

EVERYMAN'S SCIENCE

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A per decision of Council meeting held on May 03, 2014, Presidential Address will not be printed henceforth in Everyman's Science as they are already printed in the above mentioned book.

EDITORIAL**Anthropology in Forensic Science**

Forensic science, a multidisciplinary subject, encompasses the knowledge of biology, physics, computer science, geology, chemistry, and medicine. It facilitates in probing crime scenes and collecting proof to be used in prosecution of offenders in the court of law. The word "forensic" is derived from the Latin word "forensis" which means forum, a public place where, in Roman times, senators and others debated and held judicial proceedings. Forensic scientists scrutinize objects, substances (including blood or drug samples), chemicals (paints, explosives, toxins), tissue traces (hair, skin), or impressions (fingerprints or tidemarks) that are left at the crime scene. In recent years, forensic science has undergone spectacular advancement including in the area of DNA collection and analysis and the reconstruction of crime scenes.

Anthropologists play a significant role not only in the identification of a person from decomposed skeletal remains but also in the study of human skeletal differences. Forensic anthropology entails the application of the science of anthropology and its subfields, including forensic archaeology and forensic taphonomy in a legal scenario. Forensic Archaeology is a specialized application of archaeological techniques in searching and recovering of evidential material from crime scenes, often but not always related to buried human remains whereas forensic taphonomy is concerned with the study of the decomposition of human remains, particularly in the context of burial sites. Therefore, the field forensic anthropology is a sub-field contained by physical anthropology which applies the understanding of scientific principles in physical anthropology within legal framework. Twentieth century witnessed the recognition of forensic

anthropology into a fully recognized forensic domain linking trained anthropologists gathering data on decomposition and the probable effects on the skeleton by several research institutions. Thus, forensic anthropologists not only assists in the identification of deceased individuals whose remains are decomposed, burned, mutilated or otherwise unrecognizable, as might happen in a plane crash or any disaster but often assist in the investigation of war crimes and mass fatality investigations. They are also instrumental in the investigation and documentation of genocide and mass graves. Forensic anthropologists utilizing their subject knowledge can potentially determine a victim's age, sex, stature and race using physical markers present on a skeleton. The skeletal abnormalities can be used by anthropologists to possibly determine cause of death, relate trauma such as broken bones or medical procedures, as well as diseases such as bone cancer. Fingerprints find a significant position in forensic investigations. Fingerprints remain unchanged throughout individual's lifetime. It is unique to individuals and even monozygotic twins also don't share the identical finger prints, as a result fingerprint represents a specific, individual characteristic of a particular person. Fingerprint examiners rely on individual characteristics of fingerprints in their examinations. A fingerprint evidence found at scene of crime is used to match to the fingerprint of criminals stored as database; this would facilitate in linking it to a suspect in criminal activity. The Integrated Automated Fingerprint Identification Systems (IAFIS) accurately compares an individual's fingerprint with millions of fingerprint stored in computerized database within short span of time. Serologists another specialist related to

anthropology, apply several physical, biological and chemical methods to identify and analyse small amount of biological fluid such as blood, urine, semen, saliva found at scene of crime to determine origin of the biological sample i.e. whether it belongs to human or non-human species. Further it facilitates in identifying the ABO blood group of fresh blood and bloodstains, mixed and washed bloodstains and other body fluids and their stains found at scene of crime. Subsequent to establishing the human origin deoxyribonucleic acid (DNA) testing if required can be attempted. DNA profiling (or forensic DNA testing) is a scientific method employed by forensic

scientist to identify individuals on the basis of their DNA characteristics. In this, DNA extract from biological evidence (such as blood, saliva, semen sample) found at crime scene is compared with that of known criminals stored in National DNA (such as Combined DNA Index System (CODIS)) database to find the link of an individual to criminal act. Forensic DNA analysis plays a critical role in resolving paternity disputes, sexual offence cases, disaster victim identification (DVI) and wildlife forensic problems. Hence it is very clear forensic anthropology holds a distinguished position as a well-established discipline within the forensic field.

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New Delhi.

“Educating the mind without educating the heart is no education at all.”
-Aristotle

APPLICATION OF NANOTECHNOLOGY IN FISHERIES AND AQUACULTURE

Debolina Majumder and Gadadhar Dash*

Aquaculture is fastest growing food producing sector in the world. To feed the growing population of the world nanotechnology is the foremost need of the time. Nanotechnology is able to develop sustainable aquaculture. Nanotechnology is the design, characterization, production and application of structures, devices and systems by controlling shape and size at the nanoscale. This technology has number of applications in fisheries. Nanotechnology devices can clean the fish pond by using a lanthanum based particle of 40nm size, which can absorb phosphates from the water and prevents algae growth. DNA nano vaccines can be used to improve the immune system of the fishes. Iron nanoparticles can also be used to improve the growth of the fishes. This technique can be used to segregate egg and sperm for sex selection. Photodegradation of antibiotics can also be achieved in aquaculture by using nanotechnology. This technology can prevent antifouling and can improve packing techniques in fishery products. With fast development in nano-technology more and more applications of the nano science in aquatic sector is perceived.

INTRODUCTION

Genetically modified (GM) fish are likely to dominate future fish farming by growing over two times faster and being up to 30% more efficient with feed than regular fish. To feed the total population of the world nanotechnology is one of the foremost approaches now a days. Nanotechnology is able to develop sustainable aquaculture.

INVENTION OF NANOTECHNOLOGY

Richard feynman first presented the idea of nanotechnology in a lecture given at Caltech on December 29, 1959. A nanoparticle is a microscopic particle whose size is measured in nanometres ($1\text{nm}=10^{-9}\text{m}$). The National Nanotechnology Initiative was established by the in 2004 to considerably expand research and development of nanosciences and technologies.

WHAT IS NANOTECHNOLOGY?

Nanotechnology, shortened to "nanotech", is the study of the controlling of matter on an atomic and molecular scale. Generally nanotechnology

deals with structures of the size 100 nanometers or smaller in at least one dimension, and involves developing materials or devices of that size. Nanotechnology is very diverse, ranging from extensions of conventional device physics to completely new approaches, based upon molecular self-assembly. Nanotechnology is the design, characterization, production and application of structures, devices and systems by controlling shape and size at the nanoscale.

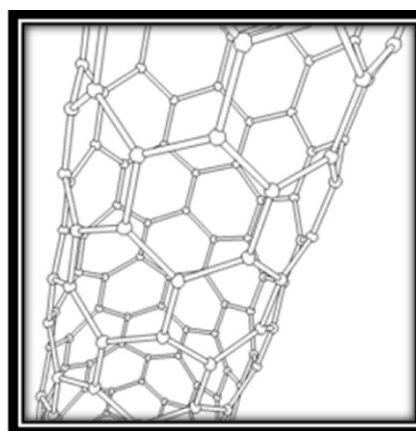


Fig.1. This animated sliding carbon nanotube showcases its 3D structure

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Nanotechnology has been defined by the U. S. National Nanotechnology Initiative (NNI) as “understanding and control of matter at dimensions of roughly 1 to 100 nm where unique phenomena enable novel applications”. More elaborately, it may be defined as “the study, design, creation, synthesis, manipulation and application of functional materials, devices, and systems through control of matter at the nanometer scale (1-100 nanometers, one nanometer being equal to 1×10^{-9} of a meter), that is, 10^{-9} at the atomic and molecular levels, and the exploitation of novel phenomena and properties of matter at that scale⁹. Several applications of nanotechnology for aquaculture production are being developed. With a strong history of adopting new technologies, the highly integrated fish farming industry may be among the best to incorporate and commercialise nanotech products.

BRANCHES OF NANOTECHNOLOGY

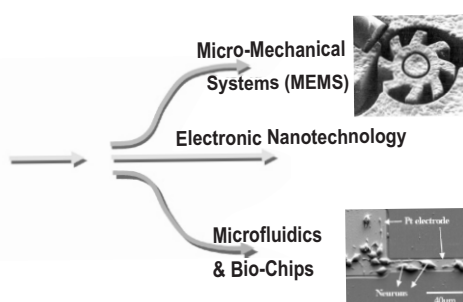


Fig.2. Branches of Nanotechnology

1. Micromechanical Systems (MEMS)

MEMS are small integrated devices or systems that combine electrical and mechanical components. MEMS extend the fabrication techniques developed for the integrated circuit industry to add mechanical elements such as beams, gears, diaphragms and springs to devices. viz. Inkjet – printer cartridges, accelerometers, inertial sensors, etc.

2. Electronic nanotechnology

Nanoelectronics refers to the use of nanotechnology in electronic components. The term covers a diverse set of devices and materials with the common characteristics. Some of these candidates

includes hybrid molecular/ semiconductor electronics, one dimensional nanotubes/ nanowires, or advanced molecular electronics.

3. Microfluidics & Biochips

Microfluidics based biochips are soon expected to revolutionize clinical diagnosis, DNA sequencing and other laboratory procedures involving molecular biology.

Microfluidics is a multidisciplinary field intersecting engineering, physics, chemistry, biochemistry, nanotechnology and biotechnology with practical applications to the design of systems in which small volumes of fluids will be handled.

Biochips are essentially miniaturized laboratories in molecular biology that can perform 100s or 1000s of simultaneous biochemical reactions.

GENERATIONS OF NANOTECHNOLOGY

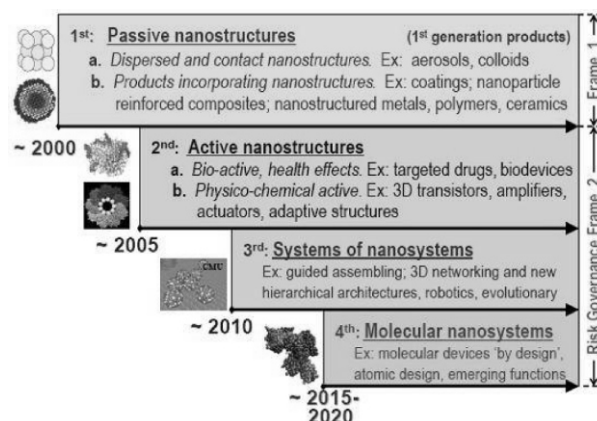


Fig.3. Generations of Nanotechnology

APPROACHES OF NANOTECHNOLOGY

Bottom-up approaches:

These seek to arrange smaller components into more complex assemblies. DNA Nanotechnology utilizes the specificity of Watson-Crick base pairing to construct well-defined structures out of DNA and other nucleic acids. More generally, molecular self-assembly seeks to use concepts of supramolecular chemistry and molecular recognition in particular, to cause single-molecule components to automatically arrange themselves into some useful conformation.

Biomimetic approaches

Bionics or biomimicry seeks to apply biological methods and systems found in nature, to the study and design of engineering systems and modern technology. Biomineralization (Fig.4) is one example of the systems studied.



Fig.4. Biomineralization

Top-down approaches

These seek to create smaller devices by using larger ones to direct their assembly. Many technologies descended from conventional solid-state silicon methods for fabricating microprocessors are now capable of creating features smaller than 100 nm, falling under the definition of nanotechnology. Solid-state techniques can also be used to create devices known as nanoelectromechanical systems or NEMS, which are related to microelectromechanical systems (MEMS). Atomic force microscope tips can be used as a nanoscale "write head" to deposit a chemical on a surface in a desired pattern in a process called dip pen nanolithography (Fig.5).

Functional approaches

These seek to develop components of a desired functionality without regard to how they might be assembled. Molecular electronics seeks to develop molecules with useful electronic properties. These could then be used as single-molecule components in a nanoelectronic device. Synthetic chemical methods can also be used to create synthetic molecular motors, such as in a so-called nanocar (Fig.6).



Fig.5. Dip pen nanolithography

Speculative approaches

These subfields seek to anticipate what inventions nanotechnology might yield, or attempt to propose an agenda along which inquiry might progress. These often take a big-picture view of nanotechnology (Fig.7), with more emphasis on its



Fig.6. Synthetic molecular motors

societal implications than the details of how such inventions could actually be created.

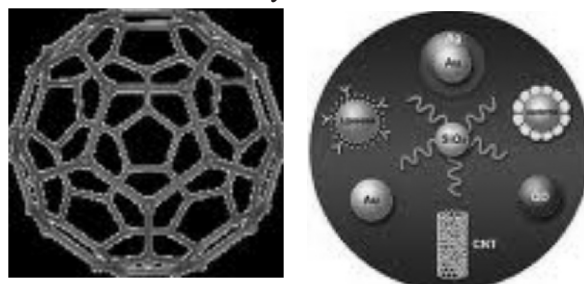


Fig.7. Development of nanotechnology products.

APPLICATIONS IN FISHERIES

DNA NANO-VACCINES USING NANO-CAPSULES AND ULTRASOUND

The USDA is completing trials on a system for mass vaccination of fish using ultrasound. Nano capsules containing short strands of DNA are added to a fishpond where they are absorbed into the cells of the fish. Ultrasound is then used to rupture the capsules, releasing the DNA and eliciting an immune response from the fish. This technology has so far been tested on rainbow trout.

DNA nano-vaccines

Outbreak of disease is one of the major stumbling blocks in the development and sustainability of aquaculture. A number of approaches have been made to solve disease problem in aquaculture, one among these is vaccination. The use of oil emulsion as adjuvant in this effort is however a drawback as some fishes and shellfishes show unacceptable levels of side effects. Use of nanoparticle carriers like chitosan and poly-lactide-co-glycolide acid (PLGA) of vaccine antigens together with mild inflammatory inducers may give a high level of protection to fishes and shellfishes against bacterial and certain viral diseases⁶. Further, the mass vaccination of fish can be done using nanocapsules containing nano-particles which are resistant to digestion and degradation. These nanocapsules contain short strand DNA which when applied to water are absorbed into fish cells. Ultrasound is applied to break the capsules which in turn release the DNA eliciting an immune response in fish. Similarly, oral administration of these vaccines and site-specific release of the active agent during vaccination will reduce the cost and effort of disease management, application of drug and vaccine delivery etc., as well as cost of feeding leading to sustainable aquaculture. Briefly nanoparticles are used as oral drug carriers for several benefits:

- | Improvement in the bioavailability of drugs with poor absorption characteristics².
- | Prolongation in the residence time and digestive stabilization of drugs in intestine.

- | High dispersion at molecular level and consequently efficient absorption.
- | Delivery of vaccine antigens to gut-associated lymphoid tissue⁵ and
- | Controlled release of drugs¹.

Gene delivery

The development of new carrier systems for gene delivery represents an enabling technology for treating many genetic disorders. However, a critical deficiency to successful gene therapy remains the formulation of an efficient and safe delivery vehicle. Non-viral delivery systems have been increasingly proposed as alternatives to viral vectors owing to their safety, stability and scope to be produced in large quantities¹⁰. Some approaches employ DNA complexes containing lipid, protein, peptide or polymeric carriers, as well as ligands capable of targeting DNA complexes to cell-surface receptors on the target cells and ligands for directing the intracellular traffic of DNA to the nucleus. Promising results were reported in the formation of complexes between chitosan and DNA⁸. Although chitosan increases transformation efficiency, the addition of appropriate ligands to the DNA-chitosan complex seems to achieve a more efficient gene delivery via receptor-mediated endocytosis. These results suggest that chitosan has comparable efficacy without toxicity associated with other synthetic vectors and therefore, can be an effective gene-delivery vehicle *in vivo*.

Smart Drug Delivery

Today, antibiotics, probiotics and pharmaceuticals / nutraceuticals are delivered through feed or injection either as preventive treatment or when symptoms are evident. Nanoscale devices may have the capability to detect and treat infection and health problems. With the help of smart delivery system that poses multifunctional characteristics such as pre-programming time control, monitoring the effect of the delivery of probiotics, hormones, chemicals and vaccines is possible.

USING IRON NANOPARTICLES TO SPEED UP THE GROWTH OF FISH

Scientists from the Russian Academy of Sciences have reported that young carp and sturgeon exhibited a faster rate of growth (30% and 24% respectively) when they were fed nanoparticles of iron (Fig.8). Research had demonstrated that different Selenium supplements (nano-Se and selenomethionine) in basal diet could improve the final weight, relative weight which gain rate, antioxidant status as well as Glutathione Peroxidase(GSH-Px) activities and muscle Se concentration of crucian carp (*Carassius auratus*

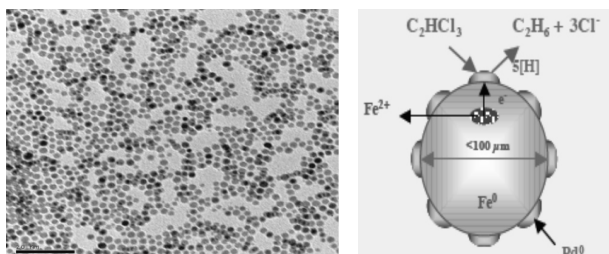


Fig.8. Iron nanoparticles to speed up the growth of fish.

gibelio). Moreover, nano-Se appeared to be more effective than organic selenomethionine in increasing muscle selenium content¹¹. Similarly, the growth and performance of the experimental fishes have been assessed higher with nano-level delivery of these nutraceuticals.

Nanodelivery of Nutraceuticals

Use of nutraceuticals for health management, value addition and stress mitigation in fish and shellfish is an emerging area of aquaculture research. In spite of their low requirement, incorporation of nutraceuticals involves higher cost. Thus, it needs to be used in such a way that wastage is minimised for efficient utilisation and the final product is economically viable. Development of nanodelivery system for these kinds of molecules may address the problems of their application in aquaculture practices at commercial level. There is an immense opportunity to use the nanoparticles to deliver nutraceuticals in fish feed and neutrogenomics studies. Moreover, various nanoformulations help to maintain better consistency and taste of feed³.

Tagging and Nano-Barcoding

Radio frequency ID (Rfid) is a chip with a radio circuit incorporating nanoscale component with an identification code embedded in it. These tags can hold more information, scanned from a distance and embedded in the product to identify any object anywhere automatically. These tags may be used as a tracking device as well as a device to monitor the metabolism, swimming pattern and feeding behaviour of fish. A nano-barcode is a monitoring device consisting of metallic stripes containing nanoparticles where variations in the striping provide the method of encoding information. By incorporating the nano-barcoding, processing industry and exporters can monitor the source or track the delivery status of their aqua product until it reaches the market. Further, coupled with nanosensors and synthetic DNA tagged with colour coded probes, nano-barcode device could detect pathogens and monitor temperature change, leakage etc., thus improving the product quality.

Nanotechnology devices for Aquatic Environment Management

Nevada-based Altair Nanotechnologies has made a water-cleaning product called NanoCheck for swimming pools and fishponds. It uses 40 nm particles of a lanthanum-based compound which absorbs phosphates from the water and prevents growth of algae. NanoCheck is currently undergoing large-scale testing in swimming pools and Altair had launched a swimming pool cleaner in early 2005. Altair is hoping for use of NanoCheck in thousands of commercial fish farms worldwide where algae and heavy metal removal and prevention are costly at present. According to Altair, the company plans to expand its test to confirm its effect on fish, and impacts of nanoparticles-laden run-off on human health or on the environment. Besides, nanoscale delivery of weedicides and soil-wetting agents may be very useful for aquatic weed control in large water bodies, and mitigation of stress due to climate change and aquatic pollution.

