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EDITORIAL

Home Remedies for Dengue & Prevention of Spread of Dengue by Sterilized Mosquitoes

(International Anti Dengue Day on 15 June)

Dengue is a worldwide problem where more than one third population in the World live in the risk prone area of dengue. Most risky areas for dengue are tropical and sub-tropical areas. At present time ~400 million people are infected. Dengue fever is a disease caused by a family of viruses. Dengue is also called as a break bone fever. It is transmitted by mosquitoes. Dengue fever virus (DENV) is an RNA virus of the Family Flaviviridae and Genus is flavivirus. A symptom of dengue includes fever, headache, muscle and joint pains and skin rashes similar to that of measles. There are three types of manifestation due to dengue infection 1) Dengue fever(DF): Dengue fever is expressed as common febrile illness associated with headache, nausea/ vomiting, redness of eye and in some instances with rashes 2) Dengue Hemorrhagic Fever (DHF): In these cases high rise of fever, rashes and bleeding from soft tissues like gum, blood vomiting, malena and haematuria occurs. Moreover, there is a tendency towards decreasing platelets 3) Dengue Shock Syndrome (DSS): In these cases high rise of fever, sudden fall of temperature, Kalmy skin and vacant look occurs. In these cases also platelet decreases. When infection is early detected supportive treatments are given which can lower the risk of medical complications and death.

Dengue virus is primary transmitted by *Aedes aegypti* mosquitoes. Humans are primary hosts but it also circulates in non-human primates. Dengue can also be transmitted by infected blood and infected organ donation.

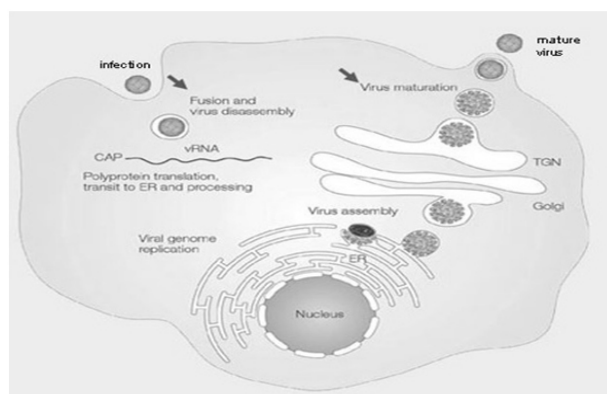


Fig: 1 Life Cycle of Dengue

Life cycle of Dengue virus involves endocytosis *via* cell surface receptor. Dengue virus uncoats intracellularly *via* a specific process. At the time of infection envelopes protein lays flat on the cell surface of the virus, it forms smooth coats with icosahedral symmetry and then virus is carried out into the cells and lysosomes in the acidic environment of the cell and lysosomes cause the protein to form into a different shape and then assembling into trimeric spike. Several hydrophobic amino acids found into the tip of spike along with inserting by into the lysosomal membrane and cause the virus membrane to fuse with lysosome as a result, viral RNA is released in the cell and infection starts.

Dengue virus contains RNA genome. In infected cells, translated by the host ribosomes it leads to translated polyprotein being subsequently cleaved by cellular & viral proteases at specific site and non-structural protein is the result of the negative

sense intermediate to replicate the positive sense RNA genome and its association with capsid protein, packaged into individuals viron and replication of all positive strand. RNA virus is in closer association with virus induced intracellular membrane structure. Dengue virus also induces the rearrangement of intracellular membranes called replication complex.

Dengue incubation period ranges from 3 to 14 days and most critical in 4 to 7 days. The characteristic symptoms of dengue in febrile phase is sudden onset fever, headache, mouth and nose bleeding, muscle and joint pain vomiting, diarrhoea and rashes just like measles. In critical phase symptoms are hypotension, pleural effusion ascites and gastrointestinal bleeding and recovery phase is altered level of consciousness, seizures itching and slow heart rate. Some of the home remedies for recovery of dengue are being reported by several groups of scientists which needs extensive research to find out the most effective active principle. These are as follows:(i) Barley Grass: - barley grass has effect on rapid increase of blood platelets counts if it is taken directly or with tea. Goldenseal:- (ii) goldenseal is with natural antiviral capacity that can cure dengue fever in a matter of days. It's ability to clear up symptoms of dengue fever and eliminate dengue virus which should be focussed. (iii) Neem leaves: - neem leaves increase blood platelet counts and white blood cell. Properly brewed neem leaves

