact of Corona on real estate and property price

"As a recent major initiative, the government has taken steps to scrap the retrospective tax law which would help resolve tax disputes and boost investor confidence," she added.[30]

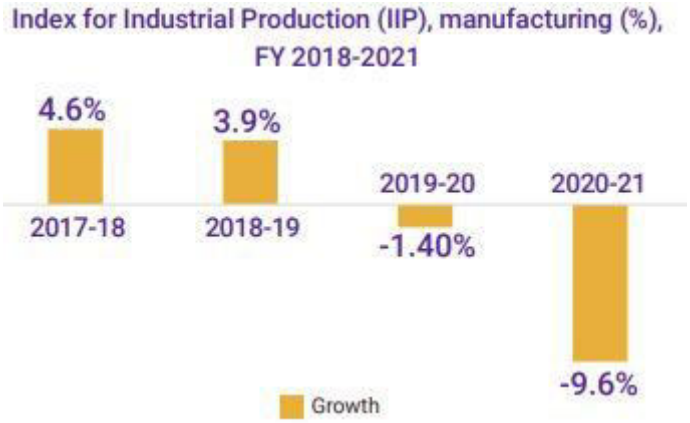


Fig.8

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"Despite the pandemic, India received its highest ever FDI inflows of USD 82.0 billion in FY 2020-21. The trend in India"s FDI is an endorsement of its status as a preferred investment destination amongst global investors," said the Union finance minister.[31]

VI. CONCLUSION

After the migrant workers' crisis during the lockdown, the focus has shifted to reverse migration. There are already reports of workers returning from their homes, where they could not find gainful employment. Incidentally, MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) has already been used by more than 86 million people in the first half of 2020-21. Therefore, the possible way through this recessionary trend in industry is to provide input tax concessions. [35] Reducing or abolishing input taxes for some time (say, initially for a year) can be a starting point. It is quite comprehensible that the government is in no position to provide input subsidies to all sectors. The process may start with the top five manufacturing in terms of weightage – metals, oil, chemicals, processed food and automobile.[32] Pharma can be, for the time being, kept out of this scheme. [34] Once some of the initial beneficiary sectors revive themselves, those can be taken out and replaced by others – machinery & equipment, textiles, electrical equipment being the prominent among those. The government has already made use of the flexibility enshrined in the FRBM Act under exceptional circumstances in 2019-20 and 2020-21 budgets, with targeted budget deficits put 0.5 percent (of GDP) higher than the FRBM mandated ones. Conforming with the FRBM leaves almost no fiscal space for any stimulus now. But there is always a case for suspension of the FRBM Act.[33]

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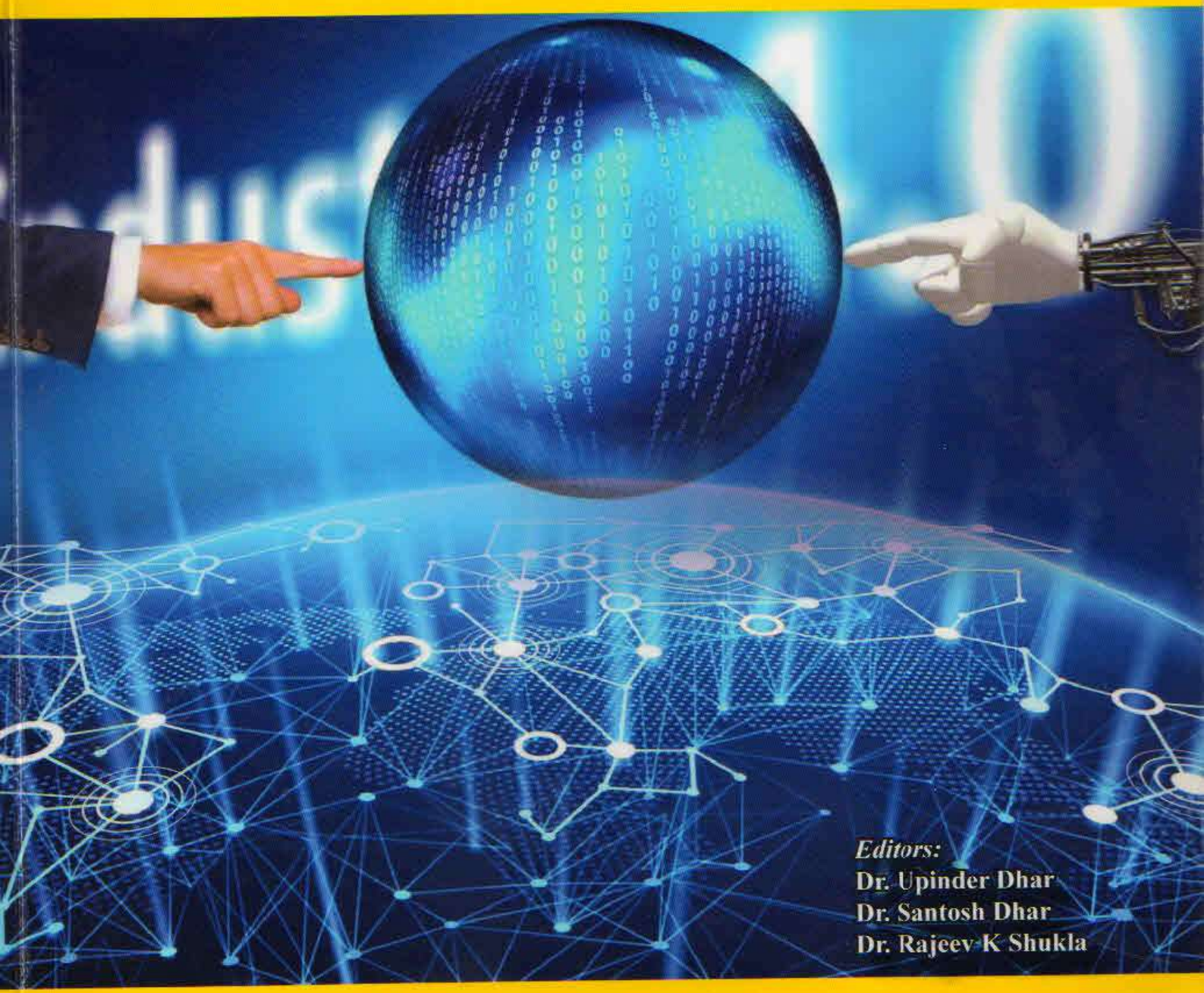
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Decoding Industry 4.0 for Inclusive and Sustainable Growth



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9

Effect of Gender on Customer Perception towards Service Quality of Post Offices

Sapana Sharma Saraswat[1], Lalita Sahu[2]

ABSTRACT

The department of posts has touched the life of every citizen, be it through mail, banking, life insurance, money transfer or retail services. Post offices have become undoubtedly one of the trusted partners of the customers for variety of services and a reliable vehicle for fulfillment of governments' social welfare obligations. The postal department has also undertaken social benefit payments, such as MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) and social security pension schemes. In order to meet the new developments and challenges, the services provided by the Department of Posts are being both upgraded, as well as, diversified and new services are being introduced. The present study was intended to know gender effect on customers' perception towards service quality of post office services. The study revealed gender-wise significant difference in customers' perception towards responsiveness dimension of service quality of post offices. Whereas, irrespective of gender, respondents have given same importance to Reliability, Tangibility, Empathy, Comfort, Operational safety, Facilities and Ease of using post office services.

