

# Science and Technology Reporter

A Quarterly Newsletter of the Haryana State Council for  
Science and Technology



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Anurag Agarwal, IAS  
Director,  
Science & Technology Department,  
Haryana



## FROM DIRECTOR'S DESK

*The Science and Technology Department has been involved in some very important activities during the second quarter of 2011.*

*A science workshop through Dr. Kailash Chander Bansal, Director, NBPGR, Delhi was organized on 16<sup>th</sup> May 2011 at Hisar for large group of students of the area with the objective to inculcate scientific temper among the participants and make them understand role of science in welfare of mankind and overall growth of nation.*

*Sh. Randeep Singh Surjewala, Hon'ble Science and Technology Minister, Haryana released a new periodical of the department, a quarterly Hindi Science Magazine 'Haryana Vigyan Darpan' on 8<sup>th</sup> June 2011. This magazine contains interesting articles in the diverse fields of science and aims in generating curiosity and interest among the students towards sciences. In this ceremony, an 'Updated Wasteland Atlas of Haryana' and a 'Report on Delineation of Paleo-Channels as Potential Sites for Ground Water Exploration in Piedmont Zone of Haryana' prepared by HARSAC, Hisar were also released by him. These will be very helpful for the planners, researchers and others searching for the information related to the district at one place in the overall developmental planning of State. The steps / initiatives taken by department in recent past, particularly in promotion of science education in Haryana were applauded by him.*

*I am hopeful that the Department will carry forward the present efforts and will also add new initiatives in making Haryana as one of the leading States of the country in all aspects.*

(Anurag Agarwal)



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## Minister released Haryanan Vigyan Darpan, Wasteland Atlas of Haryana and Report on Delineation of Paleo-Channels as Potential Sites for Drinking Water

Sh Randeep Singh Surjewala, Hon'ble Science & Technology Minister, Haryana released a Hindi Magazine 'Haryana Vigyan Darpan' published by the Science & Technology Department, Haryana in a ceremony organized on 8<sup>th</sup> June 2011 at Haryana Civil Secretariat, Chandigarh. The magazine contains interesting articles in the diverse fields of science and it will be a quarterly publication of the Science and Technology Department, Haryana. Senior officers of the State Government were also present during the ceremony. While releasing the magazine, Sh Surjewala showed concerns that a drastic decline in the number of students opting for science subjects has been observed by the Government, thereby leading to scarcity of science teachers and quality scientists. This magazine can serve as a tool to reverse this trend, by generating curiosity and interest among the students towards science.

Sh Manik Sonawane, IAS, Financial Commissioner & Principal Secretary to Govt. Haryana, Science & Technology Department expressed satisfaction at the efforts of Haryana State Council for Science & Technology in taking science to students, teachers and general masses of Haryana and inculcating scientific temper among them. Sh Anurag Agarwal, IAS, Director Science & Technology Department, Haryana elaborated that this magazine is a comprehensive package of information covering articles on diverse areas of science, technology and engineering as well as light reading material such as amazing scientific facts, profiles of scientists etc. so as to motivate and generate an interest in students towards science education.

In this ceremony Hon'ble Minister also released an 'Updated Wasteland Atlas of Haryana' and a 'Report on Delineation of Paleo-Channels as Potential Sites for Ground Water Exploration in Piedmont Zone of Haryana' prepared by Haryana Space Application Center (HARSAC), Hisar, a nodal agency for Remote Sensing and GIS works in the State under

Science and Technology Department. These will provide much needed respite to the planners, researchers and others searching for the information related to the district at one place. The wasteland atlas will provide the type and exact location of the area lying waste. The wasteland maps generated by HARSAC would be very useful for the planners particularly for watershed planning and land reclamation purposes. With increased requirement of land for non-agricultural areas, this information can also be used by various departments / organizations of the State to identify areas for urbanization, industrial development and activities other than agriculture like recreational parks etc.

Haryana Govt. is observing current year as the "Water Conservation Year" and has taken up many projects for this purpose. Palaeochannels are the old channels which have become extinct due to some climatic or geological activities but their remnants are still available underground. These features can be picked up by satellite data. The palaeochannels in the northern districts i.e. Panchkula, Ambala, Yamuna Nagar, Kurukshetra and Kaithal were identified using Indian Remote Sensing Satellite data and their existence was substantiated with the help of resistivity surveys carried out with the help of Kurukshetra University.