can improve the immune system. (iv) Organic juice: - organic juice can prevent secondary symptoms of dengue fever and eliminate dengue virus. (v) Papaya leaves: - papaya leaves are widely known as being a natural cure for dengue fever. It increases platelet count. Moreover, the high level of vitamin 'C' help to stimulate the immune system. (vi) Basil: - basil also stimulate immune system and helps in the treatment of dengue fever. (vii) Fenugreek: - fenugreek is useful for sleep of patients of dengue and also reduces fever.

Chinese researchers claims to develop mosquitoes that prevent spread of dengue. In China researchers and medical experts are finding new ways to control spread of dengue. China has established the world's largest mosquito factory – sterilized mosquito's. XIzhiyoung and his team has work on sterilized mosquitos. It can breed symbiotic bacteria called Wolbachina in the mosquito responsible for the spread of dengue called *Aedes albopictus*. Walbachina is known to live inside the cells of an insect only and has the ability to kill dengue virus. Researchers believe that releasing sterilized mosquitos into the environment may help to kill the population of dengue virus. According to them these bacteria target the virus by stopping its replication inside the mosquitoes but it cannot survive inside human bodies and mosquitoes carrying bacteria pose no harm to human.

*Dr. (Mrs.) Vijay Laxmi Saxena
Kanpur*

*Diseases can rarely be eliminated through early diagnosis
or good treatment, but prevention can eliminate disease.
-Denis Burkitt*

ETHNO-BOTANICAL STUDIES ON KATKARI TRIBALS OF MAHARASHTRA

G.V. Rao and T. Samadhan

Ethnobotany is the study of plants used by primitive and aboriginal people. It has become an important and crucial area of research and development. The primitive societies in our country are dependent on herbal medicines from the time memorial. The knowledge of Ethnobotany plays vital role in the primary health care and economy of tribals. The habitat and environment of useful folklore through generations are also changing due to unplanned management of environment. Therefore, it is important that the oral folklore about the plants must be preserved and property documented before it is lost forever.

INTRODUCTION

The Term Ethno botany was coined by J.W. Harshberger in 1895 to include the study of plants used by primitive and aboriginal people. Though this discipline has existed for ages, ethno botany emerged as a distinct academic branch of natural science in 20th century.

Due to interdisciplinary nature and socio-economic impacts, the linkages of Ethnobotany have proliferated.

Ethnobotany thus has relevance with problems of nutrition, health care and life supporting social customs, mythological association or for in plant, cottage industries, economic upliftment, conservation of bio-diversity and sustainable use of plant resources.

There are over 200 tribes in different states in India. These tribal communities utilize ethnomedicinal plant for dysentery, fever, piles, snakebites, jaundice etc. (Table No.1).

The information provided in this paper is based upon the field work conducted on the Folklore on Katkari Tribal of Village Turmal wadi and Tuksai wadi which is 20 km away from Khopoli and 23 km from Pali of Taluka Khalapur, Raigad district in Maharashtra state.

Folklore is medium through which the soul of

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the human being expresses itself colourfully and in such creation it finds an artistic fulfillment and entertainment. Myths, legends and folklore all being parts of the same oral tradition intertwine and influence each other. Themes from mythology sometimes occur in legends, while in simple culture myths are hard to separate from folktales. Mythology is closely bound up with religion. Its concern is with matters that shape the lives of men, the creation of the world, the origin of life and the meaning of death, etc.

Myths are set in a distant and unrecognizable past. Legends on the other hand, have a known historical past. In legends, facts are molded in an imaginative or even fantastic way, their heroes often possessing magical or super natural powers. But they are rooted in reality. Folklore includes songs and ballads, dances and music and traditional customs and beliefs. All these are important in maintaining a culture.

In the present work, within the limited space and obviously with a view to secure the appeal to wider public, it has been possible for us just to present some of the collections of the Floklore of Katkari tribe of Turmal wadi and Tuksai wadi villages in Raigad district of Maharashtra. The major information provided here is based on plants used by tribals for various diseases.