Keywords: Customer Perception, Service Quality, Post Office.

INTRODUCTION

The department of posts has touched the life of every citizen, be it through mail, banking, life insurance, money transfer or retail services. As on 31.03.2018, it had a network of 155531 post offices in the country, the largest in the world, of which 139882 (89.94 per cent) are in the rural areas and 15649 (10.26 per cent) are in urban area (India Post Annual Report 2018-2019). The postal service comes under the department of posts, which is a part of the Ministry of Communications and Information Technology, Government of India. The apex body of the department is the Postal Service Board. The board consists of a chairman and six members. The six members of the Board hold

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portfolios of Personnel, Operations, Technology, Postal Life Insurance, Human Resource Development (HRD) and Planning functions. The Joint Secretary and Financial Advisor to the Board is also a permanent invitee to the Board. India has been divided into 22 postal circles, each circle is headed by a Chief Postmaster General. Each Circle is further divided into Regions comprising field units, called Divisions, headed by a Postmaster General. Other functional units like Circle Stamp Depots, Postal Stores Depots and Mail Motor Service may exist in the Circles and Regions. Besides 23 circles, there is a special Circle called the Base Circle to cater to the postal services of the Armed Forces of India. The Base Circle is headed by an Additional Director General, Army Postal Service holding the rank of a Major General.

The core activity of the Department is processing, transmission and delivery of mail. Mail is collected from more than 5.62 lakh letter boxes, processed by the network of Mail Offices and conveyed by rail, road and airlines all over the country to reach the addressee. While the core activity of the department is processing, transmission and delivery of mail, there are also a diverse range of retail services undertaken by the department which include money remittance, banking, as well as, insurance. Postal operations at the post office counter encompass the entire gamut of basic postal services that include sale of stamps, booking of registered articles, insured articles, value payable articles, remittance of money through e-MO (e-money orders), i-MO (Instant Money Order), which makes money to reach in minutes, mobile to mobile money order, booking of parcels and savings bank services. More recently, the postal department has undertaken social benefit payments, such as MGNREGA and social security pension schemes. In order to meet the new developments and challenges, the services provided by the department of posts are being both upgraded, as well as, diversified and new services are being introduced.

A major IT modernization project is in the process of being implemented. Business process re-engineering and improving operational efficiency are the focus of attention. However, quality of these service offerings and the need for adoption of new schemes needed by the customers could be revealed by surveying the customers' perception. The present study was carried out to know gender effect on customers' perception towards service quality of post office services. Customer perceptions are influenced by a variety of factors. Besides the delivery of actual products or services the peripheral functions and attributes associated in the process of service delivery and customers' expectations from the services also influenced actual satisfaction derived by customers from the services. Objective service quality is the concrete measurable conformity of a working result with the previously defined benefit; since the measurability is a remarkable dependent on the definition's accuracy, a measurable quality criterion can easily turn out

as a subjective one. Subjective service quality is the customer's perceived conformity of the working result with the expected benefit; this perception is overlaid with the customer's original imagination of the service and the service provider's talent to present his performance as a good one.

SERVICES OF POST OFFICE

Speed Post

It is an express mail service for letters and documents offered in league with the international EMS service for corporate customers. Speed Post provides home collection, credit facilities, on-line tracking.

Logistics Post

It was launched in 2004-05 to carry parcels and large consignments across the nation and around the world.

Parcels

It is for sending parcels weighing up to 35 kg across and outside the country.

Media Post

Advertisements sent by media companies on post cards, letters, walls of post offices, letter boxes, stationary etc. In media post, post office provides the facility for vehicle.

Direct post

Distribution of advertising materials directly to prospective customers. This mail is posted without address of addressee/addressee(s) and delivered in indicated area either locally or other different destinations.

Non-Postal Services

Postal Life Insurance

Postal Life Insurance was started as a welfare measure for the employees of Posts and Telegraphs Department under Government of India.

E-Payment

E-Payment is a 'Many to One' service through which bills (telephone, electricity, etc.) paid by customers in post offices are electronically consolidated.

Instant Money Order Service (IMO)

The instant domestic money order facility is available with selected post offices in India.

International Money Transfer

As a result of the collaboration of the Department of Posts with the Western Union Financial Services, state of the art international money transfer service is available through post offices in India.

Other Financial Services

The post office has also traditionally served as a financial institution for millions of people in rural India. Currently these are some of the activities being supported:

- Public Provident Fund
- National Savings Certificate
- Kisan Vikas Patra
- Savings Bank Account
- Monthly Income Scheme
- Recurring Deposit Account
- i-Code Job card sold for employment opportunities
- Idendity card for Residence proof to general public.

REVIEW OF LITERATURE

Mishra and Damodaran (2004) argued that the Post office continues to be a major attraction for savers and the attraction for the Post office deposit schemes stems from the higher interest rate they offer vis-à-vis what banks give. Das (2011) revealed that the association between the education and occupation of respondents and their preferred

investment avenue were not found to be significant in case of postal saving schemes. Scherj (2001) observed that in many countries Postal Savings have long enabled provision of financial services to all segments of the population. He also argued that developing countries can help themselves to mobilize domestic savings and provide domestic financial services through postal savings and thereby provide financial services to those most likely to be excluded. G H.S and Jacob (2009) concluded that for India Post, to be successful in competition with other private competitors, it must be ready to offer high-quality IT-related services. More awareness must be created among the people about the schemes introduced and the reach of the schemes must be checked. This will also represent a significant growth opportunity for India Post beyond its current business base. Technology will continue to remain a key driver of its business practices across the country.