Harvest and Post-Harvest Technology

To catch fish, fishing lures are painted to reflect light to attract the attention of fish. However, these conventional lures reflect light only in one direction. To overcome this problem, the surface of the lure is colored and then nano-coated with a polyimide film which enhances the chance of catching fish by 2 to 3 times, compared to a lure without a polyimide coating.

DEGRADATION OF ANTIBIOTICS

Antibiotics are a class of pharmaceuticals engineered to kill pathogenic bacteria and are heavily used in aquaculture. The catfish industry is one of the largest of these industries in the U.S., and utilizes antibiotics extensively. To degrade these antibiotics we can use nanotechnology. Nanoparticles can degrade these antibiotics by producing reactive oxygen species (ROS).

OTHER APPLICATIONS

This technology of using flow cytometry to sort egg and sperm for sex selection. In advanced techniques a micro fluidic device that not only sorts sperm and eggs but also brings them together in a way that imitate natural reproduction. Such a technique also makes mass production of embryos cheap and reliable.

Similar applications of nanotechnology can be used to decontaminate soils and ground water by using iron particles that help break down dioxins and PCBs into less toxic carbon compounds. They also can help remove arsenic from drinking water, a problem that faced by many countries.

The possible areas where Nanotechnology could be applied include:

- i) production of more effective fish feed for aquaculture species
- ii) improving the physical, chemical and nutritional quality of feed and their respective ingredients by application of Nanotechnology in the different steps of their manufacturing,
- iii) new materials in the different aspects of fisheries and aquaculture like antifouling in fishing and aquaculture nets, antibacterial

substances for aquaculture tanks and new packaging materials for seafood products transports, new devices for detection of shelf life of sea products, etc. and,

- iv) scheme of polyelectrolyte multilayer capsule preparation applying the Layer-by-Layer technique, the base of the INTEL Feed concept (Fig.9). INTEL Feed is a concept where the physical and nutritional properties of a fish feed are controlled.

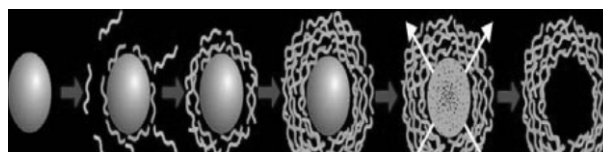


Fig.9. Layer-by-Layer technique, the base of the INTEL Feed concept.

NEGATIVE EFFECTS OF NANOTECHNOLOGY:

The greater chemical reactivity of nanomaterials results in increased production of reactive oxygen species (ROS), including free radicals. ROS and free radical production is one of the primary mechanisms of nanoparticle toxicity; It may result in oxidative stress, inflammation, and consequent damage to proteins, membranes and DNA. Studies demonstrate the potential for nanomaterials to cause DNA mutation and induce major structural damage to mitochondria, even resulting in cell death. Silver nanoparticles, which are bacteriostatic, may then destroy beneficial bacteria which are important for breaking down organic matter in waste treatment plants or farms.

CONCLUSION

Nanotechnology has a great future and it is applicable in fisheries sector. Although the application of nanotechnology is still at a very early stage in aquaculture, it may have the potential to solve most of the problems in aquaculture and fisheries with better technical innovation at different levels. In India, Central Institute of Fisheries Education has initiated research on the application of nanotechnology in aquaculture and fisheries.

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PREVENTIVE AYURVEDA: PRESERVING HEALTH NATURALLY AND SCIENTIFICALLY

Deepty Nair

With the advancement of science and technology, the gateways of lifestyle diseases have opened. The adoption of non-judicious lifestyle is the main threat to the human health these days. According to Ayurveda, which focus primarily on promotion of health and secondarily on disease cure, the majority of the diseases afflicting upon the human body are preventable. Ayurveda highlights the importance of adopting a healthy lifestyle including the dietary and practices plays a great role in promoting health thereby preventing diseases.

INTRODUCTION

With the advancement in science and technology, man has established his victory over the communicable or infectious health problems. However, the same science and technology has opened the gateway of many diseases into the human society. The adoption of unhealthy lifestyle as a result of dependence, rather surrendering, to the mechanical era has been posing serious health challenges to man as evident from the increasing incidence of lifestyle diseases in the past years. The worst part of this is that such a lifestyle affects not only the individual alone rather it runs a high risk of creating a generation with increased vulnerability to such diseases. Thus, it is the need of the hour to shift to a judiciously planned lifestyle practices.

The global acceptance of Ayurveda as a medical science has been increasing tremendously during the past decade. However, the miraculous power of Ayurveda has not yet been fully explored. Ayurveda was penned down nearly 5000 years ago. The ancient sages had crafted this life science (Ayur: lifespan; Veda: science) with two basic aims. The primary aims they identified were to promote the health of a healthy individual and to cure the diseases inflicting upon the diseased¹. Thus, Ayurveda was formulated with an equally powerful armory of

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preventive as well as curative care. The curative aspect of Ayurveda has been gaining momentum constantly however the preventive face is still not completely unveiled.

DEFINING HEALTH AND DISEASE

The theory of Ayurveda revolves around the three humours (*tridoshas* viz. *Vata*, *Pitta* and *Kapha*), the seven bodily tissues (*sapta dhatus* viz. *rasa*-lymph, *rakta*-blood, *mamsa*-muscle, *medas*-adipose, *asthi*-bone, *majja*-bone marrow, *sukra*-sperm/ovum) and the metabolic wastes (*trimalas* viz. *mutra*- urine, *pureesha*-fecal matter and *sweda*-sweat). All these have specific physiological functions in the body which is ultimately governed by the digestive moiety (*agni*) in the body². A state of equilibrium of the humours ensures normal digestive and metabolic activities which in turn support the nourishment and function of the tissues and metabolic wastes, and vice-versa, thereby maintaining the homeostasis in the body. This is known as the state of positive health³. A variation in the equilibrium of these factors leads to physiological imbalance which manifests as disease.

The parameters to assess this positive health have been laid down as⁴:

- 1 Desire to have food (*Annaabhilaasha*)
- 1 Effective digestion of the ingested food (*Bhuktasya sukhenaparipaaka*)

- | Appropriate elimination of the bodily wastes like feces, urine, flatus (*Srushtha vit, mutra, vata*)
- | Lightness of the body (*Sareera laghavam*)
- | Adequate functioning of the sense organs (*suprasanna indriyatvam*)
- | Timely sleep and awakening (*Sukha swapna prabodhanam*)
- | Maintenance of body strength, complexion, longevity (*Bala varna ayu labha*)
- | Peaceful mental disposition (*Saumanasyam*)
- | Appropriate functioning of digestion and metabolism (*Samaagnita*)

However, minute variations are taking place even on a diurnal and seasonal basis which if effectively balanced promotes the state of health and prevents the diseases⁵. However, a morbid vitiation of either of these can produce grave diseases. The diseases thus manifesting has been accommodated under seven broad headings in Ayurveda⁶:

1. Hereditary (*sahaja*) : due to impurity of the sperm and ovum during fertilization
2. Congenital (*garbhaja*): due to faulty dietary practices and inadequate care during gestation
3. Acquired (*jaataja*): due to adopting faulty lifestyle practices
4. Traumatic (*peedakrita*): due to external traumatic factors either physical or mental
5. Seasonal (*kaalaja*): due to the seasonal influence
6. Providential (*prabhavaja*) : due to the wrath of forefathers, god, teacher etc
7. Natural (*swabhavaja*) : natural conditions like hunger, thirst, old age etc

Among these the natural diseases are beyond human control, though old age can be delayed. Traumatic type can partially be prevented while the remaining five categories can be effectively prevented by adhering to the advices of Ayurveda.

The first category, i.e., hereditary diseases can be prevented by ensuring the fertilization of the best quality sperm and ovum. This can be achieved

through an effective and planned pre-conceptual care which includes diet, drugs as well as certain therapeutic measures as and when required. In the present era where infertility rates are scorching high and a drastic hike in the gynecological health issues is being reported this preventive aspect of Ayurveda has a lot to contribute.

Congenital anomalies results from the negligence in gestational care. Ayurveda upholds the importance of the care of expectant mother. The month wise development of the foetus in the womb along with the corresponding changes in the mother has been beautifully laid down in the Ayurveda literature. Based on this, month wise care of the pregnant lady has been scheduled to ensure a safe gestation and delivery. This schedule includes diet and drugs which promote the health of the mother as well as the growing foetus.

Acquired diseases form the most alarming category of the diseases today. Popularly known as Lifestyle disorders these results from the injudicious practices related to diet, sleep and physical activities. The alarming increase in the incidence of Diabetes Mellitus, Hypertension, Cardio Vascular disorders etc points to this fact. Ayurveda has advocated certain daily regimens which if followed regularly prevents the morbid accumulation of the humours in the body which may occur as a result of diurnal variations in their status. This includes therapies like application of collyrium (*anjana*), instillation of nasal medication (*nasya*), gargling (*gandoosha*), oil massage (*abhyanga*), powder massage (*udwarthana*), and exercise (*vyayama*). Special instructions have been laid down regarding the time of sleep and arousal. Similarly guidelines have been mentioned regarding bath⁷. Also the time and quantity of food intake, nature of food, processing of food, healthy combinations in food, place of cultivation and consumption of food products, regimes regarding how, when and where to consume the food has been beautifully laid down in the literature⁸. By following these practices as advised the morbid accumulation of the humours can be effectively prevented in day to day life thereby

minimizing the susceptibility for diseases.

Seasonal diseases manifest due to the seasonal variations in the status of the three humours in the environment producing a corresponding imbalance in the human body.

	VATA	PITTA	KAPHA
Increase	Summer	Monsoon	Late winter
Morbid increase	Monsoon	Autumn	Spring
Normalcy	Autumn	Early winters	Summer

To prevent such seasonal disorders Ayurveda has described in detail the regimes to be followed during each season including the diet, activities, sleep and therapeutic measures. This also includes the concept of seasonal purification which includes therapies to purify the morbid humours from the body thereby restoring the homeostasis⁹.

Thus preventive Ayurveda has a rich storehouse of resources which can maintain the physiological homeostasis thereby preventing the physical diseases. Besides, Ayurveda has also suggested the moral codes and conducts (*Sadvruttam*) to be followed by individuals which can help in preventing the mental afflictions and diseases arising out of the wrath and curse of the forefathers, teachers and the God ensuring a psychological and social well being.

Further, another unique contribution of Ayurveda is the concept of body constitution i.e., *Prakruthi*. *Prakruthi* is the outcome of the permutations and combinations of the three basic humours taking place at the time of fertilization of the ovum and sperm for the formation of an embryo based on the predominance of *doshas* in the combining sperm and ovum, *dosha* predominance considering the season at the time of fertilization, *dosha* predominance in the uterus, based on the diet and regimens of the mother¹⁰. This *prakruthi* determines the status of health as well as vulnerability to diseases. As a general rule, *prakruthi* having all the three humours in equal proportion is the best while the predominance of single or two

humours is believed to be having increased susceptibility to diseases. For example, a *prakruthi* predominant in *Vata* will be more vulnerable to joint pains, in *Pitta* to bleeding disorders and *kapha* to diseases like obesity, asthma etc. To prevent such diseases an individual should adopt a lifestyle appropriate to one's *prakruthi* with due respect to diurnal and seasonal regimes, dietary practices, exercise and sleep.

CLINICAL APPLICATION: FORMULATING A PREVENTIVE LIFESTYLE

Step 1: Assessing the *prakruthi* of the individual

Step 2: Formulating the daily regimen including with appropriate therapies with suitable drugs

Step 3: Planning the diet.

Step 4: Planning seasonal regimen

A Model Life Style Chart

	VATA-PITTA	PITTA-KAPHA	VATA-KAPHA
COLLYRIUM	<i>Chandanadi varthi</i>	<i>Chandanadi varthi</i>	<i>Elaneer kuzhambu</i>
NASAL DROPS	<i>Ksheerabala tailam</i>	<i>Anutailam</i>	<i>Tila tailam</i> (sesame oil)
GARGLING	Milk	Triphala decoction	Honey water
OIL MASSAGE	Regularly	Once in a week	
BATH	Lukewarm water processed with gooseberry (<i>Amalaki churnam</i>)	Cold water with drugs like sandal (<i>Candana -usheera churnam</i>)	Hot water (Triphala churnam)
SEASONAL PURIFICATION		Purgation in autumn	Emesis in spring
DIET	Food predominant in Sweet taste and cold potency	Sweet, bitter, astringent tastes, dry foods	Sweet taste, dry foods
SLEEP	6-8 hours, day sleep advisable	6 hours, strictly avoid day sleep	
EXERCISE	Light exercises, yoga	Moderate exercise	Daily exercise

GENERAL DIETARY INSTRUCTIONS

This should be followed to ensure an effective digestion and metabolism of the ingested food.

- | Food should be taken only when demanded by the body; hunger is the sign of body's demand which manifests only after the previously eaten meal is completely digested.
- | Food should never be had to full satiety; its healthy to have food ½ to one's capacity along with half part of fluids which will help in digestion, leaving a quarter of the stomach vacant.
- | Bath should mandatorily be before food as it promotes appetite and digestion; if in case it is to be taken after food minimum 45-50 min time gap should be maintained.
- | Avoid sedentary practices immediately after food; it is healthy to have a 15-20 min stroll after having food before you occupy your comfortable seat.
- | Food-sleep gap should not be less than 2 hours.
- | Concentrate on the food and accept it with due respect; avoid indulging in other activities while having food.
- | Satisfy the natural urges like micturition and defecation, if any, prior to having food.

CONCLUSION

Adopting a healthy lifestyle can help prevent diseases thereby improving the efficiency and productivity of the individual and the nation respectively. Further, the status of health of an individual defines the health of his progeny. Thus, adopting the regimens advised by Ayurveda, which are convenient and cost-effective can an effective health promotion.

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HAPLOID PLANT PRODUCTION THROUGH MICROSPORE CULTURE

Mohammad Danish and Hisamuddin

Angiosperms, the flowering and fruit bearing plants, are the most diverse and economically important land plants with about 350,000 species. These are the source of all plant-based materials like food, fiber, medicines, ornamentals, etc. *In vitro* culture of haploid plants provides an opportunity to shorten the breeding cycle time period and to fix certain desirable traits in their homozygous states, such as recessive genes for disease resistance and dominant genes for yield and so on. The most desirable plants raised through haploid culture are the dihaploid variants of all the major economically important crops like barley, cotton, coffee, maize, rice, rape, sunflower, wheat which are being utilized in modern crop breeding programmes. Androgenesis provides the most commonly used method for dihaploid production which can be applied in crop improvement.

MICROSPORE CULTURE

A large number of improved dihaploid cultivars have been reported with several superior agronomic characteristics. Haberlandt (1902) tried to obtain monocotyledonous plants by culturing their tissues, but he failed in his effort¹. Guha and Maheswari (1964) were the first to develop haploid plants through anther culture technique². In androgenesis, the principle involved is to induce the microspores to develop into haploid plants in which microspores can be switched over from their normal pollen development towards an embryogenic pathway. *In vitro* androgenesis leads to the formation of haploid plants either via somatic embryogenesis or callus formation. Androgenic development can be divided into three main characteristic phases: acquisition of embryogenic potential, initiation of cell divisions, and pattern formation³. Some examples of plants in which, haploidy is used for breeding purposes are cereal crops, fibre crops, Forages, and others: canola, tobacco, sunflower. Out of several methods of obtaining haploid and dihaploid, microspore culture is the most effective and widely used method⁴.

Microspores, normally destined to become

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male gametophytes, start growing in a saprophytic manner on nutrient media. After a successful experimental haploid production from anther culture of *Datura* several economically important species were cultured to develop haploid and dihaploid plants⁵. The plants obtained through pollen androgenesis exhibit different ploidy levels even in the absence of colchicine. The frequency of becoming diploids from haploids varies from crop to crop. Highest rate of diploidy incidence, up to 87%, has been reported in barley⁶ followed by rice, up to 72%⁷. Li et al (2013) screened 47 carrot accession and obtained haploid calli and embryos. When the plants were regenerated from calli or embryo, spontaneous diploidization exhibited wide difference among the lines and accessions⁸.

Exposure of plants to low temperatures before flowering increases the frequency of development of embryogenic pollen grains. It is also possible that determination of the microspores into androgenic (gametophytic) or embryogenic (sporophytic) pollen grains is a function of differential gene activity. The most suitable stage for androgenesis is the uninucleate stage, soon after microsporogenesis. In most of the plants, uni- to mid-uninucleate stages of microspores are selected for androgenic response. In

the development of androgenic haploids, the microspores follow any of the four modes described. In the first mode, the microspores are divided equally into two identical daughter cells. Both the cells may contribute in the development of androgenic haploids e.g., *Datura innoxia*. In the second mode, cell division in the uninucleate microspores is unequal, resulting in the formation of one large vegetative cell and a small generative cell. Androgenic haploid arises in the vegetative cell while the generative cell is degenerated as in *Nicotiana tabacum*. The uninucleate pollen cell divides unequally, in the third mode, producing a large vegetative cell and a small generative cell. Only the generative cell takes part in the development of androgenic haploid, as in *Hyoscyamus niger*.

The uninucleate microspore divides unequally into a generative and a vegetative cell in the fourth mode. Both the cells continue to divide giving rise to an androgenic haploid as in *Datura metel*. In any of these methods the cell divisions lead to the formation of callus or the embryoids. Irrespective of the early pattern of microspore divisions, the embryogenic pollen grains ultimately become multicellular and burst open, gradually assuming the form of a globular embryo. This is followed by the normal stages of postglobular embryogeny until development of a plant.

POLLEN CULTURE PROTOCOL

Floral buds, usually of corolla length, are collected. In these buds the pollens are in bi-celled stage.

1. The buds may be given a chilling treatment before initiating the culture process.
2. The buds are sterilized with a suitable chemical (NaOCl or HgCl₂).
3. The buds are rinsed 3-4 times with DDW in a sterile air cabinet.
4. Anthers are excised from the floral buds and collected in a sterile beaker containing liquid medium.
5. Anthers are pressed with a glass rod to allow the microspores squeeze out.
6. The suspension having anthers and microspores is filtered through a nylon sieve, which allows only the microspores to pass through.
7. The filtrate is centrifuged thrice, for 5 minutes each time, at 500-800 rpm.
8. After removing the debris, the suspension is layered onto a sucrose solution (30% or 55% percoll and 4% sucrose) and centrifuged at 1200 rpm for 5 minutes.
9. The pellet is re-suspended in fresh medium each time.
10. The microspores are inoculated onto a solid or in a liquid medium maintained at 25°C and 16:8 hr photoperiod.
11. The pollens with embryogenic potential form a band at the top of the sucrose solution while non embryogenic pollens settle to the bottom.
12. The upper band, containing embryogenic pollens, is pipetted out and suspended in the washing medium, centrifuged again, and the supernatant removed.
13. The pellet containing pollen grains is resuspended in the culture medium.
14. Such a pollen suspension gives a better response than control in terms of induction of cell division and continued growth of the callus.
15. The microspores may develop directly into embryoids within 15 days.
16. In microspore culture, spontaneous doubled haploids (SDH) are also obtained.
17. Since spontaneous dihaploids are naturally available therefore colchicine treatment is not needed.
18. Efforts are being made to increase the frequency of SDH, so that these can be multiplied and directly field tested.
19. Sometimes the nurse culture technique is used for raising haploid tissue clones from isolated pollen grains.