The total area covered by Raigad district is

Table.1: List of the Medicinal Plants used by Katkari Tribals.

Sr. No.	Plant Name		Family	Plant part used	Medicinal use
	Botanical	Vernacular			
1	<i>Achyranthes aspera</i>	Aghada	Amaranthaceae	Leaves, Root, whole plant	Scabies to cure corn, Cut & Wounds
2	<i>Azanza lampas</i>	Ran -Bhendi	Malvaceae	Root	Jaundice, Dysentery excess menstruation & Spermatorrhoea
3	<i>Blumea fistulosa</i>	Bhamurdi	Asteraceae	Leaves	Stomach Swelling, Cuts and Wounds
4	<i>Cajanus cajan</i>	Tur	Fabaceae	Leaves	Dysentery, Stomach Swelling, Toothache
5	<i>Calotropis gigantea</i>	Rui	Asclepiadaceae	Latex	Centipede Bite, Dog Bite, Pud formation in boils, Piles
6	<i>Calycopteris floribunda</i>	Baguli	Combretaceae	Leaves	Diarrhoea, Dysentery, Stomach ache
7	<i>Careya arborea</i>	Kumbhi	Lecythidaceae	Bark	Dysentery
8	<i>Cissampelos pariera</i>	Pahadvel	Menispermaceae	Root	Dysentery, Indigestion, Urinary Inflammation
9	<i>Cocculus hirsutus</i>	Tanvel	Menispermaceae	Stem, Whole Plant, Leaves	Dysentery, Diarrhoea in small children, Jaundice, Sore eyes, Intestinal ulcers
10	<i>Cordia dichotama</i>	Bhokar	Boraginaceae	Sapwood, Bark, Leaves	Excess Menstruation, Fracture, Stomachache, Headache
11	<i>Cuscuta reflexa</i>	Amarvel	Convolvulaceae	Seeds, Whole plant	Stomach Swelling, Old Wounds, Itching
12	<i>Hemidesmus indicus</i>	Anantmul	Apocynaceae	Leaves, Latex, Root	Cataract, Inflammation of eyes, Heat
13	<i>Hygrophila schulli</i>	Katari	Acanthaceae	Leaves, Whole Plant	Eczema, Urinary Problems
14	<i>Lantana camara</i>	Ghaneri	Verbenaceae	Leaves	Excess Menstruation
15	<i>Lawsonia inermis</i>	Mendhi	Lythraceae	Bark, Leaves	Burns and scalds, Headache
16	<i>Mangifera indica</i>	Amba	Anacardiaceae	Seeds of young fruit	Dysentery

17	<i>Oroxylum indicum</i>	Tetu	Bignoniaceae	Bark, Root Bark	Acidity, Diarrhoea, Dysentery
18	<i>Psidium guava</i>	Peru	Myrtaceae	Leaves	Dysentery in small children
19	<i>Solena angulata</i>	Gometichi Vel	Cucurbitaceae	Ripe Fruits, Seeds	Skin Diseases, Backache
20	<i>Tectona grandis</i>	Saya	Verbenaceae	Bark, Root	Spermatorrhoea, Retention of Urine

15,530sq.km where these Katkari tribes reside in hilly region covered with Tropical Moist Deciduous Forests. The common plant species found are *Tectona grandis* (Teak), *Madhuca indica* (Moha), *Butea monosperma* (Palash), *Terminalia cremulata* (Aien), *Bridelia retusa* (Asana), *Lagerstroemia parviflora* (Bondara), *Acacia catechu* (Khair), *Carissa carandas* (Karvanda), *Calycopteris floribunda* (Ukshi), *Woodfordia fruticosa* (Dhayati) etc.

The valuable timber species found in the region (Sag, Ain, Asana, Heddu, Kalamb, Shivan, Shisav, Moha etc.) are a curse on the forests. Large-scale deforestation in the region has destabilized the subsistence economy of tribals. Availability of foods from the forests has decreased and food security has become a major issue. People are becoming increasingly dependent on agriculture for their food needs. Loss of forests and trees from slopes and hillside is resulting in severe soil erosion, decreasing soil fertility and water shortages.