Karthikeyan (2001), found in his study that there was significant difference among the four age groups, in the level of awareness for Kisan Vikas Patra (KVP), National Savings Schemes (NSS), and Deposit Scheme for Retired Employees (DSRE), and the overall score confirmed that the level of awareness among investors in the old age group was higher than in those of the young age group. No difference was observed between male and female investors except for the NSS and KVP schemes. Out of the factors analyzed, necessities of life and tax benefits were the two major ones that influenced the investors both in semi-urban and urban areas. Majority (73.3 per cent) of investors of both semi-urban and urban areas were very much willing to invest in small savings schemes in future provided they have more for savings.

Reliability, Responsive, Assurance, Empathy, and Tangibles were considered as major determinants of Service Quality for the study.

Reliability: The ability to perform the promised service dependably and accurately.

Responsiveness: The willingness to help customers and to provide service.

Assurance: - The knowledge and courtesy of employees and their ability to convey trust and confidence.

Empathy: The provision of caring individualized attention to customers.

Tangibles: The appearance of physical facilities, equipment, personnel and communication materials.

OBJECTIVES OF THE STUDY

- To know customer perception towards services of Post Offices
- To study the effect of gender on customer perception towards service quality of Post Offices

HYPOTHESES

Following hypotheses were framed for the study and tested at 5% level of significance.

- **H_1:** Gender-wise there is significant difference in customers' perception towards tangibility of post offices.
- **H_2:** Gender-wise there is significant difference in customers' perception towards reliability of post office services.
- **H_3:** Gender-wise there is significant difference in customers' perception towards responsiveness of post office services.
- **H_4:** Gender-wise there is significant difference in customers' perception towards empathy shown by employees of post offices.
- **H_5:** Gender-wise there is significant difference in customers' perception towards convenience of post office services.
- **H_6:** Gender-wise there is significant difference in customers' perception towards operational safety of post offices.
- **H_7:** Gender-wise there is significant difference in customers' perception towards facilities of post offices.
- **H_8:** Gender-wise there is significant difference in customers' perception towards ease of using the post office services.

RESEARCH METHOD

Type of Research - Descriptive in nature based on survey design.

The Sample- Non-probabilistic purposive sampling method was used for the study. Data was collected from 100 respondents. Users of post office services were considered as sampling unit for the study.

Data Collection- Books, internet websites, magazines, journals etc. were used as source of secondary data collection. Primary data for the study was collected through structured questionnaire. Questions were framed in such a way that the answers reflect the ideas and thoughts of the respondents with regard to level of their perception in Likert scale ranging from 1 to 5 (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5=Strongly Agree).

RESULTS AND DISCUSSION

Table 1 exhibits that 53% of the respondents were male and 47% were female.

TABLE 1: Gender status profiling of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	53	53.0	53.0	53.0
	Female	47	47.0	47.0	100.0
	Total	100	100.0	100.0	

It is exhibited in Table 2 that gender-wise significant difference observed in customers' perception towards responsiveness dimension of service quality in post offices. So, hypothesis H_3 was not rejected. The study also revealed that gender-wise there was no significant difference observed in customers' perception towards Tangibility, Reliability, Empathy, Comfort, Operation safety, Facilities and Ease of using post office services dimensions of post office services. So, hypotheses H_1, H_2, H_4, H_5, H_6, H_7 andH_8 were rejected.

Male respondents were found to be relatively more concerned than female respondents towards Reliability, Responsiveness, Empathy, Convenience, Operation safety dimensions of service quality in post offices. Whereas, Ease of using post office services and Facility conditions of post office services were considered more important service quality dimensions by female respondents (Table 3).

This finding of the study is also supported by previous studies. (Karthikeyan, 2001) observed that there was no significant difference found between male and female customers as well as among different age group of customers towards services of post offices except for the NSS (National Saving Schemes) and KVP (Kisan Vikas Patra) and DSRE (Deposit Scheme for Retired Employees). Similarly, Das (2011) revealed in his research study that the association between the education and occupation of respondents and their preferred investment avenue were not found to be significant.

CONCLUSION

The present study was an attempt to know gender effect on customers' perception towards service quality of post office services. The study revealed gender-wise significant difference in customers' perception towards responsiveness dimension of service quality of post offices. It was also observed that irrespective of gender

respondents have given same importance to Reliability, Tangibility, Empathy, Comfort, Operational safety, and Ease of using dimensions of post office services. More awareness drive programs is needed to spread information regarding the postal services and newly introduced schemes. The upgradation of technology and adoption of new technology will be helpful providing better services to customers and in attracting more customers for post office services.

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TABLE 2: Test between groups of Male and Female respondents for their perception towards service quality of post office services

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2-tailed)
Tangible	Equal variances assumed	.308	.580	.832	98	.408
	Equal variances not assumed			.829	95.179	.409
Reliable	Equal variances assumed	.292	.590	.950	98	.344
	Equal variances not assumed			.953	97.346	.343
Responsiveness	Equal variances assumed	.081	.777	1.872	98	.044
	Equal variances not assumed			1.871	96.404	.044

Empathy	Equal variances assumed	.854	.358	1.347	98	.181
	Equal variances not assumed			1.340	94.206	.183
Convenience	Equal variances assumed	6.869	.010	.564	98	.574
	Equal variances not assumed			.571	97.033	.569
Operation safety	Equal variances assumed	3.094	.082	.534	98	.595
	Equal variances not assumed			.539	97.772	.591
Facility condition	Equal variances assumed	1.390	.241	-.131	98	.896
	Equal variances not assumed			-.132	97.815	.895
Ease of using	Equal variances assumed	.913	.342	-.684	98	.495
	Equal variances not assumed			-.694	96.424	.489

TABLE 3: Gender-wise mean and standard deviation for customers' perception towards service quality of post office services

	Gender	N	Mean	Std. Deviation
Tangible	Male	53	3.5283	.85093
	Female	47	3.3830	.89545
Reliable	Male	53	3.2123	.68007
	Female	47	3.0851	.65374
Responsiveness	Male	53	3.4245	.66632
	Female	47	3.1738	.67114
Empathy	Male	53	3.3396	.75530
	Female	47	3.1277	.81813
Convenience	Male	53	3.0503	.97050
	Female	47	2.9504	.77702
Operation Safety	Male	53	3.0629	.98938
	Female	47	2.9645	.83474
Facilities	Male	53	2.9528	1.02029
	Female	47	2.9787	.94384
Ease of Using	Male	53	3.6289	.99284
	Female	47	3.7518	.77231