The information generated by HARSAC on Palaeochannels for Ground Water Exploration would be very useful. These palaeochannels can act as a store-house of underground water and can be exploited to tap additional sources of water for drinking and irrigation. These could also be used as the water recharging sites. The palaeochannel maps will also be used for creating a network of drains for flood management in the region. The use of palaeochannels has also been indicated in the archeological surveys as old habitations have existed on the bank of water sources or confluences of rivers. Thus the information could be very useful for Public Health Engineering, Irrigation, Agriculture, Revenue and Archeology departments.



## Science workshop at Hisar

A science workshop was organized at Indira Gandhi Auditorium, CCS HAU, Hisar on 16<sup>th</sup> May, 2011. In this workshop about 1100 science students of 11<sup>th</sup> and 12<sup>th</sup> classes from various government and private schools of Hisar district, undergraduate / postgraduate students of HAU Hisar and about 100 teachers and faculty members participated. Dr. Kailash Chander Bansal, Director, NBPGR, Delhi gave talk on "Science for the Welfare of Mankind and Growth of a Nation". He explained in detail with the help of slides to the participants about the contribution of scientists such as Louis Pasteur:- for Pasteurization and development of vaccines against cholera, diphtheria, tuberculosis and smallpox; Alexander Fleming:- for discovery of penicillin which paved the way for the use of antibiotic therapy in treating infectious diseases; Charles Darwin:- as a naturalist who came up with the theory of evolution; Gregor Mendel:- as a father of modern genetics. He also explained the development of crop plant history through

genetic change from their wild ancestors. The gene transgenic technology helped in getting high yield of crops with improved quality. The Genetically Modified (GM) crops have improved the nutritional value of food as well. He further briefed about Norman E. Borlaug who is known as father of Green Revolution, who met the challenges of Global Wheat Production. After that an open discussion and question answer session with the participants was held. The participants showed very good response and asked lots of questions related to General Science, DNA & Gene Transgenic Tech. Dr. Santosh Dhillon, Dean, College of Basic Science, HAU Hisar and Chief Members of HAU were also present in this Workshop. The Scientists, Teachers and Students appreciated the efforts made by Science and Technology Department, Haryana for promoting/popularization of science through such workshops.



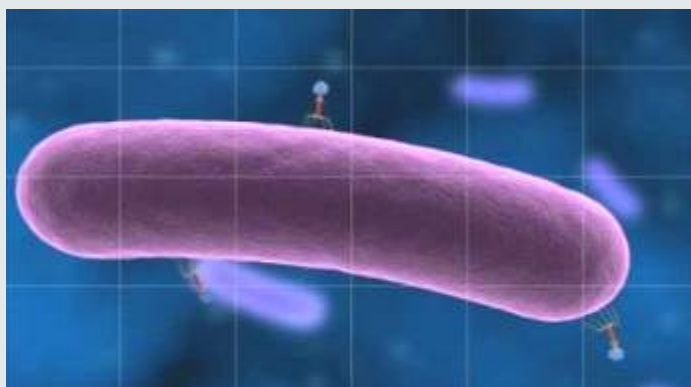
## Kurukshetra University gets project from DST, Govt. of India

The Department of Electronics Science of Kurukshetra University has been awarded a project of Rs. 2.96 crore by the Department of Science and Technology (DST), Govt. of India to strengthen its M.Tech course in nano-science and technology. This project has been sanctioned by the Nano-Mission Council in its meeting held in Bangalore under the chairmanship of Prof CNR Rao, Principal Scientific Advisor to the Prime Minister. The amount granted under this project will be utilized for the purchase of equipments like atomic force microscope, nano particle size analyzer, de-ionised water plant etc. Prof Dinesh Aggarwal of Department of Electronics Science of the University is the programme coordinator of this project. This achievement of the Department of Electronic Sciences of KU has added another feather in its recognition at national level as it has already been chosen to set up a national facility on microelectronic mechanical systems through NPMAS project awarded to it in 2009 by the Aeronautical Development Agency, Bangalore.