Here, brief information is given regarding their general feature and customs. This community represents primitive culture and thus furnishes fruitful materials in the study of Social Anthropology for a comparative study and clear comprehension of the earlier stages in the evolution of human culture.

Katkari, Kathkari or Kathodi is one of three 'Primitive Tribal Groups' in Maharashtra along with Madhia Gond and Kolam. The name Katkari is reported to have been derived from their profession

of Making "Kath" or *catechu* from the *Acacia catechu* (Khair tree). Katkaris are known for their physical strength, endurance and hunting-gathering skills.

Katkaris are socially and economically on the lowest rungs of the development ladder. Most of the families are caught up in a vicious cycle of poverty, indebtedness and bonded labour. All able-bodied men, women and children work as bonded labour on brick kilns in far away places.

The entire Katkari tribe has, at one time or another, been experts in specific professions. For instance, the occupation of making Kath was speciality of Katkaris. The number of Katkaris practicing this trade gradually declined as the population of Khair trees went down and a ban was imposed on the felling of the tree (around 1968). The Katakris then collectively became expert charcoal makers until the Government of Maharashtra banned the making of charcoal from wood (around 1985). It was at this point of time that the Katkaris turned towards brick making. Today the Katkaris are considered expert brick makers and the entire group is engaged in this profession.

The Katkari tribe resides in remote hilly region of Raigad districts. The custom of early marriage is still common amongst the Katkaris. Girls marry at an age of 10-14 years and boy 20-25, they look almost old. The Government of Maharashtra does not have any data on child mortality, deaths during pregnancy, etc. but these are common amongst Katkaris.

Katkaris continue to be hunter-gatherers when

they are not working as bonded labour on brick kilns. They have tremendous knowledge about uncultivated foods like fish, crabs, animals, bird's tubers/rhizomes, wild vegetables, fruits, nuts, etc. It is indeed amazing to see Katkari women drawing out crabs from their holes during summer months by rubbing two stones to imitate the sound of cloudbursts.

Katkaris are expert fishermen, swimmers, drivers, archers and marksmen. They are famous for their strength, endurance and hunting-gathering skills. Katkaris are the only tribal group (in Raigad-Thane region) who eat rodents (they even have a religious festival pertaining to rodents). Katkaris not only catch rodents, they also track down the food grains stored by rodents in their burrows. Food grains collected from the burrows are an important source of nutrition during food deficit periods.

The Katkaris are labourers and firewood sellers. Their women are hard workers and help them by hawking head loads of firewood. Katkaris, as a rule, are much darker and slimmer than the other forest tribes. Their women are tall and slim, singularly dirty and unkempt, and the children can always be known by their gaunt and pinched look. They have no particular language and show no signs of ever having had one. They rank among the very lowest tribes, their touch being thought to defile.

Due to low literacy rate these tribals rely upon agriculture for their meals. They do not take advantage of various schemes for their welfare by Government. Government had established various 'Boarding schools' where tribal children were educated free of cost, food and lodging and boarding is also free for them. Books and Cloths were provided by government.

Poor economic status, unsatisfactory local hygienic conditions and malnutrition with lack of modern health care service are the causes for concern for these tribal folk. Such local inhabitants along with their livestock are mainly dependent on 'traditional barefoot doctor' and his time-tested medicines to overcome illness. These tribal folks believe that various ailments are due to the

punishment given by god for their own misbehavior. A tribal medicine man examines patients in his traditional way. He advises patients to observe good conduct, to owe offering to their god and also gives some plant-based medicines.

It is observed that many – a – times when there is no cure by modern medicine, civilized patients also approach tribal bare-foot doctors. In these attempts, sometimes miraculous results are experienced which are difficult to analyze using modern laboratory tools. All these traditions are kept secret till today and passed on to the next generation carefully.

Katkari people believe in witchcraft and black magic and hence for any disease they prefer to use some plants or go to Bhagat (priest) in the village, a person who is well aware with medicinal plants and who knows some magic. These Bhagats or Mantrik sometimes cure people and sometimes harm them by doing some black magic. The old custom of doing witchcraft still exists in villages and sometimes people are using black magic. These people blindly follow the old traditions followed by their ancestors. Now a day's some of these people are literate and have migrated towards cities in search of jobs. They still follow their old traditions.