POLLEN DONOR

The two important factors that determine androgenesis are the type of the plant and its genotype, which influence the time of microsporogenesis and the amount of microspores produced. In most of the cultures, anther wall supports pollen embryo development due to endogenous occurrence of glutamine and serine, in relatively higher amounts. It has been found that microspores are immediately induced to give rise to pollen embryoids within anther wall. Optimum growth conditions of controlled light, temperature, and humidity enable the plants in maintaining healthy growth. The success rate of obtaining disease and pest free cereal plants through androgenesis is quite high.

CULTURE TECHNIQUES

In some of the cases pretreatments like exposure to low or high temperature, low sugar level in the medium, starvation and osmotic stress, combination of heat shock and starvation, and exposure to colchicines, auxin or gamma radiation are required for initiation of androgenesis. The culture medium not only provides nutrients but also commands the pathway of further development. The most commonly used media are N6 and MS^{9,10}. Modifications in the composition of nutrient media may induce the microspores to develop into gametophyte, callus or embryoids. It has been found that androgenesis can be induced, or maintained and sustained by balancing pH and concentration of the nutrients. In *Brassica nigra*, a recalcitrant species for microspore culture, it was found that 2.0 to 2.5 mm bud size was optimum for obtaining the highest proportion of totipotent and highest frequency of microspore embryogenesis¹¹. Borage (*Borage officinalis*), a medicinal plant, was for the first time tested for haploid production from microspore. It was found that 5-7 mm long flower buds when given cold treatment for 4 drop, heat shock for 3 days and placed in a medium containing 3% maltose, 2 mg/l-1 2,4-D and 1 mg/l-1 BAP, produced haploid embryos through microspore culture¹².

There are four different methods of culturing microspores in the culture medium, (i) an inflorescence with flowers having uninucleate microspores in anthers, are placed onto the medium; (ii) anthers containing uninucleate microspores are excised from the flowers and placed onto the culture medium; (iii) isolation of microspores from anthers and culturing their protoplasts on the solid media; and (iv) only anthers are placed on the surface of the agar medium.

HAPLOID DIVERSITY

The production of double haploids via androgenesis presents a powerful technique both for the production of hybrid seeds and the evaluation of genetic diversity. Though androgenesis is a naturally occurring process in some species, the *in vivo* frequency is very low¹³. Efficient androgenesis is usually induced by the application of a stress treatment to whole plants *in vivo* or tillers, buds, anthers, and isolated microspores *in vitro*¹⁴. *In vitro* embryogenesis systems by androgenesis are excellent model systems to study the developmental aspects of embryogenesis induction and embryo formation from haploid microspores. Microspores embryogenesis through anther culture in almond (*Prunus dulcis*) was performed¹⁵. As shown by several experiments, embryogenic development during androgenesis is divided into three main characteristic overlapping phases: in phase I, acquisition of embryogenic potential by stress involves repression of gametophytic development and leads to the dedifferentiation of the cells; in phase II, cell divisions lead to the formation of multicellular structures contained by the exine wall; in phase III, embryo-like structures are released out of the exine wall and pattern formation takes place.

ADVANTAGES OF HAPLOIDS

1. Haploid plant production, a naturally occurring process, can be achieved through androgenesis.
2. The technique of androgenesis is fairly simple.

3. The haploids carry only one allele of each gene.
4. Any recessive mutation or characteristic is immediately expressed.
5. The plants with lethal genes are eliminated from the gene pool.
6. Absolutely homozygous diploid and homozygous polyploid plants can be obtained.
7. The dihaploids have solved the problem of any residual heterozygosity.
8. Doubling can either occur spontaneously, or be triggered by adding colchicine.
9. The development of haploids via anther culture system requires pretreatments of cold or heat shock, or hormonal regimes.
10. It is easy to induce cell division in the immature pollen cells in some species.
11. A large proportion of anthers used in androgenesis respond in fairly high frequency.
12. Through androgenesis, haploids can be produced in large numbers very quickly.
13. Protoplast for culturing is available as isolation of protoplast from microspores is relatively easy.
14. Transformation of haploid protoplasts is less time taking.
15. *In vitro* anther culture is useful in improving vegetable and cereal crops.

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CHALLENGES, PROSPECTS AND ROADMAP FOR SUSTAINABLE NATURAL RESOURCE UTILIZATION AND LIVELIHOOD MANAGEMENT IN ARID REGIONS OF INDIA

Rashmi Sharma* and Tarun Kant**

Arid regions are primarily characterized by high temperature, high evapo-transpiration, extended dry spells, and low precipitation resulting in scarcity of water. The challenge in the area includes marginal land ownership, dependency of wage labour and scarcity of water, lack of rural infrastructure due to larger districts and outreach of various government initiatives to rural poor. The climate change phenomenon is slowly becoming all the more evident, and its presence is being felt globally. These changes are bound to worsen the already harsh and hostile arid zone conditions. Development in the dry lands depends on addressing degradation of the ecosystem, mainstreaming sustainable natural resources management and building upon the existing adaptive capacities of people and institutions. It is thus necessary to ensure economic access to food, have contingency crop/fodder/drinking water plans, crop stabilization and watershed development programs, community based natural resource management practice, organic farming to increase land productivity, revitalization of traditional crops and practices to ensure food security, and revitalization of traditional breeds of livestock. This article discusses the characteristics and challenges of the dry lands and offers recommendations for a cohesive and sustainable approach that can lead to development and prosperity in the region.

INTRODUCTION

THE CHARACTERISTICS OF DRY LANDS

Dry lands form an extremely fragile ecosystem and are invariably characterized by excessive heat and limited rainfall (usually less than 10 inches of average annual rainfall) and scarcity of water. Water is the essence of life, without it no biological component can exist in an ecological setup.

Petrov, in his book on deserts of the world describes aridity as condition that arises due to deficiency of rainy days and ground moisture¹. A more scientific explanation and classification of the term aridity is given by FAO – expressed as a function of rainfall and temperature². A Climatic Aridity Index (CAI) can be represented by the

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following formula:

$$CAI = p/ETP$$

Where, P=precipitation; ETP=potential evapo-transpiration (calculated using Penman equation³), taking into account atmospheric humidity, solar radiation, and wind.

Based on CAI, the arid zone can be categorized into three zones - hyper-arid, arid and semi-arid. Of the total global land area, the hyper-arid zone covers 4.2 percent, the arid zone 14.6 percent, and the semi arid zone 12.2 percent². Therefore, putting the three zones together, almost one-third of the total area of the world is arid land.

High temperature accompanied with moderately intense winds characterize dry lands. Another characteristic that is unique to arid region is large difference in day and night temperature. This temperature difference is an important cause of winds in arid regions. Summer peak temperature

may reach near 50°C while the night may remain around 20°C.

The soils of the arid zones are sandy in nature. Windy weather and large temperature changes result in quicker weathering of the rocks. The water holding capacity of such soils is poor. Due to poor vegetation, organic content is also poor in desert soils. Such a soil characteristic results in poor natural fertility of the soil. Due to high temperature, winds and lack of soil moisture, the sand often rises higher up in the atmosphere forming a sort of shield that reduces the intensity of the solar radiation bringing down the day temperature. This natural phenomenon is unique to deserts.

The vegetation of the arid regions is typically characterized by ephemeral annuals, thorny succulents and non-succulent perennials. Ephemeral grasses and herbs can appear after a spell of rain. The semi arid region usually has a mixture of grasses, herbs, and small, short trees and shrubs up to 2 meters in height and at a low density. Forest types include evergreen shrubs to dry deciduous forests.

THE INDIAN CONTEXT

The northern arid regions comprise largely of the desert of Rajasthan, the Rann of Kutch and the semi-arid regions of Punjab, Haryana and Gujarat. The semi-arid region is largely represented by Haryana in North and the states of Andhra Pradesh, Karnataka and Tamil Nadu in South India. About 80% of Indian desert, the 'Thar Desert' falls in two states viz. Rajasthan and Gujarat. The region is characterized by low and unevenly distributed precipitation, high rate of evapo-transpiration, extreme variations in temperature, high wind velocity, low water table, shifting dunes, poor vegetation and forest cover. Its population depends on rain fed agriculture and small animal husbandry that is adapted to extremely harsh weather condition. Extension of agricultural and pastoral activities into the marginal lands is resulting in land degradation, the declining productivity of crops and livestock, and a loss of biodiversity. Outgrowth of unwanted species due to selective and overgrazing is another problem rising in the area. The problem is most

extensive and severe in dry areas with low soil organic matter and soil nutrients. With a population of 107 million inhabitants, desert region of Rajasthan has forest area of about 3.33 million hectare with immense pressure for fuel and fodder. The severity of the problem can be imagined as out of 28.6 million ha area of Indian desert, 12.9 million ha area is wind erosion prone with removal and deposition of large quantities of soil during summer. Some districts of these areas do not have dense forest whereas wood accounts more than 85% of energy source in the region.

CHALLENGES OF ARID ZONE

Geographically, the state of Rajasthan is the largest in India and it makes up 61% of the total arid zone of country. It is primarily a rain fed agrarian state where 77% of the population lives in rural areas and 70% population earn living through agriculture. Despite harsh living conditions and number of challenges, it is uniquely beautiful and has proud history, it is a land which charms tourists across the world.

The challenge in the area includes marginal land ownership, dependency of wage labour and scarcity of water, lack of rural infrastructure due to larger districts and outreach of various government initiatives to rural poor. The state also suffers majorly due to lowest female literacy rate in the country (52.66%) and is the epicentre of child marriage and female foeticide according to 2011 Census⁴.

The livelihood of the rural folks who lack access to natural and other forms of capitals are challenged on many fronts: most important is food insecurity⁵. Food insecurity in most rural areas is associated with water scarcity for irrigation, degradation of cultivable land, loss of farm and off-farm jobs, indebtedness to local money lenders, social instability and price fluctuation of necessary commodities⁶. Rainfall patterns are unpredictable contributing to risk and uncertainties of agricultural production in semi-arid areas, and long-term temporal trends are weak or non-existent⁷. Along with the constraining biophysical conditions, access to different livelihood options is also constrained by

unequal power relations, conflicts and exclusion of some community groups such as women, small scale farming communities and livestock keepers⁸. However, to ensure food security, rural households depend on scarce natural resources as their means of coping against food shortage. This implies coping strategies against food insecurity are becoming increasingly crucial to most community members⁹. The lack of food security is a primary cause for migration of males from rural areas to cities due to gainful employment. The migratory activity doubles up the responsibility on women, to look after farm land in addition to managing family. Women are therefore forced to get involved in agricultural activities without any access to agriculture education. The urban areas are already overpopulated and with increasing influx of rural poor, the collapse of infrastructure is imminent.

LOOMING DANGERS OF CLIMATE CHANGE

With an economy closely tied to its natural-resource-base and climate-sensitive sectors such as agriculture, water, and forestry, India faces a major threat because of the projected changes in climate¹⁰. Recent reports of the IPCC have shown that the most vulnerable sectors to climate change are water and agriculture, both of which are necessary for improving livelihoods¹¹. Small changes in temperature and rainfall pattern will have tremendous effects on the quantity and quality of agricultural and horticultural productivity.

A study carried out by Indian Institute of Science¹² assessed the impact of projected climate change on forest ecosystems in India. The main conclusion is that, by the year 2085, between 68% and 77% of the forested grids in India are likely to experience shift in forest types depending upon projected climate change scenarios. India's forests are shifting towards drier condition, resulting in reduced biodiversity of its forests, and adversely affecting the hydrological cycle of the country. Indian Council of Forestry Research and Education (ICFRE), Dehradun constituted a task force in December 2011, having members from ICFRE, its

institutes/ research centres and State Forest Departments with a primary aim to revisit the forest type of India (originally classified for the first time in 1936 by Sir H.G. Champion and were later revised by Champion and Seth in 1968¹³) and assess the changes if any due to climatic and other factors. A new system of classification of India's forest type has been proposed by classifying India's forest in to 10 groups instead of 16; and 44 sub type groups instead of 221, as proposed earlier by Champion and Seth in 1968. Under this herculean exercise of revisiting Indian forest types, national level data for 1901-2009 analyzed which suggests that annual mean temperature for the country as a whole has risen by 0.56°C over the period. During the period 1931-60 and 1961-1990 there has been steady rise in the temperature in most of the regions ranging between 0.2 and 1.0°C. Of the 88 stations, for which the climate data was analyzed, 42 stations have shown reduction in the rainfall during the period 1961-1990 as compared to the previous thirty years with the variation ranging between 10 to 20% within the stations. The stations showing the reduced rainfall were found distributed throughout the country without having any specific geographic regional pattern. In this context, climate change impact on the vegetation was critically examined to see the species level responses to the changes in the rainfall and temperature regimes over the years. The results reveal that many forests are moving towards drier conditions, particularly the temperate forests which is a cause of concern¹⁴. These changes are bound to worsen the already harsh and hostile arid zone conditions.

DEPLETING BIODIVERSITY

The biodiversity range of the arid and semi-arid lands is known to be narrow. However, the species adapted in these adversities have developed adaptations to survive and thrive. But the climate change scenario is even confusing the evolutionary process. That with the pressures from human interventions and over-exploitation is leading to mass extinction of species. Some of the well established and endemic floras of the Great Indian

Desert, for example, *Commiphora wightii* (Guggal), *Tecomella undulate* (Rohida) are now threatened species in their own native habitat. The state tree of Rajasthan – 'Khejri' (*Prosopis cineraria*) is also passing through a phase of high mortality.

THE WAY FORWARD

Development in the dry lands depends on addressing degradation of the ecosystem, mainstreaming sustainable natural resources management and building upon the existing adaptive capacities of people and institutions. Climate change will further challenge the livelihoods of those living in these sensitive ecosystems and may result in higher levels of resource scarcity.

It is thus necessary to ensure economic access to food, have contingency crop/fodder/drinking water plans, crop stabilization and watershed development programs, community based natural resource management practice, organic farming to increase land productivity, revitalization of traditional crops and practices to ensure food security, and revitalization of traditional breeds of livestock.

Arid Agriculture and Agroforestry: In order to improve food security in arid regions, agricultural practices needs to focus upon desert agriculture and desert agroforestry as their mainstream agricultural technique. Arid agriculture is the farming of crops well-suited for arid conditions. Arid agroforestry is the growing of crops with environmental support of trees in desert or arid areas. Research institutions in the arid regions of India like Arid Forest Research Institute (AFRI), Jodhpur, Central Arid Zone Research Institute (CAZRI), Jodhpur, and Rajasthan Agriculture University (RAU), Bikaner have been working towards providing strategies for a sustainable agriculture and agroforestry based models for the farmers to take up.

Agroforestry systems are now recognized and have become prevalent in the hot arid region for the ecological and socioeconomic benefits including products for household and national economics like food, fodder and medicine. Trees integrated extensively in the crop and livestock production

systems are *Prosopis cineraria*, *Tecomella undulata*, *Acacia nilotica*, *Acacia tortilis* and *Ailanthus excelsa*. Trees in agroforestry systems use water from soil that shallower plant roots cannot access.

Prosopis cineraria based agro forestry for hot arid region of Gujarat and Rajasthan has been developed at AFRI, Jodhpur. The density of *P. cineraria* ranges from 3 trees ha⁻¹ in north-western to more than 80 trees/ha in northeastern part of Indian desert. However, a density of *P. cineraria* trees > 150/ha has also been observed in some cultivated fields in the Indian Thar desert. But considering an average of only 1.27% forest cover in the arid region of western Rajasthan, tree cover must be increased on agricultural fields. Growing trees at higher densities would be the best option to increase overall productivity of the farmland and to fulfil the increasing demand for fodder and fuel wood as a consequence of increasing population. Selection of tree species suitable for integration in agriculture land is more important and *P. cineraria* is one of the best species for this purpose. Further, *P. cineraria* is protected and maintained on farmer's field for ages because of its multipurpose uses, soil fertility enhancing ability and symbiotic effect on the associated agriculture crop^{15,16,17}. In addition to increased agriculture production at optimum density *P. cineraria* provides utilizable biomass of 19.96 tones/ha including leaf fodder of 0.85 tones/ha per year at 12 year age. Legumes are more suitable than *Penisetum glaucum* (pearl millet). Pearl millet was



Fig.1: *Prosopis cineraria* growing in a farmer's field.

found more competitive with tree than *V. radiata* (mung bean) as observed through reduced tree growth increment when pearl millet was the intercrop. Yield of agricultural crop increased when density of *P. cineraria* was appropriate (i.e., optimum tree density), which varied with tree size/age because of competition for soil resources. Agroforestry is more beneficial than sole agricultural crop in terms of carbon benefits also. *P. cineraria* is the best species and is less competitive with crop as compared to the other tree species (Fig. 1).

Pods of *P. cineraria* locally known as "sangan" or "sangri" are extremely rich source of Vitamin C, Ca and P as compared to commercially available fruits¹⁸. The tree has a lot of potential to be explored as a model system of diversifying income generation for local people. Apart from pods the leaves known as "loong" are rich source of protein and nutrition for the animals. The leaves are dried and stored for use in lean period. Stem bark is also known to have antibacterial property. Since the branches are loped for taking down the leaves the tree does not cast its shade and hence the agriculture can be done right until the base of the trunk. The wood of the tree is also termite resistant and has great commercial value.

Supporting the Pastoral economy: Successful integration of trees in pasture land has enhanced the productivity of degraded waste land thus addressing the issue related to livelihood and provided additional source of income to villagers. AFRI scientists have developed a silvipastoral approach for augmenting the fodder availability during lean seasons in arid regions. In the absence of favourable conditions for agriculture, livestock rearing is the alternative source of livelihood for majority of rural population in the arid zone. It has been observed that in the region every farm family keeps a herd of 15-20 animals, which sustains on crop residues and grazing on fallow lands. Agronomic researches have shown that under specific soil and climate conditions, planting of certain combination of crops and trees simultaneously and/or sequentially can increase efficiency in resource use. *Prosopis cineraria* (Khejri) and *Zizyphus spp.* (bordi) are two main

tree/shrub spp. of the arid region. Research trials with various tree grass combination were conducted. At Nagaur site, a silvi-pastoral trial was conducted with five fodder tree species (*Z. mauritiana*, *A. excelsa*, *Azadirachta indica*, *A. nilotica* and *D. nutans*) in combination with *C. ciliaris*, in August 1996 at a spacing of 5m x 5m in frost prone area of western Rajasthan, a part of the hot arid region of India. At Pali site four species of tree/shrubs (*Z. mauritiana*, *A. excelsa*, *P. cineraria* and *D. nutans*) were planted in August 1996 at a spacing of 5m x 5m along with improved variety of *C. ciliaris*-358 from CAZRI, Jodhpur in Pali district. And at Bhuj site the experimental trial with *C. ciliaris* (sown at low seed rate, 4 kg/ha) in combination with four tree species namely *Cordia gharaf*, *P. cineraria*, *Z. mauritiana* and *Colophospermum mopane*, was laid in RBD at a spacing of 6m x 4 m in July 2006. Out of seven species tried *Z. mauritiana* maintained more than 90% survival on all the three sites after 42 months, followed by *P. cineraria* 96.2% indicating its adaptability to all types of climate. *A. excelsa* recorded 96.6% at Pali but was 79% at Nagaur (frosty site). *C. gharaf* also maintained more than 90 % at Bhuj site. *D. nutans* and *C. mopane* performed poorly at Nagaur, Pali and Bhuj respectively^{19,20}. *Ailanthus excelsa*, *Acacia nilotica* and *Zizyphus mauritiana* gave highest yield over control. More than two tons per hectare grass yield seems to be better under this practice as compared to less than 0.5 ton/ha under normal conditions. Harvesting of these products for fuel wood and fodder may be beneficial in enhancing socioeconomic conditions of the local people¹⁹.