Nanotechnology is an interdisciplinary field and requires a strong backbone of microbiology, chemistry, biotechnology, electronics and physics. It has immense potential for its applications in medicine, aerospace, engineering and healthcare. Tremendous efforts have been made by developed countries for its commercialization in the past few years. M.Tech students from physical as well as biological sciences would be admitted against 20 seats in the department. Expertise from research labs of nearby areas like National Physical Laboratory, Delhi and Central Scientific Instruments Organization, Chandigarh will also be used for running the course. The trained manpower from this department would have high job potential in India and abroad. Thus, it will not only fulfill the needs of trained manpower of this field in India, but also, it will popularize nanotechnology in states like Haryana by its application to reap rich harvest in agriculture and dairy farming. This will surely help in putting India on the global map of nanotechnology.

## Bacteriophage – Applications and Potentials

Bacteriophages (“bacteria” and “phagein” = to eat or devour, in Greek i.e. phages “eat” or “devour” bacteria) are bacterial viruses found in all habitats in the world where bacteria proliferate. They are regarded as most widely distributed biological entity in the biosphere. According to morphology and nucleic acid, Phages are classified into 13 families by the International Committee on Taxonomy of Viruses (ICTV). The dsDNA tailed phages, or *Caudovirales*, account for 95% of all the phages reported in the scientific literature, and possibly make up the majority of phages on the planet. However, there are other phages that occur abundantly in the biosphere, phages with different virions, genomes and lifestyles.



*Bacteriophage attacking bacteria*

Interest in phage research has been rekindled as over the past three decades, phage research has revealed the abundance of phages in nature, the diversity of their genomes, their impact on evolution of microbial diversity, their control of infectious diseases and their influence in regulating the microbial balance in every ecosystem where this has been explored. Since their discovery in 1915 and 1917 by Fredrick Twort and Felix d'Herelle respectively, bacteriophages have been studied in many laboratories and used in a variety of practical applications, some of which are detailed below.

### Applications of Phages

#### Phage therapy

Lytic phage kills bacteria and therefore, can be considered as antibacterial. In 1930s phages were discovered to be anti-bacterial agents. Phage therapy was exploited for both diarrheal disease and the treatment of traumatic infections during and after World War II. During the 1920s and 1930s, therapeutic phage applications were used in treatment of bacterial infections like in dysentery, staphylococcal septicemia, staphylococcal meningitis and eliminate *S. aureus* from the cerebrospinal fluid in Western Europe and the USA. However, due to the sub-standards in the trails performed in the western countries which were conducted poorly and

without an idea of what a phage was, phage therapy was shortly thereafter ruled out with the advent of discovery of antibiotics which quickly grew in popularity which now has raised concerns due to emergence of drug-resistant pathogenic bacteria. There is a current renewed interest in bacteriophage therapy in Western Europe and the USA. The first regulated clinical trial of efficacy in Western Europe (against ear infections caused by *Pseudomonas aeruginosa*) was reported in the journal *Clinical Otolaryngology* in August 2009. Meanwhile, Western scientists are developing engineered viruses to overcome antibiotic resistance, and experimenting with tumor-suppressing agents. One potential treatment currently under development is a phage designed to destroy MRSA.

#### Phage lysins as antimicrobials

Phage endolysins, or lysins, are enzymes that damage the cell walls' integrity by hydrolyzing the four major bonds in its peptidoglycan component. There is enormous potential of the use of phage endolysins, rather than the intact phage, as potential therapeutics.

#### Phage display

Phage display technology is a technique by which foreign peptides, proteins or antibody fragments are expressed at the surface of phage particles. The heterologous peptide or protein is cloned into a phage or phagemid genome as a transcriptional fusion with one of the coat protein genes. These phages then become vehicles for expression that not only carry within them the nucleotide sequence encoding the expressed proteins, allowing the gene sequence to be retrieved, but also have the capacity to replicate. It is a particularly powerful molecular tool that has had a major impact on drug discovery, pharmacology, immunology and plant science.

#### Vaccines

A novel and exciting use of phages is the use of whole phage particles to deliver vaccines in the form of immunogenic peptides attached to modified phage coat proteins, or as delivery vehicles for DNA vaccines. Vaccination with phagedisplaying immunogenic peptides has a number of advantages over the use of recombinant peptides, such as the stimulation of both the cellular and humoral arms of the immune system.

#### Detection of pathogens

The specific interaction of a bacteriophage and its host lends itself to using phages for the detection of bacteria, in particular, pathogenic bacteria. Unlike other detection systems such as ELISA and PCR, detection with phage is a natural system whereby the phages specifically recognize and bind to their host cells.

