



## Research Initiatives 2009-2013

**Central University of Punjab, Bathinda**  
(Established vide an Act of Parliament in 2009)

### Central University of Punjab City Campus



Academic Block



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**Central University of Punjab, Bathinda**  
(Established vide Act No. 25 (2009) of Parliament)



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# Message From The Vice Chancellor



It gives me immense pleasure to bring out a publication that summarizes the externally funded research projects being presently handled by the faculties of Central University of Punjab, Bathinda (CUPB). As one of the fourteen new Central Universities established by the government of India in 2009, though CUPB had to confront with myriad issues of infancy, about five years down the line it has made firm and steady strides in the direction of making itself a world class educational institution. It is enabled with the state of the art facilities and expertise for learning and research and offers some of the best innovative academic programmes designed in tune with challenges of present time.

This university, in a very short time, has become the beacon of higher education in Punjab. The university has been successful in attracting exceptionally qualified, highly motivated and dedicated teachers in its various faculties of study. In a short span of nearly five years of its existence, the faculty of CUPB has clearly demonstrated its commitment to excellence. I am proud to state that within a short time the faculty could garner an impressive number of externally funded research projects from several national and international agencies in diverse areas of science and humanities. This report takes you down the details of each centre, the faculty and the projects won individually and jointly by the faculty members of the university. It is my pleasure to state that several more applications for new research projects have been submitted to various funding agencies for support.

These projects will certainly reinforce the commitment of university to cutting edge research in various fields of knowledge. I am confident that we will continue to strive hard to gain more projects and funds for conducting socially committed research in our larger endeavour of making CUPB a globally renowned institution of higher learning. I solicit the support, more ideas and constructive criticisms as well in this important mission.

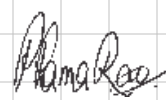
*Jai Rup Singh*  
(Jai Rup Singh)



## Forward

The Central University of Punjab, Bathinda (CUPB), established by an Act of Parliament in 2009, is amongst the fastest growing newly established universities in the country. Situated in an educationally backward region, the university contributes not only to the advancement of knowledge but also to inclusive growth and development in the field of education and beyond. The development and expansion of the university since its inception has been steadfast. The academic programmes commenced with the establishment of the Centres for Biosciences, Centre for Environmental Science and Technology, Centre for South and Central Asian Studies and Centre for Comparative Literature in 2010, to be quickly followed by the Centre for Chemical and Pharmaceutical Sciences, and Centre for Environmental Law in 2011. Subsequently ten more centres of study have been established namely Computer Science and Technology, Physical and Mathematical Sciences, Computational Sciences, Human Genetics, Museology, Archaeology and Conservation, Economic Studies, Genetic Diseases and Molecular Medicine,, Bioinformatics, Punjab Language, Literature and Culture and Education making a total of sixteen operationalized centres within a short span of nearly five years.

CUPB has been committed to attract highly qualified teachers to it, recruitment for which has been taking place from 2010 onwards with highest priority to research. The university has fifty highly talented committed teachers with national and international exposure, working in different centres of study now. The faculty of CUPB has shown their commitment to excellence and advanced knowledge production by engaging themselves in avant-garde research. The thrust area of research of the university is Environment and health in relation to local needs of the Bathinda region. In a short span of time the faculty could garner twenty eight externally funded research projects from several funding agencies in diverse areas of science and humanities and many more applications for new research grants have been submitted to different funding agencies for support. This report gives a glimpse of such externally funded research projects won by the teachers of the university which exemplifies the commitment of the university to socially relevant research. This will certainly be a continuous and unwavering process in our dedication to cutting edge research in various fields of knowledge.



(P. Ramarao)

Dean Academic Affairs

## About The University

The Central University of Punjab established by an Act of Parliament in 2009 at Bathinda is amongst the fastest growing newly established central universities of the country situated in an educationally backward region of Punjab. It offers some of the most innovative non-conventional academic programmes designed in tune with the challenges of 21st century. Within a short span of nearly five years of existence, the university has demonstrated its commitment to excellence and it is emerging as a hub of advanced learning through its unique interactive and experiential approaches. The university at present is functioning from its 37 acre transit campus called “City Campus”, located just 5 km away from the heart of Bathinda city. The campus has lush green lawns, beautiful trees, enchanting landscape and has state of the art air-conditioned lecture rooms furnished with latest audio-visual devices, well equipped science laboratories, a conference room with video-conferencing facilities, a 100-seater seminar hall and a 300-seater air-conditioned auditorium to support academic activities. Semi furnished transit faculty hostels accommodate the newly appointed faculty free of cost for first three months of their joining the university. It has a guest house, and separate hostels for boys and girls. The banking facilities including an ATM are available at the Campus.

The science laboratories are equipped with facilities like 96 capillary DNA sequencer, RT-PCR, several DNA thermocyclers, Gel Documentation System, Ultra Low Deep Freezers, High Speed Cooling Centrifuges, CO2 incubators, Milli Q Water Purification System, Automated Karyotyping System, Fluorescence Microscope, Vacuum Concentrators, Accelerated solvent extractor, Muffle furnace, Trace Metal Analyser, Fourier Transform Infra Red Spectrometer, Atomic Absorption Spectrometer, UPLC system, Gas Chromatographic Mass Spectrometer etc. for training of students and research in the disciplines of Biosciences, Chemical and Pharmaceutical Sciences, Environmental Science and Technology, Genetics and Molecular Medicine.

Excellent facilities for plant tissue culture, culturing and genetic transformation of animal and human cell lines have been created in addition to the availability of cold rooms for long term storage of experimental materials.

The air-conditioned Computer Centre is equipped with 170 Dell and 15 Apple Macintosh desktop computers and six high end computing machines with graphic card, 8GB RAM and 42” LCD monitors for academic pursuits of faculty and students. All the laboratories, class rooms, offices, guest houses, residents have 1 GB connectivity. The entire campus is Wi-Fi enabled.

The air-conditioned University Library is equipped with elegant modular furniture, Radio Frequency Identification (RFID) and electromagnetic security systems to facilitate self-issue, return and renewal. A security arrangement comprising of 20 CCTV cameras has been provided in the library. The library has over over 20,000 book titles on its racks and subscribes to 85 national and international peer-reviewed print journals. Apart from these, over 9000 full text online journals are available under several bibliographic databases and full text resources, including 'UGC INFONET' programme, Science Direct, Springer, J-STOR, Wiley-Blackwell, SAGE, Taylor & Francis, Project Muse, Science Online, IEEE/IEL online, ACS, Cambridge University Press, Oxford, Indiasat.com and PROWESS. Library providing access to periodical collections of 22 university libraries in India through JCCC UGC INFONET, World Bank E-Library and has institutional membership of DELNET. A reprographic service, with latest photocopying machines and sophisticated scanners like V-cradle planetary scanner for automated scanning is available to readers. The library has its entire bibliographic collection in online electronic database (OPAC).

The university has established its sixteen Centers of Studies under nine schools offering twelve unique and innovative M.A./M.Sc./M.Tech./M.Pharm. /LL.M./ and M.Phil.-Ph.D. integrated programmes. This publication is an attempt to introduce the research initiatives of the faculty of its different Centres of Studies so that the students choose their area of research for dissertation work which is compulsory for all students pursuing post graduate and research programmes.

Admission to all the academic programmes offered by the university is carried out through National Level Online entrance examination that is held every year at selected examination centers located in important cities across the country. The students are provided excellent study environment and world class education by enthusiastic faculty having wide international experience. Consequently of the nearly 400 students, 51 have qualified NET or JRF conducted by UGC/CSIR/ICMR etc.

The main campus of the university is coming up on a 500 acre site located at village Ghudda on Bhatinda-Badal road and construction of boundary wall has been completed.

**SCHOOL OF BASIC AND APPLIED SCIENCES**  
CENTRE FOR CHEMICAL AND PHARMACEUTICAL SCIENCES (ESTABLISHED 2011)

**FACULTY**

Name	Designation	Qualification/Training	Expertise
Dr. R.G.Saini	Invited Professor and Centre Coordinator	Ph.D. Punjab Agricultural University, Ludhiana. Training in Genetics of host parasite interactions at Sydney University, Australia	Genetics of host-parasite interactions
Dr. Felix Bast	Assistant Professor	Ph.D. Graduate School of Kuroshio Sciences, Kochi University, Japan	Phycology, marine biology, aquatic botany, evolutionary biology, biogeography
Dr. Sanjeev Kumar	Assistant Professor	Ph.D. Panjab University, Chandigarh. Experience abroad: Visiting Scientist at the Centre for Environment and Life Sciences, CSIRO, Perth, WA (2008-2009)	Stress biology, reproductive biology, molecular biology, functional genomics
Dr. Anil Mantha	Assistant Professor	Ph.D. Jawahar Lal Nehru University, New Delhi. Experience abroad: Postdoctoral fellow at Department of Biochemistry and Molecular Biology, University of Texas, Medical Branch (UTMB), Galveston, TX, USA (2006-2011) Assistant Profesor at Department of Biochemistry and Molecular Biology, University of Texas, Medical Branch (UTMS), Galveston, TX, USA (2011-2012)	Alzheimer's disease drug discovery, molecular biology
Dr. Pankaj Bhardwaj	Assistant Professor	Ph.D. Panjab University, Chandigarh. Training at Institute of Himalayan Bioresource Technology (CSIR), Palampur	Genomics and plant molecular biology

**PROGRAMMES OFFERED**

1. M.Sc. Biosciences
2. M.Sc. Molecular Genetics
3. M.Phil.-Ph.D. Integrated Programme in Biosciences

UGC-1 (2012)

## Genotoxicity Detection in Drinking Water from Malwa Region, Punjab

**Principal Investigator: Dr. Felix Bast**

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2012
Budget:	Rs.6,00,000
Duration:	Two years



**Objectives of the project**

- To quantify physicochemical properties of ground water, namely: conductivity, pH, concentration of various pesticide residues and heavy metals, including Arsenic (As), Lead (Pb) and Uranium (U), from Malwa Region, Punjab.
- To evaluate genotoxicity of ground water by Ames test and Comet Assay.
- To find correlation between physicochemical properties and genotoxicity level - if any by rigorous statistical analyses.

**PROJECT SUMMARY**

**INTRODUCTION:** Incidence of cancer in Malwa region of Punjab is reported to be significantly higher than the national average and therefore, this region is often called as “cancer belt” by the mass media. While several potential factors involved with high cancer prevalence in Malwa region were often hypothetically attributed, including increased use of groundwater leaching pesticides and chemical fertilizers fuelled by green revolution for high agricultural productivity as well as by coal based power plants that throw out high levels of fly ash, high concentration of Uranium, Thorium and Radon in drinking water due to unknown reasons etc., but about this no consensus exists.

**METHODOLOGY:**

**(i). Sampling**

Groundwater, as retrieved by hand pumps, will be sampled across identified locations in Malwa region. These locations will include cotton fields (GM as well as non-GM), wheat fields, paddy and those situated near canals. Negative control will be type 1 ultrapure water (Milli-Q Reference, available in the laboratory). Detailed reports on the samples collected from different locations will be entered in the database and tested for statistical significance for further analysis.

**(ii). Physicochemical assessment of water**

Collected water will be analyzed for electrochemical conductivity, pH and HPLC quantification of organo-pesticide residues as well as ICP-MS quantification of heavy metals Arsenic (As), Lead (Pb) and Uranium (U) will be done.

Genotoxicity detection will be conducted for the samples of ground water by using Ames test and Comet Assay

**(iii). Data analysis**

Means of the groups will be compared for differences and by rigorous statistical analyses using XLSTAT.

(iv). *Significance of the study*

Proposed project will involve primary data acquisition by environmental sampling methods, analysis of water by physicochemical methods and genotoxic assessment by biomedical methods, including comet assay and Ames test. Therefore, the interdisciplinary framework of the proposed project is expected to bring out novel findings that would help to address this regions health problems.

Proposed study would be first ever attempt to assess genotoxic effects of ground water from the Malwa region, Punjab - an area under limelight lately because of high prevalence of breast cancer. While there had been studies to determine physicochemical attributes of drinking water in this region, none are statistically robust and no studies have been attempted to test “out of cotton-field” hypothesis as proposed here. If detected, differential levels of genotoxicity at locations within and out of cotton fields in this region would be the first direct evidence for the origins of current environmental crisis and might clue the reasons behind high incidents of cancer.

**WORK ACCOMPLISHED SO FAR**

Ground water samples were collected from 120 locations throughout Punjab in GPS-aided scientific explorations. Samples were tested for electrical conductivity, TDS, salinity and pH. Samples with highest 20 EC values were selected for analysis for heavy metals with Atomic Absorption Spectrometer. Genotoxicity analysis of these samples using comet assay and Ames test are expected to complete within two months.

**Title: Chemical and Phylogenetic Diversity of Seaweeds in Indian Subcontinent**

*Principal Investigator: Dr. Felix Bast*

Funding agency:	Department of Science and Technology, Government of India.
Year of sanction:	2012
Budget:	Rs. 35,00,000
Duration:	Five years

**Objectives of the project**

- To compare the anticancer potential of selected plant and algal species isolated from various geographical regions in northern and southern India.
- To find out any correlation of morphology, genetic and karyotypic diversity, alkaloid profiles and phylogeography of plant and algal species with cancer prevalence in India.
- To find out existence of any correlation between phylogeography data and anticancer potential data i.e., do monophyletic clades of geographical isolates of anticancerous plants correspond to comparable anticancer potentials?
- To find out existence of any correlation between phylogeography/anticancer potential data and cancer prevalence data. i.e., do certain taxa of plants/plants with higher anticancer potentials more prevalent in cancer prone area?

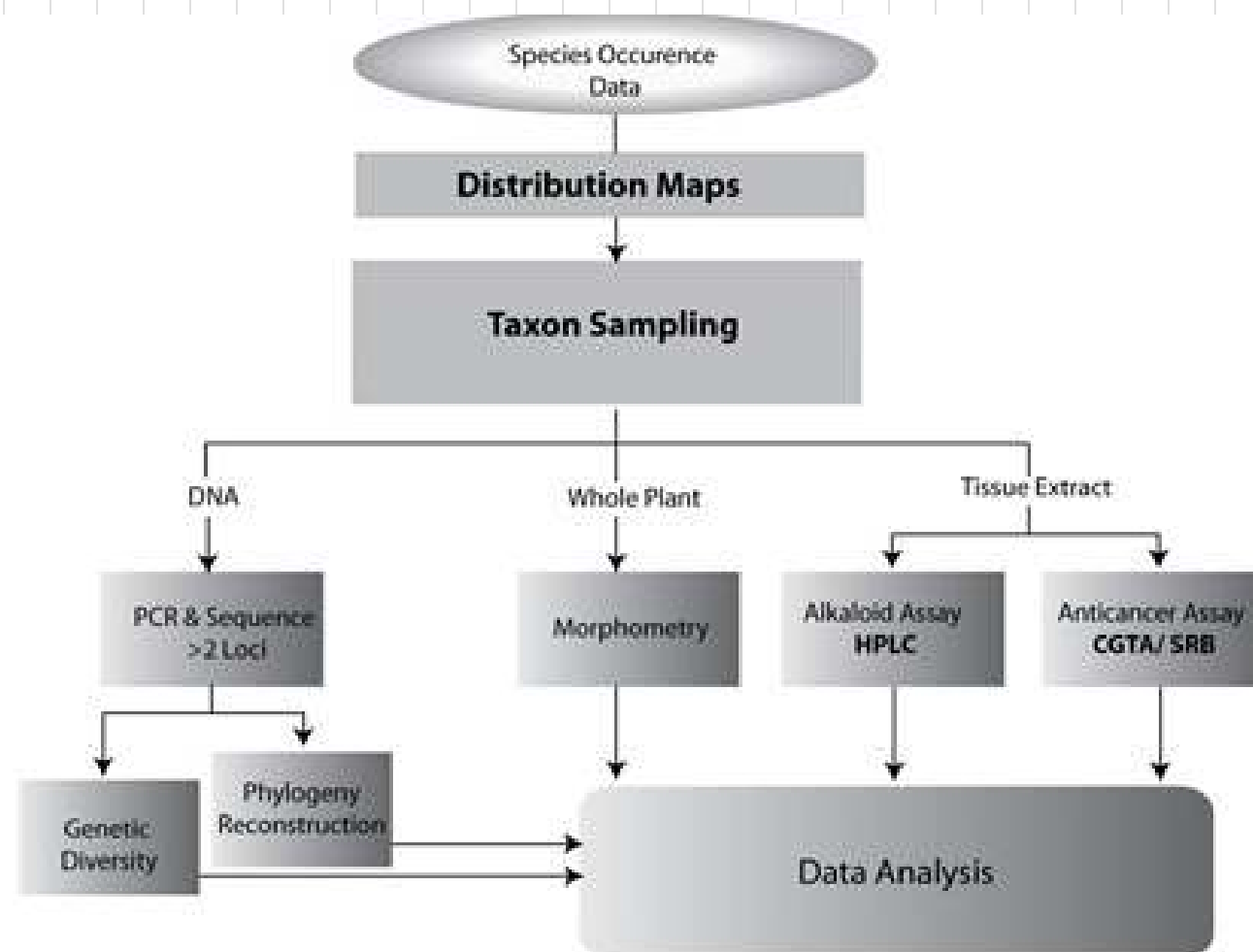
**PROJECT SUMMARY**

**INTRODUCTION:** In the wake of competing demands during the world food crisis, seaweeds (marine macroalgae) have attracted much attention lately from the researchers and environmentalists alike as a future food source. Multitude of environmental crises such as human population explosion that lead to the shortage and overexploitation of cultivable land, chemical and genetic pollutions due to yield oriented agricultural practices, and ever increasing shortage of freshwater have been encouraging farming of edible seaweeds as a sustainable alternative to the conventional agriculture. Farming of seaweeds as food has a number of definitive advantages. Seaweeds can be readily cultivated nearshore or offshore without fertilizers and drugs and its cultivation do not require land or freshwater resources. Seaweeds have been widely utilized in a number of industries, including hydrocolloid industry, pharmaceuticals, nutraceuticals, agriculture and as an energy source. Nutritional and pharmaceutical potentials of a number of seaweed natural products have been comprehensively reviewed. Seaweed-derived bioactive substances that have multitude of biomedical applications including fucoidans, lectins, sulphated polysaccharides and aplysiatoxins.



**METHODOLOGY:**

A summary of the methodology is presented in the schematic illustration in Fig. 1 and explained below:

**(i). Taxon Sampling**

Target taxa will include green, brown and red intertidal seaweeds. Samples will be collected from >500 target geographical regions in collaboration with regional universities and fishermen. Species occurrence data will be downloaded from Global Biodiversity Information Facility data portal (<http://www.gbif.org>). From the distribution maps of target taxa, one-degree cell density overlay for Google Earth® (available at <http://www.google.com/earth/index.html>) will be designed to assist taxon sampling expeditions. Care will be taken to randomize the target regions and to cover most of the species range.

**(ii). Morphometry**

Morphological features will be documented for each collected specimen to aid in the identification, which include shape and size of plant body and cells. A landmark-based geometric morphometrics will be performed to ensure reproducibility of the data. Principal Component Analysis (PCA) will be performed to normalize the data and to reduce it to low-dimensional form. Comparative morphometric analyses will be carried out using computational geometric morphometry and phylogenetic relationships will be tested using clustering analysis. Statistical hypothesis testing will be performed using multivariate analysis.

**(iii). Amplification and sequencing of Genomic DNA**

Total genomic DNA will be extracted from the collected specimens following standard protocols. Universal primers for at least three target genomic regions will be used for PCR amplification. Loci will be (i) Internal Transcribed Spacer (ITS1-5.8S-ITS2) region of nrDNA (ii) trnL intron of cpDNA and (iii) Microsatellites. PCR amplicons will be sequenced by capillary electrophoresis.

**(iv). Phylogeny Reconstruction**

Sequence fragments will be assembled and contigs will be constructed using computer program Geneious (available at <http://www.geneious.com>). Sequences will be correctly annotated, aligned using an appropriate algorithm like MUSCLE or Clustal X and edited using eye. Phylogenetic analyses using Bayesian Inference (BI) and Maximum Likelihood (ML) will be conducted for the dataset. For BI analysis, appropriate MrBayes plug-in will be used. Analysis by ML algorithm will be conducted following PhyML plug-in with starting tree generated by BioNJ. Nucleotide substitution bias will be modeled by an appropriate model like general time-reversible model with invariable sites and rate heterogeneity will be modeled using the gamma distribution method. Heuristic searches will be performed with tree bisection-reconnection, MULTREES and steepest descent options in effect.

**(v). Anticancer Assay**

Ethanol extracts of plants will be obtained and assayed for their activity on the growth and initiation of crown-gall tumors on potato disks, the Crown Gall Tumor Assay (CGTA). In summary, surface sterilized potato discs (1.5 x 1.0 cm) will be inoculated with *Agrobacterium tumefaciens*. The discs will be placed into a petri disc containing 1.5% agar with solvent-dissolved samples. A standard anti-cancer drug like Vincristine will be used as positive control. After a period of incubation, discs will be stained with Lugol's solution and microscopically checked for the number of developed crown-gall tumors. The crude extracts will also be subjected to sulforhodamine B (SRB) calorimetric cytotoxicity assay for anticancer activity profiling. In summary, after incubating the adherent cancer cell lines with the plant extract for a specified period of time, monolayers are fixed with 10% (wt/vol) trichloroacetic acid to stain the protein contents. After the washing step, protein-bound dye is dissolved in 10mM Tris base solution and absorbance is determined at 510 nm using a microplate reader. Immortalized cell lines needed for this study will be procured from reliable sources and cultured using a standard protocol.

**(vi). Genetic Diversity Analysis**

Distribution patterns and genetic diversity for each of the locus will be thoroughly investigated for each target taxon in order to draw general conclusions about the ecological habitat selection. Levels of genetic diversity will be calculated for populations with a sample size of  $N \geq 4$ . Gene diversity (H) calculated on haplotype frequencies and heterozygosity (HO and HE) calculated on nuclear microsatellite allele frequencies will be calculated using the ARLEQUIN software package (<http://cmpg.unibe.ch/software/arlequin3/>).