Integration of silvipastoral methodology for the improvement of socio-economic status of Raikas/Rewaris tribes in the western district of Rajasthan and Gujarat is desired. Traditionally these tribes are related with camel breeding activity and are currently engaged with herding sheep in migratory systems. Capacity building among the community in scientific methods of sheep rearing through development of individual/community grazing land and introduction of improved species intend towards

better quality of meat, generating higher economic returns through marketing linkages. Such interventions are successfully demonstrated by CSWRI, Avikanagar and needs to be replicated in the arid region. Technology package involving scientific means of sheep rearing developed by CSWRI, Avikanagar has been successfully demonstrated at two village sites Phalsund and Rataria through the support of Department of Science and Technology*. It involves construction of rain water harvesting structures to assure the availability water, plantation of fodder providing plants (Khejri, Kumat, Khari, Ber etc) using pitcher irrigation techniques to assure the availability of fodder and effective means to manage diseases in sheep through introduction of vaccination chart (Fig. 2). Silvopastoral interventions anticipate decreasing the migratory period and improving the socio-economic condition of the community.



Fig.2: Village level sheep vaccination camp organized by Shikshit Rojgar Kendra Prabandhak Samiti (SRKPS), Jhunjhunu (Rajasthan), India under DST funded project.

Rainwater harvesting: Rain water harvesting is one of the important technological interventions that alone can benefit the arid regions through increased water availability, increased grass production and increased fuel wood supply. It results in increased water availability, higher fodder production and an increased fuel wood supply.

Cultivation of medicinal plants: The medicinal & aromatic crops are economically important as they provide the basic raw material for pharmaceutical,

perfumery, flavor, soaps, cosmetic industries etc. throughout the world. Keeping in view the various end uses and economic importance of the medicinal, the work of silvicultural management practices are of greater relevance and impact, especially in enhancing rural economy. Such management practices should be given emphasis and the locals should be trained specifically on cultivation practices and management of medicinal plants of that region. National Medicinal Plant Board had identified 31 medicinal plants i.e. *Ashwagandha*, *Nim Giloy*, *Satavar*, *Senna*, *Safed Museli*, *Guggal*, *Mulheti*, *Isapgol* that grow well in the arid regions. Awareness regarding the medicinal and economic value of these plants will help in upliftment of the farmers of the region. There is a constant need to organize the medicinal plant cultivation sector for conservation of germplasm, protection of traditional knowledge and to maintain the fragile ecosystems of the deserts.

Management of salt-affected lands: Salt-affected soils are wide spread in arid and semi-arid regions where annual precipitation is insufficient to meet potential evapo-transpiration. Salt affected wastelands especially in the arid region are highly underutilized. Selection of appropriate salt tolerant plants, halophytes and planting methods can help rehabilitation of arid salty areas-that are characterized by low rainfall, high evapo-transpiration demands, highly saline ground waters and calcareous sub-soils. Salt tolerant plants found suitable for arid salty land mainly involves castor, pigeonpea, cotton, guar, sorghum and halophytes such as *Salvadora*, *Salicornia*, *Tamarix* and *Suaeda*. Appropriate technologies developed for the production of fodder, fuel, small timber, fruits and medicinal plants from the salt-affected wasteland is extremely useful for the farmers.

In the absence of favourable conditions for agriculture, livestock rearing is an alternative source of livelihood for majority of rural population in arid zone of Rajasthan. Work done on enhancing the productivity of degraded lands through silvipastoral systems is very useful for improving arid economy.

Acacia nilotica timber is already accepted and used by many wood industries in India. It has been evident from the work done at AFRI that wood of *A. tortilis* and *P. juliflora* with appropriate preservative treatment and seasoning can substitute the traditionally used wood²¹. Application of this technique on utilization of plantation grown timbers can reduce pressure on supply of traditionally used timber species like teak and shisham, thus will help in the conservation of natural resource and higher returns to artisans in the region.

Camel 'The Ship of Desert': Camel is the eminent part of the desert ecosystem and is known as 'Ship of Desert' due to its adaptability in the arid and semi arid region. Distribution of dromedary camel is mainly confined to arid and semi arid regions of Rajasthan, Gujarat and Haryana. Milk of camel is important source of nutrition and is extremely high in calcium, iron, vitamin and low in fat and protein content. It has been found to boost the immune system and is effective against new age disease like diabetes. India currently has more than 62 million diabetic individuals which is highest in the world. High concentration of insulin (~52units/l) is reported in Camel's milk as compare to milk of other animals. Due to its nutritive and therapeutic value dairy giant like Amul is planning to process and market camel's milk. The market within country is huge and has lot of potential for new entrepreneurship avenues in dairy sector leading to socio-economic upliftment in the region. Camel rearing needs integration in terms of collection of milk, hair, dung in order to have sustainable source of income. Camel hair is being used at the village level to make rugs, carpets, blankets ropes etc. while dung is used for making handmade paper and is used as biofertilizer in the fields. There is need to work closely with pastoral community towards documentation of traditional knowledge and practices. At institutional level lot of work is going on to mobilize pastoralism towards sustainable economic development of the area. It has been reported that the blending of camel kid hair with Chokla wool in 3:1 ratio improves warmth, quality of fabric in terms of abrasion loss and better knitting

performance²² and thus can be used for the preparation of value added knitwear instead of cheap traditional products such as rope and rugs at village level for high economic returns.

PROMOTING HANDICRAFT INDUSTRY

According to the Bureau of Investment Promotion, Rajasthan is indisputably recognized worldwide for its manufactured handicrafts, including wooden, metal-based, stone, ceramics & textile products. Investments over INR 20 billions (USD 312 millions) have been made in the sector. Jodhpur and Jaipur are prominent centres for handicraft industry. Handicraft exports from the State stand over INR 20 billions, accounting for 20% of India's export. Currently, there are more than 2000 units in the handicraft export business, employing more than 5 lakh people. The State's handicraft sector is witnessing a growth of 10% annually

Though India possesses a incredible tradition of handicrafts, many artisans struggle not only to keep their skills alive but also to satisfy an ever-increasing demand of high-quality products and designs. The sector is highly unorganised and the artisans lack access to key resources, such as information on market trends, raw material, adequate credit and technology. Recently, there has been mounting pressure by the importers of the wood based handicrafts to accept only those products, which are made of wood from certified areas or forests. The move by the foreign countries is aimed at conserving forests and environment by developing sustainable managed forest resources and paving the way to discourage reckless tree felling that leads to mass deforestation. In this light, emphasis should be given to the use of alternative timber sources outside forest areas. More exploration needs to be done on this aspect. Department of Science and Technology, Government of India is supporting AFRI, Jodhpur to perform studies on post harvest technologies on *Azadirachta indica* and *Acacia senegal* to be used as alternative species for handicraft industries** (Fig. 3). Advanced work on wood seasoning from hitherto untapped non-forest tree species should be encouraged. Handicraft industry has a tremendous

potential therefore, proper guidelines for improving the production of the handicrafts in an environmentally sustainable way is the need of the hour.



Fig. 3. *Acacia senegal*, an alternative tree species for handicraft industry, growing wild in arid Rajasthan.

PUSHING THE ANIMAL HUSBANDRY

Animal Husbandry is a major economic activity of the rural peoples, especially in the arid and semi-arid regions of the Rajasthan. Development of livestock sector has a significant beneficial impact in generating employment and reducing poverty in rural areas. As per the 19th Livestock census (2012), there are 577.32 lacs (57.732 millions) Livestock (which include Cattle, buffalo, Sheep, Goat, Horse & Ponies, Mules, Donkeys, Camel, Pig) and Poultry 80.24 lacs (8.024 millions). According to the Department of Animal Husbandry, Rajasthan, about 8% of G.D.P. of the State is contributed by Livestock sector alone. This sector has great potential for rural self-employment at the lowest possible investment per unit. Therefore, livestock development is a critical pathway to rural prosperity.

- * DST supported project; Title: Reducing the migration period of the Raika community of Pokhran tehsil of Jaisalmer district by intervention of scientific technology of sheep rearing,
- ** DST supported project; Title: Studies on postharvest technologies of *Azadirachta indica* and *Acacia senegal* as alternative timber species for handicraft Industries.

FINAL REMARKS

Based on the facts it is quite evident that the pressures of the arid and semi-arid regions are high and unique in their own standing. The challenges imposed by environmentally harsh, demographically vivid and socio-economically orthodox scenario are complex. The following diagram represents a tri-prong strategy to alleviate the region out of its problems and make it a blooming and thriving land of opportunities marked with progress in every sector (Fig. 4). The key to the solution strategy lies with developing a tailor-made, region-specific Socio-



Fig. 4. Integrated strategy to address challenges in dry lands of India.

economic policy, along with technological interventions for management of natural resources, vis-a-vis a focus on development of technology package. The recommendations for uplifting the arid land socio-economy are as follows:

- 1. As agriculture contributes significantly to the economy of arid and semi arid regions it is extremely important that the farmers are kept informed about the availability of crop varieties that grow under water deficit condition and are salt tolerant through knowledge sharing platforms.
- 1. Encouragement should be given to cultivation of species endemic to this area especially

rain-fed cucurbits and millets. Village level seed banks should be created in order to ensure the availability of seeds during the sowing season and to maintain the varietal diversity of the crops exclusive to the region.

Intercropping packages developed by institutions for greater food security should be diffused at farmers' field. Farmers' should be encouraged to grow economically important plants for cultivation as hedge plants in fields. Cultivation of water intensive species should be discouraged as it depletes the water table and pull out fluorides etc to the food and water cycle on the surface.

Agriculture alone cannot sustain on its own, particularly in the arid and semi-arid region unless it is tied up with robust silvicultural and agro-forestry models. A lot of models have been tested and are available. The only need at the moment is to bring those models out and get them implemented on farmer's fields.

Minimum Support Price (MSP) protection policy for the crops such as guar, cumin, ajwain, fenugreek etc grown majorly in Rajasthan and Gujarat needs to be formulated in order to minimize the loss of farmer. Special crop insurance scheme for seed crops which are prone to destruction by vagaries of weather should be set-up.

R&D efforts on varietal improvement / development for higher yield and resistance to water scarcity and disease should be given impetus at the institutional level. As the soils in these areas are rich in micronutrients, R&D efforts to analyze the micronutrients content in produce of these areas for preparing enriched nutraceuticals should be emphasized upon.

High value medicinal plant cultivation in simulated natural conditions by means of tie up with manufactures of Ayurvedic/herbal medicine has an excellent potential. Since manufacturers require bulk biomass, cooperative efforts needs to be encouraged in villages using models such as collective

farming, contract farming or buy back at local level. Training in such income generation activities through value addition of both agricultural and livestock produce should be provided at village level in order to evade migration to cities.

A large scale micronutrient deficiency has been observed in the population of the areas due to non availability of GLV's throughout the year. In order to tackle the problem effectively interventions for drying, storing and use of greens in individual house hold and in midday meals at anganwadis in lean months should be promoted.

Mission mode intensive inputs for enhancing and monitoring organic carbon in semi arid and arid soils should be implemented and mechanism for organic certification needs to be devised as the agriculture produce in the area is organic by default.

Since balanced feeding of both poultry and cattle is essential to fully exploit the genetic potential of livestock, a more focused approach is the need of the hour. Veterinary health coverage programme for the livestock production also needs reform.

As the country is moving forward from its traditions, it is imperative that technological interventions for grading, sorting and preservation are offered at the grassroots level to tap the nutritional and culinary practices in the region for generating additional revenue to the farmers.

Traditional practices of the region need to be protected. Plant protection management practices such as use of Ash or '*lichhmi*', bark extract of *P. juliflora* are significant for environment protection and organic cultivation. On the other side rearing of high yielding indigenous cow breeds '*Gir*', '*Rathi*' and '*Tharparkar*' needs to be promoted due to nutritional superiority of the milk obtained from these breeds over the exotic breeds.

Ecotourism is not just the buzzword, but an important tool to safeguard fragile ecosystem and is an instrument for economic development and spreading awareness about the sustainable environmental practices. Ecotourism could be a major employment generator and in order nucleate this initiative infrastructure development could be undertaken under Government of India's Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) scheme and training on hospitality and biodiversity management could be given in collaboration with international agencies. The eco-tourism policy has been implemented in arid regions, and extra efforts should be made for its success to remain effective particularly through a genuine and friendly 'Government-People' partnership.

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CITIZEN SCIENCE CAN BENEFIT NATIVE BEES

Manjishtha Bhattacharyya and Susanta Kumar Chakraborty

Bees are providers of a crucial ecosystem service – pollination, but their importance is seldom appreciated by humans owing to a dearth of knowledge about their diversity and biology. Through Citizen Science programs it is possible to create awareness about these insects and their role, enabling their conservation and management.

INTRODUCTION

Pollination is an important ecosystem service and insects are important agents of pollination. Although insignificant in proportions, these tiny creatures are responsible for pollination of majority of all angiosperms (flowering plants) on earth. Insects like ants, bees, beetles etc. go on providing us with invaluable ecosystem service often unbeknownst to us. Although it is the gardens, parks, lawns and forests where these insects abundantly thrive, information about their biology, ecology, as well as their importance, seldom reaches the common public. As such, often unsustainable management practices are adopted without knowledge of their consequences on the local insect populations to the detriment of the precious entomofauna.

However, it has been shown that awareness among the common people can often lead to effective conservation and management of local insect biodiversity, as evidenced by several successful programs conducted across developed countries. The flagship insect species which command the most attention in such 'citizen science' programs are the butterflies and the bees. From an ecological standpoint, bees are significant pollinators of flowering plants although their diversity is less apparent to humans compared to the conspicuous butterflies. Human knowledge of bees is usually restricted to the commercially viable honeybees and the whole other group of 'native' or 'wild' bees is widely ignored. As such the diversity of these bees,

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their potential as pollinators and the threats they face seldom manages to stir interest outside the scientific community. However, these native bees can benefit immensely from affirmative public involvement in research and management practices involving them. The present paper attempts to throw light on the pollination potential and threats faced by the native bees and highlights how dedicated 'citizen science' programs can benefit their survival and conservation from an Indian perspective borrowing examples from the western world.

NATIVE BEES AS POLLINATORS – A BRIEF OVERVIEW

Bees are insects of the order Hymenoptera. Although by bees, most of us think of the honey making, comb building colonial bees of the Apidae family, commonly called the honeybees, there are over 20000 species of bees belonging to 7 different families, in the world¹. They come in all kinds of sizes and colours. Most of these bees do not build combs as do honeybees, and usually live solitarily or in small groups or aggregations in the soil, cavities in wood, leaf lined nests etc². Also, these bees do not produce honey and wax like the honeybees. But they are important pollinators of plants, chiefly the wild plants, and they also pollinate several crops that humans cultivate. However, since they are less known to humans than the honeybees, their importance as important ecosystem service providers goes unappreciated.

Several of these non-*Apis* bees, loosely referred to as native bees, are vital for protecting rare

angiosperms from going extinct. Many angiosperms have such highly modified flowers that they can be entered by only one a single or a few species of insects, and as such in the absence of that specific insect species, pollination shall not occur and the plant shall go extinct. One such example is the Brazil nut tree (*Bertholletia excelsa*) native to the Amazon rain forests, which depends on the female Euglossa orchid bee to pollinate its.

Big robust bees, like the bumble bees (*Bombus* sp.) and the large carpenter bees (*Xylocopa* sp.) are instrumental in buzz pollinating plants in which the pollens tightly adhere to the anthers of the flowers and are thus not easily dislodged⁴. The bees which pollinate these plants attach themselves to the flower and vibrate their flight muscles to loosen the pollens out of the anthers. This process is common in the plants of the Solanaceae family, viz., tomatoes, brinjals etc.

Bees, in their mutualism with angiosperms, may display *monolecty*, i.e., when they depend on a single plant species for food, e.g., *Hesperapis oraria* that feeds exclusively on the pollen and nectar of *Balduina angustifolia*⁵, *oligolecty*, i.e., when they forage on the flowers of plants of related species, like the sweat bee *Lasioglossum nelumbonis* which forages on the flowers of lotus, water lily⁶ etc. , or *polylecty*, when they forage on diverse flowers of varied plant species and are generalists in their feeding preferences. Honeybees and Bumble bees are the most prominent polylectic bees⁷. The importance of the monolectic and oligolectic bees in pollination of the plants they forage on can be easily envisioned. Without these minuscule creatures, pollination of the plants would be in peril.

So how efficient pollinators are these bees?

Although global estimates are unavailable, scientists in Canada and the USA have estimated that roughly 75% of the flowering plants in those countries are pollinated by bees². Honeybees are quite well known for their pollination activities, but native bees are efficient pollinators too. One estimate suggests that honeybees contributed as much as \$11.68 billion to US economy in 2009, while the non-

Apis native pollinators contributed about \$3.44 billion during the same period⁸. Global estimates, although currently lacking, would undoubtedly testify to the importance of native bees as vital pollinators across varied ecosystems around the world.

THREATS TO NATIVE BEES

Despite of the supreme importance of the native bees in pollinating our wild and cultivated crops, their sustenance is being threatened, partly due to a lack of awareness among common people about their importance and partly because of rampant destruction of their natural nesting sites through agricultural intensification and unscientific land use practices.

Most of the native bees are ground nesters or live in small holes on the stems of shrubs or trees. Scientists suggest that by removing native vegetation, for purposes of farming, making pasturelands, construction etc. bee populations get negatively affected through the loss or change of floral resources and nesting sites⁹. Agriculture, involving intensive use of farm machineries and agrochemicals, also reduces plant diversity dramatically, and diminishes bee nesting and feeding opportunities and kills adult and larval bees¹⁰.

The introduction of invasive species of plants which competitively exclude the natural food sources of native bees is also one of the threats faced by these bees¹¹. Surprisingly enough, even the introduction of honeybees, chiefly *Apis mellifera*, in some countries of the western world have been regarded as an invasion by an exotic species which is hypothesized to have increased competition for floral resources and nesting sites of highly social stingless bees¹².