## Role in environment

In marine environment the lysis of bacteria by phages releases organic carbon that was previously particulate (cells) into dissolved forms, which makes the carbon more available to other organisms. Bacteriophages have also been used in hydrological tracing and modelling in river systems especially where surface water and groundwater interactions occur. The use of phages is preferred to the more conventional dye marker because they are significantly less absorbed when passing through ground-waters and they are readily detected at very low concentrations.

## Other potential areas of use

Bacteriophages can be used for application in agriculture for protecting plants and vegetable produce from decay and the spread of bacterial disease. They can be used as a biocide for environmental surfaces, e.g., in hospitals, and as a preventative treatment for catheters and medical devices prior to use in clinical settings. The technology now exists for phages to be applied to dry surfaces, e.g., uniforms, curtains, even sutures for surgery. Clinical trials reported in the Lancet show success in veterinary treatment of pet dogs with otitis. Their potentials in

food industry for control of food-borne bacterial pathogens have already been demonstrated in Western countries.

One can say that phage research has played a central role in some of the most significant discoveries in biological sciences, from the identification of DNA as the genetic material, to the deciphering of the genetic code, to the development of the science of molecular biology over last few decades. Phage research has given new dimensions to our understanding of the basic molecular mechanisms of gene action and biological structure. In modern -omic era, phage genomics is revealing novel biochemical mechanisms for replication, maintenance and expression of the genetic material and is providing new insights into origins of infectious disease and the potential use of phage gene products and even whole phage as therapeutic agents opening new horizons to attractive and possible potentials of uses of phage in various sectors.

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## Potential for Biomass Energy in Haryana

Drs V.K. Kochhar and Sunita Kochhar

Retired Deputy Directors & Heads of Biotechnology, National Botanical Research Institute, Lucknow.

While the world's natural oil reserves are fast depleting and demand is rising exponentially, it is being increasingly realized that the hydrocarbon or fossil fuel resources of the earth are not infinite. The excessive use of fossil fuels, chemical pollutants especially fluorocarbons produced from refrigeration gases and others have already resulted in the increasing global warming and climate change and over all environmental degradation. According to some estimates the present oil reserves are sufficient only for the next 25-30 years. This coupled with rapid deforestation and urbanization is also resulting in unbelievable changes in the overall environment of the earth. There are already evidences of melting of polar ice caps and in general melting of glaciers.

Right from the 70's during the first energy crisis emphasis has been laid on the alternative sources of energy. These alternative sources of energy such as wind energy, solar energy, water energy and the energy from biomass need to be explored vigorously. Haryana has a good resource of alternative energy sources. First and foremost is energy from biomass which is renewable and clean. Biomass is produced from plants by a process called photosynthesis which uses carbon dioxide to generate sugars in sunlight which provide energy to the plant for growth and is stored in the form of biomass. Forest wood has long been used to burn in rural households of Haryana for cooking. Even now 50% of the rural households in Haryana obtain energy for cooking from wood. Biomass waste can be

burnt for gasification and gas used to generate electricity. Cow dung and other animal wastes have been used to generate biogas (Fig. given below). Haryana grows lot of sugarcane and the sugarcane waste can also be used for gasification. It can also be used to manufacture alcohol which in itself is a potential biofuel. The biomass wastes from all sources in Haryana are able to generate about 470000 mega joules of energy. But we in Haryana have a requirement of about 600000 mega joules. Therefore, we need to expand our biomass resources to generate energy from biomass



Common sight in a Haryana village showing resources for the generation of energy from biomass. Buffaloes provide dung (also seen in the picture) which can be used for biogas. Trees show woody biomass which is also a source of bioenergy.

# PLANT TISSUE CULTURE : SUGARCANE CASE STUDY

Dr. Subhash Kajla, Anil K Poonia and Shalima Sihag  
Centre for Plant Biotechnology, Hisar

## Plant Tissue Culture:

Plant Tissue culture is a technique for commercial multiplication of elite plant materials in the laboratory. Traditionally, it is used for rapid multiplication of high quality, disease free plants.

Principle: Totipotency i.e. capability to each and every cell of plant to develop into complete plant.