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RESEARCH ARTICLE

आधुनिक कृषि व्यवस्था में किसानों की सामाजिक अध्ययन

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ABSTRACT:
हाल ही में, एक शोध रिपोर्ट के अनुसार वैश्विक स्मार्ट खेती बाजार में 2022 तक 1.64 लाख करोड़ रूपये के आँकड़े तक पहुँचने की संभावना व्यक्त किया गया है। इसमें खेती में बुआई से लेकर कटाई तक की प्रक्रिया को बढ़ावा देने सहित लगभग सभी जानकारी शामिल हो रहा है। भारत कर्नाटक, आन्ध्रप्रदेश, तेलंगाना, गोवा एवं गुजरात जैसे राज्यों में कई प्रगतिशील किसान डिजिटल खेती कर रहे हैं।

KEYWORDS: डिजिटल कृषि, स्मार्ट खेती, MSP, KCC, New India, किसान सम्मान निधि।

INTRODUCTION:

भारत एक कृषि प्रधान देश है। यहाँ कृषि, जीडीपी में अपना महत्वपूर्ण स्थान रखता है। कृषि क्षेत्र में बढ़ती समस्याओं और अनिश्चितताओं के बीच डिजिटल खेती बेहतर विकल्प के रूप में सामने आया है। खर्चीला होने के बावजूद भारत सहित कई एशियाई देशों में इसकी ओर बड़े किसानों के साथ सीमान्त किसानों का रूझान बढ़ रहा है। यूरोप, पश्चिमी एशिया, लेटिन अमेरिका और अमेरिका में डिजिटल प्रयोग तेजी से बढ़ रहा है। नई तकनीकों और उपकरणों के प्रयोग में शुरूआती लागत अवश्यक आती है, पर लम्बे समय में खेती की लागत काफी घट जाती है।

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डिजिटल खेती में बुआई से लेकर निराई, खरपतवार के निपटान, फसल की देखरेख, फसल की कटाई एवं फसल विक्रय तक की प्रत्येक प्रक्रिया की सम्पूर्ण जानकारी शामिल है। हाल ही में, एक शोध रिपोर्ट के अनुसार वैश्विक स्मार्ट खेती बाजार में 2022 तक 1.64 लाख करोड़ रूपये के आँकड़े तक पहुँचने की संभावना व्यक्त किया गया है। केन्द्र व राज्य सरकार द्वारा कृषकों की अधिकतर समस्याओं को ध्यान में रखते हुए विभिन्न प्रयास किए हैं। 2018–19 के बजट में सरकार ने सभी अधिसूचित वस्तुओं के लिए न्यूनतम समर्थन मूल्य (MSP) उत्पादन की लागत का 1.5 गुना तय किया है। प्रधानमंत्री अन्नदाता आय अभियान, दालों एवं तिलहन के उत्पादन को बढ़ावा दे रहें है। 2016 में प्रधानमंत्री बीमा योजना की शुरूआत किए हैं, इससे कृषक कल्याण परिप्रेक्ष्य में प्रधानमंत्री किसान सम्मान निधि योजना का महत्व स्पष्ट हो जाता है। 6 करोड़ से अधिक किसानों को किसान क्रेडिट कार्ड (Kisan Credit Card - KCC) देने का लक्ष्य रखा गया है। यह समय नए भारत (New India) के निर्माण का दौर है, जहाँ किसानों के

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RESEARCH ARTICLE

ग्रामीण विकास में पंचायती राज की भूमिका

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ABSTRACT:

प्रस्तुत शोध अध्ययन ''ग्रामीण विकास में पंचायती राज की भूमिका'' में अध्ययन क्षेत्र राजनांदगाँव जिले के तीन जनपद पंचायतों एवं ग्राम पंचायतों का चयन किया गया। जिसके अन्तर्गत् सचिव, सरपंच, उपसरपंच एवं पंचों पारिवारिक, सामाजिक–आर्थिक एवं राजनैतिक समस्याओं, सरकार से प्राप्त होने वाले सुविधाओं एवं पंचायतों एवं प्रशासन के मध्य भूमिकाओं का किया गया है। संभावित निदर्शन विधि के प्रयोग से पायलेटिंग सर्वे के द्वारा 25–25 उत्तरदाताओं का चयन कर साक्षात्कार व अवलोकन विधि तथा द्वितीयक आँकड़ों का प्रयोग किया गया। राजनांदगाँव जिले के तीन तहसील खैरागढ़, छुईखदान व डोंगरगढ़ का चयन किया गया। जिसमें पंचायत के कार्यों में आने वाले समस्याओं के अन्तर्गत्–वित्तीय समस्या, शासकीय योजनाओं के संचालन में जनता की राय, विरोध–समर्थन न मिलना, स्वास्थ्यगत् समस्याएँ आदि।

KEYWORDS: सर्वांगीण, जाल, विभक्त, हाट–बाजार, यादृच्छिक, वित्तीय राशि।

प्रस्तावना –

भारत गाँवों का देश है तथा भारत की आत्मा गाँवों में निवास करती है। यह उक्त कथन हमारे राष्ट्रपिता महात्मा गाँधी जी ने कही है। यदि देश का सर्वांगीण विकास करना है तो गाँवों की स्थिति में परिवर्तन करना अनिवार्य है, तभी सम्पूर्ण ग्राम एवं साथ ही साथ राष्ट्र का उत्थान किया जा सकता है।

ग्रामों की वास्तविक कायाकल्प 73वें संविधान संसोधन 1993 से प्रारम्भ हुआ जब गाँवों की स्थितियों में बहुत कुछ सुधार हुआ है। आज प्रत्येक ग्राम में प्राथमिक एवं माध्यमिक विद्यालय अवश्य है। गाँव से खेत की ओर जाने के लिए सड़क मार्ग से जोड़ दिया जाता है। वर्तमान में एक भी गाँव ऐसा नही है जो प्रधानमंत्री ग्राम सड़क योजना तथा छत्तीसगढ़ जैसे आदिवासी राज्य में मुख्यमंत्री सड़क योजना के माध्यम से सम्पूर्ण राज्य में सड़कों का जाल बिछा हुआ है जिसकी सहायता से यातायात में बहुत सुधार एवं सुगमता आ गया है।

छत्तीसगढ़ में पंचायती राज व्यवस्था को तीन स्तरों में विभक्त किया गया है–ग्राम पंचायत, जनपद पंचायत एवं जिला पंचायत। जिसमें परिसीमन 2015–16 के अनुसार 11,664 ग्राम पंचायत, 146 जनपद पंचायत एवं जिला पंचायतों की संख्या 27 है। ग्राम पंचायत, जनपद पंचायत एवं जिला पंचायत का विकास कार्य के