**(vi). Significance**

While global seaweed diversity documentation is still in the infancy, seaweeds distributed in Indian subcontinent have never been subjected to extensive scrutiny and none of the modern tools of algal taxonomy, including phylogenetics and chemical systematics; have ever been applied to this biological group. Simple tools such as field identification keys based on morphology do not exist for seaweeds in India, further complicating correct identification and thereby its utilization. Apart from some preliminary studies on antimicrobial properties, Indian Seaweeds have never been scrutinized for chemical diversity in terms of phytochemical profiles. Ambitious "Drugs from the sea" program of Government of India have been making some efforts to identify antimicrobial and antiviral compounds from marine algae. Except one that documented anticancer activities of lipid extracts of marine alga *Sargassum marginatum*, extensive studies on anticancer potentials of marine or terrestrial algae from India have never been conducted as well.



WORK ACCOMPLISHED SO FAR

Two research expeditions have been completed in this project for the collection and identification of seaweeds in Indian Subcontinent. First expedition concentrated on Western coast from Goa to Ponnani, Kerala covering coasts of Goa, Karnataka and Northern Kerala. Second Expedition targeted on Eastern Coromandel Coast, from Ennore, North of Chennai to Rameswaram, Tamil Nadu. In both the expeditions, 200 individual algal samples were collected and these were subjected to morphometric and DNA analysis. Photographs were taken, pressed herbaria vouchers were prepared and total genomic DNA was extracted. PCR amplification of extracted DNA was carried out at three plant DNA barcoding loci (nucleoribosomal DNA Internal transcribed Spacer (ITS1-5.8S-ITS2), Plastid DNA *rbcL* gene and *trnL-trnF* Spacer region). PCR amplicons were subjected to DNA sequencing through capillary electrophoresis. Forward and reverse sequences were assembled to make contigs. Currently the project is in the final stage of contig assembly, submission of sequences to GenBank and further analysis.

PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

Bast, F. (2013). Sequence similarity search, multiple sequence alignment, model selection, distance matrix and phylogeny reconstruction. *Nature Protocol Exchange*. Nature Publishing Group. doi: 10.1038/protex.2013.065

Bast, F. (2012). Systematics and taxonomic keys for the marine green algal family monostromataceae. In *Algae: Ecology, Economic Uses and Environmental Impact* Eds: Dagmar Krueger and Helga Meyer, Nova Publishers, New York, pp. 105-120.

Bast, F. (2012). Cancer Phylogenetics: Computational Modeling of Tumor Evolution. In: *Bioinformatics: Genome Bioinformatics and Computational Biology*. Eds.: Renu Tuteja, Nova Publishers, New York, pp. 211-230.

Bast, F. and Okuda, K. (2010). Gametangial Ontogeny in Intertidal Green Alga: *Monostroma latissimum* (Kützinger) Wittrock. *International Journal of Plant Reproductive Biology* **2**:11-15.

Bast, F., Hiraoka, M. and Okuda, K. (2009). Spatiotemporal Sex Ratios of a Dioecious Marine Green Alga: *Monostroma latissimum* (Kützinger) Wittrock. *International Journal of Algae* **11**: 141-150.

Bast, F., Shimada S., Hiraoka M. and Okuda, K. (2009). Asexual life history by biflagellate zooids in *Monostroma latissimum* (Ulotrichales). *Aquatic Botany* **91**: 213-218.

Bast, F., Shimada, S., Hiraoka, M. and Okuda, K (2009). Seasonality and thallus ontogeny of edible seaweed *Monostroma latissimum* (Kützinger) Wittrock, (Chlorophyta, Monostromataceae) from Tosa Bay, Kochi, Japan. *Hydrobiologia* **630**: 161-167.

Investigating the Mechanisms Associated with Temperature Stress Tolerance imposed by Non-lethal stress conditions; Understanding Metabolic Relationship between Drought x Cold and Drought x Heat stress in Chickpea (*Cicer arietinum* L.)



Principal Investigator: Dr. Sanjeev Kumar

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2012
Budget:	Rs. 6,00,000
Duration:	Two years

Objectives of the project

- Evaluation of cultivated varieties for assessment of the damage caused by stress.
- Metabolic characterization in terms of alterations in carbohydrates, proteins aminoacids and cryoprotectants i.e. Glycine Betaine, Proline and Trehalose.
- Exogenous application/ foliar application of cryoprotectants, osmoprotectants during different stages of growth and development to ameliorate the impact of temperature and drought stress.
- Organ wise distribution of cryoprotectants and osmoprotectants by HPLC analysis establishing a cross talk between source and sink.

PROJECT SUMMARY

**Introduction:** All the plant species are exposed to various adverse environmental constraints during their life cycle. These environmental adversities are known as “environmental or abiotic stresses”, which limit the crop productivity. Under these limiting conditions crop plants suffer maximum loss in yield. Being sessile, these crop plants have capability to sense and adjust to abiotic stresses. The degree of adaptability to specific stress varies from species to species. This study is focusing on two major limiting environmental factors, water stress and temperature stress (Low & high) on chickpea, which is a major pulse crop of India, accounts for 75-80% of total world production. This crop suffers a drastic yield loss of up to 50% due to these major abiotic stresses world over.

The ultimate damage occurs due to stress at cellular and sub-cellular level is oxidative damage. Apart from other changes in the cellular processes, the production of free radical species is more damaging for membranes, electron transport chain and photosynthesis. To combat these stresses, the internal defense system provide a backup of certain endogenous chemical substances whose presence/ accumulation protects plants from these damages also called compatible solutes and regarded as cryoprotectant and osmoprotectant solutes.

A lot have been studied regarding the metabolic mechanism underlying chilling injury in this crop but still there is enough

gaps which are not well understood. It is hypothesized whether a single variety can handle the multiple stresses because understanding the stress tolerance for one single factor (cold) is not sufficient to counter the simultaneous unexpected stress factor like heat which is unexplored at moment. Since, it is very well documented that drought provides resistance to the cold stress, therefore, imposing the crop varieties (sensitive) to simultaneous drought would give a definite insight to new horizons. Hence, it is imperative to understand the drought induced cold tolerance responses and drought induced heat tolerance in chickpea. The basic idea is to activate the plant immune system well in advance for unexpected stressed environment.

#### **SIGNIFICANCE OF THE STUDY AND ITS POTENTIAL CONTRIBUTION TO KNOWLEDGE IN THE FIELD OF SOCIAL RELEVANCE OR NATIONAL IMPORTANCE:**

Reason behind selecting this crop is that; once Punjab was the largest grower in India. But now farmers have stopped cultivating chickpea for other reasons like biotic and abiotic stresses. With global increase in the temperature and terminal drought, this crop has lost its hold in this area. On the other hand Andhra Pradesh has taken the number one place. Selection and giving the improved varieties for cultivation in Punjab may increase the interest of the farmers in this crop and also it can be added as soil conditioning crop to get rid of the extra use of fertilizers which are spoiling the soil habitat. Studying the mechanisms of tolerance would surely open the way to combat with the global climate change in terms of temperature.

#### **METHODOLOGY:**

Stress injury shall be measured as electrolyte leakage with other associated parameters like lipid peroxidation, relative leaf water content (%), various pigments contents. The main focus shall be given to the alteration in the carbohydrate metabolizing enzymes, sugars and other cryoprotectant solutes. Also the antioxidant system shall also be studied during and after preconditioning of chickpea genotypes.

#### **WORK ACCOMPLISHED SO FAR**

Collected the germplasm from PAU and standardized the sensitivity of the germplasm. Work is under progress to assess the drought induced cold tolerance and associated mechanisms in terms of membrane damage, lipid peroxidation and mitochondrial dysfunctioning.

#### **PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR**

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APE1/Ref-1's Dual Functions Countering Beta Amyloid Induced Genotoxicity.

Principal Investigator: Dr. Anil K. Mantha

Funding agency:	Alzheimer's Association, USA
Year of sanction:	2011
Budget:	US \$ 99990 (approximately Rs. 54 Lakhs)
Duration:	Two years

Objectives of the project

- To elucidate the APE1-dependent repair of Aβ-induced DNA-damage in terminally differentiated SH-SY5Y neurons.
- To establish physical and functional association of APE1 with ADO for controlling altered REDOX states of TFs.

PROJECT SUMMARY

**Introduction:** Human genome is constantly damaged due to intrinsic and extrinsic genotoxic agents that contribute towards oxidative DNA base damage. These oxidative DNA base lesions often mutagenic and toxic are repaired via the base excision repair pathway (BER) in which the abasic (AP) endonuclease, APE1, a multifunctional essential protein, plays a central role. APE1 also functions as a transcriptional co-regulator reductively activating several transcription factors (TFs, e.g., AP-1, NF-kB, and named Ref-1).

Amyloid beta (Aβ) protein deposition in Alzheimer's disease (AD) brains induces oxidative damage in neuronal genomes causing their death. APE1/Ref-1 and ADO's (cysteamine [2-aminoethanethiol] dioxygenase, ADO found to be associated with APE1/ref-1 upon Aβ-stress) protective mechanism against Aβ - induced damage is poorly understood.

The central hypothesis “APE1 plays a key role in countering Aβ-mediated genotoxicity and associated with controlled regulation of TFs and down-stream genes” will address the gaps in current understanding of oxidative stress elicited neurodegeneration in response to Aβ toxicity during AD. As proposed, ADO is a novel candidate “thiol exchanger” that partakes in REDOX function of APE1, and also maintains APE1's repair function intact by maintaining Cys-SH groups. Knowledge gained from the successful completion of this project will define the molecular mechanisms involving APE1 in neuronal cell survival. Eventually may help design new therapeutic interventions to treat AD utilizing APE1's interacting inter-phase the “N-terminal” region involved in its divergent functions.

METHODOLOGY:

The current project aimed to understand the oxidative genome damage and role of APE1 towards neuro-protection against amyloid beta toxicity would be studied using SH-SY5Y neuronal cells as an in vitro study. This project also utilizes recombinant APE1 and ADO proteins along with siRNA technology to understand the mechanism(s) involved.

WORK ACCOMPLISHED SO FAR

The studies conducted so far have suggested that differentiated neurons have limited availability of APE1 a key enzyme involved in BER-pathway and transcriptional regulation of key TFs as compared with that of undifferentiated neuronal cells.

Model AD studies with Aβ accumulated AP sites and increased APE1's endonuclease activity. In addition, prolonged exposure of Aβ to SH-SY5Y neurons have accumulated AP sites, while decreased endonuclease activity of APE1 has been observed. Aβ-stress also activated binding of AP-1 and NF-kB to their cis elements, which may be associated with uncontrolled gene expression.

Aβ further enhanced ADO's association with APE1, and furthermore, siRNA-mediated combined down-regulation of ADO and APE1 sensitized SH-SY5Y cells to Aβ-stress, whose physiological significance is under investigation.

Mitochondrial Oxidative DNA Damage-Repair in Alzheimer's disease: AP-endonuclease (APE1/Ref-1) as a Potential Therapeutic Target.

Principal Investigator: Dr. Anil K. Mantha

Funding agency:	Department of Science and Technology, Government of India
Year of sanction:	2013
Budget:	Rs. 51,00,000
Duration:	Three years

Objectives of the project

- To characterize the physical and functional association of APE1 with ADO, and its significance in countering Aβ-challenge.
- To determine APE1 and ADO role in mitochondrial integrity and correlate with synaptic functionality/integrity.

PROJECT SUMMARY

**Introduction:** Deposition of amyloid-beta (Aβ) in Alzheimer's disease (AD) induces oxidative damage in neuronal genomes. Oxidative DNA base lesions, often mutagenic are repaired via BER-pathway utilizing APE1. Using 2-D proteomics ADO (mammalian thiol dioxygenase and key enzyme in mitochondria) has been identified as one of the binding partners of APE1. ADO is highly expressed in brain, and is up-regulated significantly upon Aβ-stress in PC12 and SH-SY5Y cells. In addition, Aβ-oligomers are identified to attack the mitochondria in the AD (human brain samples). Based on these compelling preliminary results, the central hypothesis is that “physical interactions between APE1 and ADO are important in countering oxidative stress-induced by Aβ and maintaining the mitochondrial genome integrity”, which is altered/damaged in case of progressive AD.

METHODOLOGY:

The current project is aimed to understand the oxidative mitochondrial genome damage upon Aβ-toxicity that might be one of the underlined mechanism (s) for AD occurrence. Using cultured SH-SY5Y neuronal cells, rat brain slice culture, recombinant APE1 and ADO proteins including their phosphorylated forms along with siRNA technology, the proposed objectives will be studied to understand the neuro-protective mechanism (s) involved which might be exhausted in case of progressive disease state in AD.

WORK ACCOMPLISHED SO FAR

The preliminary results have demonstrated that oligomeric Aβ is more toxic than the thought fibrillar form. APE1 along with ADO is countering Aβ-toxicity and found to be essential for neuronal cell survival. Other studies will be initiated upon receipt of funds from the funding agency.



Apurinic/Apyrimidinic Endonuclease (APE1) as an Anti-cancer Therapeutic Agent for Glioblastoma Therapy.

Principal Investigator: Dr. Anil K. Mantha

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs.6,00,000
Duration:	Two years

Objectives of the project

- To Evaluate the Extent of Oxidative Damage by Pesticides (MCP and CP) on Human Glioblastoma (U-87 MG) Cell Line.
- To Study the Pesticide-Mediated Altered Cellular Functions of APE1/Ref-1.

PROJECT SUMMARY

**Introduction:** In this proposal, at first it is hypothesized that altered APE1/Ref-1's activities are associated with risk for glioblastoma progression in presence of organo phosphorus (OP) pesticides, namely Monocrotophos (MCP) and Chlorpyriphos (CP). Secondly, it is concerned with therapeutic point of view as most of the current chemotherapeutic approaches in use are failing due to complexity of the tumor microenvironment and other governing factors. Being a versatile key enzyme involved in repair of oxidized base damage (including AP sites and single stranded breaks, SSBs) and also in transcriptional regulation of various TFs, inhibition of these two activities of APE1/Ref-1 will provide key therapeutic strategy to combine with some of the chemotherapeutic agents for effective glioblastoma therapy. Moreover, screening of phytochemicals from ethnobotanical plant parts for anti-APE1 or Ref-1 activities can also help to design new anti-cancer therapeutic strategies.

METHODOLOGY:

The current project aimed to understand the role of APE1 towards cell proliferation in U-87 MG cells. It is proposed to understand how cancer cells employ the key repair and redox enzyme, APE1 to overcome the oxidative stress produced with in the microenvironment. This project utilizes recombinant and mammalian expression forms of APE1 and siRNA technology. Studies are designed to understand the mechanism(s) that are involved.

WORK ACCOMPLISHED SO FAR

With the available data on polymorphism (SNP) and brain cancer, this project is aimed to understand how pesticides ameliorate the toxicity of the polymorphic variant reported in APE1, i.e. D148E in connection with glioblastoma. Further studies will be carried out upon receipt of funds from the funding agency.

PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

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## Analysis of Genetic Variations and Structure of Rhododendron, a Rare and Endangered Tree Species in western Himalaya.

**Principal Investigator: Dr. Pankaj Bhardwaj**

Funding agency:	Department of Science and Technology, Government of India
Year of sanction:	2013
Budget:	Rs.16,00,000
Duration:	Three years

### Objectives of the project

- To estimate levels of genetic diversity in native populations of Rhododendron in Western Himalaya employing AFLP.
- To measure the distribution of genetic variation within and among populations.
- To assess the implications for conservation of this species in Western Himalaya.

### PROJECT SUMMARY

**Introduction:** The Indian Himalayan region (IHR) occupies a special place in the mountain ecosystem of the world and is one of the most fragile mountain regions of the world and holds huge repository of biological diversity, which is increasingly under pressure from the man activities.

The region comprises a rich variety of flora, fauna, and human communities. During the estimated 8000 species of vascular plants in the Himalayan region, around 3160 are endemic and 450 species are endangered. Some of the plants have disappeared during indiscriminate exploitation, destruction of habitats, spray of chemicals and introduction of alien species while number of plants await a similar fate. In this regards, global efforts are being made to conserve the diversity especially of rare, endangered and threatened species, which are known to be important component of biodiversity.

The subalpine to alpine transition zone that includes timberline is the most fragile ecosystem in the Himalayas. Rhododendron is the only group of plants that has continuum in the aforesaid ecotone and beyond doubt maintains the biological sustenance in this fragile zone. Furthermore, Rhododendrons are the most abundant in the sites with the highest potential for forest productivity, which increases the importance of the influence that Rhododendrons have on the forests. Restoration of Rhododendrons and their conservation in nature promotes the existence of other biodiversity components. Consequently, critical adjustment in forest management protocols and forestry practices may be required based on the mechanisms by which Rhododendrons have the impact on associated biodiversity.

Due to human interference the natural population of Rhododendrons in the entire Himalayan region is gradually diminishing. The major threat to Rhododendrons are deforestations and unsustainable extraction for firewood and incense by the local people. A set of rhododendrons which are classified as rare/endangered may be wiped out from the biota in the near future if proper conservation measures are not made. The present work on Rhododendron of IHR is based on the western Himalayan region in the states of J&K, Himachal Pradesh and Uttaranchal. The western Himalayan region is targeted for study of genetic diversity via AFLP analysis in this project. This can provide some proof for the classification and genetic diversity of Rhododendron & know more about its phylogeny and its adaptations so as to protect and utilize Rhododendron resources efficiently.

### METHODOLOGY:

The western Himalayan region is targeted for study of genetic diversity via AFLP analysis in this project.

### WORK ACCOMPLISHED SO FAR

The samples representing various populations have been collected from different locations of Himachal Pradesh and DNA isolation and purification is in progress.

### PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

Sharma, R. K., Bhardwaj, P., Negi, R., Mohapatra, T. and Ahuja, P. S. (2009). Identification, characterization and utilization of unigene derived microsatellite markers in tea (*Camellia sinensis*, L). *BMC Plant Biology* **9**: 1-24.

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Kamunya, S., Sharma, R. K., Korir, R., Sharma, V., Kumar, R., Bhardwaj, P., Chalo R. and Ahuja, P. S. (2010). Quantitative trait loci mapping for yield in tea (*Camellia sinensis* (L.) O. Kuntze). *Tree Genetics and Genome* **6**: 915-929.

Sharma, H., Kumar, R., Sharma V., Kumar, V., Bhardwaj, P., Ahuja, P. S. and Sharma, R. K. (2011). Identification and cross species transferability of 112 novel unigene derived microsatellite markers in tea (*Camellia sinensis* L). *American Journal of Botany* 10.3732/ajb.1000525.

Raina, S. N., Ahuja, P. S., Sharma, R. K., Das, S. C., Bhardwaj, P., Negi, R., Sharma, V., Singh, S. S., Sud, R. K., Kalia, R. K., Pandey, V., Banik, J., Razdan, V., Sehgal, D., Dar, T. H., Kumar, A., Bali, S., Bhat, V., Sharma, S., Prasanna, B. M., Goel, S., Negi, M. S., Vijayan, P., Tripathi, S. B., Bera, B., Hazarika, M., Mandal, A. K. A., Kumar, R. R., Vijayan, D., Ramkumar, S., Chowdhury, B. R. and Mandi, S. S. (2012). India hybrid tea - an extraordinarily important event in the rapid origin and evolution, and widespread expansion of modern commercial tea-genetic structure and diversity among 1644 accessions and clones inferred by AFLP markers. *Genetic Resource and Crop Evolution* **59**: 1527-1541.

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## SCHOOL OF BASIC AND APPLIED SCIENCES

CENTRE FOR CHEMICAL AND PHARMACEUTICAL SCIENCES (Established 2011)

### FACULTY

Name	Designation	Qualification/Training	Expertise
Prof. P. Ramarao	Centre Coordinator	Ph.D. Banaras Hindu University, Varanasi.	Establishment of cause and effect relationship in biological process, G-protein coupled receptors signaling, influence of diabetes on the cardiovascular complications and cancer
Dr. Raj Kumar	Assistant Professor	Ph.D. National Institute of Pharmaceutical Education & Research, Mohali. Experience abroad: Postdoctoral fellow at Department of Chemistry and Biochemistry, University of Maryland Baltimore County (UMBC), USA (2007-08)	Design and synthesis of novel small heterocycles as anticancer, antimalarial and xanthine oxidase inhibitors
Dr. Vinod Kumar	Assistant Professor	Ph.D. Institute of Himalayan Bioresource Technology, CSIR, Palampur, H.P. Experience abroad: Postdoctorate fellow at at European Research Centre for Drug Discovery and Development, Dipartimento Farmaco Chimico Tecnologico, Università di Siena, Siena, Italy (2008-2009) Research Officer at Department of Pharmacy and Pharmacology, University of Bath, BA2 7AY, UK (2010-2012)	Green chemistry, multistep organic synthesis
Dr. Vikas Jaitak	Assistant Professor	Ph.D. Institute of Himalayan Bioresource Technology, CSIR, Palampur, HP.	Natural product chemistry, synthesis of bioactive molecules targeting cancer and diabetes., green chemistry, molecular modelling

### PROGRAMMES OFFERED

1. M.Pharm. Medicinal Chemistry
2. M.Sc. Medicinal Chemistry
3. P.G. Diploma in Translational Biomedical Research

DST-4 (2012)

## Design, Synthesis and Biological Screening of Novel Multi-target Inhibitors of Tyrosine Kinase(s) and Topoisomerase-I.



**Principal Investigator: Dr. Raj Kumar**

Funding agency:	Department of Science and Technology, Government of India
Year of sanction:	2012
Budget:	Rs.27,00,000
Duration:	Three Years

### Objectives of the project

- Design and synthesis of novel heterocycles as multi-target inhibitors of EGFR, Her-2 and topoisomerase.
- In vitro screening of the synthetics against EGFR, Her 2 and topoisomerase I assay kits and cancer cell lines.

### PROJECT SUMMARY

**Introduction:** Traditional cancer treatments include three different routes to target cancer cells which include surgery, radiotherapy and chemotherapy. Chemotherapy of cancer includes various major classes like alkylating agents, antimetabolites, topoisomerase inhibitors and spindle poisons in combination or alone. The development of multi drug resistance and drug induced toxicity are the major hurdles in the chemotherapy of cancer. Although, several anticancer drugs are available, the failure to achieve the desired therapeutic efficacy with existing agents warrants newer methods and newer technologies.