## Objectives:

- ✦ Conservation of biodiversity
- ✦ Fast multiplication
- ✦ True to the type & Disease free plant production
- ✦ Production of new varieties

## Why tissue culture?

- ✦ Export value: Quarantine rule (for export and import purpose)
- ✦ Fast multiplication
- ✦ Completely disease free plants

## Applications:

- ✦ Conservation of endangered plants species
- ✦ Quick multiplication of elite genotypes
- ✦ True to the type & Disease free plant production
- ✦ Production of new varieties

## Methodology/Steps involved:

- ✦ Washing
- ✦ Explants preparation
- ✦ Media preparation
- ✦ Sterilization
- ✦ Inoculation
- ✦ Hardening

## Washing:

- ✦ Physically separated area from other part of laboratory
- ✦ Nontoxic detergents
- ✦ Store in dust free cabinet

## Explants preparation:

- ✦ Selection of Healthy mother plant
- ✦ Use Sharp knife for cutting
- ✦ Explants include Shoot tip/Nodes/ internodes /Leaf
- ✦ Thorough Cleaning
- ✦ Standardization of size

## Media preparation: It includes

- ✦ Inorganic Nutrients
- ✦ Vitamins
- ✦ Carbon source
- ✦ Growth regulators
- ✦ organic Nutrients

## Sterilization Techniques:

- ✦ Dry Heat
- ✦ Flame
- ✦ Autoclaving
- ✦ Wiping with alcohol
- ✦ Filter
- ◆ Glasswares and Plasticwares
- ◆ Forceps ,Scalpels, Needles
- ◆ Media and culture vessels
- ◆ Operators hands, Laminar surface
- ◆ Some Growth regulators

## Sterilization of plant material:

- ✦ Calcium Hypochlorite
- ✦ Sodium Hypochlorite
- ✦ Mercuric Chloride
- ✦ Silver Nitrate etc.

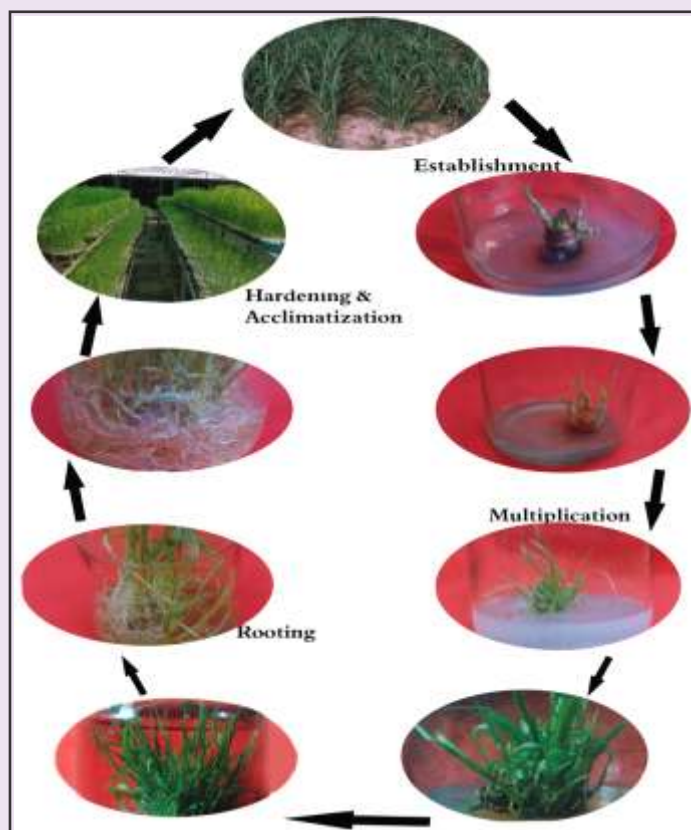
## Inoculation:

- ✦ Establishment of explants
- ✦ Multiplication:
- ✦ Elongation
- ✦ Rooting
- ✦ Hardening/Acclimation
- ✦ Transfer to the field

Plant Tissue Culture is a novel and innovative technique employed to obtain high quality, disease free plants quickly and in a large quantity. This technique is especially useful when the planting material is scarce or on the edge of extinction. Also, the tissue culture plants are true to type and resemble the mother plant in all traits. The technology has enormous potential for meeting the demands of both domestic and export market in terms of high quality planting materials. Since the cost of production in India is comparatively low, the growers in Europe and USA are expected to be interested to tie-up with Indian counterparts for production of tissue culture raised plants on commercial basis.