But the worst danger that the native bees face, perhaps, is the ignorance of common people about their entire existence and their undeniable importance in providing the valuable ecosystem service of pollination. Awareness among people would have facilitated easier conservation practices to be adopted and would have reduced the formulation of negatively affecting policy decisions

in agriculture, development and ecosystem management.

FATE OF THE NATIVE BEES – ROLE OF CITIZEN SCIENCE

A concerted effort is needed to save these precious pollinators, involving the academia, industry, policy makers and the general public. At present, awareness about the native bees in India is restricted only to the academic interest of the academicians. Compared to this disheartening scenario in our country, the general public in the western countries, chiefly in the USA, the UK and other nations of the European Union, are being made aware by outreach programs sponsored by the government and the academic institutions. Even the active participation of the common people is being encouraged through citizen science projects.

Citizen science projects, beginning in the early 1900s in the USA followed closely after in the UK and other European countries, enlist the help of science minded enthusiastic civilians who render voluntary service in surveying, inventorying and documenting the state, health, components and other aspects of local ecosystems. Citizen scientists are usually not scientists and are not paid for their services, which they do mostly out of a passion for the environment and an eagerness to preserve and protect it. They do the leg work and collect the field data in ecological studies of big scale, which are then analyzed and interpreted by the scientists. Using technological tools like the smart phones and its various apps, viz., Maps, GPS data etc., and high end cameras, binoculars and the like, these amateur scientists document local biodiversity and then record, share and verify their data with the wider audience through the internet. Some software and programs that are of particular importance to the citizen scientists in the developed nations are the CyberTracker and the PlantNet and use of other social media platforms like Flickr, Twitter, Facebook etc. are also done to engage with the scientific community. Once the data has been generated it is then suitably analyzed and interpreted and used in bigger ecological studies.

In essence, citizen science represents “*a partnership between volunteers and scientists to answer real-world questions*”¹³.

This approach has shown positive results in identifying species prior to policy formulation and implementation¹⁴. In the developed world, citizen science has been successfully implemented to document the diversity of native bees in the locality and to identify their host vegetation¹⁵. Armed with the data scientists and policy makers have formulated civilian policies which encourage homeowners to adopt gardening and private land use practices that would ensure sustenance of these important animals, for example planting a '*pollinator garden*' with weedy species instead of exotic non-native plants which might not be a food source for the native bees. The result is people have become aware of the importance of these tiny animals and in their limited capacity are striving to help preserve them.

India is ages behind the developed nations in communicating science to its vast populace and therefore enlisting such voluntary service from its citizens is at present perhaps an unrealistic dream. However, because India has such a vast populace, that is precisely why, our scientists and policy makers should try and encourage citizen science programs to document our country's biodiversity; especially if the diversity is of small animals like the backyard bees. A little training and the use of easily available and cheap technological tools could enable our nature loving citizens to turn into amateur entomologists. And their inputs could prove to be invaluable in documenting our country's diverse insect faunal wealth, not just the diversity of native bees. Science is definitely for the people, but real progress is perhaps attainable only if science by the people is given due recognition. Although Citizen Science programs were initiated in 2007 in India (with the initiation of two programs – Migrant Watch and Season Watch by the National Center for Biological Sciences, Bangalore), such programs have not become widespread. And dedicated Citizen Scientist programs to monitor bee populations have not been initiated in India till date¹⁶.

CONCLUSION

In any ecosystem, the species richness of native bees is by far greater than the species richness of honeybees. Native bees are quintessential for the maintenance of the ecosystem and are not dispensable, in spite of being minuscule, easily overlookable living things. The sooner mankind realizes their significance and acts to preserve them the better it will be for the survival of man on this planet. And for that participation of scientists and non-scientists alike is essential. Citizen science projects are powerful tools of engaging common people in documenting bee diversity in their backyard and should be encouraged to obtain holistic information at a regional level which cumulatively, be used to formulate a biodiversity map at the national level. Perhaps in the coming days we shall see this as a vision of our country's biodiversity documentation programs.

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SMART GRID AND POWER MANAGEMENT IN INDIA

Ashok Kumar *, Abhilotsav** and Ankita

Electricity is the basic need for economic development of any country. It is one of the major core sector industry in India. The process of Industrialisation led to modernization which in turn increases productivity in every dimension of development. This advancement is only possible due to availability of power. Each grid operates independently however power can be transmitted from one grid to other during increase in load or sudden loss of generation or trippings of Generating units and Tripping of H.V. Lines. State load dispatch centres (SLDC) has been set up to ensure optimum utilization of transmission & generation energy in each state. In addition to it and Northern Regional Load Dispatch Centre (NRLDC) has been setup to assess & track energy generation, transmission and distribution statistics. Still a lot of energy is wasted due to transmission losses & faults resulting in poor voltage regulation, load shedding, energy over and underdrawl etc. . Smart Grid as most advanced technological concept on one hand optimize energy consumption and on the other hand allows everyone to sell unused power back to system as per Availability Based Tarrif (ABT) Grid code 2002 and 2003.

INTRODUCTION

1st Major Generating Station started in India in 1902. The 4.5 megawatt hydroelectric power station near Sivasamudram¹ falls of the Cauvery in Karnataka was the first major power station in India. Owned by a few British companies, it was set up by General Electric of the US. It was commissioned in 1902, and its output was mostly meant for the Kolar gold mines, located about 90 miles away. Much smaller power plants started functioning earlier in different parts of India. The first small hydro power plant, a 130 kilowatt plant, started functioning in 1897 at Darjeeling. since then government is spending a major portion of their budget on power plants / transmission lines/substations/distribution setup. When generating plants fails, power production stops to prevent this *Grid* was formed.

“*Grid* is simply interconnection of different components of power system i.e. Generation station & distribution system are connected via Transmission lines. So interconnection different power system forms grid network of an area.

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Most of today's generation capacity relies on fossil fuels and contributes significantly to production of carbon dioxide & other green houses gases in the world's atmosphere. Gas power plants, Nuclear Power plants, Diesel and Thermal plants have their own limitations and risks.

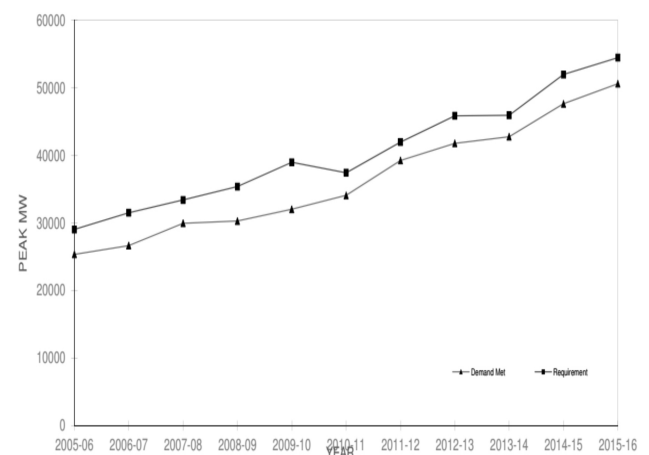


Fig.1. Demand met vs Requirement in peak hours (in MW) in Northern region² (Source NRLDC)

Thus to satisfy both the increasing demand for power and the need to reduce carbon dioxide

emissions, we need an electric system that can handle these challenges in a sustainable, reliable and economic way.

Smart grid means two way flow of power between grid & consumer along with line automation & quick restoration during faults. It is just not limited to enhancing energy asset utilization but also

- 1 Helps in intregation of renewable energy resources into grid
- 1 use of smart meters
- 1 Robustness
- 1 Smart equipment
- 1 Supplying unused power back to grid system.

Title XIII of this bill provides a description, with ten characteristics, that can be considered a definition for *Smart Grid*, as follows:

"It is the policy of the United States to support the modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth and to achieve each of the following, which together characterize a *Smart Grid*:

- (1) Increased use of digital information and controls technology to improve reliability, security, and efficiency of the electric grid.
- (2) Dynamic optimization of grid operations and resources, with full cyber-security.

Table 1. Power plant installed capacity(in MW) in India (Source NRLDC)³

Region	Ownership/ Sector	Modewise breakup						Grand Total	
		Thermal			Nuclear	Hydro	RES * (MNRE)		
		Coal	Gas	Diesel					Total
Northern Region	State	16598.00	2879.20	0.00	19477.20	0.00	7638.55	662.06	27777.81
	Private	17926.00	558.00	0.00	18484.00	0.00	2478.00	8314.38	29276.38
	Central	12000.50	2344.06	0.00	14344.56	1620.00	8266.23	0.00	24230.79
	Sub Total	46524.50	5781.26	0.00	52305.76	1620.00	18382.78	8976.44	81284.98
Western Region	State	23160.00	2993.82	0.00	26153.82	0.00	5480.50	311.19	31945.51
	Private	36775.00	4676.00	0.00	41451.00	0.00	447.00	15507.30	57405.30
	Central	12898.01	3533.59	0.00	16431.60	1840.00	1520.00	0.00	19791.60
	Sub Total	72833.01	11203.41	0.00	84036.42	1840.00	7447.50	15818.49	109142.40
Southern Region	State	17482.50	791.98	287.88	18562.36	0.00	11689.03	512.55	30763.94
	Private	8930.00	5322.10	554.96	14807.06	0.00	0.00	19765.27	34572.33
	Central	12690.00	359.58	0.00	13049.58	2320.00	0.00	0.00	15369.58
	Sub Total	39102.50	6473.66	842.84	46419.00	2320.00	11689.03	20277.82	80705.85
Eastern Region	State	7245.00	100.00	0.00	7345.00	0.00	3177.92	225.11	10748.03
	Private	8731.38	0.00	0.00	8731.38	0.00	195.00	339.28	9265.66
	Central	14221.49	0.00	0.00	14221.49	0.00	1005.20	0.00	15226.69
	Sub Total	30197.87	100.00	0.00	30297.87	0.00	4378.12	564.39	35240.38
North Eastern Region	State	60.00	445.70	36.00	541.70	0.00	382.00	259.25	1182.95
	Private	0.00	24.50	0.00	24.50	0.00	0.00	9.47	33.97
	Central	250.00	1253.60	0.00	1503.60	0.00	860.00	0.00	2363.60
	Sub Total	310.00	1723.80	36.00	2069.80	0.00	1242.00	268.72	3580.52
Islands	State	0.00	0.00	40.05	40.05	0.00	0.00	5.25	45.30
	Private	0.00	0.00	0.00	0.00	0.00	0.00	5.85	5.85
	Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sub Total	0.00	0.00	40.05	40.05	0.00	0.00	11.10	51.15
ALL INDIA	State	64545.50	7210.70	363.93	72120.13	0.00	28368.00	1975.40	102463.53
	Private	72362.38	10580.60	554.96	83497.94	0.00	3120.00	4394.155	130559.49
	Central	52060.00	7490.83	0.00	59550.83	5780.00	11651.43	0.00	76982.26
	Total	188967.88	25282.13	918.89	215168.90	5780.00	43139.43	45916.95	310005.28

DEFINITION OF "SMART GRID"

The first official definition⁴ of *Smart Grid* was provided by the Energy Independence and Security Act of 2007 (EISA-2007), which was approved by the US Congress in January 2007, and signed to law by President George W. Bush in December 2007.

- (3) Deployment and integration of distributed resources and generation, including renewable resources.
- (4) Development and incorporation of demand response, demand-side resources, and energy-efficiency resources.

- (5) Deployment of 'smart' technologies (real-time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices) for metering, communications concerning grid operations and status, and distribution automation.
- (6) Integration of 'smart' appliances and consumer devices.
- (7) Deployment and integration of advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal storage air conditioning.
- (8) Provision to consumers of timely information and control options.
- (9) Development of standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid.
- (10) Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.

SMART GRID AND REQUIREMENT OF INDIAN ECONOMY

The digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines is what makes the grid smart. The Smart Grid will consist of controls, computers, automation, and new technologies and equipment working together. These technologies will work with the electrical grid to respond digitally to our quickly changing electric demand i.e. sensors can perceive peak load problems and utilize automatic switching to divert or reduce power usage in strategic places, reducing overload, improving voltage regulation resulting in less power failure . Environmental benefits of smarter grid include reduced peak demand, integration of more renewable power sources, reduced CO₂ emissions and other pollutants ,improving air quality & thus enhancing energy efficiency.

Table 2. Summarizing Electricity Demand and Supply in India (source NSGM).

Fiscal Year (FY)	Energy				Peak Demand			
	(MU)				(MW)			
	Demand	Availability	Shortage	%	Demand	Met	Shortage	%
2002-03	545,983	497,890	48,093	8.8	81,492	71,547	9,945	12.2
2003-04	559,264	519,398	39,866	7.1	84,574	75,066	9,508	11.2
2004-05	591,373	548,115	43,258	7.3	87,906	77,652	10,254	11.7
2005-06	631,024	578,511	52,513	8.3	93,214	81,792	11,422	12.3
2006-07	693,057	624,716	68,341	9.9	100,715	86,818	13,897	13.8
2007-08	737,052	664,660	72,392	9.8	108,666	90,793	18,073	16.6
2008-09	777,039	691,039	86,001	11.1	109,809	96,785	13,024	11.9
2009-10	830,594	746,644	83,950	10.1	118,472	102,725	15,747	13.3

Indian Economy may look *Smart Grid* approach⁵ and it's requirement in following way:

- | Removing human element in operations
- | Quick restoration under fault condition
- | Here peak load is not Industrial
- | No load shedding
- | Demand is more than supply
- | Energy theft is major concern
- | Unmetered load segment
- | Requirement of power for all
- | Boosting agriculture production by providing power round the clock
- | Demand response on the basis of time based rates
- | Minimizing effect of islanding in Grid
- | Establishment of Smart cities with deployment of Internet of Things(IOT)

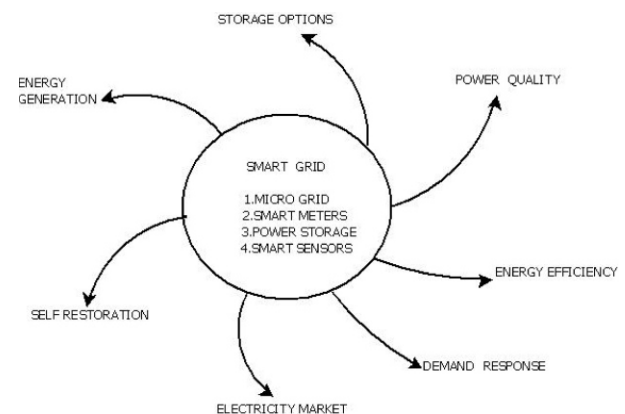


Fig 2. Benefits of Smart Grid.

DISCUSSION

The basic concept of *Smart Grid* in India is to add monitoring⁶, analysis, control, and two way communication capabilities to the national grid system to maximize the throughput while reducing the energy consumption. The Smart Grid will allow utilities to move electricity around the system as efficiently and economically as possible. It will also allow the home owner and business to use electricity as economically as possible. *Smart Grid* components include smart homes, smart meters, automatic Transmission line fault detection, Energy efficient appliances, giving customer control, new and improved sensors.

- | Synchrophasor technology has emerged for improving transmission reliability and operations.
- | Phasor measurement units (PMUs)⁸.
- | Phasor data concentrators (PDCs)¹⁷.
- | Wide area communications networks.
- | Real time monitoring and advanced transmission applications are building blocks of a smarter and more reliable transmission system.

2. SMART GRID DISTRIBUTION

"Distribution intelligence" refers to the utility distribution System, that is, the wires, switches, and

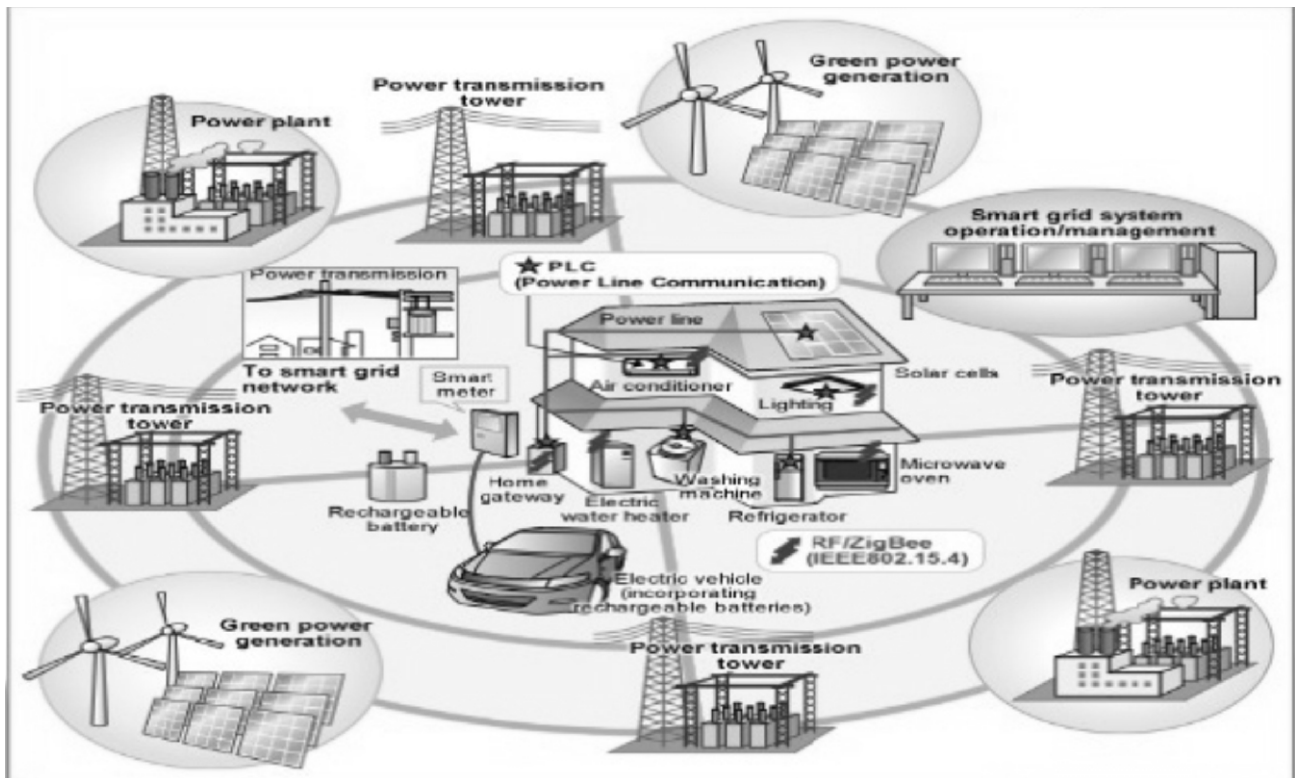


Fig. 3. Showing different components of Smart Grid.

1. SMART GRID TRANSMISSION

Electric transmission systems carry large amounts of power at high voltages from generators to substations. Transmission systems must be kept highly reliable⁷ to prevent blackouts and ensure robust energy markets.

transformers that connect the utility substation to the customers. Along with smart meters, distribution intelligence will help to quickly point the source of a power outage so that it can be repaired & restored.