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भारत में दिव्यांगकता का सामाजिक अध्ययन

डॉ० खोमन लाल साहू

गेस्ट फेकल्टी, गवर्नमेंट पीजी कॉलेज, कवर्धा, छत्तीसगढ़

डॉ० अश्वनी महाजन

गवर्नमेंट वी.वाई.टी ऑटोनोमस स्नातकोत्तर महाविद्यालय, दुर्ग, छत्तीसगढ़

Abstract :- प्रस्तुत शोध अध्ययन छत्तीसगढ़ राज्य के राजनांदगाँव के दिव्यांगजनों की सामाजिक- आर्थिक समस्या पर आधारित है। अध्ययन राजनांदगाँव जिले के सभी 09 तहसीलों में रहने वाले सभी प्रकार के दिव्यांगजनों पर केन्द्रित है। अध्ययन में दैव निदर्शन के माध्यम से कुल 100 उत्तरदाताओं की सामाजिक-आर्थिक समस्या को ज्ञात करने का प्रयास किया गया है। अध्ययन में तथ्यों का संकलन हेतु साक्षात्कार अनुसूची एवं अवलोकन विधि का प्रयोग किया गया है। शोध अध्ययन से प्राप्त तथ्य से स्पष्ट है कि वर्तमान में दिव्यांगजों को सामाजिक-आर्थिक समस्याओं का सामना करना पड़ रहा है। अध्ययन क्षेत्र में सामाजिक-आर्थिक जैसे विभिन्न शासकीय, गैरशासकीय कार्यक्रमों के लागू होने के पश्चात् भी दिव्यांगजनों में व्याप्त उदासीनता स्पष्ट देखी जा सकती है।

कीवर्ड्स:- दिव्यांगजन, अक्षमता, सम्प्रेषण, पारदर्शी, प्रतीत, नगण्य।

ईश्वर की दृष्टि में प्रत्येक मनुष्य एक सामान है, किन्तु शारीरिक एवं मानसिक दृष्टि में कई लोगों में विभिन्नता दिखायी देती है। अन्तर्राष्ट्रीय दिव्यांगता दिवस प्रत्येक वर्ष 03 दिसम्बर को विश्वभर में मनाया जाता है, जिसका मुख्य उद्देश्य है शारीरिक अथवा मानसिक रूप से अशक्त लोगों की सोच को सकारात्मक कर उनके साथ-साथ समाज के सभी वर्गों की भागीदारी व सहयोग के माध्यम से प्रोत्साहन देकर उन्हें विकास की मुख्य धारा से जोड़कर देश व समाज की भलाई का कार्य किया जा सके। वास्तव में मानव समाज की सभ्यता के प्रारम्भिक चरणों से ही दिव्यांगता से आ रहा है तथा 21वीं सदी में भी दिव्यांगों की स्थिति (मानसिक, सामाजिक-आर्थिक) में विशेष परिवर्तन नहीं हुआ है। संयुक्त राष्ट्र संघ की एक रिपोर्ट के अनुसार-वर्तमान समय में विश्वभर में लगभग एक अरब दिव्यांग लोगों की जनसंख्या है।

विश्व स्वास्थ्य संगठन एवं विश्व बैंक की रिपोर्ट 2017-18 में स्पष्ट किया कि सभी देशों में दिव्यांगों की समस्या भिन्न-भिन्न होने के होने के पश्चात् उनकी स्वास्थ्य एवं आर्थिक परिस्थिति मूल समस्याएँ लगभग एक जैसी है। सभी समाजों में दिव्यांगजनों के साथ प्रत्यक्ष-अप्रत्यक्ष रूप से भेदभाव के शिकार होने की बात देखने-सुनने को मिल ही जाती है। दिव्यांगजनों को शैक्षणिक सुविधाएँ, यातायात, रोजगार स्वास्थ्य आदि मूलभूत आवश्यकताएँ सरलतापूर्वक नहीं मिल पाता है। भारत की जनगणना 2011 के अनुसार दिव्यांगों की कुल जनसंख्या 2.68 करोड़ है। इसके अन्तर्गत् दृष्टिहीनता, अस्थिबाधित, मानसिक मंदबुद्धि, मानसिक बिमारी एवं बहु दिव्यांग शामिल है।

शारीरिक एवं मानसिक दुर्बलता सही मायने में अत्यन्त गंभीर समस्या में से एक है। इसके कारण व्यक्ति की जीवन नरक जैसे हो जाती है। लेकिन अस्थि बाधित दिव्यांग एक असन्तुलन की स्थिति को कहा जाता है, जो किसी भी दिव्यांग व्यक्ति के लिए उसे दिव्यांग कहना अच्छा नहीं होता है।

प्रस्तावना

दिव्यांगता जैसे गम्भीर समस्याओं को अध्ययन के लिए चुनाव करना स्वयं में एक बड़ी बात है। इसमें राजनांदगाँव, जिले के समस्त दिव्यांग जैसे संस्थाओं का अध्ययन किया गया है। इसमें मुख्यत: मानसिक रूप से दिव्यांग बच्चे एवं उनकी मानसिक स्थिति को समझने का प्रयास किया है। दिव्यांग संस्था में कुछ बच्चे घर से आना-जाना एवं कुछ छात्रावास या संस्था में ही रहते हैं। इन संस्थाओं में दिव्यांगजनों के लिए पढ़ने-लिखने, खेलकूद और उन्हें कई प्रकार से जीवन यापन हेतु मूलभूत प्रशिक्षण जैसे - काड्र्स या गमला बनाना अथवा अन्य वस्तुओं के निर्माण हेतु प्रशिक्षण दिया जाता है और उन तैयार वस्तुओं को बाजार में विक्रय कर मुनाफा इन्हीं दिव्यांगजनों के हित में खर्च किया जाता है। जो भी दिव्यांग बच्चे ऐसे संस्था में लाया जाता है, उनके पारिवारिक, आर्थिक स्थिति पर निर्भर करता है। अधिकांश बच्चों के पालक बाहर में कार्य करते हैं या निवास करते है, जिनकी आर्थिक स्थिति सामान्य या सामान्य से बेहतर अर्थात् जिनकी वार्षिक आय 3-5 लाख रूपये तक है। अधिक बच्चों के पालक शासकीय सेवा में है।