Government had established centers like 'Adivasi Vikas Bhavans' (Tribal Development Centers) for upliftment of tribals with its head office in Pune, which conducts surveys and give opportunity to the young tribals for employment. Thus government had taken some steps for development of these tribals.

The Katkari tribe celebrates mainly Shimga and Gudhipadava festivals. During Gudhipadava the Katkari tribes go to the Dogar devi (Mountain goddess) called as Kalkai Devi whose small temple is located on the top of the mountain near their villages. Once in a year the Katkaris visit to the Kalkai Devi temple during Gudhipadava. Katkaris offer Ghat (Metal Bell), *Cocos nucifera* (Coconut) and Agarbatti (Incense Sticks), Diyas, Yellow and Saffron flags to the Devi. They also offer *Tagetes erectus* (Marigold) and *Plumeria alba* (Chafa) to the Devi. During the visit to the mountain Katkaris to

fulfill their wishes they sacrifice Goats and Hens to the Devi. They believe that by doing this the Goddess will fulfill their wishes.

Agriculture is the main occupation of Katkari tribe. *Oryza sativa* (Paddy) is the major crop cultivated in Raigad district. Besides this *Cajanus cajan* (Tur), *Eleusine coracana* (Nachani) and *Phaseolus mungo* (Udad) are also cultivated in small scale.

Fruits like wild *Mangifera inidca* (Mango), *Carissa carandas* (Karvand) and *Colocasia esculenta* (Alu) etc is collected from Forest and sold in small quantity in different villages and towns.

The tribals work in fields owned by other peoples. These people are known as 'Ardalni Kasdars', who work on yearly basis in the fields. At the time of harvesting the owners of field provide food and half of the total crop cultivated.

Goat farming is side business along with the farming. Fishing is done on small scale by the people in rivers throughout the year.

A majority of the Katkari families are landless. Those who own land generally do not have any paddy fields. As a result Katkaris have not turned towards agriculture for their livelihood. However, some of them have been cultivating crops on forest land. It is indeed a sorry state of affairs that tribals, who are the original inhabitants of this land, are today landless and staying on land owned by someone else. It is sad to hear Katkaris being termed "encroachers".

Families migrate to brick kilns for 6-7 months during the dry period, returning to their villages in the months of monsoon. Work on the brick kiln begins at 6-7 a.m. in the morning and goes on till 7-8 p.m. Men, women, adolescent girls and small children work in the harsh conditions. Each Katkari family is allowed to build a small makeshift hut.

A Katkari family (husband, wife and small children) makes about 1,500 bricks per day. The Katkaris work for 6 days in week, the weekly bazaar day being an off day. Each family earns upto Rs.4,800 per month. Katkaris work for 6 to 7 months on brick kilns. So in a year, each family earns around

Rs.29,000 to 33,600.

For house building, these peoples used *Tectona grandis* (Sagwan) as the pillar to give support to the ceiling which is made of *Bambusa arundenecia* (Bamboo).

The walls are made of Bamboo strips and *Leea macrophylla* (Dinda) stems. The walls are applied with a paste made up of mixture of cow dung and clay which is pasted on the walls.

They keep on applying cow dung on the wall and floor in their houses. There is no proper sanitation system and all these factors add to microbial, fungal and insect growth which results in debility and disorders.

Katkaris keeps animals like goats and hens under one roof along with human beings which causes infectious diseases. They store grains in drums made of *Bambusa arundenecia* (Bamboo) strips pasted with cow dung. On main door they draw pictures of different types of flowers and trees.

After harvest, the crops were arranged in bunches near the fields for further processing viz cutting and separating grains from the pods. Katkaris arrange crop in bunches usually upto 8 to 10 feet in height with circular arrangement called as "Malani". The tribal stay here for some days after the crop is harvested to protect the grains from grazing animals.

The crops are traditionally processed by hand. The place is cleaned and pasted with soil and cow dung where the crop is to be processed to separate the grains like rice. The crop is then taken in small bunches and then beaten down on big stones or on drums. The remaining paddy and other waste material are then given to the animals as fodder.

The typical way of dressing of the Katkaris distinguishes them from, the local non-tribals. The men generally wear a loincloth, a blanket, and some tattered cloth round their heads.