If fault occurs at one substation consumer will be provided power via alternate link activated by

smart sensors. Increasing use of distributed energy resources (DERs) will be an important feature of future distribution systems. Distribution system operator typically controls the distribution system remotely. Communication infrastructure to exchange information between the substations and a central distribution management system (DMS) therefore should be in place.

3. SMART GRID CUSTOMERS

- | In smart grids, customers are going to play a very important role via demand response.
- | By peak-load shedding
- | Valley filling, and emergency response⁹
- | Customers are going to play an active role in better operation of the distribution system.
- | Home automation¹⁰ system will monitor and control the power consumption at the consumer premises in an intelligent way.
- | Extra or Unused power will be returned to Grid thus enhancing its capability

4. SMART METERS

A smart meter is an electronic device that records consumption¹¹ of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing. Smart meters enable two-way communication between the meter and the central system. Unlike home energy monitors, smart meters can gather data for remote reporting¹². Such an advanced metering infrastructure (AMI) differs from traditional automatic meter reading (AMR) in that it enables two-way communications with the meter. It records amount of energy withdrawn from grid and energy supplied to grid which is generated from non conventional resources like solar cells.

5. SMART TRANSDUCERS

A smart transducer is an analog or digital transducer or actuator combined with a processing unit and a communication interface.

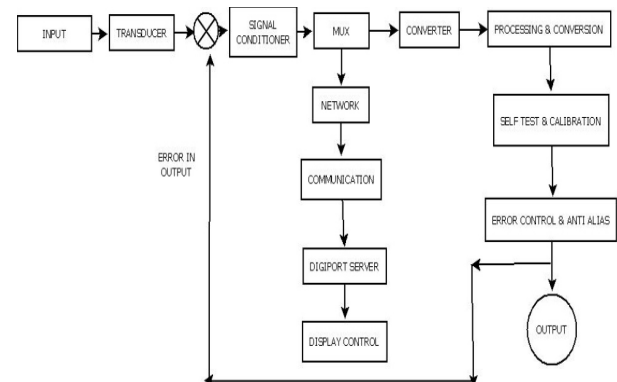


Fig 4. Showing working of smart transducer.

6. PHASOR MEASUREMENT UNITS(PMU)

A Phasor Measurement Unit measures electrical Waves¹⁷ on Electricity Grid using common time source for synchronization. This allows Synchronization of real time measurements of multiple remote measurement points on the Grid. The resulting measurement is known as synchrophasor. A Phasor Measurement Unit can be a protective device or can be incorporated into a protective a relay or other device. Synchrophasor¹⁸ also allows collection and sharing of high speed real time synchronized grid condition data across entire system.

7. PHASOR DATA CONCENTRATORS (PDC)

A Phasor Data Concentrator time-synchronizes¹⁹ phasor data from multiple phasor measurement units (PMUs) to produce a real-time, time-aligned output data stream. A PDC can exchange phasor data with PDCs at other locations. Through use of multiple PDCs, multiple layers of concentration can be implemented within an individual synchrophasor data system.

SMART GRID ROAD MAP IN INDIA

Main aim of Smart Grid is to Enhance energy production by reducing losses , increasing Power access to everyone, Smart sensors in Transmission and Distribution lines thereby helping in fault restoration quickly & empowering customer to use demand based tariff¹³.

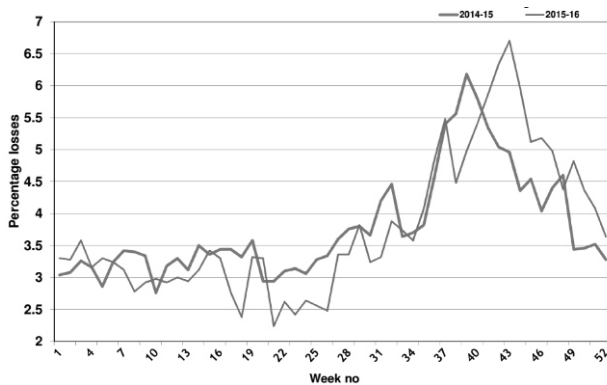


Fig. 5. Pooled Interstate Transmission Losses for Northern Grid(source CERC)

In India about 400 million people have no access to electricity. Smart grids for rural electrification can address the problem of (energy) poverty.

NWO (Netherlands Organization for Scientific Research) project granted under the funding line Responsible Innovation on the development and implementation of smart grids in India to complete project in 2015-2019.

The project's work is divided into five work packages (WPs)¹⁴:

1. WP1 investigates technical specifications and develops a smart grid prototype.
2. WP2 investigates how smart grids can be embedded and commercialized in the rural Indian energy market, using the Hidden Design method.
3. WP3 investigates how societal and institutional factors affect the viability of smart grid implementation and use in India, using an ethnographic approach in combination with insights from transition studies.
4. WP4 addresses ethical challenges, especially the question to what degree hidden design can replace deliberative processes as a fair and just method of stakeholder involvement.
5. WP5 investigates which key factors affect the potential for upscaling smart grids throughout India. Goal of the project is to answer the

research question by the actual responsible development and implementation of a smart grid prototype.

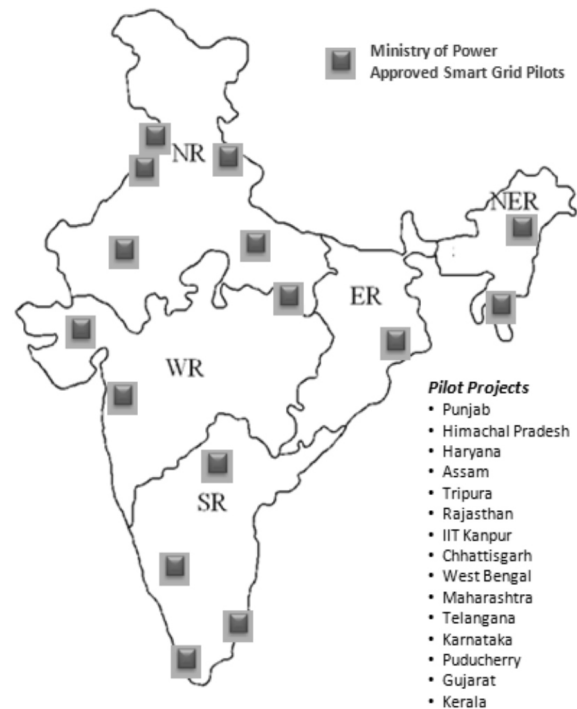


Fig 6. Showing Approved Smart Grid Pilot Projects¹⁵ (source internet)

INTERVENTIONS IN SMART GRIDS

The indicative components of smart grids implemented¹⁶ in India in First Phase will be as follows:

- | Deployment of Smart Meters
- | Substation renovation and Modernisation with deployment of GIS
- | Development of medium sized Microgrids
- | Development of Distributed Generation in form of Roof Top (Photo Voltaic Cells)PVs
- | Real-time monitoring and control of Distribution Transformers
- | Provision of Harmonic Filters and other power quality improvement measures
- | Creation of Electric Vehicle (EV) Charging Infrastructure for supporting proliferation of Electric Vehicles.

Table 3. Showing Budget and Estimation of Smart Grid Project

PROJECT	ESTIMATED COST (Rs. CRORES)	PROPOSED BUDGET (CRORE)	2015-16	2016-17
Development of Smart Grid in cities	890	267	155	111
Development of micro grids	27	8	4	3
Funding to Discoms	30	8	4	3
Training and capacity building	8	30	13	15
NSGM establishment ,O&M	25	25	10	10

CONCLUSION

Ministry of Power along with India Smart Grid Task Force had shortlisted 14 Smart Grid Pilot Projects and 1 Smart City Research and Development(R&D) Platform in India. Implementation of Smart Grid will lead to Electrification of all houses, Reduction in power cuts, reduction in Aggregate Technical and Commercial losses (AT&C) losses, Demand response programme, Renewable energy integration, establishment of roof top (Photo voltaic cells) PV and Energy efficient buildings, implementation of dynamic tariffs, Establishment of Smart Grid Test Beds, implementing Smart Transducers.

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CSIR – CENTRAL BUILDING RESEARCH INSTITUTE, ROORKEE

CSIR-Central Building Research Institute, Roorkee, India, has been vested with the responsibility of generating, cultivating, and promoting building science and technology in the service of the country. Since its inception in 1947, the Institute has been assisting the building construction and building material industries in finding timely, appropriate, and economical solutions to the problems of Building Materials, Health Monitoring and Rehabilitation of Structures, Disaster Mitigation, Fire Safety, Energy Efficient Rural and Urban Housing. The Institute is committed to serving the people through R&D in the development process and maintains linkages at international and national level.

Vision

A world class research and knowledge center of National importance for providing innovative solutions to all aspects of building science and technology.

Mission

Dedicated to research, development, and innovation (RD&I) in solving National challenges of

planning, design, materials, capacity building and construction including disaster mitigation in buildings to achieve safety, sustainability, resilience, smartness, comfort, functional efficiency, speed, productivity in construction, environment preservation, energy efficiency and economy.



MAJOR AREAS OF RESEARCH & DEVELOPMENT

CSIR-Central Building Research Institute, Roorkee through its extensive research and

development works has made tremendous efforts and has evolved technologies, to apply the scientific knowledge in the advancement of housing sector through efficient planning and utilizing sustainable, environment friendly, advanced materials to improve environment through proper waste utilization, management, and disposal. The Institute plays a pivotal role in the areas of building science and technologies. A glimpse of some of the scientific activities that are ongoing in the Institute are given below:

Advanced Building Materials

Wood Substitute Building Materials

- | Rice husk plastic wood (Wood Without Tree)
- | Natural fiber based laminates / panels/ sheets
- | Jute-Sisal fiber products
- | EPS door shutter- Wood Substitute
- | Coir-CNSL board - Wood Alternative
- | Pine needle composite boards/panels
- | Bagasse-cement boards and panels- Agro-Waste Utilization
- | MDF board from plywood/veneer waste
- | Low density board/ light weight sandwich panels using paper industry waste

Polymeric Building Materials

- | Polymer composites based on natural / synthetic fibers
- | Polymer modified bitumen
- | Recycling, reuse and durability of plastics

Building Materials from Industrial Wastes

- | Thermal Insulation of tiles using exfoliated vermiculite
- | High strength plaster from flourogypsum
- | Phosphate bonded bricks
- | Geo-polymer concrete and its application
- | Transparent concrete

Building Pests & Mycology

- | Bio-concrete as self-healing material
- | Termite prevention in buildings
- | Prevention of fungi attack in buildings

Nanotechnology

- | Nanotechnology in the development of Durable and Ultra High Strength Concrete

Process & Technologies

- | Process technologies for the manufacture of cementitious products from agro-industrial wastes such as rice husk, fly ash, blast furnace slag, phosphogypsum, lime sludge and electroplating wastes
- | Use of Kota stone dust for making building components
- | C&D waste utilization in building products
- | Improved brick production and commercialization
- | Design and development of thermally efficient fixed chimney brick kiln

Environmental Impact Assessment and Environmental Management Plan

- | Environmental audit of building material industries
- | Environmental planning for problem areas
- | Air pollution monitoring and control
- | Water quality monitoring, water supply and resource management
- | Engineering design and impact assessment of hazardous waste disposal facilities
- | Computer modeling of surface water, ground water, ambient air, and indoor air quality
- | Solid Industrial waste and contaminated soil

Disaster Mitigation

- | Building Dynamics, Pre & Post Disaster Management with reference to Cyclones, Earthquakes, Landslides & Fire Hazards in Buildings

- | Distress diagnosis and strengthening of RC structures against distress
- | Vulnerability assessment of buildings due to earthquake/ wind
- | Constitutive modeling and non-linear finite element analysis of structures
- | Service life prediction and reliability analysis of structures
- | Testing of models and prototype structural elements
- | Instant, temporary and permanent shelters for disaster (earthquake/cyclone) prone areas

| **Landslide Hazards Mitigation**

- | Geological and geophysical investigation
- | Geo-hazard-earthquakes and landslide studies
- | Application of remote sensing and GIS

| **Fire Hazard Mitigation**

- | Fire resistance of building elements and passive fire Protection systems
- | Fire spread modeling and simulation
- | Fire behavior of building materials
- | Fire retardant chemistry and coatings
- | Post fire assessment and rehabilitation of building structures
- | Fire extinguishment
- | Enclosure fire and response of heat sensitive devices
- | Use of Nanotechnology in the development of fire retardant materials
- | Development of cable penetration seal system

| **Energy Efficient Buildings**

- | Development of low cost technologies for EWS
- | Development of guidelines for green and energy efficient buildings
- | Development of space norms and standards for human settlements

- | Development of space norms and standards for educational and health care buildings
- | Industrialized building systems for low and medium rise structures
- | Development of guidelines for physically challenged
- | Guidelines, bye-laws code of practice for use of glass in buildings
- | Development of climatic zone map of India
- | Evolution of methods for designing energy efficient buildings
- | Thermal performance of building components and evaluation of thermal properties of building materials
- | Solar energy applications in buildings – passive heating and cooling of buildings
- | Wind tunnel measurements for estimation of aero-dynamic forces
- | Energy simulation and energy conservation aspects in buildings to provide comfortable indoor environment

| **Health Monitoring & Rehabilitation of Structures**

| **Distress Diagnosis & Strengthening of RC & Heritage Structures**

- | Assessment of physical condition and techno-economic analysis of RCC structures
- | Non Destructive Testing (NDT) of concrete structures
- | Assessment of corrosion of reinforcement using half-cell potential and resistively measurements
- | Stress Analysis of structures
- | Suitable recommendations for repair and protective measures
- | Repair and rehabilitation of expansion joint in buildings
- | Repair and coating materials

- | Development of cathodic protection system for prevention of corrosion of reinforcing bars in RCC structures

- | Foundations and ground improvement

| **Rehabilitation of heritage structures**

- | Sun Temple Konark, Chittorgarh Fort, Qutab Minar, Taj Mahal, Patal Bhubaneshwar

Ph.D. Programme on Building Engineering & Disaster Mitigation (BEDM)

CSIR-CBRI is offering Ph.D. Programme on "Building Engineering and Disaster Mitigation (BEDM)" under the Academy of Scientific and Innovative Research (AcSIR) to impart training to the young Civil Engineering professionals.

OUTREACH

Publication & Publicity

The Publication Group is the nerve center of the Institute conducting and coordinating multifarious activities, such as,

- | Collection, storage, and dissemination of R&D information
- | Handling scientific and technical enquiries
- | Press Meets-Jan Sanvad
- | Publicity and public relations
- | Compilation, editing and publication of Annual Report to meet the inter and intra-institutional information needs
- | Editing and publication of CSIR-CBRI Newsletter and Bhavanika (Bilingual Newsletter) periodically
- | Publication of Building Research Notes
- | Project Profile
- | Technical and Divisional Brochures
- | Preparation of other scientific/technical reports
- | Filling up of questionnaires / organizations
- | Outreach through CSIR Annual Report, CSIR News and CSIR Samachar

- | Reporting of the scientific and technical work carried out at the Institute

- | Publicity of the Institute's R&D capabilities through Print Media

- | Organizing training programmes for teachers, students, and outreach programmes for public

Business, Information, Development & Extension

- | Dissemination of R&D technologies through exhibitions, seminars, workshops, and awareness camps etc.

- | Building confidence and capacity by live demonstration.

- | Trainings and skill development programmes for engineers and artisans.

- | Counseling for production and use of newer technologies.

- | Sustainable partnership with all stakeholders.

- | Providing training to Government Departments, Industries, educational Institution Exhibition at Dhudwa and NGOs on various aspects related to housing.

- | Implementation of innovative housing programmes under CSIR 800.

Training / Skill Development Programmes

- | Housing for All – Innovative Technologies for Construction of Affordable Housing

- | Design of Disaster Resistant Housing and Risk Mitigation

- | Control Measures for Landslides

- | Fire Retardant Thatch Roof

- | Bhawan Nirman Technique Prashikshan Karyakaram

- | Knowledge to Villagers about Purification of Waste Water Before Discharging into Fish Pond

- | Workshop Popularizing CSIR Rural Technologies (Popular Tech-2016)

- | Construction of Affordable Housing for Engineer, Supervisors, and Masons
- | Earthquake Resistant Rural Housing
- | Faculty Training, Motivation and Adoption of Schools and Colleges

Contact:

Director

CSIR- Central Building Research. Institute,
Roorkee-247667, Uttarakhand, India, Phone: 01332-
272243, 283323, Fax: 01332-272543, 272272,

E-mail: director@cbrimail.com,

Website: www.cbri.res.in

CONFERENCES / MEETINGS / SYMPOSIA / SEMINARS

The 1st International Conference on Natural Medicine: From Local Wisdom to International Research, 5-6 August, 2017 , Bangkok, Thailand.

Topics:

- | | |
|---------------------------------|---|
| Pharmacognosy | Translation Research, Policies and Regulations |
| Nutrition and Functional Food | Complimentary and Alternative Medicines. |
| Pharmaceutical Biotechnology | Natural Drug Discovery and Chemistry |
| Pharmacology and Toxicology | Standardization and Quality of Natural Products |
| Cosmetic Science and Technology | |

Contact :

Ubon Ratchathani University, 85, Sathonlamark Road, Warin Chamrap, Ubon Ratchathani 34190, Ubon Ratchathani University, Thailand, Phone : +66 45 353035, E-mail : icnm@ubu.ac.th
Website : www.icnm.ubu.ac.th

4th International Conference on Mathematics and Computers in Sciences and Industry (MCSI 2017), August 24-27, 2017, Corfu Island, Greece.

Topics:

- | | |
|--|--|
| Nature-Inspired Computation | Computational Models in Environmental Science |
| Mathematical Modeling, Numerical Algorithms for Aerospace Techniques | Computational Models in Chemistry and Chemical Engineering |
| Communications - Informatics | Computational Models in Business and Economics |
| Signal Processing, Computational Geometry | Applied and Numerical Mathematics in Mechanics |
| Microelectronics, Nanoelectronics, Optoelectronics | Mathematical Biology and Ecology |
| Power and Energy Systems | |

Contact: Send your emails to mcsi.conf@gmail.com & visit website: www.mcsi-conf.org

International conference on "Interdisciplinary interaction on non-communicable diseases", September 22-24, 2017, Tamil Nadu.

Topics:

- | Recent trends in non-communicable diseases (diabetes mellitus/cancer/cardiovascular diseases/neurodegenerative diseases)
- | Biochemical, histological and molecular approaches towards non-communicable diseases (diabetes mellitus/cancer/ cardiovascular diseases/neurodegenerative diseases)
- | Effect of medicinal plants, their bioactive constituents, and synthetic entities in the prevention of non-communicable diseases (diabetes mellitus/cancer/cardiovascular diseases/neurodegenerative diseases)
- | Role of reactive oxygen species and enzymatic and non-enzymatic antioxidants on non-communicable diseases (diabetes mellitus/cancer/cardiovascular diseases/ neurodegenerative diseases)

Contact: Dr. S. Manoharan, Conference Director (NCD-2017), Associate Professor, Department of Biochemistry and Biotechnology, Annamalai University, Annamalainagar – 608 002, Phone : +91-4144-239141 (Extn.230)(Off) Mobile : 09442548117 & 09487748117, Email: smauncd@gmail.com

The IIER - 269th International Conference on Applied Physics and Mathematics (ICAPM), 25-26 September, 2017, Pune.