The use of DML (design multiple ligand) approach to design and synthesize the novel molecules to combat the disease is a promising method. In human genome at least fifty six receptor tyrosine kinases are expressed, which can be divided into 19 families (AATYK, ALK, AXL, DDR, EGFR, EPH, FGFR, INSR, MET, MUSK, PDGFR, PTK7, RET, ROR, ROS, RYK, TIE, TRK and VEGFR families). In addition to these, 32 cellular tyrosine kinases expressed, which can be classified into 11 families [ABL, ACK, CSK, focal adhesion kinase (FAK), FES, FRK, JAK, SRC-A, SRC-B, TEC and SYK families]. Among these, the ABL, SCR, EGFR, PDGFR and VEGFR families have been the primary targets for the development of tyrosine kinase inhibitors. All the kinases use ATP as the phosphorylating agent and so there is the region within the active site that binds ATP. The knowledge of how ATP is bound to the kinase active site has been an immense help in the design of potent and selective agents.

Majority of the EGFR tyrosine kinase inhibitors suffer from resistant to drug treatment and dose dependant typical skin toxicity. Resistance occurs due to secondary mutation in EGFR, impairs the proper binding of the inhibitor, while maintaining intact kinase activity of the receptor by trans-activating Her 3. To overcome this unique resistance, researchers are prompted to depend upon the use of combined strategies or DML approach. Thus multi-targeting of EGFR, Her 2 and topoisomerase via the above designed hybrid pharmacophore can be a rational approach to preferentially kill the EGFR resistant cancer cells/tumors and simultaneous decrease of dose and thereby drug induced toxicity.

### METHODOLOGY:

The work will not only include the synthesis of compounds but also require their screening against EGFR and other kinases and a variety of cancer cell lines using MTT assay.

### WORK ACCOMPLISHED SO FAR

Some of the intermediates have been synthesised using routine organic transformations.



# Design, Synthesis and Biological Screening of Novel Heterocycles as Inhibitors of Dual Tyrosine Kinase(s) and Histone Deacetylase as Potential Anticancer Agents

**Principal Investigator: Dr. Raj Kumar**

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs.12,59, 000
Duration:	Three Years

## Objectives of the project

- In this work, design and synthesis of novel heterocycles derived from pyrazolo [1,5-c] quinazoline nucleus will be undertaken which are designed rationally considering the common pharmacophoric features of EGFR, Her 2 and HDAC inhibitors.
- In vitro biological screening of the synthetics will be undertaken against EGFR, Her 2 and HDAC enzymes and against cancer cell lines.

## PROJECT SUMMARY

**Introduction:** Protein kinases are involved in different cellular functions which include extracellular signaling, intracellular communication, proliferation and cell cycle control or apoptosis. These kinases can be divided into two main categories-the tyrosine kinases and the serine-threonine kinases that catalyse the phosphorylation of tyrosine and serine/threonine residues respectively in various proteins involved in the regulation of all functions.

The EGFR family consists of the tyrosine kinase receptors EGFR (ErbB1, Her1), ErbB2 (Her2), ErbB3 (Her3) and ErbB4 (Her4). The activation of these kinases results in deregulation of cell growth, avoidance of apoptosis and angiogenesis in epithelial malignancies. EGFR mutations play an important role in non-small cell lung cancer (NSCLC), while several mutations enhance the sensitivity to EGFR tyrosine kinase inhibitors gefitinib and erlotinib. The tyrosine kinase inhibitor gefitinib inhibits mutated EGFR and is registered for treatment of NSCLC. Gefitinib is active in patients who have mutations in the EGFR kinase domain and to a lesser extent EGFR amplification which corresponds with 10% of the patient group. Clinical trials are ongoing for other types of cancer. Another approved inhibitor of EGFR, erlotinib, which is used in a selected patient group with NSCLC, is usually preferred to gefitinib. However, although an initial response rate of 75% has been shown in patients with mutations in EGFR but these patients only rarely achieve complete response.

In half of the patients this is due to a Thr 790M mutation in EGFR. Though lung tumors might be resistant to erlotinib, metastases of these tumors to the brain can be sensitive to the drug. Another EGFR inhibitor is lapatinib, which in addition to EGFR, inhibits ErbB2. This inhibitor gave good results in Phase III ErbB2 positive breast cancer trials. Canertinib is an inhibitor of all EGFR family members. Phase II studies are ongoing in metastatic NSCLC and breast cancer.

In general, most of the clinically approved and recently reported EGFR tyrosine kinase inhibitors are either derived from quinoline or quinazoline structural framework with modification on 4-aniline ring and dialkoxy side chains.

Majority of the EGFR tyrosine kinase inhibitors suffer from resistant to drug treatment and dose dependant typical skin toxicity. Resistance occurs due to secondary mutation in EGFR impairs the proper binding of the inhibitor, while maintaining intact kinase activity of the receptor by trans-activating Her 3.

## METHODOLOGY:

The present work will include the synthesis of compounds and their screening against EGFR and HDAC and a variety of cancer cell lines using MTT assay.

## WORK ACCOMPLISHED SO FAR

Some of the intermediates have been synthesised using routine organic transformations and will be utilised for the synthesis of final compounds.

## PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

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## Synthesis of Bioactive Heterocyclic Scaffolds Using Novel Green Technologies



**Principal Investigator: Dr. Vinod Kumar**

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs. 6,00,000
Duration:	Two years

### Objectives of the project

- Development of new efficient protocols for the synthesis of highly biologically active heterocyclic scaffolds
- Use of benign reagents such as aqueous conditions and microwave for a move to greener chemical processes
- Use of ionic liquids as solvent and catalyst for the synthesis of target heterocyclic scaffolds.

### PROJECT SUMMARY

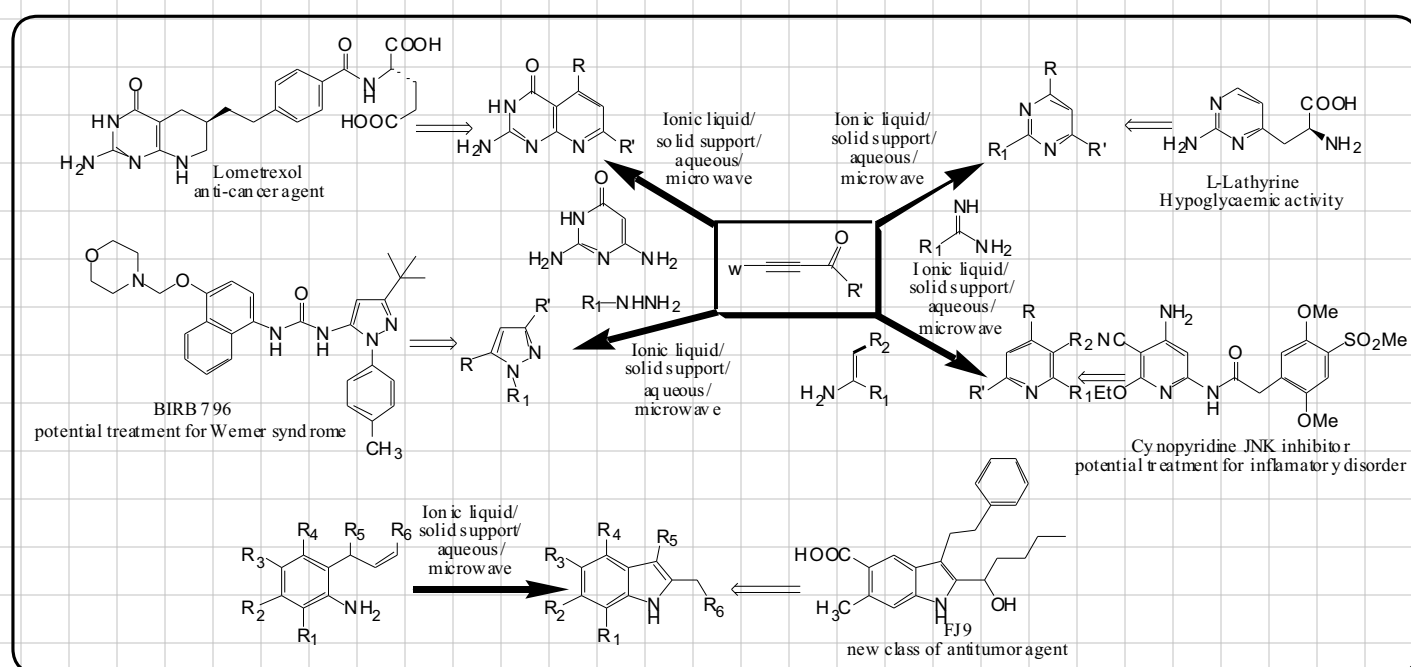
**Introduction:** Substituted heterocyclic compounds offer a high degree of structural diversity and prove to be economic and effective therapeutic agents. These compounds play an imperative role in human lives as lead candidates in hormones, vitamins, dyes, agrochemicals and as drug molecules. Depending upon the structural variations, heterocyclic compounds possess wide range of biological activities such as anti-cancer, anti-inflammatory, antibacterial, antifungal, antiviral, anti-HIV etc. Due to immense importance of these heterocyclic compounds as chemotherapeutic agents and emergence of microorganism resistance to conventional treatments, a continuous innovation is desired in heterocyclic synthesis. Further improvements in existing protocols are highly desirable in the form of enhanced yield, use of mild chemical reagents, shorter reaction time and wastage minimization in order to reduce or eliminate the harmful effect of the chemicals on environment.

### METHODOLOGY:

New green protocols for the synthesis of a range of biologically relevant heterocyclic scaffolds in lieu of the existing conventional processes will be proposed. The major focus will be on the syntheses of derivatives of pyridines, indoles, pyrimidines, pyrazoles etc. Some of the target molecules are given in Figure 1.

As part of the process development for the synthesis of these target molecules, the described principles of green chemistry will be explored in turn. Moreover, the use of toxic and hazardous chemical reagents will be avoided and aqueous reaction conditions will be emphasized. In addition, wherever possible, energy efficient microwave heating techniques will be employed as a green source of energy.





## WORK ACCOMPLISHED SO FAR

Protocols for the synthesis of ionic liquids have been developed and two ionic liquids have been synthesized. Reaction conditions are being optimized for the synthesis of 1, 2, 4-triazoles.

## PUBLICATIONS OF THE PRINCIPLE INVESTIGATOR

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## Synthesis of Rebaudioside – A: Natural Substitute for Sugar from *Stevia rebaudiana* (Bertoni)

**Principal Investigator: Dr. Vikas Jaitak**

Funding agency:	Department of Science and Technology, Government of India
Year of sanction:	2013
Budget:	Rs. 25,50,000
Duration:	Three Years

### Objectives of the project

- Isolation and characterization of new steviol glycosides including stevioside from *Stevia rebaudiana* leaves
- Synthesis of rebaudioside-A by using chemical and enzymatic processes

### PROJECT SUMMARY

**Introduction:** In Diabetes mellitus, a person has high blood glucose level, either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced. Hence, glucose is not metabolized in human body. Synthetic sweeteners such as aspartame, saccharin, sucralose and acesulfame potassium are currently in use but the side effects of these sweeteners have been the subject of debate over many years and is yet to be resolved. *Stevia rebaudiana* (Bertoni) family Asteraceae is an herbaceous perennial plant indigenous to Paraguay and Brazil where its leaves are used by local Guarani Indians as natural sweetener for hundreds of years. Its leaves contain nine ent-kaurene diterpene glycosides which belong to steviol skeleton (ent-13-hydroxy kaur-16-en-19-oic acid) and exhibit characteristic organoleptic properties. Collectively all the nine are known as steviol glycosides. *S. rebaudiana* leaves generally contain 6-10% (stevioside), 1-2% (rebaudioside-A) and other minor glycosides present upto 0.1-1%. Stevioside is reported to be 250-300 times and rebaudioside-A 300-400 times sweeter than sucrose. Although concentration of stevioside in *S. rebaudiana* leaves is higher than rebaudioside-A but aftertaste bitterness of stevioside and its low solubility in water restricts its use for human consumption and limits its application in food and pharmaceutical products. Rebaudioside-A, one of the other major constituents next to stevioside in *S. rebaudiana* leaves is preferred than stevioside, being more sweetener, high solubility in water and devoid of aftertaste bitterness.

### METHODOLOGY:

Steviol glycosides alongwith stevioside will be isolated from *Stevia rebaudiana*. Synthesis of rebaudioside from stevioside as well as steviol will be performed with chemical as well as enzymatic processes. Progress of the reaction will be analysed with TLC and HPLC system.

### WORK ACCOMPLISHED SO FAR

Different extracts for the isolation of steviol glycosides have been prepared.

### PUBLICATIONS OF THE PRINCIPLE INVESTIGATOR

Jaitak, V., Gupta, A., Kaul, V. and Ahuja, P. S. (2008). Validated high-performance thin-layer chromatography method for steviol glycosides in *Stevia rebaudiana*. *Journal of Pharmaceutical and Biomedical Analysis* **47**: 790-794.

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Bandna, Jaitak, V., Kaul, V. and Singh, B. (2009). Synthesis of novel acetates of  $\beta$ -caryophyllene under solvent-free Lewis acid catalysis. *Natural Product Research* **23**: 1445-1450.

Jaitak, V., Sharma, K., Kalia, K., Kumar, N., Singh, H., Kaul, V. and Singh, B. (2010). Antioxidant activity of *Potentilla fulgens*: An alpine plant of western Himalaya. *Journal of Food Composition and Analysis* **23**: 142-147.

Kurade, N. P., Jaitak, V., Kaul, V. K. and Sharma, O. P. (2010). Chemical composition and antibacterial activity of essential oils of *Lantana camara*, *Ageratum houstonianum* and *Eupatorium adenophorum*. *Pharmaceutical Biology* **48**: 539-544.

Jaitak, V., Kaul, V. K., Kumar, N., Singh, B., Dhar, J. and Sharma, O. (2010). New hopane triterpenes and antioxidant constituents from *Potentilla fulgens*. *Natural Product Communications* **5**: 1561-1566.

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Saini, R., Jaitak, V., Guleria, S., Kaul, V. K., Kiran Babu, G., Singh, B., Lal, B. and Singh, R. (2012). Comparison of headspace analysis of volatile constituents with GCMS analysis of hydrodistilled and supercritical fluid extracted oil of *Capillipedium parviflorum*. *Journal of Essential Oil Research* **24**: 315-320.

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## SCHOOL OF ENVIRONMENT AND EARTH SCIENCES

CENTRE FOR ENVIRONMENTAL SCIENCE AND TECHNOLOGY (Established 2009)

### FACULTY

Name	Designation	Qualification/Training	Expertise
Prof. A. K. Jain	Centre Coordinator	Ph.D. Panjab University, Chandigarh.	Renewable energy technologies, environment engineering
Dr. Sunil Mittal	Assistant Professor	Ph.D. Panjab University, Chandigarh.	Water pollution and waste water management, development of plant based bioherbicides
Dr. Dhanya M. S	Assistant Professor	Ph.D. Indian Agricultural Research Institute, New Delhi.	Environmental microbiology, biomass and bioenergy - biofuel, waste management
Dr. Yogalakshmi K. N	Assistant Professor	Ph.D. Anna University, Chennai.	Biological wastewater treatment, membrane technologies, membrane bioreactor, nutrient removal
Dr. Puneeta Pandey	Assistant Professor	Ph.D. Jawaharlal Nehru University, New Delhi.	Environmental Chemistry, Geographic Information System (GIS), remote sensing, air and water pollution
Dr. J. Nagendra Babu	Assistant Professor	Ph.D. Guru Nanak Dev University, Amritsar.	Supramolecular chemistry, environmental analytical chemistry, energy

### PROGRAMMES OFFERED

1. M.Sc. Environmental Science and Technology
2. M.Phil.-Ph.D. Integrated Programme in Environmental Science and Technology

DST-6 (2012)

## Bioherbicidal Potential of Immobilized (encapsulated/entrapped) Formulations of Essential Oil from Leaves of Plant *Callistemon viminalis*.



**Principal Investigator: Dr. Sunil Mittal**

Funding agency:	Department of Science and Technology, Government of India
Year of sanction:	2012
Budget:	Rs. 23,00,000
Duration:	Three Years

### Objectives of the project

- Extraction of essential oil from the leaves of the plant *Callistemon viminalis* and identification of its components.
- To develop immobilized formulations of the essential oil by using biodegradable polymers.
- To study the encapsulation/entrapment efficiency, particle size, life span and stability of developed formulations.
- To study the phytotoxicity of the developed formulation against weeds under controlled conditions.
- To study the phytotoxicity of the developed formulation against weeds under natural environments.
- To study mechanism of action of the developed bioherbicide formulations.
- Compare the efficacy of the developed formulation with commercially available herbicide glyphosate used to control weeds of wheat and rice.
- To access the degradation time of the developed formulation under natural environmental conditions.

### PROJECT SUMMARY

**Introduction:** India being primarily agriculture based country; its economy largely depends on agricultural production which in turn is governed by various factors like climatic, edaphic, seed quality etc. However, other natural factors like pests especially weeds, plant diseases and insect also effect the agricultural production. Weeds are the unwanted plants that grow and reproduce aggressively at the cost of agricultural plants. Weeds compete with agricultural crops for all resources required for their growth and hence lead to economic losses by affecting quality and yield of crops.

In modern agricultural practices, chemical methods are preferred worldwide for controlling weeds. But, unfortunately the indiscriminate use of synthetic and chemical herbicides in agriculture has led to multiple toxic effects on the ecology and environment.

The continuous use has not only contaminated ground water, surface water, soil and air, but has also started adversely affecting various life forms including human beings. The direct and indirect effects of the synthetic herbicides on soil biodiversity, domestic and stray animals including humans have been reported worldwide. In humans exposure to pesticides results in acute and chronic health problems. These range from temporary acute effects like irritation of eyes,



excessive salivation to chronic diseases like cancer, reproductive and developmental disorders etc. The environmental impacts include widespread decline in bird and Insect populations. To overcome the problem, research leading to find new molecules delivering novel properties, having new modes of action, effective in low concentration, environmentally safe, more target specific and economical is an ongoing process. Efforts to search new herbicide chemistry have been made by different researchers in various ways including natural products of animal and plant origin.

Essential oils from aromatic plants like Eucalyptus, Callistemon have been reported to be excellent material for the purpose. Although a number of studies have established their bioherbicidal potential under laboratory conditions, yet only a limited success has been reported under natural conditions. The main causes of limited success under natural conditions are their high volatility, limited production, faster degradation and high cost.

In order to improve the life span, environmental sustainability and efficacy of essential oils, immobilization (entrapment and encapsulation) has been reported by some scientists. Immobilized formulations of essential oils means entrapment/encapsulation of essential oils in biodegradable polymers. For entrapment and encapsulation of essential oils, different type of biodegradable polymers and their formulations (micro sphere, liposome and nanoparticles) are under exploration.

METHODOLOGY:

The essential oil will be extracted using Clevenger's apparatus followed by GCMS analysis. Weeds of common cash crops (wheat and rice) which are able to grow under laboratory conditions will be selected. The toxicity of essential oil from plant will be studied against selected weeds. Only weeds sensitive to essential oil toxicity will be selected for further studies. Various polymers like chitosan (CH) and angico gum (AG), solid lipids, alginate, etc. will be used for the immobilization of essential oil either by entrapment or by encapsulation. Standardization of the polymer and oil ratio for achieving highest immobilization in terms stability, loading capacity and controlled release and sustainable delivery of essential oil will be assessed.

WORK ACCOMPLISHED SO FAR

During the last few months from start of the project, the essential oil from the leaves of plant *Callistemon viminalis* has been extracted for summer season and monsoon seasons. The GC-MS analysis of the oil reveals monoterpinenes as the major component of this oil. Monoterpene 1,8- Cineole (60%) and  $\alpha$ -Terpeneol (20%) constitute 80% of the oil. The oil has been used to make stable formulations using sodium alginate and cyclodextrin. The preliminary phytotoxic studies of essential oil on weeds *Echinochloa crus-galli* and *Amarantus* indicate its suppressing effect on seed germination, development of seedling (root and shoot) and dry weight. The effect has been observed to be linked to concentration gradient. At highest conc. of 500 $\mu$ g/ml of essential oil, the percent germination and seedling growth was less than 10%. The results of preliminary studies indicate the possible bioherbicidal use of the essential oil from *C. viminalis* against weeds.

Effect of Arsenic (As) Toxicity on Growth and Physiology of *Oryza sativa* L. varieties Grown in Malwa Region of Punjab

Principal Investigator: Dr. Sunil Mittal

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs. 6,00,000
Duration:	Two Years

Objectives of the project

- Effect of different concentrations of arsenic on different varieties of *O. sativa* in terms of growth parameters.
- Biochemical changes in *O. sativa* varieties in response to different concentrations of arsenic
- To evaluate the hyper accumulator variety of *O. sativa* among the varieties grown in Malwa region of Punjab.
- To find stress/sensitive variety of *O. sativa* in terms of growth and production.
- To screen the accumulation of arsenic in different parts of *O. sativa*.

PROJECT SUMMARY

**Introduction:** Arsenic (As) contamination in environment has aroused considerable attention due to its harmful affects to plants and animals including humans. Human exposure to arsenic is either by drinking arsenic contaminated water or through consumption of arsenic contaminated food. The adverse affects of arsenic in human range from irritation of stomach, intestine and skin, damage to peripheral nerves, cardiovascular system, and hair fall to various mental disorders. Moreover, the long term arsenic toxicity is known to have carcinogenic and mutagenic potential. In recent times, the impact of irrigation with high arsenic ground water on soil and crop has drawn more attention due to transfer of arsenic to food chain via water–plant–soil system. Long term use of arsenic contaminated water leads to accumulation of arsenic in soil from where it can be taken up by plants. Arsenic is known to have strong capacity of accumulating and bioenrichment in plants. The lower concentration of arsenic is known to stimulate growth in plants. However, high concentration of arsenate negatively affects the plants in terms of stress to plants, inhibition of growth, physiological disorders, affect the biomass and yield of the crops. As shows negative affects in plants by affecting, transpiration rate, uptake and transport of water, micronutrients uptake etc.

The ground water in many parts of Malwa region of Punjab has also been reported to have high concentration of arsenic. As per Jain and Kumar (2005), the arsenic concentrations in the Malwa region ranges from 11.4 to 688  $\mu$ g/L with average value of 76.8  $\mu$ g/L. The aquifers samples of Malwa region has been reported to comprise 11% moderate ( $\Rightarrow$ 10 to <25  $\mu$ g/L), 54% high ( $\Rightarrow$  25 to <50 $\mu$ g/L) and 35% in very high ( $\Rightarrow$  50 $\mu$ g/L) arsenic category. Hundal et al., (2007) have reported that the presence of arsenic bearing rocks in the earth crust are responsible for naturally high content of arsenic in water and soil. Different researchers working in the region has reported arsenic contamination in different districts of Malwa Region. PPCB-PGIMER Report (2007), has reported high content of arsenic in ground water of Bathinda (<http://www.appcb.ap.nic.in/faq/punj.htm4>, accessed on 23-3-2012). Similarly, many newspaper articles (non scientific data) have also reported arsenic contamination in Mansa, Bathinda and other districts of Malwa region. The problem



becomes a serious issue in Malwa region as major part of agriculture. This is because as it is dependent on groundwater for the irrigation purpose.