Then women wear green, blue or brown print sarees which is the traditional dress with $\frac{3}{4}$ th sarees around the body. The women wear a robe and no bodice.

CONCLUSION

The primitive societies in India have been dependent on herbal medicines from the time immemorial. In fact, all traditional systems of medicines had their roots and origin in folk medicines or ethnomedicines. The knowledge of Ethnobotany plays a vital role in the primary health care and economy of tribal and aboriginal population of our country and has potential for the discovery of new herbal drugs.

The habitat and environment where the tribal have learnt useful folk-lore through generations are also changing due to deforestation and unplanned management of environment. It is therefore, important that the oral folk-lore about the plants must be preserved and properly documented before it is lost forever.

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HIGH ALTITUDE HYPOBARIC HYPOXIA: PARADOXICAL EFFECTS ON DNA DAMAGE AND METABOLIC PERFORMANCE

Uma Addepally*¹, Chiranjeevi Thulluri¹ and Pranit Mallela²

Increased DNA damage that is expected at high altitude hypoxic conditions impacts mitochondrial biogenesis through PARP, SIRT1 and AMP kinase. It is interesting to gain insights into how the balance between NAD⁺/NADH is maintained and how the activities of SIRT1, AMP Kinase, PGC1 α are altered. Some of these molecules may act as lead molecules in the phenomenon of hypobaric hypoxic stress, either as biomarkers or as drug targets or to decipher the molecular mechanisms associated with the given stress phenomenon and also insights about the effect of DNA damage on the regulation of metabolism with a concomitant impact on physical performance of the individual.

INTRODUCTION

Molecular oxygen is vital to the survival of all mammalian cells as a terminal acceptor of electrons in the Electron Transport Chain (ETC) during oxidative processes. Oxygen tension in mammalian tissues varies as much as 150mm Hg in the lungs, 40mm Hg in venous blood and less than 10 mm Hg in ischemic conditions¹. Barometric pressure decreases with increasing altitude, thereby decreasing the partial pressure of oxygen. This results in the reduced ability of oxygen to diffuse from the atmospheric air to the blood and tissues. Other distinct environmental conditions such as: extreme cold, low humidity and low barometric pressure observed in high altitudes may induce physiological complications which include cardio, respiratory, endocrine, metabolic, nutritional and thermal homeostasis. These complications can be attributed to hypoxia, a condition in which the body experiences deprived supply of oxygen. Concomitant oxidative stress can be a result of hypoxia as they may cohesively impact the body's physical performance^{2,3}.

Oxidative stress defines an imbalance between the Reactive Oxygen and Nitrogen species (RONS)

formed and reduced ability of anti-oxidative defense mechanisms⁴. Many mammalian species inherently possess defense mechanisms to counteract RONS. The cellular and molecular adaptive responses to oxidative stress involve increased expression of phase II detoxification enzymes, and stress-inducible cytoprotective genes. In unison, their purpose is to reverse the oxidant imbalance and achieve cellular homeostasis. The ability and efficacy of these adaptive responses to achieve and maintain redox homeostasis dictate whether the cell or organ will survive the oxidant burden. The antioxidant enzyme system suffers from weakened effectiveness at high altitudes⁵.

One of the targets of excess RONS generated either from normal cellular metabolism or due to the effect of external sources is DNA. DNA, unlike proteins, lipids and RNA, cannot be replaced when damaged and thus must be repaired⁶. Potential DNA damage includes single-strand breaks (SSBs), double-strand breaks (DSBs), mismatches, chemical modifications of the bases or sugars and inter- or intra strand cross-links⁷. To avoid the detriments of damage accumulation, multiple DNA repair pathways have evolved-each pathway associated with a specific class of lesions. In mammalian cells, there are at least four major pathways of DNA repair:

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First, a simple reversal of the damage. Nucleotide Excision Repair (NER) is the second pathway, which includes mismatch and transcription-coupled repair. The third is base excision repair (BER). Finally, recombination repair including non-homologous end joining. BER is, perhaps, the most fundamental and ubiquitous DNA repair mechanism in all higher organisms, as it has evolved to handle several minor alterations. These include spontaneous modification, oxidation, deamination and loss of bases that can occur in the structure of DNA as a result of cellular metabolic activity⁵. High-altitude hypoxia may induce DNA damage that may be repaired by BER pathways during G1 phase of the cell cycle⁵.