Topics:

- | Advances in Instrumentation and Techniques
- | Applications of Microscopy in the Physical Sciences
- | Applied Materials Science & Engineering
- | Applied Non-linear Physics
- | Applied Optics, Non-linear optics, Laser Physics, Ultrafast phenomena, Lasers application to Medicine, Chemistry
- | Applied Solid State Physics/Chemistry and Materials Science and Technology Advanced Materials
- | Astrophysics and Plasma Physics
- | Atomic, Molecular and Chemical Physics
- | Biomaterials Science and Biomedical Engineering
- | Biomedical Engineering, Medical/Biological Physics, Health Physics, Biomechanics
- | Biophysics, Bio (electro) magnetism, Biophysical Chemistry
- Complex systems
- Computational Physics, Non-linear Physics
- Condensed Matter Physics
- Condensed Matter Physics and Materials Science
- Engineering and Industrial Physics, Instrumentation, Metrology and Standards
- Environmental Physics
- Imaging Techniques, Microscopy
- Large-code development
- Medical Physics
- Methodological advances
- Nanoscale physics
- Nanoscience and Nanotechnology
- Nanoscience and Nanobiotechnology
- Non-equilibrium systems
- Nuclear Physics/Chemistry, Radioactivity, Radiochemistry, Radiation Safety

- | | |
|--|---|
| Nuclear Sciences and Engineering | Applied Mathematics and Engineering: Modeling, Analysis and Computation |
| Particle Physics | Applied partial differential equations |
| Petascale computing | Numerical analysis and methods |
| Physical Chemistry | Scientific computation |
| Physical Properties of Biological / Biomedical Systems through Microscopy | Mathematical methods in optics and electromagnetics |
| Plasma physics | Mathematical modeling in materials science and biology |
| Polymers | Nonlinear problems in mechanics |
| Optical Physics, Quantum Electronics and Photonics | Homogenisation and multiscale analysis |
| Quantum Physics | Inverse problems |
| Quantum Monte Carlo | Algebra and its application |
| Radiation Physics, Radiation Chemistry, Radiation Processing, Radiation-Matter interaction, Spectroscopies | Differential equations, dynamical systems and their applications |
| Radioactivity and Radiochemistry, Radiation Protection and Safety Issues | Engineering applications and scientific computations |
| Semiconductors devices and Photonics, Opto-electronics, Quantum Electronics | Financial and actuary mathematics |
| Soft and granular matter | Fuzzy mathematics and its applications |
| Solid State Physics | Geometry and its application |
| Surfaces, Interfaces and Colloids | Modeling and simulation |
| | Statistical methods in technical and economic sciences and practice |

Contact - Conference Coordinator , F3/13, Labony Estate , EB Block, Sector 1, Salt Lake, Kolkata 700064, West Bengal , Email - info@theiier.org, Website: <http://theiier.org/Conference 2017/India/2/ICAPM/>

IEEE sponsored International Conference on Intelligent Systems and Information Management, 5th to 6th October, 2017, Aurangabad, Maharashtra.

Theme: Intelligent Systems: Architectures & Applications

Topics:

Intelligent Systems

- | Image and Signal Processing
- | Computational Biology and Bioinformatics
- | Control and Automation
- | Mobile based applications
- | Interactions between neural networks and fuzzy inference systems.
- | Fuzzy Systems and Neural Networks.
- | Fuzzy clustering algorithms and optimization techniques
- | Fuzzy inference system optimization
- | Hybrid Systems

- Intelligent Decision Making Systems
- Autonomic computing
- Artificial Intelligence

Intelligent Systems: Applications

- Health, Medicine and Bioengineering
- Transportation, Vehicle based intelligent system
- Telecommunication
- Education, e-Learning
- Business & Finance
- Environmental Engineering
- Process Control & Manufacturing

Information Management

- | Big Data Analytics
- | Cloud Computing
- | Data mining on Big Data
- | Data Fusion
- | Grid Computing
- | Virtualization
- | Data Visualization
- | Distributed File System
- | NLP

Intelligent Systems: Applications

- | Health, Medicine and Bioengineering
- | Transportation, Vehicle based intelligent system
- | Telecommunication
- | Education, e-Learning

- | Business & Finance
- | Environmental Engineering
- | Process Control & Manufacturing

Communications & Networking

- | WSN
- | Ad-hoc Networks
- | Network Security
- | Optical Switching & Networking
- | Mobile Computing
- | Green Communication systems and Network
- | Ubiquitous computing
- | Network and information security
- | Routing and Control Protocols
- | Broadband wireless access
- | Mobile backhaul for small cells
- | Multiple antenna techniques,
- | Cognitive radio and networks

Contact : Organizing Chair, Dr M S Joshi, icisim@jnec.ac.in, madhuris.joshi@gmail.com, (+91)9423707652, Mr. S. N. Jaiswal, icisim@jnec.ac.in, hodit@jnec.ac.in, (+91)9657715348, Website: <http://icisim.jnec.org>

21st (WCCN) World Congress of Clinical Nutrition, 6 to 8 October, 2017, Budapest.

Topics :

- | Research news in the agriculture and medicine with reference to GM foods and nanotechnology
- | Efficacy and safety of bioactive compounds from plant and animal sources
- | Healthy food processing, suggestions for the industry
- | Nutraceuticals and functional food
- | Research news in the field of medical nutrition
- | Nutrition in preventive and social medicine
- | Pharmaconutrition and natural health products
- | Home enteral and home parenteral nutrition
- | Prebiotics and probiotics in healthy lifestyle management
- | Impact of proper hydration and healthy drinking water
- | When to eat foods and when to exercise

Contact : Dr. I.G. Telessy, Ph.D., FICN, Associate Professor, President of the Local Organizing Committee, Telefon : 061-299-0184, 299-0185, 299-0186, Fax : 061 299-0187, Website: www.convention.hu / E-mail : convention@convention.hu

18th Biotechnology Congress, BioAmerica 2017, Oct 19-20, 2017, New York, USA.

Theme :

Novel Insights and Innovations in Biotechnology for Leading a Better Life.

Contact :

Woodrow Wilson, Program Manager, BioAmerica 2017, Office : 1 – 650 – 268 – 9744, T : 1 – 702 – 508 – 5200
Ext: 8117, Customer Service: +1 (800) 216 6499, Email: bioamerica@conferenceseries.net, Website:
www.biotechnologycongress.com

International Conference on Sports Engineering ,23rd to 25th October 2017 Jaipur, Rajasthan.

Topics:

- | | |
|---|---|
| Aero-and hydrodynamics | Sports textile, Materials and modeling |
| Analysis and simulation of equipment or athlete | Mechanics and dynamics of sports equipment |
| Analysis of movement | Simulation and mathematical modeling |
| Design manufacturing and testing of track | Sports equipment design and testing |
| Facility maintenance and sports performance | Surface interaction |
| Innovation and startup in sports technology | Synthesis and analysis of equipment for group and individual sports etc |

Contact: | Prof. M. S. Dasgupta (Conference Chair), +91-9829227459 | Dr. Pintu Modak (Convener) +91-9468827020, Website: <http://www.bits-pilani.ac.in/icse2017/>

S & T ACROSS THE WORLD

INTELLIGENT MOBILE ROBOTICS

Autonomous Search Robot

The autonomous search robot can perform 3D mapping of an indoor area on its own. In addition to localization, mapping, and path planning, it employs an exploration algorithm which searches for all unknown areas until they have been mapped. Apart from a LIDAR, it uses a RGBD sensor for 3D depth data capture. With the help of these sensors, this robot can identify 3D obstacles and avoid them during navigation. It can continuously create a 3D map of the indoor scene, which is displayed on a remote user device. The user can select an object to be searched, are then marked by the robot when they are found in the scene. It uses algorithms for object detection to perform the search. The user can fly through the map and interactively locate searched objects in the map. The autonomous search robot is useful for indoor counter insurgency operations, search and rescue operations, and remote mapping of indoor environments with NBC hazard, when mounted with a NBC sensor.

Intelligent Collaborative Robotics System

CAIR is working on developing a multi-agent robotics framework, which utilizes a heterogeneous set of robots to collaboratively achieve the mission objectives. The heterogeneous platforms are connected to a Master Control Station (MCS) which collects all the mission data, maps, and live views. The wheeled robots are targeted to perform exploration outdoors, the tracked platforms are targeted towards indoor multi-floor exploration, and smaller ballbots with limited motion capability are intended as static surveillance robots, which are dropped at desired locations by the MINIUGV. The heterogeneous composition and collaboration capability lends to a myriad of military applications, such as static surveillance, indoor or outdoor mapping, search and rescue, etc. Collaboration

among the heterogeneous robotic team is enabled using the MARF through a multi-layered architecture. A semantic Service Oriented Architecture (SOA) layer has been established using Java Agent Development (JADE) framework, which describes the capabilities and services on a conceptual agent level. To aid in the actual execution of the service on the robotic platform, Robot Operating System (ROS) forms the lower of the MARF framework.

Dependable Autonomous Unmanned Ground Vehicle

System dependability is becoming crucially important for a new generation of open, cooperative, often autonomous unmanned ground vehicles. UGVs have many potential application of UGVs ranges from military missions such as reconnaissance, surveillance and combat, industrial and search and rescue operations. In particular, based on specific mission or safety critical application scenarios, the autonomous unmanned ground vehicles should be characterized by one or more of the dependability attributes such as reliability, availability, safety, integrity, maintainability, and timeliness. The design of dependable unmanned ground vehicles is even more challenging due to aggressive advances in the technology scaling, higher frequencies and power densities that have negatively affected the reliability of the components constituting such systems. In addition, development of dependable systems by means of new software/hardware technologies for runtime adaptation to mitigate the effects of failures and to permit life time improvements is an important requirement and needs careful and rigorous consideration. The choice of system level architecture, configuration, sensors and components provide significant synergy within a robotic system. CAIR is working towards establishing dependable autonomous unmanned ground vehicles which address the key attributes of dependability.

(Source : Technology Focus, Nov–Dec 2016)

CURCUMIN LOADED NANOFIBERS REGENERATE BONE TISSUE

Researchers from the Indian Institute of Science, Bangalore have found that a polymeric nanofiber that releases curcumin over a period of time can enhance bone tissue regeneration. As a prosthetic material, it could benefit people with bone defects. Bones have a natural ability to regenerate but in some people such as older patients or those with large bone defects, regeneration might be hampered requiring medical interventions. Some medical procedures lead to complications and researchers always look for safer alternatives. Phytochemicals, biologically active chemical compounds found in plants, are known to accelerate bone tissue regeneration. However, till now, there were no such studies on curcumin, a phytochemical, and a popular dietary supplement with antibacterial, antifungal, anti-inflammatory, anti-arthritis and anticancer properties. The researchers loaded curcumin into poly (E-caprolactone) or PCL nanofibers. PCL is a biocompatible polymer approved for clinical use. By utilizing electrical forces, the researchers drew ultra-thin fibers of PCL, and filled them with two different concentrations of curcumin. Nanofibres, drawn by electrical forces, have a unique property: their topography is similar to that of the extracellular bone matrix. They studied the release of curcumin in an aqueous solution, and its subsequent effect on bone tissue regeneration. Analysis of gene and protein expressions confirmed that the presence of curcumin augmented bone tissue regeneration. Interestingly, out of the two curcumin concentrations studies, the one with lower concentration was found to be more effective.

(Source: Nature India Update, 24th October 2016)

WARMING MAY BE RAISING SEAS FASTER THAN ANYTIME IN AT LEAST 2,800 YEARS

Global warming is probably already fueling a sea level rise that's faster than at any time in at least 2,800 years, scientists are reporting. Publishing their findings this week in the journal *Proceedings of the National Academy of Sciences*, researchers report an estimate of global sea-level changes over the past 3,000 years. The investigators, Robert Kopp of Rutgers University in Piscataway, N.J. and colleagues, estimated global sea-level changes over the period using regional sea-level reconstructions from 24 locations.

Between the years 0 and 1900 A.D., global sea level variation was likely between 7 cm and 11 cm, or up to about four inches. Between 1000 and 1400, the levels decreased an average of one fifth of a millimeter per year, or less than a thousandth of an inch, coinciding with a slight global temperature drop, they estimated. They also concluded based on their reconstruction that it is extremely likely that the sea-level rise in the 20th century—14 cm, or 5.5 inches was faster than during any previous century since at least 800 B.C. After creating a model to relate the rate of sea-level change to the average temperature, the researchers estimated the human contribution to 20th-century sea-level rise, concluding that it probably accounts for more than half of that increase.

(Courtesy of PNAS and World Science staff Feb. 23, 2016)



THE INDIAN SCIENCE CONGRESS ASSOCIATION
14, DR BIRESH GUHA STREET, KOLKATA- 700 017

ANNOUNCEMENT FOR AWARDS: 2017-2018

Nominations / Application in prescribed forms are invited from Indian Scientists for following Awards:

- | | |
|---|--|
| Asutosh Mookerjee Memorial Award | Pran Vohra Award – Agriculture and Forestry Sciences |
| C. V. Raman Birth Centenary Award | Professor Umakant Sinha Memorial Award – New Biology |
| Srinivasa Ramanujan Birth Centenary Award | Dr. B. C. Deb Memorial Award for Soil / Physical Chemistry – Chemical Sciences |
| Jawaharlal Nehru Birth Centenary Awards | Dr. B. C. Deb Memorial Award for Popularisation of Science |
| M. N. Saha Birth Centenary Award | Prof. K. P. Rode Memorial Lecture – Earth System Sciences |
| P. C. Mahalanobis Birth Centenary Award | Dr.(Mrs.) Gouri Ganguly Memorial Award for Young Scientist – Animal ,Veterinary and Fishery Sciences |
| P. C. Ray Memorial Award | Prof. G. K. Manna Memorial Award–Animal, Veterinary and Fishery Sciences |
| H. J. Bhabha Memorial Award | Prof.Sushil Kumar Mukherjee Commemoration Lecture–Agriculture and Forestry Sciences |
| J. C. Bose Memorial Award | Prof. S. S. Katiyar Endowment Lecture–New Biology/Chemical Sciences |
| Vikram Sarabhai Memorial Award | Prof. R. C. Shah Memorial Lecture–Chemical Sciences |
| B. P. Pal Memorial Award | Prof. William Dixon West Memorial Award–Earth System Sciences |
| M. K. Singal Memorial Award | *Asutosh Mookerjee Fellowship |
| Jawaharlal Nehru Prize | **Infosys Foundation –ISCA Travel Award |
| Millennium Plaques of Honour | |
| Excellence in Science and Technology Award | |
| R. C. Mehrotra Memorial Life Time Achievement Award | |
| B. C. Guha Memorial Lecture | |
| Raj Kristo Dutt Memorial Award | |
| G. P. Chatterjee Memorial Award | |
| Professor Hira Lal Chakravarty Award – Plant Sciences | |
| Prof. Archana Sharma Memorial Award – Plant Sciences | |
| Dr. V. Puri Memorial Award –Plant Sciences | |

***Last date 15th July, 2017; **Last date 15th November, 2017**

Last date of Receiving of Nominations / Application for different ISCA Awards and Lectures of 2017-2018 is **July 31, 2017**. For proforma of application forms and necessary information, please write to the General Secretary(Membership Affairs). The Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700 017, E-mail: iscacal@vsnl.net. The form also can downloaded from-<http://www.sciencecongress.nic.in>



THE INDIAN SCIENCE CONGRESS ASSOCIATION
14, DR. BIRESH GUHA STREET, KOLKATA-700017

ISCA YOUNG SCIENTIST AWARD PROGRAMME : 2017-2018

To encourage Young Scientists, The Indian Science Congress Association has instituted a number of awards in different disciplines. These awards carry a sum of ₹ 25,000/- besides a Certificate of Merit.

1. Applications are invited from members (Life & Annual) of the Association who have paid their subscription on or before **July 15, 2017**. The upper age limit of the candidates for the award is 32 years as reckoned on **December 31, 2017 (born on and after January 01, 1986)**.
2. Four copies of the abstract (not exceeding 100 words) along with four copies of full length paper must reach the office of the General Secretary (Membership Affairs) not later than **August 16, 2017**. At the top of each copy of the paper and its abstract, the name of the Section under which the paper is to be considered should be indicated. For details of Sections see <http://www.sciencecongress.nic.in/html/paper/presentations.php>
3. Along with the Four copies of paper, Four copies of the Application Form (to be downloaded from ISCA website (http://www.sciencecongress.nic.in/html/young_sc_programme.php) with brief bio-data of the candidate (not exceeding 2 pages), list of publications, with copies of reprints of already published papers if any and a soft copy of the duly filled application form with scanned copies of enclosures (excluding reprints), full length paper and abstract in MS Word (not PDF) along with bio data in the form of a CD must also be sent simultaneously along with the hard copies.
4. The Paper submitted must be a **single author paper** and the research work should have been carried out in India and this has to be certified by the Head of the Institution from where the candidate is applying.
5. The candidate should give an undertaking that the paper being submitted has not been published in any journal or presented in any other Conference / Seminar / Symposium or submitted for consideration of any award.
6. A Young Scientist can present only one paper in any one Section (and not a second paper on the same or any other topic in any other Section).
7. A person who has already received Young Scientist Award in any section once will not be eligible to apply for the above Award in the same or any other section.
8. Incomplete Applications will not be considered.
9. The papers submitted will be subjected to verification for authenticity.
10. Full length paper will be evaluated by experts and the selected Young Scientists (maximum of six) in each section will be invited to make oral presentation of their paper during 105th Indian Science Congress at Osmania University, Hyderabad. The selected candidates will be provided admissible travelling allowances by ISCA.
11. The final selection for the Awards will be made by a duly constituted committee and the awards will be given during the Valedictory Session of 105th the Indian Science Congress session to be held on January 7, 2018 at Osmania University, Hyderabad.
12. Applications submitted for the above award will not be returned.
13. The last date for receiving papers at ISCA Headquarters is **August 16, 2017**.

All Correspondences should be made to: The General Secretary (Membership Affairs.), The Indian Science Congress Association, 14, Dr. Biresw Guha St., Kolkata-700017. Tel. Nos. (033) 2287-4530/2281-5323, Fax No.91-33-2287-2551, E-mail: iscacal@vsnl.net / es.sciencecongress@nic.in, Website:<http://www.sciencecongress.nic.in>

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Alhaj Rotarian Tayebul Haque, Advocate, Journalist.
Secretary General, Indian Representative,
Mobile:- +91 9831725796, 9903954513
Email: tayebul.haque@yahoo.com



भारतीय विज्ञान कांग्रेस संस्था

14, डॉ० बिरेश गुहा स्ट्रीट, कोलकाता - 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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दूरभाष/Telephone : (033) 2287-4530, 2281-5323

फैक्स/Fax : 91-33-2287-2551

वेबसाइट/ Website : <http://sciencecongress.nic.in>

ई-मेल/E-mail : iscacal@vsnl.net

es.sciencecongress@nic.in

सदस्यता की शर्तें और सदस्यों की विशेषाधिकार/Terms of Membership and Privileges of Members :

संस्था की सदस्यता उन सभी लोगों के लिए खुली हैं, जो स्नातक या उसके समान स्तर पर शैक्षणिक योग्यता अर्जन कर चुके हैं, और जिन्हें भारत में विज्ञान की तरक्की में रुचि हैं।

Membership of the Association is open to person with Graduate or equivalent Academic Qualifications and interested in the advancement of Science in India.