The continues and repeated use of arsenic contaminated water for irrigation of various crops and vegetables not only contaminates the soil but also the eatables grown in the area. Moreover, arid climate with high temperature and very low rainfall in this region results in more evaporation leaving behind evaporates in upper soil layers. Thus, one of the reasons of increase in arsenic concentration may be increased evaporative factor.

METHODOLOGY:

Seeds of different varieties of *O. sativa* grown in malwa region of Punjab will be obtained from Punjab Agricultural University, Ludhiana. Different parameters like percent growth, chlorophyll, respiration, protein content, carbohydrate content and arsenic estimation will be studied by standard methods.

WORK ACCOMPLISHED SO FAR

In order to study the effects of different concentrations of arsenic on different varieties of *O. sativa*, experimental works have been carried out in the laboratory conditions for this four varieties of this region named PR122, PR116, PR118, PUSA 1121 collected from PAU Ludhiana. The different concentrations of arsenic from 0 to 500 µM have been tested for the germination study of seeds. Then different physiological parameters i.e. effect on root length, shoot length development and dry weight of these varieties has been studied from 0 to 500 µM concentration of arsenic. All the parameters reduced with the increase of the concentration of arsenic. The highest reduction has been observed in the varieties PUSA 1121 and PR122, so they are considered as sensitive varieties and other two are comparatively resistant to the arsenic toxicity. So among the four varieties PUSA 1121 and PR122 has been selected for the further study of biochemical parameters.

PUBLICATIONS OF THE PROJECT INVESTIGATOR

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Assessment of Chlorpyriphos in Non Bt Cotton Soil of Talwandi Sabo, Bathinda and the effect of Amendments and Organic Matter on Chlorpyriphos Degradation.

Principal Investigator: Dr. Dhanya M.S.

Funding agency:	University Grants Commission, New Delhi.
Year of sanction:	2012
Budget:	Rs. 6,00,000
Duration:	Two years



Objectives of the project

- To evaluate the chlorpyriphos content in non Bt- cotton soils of Talwandi Sabo block
- To investigate the chlorpyriphos residues against different soil depths in the soil profile of cotton grown areas
- To study the leaching effect of chlorpyriphos by soil column studies
- To study the effect of pH on chlorpyriphos degradation
- To study the effect of chlorpyriphos on the germination of rice and wheat seeds
- To study the effect of amendments in chlorpyriphos degradation
- To study the effect of organic matter in soil and chlorpyriphos degradation
- Screening of efficient microbes (biofertilizer) for bioremediation of Chlorpyriphos
- Assessment of microbes as biofertilizer in chlorpyriphos contaminated soil

PROJECT SUMMARY

**Introduction:** Punjab consumes about 18 per cent of total pesticides used in India against its 2.5 per cent coverage of nation's total land area. About 54 per cent of the total pesticides used in Indian agriculture are for cotton crop which accounts only 5 per cent of the total cultivated area. Malwa region is one of the major cotton belts of Punjab that consumes 75 per cent of pesticides used in the state. Talwandi sabo one of the blocks in Bathinda district covers an area of 97 ,364 hectares is reported as a high pesticide consuming area. Presently the highly persistent organochlorines are replaced by organophosphate pesticides. But these organophosphate pesticides are also toxic and act as acetylcholine esterase inhibitor, which interferes in the transmission of nerve impulses at the nerve endings.

Chlorpyrifos (O, O-diethyl O-[3,5,6-trichloro-2-pyridyl] phosphorothioate is a broad spectrum contact insecticide widely used to control insects in the home, workplace, and in agriculture. Chlorpyrifos is the fourth highest consumed pesticide in India. The application of chlorpyriphos against American boll worm and tobacco caterpillar is recommended in approved package of practices of cotton in Punjab. The Chlorpyriphos is widely used in non-Bt cotton than the Bt-cotton against control of pests. The chlorpyriphos residues was detected in 85% of the blood samples at mean level of 0.0662 mg/l in blood samples analysed in Talwandi sabo block by Centre for Science and Environment and Pollution Monitoring laboratory. There were also reports of chlorpyriphos residues in water samples of the region.

Chlorpyrifos is stable in soils with reported half-lives ranging between 7 and 120 days depends on the factors such as pH, temperature, moisture content, organic carbon content, and pesticide formulation. The degradation of chlorpyrifos in the soil environment is enhanced by UV light, chemical hydrolysis, and soil microbes. The chlorpyrifos and its major metabolites in aqueous, soil or sediment systems like TMP (3, 5, 6-trichloro-2-methoxypyridine) and TCP (3, 5, 6-trichloro-2-pyridinol) have different sorptive behaviour. The dissipation and distribution of chlorpyrifos residues in soil also varies over depth.

Microbial degradation is considered to be an efficient and cost effective method for decontamination of toxic organophosphorus pesticides from the environment. Chlorpyrifos has proved to undergo enhanced microbe mediated decay into less harmful and non-toxic metabolites, under a set of favourable abiotic conditions. *Pseudomonas fluorescens*, *Brucella melitensis*, *Bacillus subtilis*, *Bacillus cereus*, *Klebsiella* species, *Serratia marcescens* and *Pseudomonas aeruginosa* have potential for the degradation of chlorpyrifos.

#### METHODOLOGY:

The soil samples are collected from agricultural fields of various villages of Talwandi Sabo, Bathinda, Punjab. Soil samples are air dried overnight and then sieved and stored. The degradation of Chlorpyrifos of different concentrations in the soil will be studied at different pH. The soil biological activity will be estimated by determination of different enzymatic activities. The samples will be collected at regular and analysed for pesticide residues by standard methods. The vertical migration of chlorpyrifos is estimated by the method described by El Bakouri (2007) by addition of different concentrations of Chlorpyrifos against a reference. The microbes selected for screening the degradation potential of chlorpyrifos as a sole carbon source in different concentrations of chlorpyrifos in suitable culture medium will be identified.

#### WORK ACCOMPLISHED SO FAR

The amount of the grant sanctioned was used for the procurement of chemicals and other consumables for the experiments. The sampling tools for soil sampling were also purchased. The first round of sample collection from the villages of Talwandi sabo block was done and questionnaire-cum-interview survey was conducted. The basic characterization of the soil samples and analysis are in progress.

#### PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

- Prasad, S., Dhanya, M. S., Gupta, N. and Kumar, A. (2012). Biofuels from Biomass: A sustainable alternative to energy and environment. *Biochemical and Cellular Archives* **12**: 255-260.
- Mishra, D. and Dhanya, M. S. (2012). Biofertilizers: As bioprotecting agents. *International Journal of Environmental Engineering and Management* **3**: 298-302.
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## Fluorimetric Estimation of Uranium and its Source Apportionment in Groundwater of Bathinda District in Punjab.



**Principal Investigator: Dr. Yogalakshmi K. N**

Funding agency:	University Grants Commission, New Delhi.
Year of sanction:	2012
Budget:	Rs.5,40,000
Duration:	Two years

#### Objectives of the project

- To estimate the Uranium present in this region by adopting fluorimetric technique
- To study the spatial variation of Uranium concentration in the groundwater of Bathinda district of Punjab and investigate potential seasonal variations
- To conduct the source apportionment study and identify the possible sources for Uranium pollution in Bathinda district of Punjab
- To use multivariate statistical analysis and factor analysis as a tool for source apportionment of Uranium

#### PROJECT SUMMARY

**Introduction:** Uranium received an alarming attention in Bathinda district of Punjab due to the increased incidence of cancer, believed to be due to intake of groundwater contaminated with high levels of Uranium. Studies in the past few years, reported the presence of Uranium at levels (20-120 µg/L) above the permissible limit as prescribed by WHO and USEPA. The World health organization (WHO) and United States Environmental Protection Agency (USEPA) has prescribed Uranium in drinking water to be 15µg/L and 30µg/L, respectively due to their adverse health impacts. However, the source of Uranium in this region still remains dubious. Some authors reported that, the source could be geological, since the area is rich in granite and phosphate rocks; the weathering of which could have led to elevated Uranium levels. Anthropogenic sources are also predicted by few others, as Bathinda hosts several industries like thermal power plants, fertilizer factories and chemical factories.

In order to mitigate and remediate, it is essential to identify the actual source of Uranium and its relative contribution through source apportionment studies. The source apportionment assessment of pollutant loads is great concern for proper pollution management. Source tracking involves identifying the specific source responsible for a given pollutant, and source apportionment involves determining the relative contributions of multiple sources that contribute to the occurrence of a given pollutant. Increasingly, source apportionment analyses are being used as a relatively accurate, rapid, and cost-effective means of identifying and targeting sources and their relative contributions to the total pollution load. The application of receptor models to the environmental samples allows the identification and apportionment of pollutants to their sources. Multivariate statistical analysis and models like Principal Component Analysis (PCA), Positive Matrix Factorization (PMF), UNMIX, Absolute Principal Component Scores (APCS) and Chemical Mass Balance (CMB) is used for source apportionment studies.



The major purpose of the proposed study would be to identify the major types of Uranium in the environment and estimate their relative contribution. The receptor models will be used as a tool for Uranium source apportionment studies. The study will also determine the Uranium concentration in Bathinda district by adopting fluorimetric method, and would provide its spatial and temporal distribution along with the flow path in the region.

#### METHODOLOGY:

Study area and sample collection: Preliminary data viz. Bathinda district maps, geographical extent, topology, contours, meteorology, geology and hydrogeology of the study area (Bathinda) would be collected. Field data related to the sources of groundwater, depth of groundwater table and its direction of flow would be collected during sample collection. For measuring the Uranium concentration in groundwater, the entire area of Bathinda district would be divided into a grid of 10 km<sup>2</sup> each. Sampling points would be taken preferably at the center of each grid where groundwater would be collected to measure the concentrations of Uranium. Further, after analysis of all the water samples, the results obtained would be used in GIS software to generate a spatial distribution map, isoconcentric distribution and spread pattern of Uranium concentrations of Bathinda district. The spatial map would give an idea about concentrations of Uranium at different places, based on which, further mitigative actions can be taken. The flow path of the Uranium in this region would also be investigated.

Besides determining the spatial distribution of Uranium in Bathinda district, an effort would be made to study the seasonal variations in the concentrations of Uranium in groundwater. That is, the sampling at above mentioned sites would be carried out every three month once to investigate their effects in causing local or regional level variations. Thus, the study would comprise of comprehensive study to ascertain both spatial and temporal variations in uranium concentrations in groundwater. The Uranium will be determine using spectrofluorimeter at 266 nm. Emission spectra would be recorded over the range 450 nm to 650 nm.

#### Source apportionment studies

The proposed study aims at using two types of approaches for source apportionment. The first is a qualitative approach which helps us identify important factors which can explain the variations in the data set measured. The second is based on quantitative estimate and it helps us the contributions of various sources. Accordingly, principal component analysis would be carried out to assign the sources of uranium based on signature sources. At the end suitable models such as chemical mass balance would be applied to gain an insight into the dispersion and fate of uranium in ground water to suggest appropriate mitigative steps.

#### WORK ACCOMPLISHED SO FAR

Primary data collected, sampling sites were identified, and groundwater sampling is under progress.

#### PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

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## Assessment of Organochlorine Pesticide Residues in Groundwater and Soil of Bathinda district, Punjab



**Principal Investigator: Dr. Puneeta Pandey**

Funding agency:	University Grants Commission (UGC)
Year of sanction:	2013
Budget:	Rs. 6,00,000
Duration:	Two Years

#### Objectives of the project

- To estimate quantitatively the concentration of pesticides present in the surface water, groundwater and soil of Bathinda region.
- To study the spatial variation of pesticides concentration in the surface water, groundwater and soil of Bathinda district of Punjab and investigate potential seasonal variations.
- To conduct the source apportionment study and identify the possible sources for pesticides in the selected matrix in Bathinda district of Punjab.

#### PROJECT SUMMARY

**Introduction:** One of the major environmental health concerns throughout the world is the human exposure to hazardous chemicals. Despite various initiatives taken by different countries to minimize such exposures, environmental health consequences are worsening because of the continuous and excessive release of such chemicals from industry and agriculture. A major group of such hazardous chemicals include Persistent organic pollutants (POPs); which have three main characteristics: persistence, bioaccumulation and long range transport. As a result, they are able to resist degradation in various environmental matrices, such as air, water, soil and sediment. With the adoption of Stockholm Convention on POPs in May, 2001; there has been a growing interest in these chemicals due to their potential toxicity and human health impacts. As per Stockholm Convention, POPs include nine organochlorine pesticides (OCPs) and three industrial chemicals or by-products. The nine pesticides targeted by the Stockholm Convention were produced internationally and used on agricultural crops or for public health vector control. These pesticides include Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene (HCB), Mirex, Toxaphene and DDT. By 1970s, these pesticides have been either banned or restricted in many countries. However, they are still used in many developing countries including India in very large quantities, mainly because of their low cost and effectiveness.

OCPs are particularly problematic because they are persistent, broad spectrum toxicants that tend to accumulate in the food web and have the potential to adversely affect ecosystem and human health. Some of the OCPs (DDT, DDE, heptachlor, endosulfan, and chlordane) are suspected to be carcinogens and/or endocrine disrupters because of their chemical stability, estrogen-like characters and potential animal toxicity. Due to high lipophilicity, residues of organochlorine pesticides are still detectable years after use in soils, water and sediments.

Punjab became the food basket of India with the advent of Green Revolution in 1965. This led to an increased production



of food and cash crops due to introduction of high-yielding varieties, new irrigation techniques and fertilizers and pesticides. The pesticide consumption in India increased from 154 metric tons in 1954 to 88,000 metric tons in 2000–2001. Although Punjab covers only 1.5% of total geographic area of the country, it is responsible for 17% of pesticides consumed in India. The residual effects of Green revolution can still be seen in environment and food products in Punjab. Cotton crop accounts for only 5% of total cultivated area of the country and about 54% of total pesticides used in agriculture are used on this crop alone. A hazardous combination of pesticides (cocktail) is used to protect cotton crop – Organochlorines (Aldrin, Heptachlor), Carbamates (Aldicarb), Organophosphates (Chloropyriphos, Acephate, Ethion, Triazophos) and Synthetic pyrethroids (Fenvelrate, Alphametharin, Cypermetharin). The district of Bathinda falls in Malwa region of Punjab, a region facing adverse health effects due to indiscriminate use of pesticides. Various cases of cancer and reproductive disorders have been reported in this region in the recent years. Death of 61 persons due to inhalation of pesticides during field sprays has been reported between the years 2004–2008 in the Bathinda district. Department of Health and Family Welfare (DHFW, 2013) in India indicates the cancer prevalence (per million) in the Malwa region to be 1089; hence, the region has been called India's Cancer Capital. Out of the 11 districts in the Malwa region, 4 districts, i.e., Muktsar, Mansa, Bathinda, and Faridkot are the worst afflicted by various cancers. The indiscriminate use of pesticides started with the introduction of first cotton hybrid varieties A-846 in 1985-86 by Punjab Agricultural University. Since the hybrid seed attracted American bollworm (*Helicoverpa armigera*) in 1988; pesticides began to be used to combat the problem of bollworm. Further, as the pest became increasingly resistant to pesticides; the dosage was increased from Rs. 550/acre to Rs. 10000/acre. The Punjab Agricultural University recommended 7 sprays / 6 months on cotton plantation; however, the farmers in Bathinda region sprayed 32 times more than these limits to make the pesticides more effective. Further exposure to pesticides occurs during purchase, transport, storage and dilution of pesticides; besides leaking of spray equipment, and inhalation during pesticide spraying. Vacant containers of pesticides are used for storing food items by the rural communities; thus, further aggravating the impacts.

#### METHODOLOGY:

##### (i). Study area and sample collection

For measuring the pesticide concentration, the entire area of Bathinda district would be divided into a grid of 10 km<sup>2</sup> each. Sampling points would be taken preferably at the center of each grid where soil samples and groundwater would be collected to measure the concentrations of OCPs. Further, surface water samples would be collected from the canal and lake adjacent to thermal power plant. Seasonal variations in the concentration of organochlorine pesticides in this region, viz. premonsoon, monsoon and post-monsoon season; would also be investigated for ground water, surface water as well as soil samples. The trend and flow path of the organochlorine pesticides in the groundwater of this region would also be investigated.

##### (ii). Estimation of pesticides by GC-ECD/MS

USEPA Method 8081B shall be followed for sample preparation, extraction USEPA (Method 3540), cleanup (USEPA Method 3630C) and analysis using GC-ECD/MS.

##### (iii). Spatial distribution using GIS software

After analysis of all the samples, the results obtained would be used in GIS software to generate spatial distribution map of organochlorine pesticides in the district. Preliminary data for generating distribution maps of OCPs such as Bathinda district maps, meteorological and hydrogeological data of the study area would be collected. Field data regarding the soil type, source of groundwater, depth of groundwater table and its direction of flow would be acquired during sample collection. The spatially interpolated maps thus generated would be indicative of organochlorine pesticides concentrations at different sites in Bathinda district. Thus, the proposed study shall assess both spatial and temporal variations in organochlorine pesticide concentrations in a comprehensive manner to investigate the changes occurring at local as well as regional level; based on which, further mitigative actions can be taken.

##### (iv). Source apportionment studies

Source apportionment studies would be carried out to know the exact contribution of each OCP in the total pesticide

mixture using both qualitative and quantitative approach. Thus, source apportionment would help in identifying the potential sources of OCPs as well as quantifying the contribution of known emissions sources. Principal Component Analysis (PCA) combined with Multiple Linear Regression Analysis (MLRA) would be used to assign the sources of OCPs based on signature sources in the proposed study. At the end suitable models such as chemical mass balance would be applied to gain an insight into the dispersion and fate of OCPs in ground water and soil so as to suggest appropriate mitigative steps.

#### WORK ACCOMPLISHED SO FAR

Soil sampling for the monsoon season has been carried out from different land use/ land cover sites such as agricultural fields, residential area, roadside and commercial area in Bathinda city (30.2039° N, 74.9426° E). Samples have been collected from a depth of 0 to 15cm and carried to the laboratory. Roots, stones, etc. were removed and samples have been crushed and air dried at room temperature. Then the samples were sieved using a 2mm sieve and refrigerated at 4°C for further analysis.

#### PUBLICATIONS OF THE PROJECT INVESTIGATOR

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Singh, M., Kumar, D., Pandey P., Kumar, K. and Jain, V. K. (2011). Ambient noise levels due to dawn chorus at different habitats in Delhi. *Environment and We: An International Journal of Science and Technology* **6**: 123-134.

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## Synthesis and Evaluation of Calixarene Capped Quantum Dots for Sensing of Organic Analytes

**Principal Investigator: Dr. J. Nagendra Babu**

Funding agency:	Department of Science and Technology, Government of India.
Year of sanction:	2012
Budget:	Rs. 24,30, 000
Duration:	Three Years

### Objectives of the project

- The work described will present an inclusion sensing functional material, which would yield a phenomenal breakthrough in the inclusion behavior studies of calixarene and their bridging methylene functionalized derivatives.

### PROJECT SUMMARY

**Introduction:** Quantum dots are semiconductor nanoparticles confined in all three dimensions to 1-10 nm length scale and are commonly referred to as zero dimensional materials. These nanocrystals have drawn great research interest in recent years owing to their optical properties like, broad excitation, high quantum yield and narrow size-tunable emission spectra with reduced susceptibility to photobleaching and high photochemical stability. These optical properties are sensitive to the presence and nature of adsorbate on the surface of the quantum dots. Thus, introduction of organic ligand on the surface of the quantum dots leads to the stabilization of quantum dots with the surface carrying various functionalities for participation in molecular recognition events based on complementarity and preorganization of the functionalities. It is expected that a chemical sensing system based on quantum dots can be developed using fluorescence changes induced by molecular recognition at the surface of quantum dots.

Few quantum dot based sensors have been reported for the sensing of temperature, flow and analytes like pH, metal ions, anions, organic analytes and bioanalytes. The sensing of organic analyte, pesticides in particular is becoming essential due to the manifestation of organics in our life in several ways from fuels to electronics, polymers and biomedical to warfare agents. Present existent procedures are not full proof, have low throughput and requires advanced instrumentation. Thus, there is a need for efficient method of analysis for such organic analytes, which can be used in field monitoring. Thus a suitable host molecule forming inclusion complex with these class of organic analytes when attached to quantum dots would relay the binding event as the change in the fluorescence is due to the quantum dots.

Calixarenes having vase like shape, are an interesting class of host moieties, comprising of an internal cavity suitable for inclusion based molecular recognition. Calixarenes, are a 1n-class of metacyclophanes, formed by base-catalyzed condensation of p-substituted phenols and formaldehyde. Calixarenes have vastly been studied for recognition of various analytes like anions and cations based on the suitable decoration of the host scaffold on either the upper rim or the lower rim. Parent calixarenes and their water soluble derivatives have been studied for their inclusion properties for various small organic analytes like terpenes, steroids, aminoacids and paraquats to name some. However, there are no reports on the utilization of methylene bridges to decorate and strengthen the arene core of calixarenes for study of inclusion behaviour. We envisage that methylene bridges of calixarene when suitably functionalized with various functionalities would lead to novel receptors, which when adhered to the surface of quantum dots would act as a selective fluorophoric sensor of organic analytes.