दिव्यांगता के प्रकार

1. दृष्टि बाधित
2. श्रवण बाधित
3. मानसिक मन्दता
4. बौनेपन दिव्यांगकता
5. विशिष्ट शिक्षण दिव्यांगता आदि, किन्तु वर्तमान समय में भारत सरकार द्वारा 21 प्रकार के दिव्यांगता के प्रकार बताये गये है।

पंचायती राज एवं ग्राम विकास

केदार साहु

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प्रोफेसर अश्वनी महाजन

Professor Ashwani Mahajan (Sociology) V.Y.T.P.G Auto. College, Durg (C.G)

Abstracts :- प्रस्तुत शोध अध्ययन "पंचायती राज एवं ग्राम विकास" पर आधारित है। अध्ययन राजनांदगाँव जिले के 03 तहसील राजनांदगाँव, खैरागढ़ हुर्रुवान के तीन जपनद पंचायतों एवं ग्राम पंचायतों का चयन किया गया है। जिसके अन्तर्गत सरपंच, पंच, जिला पंचायत सदस्य एवं जनपद पंचायत ...ों का चयन किया गया है। अध्ययन में दैव निदर्शन के माध्यम से कुल 100 उत्तरदाताओं की पारिवारिक, सामाजिक-आर्थिक एवं राजनैतिक समस्याओं, ...ास से प्राप्त होने वाले सुविधाओं एवं पंचायतों एवं प्रशासन के मध्य भूमिकाओं को ज्ञात करने का प्रयास किया गया है। अध्ययन में तथ्यों के संकलन ...ु साक्षात्कार अनुसूची और अवलोकन विधि का प्रयोग किया गया है। शोध अध्ययन में प्राप्त तथ्य से स्पष्ट है कि पंचायत के कार्यों में आने वाले समस्याओं ...न्तर्गत वित्तीय समस्याओं, शासकीय योजनाओं के संचालन में जनता की सलाह व समर्थन न मिलना, जनता द्वारा विरोध, स्वास्थ्यगत् समस्याएँ आदि।

Keywords : सर्वांगीण, जाल, विभक्त, हाट-बाजार, यादृच्छिक, वित्तीय राशि।

ग्रामीण विकास शब्द ग्रामीणों के जीवन स्तर सुधारने के साथ ग्रामीण क्षेत्रों के समग्र विकास को प्रदर्शित करता है, इस अर्थ में कि यह व्यापक एवं ...ार्थक संकल्पना है। इसमें कृषि और सहायक गतिविधियाँ, ग्रामीण एवं कुटीर उद्योग और शिल्पकारी, सामाजिक-आर्थिक अधोसंरचना, सामुदायिक सेवाएँ ...ी सुविधाएँ, साथ ही इस सभी के ऊपर ग्रामीण क्षेत्रों के मानव संसाधन का विकास सम्मिलित है।

...क तथ्य के रूप में ग्रामीण विकास विविध भौतिक, तकनीकी, आर्थिक, सामाजिक-सांस्कृतिक एवं संस्थागत कारकों के मध्य अन्तर्सम्बन्धों का अन्तिम ...ाम है। एक रणनीति के रूप में विशेषत: ग्रामीण गरीबों की आर्थिक एवं सामाजिक समृद्धि में सुधार हेतु की गई है। एक अनुशासन के रूप में इसकी ...ति बहुअनुशासनिक है। जिसमें कृषिगत, सामाजिक, व्यावहारिक, अभियांत्रिक एवं प्रबन्धकीय विज्ञानों का प्रतिनिधित्व है।

...ंचायती राज से सम्बन्धित विधेयक लोकसभा और राज्यसभा में क्रमश: दिसम्बर 1992 उको सर्वसम्मति से पास कर दिया। इस विधेयक को 17 राज्यों ...विधानसभाओं ने भी अपनी सस्तृति प्रदान कर दी है। यह विधेयक संविधान के (73वें संशोधन) अधिनियम 1993 में 24 अप्रैल 1993 से एक साथ ...ागू हो। भारत की आत्मा कहे जाने वाला मध्यप्रदेश देश का पहला प्रदेश है, जिसने 30 दिसम्बर 1993 को पंचायती राज अधिनियम पारित किया। ...महामहिम राज्यपाल की स्वीकृति 24 जनवरी 1994 को मिली। 27 जनवरी को यह अधिनियम सम्पूर्ण मध्यप्रदेश में एक साथ लागू हो गया।

...ाम पंचायत के सरपंच का सभी मतदाताओं द्वारा प्रत्यक्ष रूप में निर्वाचित किया जाएगा। ग्राम पंचायत के कुल पदों में से एक तिहाई पद महिलाओं के ...आरक्षित होंगे। इन दिनों पूरे देश में 10 लाख से अधिक महिलाएँ सरपंच के रूप में अपनी भूमिका निभा रही हैं। वर्तमान में छत्तीसगढ़ में 4928 महिला ...ं तथा लगभग 80829 महिलाएँ वार्ड पंच के रूप में कार्य कर रहीं है।

...ावना

...सी भी समाज का सकारात्मक विकास उस समाज की प्रतिनिधित्व करने वाले व्यक्तियों के नेतृत्व पर समाज निर्भर करता है। भारत वर्ष मुख्यत: गाँवों ...ं है। प्राचीन काल से ही भारतीय समुदाय की सामाजिक संरचना के तीन महत्वपूर्ण आधार जाति प्रथा, संयुक्त परिवार और ग्राम पंचायत रहे हैं। स्वशासन ...के रूप में ग्रामीण पंचायतों का यहाँ विशेष महत्व रहा है। महात्मा गाँधी की मान्यता थी कि, भारतीय ग्रामीण जीवन का पुनर्निर्माण ग्राम पंचायतों की ...ापना से ही सम्भव है। ग्राम पंचायत ग्रमीण क्षेत्रों में शासन प्रबन्ध, शांति और सुरक्षा की एक मात्र संस्था रही है। यहाँ ग्रामीण विकास में महिला सरपंचों ...की से पहले विकास एवं ग्रामीण विकास क्या है? इस तथ्य को समझना आवश्य है।