## “Sugarcane” Tissue Culture

Tissue culture of elite genotypes of sugarcane is done for rapid multiplication of high quality, disease free plants of sugarcane.



## Why tissue culture in sugarcane

In sugarcane, tissue culture is a special technique for multiplication of yet to be released varieties. It is a vegetatively propagated crop and the seed multiplication ratio by conventional methods is 1:10, whereas by tissue culture it is 1:10,000 or more. Thus newly released varieties take very short spell to obtain sizable area under cultivation if multiplied through tissue culture, as compared to 8 to 10 years otherwise.

### Procedure

- ✍ **Explant:** The plant part used for starting a tissue culture is commonly referred to as explants. The apical dome which includes meristematic tip, shoot apex and a few young leaves around it, is the preferred explants in sugarcane.
- ✍ **Establishment of aseptic cultures:** The explants washed with detergent and sterilized in 0.1% mercuric chloride are inoculated in initiation media. New buds arise from these in 15 to 20 days.
- ✍ **Multiplication:** Newly formed buds are separated from the explants and cultured in multiplication media. These form clumps of shootlets in 20 to 25 days which are separated and subcultured on fresh media 3 to 4 times.
- ✍ **Rooting:** Newly formed shoots are kept in a rooting media for 7 to 10 days for rooting.
- ✍ **Hardening and establishment in soil:** Rooted plantlets

are shifted to glass house in poly bags under high humidity conditions until well established (30-45 days). These are finally transplanted in the field.

### Important points / cultivation practices -

- ◆ With a row to row 75cm and plant to plant 50 cm distance, about 1000 plants are required per kanal area. Save 20 to 30 plants for each kanal area. These may be required for gap filling.
- ◆ After planting, field has to be irrigated immediately and kept wet for 10 to 15 days by providing 2 or 3 light irrigations.
- ◆ Apply 5.0 Kg urea per kanal twice at monthly intervals in addition to recommended doses of fer tilizer
- ◆ Compared to set-propagated plants tissue culture raised plants have better tillering and hence canes are somewhat thin.
- ◆ In the procedure described above, the seedlings are uniform and true to type.
- ◆ Tissue culture seedlings when transplanted to the field show over 95% establishment, compared to 35-40% germination shown by sets and tillering is also better in tissue-cultured plants.
- ◆ As a technique, tissue culture seedlings may be used for building up breeder/ foundation seed of newly developed varieties.
- ◆ Only released varieties or those in very advanced stage of testing may be multiplied through tissue culture.

## A Tribute to Indian Scientist



Prasanta Chandra Mahalanobis  
(1893 - 1972)

Prasanta Chandra Mahalanobis was born in Kolkata on 29<sup>th</sup> June 1893. Prasanta Chandra did his early schooling from the Brahma Boys School, Kolkata. He obtained the Bachelor of Science degree with Honours in Physics from Presidency College, Kolkata in 1912. In 1913, he went to England where he completed the Tripos in Mathematics and Physics from King's College, Cambridge. He was the only candidate to get first class in Physics in Part II of the Tripos. King's College awarded

him a senior research fellowship. However, before starting his research, he came to Kolkata for a short vacation. While in Kolkata, he was offered the post of Assistant Professor of Physics in Presidency College, Kolkata. He accepted and was to remain there for thirty three years, retiring as the Principal of the College in 1948. However, it was his work in statistics that would bring him worldwide recognition and fame.

Just before he left Cambridge, his tutor, W.H. Macaulay, drew his attention to the statistical journal *Biometrika*. Mahalanobis found the articles interesting and purchased the whole set of available volumes and brought these back to Kolkata.

His early statistical work in India started with the analysis of examination results of the University of Kolkata, the analysis of

the data collector on anthropometric measurements on Anglo Indians of Kolkata and study of some meteorological problems, which led to his appointment as Presidential address to the Anthropological Section of the Indian Science Congress, he introduced the  $D^2$  - statistic, otherwise known as the Mahalanobis generalized distance. In 1928, his work on floods for the Governments of Bihar and Orissa led to the establishment of the Statistical Laboratory in a room adjoining his office in the Presidency College. This was the modest beginning of what was to become the Indian Statistical Institute (ISI). The ISI was formally established in 1931, bringing to India many new technologies, like the sample surveys, statistical quality control, design of experiments and planning for national development. Mahalanobis was instrumental in setting up to National Sample Survey in 1950, the largest of its kind in the world. He was also the architect of the Second Five Year Plan. In 1951, the Central Statistical Organization of the Government of India was set up, again with Mahalanobis and the ISI leading a helping hand. The ISI also founded the *Sankhya: The Indian Journal of Statistics*, the first issue of which was brought out in June 1933 with Mahalanobis as its founder editor.