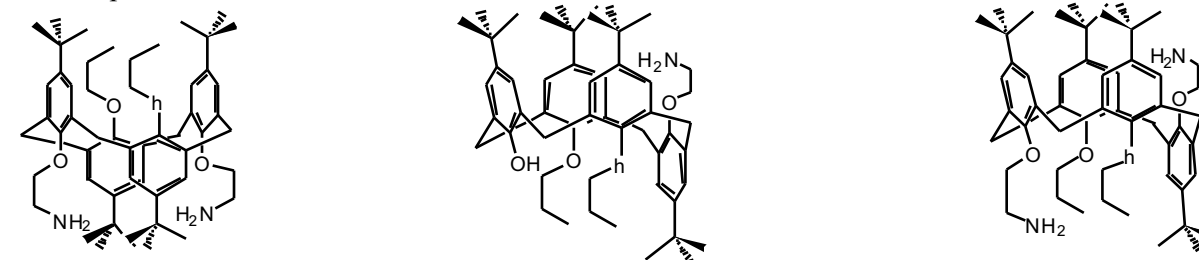
Thus in the present work, we are interested in the synthesis of quantum dots appended with such functional calixarenes for selective spectrofluorometric determination of organic analytes by inclusion of the guest analyte in the cavity inscribed by the calixarene moiety.

### METHODOLOGY:

Functionalization of the calixarene methylene bridges will be carried out to fetch expanded calixarene suitable for inclusions. The structure and conformation of the calixarene derivatives will be established. Quantum dot capped with these functionalized calixarene derivatives would be prepared and fluorescence studies will be performed to establish the molecular recognition behavior of the capped calixarene. Binding modes for fluorescence molecular recognition of calixarene will be established. The derivatives would be fine tuned for selective and sensitive recognition of organic analyte.

### WORK ACCOMPLISHED SO FAR

Recently, naphthalene recognition by the lower rim 1,3-diamine of calix [4] arene in cone conformation has recently being reported. However, there have been no studies in the molecular recognition of organic analyte by the such derivatives in 1,3-alternate and paco conformation.



In the present work, we have synthesized the amines in 1,3-alternate (1-2) and paco (3) conformation. The preparation of the CdSe quantum dot is being carried out in the laboratory. The resulting quantum dot will be coupled with the amines and studies for their recognition behavior towards various pesticides, PAH and picric acid etc.

### PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

- Kumar, M., Sharma, V. and Babu, J. N. (2002). Synthesis of New Cryptands Containing 1-Methyl or 1-Hexadecylpyrazole. *Journal of Inclusion Phenomenon and Macrocyclic Chemistry* **42**: 247-250.
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- Kumar, M., Babu, J. N., Bhalla, V. and Athwal, N. S. (2007). Visible colorimetric sensors for fluoride ion based on o-Phenylenediamine. *Supramolecular Chemistry* **19**: 511-516.
- Babu, J. N., Bhalla, V., Kumar, M., Mahajan, R. K. and Puri, R. K. (2008). Chloride selective sensor based on calix [4] arene having urea moiety. *Tetrahedron Letters* **49**: 2772-2775.
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- Kumar, M., Babu, J. N., Bhalla, V. and Kumar R. (2010). Ratiometric/ 'On-Off' Sensing of Pb<sup>2+</sup> ion Using Pyrene Appended Calix[4]arenes. *Sensors and Actuators B : Chemistry* **144**: 183-191.
- Kumar, M., Babu, J. N. and Bhalla, V. (2010). Fluorescent Chemosensor for Cu<sup>2+</sup> Ion Based on Iminoanthryl Appended Calix[4]arene. *Journal of Inclusion Phenomenon and Macrocyclic Chemistry* **66**: 139-145.

# SCHOOL OF EMERGING LIFE SCIENCE TECHNOLOGY

CENTER FOR GENETIC DISEASES AND MOLECULAR MEDICINE

(Established 2013)

## FACULTY

Name	Designation	Qualification/Training	Expertise
Prof. R.G.Saini	Centre Coordinator	Ph.D. Punjab Agricultural University, Ludhiana.	Genetics of host-parasite interactions
Dr. Sandeep Singh	Assistant Professor	Ph.D. National Centre for Cell Science, Pune.  Experience abroad: Postdoctorate fellow at Hematopoietic and leukemia stem cell division, Bekman Research Centre, City of Hope, National Medical Centre, California, USA (2010-2011)	Cancer biology
Dr. Monisha Dhiman	Assistant Professor	Ph.D. Himachal Pradesh University, Shimla, H.P.  Experience abroad: Postdoctrate fellow at Department of Microbiology and Immunology, University of Texas Medical Branch, Galveston, TX, USA (2006-2010)	Genetics of the metabolic disorders (diabetes type 2, cardiovascular diseases, reproductive disorders, cancer), Immunogenetics

UGC-10 (2013)

## Assessment of Underground Water Quality in Bathinda District for its Impacts on Human Cells in-Vitro



*Principal Investigator: Dr. Sandeep Singh*

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs. 6,00,000
Duration:	Two years

### Objectives of the project

- Effect of contaminated water on Normal Cells (proliferation, apoptosis).
- Assessment of DNA damage by contaminated water in normal and cancer cell lines.
- Understanding the regulation of free radicals by contaminated water versus ultrapure water.
- Effect of water contamination on normal or cancer cell migration.
- Understanding the correlation between TDS levels and genotoxic potential of the underground water.

### PROJECT SUMMARY

**Introduction:** Cancer cases amongst population in Malwa region of Punjab are on the rise. Different studies attribute the increase in cancer cases due to the environmental pollution, underwater contaminants and agricultural pollutants like pesticides. The proposal is aimed to decipher the role of underground water in causing cancer in human cells in-vitro. Various cell lines and primary cells will be used to assess ground water for its effect on human cells especially free radical production, DNA damage and cell cycle regulation.

### METHODOLOGY:

The aim of the project is to understand the direct effect of underground water on human cells. This will be ascertained by use of primary cell cultures and testing the health of these cells (in the form of DNA damage, free radical generation and movement potential) when exposed to the contaminated water.

The water samples will be collected by December 2013. These water samples will be collected from thermal plant, NFL and two from the agricultural fields each from wheat-paddy and wheat-cotton cycle) and will be analyzed for their potential to cause DNA damage and cell cycle deregulation by various experimental approaches. The major techniques to be used for the study are; cell culture, MTT assay, free radical assays using fluorescent probes, PI based cell cycle analysis, migration assays like gelatin zymography etc.

Furthermore, in this study, it will also be observed if the water contaminant may assist the process of carcinogenesis by aiding into cancer cell migration or not. Overall the project is aimed to correlate the quality of water in the region and will serve as one of the first indication of direct involvement of underground water in the process of carcinogenesis. The study will provide scientific data which may be used to create public awareness amongst the residence of Malwa region of Punjab.



WORK ACCOMPLISHED SO FAR

One water sample has been acquired from cotton field and tested in the human cells for genotoxicity. The preliminary finding indicated that higher TDS water causes free radical stress (as evaluated with spectrophotometer as well as fluorescence microscopy) and the increase in free radical stress which led to higher DNA damage (as measured by comet assay and DNA laddering assay). Further, upon incubation for 48 hours, more than two folds increase in cell death was observed. All these results indicated that the water is toxic to normal human cells and causes excessive DNA damage and cell death.

PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

Singh, S., Raina, V., Dubash, T., Sreenath, K., Pavithra, L. and Chattopadhyay, S. (2012). Regulation of GAD 65 promoter by SMAR1 and p53 upon Streptozotocin treatment. *BMC Molecular Biology* **13**: 28-39.

Singh, S., Sreenath, K., Pavithra, L., Roy, S. and Chattopadhyay, S. (2010). SMAR1 regulates free radical stress through modulation of AKR1a4 enzyme activity. *The International Journal of Biochemical & Cell Biology* **42**:1105-1114.

Sreenath, K., Pavithra, L., Singh, S., Sinha, S., Dash, P. K., Siddappa, N. B., Ranga, U., Mitra, D. and Chattopadhyay, S. (2010). Nuclear matrix protein SMAR1 represses HIV-1 LTR mediated transcription through chromatin remodeling. *Virology* **400**: 76-85.

Pavithra, L., Sreenath, K., Singh, S. and Chattopadhyay, S. (2010). Heat-shock protein 70 binds to a novel sequence in 5' UTR of tumor suppressor SMAR1 and regulates its mRNA stability upon Prostaglandin A2 treatment. *FEBS Letter* **584**:1187-1192.

Kaul-Ghanekar, R., Singh, S., Mangain, H., Jalota-Badhwari, A., Paknikar, K. M. and Chattopadhyay, S. (2009). Tumor suppressor protein SMAR1 modulates the roughness of cell surface: combined AFM and SEM study. *BMC Cancer* **9**: 350-362.

Chemotherapeutic Drug Induced  
Cardiomyocyte Toxicity: Evaluation of  
Ethno-Botanical Plants to Minimize the  
Cardiac Damage.



Principal Investigator: Dr. Monisha Dhiman

Funding agency:	Department of Science and Technology, Government of India
Year of sanction:	2013
Budget:	Rs. 27,60,000
Duration:	Three Years

Objectives of the project

- To demonstrate the immune toxicity of DOX-induced inflammation in cardiomyocytes.
- To characterize the mitochondrial crosstalk that signals PGC-1 $\alpha$ -dependent cell death responses in cardiomyocytes.
- To evaluate the beneficial effects of phytochemicals in preserving cardiac function in DOX-induced toxicity in cardiomyocytes.

PROJECT SUMMARY

**Introduction:** Heart failure (HF) is a leading cause of the morbidity and mortality worldwide. HF is a final common phenomenon/pathway of various cardiovascular diseases, including sustained pressure overload (i.e., hypertension), myocardial ischemia or infarction, volume overload (i.e., valvular heart disease), inherited or acquired cardiomyopathies. More recently it is suggested that cardiotoxicity may occur due to the administration of anti-cancer drugs used in chemotherapy, these drugs can damage normal tissue and can initiate the cascade of reactions which can be detrimental to the cardiac tissue. It is very important to identify the molecular mechanisms which are disturbed in the HF patients during all these events.

METHODOLOGY:

In the present study, the effect of chemotherapeutic drug namely Doxorubicin (DOX) on cardiotoxicity will be accessed by evaluating its effect on pro-inflammatory cytokines, NADPH-oxidase activation, reactive oxygen species generation and mitochondrial dysfunction. Thereafter, the impact of extracts of various ethanobotanical plants will also be observed on above studied parameters. Upon completion of above studies, the pathways (s) involved in DOX-induced cardiotoxicity during chemotherapy and possible herbal remedies for modulating the cardiotoxic effects will be identified. This trial will also identify the novel mechanism (s) of immune-mediated cardiac pathologies and provide directions for the developments of adjunct therapies to control oxidative disarray happening during chemotherapy resulting in heart failure.

WORK ACCOMPLISHED SO FAR

The preliminary work showed that DOX, a broad-spectrum anthracycline representing one of the most commonly used anticancer drug has major side effects and concentration as low as 2 $\mu$ M causes cardiac toxicity.

PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

Gupta, S., Wan, X., Zago, M. P., Martinez Sellers, V., Silva, T. S., Assiah. D., Dhiman, M., Nuñez, S., Petersen, J. R., Vázquez-Chagoyán, J., Estrada-Franco, J. G. and Garg, N. J. (2013). Antigenicity and diagnostic potential of vaccine candidates in human Chagas disease. *PLoS Neglected Tropical Diseases* **7**: e2018.

Dhiman, M., Zago, P. M., Nunez, S., Spratt, H., Yun, C. F. and Garg, N. J. (2013). Innate immune responses and antioxidant/oxidant imbalance are major determinants of human Chagas disease. *PLoS Neglected Tropical Diseases* **7**: e2364.

Mantha, A. K., Dhiman, M., Taglialatela, G., Perez-Polo, R. J. and Mitra, S. (2012). Proteomic study of amyloid beta (25-35) peptide exposure to neuronal cells: Impact on APE1/Ref-1's protein-protein interaction. *Journal of Neuroscience Research* **90**:1230-1239.

Dhiman, M., Paola, M. Z., Nunez, S., Federico, N. B. and Garg, N. J. (2012). Cardiac-oxidized antigens are targets of immune recognition by antibodies and potential Molecular Determinants in Chagas Disease Pathogenesis. *PLoSOne* **7**: e28449.

Dhiman, M. and Garg, N. J. (2011). Inhibition of NADPH-oxidase attenuates T cruzi-induced cardiac pathology. *Journal of Pathology* **225**: 583-596.

Aparicio-Burgos, J. E., Ochoa-García, L., Zepeda-Escobar, J. A., Gupta, S., Dhiman, M., Martínez, J. S., de Oca-Jimenez, R. M., Val Arreola, M., Barbabosa-Pliego, A., Vazquez-Chagoyan, J. C. and Garg, N. J. (2011). Testing the efficacy of a multi-component DNA-Prime/DNA-Boost vaccine against Trypanosoma cruziInfection in Dogs. *PLoS Neglected Tropical Diseases* **5**: e1050.

Wen, J-J., Gupta, S., Guan, Z., Dhiman, M., Condon, D., Lui, C. Y. and Garg, N. J. (2010). Phenyl-alpha-tert-butyl-nitrone and benzonidazole treatment controlled the mitochondrial oxidative stress and evolution of cardiomyopathy in chronic chagasic Rats. *Journal of American College Cardiology* **55**: 2499-2508.

Dhiman M, Pando, J., Estrada-Franco, J. G., Aguilar, F. R., Corzo, S. B., Perez, G. M., Sandoval, R. G. and Garg, N. J. (2009). Increased myeloperoxidase activity and protein nitration are indicators of inflammation in chagasic patients. *Clinical and Vaccine Immunology* **16**: 660-666.

Dhiman, M., Nakayasu, E. S., Hosakote, Y. M., Reynolds, B. K., Wen, J. J., Almeida, I. C. and Garg, N. J. (2008). Enhanced nitrosative stress during Trypanosoma cruziInfection causes nitrotyrosine modification of host proteins. Implications in chaga's disease. *Americal Journal of Pathology* **173**: 728-740.

Wen, J-J., Dhiman, M. and Garg N. J. (2008). Tissue-specific oxidative imbalance and mitochondrial dysfunction during Trypanosoma cruzi infection in mice. *Microbes Infection* **10**:1201-1209.

Deep, G., Dhiman, M., Mendiz, E., Rao, A. R. and Kale, R. K. (2005). Chemo preventive effects of mustard seeds in chemically induced fore stomach and uterine cervix tumors in murine model system. *Human & Experimental Toxicolgy* **24**: 303-312.

Deep, G., Dhiman, M., Rao, A. R. and Kale, R. K. (2005). Chemopreventive potential of Triphala on Benzo(a)Pyrene induced forestomach tumorigenesis in murine tumor model system. *Journal of Experimental & Clinical Cancer Research* **24**: 555-563.

Dhiman, M., Malhotra, N. and Kale, R. K. (2004). Quercetin as a radiomodulator. *Indian Journal of Radiation Research* **1**: 18-19.

Gupta, S., Dhiman, M., Wen, J. J. and Garg, N. J. (2011). ROS signaling of inflammatory cytokines during T. cruzi infection. *Advances in Parasitology* **76**:153-170

SCHOOL OF GLOBAL RELATIONS

CENTRE FOR SOUTH AND CENTRAL ASIAN STUDIES (Established 2009)

FACULTY

Name	Designation	Qualification/Training	Expertise
Dr. V. J.Varghese	Officiating Incharge of Centre	Ph.D. University of Hyderabad.	Modern South Asian history, Transnational migrations from South Asia
Dr. Kiran K Singh	Assistant Professor	Ph.D. Banaras Hindu University, Varanasi.	Environment degradation and management with particular emphasis on land, land use/land cover change, Geopolitics, Geography in warfare and Geographical Information System
Dr. Baba Singh	Assistant Professor	Ph.D. Panjab University, Chandigarh.	Geopolitics of Southeast Asia, Central Asia and Indian Ocean
Dr. Nishtha Kaushiki	Assistant Professor	Ph.D. Jawahar Lal Nehru University, New Delhi.	India's foreign policy, strategic interests of major powers, international politics, south Asian politics, regional security, security studies, geopolitics

PROGRAMMES OFFERED

- 1. M.A. International Studies
- 2. M.Phil-Ph.D Intgrated Programme in South and Central Asian Studies



## Assessment of Urban Environment Quality of Bathinda: a Socio-Geographical Perspective

**Principal Investigator: Dr. Kiran K. Singh**

Funding agency:	Indian Council of Social Science Research, New Delhi
Year of sanction:	2013
Budget:	Rs. 4,00,000
Duration:	Two years

### Objectives of the project

- The aim of the research is to assess urban environment quality of 50 wards of Bathinda on the basis of physical and other parameters which are derived from remote sensing satellite data, secondary data and primary data obtained through questionnaire survey of urban residents. This would reveal the status of urban environment in different wards and will provide scope for the generation of suitable action plans that can be taken up to control and improve the urban environment quality of the city. The specific objectives of the project are:
- To examine the demographic profile of Bathinda for three decades: 1991, 2001 and 2011 and to project the same for year next decade.
- To assess the land use/land cover of Bathinda during 2001-2011 with special emphasis on open spaces, vegetation cover and built up area;
- To examine the spatial pattern of solid waste generation, collection and its management;
- To assess the sources of pollution problems in terms of air, water and noise.
- To examine people's perception on urban environment and create satisfaction index using their response.
- To suggest action plans and to formulate a model that emphasizes and enhances the qualities of urban environment components which are vital for city.

### PROJECT SUMMARY

**Introduction:** Bathinda is located in Malwa region of Punjab and faces the growing problems of environmental pollution, contaminated ground water, traffic congestion, poor sewerage, haphazard solid waste disposal, erratic electric supply, insufficient water supplies, increasing built up area and decreasing open/green spaces. The industrial development in this area is causing various kind of environmental pollution. Exponential growth of urban population through natural increase as well as migration and the consequent strain on existing systems have manifested environmental problems which present huge challenges for modern societies. Assessment of environmental quality of Bathinda city cannot be captured with a single measure because the components of environment are inter-woven. This study endeavours to assess and analyze the urban environmental quality, looking at the physical environmental conditions and the opinions and experiences of people who live in Bathinda.

### METHODOLOGY:

An innovative multi-method approach, combining qualitative and quantitative data collection techniques, will be developed and employed taking 22 environmental variables. Physical environmental variables such as land use/land cover, open space, normalized difference vegetation index, water logging, water quality, accessibility to roads, noise pollution and foul smell. To assess the quality of urban environment eight parameters (I) percentage of built-up area (II) open spaces (III) household density (IV) occupancy ratio (V) population density (VI) accessibility to roads (VII) noise pollution (VIII) foul smell will be assessed. These parameters will be assigned weightages according to their relative importance. All the above parameters will be taken into consideration for 2011 barring two parameters housing density

and occupation ratio for the year 2001 due to their non-availability. Weighted Overlay Technique will be applied for assessing and evaluating the quality of the urban environment. Quantitative weights will be given to all parameters according to their relative importance for the assessment of quality of urban environment.

The satellite data will be enhanced before classification using histogram equalization in ERDAS Imagine 8.7 for the better quality of the image and to achieve better classification accuracy. Further both satellite data will be re-projected to a common Universal Traverse Mercator (UTM) projection/coordinate system on 1:50,000 scale. The data will be resampled to a common spatial resolution of 15 m. Then supervised classification will be performed using maximum likelihood algorithm for IRS 1C LISS IV (2011) data with four bands and IRS 1D LISS-III with PAN merged data (2001).

Two land use land and cover maps will be prepared using satellite data (1) of 2001 and (2) 2011. Thereafter from these two maps built-up area, open spaces which also include open green space will be extracted for analysis. Digitized administrative boundary will be superimposed on the classified land use/ land cover map in order to get ward-wise information of both the years 2001 and 2011.

On the basis of importance the score for the parameters I, II, III, IV, and V will be multiplied by three before adding with the parameters VI, VII and VIII for the year 2011, while for the year 2001 the sum of selected parameter I, II and V will be multiplied by five instead of three before adding to the VI, VII and VIII parameters. This will be done for making comparability in the two years in terms of their values assigned, because in 2001, the parameters III & IV, i.e., housing density and occupancy ratio will not be used due to non-availability of data. The weighted layers will be clubbed by using the composite score and based on it the final layer of quality of environment map for Bathinda will be prepared. To assess the change in environment quality the composite scores of 2011 will be subtracted from the composite scores of 2001. Finally the resulting composite scores will be categorized into seven different classes.

### (i). Primary data collection

In the present study primary data will be collected at the household level for resident's perception of urban environmental considering 22 environmental variables. For the primary sources of information, 450 households will be surveyed in the study area with a questionnaire prepared on the basis of selected environmental variables. For the household survey all 50 wards of Bathinda City will be taken in to consideration equally and only those will be selected as sample respondent who is living in Bathinda from last five years so that correct opinion could be obtained about urban environmental quality. For each ward 9 households will be surveyed, representing at least 3 households from each income groups.

From the individual ranking of the ward for all 22 environmental variables finally two summarized environmental quality map will be prepared i.e., Physical environmental quality map and Neighborhood environmental quality map. Afterwards, ranking value of all the variables of each ward will be added to get an environmental quality map based on people's perception. Finally, the environmental quality map prepared on the basis of all the variables in GIS environment using satellite data will be added with the environmental quality map based on people's perception to get urban environment quality map of Bathinda city. On the basis of the outcome suitable action plans will be suggested to improve the environment quality and sustainability of Bathinda.

### WORK ACCOMPLISHED SO FAR

Base maps have been procured and first phase of literature survey is over.

### PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

Singh, K. K. (2013). Re-designing geography through inter-linking of rivers: A feasibility study. *International Journal of Science, Environment and Technology* **1**: 358–362.

Singh, K.K. (2010). Land Degradation Studies in Retrospect: A Review. *Journal of International Environmental Application & Science* **5**: 609-620.

Singh, K. K. and Raju, K. N. P. (2009). Choice of Remote Sensing Data (IRS-1C LISS III) for Geomorphic Mapping. *Asian Journal of Geoinformatics* **9**: 53-54.

Singh, K. K. and Londe, S. K. (2009). Monitoring Wasteland in Part of East Singhbhum District Using LISS III Data. *Indian Journal of Geomorphology* **13**: 99-105.

Singh, K. K. (2007). Environmental Protection: A way to achieve sustained economic development in Nepal. *Indian Journal of Nepalese Studies* **XIII**: 93-103.