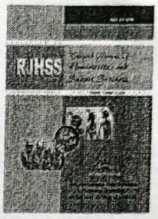
...0 में पहली बार पंचायती राज दिवस मनाने के बाद इस दिन का आयोजन हर साल किया जाता है। दरअसल, पंचायतों को शासन के लघु रूप में ...करने के उद्देश्य होने पर किए जा चुके समूहों को सत्ता में भागीदार बनाना। हालांकि इस उद्देश्य में पूर्ण रूप से कामयाबी नहीं मिली है लेकिन इस ...कारा भी नही जा सकता कि पंचायती व्यवस्था के स्थापना में समाज के दबे-कुचले वर्गों को सशक्त करने की योजना को बल मिला है। पंचायती ...स्थापना 1950 के दशक में ही हो गई थी, लेकिन 1993 में से संवैधानिक दर्जा मिलने के बाद ही इसके सकारात्मक परिणाम सामने आए है। 26 ...पंचायती राज व्यवस्था ने गाँवों की स्थतियों में काफी परिवर्तन आया है। महिला आदिवासी और दलितों को मिले आरक्षण ने इस व्यवस्था को समावेशी

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RESEARCH ARTICLE

Socio-Economic Impact of Land Acquisition in Chhattisgarh

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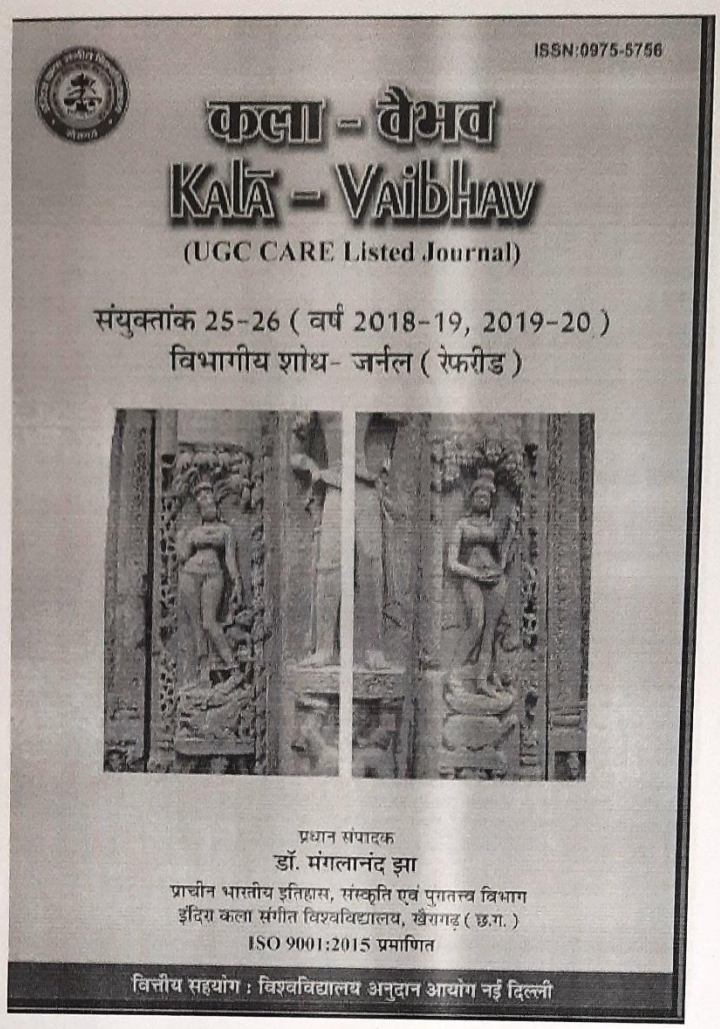
ABSTRACT:
As we know land reforms on land acquisition is directly associated with different development. It aims to improve poor people access towards mean of social welfare. In fact India and Chhattisgarh state is not an exception the above rule and policies. For land reform and acquisition in Chhattisgarh. In this research paper, an attempt has been made to cover various land displacements in Chhattisgarh. This research paper has been prepared mainly on the basis of secondary data from it. Like other places, Chhattisgarh has also seen the following effects of land displacement, such as in social life, in children, in women, in employment, the opposite effect is seen. An attempt has been made to explain the impact of land displacement in Korba, Chhattisgarh, where the common life of the displaced people has been particularly affected.

KEYWORDS: Cultivators, Agriculture Labor, Land Use, Irrigation Geographical Area, Follow land, cropping intensity, poverty alleviation.

INTRODUCTION:

Every society is always in motion along with the growth and development of the economy. As the world population grows, there is a need for infrastructural development. After that in agricultural land constitutes a major proportion of India's geographical area, with land reform and land use. Irrigation also. When large parcels of land are needed for the construction of roads, railways and canals or other public infrastructures, urban housing or any other public purpose, land is acquired compulsory by the both government (Central and State) on payment of compensation in accordance with land acquisition laws. While changes in land use cake place gradually and incrementally over time through decisions by land owner.

Big changes require decision by the both government (Central and State) and compulsory land acquisition in is the main vehicle for bringing changes on a large scale. The aim of this research paper is to analyze the need for land reforms as a source to eradicate poverty and the utility of "The rights to fair compensation and transparency in land acquisition, Rehabilitation and Resettlement Act, 2016 (LARR)" do to distributive justice for better utilization of resources in India. And India has inrested in industrial projects, Dams, Roads, Mines,. Power Plants like NTPC (National Thermal Power Corporation Limited), NMDC (National Mineral Development Corporation), BALCO (Bharat Aluminium Company Ltd.) and new cities (Nawa Raipur in Chhattisgarh) to archive rapid economic growth. This has been made possible through massive acquisition of land and subsequent displacement of people. As we know development displacement population is the single largest category among all internally displaced populations (IDPs). "Around 21.3 million development included IDPs include those displaced by Dams and Mines (16.4 Million). Industrial development (1.25



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बस्तर की आदिवासी संस्कृति एवं पर्यावरण

विनोद कुमार साहू
डी. एस. पाण्डे

वर्तमान बस्तर छत्तीसगढ़ राज्य के दक्षिण में स्थित है, जिसे सामान्य रूप से सघन वनाच्छादित एवं भौगोलिक सुविधाओं की दृष्टि से पहाड़ एवं अनेक जिलों में विभाजित कर दिया गया है। प्राचीन दण्डक एवं मध्यकालीन चक्रकोट के रूपमें विख्यात बस्तर राज्य छत्तीस गढ़ के सबसे गावाडी भाग के किनारे तक फैला था। राज्य का यहाँ की प्रमुख नदी इन्द्रावती से नाम से विभाजित होती है। अब इन्द्रावती के उत्तरी क्षेत्र को उत्तर बस्तर तथा दक्षिणी क्षेत्र को दक्षिण बस्तर कहा गया।[1]