Several factors come into play after DNA damage. Amongst, Poly ADP Ribosyl Phosphorylase-1 (PARP1) and PARP-2 are the ones which rapidly recognize DNA-strand breaks and trigger the self-activation process⁸. Activated PARPs hydrolyze β NAD⁺, and catalyze transfer of ADP-ribose moiety onto amino acid residues of proteins (Fig.1)⁸.

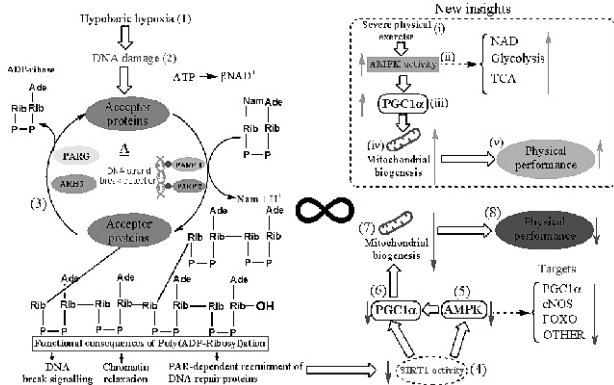


Fig. 1. Effects of high altitude hypobaric hypoxia on DNA damage and metabolic performance

The acceptor proteins are usually involved in chromatin structure and transcription as well as DNA repair. Poly ADP-ribosylation of proteins has functional consequences like DNA-break signaling, Chromatin relaxation and recruitment of DNA repair proteins⁹. DNA damage which recruits PARP and its co-substrate, NAD⁺ may lead to cellular depletion

of the latter based on the severity of DNA damage with a concomitant affect on the catabolic pathways involved in NADH generation (Glycolysis, TCA, β -oxidation of lipids etc.). The reducing energy from biomolecules during oxidation is transferred to NAD⁺ resulting in NADH which subsequently is oxidized in electron transport chain to yield ATP.

Reduced levels of NAD⁺ due to excess PARP1 and PARP2 inhibit the production of SIRT1 and other NAD⁺ dependent enzymes¹⁴. Another repercussion that stems from PARP activation is PARP1 and PARP-2 bind to the SIRT1(silent mating type information regulation 2 homolog) promoter, inhibiting transcription and resulting in reduced SIRT1 levels through different pathways. SIRT1 affects metabolism by deacetylating the key transcriptional regulators of energy expenditure. Reduced levels of SIRT1 activity would reduce the deacetylation rate of several transcriptional regulators like peroxisome proliferators-activated receptor- γ co-activator (PGC-1 α)¹⁰. The resulting hyperacetylation of PGC-1 α would then decrease mitochondrial-related gene expression, hence, greatly impacting the metabolism¹¹. Therefore, the possible effect of PARP activation is minimization of oxidative metabolism through SIRT1 deactivation; the consequence of this deactivation being decreased energy expenditure and decreased mitochondrial content.

Another molecule that acts along with SIRT1 is AMP kinase. AMPK serves as a master sensor of the cell's energy status. Mammalian AMP kinase is a Ser/Thr kinase that is activated in lieu of alterations in this ratio due to either defective energy production or increased energy consumption will activate the kinase. Once activated, AMPK switches on catabolic pathways to produce ATP while simultaneously shutting down energy-consuming anaerobic processes. In order to perform these actions, AMPK can quickly regulate metabolic enzymes through direct phosphorylation.