## SCHOOL OF LANGUAGES, LITERATURE AND CULTURE

Centre for Comparative Literature (Established 2009)

### FACULTY

Name	Designation	Qualification/Training	Expertise
Dr. Zameerpal Kaur	Officiating Centre Coordinator	M.A. Sanskrit, Punjabi University, Patiala. M.A. Persian, Punjabi University, Patiala. Ph.D. Punjabi University, Patiala.	Poetics and literary theories, textual analysis, Indian poetics and linguistic tradition, Indian philosophy
Dr. Rajinder Kumar Sen	Assistant Professor	Ph.D. Punjabi University, Patiala.	Novel analysis (anchalik upnyas)
Dr. Alpna Saini	Assistant Professor	Ph.D. Punjabi University, Patiala.	Literary Theory with special focus on theories of Subjectivity, Drama and Theatre, Translation Studies, Film Studies
Dr. Amandeep Singh	Assistant Professor	M.A. Punjabi, Punjabi University, Patiala. M.A. English, Punjabi University, Patiala. Ph.D. Punjabi University, Patiala.	Diasporic Fiction, Comparative Literature

### PROGRAMMES OFFERED

1. M.A. (Hons.) Punjabi and Comparative Literature
2. M.Phil.-Ph.D. Integrated Programme in Comparative Literature

UGC-11 (2013)

## Ecocriticism and Modern Punjabi Poetry

*Principal Investigator: Dr. Zameerpal Kaur*



Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs.7, 96,100
Duration:	Two years

### PROJECT SUMMARY

**Introduction:** The present study would focus on the ecocritical analysis of literary works of modern Punjabi poets Bhai Veer Singh, Shiv Kumar and Surjit Patar. Since 1990s, a number of scholars in different branches of humanities like anthropology, geography, philosophy, politics etc. have been engaged in global environmental challenges and ecological problems. Now-a-days, environmental and animal considerations along with culture are being regarded as necessary basis for human studies. Though, environmentalism has been the slowest to develop as an independent school of criticism, the creative writers, intellectuals and theorists of all over the world have given importance to natural environment, animal subjects, including all environmental problems and issues as well. While literary thinkers and critics have foregrounded its relevance in their works arguing that roles played by environment and animals shape the future of human lives. Ecocriticism thus applies ecological concepts to the study of literature. Basically, ecocriticism is content oriented, sociopolitical, sociocultural study of literary texts in which the texts are examined under the criteria such as their degree of environmental awareness, attention to natural phenomena, recognition of bio-diversity, including the awareness and interconnectedness between local and global ecological issues. It is the study of the relationship of human and non-human, throughout human cultural history and entailing critical analysis of the term 'human' itself. According to Kend Ryden, the ecocritical stance reconnects literary to both the process and problems inherent in living on this heavily burdened planet, focusing our attention on the ground beneath our feet, on our complex relationship to that ground. Richard Kerridge considers ecocriticism as literary and cultural criticism from an environmentalist view point, where the texts are evaluated in terms of their environmentally harmful or helpful effects. Beliefs and ideologies are assessed for their environmental implications. Present century poses new global challenges of environmental degradation and ecological balance. We live in a world increasingly lost to pollution, contamination and industry sponsored bio-disaster. Mankind is committing ecocide and the planet is becoming inhospitable. Industrial pollution is the main threat along with destructive ways of consuming natural resources. Dematerialization of pollution has significant ramifications in our culture. Environmental problems require analysis in cultural as well as scientific terms, because they are the outcome of interaction between ecological knowledge of nature and its cultural inflection. Environmental crisis demands a return to literal reading of literary texts. To analyze relationship of man with environment contemporary literary texts is important. Literary production is considered as an important characteristic of human species. A careful and honest examination of literary texts discovers its influence on human behaviour and natural environment. Further it determines the role played by literary creation for the welfare and survival of mankind and explores the insights it offers into human relationship with other species and with the world around.

Since 1990, literature and literary criticism both have been discussing ecological issues in literary studies. Ecocriticism explores the relationship between humans and the environment. Ecocritics want to track environmental ideas and representations and seeks to evaluate texts and ideas in terms of their coherence and usefulness as a response to

environmental crisis. So, ecocriticism is the study of the relationship between literature and physical environment. The main challenge of ecocritics is how the nature is culturally constructed? They try to understand the cultural developments that have led to present global ecological crisis.

Ecocritical study is interdisciplinary in nature, it also includes cultural connotations because nature and culture are inseparable and regarded as two sides of the same coin. Ecocritical approach is based on cooperation, contact and co-evaluation. Rather, in this way ecocritical analysis stands in opposition to postcolonial fragmented man and it explores the alienation of human beings having distorted natural and social life. It considers literature as a potential medium of consciousness, change and an increased ecological sensibility, which however indirectly can help in contributing to a change in political and social practices.

Ecocriticism has been interlinked and influenced by different insights from philosophy, development studies in sociology, ecology, Marxism, feminism, and many other disciplines. Because of its links it draws together a culture's ecological approaches and its cultural texts that address or ignore the same. So, ecocriticism is a critical mode that looks at the representation of nature and landscape in cultural texts, paying particular attention to attitudes towards nature. It aligns itself with ecological activism and social theory assuming that the rhetoric of cultural texts reflects material practices towards the environment, while seeking to increase awareness about it.

This field is almost a raw field. No previous work based on ecocritical analysis of Punjabi poetry has been done before. Though, the study of nature as an object of beauty has already been discussed at length. But, the environmental crisis, its challenges, role and contribution of literature in terms of consciousness raising and towards the politics of development has never been analyzed under the specific theoretical framework of ecocriticism.

Environmental degradation, destruction of vegetation and wildlife, population explosion etc. has threatened the ecosystem and people became vigilant and concerned about the environment. In India, 42nd amendment act of 1976 inserted Article 48 A in the constitution, which is based on the protection and improvement of the environment and for the safeguard of the forest and wildlife of the country. Some social activists and NGO's started fighting and raising the issues for the protection of wildlife and environment in the recent years. Literary production of recent years, in some Indian languages has also shown environmental awareness and concern deliberately. In Indian English writing Arundhati Roy is associated with many international and national issues on environment. Her non-fictional and fictional works like *The End of Imagination*, *The Greater Common God*, *The God of Small Things* etc. are of worth consideration in this regard. Other writers like Amitav Gosh, Kamla Das have also raised some environmental issues in their works.

On the other side, a few attempts for theoretically studying the literary texts from ecocritical view point can be seen scattered. Ecocriticism still has not become a common or popular approach of literary analysis as it should be. So, there is a huge requirement of nature writing, raising environmental awareness, challenging the politics of development on the basis of ecocritical study of Indian literature.

Endangered wild life, environment and human health require not only the serious attention of scientists, intellectuals and policy makers but also emphasize on public awareness and active participation in maintaining the ecological balance. Implementation of ecocritical approach to evaluate the literary production is an attempt to accept literature as a potential medium for assuring consciousness, change and an increased ecological sensibility among common public, which however indirectly would help to contribute to a change of political, social and cultural practices through consciousness, active participation, mutual cooperation and contact.

#### METHODOLOGY:

The study is limited to analysis of the works of three modern Punjabi poets Bhai Veer Singh, Shiv Kumar and Surjeet Patar in the context of ecocriticism. The study material for analysis will be selected from poetry books, journals and magazines. The purpose behind the selection of above three poets is that all these writers have immensely used the images,

symbols, metaphors from nature, environment, hills, rural and peasantry life. Role and response of nature, personification etc., comes at different levels and shades throughout their compositions. Birds, trees, plants, flowers, crops, animals, seasons, rivers, hills and other similar objects are an integral and important part of their literary discourse. The study will follow a multidisciplinary approach regarding ecocriticism to analyse the relevant data.

#### WORK ACCOMPLISHED SO FAR

Project Fellow has been appointed. Half of the books have been purchased and rest are in the purchase process. At first we concentrated on data collection. So, we got photocopy and printing of the required material. Now we are working on the theory part of the work especially concentrating on the theory, basic concept and historical development of ecocriticism.

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# Grammatical Structure of Bagri Dialect

## बागड़ी भाषा : व्याकरणिक संरचना

*Principal Investigator: Dr. Rajinder Kumar*

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs.8,90,600
Duration:	Two years

### Objectives of the project

- To prepare the grammar of Bagri dialect
- To promote the Bagri dialect
- To study the variation as sub dialects of Bagri
- To survey the native speakers of Bagri dialect

### PROJECT SUMMARY

भारत अनेक भाषाओं और बोलियों का देश है। इन बोलियों की विशेषता इनकी विविधता और एक दूसरे से इनकी अपसी संबंधता है। प्रांतीय भाषाओं का इनकी विलक्षणता में अपना विशिष्ट सौन्दर्य है, वहीं एक दूसरी भाषा पर पड़ने वाला प्रभाव भी अपने आप में अत्यधिक महत्त्वपूर्ण है। प्रांतीय और भाषिक सीमाओं पर विविध भाषाओं का मिलन एक विशिष्ट प्रकार की भाषिक संरचना का आधार तैयार करता है, जो सांस्कृतिक दृष्टि से भी विलक्षणता एवं विशिष्टता का पटल प्रस्तुत करती है।

दक्षिण-पश्चिमी पंजाब, उत्तरी राजस्थान, उत्तर पश्चिमी हरियाणा एवं पाकिस्तान की सीमाओं पर भाषाओं के सम्मिलन ने एक प्रकार की भाषिक एवं सांस्कृतिक इकाई का निर्माण किया है जो भाषा एवं संस्कृति दोनों ही दृष्टियों से अति महत्त्वपूर्ण है। इस क्षेत्र की भाषा को बागड़ी भाषा के नाम से जाता है तथा इस भाषा का प्रयोग करने वाले बागड़ी लोग कहलाते हैं।

**बागड़ी भाषा का परिचय** — भाषा की दृष्टि से बागड़ी एक लोक भाषा है। इस भाषा की विशेषता यह है कि यह एक मिश्रित भाषा है। इसमें राजस्थानी, हरियाणवी, पंजाबी और बहावलपुरी बोली के शब्द मिश्रित हैं। मिश्रित होने के कारण इसे बिगड़ी भाषा कहा गया जो धीरे धीरे बागड़ी के रूप में विख्यात हो गयी। मारवाड़ी भाषा के निकट होने के कारण इसे कुछ लोग मारवाड़ी का ही एक उपरूप कहते हैं परंतु यदि इसमें निहित पंजाबी एवं हरियाणवी के शब्दों को देखा जाए तो मारवाड़ी से इसका अंतर स्वतः स्पष्ट हो जाता है। बागड़ी भाषा में विपुल लोक साहित्य है। लोकगीत एवं लोक कथाओं, मुहावरों एवं लोकोक्तियों के रूप इस भाषा में एक समृद्ध साहित्यिक विरासत मौखिक रूप में निहित है।

**बागड़ी भाषा का भौगोलिक प्रसार** — बागड़ी भाषा का प्रसार दक्षिण-पश्चिमी पंजाब (अबोहर, फाजिलका एवं मलोटे), उत्तरी राजस्थान (श्रीगंगानगर एवं हनुमानगढ़), उत्तर पश्चिमी हरियाणा(सिरसा एवं डबवाली) एवं पाकिस्तान (बहावलपुर रियासत) आदि क्षेत्रों में लगभग दो करोड़ लोग इस भाषा का प्रयोग करते हैं।

**शोध के लक्ष्य**— भूमण्डलीकरण के इस दौर में पाश्चात्य संस्कृति का निरंतर हो रहा प्रसार लोक संस्कृतियों को लीलने के लिए तत्पर है। लोक संस्कृतियों के साथ साथ क्षेत्रीय बोलियों का अस्तित्व भी संकट में है। जो क्षेत्रिय भाषाएं और बोलियां अपनी मौखिक परंपरा के कारण अपने अस्तित्व को बनाए हुए हैं उनमें बागड़ी भाषा भी एक समृद्ध भाषा है। इस भाोध कार्य के द्वारा संपर्क भाषा के रूप विख्यात इस भाषा की व्याकरणिक संरचना को प्रस्तुत किया जा सकेगा जो इस भाषा के संवर्द्धन के लिए महत्त्वपूर्ण है।

### इस दिशा में पूर्वकृत कार्य

इससे पूर्व बागड़ी भाषा के लोकगीतों का संकलन 2007 में मेरे द्वारा 'बागड़ी : गीत मंजरी' भीर्षक के अंतर्गत किया गया है जिसमें जन्म से मृत्यु तक के विविध संस्कारों से संबंधित गीत, त्यौहारों के गीत, देवी देवताओं की आराधना के गीत आदि हैं।

### संभावित प्रारूप

इस भाोधकार्य को संपन्न करने के लिए संभावित प्रारूप के अंतर्गत निम्न छह अध्यायों में विभक्त किया जा सकता है

### अध्याय प्रथम

बागड़ी भाषा : एक परिचय

### अध्याय द्वितीय

बागड़ी भाषा में भाब्द संरचना

### अध्याय तृतीय

बागड़ी भाषा में संज्ञा, सर्वनाम, क्रिया, विशेषण, क्रिया विशेषण, संबंधबोधक, योजक और विस्मयादि बोधक

### अध्याय चतुर्थ

बागड़ी भाषा में लिंग, वचन और कारक

### अध्याय पंचम

बागड़ी भाष में वाक्य संरचना

### अध्याय षष्ठम

बागड़ी भाषा में मुहावरे और लोकोक्तियां

**कार्यप्रणाली** — बागड़ी एक लोक भाषा है। इस भाषा की आगे पांच उपबोलियां हैं 1. अबोहर—फाजिलका की बोली, 2. पल्लु—रावतसर की बोली, 3. नोहर—भादरा की बोली, 4. बहावलपुर रियासती बोली, 5. सूरतगढ़—अनूपगढ़ बोली, 6. संगरिया—ऐलनाबाद बोली आदि। इसका क्षेत्र व्यापक है एवं विविधता से परिपूर्ण है। अतः कार्यक्षेत्र में जाकर कार्य करना परम अनिवार्य है। भाब्दों का चयन, भाब्द संस्कृति का ज्ञान, भाब्द संरचना का अध्ययन, उनकी विविध भाषाओं से तुलना आदि एक दीर्घ एवं श्रमपूर्ण कार्य है। इसके लिए कार्यक्षेत्र कार्यप्रणाली अधिक उपयोगी सिद्ध होगी।

**प्रासंगिकता** — इस भाोध कार्य के द्वारा बागड़ी भाषा अपनी व्याकरणिक पहचान प्राप्त कर सकेगी और बागड़ी लोक साहित्य को उचित ढंग से संकलित करने में सहायता प्राप्त होगी। यह भाोध कार्य जहां एक ओर बागड़ी भाषा को अधिक अनुशासित करेगा वहीं दूसरी ओर बागड़ी भाषा के लोक साहित्य को संकलन करने में आ रही कठिनाइयों को दूर किया जा सकेगा। एक विशाल जनमानस की भाषा को पहचान प्राप्त होगी जिससे इस समाज का सामाजिक सांस्कृतिक अध्ययन संभव हो सकेगा।

कार्य की प्रगति: 25 मार्च, 2013 को धनराशि की पहली किशत 5,92,600 /— जारी होने संबंधी पत्र प्राप्त हुआ। इसके उपरांत विश्वविद्यालय द्वारा प्रोजेक्ट कार्य आरंभ करने संबंधी समिति का गठन किया गया। प्रोजेक्ट फैलो की नियुक्ति हेतु 15 जून, 2013 को 'द ट्रिब्यून' समाचार पत्र में विज्ञापन प्रकाशित करवाया गया। आवेदन पत्र प्राप्त करने की अंतिम तिथि 15 जुलाई, 2013 है। प्रोजेक्ट कार्य हेतु उपकरण आदि क्रय करने हेतु समिति का गठन हो गया तथा भीष्म ही इस दिशा में कार्य आरंभ कर दिया जाएगा। पुस्तकों की सूची तैयार की जा रही है तथा उन्हें क्रय करने की प्रक्रिया भी आरंभ कर दी जाएगी। प्रोजेक्ट फैलो की नियुक्ति के उपरांत प्रोजेक्ट का क्षेत्र में कार्य (पिमसकूवता) आरंभ किया जाएगा।

### PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

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Kumar, R. (2008). Hindi Gazal mein Sarthak Kadam. *Shabad Sarokar* **18**:74-75.

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Taboo Issues in Contemporary Indian Cinema and Theatre and Their Treatment with Special Focus on Theories of Subjectivity.



Principal Investigator: Dr. Alpna Saini

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs.1,25,000
Duration:	18 months

Objectives of the project

- To prepare a detailed bibliography of literature and filmography that dwell on Taboo issues in India and abroad as to facilitate further study.
- To understand the notions of taboo in the context of culture and civilization as represented in literature and films.
- To evaluate the surveyed literature and films from the view point of treatment of taboo and construction of subjectivity.
- To understand the notion of subjectivity as it emerges in poststructuralist thought.

PROJECT SUMMARY

**Introduction:** Contemporary Indian cinema and theatre has handled with great success some comparatively less explored themes, such as alternate sexualities, the third gender, conjoined twins, child abuse and incest. Where on the one hand, films like That Girl in Yellow Boots by Anurag Kashyap and Matrubhoomi: A Nation Without Women by Manish Jha handle the delicate issue of child abuse and incest with unprecedented intricacy and understanding, recent films like I Am by Onir and Fire by Deepa Mehta deal with lesbian and queer issues with rationality and compassion, even in the face of mockery and comic representation of queer subjectivity in films like Dostana and Kal Ho Na Ho.

Similarly, Indian English drama too chooses to walk on untrodden paths selecting unusual themes and issues. Asha Kuthari Chaudhuri points out with reference to the work of renowned playwright, Mahesh Dattani who takes up “issues that remain latent and suppressed, or are pushed to the periphery” (Mahesh Dattani, 47). In A Muggy Night in Mumbai, for instance, Dattani chooses to dwell on same-sex relationships crumbling under the powerful influence of social demands. The play lifts the veil of secrecy which hangs over marginalised sexualities and lifestyles. The play is the first modern Indian effort to openly handle queer themes, raising serious issues that generally remain unaddressed. Playwrights like Mahesh Elkunchwar and Satish Alekar have taken up themes of incest and obsession in their plays generating fresh insights and new connotations.

These works of art are the studies of very important aspects of the experience of a very wide but little discussed segment of society. This is a part of subjectivity which has generally remained largely unanalysed in literary and critical studies.

Indian cinema and theatre have hitherto exposed unexplored and marginalised subjectivities to light. These consciously choose to bring to light those strands of subjectivity whose mention and discussion have remained a taboo in Indian society.

But whereas these films and plays are bold efforts of their own kind, it remains to be seen whether these are able to really disintegrate the discourses surrounding the taboo issues they are dealing with or have substantiated them even more. The present research wishes to focus on the treatment of taboo issues in Indian cinema and theatre with special reference to the theories of subjectivity and discourses of power woven around these issues. The thrust area will be to focus on the dismantling of discourses around taboo issues in their representations in theatre and cinema.

#### SIGNIFICANCE OF STUDY:

The present research wishes to focus on the treatment of taboo issues in Indian cinema and theatre with special reference to the theories of subjectivity and discourses of power woven around these issues. The thrust area will be to focus on the dismantling of discourses around taboo issues in their representations in theatre and cinema. The present study will attempt to deconstruct, analyse and disintegrate the taboos surrounding important social issues whose mention and discussion is considered blasphemous. The objective is to dismantle power/knowledge discourses that go on to formulate taboos. In this way, the functioning of repressive power of discourses can be understood.

#### METHODOLOGY:

Most of this work is based on textual analysis of literary texts available in India and abroad. After the survey, significant texts will be studied from the view point of construction of discourses of taboo. Discourse analysis is a well-established method of literary analysis. It is used widely in analysing literary and non-literary texts and it is often employed to signal a certain theoretical sophistication in ways which are vague and sometimes obfuscatory. It has perhaps the widest range of possible significations of any term in literary and cultural theory.

Insights from cultural studies will also be used to understand the relationship between various streams and areas that facilitate formation of taboos. The techniques of film studies will be brought in to lend insights into the treatment of such issues on the celluloid.

This project has been planned to be complete within one and a half years which has been further divided into three phases of six months each. In the first phase, brief study of contemporary literature and films will be carried out to identify texts that are important from thematic point of view. In the second phase, focused study of identified texts will be carried out to find and understand the treatment of various taboos in literature and films. Third phase will be for overall analysis, report writing and creation of detailed bibliography.

During this period, study of theories of subjectivity and discourse analysis, especially from post-structuralist perspective, will be taken simultaneously so as to have a better perspective of concerned issues and their representation.

#### WORK ACCOMPLISHED SO FAR

The present research focusses on the treatment of taboo issues in Indian cinema and theatre with special reference to the theories of subjectivity and discourses of power woven around these issues. The thrust area is to focus on the dismantling of discourses around taboo issues in their representations in theatre and cinema. Attempt is being made to deconstruct, analyse and disintegrate the taboos surrounding important social issues whose mention and discussion is considered blasphemous. The objective is to dismantle power/knowledge discourses that go on to formulate taboos. In this way, the functioning of repressive power of discourses can be understood. Presently a detailed bibliography of literature and filmography that dwell on taboo issues in India and abroad is being prepared so as to facilitate further study and research. Attempt is being made to understand the notions of taboo in the context of culture and civilization as represented in literature and films.

#### PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

Saini, A. (2008). Negotiating the Ethical Crisis: A View of Contemporary Indian Drama. Trends in Indian English Literature. ed. T. S. Anand (Creative Books) 159-168.

Saini, A. (2008). Sakharan Binder: A Study in Contemporary Indian Subjectivity. *English Journal* **9**: 57-62.

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Saini, A. (2011). Book Review of Performing Women/ Performing Womanhood: Theatre, Politics and Dissent in North India by Nandi Bhatia. *South Asian Ensemble* **3**: 131-134.

Saini, A. (2011). Book Review of Seven Plays on Sikh History by Sant Singh Sekhon. *South Asian Ensemble* **3**: 125-127.

Saini, A. (2011). Film review of Prakash Jha's Aarakshan. *South Asian Ensemble* **3**: 132-133.

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Saini, A. (2012). Myth and Adaptation: Videsh as a Diasporic Reworking of the Folk Narrative. The Literati, Winter: 119-125.

Saini, A. (2013). The Comic and the Surreal: an Analysis of Death and Destruction in Satish Alekar's The Terrorist and Mahesh Dattani's Brief Candle. Indian Drama in English: Some Perspectives ed. Abha Shukla Kaushik, Atlantic Publishers: 264-271.

Saini, A. (2012). Subjectivity as a Locus of Conflicts in Girish Karnad: a Discussion of his Plays. Germany: Lambert Academic Publishing.

Saini, A. and Purohit, N. (2013). Eds. Negotiating Boundaries: A Study of Bushra Ejaz's Writings. Chandigarh. Unistar Books.