बस्तर और कांकेर की ये रियासतें अधिकांशतः वनाच्छादित और आदिवासी बहुल रही हैं। बस्तर क्षेत्र की प्रमुख विशेषता यहाँ का विस्तृत पठार है जो सात हजार से अधिकांशतः है और इन्द्रावती नदी से दक्षिण तक फैला है। इस क्षेत्र में प्रमुख निवासी मुरिया जाति के आदिवासी हैं। इस क्षेत्र में मालिक की भी अच्छी संख्या है।[2]

प्राकृतिक सुरक्षा और प्राकृतिक सम्पदा से भरपूर होकर, जहाँ पर झुके हुए से पर्वत, बहते हुए कुछ-कुछ तक फैले हरीतिम वाले वृक्ष से एक नेत्र गर्जन करती हुए सजीव उपस्थिति, तो कहीं पर शांतचित्त स्वभाव का अभास कराती हुई छोटी-मोटी पहाड़ियों का समूह है, जो सभी का ध्यान अपनी ओर आकर्षित करता है। बरसती रिमों में कलरव गर्जन के साथ बरसता श्रावण, आकाश से बरसता पय बस्तर को अभिसिंचित कर देता है। यहाँ की वसुधा हिमकणों वाली सुबह अपने साथ सारे रंगों का संगम लेकर आती है। शीत ऋतु में सायंकालीन जहाँ धनु-धनी कहीं छोर की गगन में छोर एक दूजे की आस लिए प्रकृति के गोधूलि में आगम हम अपने समक्ष पेखन है। यहाँ ज्ञातव्य है कि ये लोग शहर से दूर घने जंगल अंचल इलाकों निवास का परिवर्तित रूपमें ले लिया आए, ये ही कारण है इसका साथ एस गुणागार होकर रह गए कि ये अपना अस्तित्व ही भूल गए। यहाँ प्रकृति का नियोग क्रम निरंतर चलता रहता है।[3]

बस्तर के आदिवासियों की जनसंख्या बहुत अधिक तथा विविध है, किन्तु विशेष अध्ययन के बस्तर के अभिलक्षीय निवासों में प्रथम मारिया, गोंड, मारिया, हलबिया, धुरवा तथा हलबाओं का ही विवरण है। प्रथमीन निवासों पर दृष्टिपात करने से स्पष्ट होता है कि 'मारिया' बस्तर की अभिलक्ष्यवा जाती है। ये चित्रकार, सामाजिकसंगठन तथा घुटना वाद्यों में निपुण होते हैं। ये बीजापुर के बहुत बड़े क्षेत्र में बसते हैं, जो भुरीशाह, नारायणपुर अन्तागढ़ तथा भुआलाडंडा तक फैला है। गोंडाडा की ओर इन्हें मारिया कहा जाता है। ये अन्तर घन जंगलों में रहते हैं और बहुत सामीप्य संस्कृति के हैं। यहाँ के आदिवासी की आकृतिपरक अलंकरण में उनकी तथा आत्मिक रूप में आवृत्त पर निर्भर होती है। ये जंगलों के फलमूल और शुद्ध मूल्य से की जीविका चलाते हैं। यहाँ की घोटल उनकाजाति विदेही का परिचय मानती है, और मड़ीसंघ की पूजा करती है।[4]

यहाँ की अन्य जातियों में पशुविनिमय की परम्परा है और विशेष अवसरों पर प्रकृति की पूजा की जाती है, विवेच उत्सवों का विशाल दृश्य, जिनमें मड़ी विवाह या बीज पुनर्नी माड़ी जिसिया, धान जलाना दिवाली विवाह चर्मी उत्सव बड़े जगार अर्दुस विवाह उत्सवाचर्मी-पूजा

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A Study of Daundi-Lohara Peasant Movement

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Abstract

The present paper deals with peasant movement in Daundi-Lohara Zamindari of Chhattisgarh as well as attitude of ruling Congress ministry towards the movement. Using their social and economic resources the Congress politicians won widespread support in the election of 1937 for the Congress among the peasants, tribals, and labouring classes as the party pledged to replace British rule with a government that would serve the interests of all. We find that all peasant movements from 1857 till rise of Gandhi were sporadic in nature. Absence of proper leadership and unorganized peasantry were the drawbacks of these movements. During Gandhian Phase (1920-1947), priority was given to peasants' problems in the national movement. Radical wings of the peasant movement, whose ideology were based on socialism, had realized that Congress was not playing honest role in the fight of peasants with zamindars and landlords. In 1936, All Indian Kisan Sabha was formed at Lucknow with Swami Sahajanand Saraswati as its first president. The programmes of the Kisan Sabha reflected the aspirations and needs of the entire peasantry. Like other peasant movement, the Daundi-Lohara movement was also against the oppressive policy of zamindar and his agent. Congress leaders of Durg district supported the movement, but strong action was taken by police officials and colonial authorities finally suppressed the movement

Keywords: Agrarian Issues, Malguzari System, Chari Nistari.

Early nationalist leaders like Dadabhai Naoroji, Weddernburn, etc., had drawn attention of the Indian British rulers towards the extreme poverty and sufferings of the Indian People. But, it is also true that Indian National Congress focused on peasant's problems only from 1920 and tried to solve them in the beginning of the 1930s. Undoubtedly, it was Mahatma Gandhi who made Indian National movement in a true sense a mass movement by gaining support of landlords, capitalists, peasants, workers, women, students, minority and depressed classes for liberating Indians from oppressive colonial rule. The first three decades of the twentieth century witnessed peasant resentment in some form or other in India. Throughout 1920s and 1930s whenever occasion arise the Congress leaders had criticized the administrative colonial set up, but they did not take any strong measures for restoration of peasant's right. They wanted to mobilize the peasantry against the colonial rule but at the same time they were also sympathetic to the landlords.

Influenced by the Karachi Congress's resolution on agrarian issue (1931) the policy of the Congress Working Committee (1937) laid down that the programme as enunciated in the election manifesto, particularly the agrarian resolution should be taken by the different provincial ministries. Above all, the year 1936 also proved more beneficial to the peasants at the movement, when the agrarian programme of Faizpur was accepted by the Congress organization. A unanimous decision for the solution of the peasants have been taken to the effect that Congress is concerned about the apparent poverty, unemployment and indebtedness of the Indian Peasantry and eager to work for their upliftment. The agrarian conditions, land revenue system, however differed not only from province to province but also within the same province. The Congress therefore directed all Provincial Congress committees to draw up an all India agrarian programme.[1]

Indian National Congress leaders realizing that the integration of the peasantry with the nation and national movement was essential for strengthening the striking capacity of the anti-imperialist forces,

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