1. **वार्षिक सदस्य** : जो व्यक्ति नये रूप से वार्षिक सदस्यता ग्रहण करना चाहता है उसे वार्षिक सदस्यता शुल्क ₹ 200/- के साथ भर्ती शुल्क ₹ 50/-* (विदेशियों के लिए** U.S. \$ 70) मात्र देने पड़ेंगे। वार्षिक सदस्यता शुल्क प्रत्येक वर्ष के 01 अप्रैल को देय हो जाएगा। जो भी 15 जुलाई के भीतर अपनी सदस्यता शुल्क नहीं अदा कर पाएगा वह उस साल के लिए अपनी वोट देने की क्षमता से वंचित हो जाएगा और/या वह उस वर्ष के लिए संस्था के कार्यालय को भी नियंत्रण नहीं कर पाएगा। वार्षिक सदस्य अपनी सदस्यता दोबारा अगले साल 15 जुलाई के भीतर बिना शुल्क दिए पुनः अपनी सदस्यता प्राप्त कर सकता है।

सदस्यगण अपना पेपर कांग्रेस सत्र के समय पेश कर सकते हैं। उन्हें वार्षिक विज्ञान कांग्रेस सत्र की कार्यविवरण की एक प्रति बिना मूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोजनामचा "एवरीमैन्स साइंस" की प्रति भी बिना मूल्य उस साल के लिए प्राप्त कर सकते हैं। सदस्यता के नवीकरण के लिए कृपया ISCA वेबसाइट से फार्म डाउनलोड करें।

1. **Annual Member** : A person willing to be enrolled as new Annual Member has to pay an annual subscription of ₹ 200/- along with an admission fee of ₹ 50/-* (for foreign ** U.S.\$ 70) only. The annual subscription of a Member shall become due on the 1st April of each year. Anyone who fails to pay the subscription on or before the 15th July in any year shall lose the right of voting and/or holding any office of the Association for that year. A member failing to pay the annual subscription by the end of March of the following year shall cease to be a Member. Annual members can renew their Membership without paying the admission fee in the next year by remitting subscriptions in time i.e. within 15th July. Members may contribute papers for presentation at the Science Congress. They will receive, free of cost, reprints of the Proceedings of the Session of any one section of their interest and also the bi-monthly journal of the Association Everymans Science for that year only. For Renewal of Membership please download the form from ISCA website.

2. **सत्र सदस्य** : यदि कुछ कारणों से वार्षिक सदस्य अपनी सदस्यता उस वर्ष के 15 जुलाई के अंदर दोहराना भूल जाएँ, तो उनकी सदस्यता, सत्र सदस्यता के रूप में बिना वोट डालने की क्षमता में सीमित कर दिया जाएगा। सत्र सदस्यको ₹ 200/- (विदेशियों के लिए \$ 50) अदा करना पड़ेगा। एक सत्र सदस्य को लेख/पोस्टर प्रस्तुतीकरण का अधिकार प्राप्त होगा जिस कांग्रेस सत्र का वह सदस्य है। एक सत्र सदस्य वोट प्रक्रिया में भाग लेने के योग्य नहीं हैं। सत्र सदस्य को विभागों के व्यवसाय बैठकों और साधारण बैठकों में भाग लेने की योग्यता प्राप्त नहीं है।
2. **Sessional Member** : If for some reasons, Annual Members fail to renew their Membership by remitting subscription prior to 15th July each year, their Membership for the year would be restricted to Sessional Membership without voting right. Sessional Member has to pay ₹ 200/- (for foreign \$50). A Sessional Member shall have the right to present paper / poster at the session of the congress of which he/she is a member. A Sessional Member shall not be eligible to participate in the voting process. A Sessional member shall not be eligible to participate in the Business meetings of the Sections and the General Body.
3. **छात्र सदस्य** : जो व्यक्ति स्नातक स्तर से नीचे पढ़ाई कर रहा है, उसे वार्षिक सदस्यता शुल्क ₹ 100/- मात्र देने पड़ेंगे अपना नाम छात्र सदस्य के रूप में लिखवाने के लिए, बशर्ते उसके आवेदन पत्र पर उसके प्राचार्य/विभागाध्यक्ष/संस्थान के प्रधान के हस्ताक्षर हों। एक छात्र सदस्य को यह अधिकार दिया जाएगा, कि वह अपना पेपर कांग्रेस सत्र के समय पेश कर सकें, बशर्ते वह पेपर वह किसी वार्षिक सदस्य या संस्था के कोई अवैतनिक सदस्य के साथ पेश करें। उसे वोट करने का या कार्यालय को नियंत्रण करने का अधिकार प्राप्त नहीं होगा। छात्र सदस्य को विभागों के व्यवसायबैठकों में भाग लेने की योग्यता प्राप्त नहीं है।
3. **Student Member** : A person studying at the under - graduate level may be enrolled as a Student Member by paying an annual subscription of ₹ 100/- **only provided his/her application is duly certified by the Principal/Head of the Institution/Department.** A student member shall have the right to submit papers for presentation at the Session of the Congress of which he / she is a member, provided such papers be communicated through a Member, or an Honorary Member of the Association. He/She shall not have the right to vote or to hold any office. A student member shall not be eligible to participate in the Business Meetings of the Sections and the General Body.
4. **आजीवन सदस्य** : एक सदस्य अपने भविष्य की सारी वार्षिक सदस्यता शुल्क एक बार में ₹ 2,000/- (विदेशियों के लिए U.S.\$ 500) मात्र अदा करके पा सकता है। एक व्यक्ति जो 10 साल या उससे अधिक नियमित रूप से सदस्यता प्राप्त कर चुका है, उसे उसकी संयुक्त सदस्यता शुल्क के ऊपर प्रतिवर्ष ₹ 50/- की छूट दी जाएगी, बशर्ते कि उसकी संयुक्त शुल्क ₹ 1,200/- से नीचे न हों (विदेशियों के लिए U.S.\$ 12.50 और U.S.\$ 300 क्रमशः)। एक आजीवन सदस्य को उसके पूरे जीवन काल में सदस्यता की सारे विशेषाधिकार प्राप्त होंगे।
4. **Life Member** : A Member may compound all future annual subscriptions by paying a single sum of ₹ 2,000/- (for foreign** U.S.\$ 500) only. Any person who has been continuously a member for 10 years or more, shall be allowed a reduction in the compounding fee of ₹ 50/- for every year of such membership, provided that the compounding fee shall not be less than ₹ 1,200/- (for foreign** U.S.\$ 12.50 and U.S.\$ 300 respectively). A life Member shall have all the privileges of a member during his/her lifetime.
5. **संस्थान सदस्य** : एक संस्थान जो ₹ 5,000/- सदस्यता शुल्क के रूप में दे वही संस्था के संस्थान सदस्य उस वित्तीय वर्ष के लिए बन सकता है, (विदेशियों के लिए U.S.\$ 2,500)। इसमें वह विज्ञान कांग्रेस के वार्षिक सत्र में अपने एक व्यक्ति का नाम नामांकित कर सकता है, जो उनका प्रतिनिधि हों। एक संस्थान सदस्य को वार्षिक विज्ञान कांग्रेस

सत्र की कार्यविवरण की एक पूर्ण प्रति बिना मूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोज़नामचा "एवरीमैन्स साइंस" की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

5. **Institutional Member** : An Institution paying a subscription of ₹ 5,000/- (for foreign** U.S.\$ 2,500) only, can become an Institutional Member of the Association for that financial year. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy each of the Associations journal Everymans Science.
6. **दाता** : कोई भी व्यक्ति जो एक साथ ₹ 10,000/- (विदेशियों के लिए U.S. \$ 5,000) मात्र दें, वह संस्था के दाता बन सकते हैं। एक व्यक्तिगत दाता को वह सारे अधिकार और विशेषाधिकार मिलेंगे जो एक सदस्य को उसके पूर्ण जीवन काल में प्राप्त होते हैं।

एक संस्थान जो एक साथ ₹ 50,000/- (विदेशियों के लिए U.S. \$ 25,000) मात्र दें, सदा के लिए इस संस्था के संस्थान दाता बन सकते हैं, जिसे वह एक व्यक्ति को नामांकित करके उसे अपने संस्थान के प्रतिनिधि के रूप में विज्ञान कांग्रेस के वार्षिक सत्र में भेज सकते हैं। एक संस्थान/व्यक्तिगत दाता वार्षिक विज्ञान कांग्रेस के कार्यविवरण और संस्था के रोज़नामचा "एवरीमैन्स साइंस" की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

6. **Donor** : Any person paying a lump sum of ₹ 10,000/- (for foreign ** U.S.\$ 5,000) only, can become an Individual Donor of the Association. An **INDIVIDUAL DONOR** shall have all the rights and privileges of a member during his/her lifetime.

An Institution paying a lump of ₹ 50,000/- (for foreign ** U.S.\$ 25,000) only, can become an **INSTITUTIONAL DONOR** of the Association forever, which shall have the right to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional/ Individual Donor shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also the Associations journal Everymans Science.

* भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रूरी है। यह सत्र सदस्य/आजीवन सदस्य/ संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रूरी नहीं है।

* *Admission fee of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.*

** (एक विदेशी सदस्य का अर्थ है, जो भारतवर्ष के बाहर का नागरिक हों।)

** (A Foreign Member means one who is normally Resident outside India).

- (अ) **पेपर पेश करना** : एक पूर्ण पेपर की प्रति उसके साथ तीन सारांश की प्रति जो 100 शब्दों से ज्यादा न हों और जिसमें कोई आरेख या फार्मूला न हों, वह प्रत्येक वर्ष 15 सितम्बर के अंदर अनुभागीय अध्यक्ष तक पहुँच जाना चाहिए।

(A) **Presentation of Papers** : A copy of complete paper accompanied by an abstract in triplicate not exceeding one hundred words and not containing any diagram or formula, must reach the Sectional President latest by September 15, each year.

- (ब) सभी वर्गों के सदस्य जो विज्ञान कांग्रेस सत्र में भाग लेने के पश्चात लौटते समय के टिकट में रियायत प्राप्त कर सकता है, बशर्ते कि उनकी यात्रा के खर्च का थोड़ा भी भाग सरकार (केन्द्रीय या राज्य),

कोई कानूनी सत्ता या कोई विश्वविद्यालय या कोई नगरपालिका न उठाएँ और उनकी कुल कमाई या परिलब्धियां ₹ 5,000/- (प्रति माह पाँच हजार रुपए) से अधिक नहीं हैं। कृपया ISCA वेबसाइट से रेलवे रियायत फार्म डाउनलोड करें।

- (B) Members of all categories are entitled to **Railway Concession** of return ticket by the same route with such conditions as may be laid down by the Railway Board for travel to attend the Science Congress Session provided that their travelling expenses are not borne, even partly, by the Government (Central or State), Statutory Authority or an University or a City Corporation and their total earning of or emoluments drawn do not exceed ₹ 5,000/- (Rupees Five Thousand per month). Please download the Railway Concession form from ISCA Website.
- (स) संस्था के पुस्तकालय में सभी वर्गों के सदस्य को पढ़ने की सुविधा सुबह 10.00 बजे से शाम को 5.30 बजे तक सभी काम के दिनों में (शनिवार और रविवार) को छोड़कर प्राप्त होगी।
- (C) Members of all categories are entitled to reading facilities between 10.00 a.m. to 5.30 p.m. on all weekdays (except Saturdays & Sundays) in the library of the Association.
- (ड) समय समय पर संस्था द्वारा तय की गई मूल्य दरों पर विश्रामगृह, सभागार आदि सुविधाओं की प्राप्ति भी सभी वर्गों के सदस्य कर सकते हैं।
- (D) Members of all categories may avail Guest House facilities, Lecture Hall hiring at the rates fixed by the Association from time to time.
- (ई) भविष्य में भारतीय विज्ञान कांग्रेस संस्था द्वारा आयोजित परिसंवाद, सम्मेलन और वार्षिक कांग्रेस में सभी वर्गों के सदस्यों द्वारा भाग लेने के लिए अपनी-अपनी सदस्यता पत्र को लाना ज़रूरी होगा।
- (E) Members of all categories should bring the Membership Card always for attending any Seminar, Conference and Annual Congress organized by ISCA in future.

ध्यान दें : (1) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ, और जो कोलकाता के किसी भी शाखा में देय हों। सदस्यों से यह निवेदन किया जा रहा है, कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के वक्त अवश्य करें।

(2) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा। कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।

(3) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।

Note : (1) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association* Payable at any branch in Kolkata. Members are requested to mention their Membership No. while making any correspondence to ISCA office.

(2) No money order, I.P.O., ECS or cheque will be accepted by ISCA. No Membership will be taken without duly filled in prescribed Membership Form (Application Form for New Membership/ Application for Renewal of Membership).

(3) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the Cash by Post within the envelope.



भारतीय विज्ञान कांग्रेस संस्था

14, डॉ० बिरेश गुहा स्ट्रीट, कोलकाता - 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata-700 017, INDIA

दूरभाष/Telephone : (033) 2287-4530, 2281-5323

फैक्स/Fax : 91-33-2287-2551

वेबसाइट/Website : <http://sciencecongress.nic.in>

ई-मेल/E-mail : iscacal@vsnl.net

es.sciencecongress@nic.in

सदस्यता के लिए नया आवेदन पत्र / Application Form For New Membership

सेवा में/To

महासचिव (सदस्यता कार्य)/ The General Secretary (Membership Affairs)

भारतीय विज्ञान कांग्रेस संस्था/The Indian Science Congress Association

14, डॉ० बिरेश गुहा स्ट्रीट/14, Dr. Biresh Guha Street,

कोलकाता - 700 017/Kolkata - 700 017

महोदय/Dear Sir,

मैं भारतीय विज्ञान कांग्रेस संस्था का आजीवन सदस्य/वार्षिक सदस्य/सत्र सदस्य/छात्र सदस्य/संस्थान सदस्य/व्यक्तिगत दाता/संस्थागत दाता अपना नाम लिखवाना चाहता/चाहती हूँ।

I like to be enrolled as a Life Member/Annual Member/Sessional Member/Student Member/Institutional Member/Individual Donor/Institutional Donor of The Indian Science Congress Association. (Pl. Tick)

मैं इसके साथ ----- सदस्यता शुल्क के रूप में नक़द ₹ -----/बैंक ड्राफ्ट संख्या ----- दिनांकित ----- प्रचालक बैंक ----- 01 अप्रैल 20--- से 31 मार्च 20--- तक भेज रहा/रही हूँ।

I am sending herewith an amount of ₹ in payment of my subscription by Cash/Bank Draft No. dated issuing bank from the year 1st April 20 to 31st March 20.

मैं निम्नलिखित विभाग में रुचि रखता/रखती हूँ (कृपया किसी एक में निशान लगाएँ)/ I am interested in the following section (Please tick any one).

विभाग/Sections

1. कृषि और वानिकी विज्ञान/Agriculture and Forestry Sciences
2. पशु, पशुचिकित्सा और मत्स्य विज्ञान/Animal, Veterinary and Fishery Sciences
3. मानवशास्त्रीय और व्यवहारपरक विज्ञान (जिसमें सम्मिलित हैं, पुरातत्व-विज्ञान, मनोविज्ञान, शैक्षिक विज्ञान और सेना विज्ञान)/Anthropological and Behavioural Sciences (including Archaeology, Psychology, Education and Military Sciences)
4. रसायन विज्ञान/Chemical Sciences

5. भू-पद्धति विज्ञान/Earth System Sciences
6. अभियन्ता विज्ञान/Engineering Sciences
7. पर्यावरण विज्ञान/Environmental Sciences
8. सूचना और संचारण विज्ञान और प्रौद्योगिकी (जिसमें कंप्यूटर विज्ञान भी सम्मिलित है)/Information and Communication Science & Technology (including Computer Sciences)
9. भौतिक विज्ञान/Materials Science
10. गणित विज्ञान (जिसमें सांख्यिकीय सम्मिलित है)/Mathematical Sciences (including Statistics)
11. चिकित्सा शास्त्र (जिसमें शरीर विज्ञान भी सम्मिलित है)/Medical Sciences (including Physiology)
12. नया जीवविज्ञान (जिसमें जीव रसायन, जीव भौतिकी और आणविक जीवविज्ञान और जीव-प्रौद्योगिकी भी सम्मिलित है)/New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. भौतिकीय विज्ञान/Physical Sciences
14. वनस्पति विज्ञान/Plant Sciences

(कृपया टंकित करें या ब्लॉक अक्षरों में भरें/Please type or fill up in Block Letters)

नाम/Name (ब्लॉक अक्षरों में/in Block Letters) :

श्री/सुश्री/श्री/श्रीमती/डॉ॰/प्रो॰/Mr./Ms./Shri/Shrimati/Dr./Prof (कृपया टिक करें)/(Please tick)

कुलनाम/Surname

प्रथम नाम/First Name

मध्य नाम/Middle Name

शैक्षणिक योग्यता/Academic Qualifications :

(अंतिम शैक्षणिक योग्यता प्रमाण-पत्र अंक-सूची का स्वतः सत्यापित जिराक्स प्रति संलग्न करना है / Self attested xerox copy of last educational certificate/marksheet must be attached)

पदनाम/Designation

सम्पर्क का पता/Address of communication :

(राज्य, शहर/नगर और पिन कोड सहित/including state, city/town and pin code)

दूरभाष संख्या/मोबाईल संख्या और ई-मेल/Phone No./Mobile Number & E-mail :

स्थायी पता/Permanent Address :

टिप्पणी (अगर कोई)/Comments (if any)

दिनांक/Date :

भवदीय/Yours Faithfully

हस्ताक्षर/Signature

ध्यान दें : (i) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ और जो कोलकाता के किसी भी शाखा में देय हों।

- Note :** (i) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association* Payable at any branch in Kolkata.
- (ii) सभी सदस्यता और सदस्यता के नवीकरण के लिए आवेदन-पत्र आवेदकों को अपने खुद के पते उपलब्ध कराके करने चाहिए न कि देखभाल के पते प्रस्तुत करने चाहिए।
- (ii) All Application Forms for Membership and the renewal of Membership must be submitted by providing the address of the applicants themselves only and not any care of address.
- (iii) भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रूरी है। यह सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रूरी नहीं है।
- (iii) Admission fee of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.
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- (iv) Members are requested to mention their Membership No. while making any correspondence to ISCA office.
- (v) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा।
- (v) No Money order, I.P.O., ECS or Cheque will be accepted by ISCA.
- (vi) कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।
- (vi) No Membership will be taken without duly filled in prescribed Membership Form (Application Form for New Membership/Application For Renewal of Membership)
- (vii) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।
- (vii) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the cash by Post within the envelope.