His scientific output was enormous by any standard. He wrote four books and around 271 scientific papers in a wide range of statistical topics.

He was awarded the Weldon Medal of Oxford University in 1944 and the Srinivasa Ramanujan Gold medal in 1968. He was elected a Fellow of the Royal Society, London in 1945, and Honorary President, International Statistical Institute in 1957. He was awarded the Padma Vibhushan by the Government of India in 1968.

## HARSAC started Six Weeks Summer Training Course on “Remote Sensing &GIS” for Post Graduate students on 20<sup>th</sup> June 2011

Six weeks Summer Training Course on “Remote Sensing &GIS” was started by HARSAC on June 20, 2011 for Post Graduate level students. This programme will continue upto July 29, 2011. Forty two (42) students of various colleges / universities from all over the State are participating in this course. This programme was inaugurated by Dr. (Ms.) Sucheta Khokhar, Dean, College of Agriculture, CCS HAU, Hisar at HARSAC. In addition to HARSAC Scientists, resource persons from outside has also been invited to deliver the lectures during this training programme. The Participants are being given training in Visual Image Interpretation, Digital Image Processing, GIS and Global Positioning System (GPS). A project will also be given to every group of three trainees. The projects are related to the preparation of various thematic maps like landuse / land cover map, landform map and Physiography map of the Siwani area. The participants will also be taken to the field for ground truth survey as well.



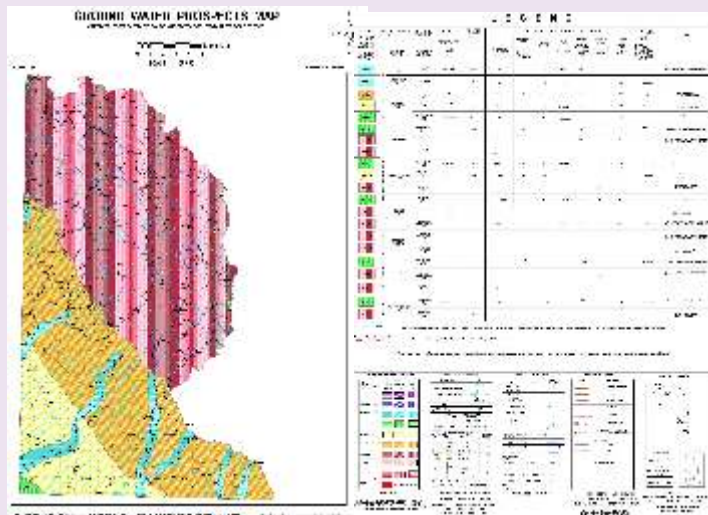
## Groundwater Prospects Mapping in Haryana under Rajiv Gandhi National Drinking Water Mission Project

Anup Kumar and R.S.Hooda

Haryana Space Applications Centre, CCS HAU Campus, Hisar

National Remote Sensing Centre (NRSC), Department of Space, Govt. of India, Hyderabad sponsored project “Groundwater Prospects Mapping in Haryana” has been done by HARSAC. In the project 18 thematic layers like base, lithology, structure, geomorphology and hydrology have been prepared using IRS P6 LISS-III satellite data, ground truth and well inventory data toposheet wise. Final groundwater prospects map on 1:50,000 scale has been prepared by integrating base, lithology, structure, geomorphology and hydrology layers for 103 toposheets of the state. The groundwater prospects map has 13 column legend having information like geological sequence/rock type, geomorphic unit, depth to water level, recharge conditions, aquifer material, type of wells suitable, depth range of wells suitable, yield range of wells, homogeneity of aquifer, quality of groundwater, groundwater irrigated area, recharge structures suitable and remarks for any other information. The maps are highly useful for groundwater investigations on 1:50,000 scale for narrowing down the well site for geophysical investigations

in a particular hydrogeomorphic unit. The map also give a synoptic view of groundwater prospects on 1:50,000 scale of an area.



Groundwater Prospects Map of Part of Panchkula District

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