SCHOOL OF SOCIAL STUDIES

Centre for Economics Studies (Established 2012)

FACULTY

Name	Designation	Qualification/Training	Expertise
Dr. A.S.Kahlon	Centre Coordinator	Ph.D. Kansas State University, USA.	Agricultural Economics, marketing management, behavioural science
Dr. Sandeep Kaur	Assistant Professor	Ph.D. Guru Nanak Dev University, Amritsar.	International trade, agriculture and human development
Dr. Naresh Singla	Assistant Professor	Ph.D. Guru Nanak Dev University, Amritsar.	Agricultural price policy, fresh food supply chains, Institutional economics, agricultural diversification
Dr. Kulwinder Singh	Assistant Professor	Ph.D. Punjabi University, Patiala.	International Economics, development economics and agricultural economics are core area of specialisation

PROGRAMMES OFFERED

M.Phil.-Ph.D. Integrated Programme in Development Economics

ICSSR-2 (2013)

Socio Economic Externalities of Guru Nanak Dev Thermal Power Plant in Bathinda



Principal Investigator: Dr. Sandeep Kaur

Funding agency:	Indian Council of Social Science Research
Year of sanction:	2012
Budget:	Rs.4,85,900
Duration:	Two years

Objectives of the project

- The main aim of the present study is to describe the problems of residents of the nearby colonies due to fly ash, smoke and other unhealthy trends in and due to this thermal power plant. Study will also describe and try to prove the other socio- economic externalities of GNDTP in Bathinda city. The study will access and address the following:
- The participation of GNDTP in the city land development, local industries and other organizations (like educational institutes and shopping mall etc.) of the city and the development of state in terms of electricity producer and raw material provider.
- The social benefits like employment directly (all employees of GNDTP) or indirectly (temporary labor, shopkeepers, hawkers etc.) and income generation by GNDTP.
- The immigration due to employment generated by GNDTP, covering the people in above objectives.
- Comparision of the health problems (like asthma, tuberculosis, black lung, kidney diseases etc.) and environmental problems (air pollution etc.) faced by the people living in the colonies in the vicinity of GNDTP and other citizens of Bathinda due to fly ash and other contents produced by GNDTP.
- Addressing the impact of GNDTP, to the local officials and the state government.
- The future prospects so that environmental and social problems, faced by Bathinda city, may not occur in the area of influence around upcoming thermal plants in Punjab.

PROJECT SUMMARY

**Introduction:** GNDTP Bathinda has contributed to the economic upgradation of the region. There are approximately 3000 employees working inside the thermal plant in different departments (PSPCL, 2011). The major percentage of these employees belongs to Bathinda district only. Besides giving direct employment to the people of the region, it is also providing livelihood to the outstation people who are associated indirectly to the thermal plant e.g. transporters, contractors, vendors, suppliers, daily wagers and masons etc. But at the same, it has been stated that GNDTP Bathinda has outlived its life and is to be closed.The plant burns 6500 tonnes of coal every day and has been running without electrostatic precipitators that arrest the flow of ash from the chimneys leading to air pollution. Therefore, a socio-economic impact assessment of GNDTP in terms of the social benefits like employment, income, immigration and other



externalities like health problems (like asthma, tuberculosis, black lung, kidney diseases etc.) and environmental problems (air pollution etc.) faced by people living in the colonies in the near vicinity of the GNDTP and other surrounding areas of Bathinda will be assessed in this study.

#### METHODOLOGY:

##### (i). Coverage

Socio-economic assessment will be designed to estimate the effects on residents' social and economic welfare. The process will be rely heavily on involving the people who may be affected by the development. Thus, keeping in mind the nature of study, two primary surveys will be held. First survey will be done in the colonies near to GNDTP named Panchvati Nagar, Vir colony, Adarsh Nagar and Thermal Colony and also in the other areas of city to assess the social impacts. Second survey will do direct interaction with the employees and workers of GNDTP, temporary labor working in and near the GNDTP, shopkeepers outside the GNDTP compound and the Businessmen of city, to assess the economic impact. Another short schedule will also be prepared for getting information from the specialists who will inform harmful effects of the pollution, emitted by GNDTP, on the environment and individuals' health.

##### (ii). Collection of the Data

Data will be collected through a well defined questionnaire. Proposed questionnaires will be approximately 50-60 questions. It will approximately take 10-15 minutes to be filled up. Usage of likert, nominal as well as ordinal scale will be used to get the optimum information as well as data from from the questionnaires.

##### (iii). Data Processing:

The data collected will be thoroughly cleaned and entered into excel spread sheets and the statistical analysis will be carried out.

#### WORK ACCOMPLISHED SO FAR

The schedules to gather detailed information related to socio economic aspects of their lives from Residents, Doctors, thermal plant employees (under progress), small shopkeepers & vendors, people from nearby villages was prepared. These schedules were prepared on the basis of the requirements of the project and the feedback given by the citizens. Primary data collection starts after the preparation of the schedules. The collection of data is under progress.

#### PUBLICATIONS OF THE PRINCIPAL INVESTIGATOR

Kaur, S. and Nanda, P. (2007). Intra Regional Trade of SAARC under WTO Regime. *Apeejay Journal of Management and Technology* **2**:74-82.

Kaur, S. and Nanda, P. (2008). Growth and Performance of India's Trade with SAARC. *Apeejay Journal of Management and Technology* **3**: 42-49.

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Kaur, S. and Nanda, P. (2009). Determinants of Foreign Capital Inflows in India. *Apeejay Journal of Management and Technology* **4**:143-149.

Nanda, P. and Kaur, S. (2011). Globalization of finance: India's experience of capital flows. *International Journal of Global Economy* **3**:121-137.

Kaur, S. and Nanda, P. (2010). Export and import potentials of Pakistan to other SAARC countries in gravity O panel data models, 1981 -2005. *Applied Econometrics and International Development* **11**:179-196.

Kaur, S. and Nanda, P. (2010). India's trade with Central Asia: Trends and prospects. *International Journal of Central Asian Studies* **15**: 251-276.

Kaur, S. and Deepika. (2010). Complementarities in production between ASEAN and India. *Journal Gobar Economics* **6**: 383-86.

Kaur, S. and Nanda, P. (2010). The dynamic effects of SAARC. *International Journal of Economics* **4**: 345-55.

Kaur, S. and Nanda, P. (2010). Education, human development and economic growth in Punjab: A casual analysis. *ArthVijnana* **52**: 197-211.

Kaur, S. and Nanda, P. (2010). India's export potential to SAARC countries: A gravity model analysis. *Journal of Gobar Economics* **6**: 163-84.

## SCHOOL OF BASIC AND APPLIED SCIENCES

Centre for Physical and Mathematical Sciences (Established 2012)

### FACULTY

Name	Designation	Qualification/Training	Expertise
Dr. Achchhe Lal Sharma	Assistant Professor	Ph.D. Indian Institute of Technology, Kharagpur  <i>Experience abroad:</i> A week at Singapore	Experimental condensed matter physics
Dr. Kamlesh Yadav	Assistant Professor	Ph.D. Indian Institute of Technology, Roorkee	Experimental condensed matter physics
Dr. Jaiprakash	Assistant Professor	Ph.D. Indian Institute of Technology, Delhi  <i>Experience abroad:</i> Post doctoral experience at San Francisco State University, San Francisco, CAUSA (2010-2011)	Ferroelectric liquid crystals and their applications
Dr. Sunil Kalkal	Assistant Professor	Ph.D. University of Delhi	Nuclear physics
Dr. Amarpreet Kaur	Assistant Professor	Ph.D. Thapar University, Patiala	Operations research (Fuzzy optimization), fuzzy set theory

### PROGRAMMES OFFERED

1. M.Sc. Nano Physics
2. M.Phil. Physics

UGC-14 (2013)

## Development of nanostructured Plastic Separator as Rechargeable Battery Component



**Principal Investigator: Dr Achchhe Lal Sharma**

Funding agency:	University Grant Commission, New Delhi
Year of sanction:	2013-14
Budget:	Rs. 6,00,000
Duration:	Two years

### Objectives of the project

- To explore the rigorous characterization and evaluation of optimized plastic separators application possibility for light weight rechargeable battery/capacitors operating in the ambient/sub ambient temperature limits.

### PROJECT SUMMARY

**Introduction:** Development of plastic separators having mechanical stability, physical flexibility and feasibility of fast ion transport (Li<sup>+</sup> ion conduction) has ever been a desired R & D goal for both the academia and industry working for efficient energy storage devices (high energy density lithium battery, supercapacitors, PEM fuel cells etc.). There has been continuous effort, over the last three decades, to develop optimized materials combination (appropriate electrolyte/separator with suitable electrodes) for design of miniaturized devices with high energy density and power density. The state-of-the-art problems of the existing brands such as; bulky design, low energy density, high self discharge, instability towards electrode reaction at the electrode-electrolyte interface and performance degradation at sub-ambient ( $\leq 55^{\circ}\text{C}$ ) and also at elevated temperatures ( $\geq 35^{\circ}\text{C}$ ) need serious attention.

### METHODOLOGY:

#### *System selection criteria*

The basic criteria for selecting appropriate system constituents for developing a solid polymer electrolyte films for low temperature renewable application are defined as;

The selection of the host polymer will be based on the following criteria;

#### *Polymer Host*

- Low glass transition temperature
- High ionic conductivity at least at room temperature
- High molecular weight
- Appropriate Salt
- Low lattice energy

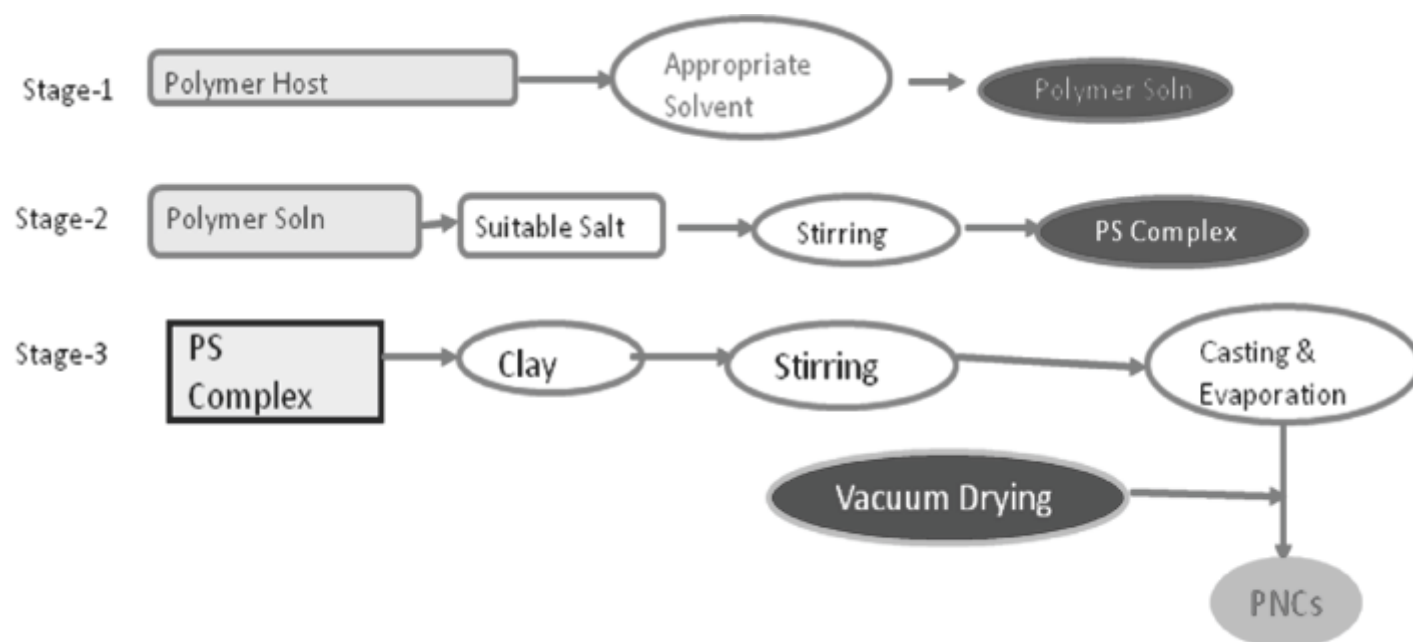
- Bulky anion to assist solvation, prevent ion pairing

#### Filler/Clay

- Should have appreciable polarity (normally insulating nanoceramic powder)
- Should be preferably organophilic and not an organophobic
- Should act as a Lewis acid on organo modification as in the case of an inorganic clay like MMT.

#### Sample Preparation

A simple process has been adopted to obtain dimensionally stable freestanding ion conducting polymer films to be used as the separator components in the device fabrication. A summary of the steps involved is given in the following flow-chart diagram.



#### Measurements and Analysis

Structural analysis: HRXRD/ FTIR

Surface property analysis: HRTEM

Thermal analysis: DSC/TGA

Electrical property analysis: Impedance Spectroscopy (CIS), Dielectric Analysis, Transport Number Analysis, I-V Characteristics and Cation transport number analysis and battery performance on using available commercial electrodes.

#### WORK ACCOMPLISHED SO FAR

The current research interest is to fabricate prototype energy storage device (Lithium ion battery, Supercapacitors) and their evaluation. I have already prepared plastic separator based on high temperature plastic separator but present project work need to done. Related to project I am in process of procuring the materials, instruments and accessories.

#### PUBLICATIONS OF THE PROJECT INVESTIGATOR

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Sharma, A. L. and Thakur, A. K. (2011). Improvement in Voltage, Thermal, Mechanical stability and Ion Transport Properties in Polymer-Clay Nanocomposites. *Journal of Applied Polymer Science* **118**: 2743-2753.

Sharma, A. L. and Thakur, A. K. (2010). Polymer-Ion-Clay Interaction based Model for Ion Conduction in Intercalation Type Polymer Nanocomposite. *Ionics* **16**: 339-350.

Sharma, A. L., Shukla, N. and Thakur A. K. (2008). Studies on Structure Property Relationship in a Polymer-Clay Nanocomposite Film Based on (PAN)8LiClO4. *Journal of Polymer Science: Part B Polymer Physics* **46**: 2577-2592.

Sharma, A. L. and Thakur, A. K. (2008). Studies on Ion Association-Dissociation Effect in Polymer Nanocomposite Film Based on (PAN)8LiCF3SO3 + xwt%MMT. *Solid State Ionics: New Materials for Pollution Free Energy Devices* 10 0230-63567-9: 675-685.

Sharma, A. L. and Thakur, A. K. (2008). Ion Transport in Intercalated Polymer Nanocomposites based on PAN. *Proceedings of the DAE Solid State Physics Symposium* **53**: 1021-1023.





## Synthesis and Study of Structural, Magnetic, Dielectric and Transport Properties of Doped Nanodimensional BiMnO<sub>3</sub> Perovskite Manganites

**Principal Investigator: Dr. Kamlesh Yadav**

Funding agency:	UGC
Year of sanction:	2013
Budget:	Rs. 6,00,000
Duration:	Two years

### Objectives of the project

- The effect of A-site cation radius mismatch and 6s<sup>2</sup> lone pair in alkaline earth/alkali metal doped nanodimensional BiMnO<sub>3</sub> perovskite manganites on structural, magnetic, dielectric and transport Properties.
- Study of structural, magnetic, dielectric and transport Properties of transition and p-block element doped nanodimensional BiMnO<sub>3</sub> perovskite manganites.
- Study of different sintering temperature and Ph value effect on magnetic, dielectric and transport properties in doped nanodimensional BiMnO<sub>3</sub>.
- Study of the particle size effect by synthesizing the samples via various chemical routes i.e. modified citrate route, modified sol-gel route, co-precipitation technique etc.

### PROJECT SUMMARY

**Introduction:** Doped RE<sub>1-x</sub>AE<sub>x</sub>MnO<sub>3</sub> manganites (wherein RE is a rare earth cations and AE is an alkaline earth cation) exhibit various unconventional properties, such as paramagnetic to ferromagnetic (PM-FM) and insulator to metal (I-M) transition, colossal magnetoresistance (CMR), antiferromagnetic and charge/orbital ordering (AFM and CO/OO). The substitution at A-site modifies the average A-site ionic radius ( $\langle r_A \rangle$ ) and introduces disorder ( $\sigma^2$ ) which is found to have significant influence on magnetic and transport properties. Moreover, the physical properties of these materials can be easily adjusted by only a few impurity substitutions on the Mn-sites. In contrast to RE<sub>1-x</sub>AE<sub>x</sub>MnO<sub>3</sub>, bismuth based manganites (Bi<sub>1-x</sub>AE<sub>x</sub>MnO<sub>3</sub>) have not been studied in much detail. The special role of the 6s<sup>2</sup> lone pair of Bi<sup>3+</sup> in these manganites is also investigated. Despite several investigations relating to the doping at A and B-site of the bulk perovskite, very little attention is paid to the doped nanodimensional Bi based manganites.

### METHODOLOGY:

Possible approaches to accomplish the proposed work:

#### (i) Synthesis

The materials will be prepared in the following manner:

- The bulk samples will be prepared via solid state reaction method.
- Doped nanodimensional BiMnO<sub>3</sub> perovskites will be synthesised via chemical routes i.e. modified citrate route, modified sol-gel route etc.

#### (ii). Characterization

The crystal structures of these materials will be studied via X ray diffraction and TEM techniques. The microstructural and elemental analyses will be carried out through FESEM and EDAX coupled with FESEM. The resistivity measurement with and without field will be made by standard four probe method in the temperature range (10K-500K). The temperature dependence of magnetization (M-T) and field dependence of magnetization (M-H) will be studied by using VSM or SQUID magnetometer. The dielectric measurements will be carried out using a LCR Hi-tester as a function of temperature and frequency. The ferroelectric properties will be studied by automatic P-E loop tracer.

#### (iii). Measurements of magnetoresistance at various fields in the temperature range (10K-500K)

We will use a four probe setup for measuring the magnetoresistance with or without magnetic fields to determine the change in magnetoresistance at different temperatures.

#### (iv). To study the magnetic properties of the synthesized materials by using VSM or SQUID magnetometer

These materials exhibit a large variety of magnetic phase transformations with a sharp change of electrical properties. An external magnetic field induces a transition from antiferromagnetic state to ferromagnetic state in these materials. Hence they are appropriate objects to study the magnetic states. The temperature dependence of magnetization in different magnetic field and field dependent magnetization study will be studied by using vibrating sample magnetometer (VSM) or SQUID magnetometer.

#### (v). To study the A-site cation radius mismatch and B-site doping effect at nanoscale through chemical substitutions

The doping of various suitable (valence and ionic radius) elements can change the physical properties of these materials. By the substitution of a larger size ion to smaller ion, a large change in the volume of unit cell and crystal symmetry is observed which affects the properties of these materials. So study will be done to understand the effect of internal chemical pressure generated due to substitution of a larger size ion by a smaller ion in nanodimensional perovskite manganites.

#### (vi) To study the particle size effect by synthesizing the samples via various routes

The change in particle size of the material has crucial role in changing the electrical and magnetic properties of materials. I have planned to study the particle size effect by changing the various synthesis parameters and different routes for making these materials. I will prepare the sample via solid state reaction and sol gel process. By using the sol-gel/citrate method I can grow the particles of smaller size up to nano scale because it is the low temperature technique. The particle size can also be varied by changing the annealing temperature and duration of heat treatment. The particle size of these samples will be determined by the x-ray diffraction and TEM techniques. The particles size can also be estimated from the broadening of x-ray diffraction peaks using the Scherrer equation.

### WORK TO BE ACCOMPLISHED

Procurement and purchase of items required for synthesis of materials will be done in first six months of the proposed project. Synthesis and characterization of the materials will be done within next one year. The outcome of project will be published in peer-reviewed international journals within last one year.

### PUBLICATIONS OF THE PROJECT INVESTIGATOR

- Yadav, K., Singh, M. P., Singh, H. K., Razavi, F. S. and Varma, G. D. (2012). Magnetic and charge ordering properties of Bi<sub>0.6-x</sub>(RE)<sub>x</sub>Ca<sub>0.4</sub>MnO<sub>3</sub> (0.0 ≤ x ≤ 0.6) perovskite manganites. *Journal of Applied Physics* **111**: 07E128-2.
- Yadav, K., Vaithyanathan, V., Inbanathan, S. S. R. and Varma, G. D. (2012). Magnetic and charge ordering properties of Bi<sub>0.2</sub>Ca<sub>0.8</sub>Mn<sub>0.9</sub>X<sub>0.1</sub>O<sub>3</sub> (where X=Ti, Cr, Fe, Co, Ni, Cu). *Journal of Alloys and Compounds* **533**: 19-24.
- Yadav, K., Singh, M. P., Razavi, F. S. and Varma, G. D. (2012). Effect of Cu doping and oxygen-annealing on the magnetic properties of Nd<sub>0.5</sub>Sr<sub>0.5</sub>Mn<sub>1-x</sub>Cu<sub>x</sub>O<sub>3</sub> (x = 0.0, 0.01, 0.03, 0.05 and 0.10). *Material Chemistry and Physics* **137**: 323-330.
- Yadav, K., Singh, M. P., Singh, H. K., Razavi, F. S. and Varma, G. D. (2013). Effect of Nd doping on the magnetic

properties of charge ordered  $\text{Bi}_{0.6-x}\text{Nd}_x\text{Ca}_{0.4}\text{MnO}_3$  ( $0.0 \leq x \leq 0.6$ ) perovskite manganites. *Applied Physics A* **111**: 845-851.

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Yadav, K., Singh, M. P., Razavi, F. S. and Varma, G. D. (2012). Effect of A-site cation size on magnetic and charge-ordering properties of  $\text{Ln}_{0.5}\text{Sr}_{0.5}\text{Mn}_{0.90}\text{Cu}_{0.10}\text{O}_3$  ( $\text{Ln} = \text{La, Pr, Nd or Ho}$ ). *Material Science and Engineering B* **177**: 1219-1225.

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Yadav, K. and Varma, G. D. (2012). Magnetic and Charge Ordering Properties of  $\text{Bi}_{0.2-x}\text{Pr}_x\text{Ca}_{0.8}\text{MnO}_3$  ( $0.0 \leq x \leq 0.20$ ) Perovskite Manganite. *Journal of Superconductivity and Novel Magnetism* **25**: 1097-1104.

Chand, U., Yadav, K., Gaur, A. and Varma, G. D. (2010). Effect of different synthesis techniques on structural, magnetic and magneto-transport properties of  $\text{Pr}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$  manganite. *Journal of Rare Earths* **28**: 760-764.

Gaur, A., Gaur, U. K., Yadav, K. and Varma, G. D. (2010). Study of structural, magnetic and magneto-transport properties of nanocrystalline  $\text{La}_{2/3}\text{Ca}_{1/3}\text{MnO}_3$  manganite. *Optoelectronics and Advanced Materials – Rapid Communications* **4**: 989-994.

Chand, U., Yadav, K., Gaur, A. and Varma, G. D. (2010). Structural, magnetic and magnetotransport properties of  $\text{Pr}_{1-x}\text{Sr}_x\text{MnO}_3$  ( $x=0.2, 0.3 \text{ \& } 0.5$ ) synthesized by co-precipitation method. *Optoelectronics and Advanced Materials – Rapid Communications* **4**: 1747-1751.

Chand, U., Yadav, K., Gaur, A. and Varma, G. D. (2011). Magnetic and magnetotransport properties of  $(\text{Pr}_{0.7}\text{Sr}_{0.3}\text{MnO}_3)_{1-x}\text{NiO}_x$  composites. *AIP Conference Proceedings* **1349**: 1263-1264.

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# Dielectric and electro-optical studies of metal oxide nanoparticles doped ferroelectric liquid crystal and their applications.



**Principal Investigator: Dr. Jai Prakash**

Funding agency:	University Grants Commission, New Delhi
Year of sanction:	2013
Budget:	Rs. 6,00,000
Duration:	Two years

## Objectives of the project

- Study dielectric and electro-optical properties of metal oxide NPs such as  $\text{TiO}_2$ ,  $\text{ZrO}_2$ ,  $\text{MgO}$ ,  $\text{NiO}$  etc. doped FLC materials
- Apply them to fabricate better electro-optic devices based on them.

## PROJECT SUMMARY

**Introduction:** The liquid crystalline (LC) phase, sometimes referred as fourth state of the matter, is the state of aggregation that is intermediate between highly ordered crystalline solid and the isotropic liquid state. The LC materials have proved themselves the most promising candidates in the field of highly growing electro-optical display as well as non-display devices (such as optical devices based on LC). The LC based devices currently available in the market use the nematic type LC materials. But, ferroelectric liquid crystals (FLCs) which are the special member of LC family and are well known because of their good optical contrast, low threshold voltage, memory effect, fast response etc. So, they could be better candidates than nematics counterpart in the next generation of LC based devices. The specialty of FLCs is that they possess permanent dipole moment due to chirality in molecules and due to this feature they are represented as chiral smectic C\* ( $\text{SmC}^*$ ) phase of LC materials. The development of spontaneous polarization ( $P_s$ ) within a layer of  $\text{SmC}^*$  phase produces high switching speed from micro to nano second response, better alignment for high contrast displays, etc. On the other side, of all the interesting materials emerging from the field of nanotechnology, nanoparticles (NPs) continue to attract immense research interest. These two active areas of research, LCs and NPs, amalgamated together when material scientists and technologists all around the world started to improve dielectric and electro-optical properties of the former by doping NPs in them. The NPs doped LCs have been studied due to their attractive properties and potential applications in electronic industry by various groups around the world for observing the different aspects such as electro-optical, dielectric, memory effect, phase behavior, etc. Much of the reported work has been focused on nematic LCs. So, we want to initiate to dope metal oxide NPs (MoNPs) such as  $\text{TiO}_2$ ,  $\text{ZrO}_2$ ,  $\text{MgO}$ ,  $\text{NiO}$  etc., because of their unique physical and chemical properties due to their limited size and a high density of corner or edge surface sites, in FLC material to improve the dielectric and electro-optic properties of the latter.



**METHODOLOGY:**

(i) Procurement and purchase of metal oxide NPs and chemicals: Under this step, nanoparticles of TiO<sub>2</sub>, ZrO<sub>2</sub>, MgO, NiO etc. which will be used in the above project, will be procured and purchased. Some chemicals needed for carrying out LC based studies will also be procured and purchased.

(ii) Fabrication of pure and metal oxide NPs doped FLCs cells: This step will cover the fabrication of pure and MoNPs doped FLCs cells. In order to understand the properties of pure and doped FLC, the most significant steps is the preparation of sample cells on which all experiments are to be carried out. The basic sample cell fabrication process can be divided into four major steps:

- Deposition of a transparent conducting coating on glass plates.
- Photolithography and etching of the pattern.
- Alignment of etched plates.
- Assembling, sealing and filling the cell.

(iii) To study the effect of metal oxide NPs on dielectric and electro-optical properties of ferroelectric liquid crystal materials:

This step will involve studying the effect of MoNPs on dielectric and electro-optical properties of FLC materials. In order to observe the effect of MoNPs several dielectric and electro optical parameters of pure and doped LC will be measured. The material constants of pure and doped LC are determined using the various equipments. The sample cell is mounted onto the sample holder of the hot/cold stage and kept on the rotating table of the polarizing microscope. The sample can be viewed through the microscope. The temperature of the sample cell can be controlled by temperature controller and dielectric and electro-optical measurements can be taken. A dielectric set up comprising the impedance analyzer with the cell under study in the sample holder of the hot/cold stage will be used. Using the above set-ups, the parameters like transition temperature, tilt angle, helical pitch, spontaneous polarization, response time, and rotational viscosity would be measured in pure and doped LC cases. Thereafter, a comparison will be performed in pure and doped LC in order to observe the improvement in material parameters of the latter.

**WORK ACCOMPLISHED SO FAR**

The project has been recommended in September 2013. The equipments and other materials are being procured.

**PUBLICATIONS OF THE PROJECT INVESTIGATOR**

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Joshi T., Kumar A., Prakash J. and Biradar A. M. (2010). Low power operation of ferroelectric liquid crystal system dispersed with zinc oxide nanoparticles. *Applied Physics Letters* **96**:1-3.

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Singh G., Inam M., Prakash J., Joshi T., Biradar A. M. and Mehta D. S. (2011). Investigations of a wedge shaped nematic liquid crystal using Mach Zehnder interferometer. *Journal of Modern Optics* **1**: 1-6.



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Malik A., Prakash J., Kumar A., Dhar A. and Biradar A. M. (2012). Copper oxide decorated multi-walled carbon nanotubes/ferroelectric liquid crystal composites for faster display devices. *Journal of Applied Physics* **112**:1-4.

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Zhang Z., Liu J. J., Zhang P., Ni P., Prakash J., Hu Y., Jiang D. S., Christodoulides D. N. and Chen Z. (2013). Generation of autofocusing beams with multi-Airy beams. *Acta Physica Sinica* **62**:1-6.

Mehta D. S. Inam M., Prakash J. and Biradar A. M. (2013). Liquid-crystal phase-shifting lateral shearing interferometer with improved fringe contrast for 3D surface profilometry. *Applied Optics* **52**: 6119-6125.

Chandran A., Prakash J., Ganguly P. and Biradar A. M. (2013). Zirconia nanoparticles/ferroelectric liquid crystal composites for ionic impurities free memory applications. *RSC Advances* **3**: 17166-17173.

SCHOOL OF BASIC AND APPLIED SCIENCES

Centre for Computational Sciences (Established 2013)

FACULTY

Name	Designation	Qualification/Training	Expertise
Dr. Kousik Giri	Assistant Professor	Indian Institute of Technology, Kanpur.  <b>Experience abroad:</b> Postdoctrante experience at University of Birmingham, UK (2007-2009) Postdoctrante experience at University of Sheffield, UK (2009-2012)	Theoretical and computational chemistry-reaction dynamics
Dr. Pawan Kumar Gupta	Assistant Professor	National Institute of Pharmaceutical Education & Research, Mohali.	Computer aided drug design and molecular modeling studies against HIV, cancer, and malaria for identification of new leads/inhibitors

PROGRAMMES OFFERED

- 1. M.Sc. Computational Sciences
- 2. M.Phil. Physics



## Arsenate and Arsenite Reaction Kinetics with Ferric Hydroxides Using Quantum Chemical Calculations

**Principal Investigator: Dr. Kousik Giri**

Funding agency:	UGC, New Delhi
Year of sanction:	2013
Budget:	Rs. 6,00,000
Duration:	Two years

### Objectives of the project

- Investigate the reactions involved in arsenate and arsenite adsorption and desorption with ferric hydroxides
- Calculating reaction path for these reactions
- Dynamics in reduced dimensions

### PROJECT SUMMARY

#### Introduction:

#### Origin of the research problem

Arsenic contamination in natural water is a worldwide problem. Arsenic is often present in contaminated groundwater due to weathering of rocks, disposal of industrial wastes, sewage sludges, mining and smelting operations, agricultural use of arsenical herbicides and pesticides, and from many others sources. Arsenic occurs in the environment in several oxidation states ( $-3$ ,  $0$ ,  $+3$ ,  $+5$ ). In natural water, inorganic arsenic is mostly found as trivalent arsenite or pentavalent arsenate. In surface water under oxidizing conditions, arsenate predominates while in anoxic water under reducing conditions, arsenite becomes stable. At near neutral pH, the predominant arsenate species are  $\text{H}_2\text{AsO}_4^-$  and  $\text{HAsO}_4^{2-}$ , and arsenite state is available mostly as uncharged  $\text{H}_3\text{AsO}_3$ . Arsenic toxicity is dependent on its chemical form. Arsenate is well adsorbed onto the surface of minerals. The adsorption of arsenate by iron oxides plays an important role in preventing widespread arsenic pollution in water. Arsenite is a neutral molecule at near neutral pH and is therefore less adsorbed on most mineral surfaces than arsenate. Thus, arsenite is generally more mobile than arsenate and may be more likely to contaminate water supplies.

Because of the hazards invoked by arsenic in both oxidation states, reactions that remove these species from the aqueous phase rendering them immobile and limiting their bioavailability are desirable. Both arsenic (III) and arsenic (V) are strongly adsorbed by iron oxide minerals and by amorphous ferric hydroxide coatings on soil and sediment. The strong adsorption of arsenic to ferric hydroxide is a significant natural attenuation mechanism for arsenic contamination in groundwater and has also been exploited for removing arsenic from drinking water. Understanding arsenic reactions with ferric hydroxide is important for understanding and modeling the movement of arsenic in the environment and in designing systems for removing arsenic from potable water. Both adsorption and desorption and the kinetics of these reactions are important in this regard. The kinetics of arsenic adsorption is important not only for predicting the fate of arsenic and its dynamic interaction with soil but also for providing insight into the mechanism of adsorption on hydrous metal oxides. The kinetics for adsorption and desorption of arsenate on ferric hydroxides play an important role in the

transport of arsenic in groundwater and also effect arsenic removal from drinking water using iron oxide-based adsorbents. Adsorption of arsenate on hydrous iron oxides has been seen to be rapid initially followed by a slow stage. The proposed slow stage includes interparticle/intraparticle diffusion, surface participation, heterogeneity of adsorption sites, and formation of a solid-solution on the surface. Some group argued that the slow stage is most likely due to the heterogeneity of the surface site bonding energy rather than the diffusion processes. So far very little information is available about the adsorption of kinetics of arsenic to ferric hydroxides. A thorough understanding of the adsorption and sorption processes is essential for the development of the iron oxide-based arsenic removal in water treatment.

### METHODOLOGY:

Calculations of structures and corresponding energies of arsenate and arsenite in water and how the frequencies are changing with number of water molecules will be determined. Calculations of structures and corresponding energies of ferric hydroxide in water and how the frequencies are changing with number of water molecules will be analysed. Transition states for different reactions and calculating corresponding reaction paths and reaction rates will be determined. Most of these computations would be using density functional theory. We will use Gaussian09 for most of these above computations. We may use Vienna Ab-initio Simulation Package or Car-Parrinello molecular dynamics packages to check everything is in right track. Reaction rate will be calculated using home grown programme and also using some available programmes.

### WORK ACCOMPLISHED SO FAR

Some of the simulation packages are installed to start computations.

### PUBLICATIONS OF THE PROJECT INVESTIGATOR

Panda, A. N., Giri, K. and Sathyamurthy, N. (2005). Three Dimensional Quantum Dynamics of ( $\text{H}^-$ ,  $\text{H}_2$ ) and its Isotopic Variants. *Journal of Physical Chemistry A* **109**: 2057-2061.

Lourderaj, U., Giri, K. and Sathyamurthy, N. (2006). Ground and Excited States of the Monomer and Dimer of Certain Carboxylic Acids. *Journal of Physical Chemistry A* **110**: 2709-2717.

Giri, K. and Sathyamurthy, N. (2006). Rotational Excitation in ( $\text{H}^-$ ,  $\text{H}_2$ ) Collisions: A Quantum Mechanical Study. *Journal of Physics B: Atomic and Molecular Physics* **39**: 4123-4130.

Giri, K. and Sathyamurthy, N. (2006). The Influence of Reagent Rotation on ( $\text{H}^-$ ,  $\text{D}_2$ ) and ( $\text{D}^-$ ,  $\text{H}_2$ ) Collisions: A Quantum Mechanical Study. *Journal of Physical Chemistry A* **110**: 13843-13849.

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Sharma, V., Bapat, B., Mondal, J., Hochlaf, M., Giri, K. and Sathyamurthy, N. (2007). Dissociative Double Ionization of  $\text{CO}_2$ : Dynamics, Energy Levels and Life Time. *Journal of Physical Chemistry A* **111**: 10205-10211.

Burghardt, I., Giri, K. and Worth, G. A. (2008). Multimode Quantum Dynamics Using Gaussian Wavepackets: The Gaussian-based Multiconfiguration Time-dependent Hartree (G-MCTDH) Method Applied to the Absorption Spectrum of Pyrazine. *Journal of Chemical Physics* **129**: 174104-174118.

Giri, K., Chapman, E., Sanz Sanz, C. and Worth, G. A. (2011). A Full-dimensional Coupled-surface Study of the Photodissociation Dynamics of Ammonia Using the Multiconfiguration Time-dependent Hartree Method. *Journal of Chemical Physics* **135**: 044311-044323.

Kolakkandy, S., Giri, K. and Sathyamurthy, N. (2012). Collision-induced Dissociation in ( $\text{He}$ ,  $\text{H}_2^+$  ( $v = 0-2$ ;  $j = 0-3$ )) System: A Time-dependent Quantum Mechanical Investigation. *Journal of Chemical Physics* **136**: 244312-244316.

## SCHOOL OF LEGAL STUDIES AND GOVERNANCE

Centre for Enviornmental Law (Established 2011)

### FACULTY

Name	Designation	Qualification/Training	Expertise
Dr. Deepak Chauhan	Assistant Professor	D.Phil. Chaudhary Charan Singh University.	Environmental Law, Constitutional governance, Fundamental rights, Information technology Law and Agricultural Law
Dr. Puneet Pathak	Assistant Professor	D.Phil. University of Allahabad.	Environmental Law, Judicial process, Human rights
Dr. Hans Raj	Assistant Professor	Ph.D. Punjabi University, Patiala.	Legal studies, Fundamental law

### PROGRAMMES OFFERED

LL.M.-Ph.D. Integrated (Enviornmental law)

LL.M. (Enviornmental law)

UGC-18 (2013)

## Impact of Laws and Policies to Prevent and Regulate Pollution form Agriculture Residue Burning: A Case Study of Bathinda District of the State of Punjab.



***Principal Investigator:* Dr. Deepak Kumar Chauhan**

Funding agency:	University Grant Commission
Year of sanction:	2013
Budget:	Rs. 3,00,000
Duration:	Two year

### Objectives of the project

- Find out and scrutinizing the reasons of crop residue burning
- To monitor the effects of present laws and policies for agricultural fire detection in the commencing period of the project
- Find out the loopholes in laws and policies regarding the problems
- Protect public health and welfare by reducing burning practices
- To suggest and adopt alternative technology and methods for management
- To publish a booklet on the problem and its consequences with possible solutions

### PROJECT SUMMARY

**Introduction:** Agriculture residue burning can be defined as the burning of materials that are wholly produced from growing and harvesting crops or raising animals for the primary purpose of providing a livelihood. Recently, attention towards agricultural residue and its effects have been increased. Agriculture residue burning is a cheap method to management used by farmers of the country to with an opinion to improve yields, to control disease, weeds & pests and for various reasons. Indian farmers in majority are uneducated, less aware and have little knowledge about the effects of crop residue burning, like emission of greenhouse gases, smoke, associated health hazards and cause pollution in ambient air & deteriorate the quality of air which we breathe which can endanger public health. Burning of agricultural residue is now recognized as an important source of pollutant emissions. It leads to emission of trace gases like CH<sub>4</sub>, CO, N<sub>2</sub>O, NO<sub>x</sub>, SO<sub>2</sub>, and hydrocarbons. Burning of straw also emits large amount of particulates that are composed of a wide variety of organic and inorganic species. One tone straw on burning releases 3 kg particulate matter, 60 kg CO, 1460 kg CO<sub>2</sub>, 199 kg ash and 2 kg SO<sub>2</sub>. These gases and aerosols consisting of carbonaceous matter have an important role to play in the atmospheric chemistry and can affect regional environment, which also has linkages with global climate change.

In past years, the health effects resulting from agricultural burning were not always considered to be significant. But the development in this field also goes for consideration in the form of environment pollution and depletion of natural resources. This is against right to live in pollution free environment in various forms and by various causes. Such types of



agriculture activities are polluting the environment.

Agriculture residue burning is an environment and health policy issue at the international, regional, national and state level and is a serious nuisance and a health risk. Our aim regarding environment protection is to achieve sustainability overall for the benefit of future generations and for this purpose we have various conventions, treaties, conferences, protocol etc., at various levels and legal & regulatory framework.

#### **METHODOLOGY:**

This study will be based on data analysis at various levels and micro investigation at the same level, field survey in various areas with the help of interview techniques of farmers and the opinion of experts will also be base of this work. For monitoring the researcher will try to go in the nearby areas in the months of May –June and September- October, and will maintain records of the field work for analysis and use.

The process to find out the cost effective and easy methods or technology to suggest the farmers to reduce and prevent the problem the researcher will collect the data and take help form the experts.

#### **WORK ACCOMPLISHED SO FAR**

Agriculture residue burning is an environmental policy and law issue at the international, regional, national and state level. This is a serious nuisance and a health risk. The aim of the project is to protect the environment and to find some of the ways to achieve sustainability overall. For this purpose legal and regulatory framework at national and state level has been analysed with a view to find some solutions. The work under the project helps to manage the problem of crop residue burning with the help of laws

#### **PUBLICATIONS OF THE PROJECT INVESTIGATOR**

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Kumar, D. and Kumar, K., (2012). Environmental Management: Hindu Religious and Ethical Consciences. GSSDGS Khalsa College Patiala: 78-89.

## **Central University of Punjab City Campus**



**A Research Laboratory**



**The University Library**



# Central University of Punjab

## City Campus

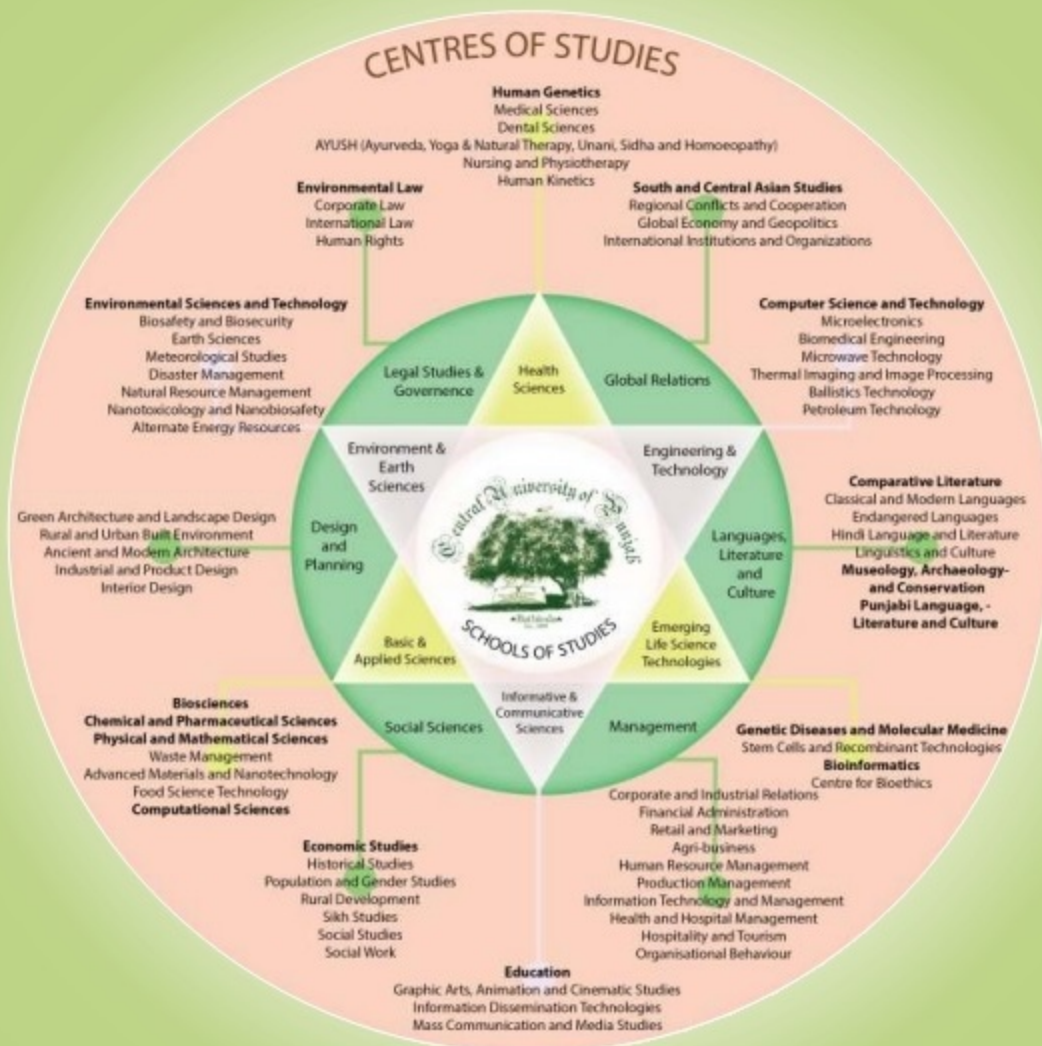


**University Computer Centre**



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# Central University of Punjab



Centres shown in bold are functional



## Central University of Punjab, Bathinda

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