As a caveat, AMPK also has long-term effects at the transcriptional level in order to adapt gene

expression to energy demands. In the event of energy deficiency, AMPK will enhance the expression of genes related to glucose transport, glycolysis¹² and mitochondrial respiration¹³ while down regulating lipid synthesis genes¹⁴, which in turn regulate the activity of numerous metabolic enzymes¹⁵. When ATP depletion remains protracted, AMPK will phosphorylate a number of transcription factors and transcription co-regulators related to the metabolism (such as HNF-4 α , FoxO3A (formerly identified as FKHR-L1), PGC1 α (peroxisome proliferator-activated receptor- γ co-activator 1 α), and p300)¹⁶. SIRT1 and AMPK actions regulate lipid oxidation and mitochondrial biogenesis by converging via PGC1 α (peroxisome proliferator-activated receptor- γ co-activator 1 α). These factors are also the regulation targets for SIRT1. In turn, SIRT1 regulates AMP kinase activity. Severe physical exercise can activate AMP kinase which improves glycolysis and mitochondrial biogenesis through PGC1 α and generates the required levels of NAD⁺. This situation can be further promoted by hypoxia induced ROS generation by mitochondria at Complex III leading to transcriptional activation of erythropoietin, glycolytic enzymes, and vascular endothelial growth factor.

Therefore, it appears likely that there are two factors which work paradoxically: One is deployment of PARP to attend DNA damage which depletes the levels of cofactor-oxidized form of NAD. Second is increased physical exercise which can increase the levels of AMP kinase to improve upon mitochondrial biogenesis, but, NAD⁺ as the acceptor of reducing equivalents in the catabolic pathways is a limiting factor.

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EARTHWORMS: NATURE'S GIFT TO MANKIND

Pulikeshi M. Biradar

Earthworms play an important role in the nature; hence, they are called as 'friend of farmers', 'plough man of earth', 'Cinderella of organic farming' etc. Earthworms are also known as 'planets soil processors and builders' as they significantly modify the physical, chemical and biological properties of soil. Earthworms are one of the earth's original recyclers and composters and they perform great service by liberating essential nutrients into soluble forms so that plants can easily utilize them. There are more than 4400 variety of earthworms perfectly designed to work without arms, eyes and ears. Hence, they need no further evolutionary adaptation and have been this way for millions of years. Some special kinds of earthworms contribute much more in the organic waste management and in the production of vermicompost in the form of valuable bio- fertilizer.

INTRODUCTION

Earthworms may lack the charm or excitement compared to other animals, as they are unrecognised soil creatures play a vital role within the natural soil ecosystem. They are valued for their contribution to ecosystem through their action on soil processes.

WHAT ARE EARTHWORMS?

Earthworms are specific group of invertebrate animals belongs to the class Oligochaeta within the taxonomic phylum Annelida. Earthworms are terrestrial have permeable skin always maintain moist for respiration and not to dry. Earthworms need few requirements such as darkness, moist environment; with plenty of food. Earthworms consume any non toxic organic matter such as old news paper, plant organic wastes, kitchen garbage wastes etc and produce nature's perfect fertilizer through the actions of enzymes and bacteria present in their digestive tract. They perform a great service by liberating essential nutrients into soluble forms that can be easily utilized by plants.

Earthworms are the planet's perfect soil processors and builders through their constant burrowing activity, they improve aeration in the soil,

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water holding capacity of soil, bring up mineral elements from the subsoil, breakup hardpans, create fertile channels, liberate essential plant nutrients into soluble forms and neutralizes soil that are too acid or too alkaline that facilitates the growth of all kinds of plants.

Earthworms are one of the most streamlined creatures on this planet, tapered at both the ends. It works in the darkness so it needs no eyes, no visible ears, no arms or legs. Hence, earthworms need no further evolutionary adaptation because it is same as it is since from millions of years.

Earthworms are cold blooded animals. They are slimy form with a film of mucus helps to hold moisture. The evaporation of its moisture helps to keep the earthworms cool and must keep moist in order to survive. The mucus layer has other important functions such as it is an effective lubricant that helps the earthworm to burrow through dense, rough soils. Mucus also serve as an important reproductive function as two earthworms mate, a special type of mucus is secreted that helps earthworms to protect the spermatozoa while copulation.

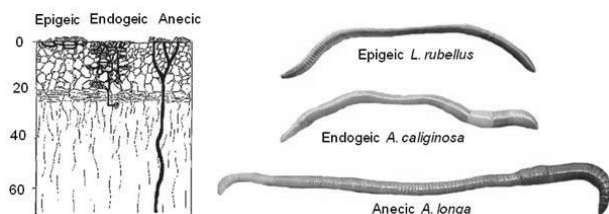
Earthworms are neither male nor female; they are hermaphrodite, which means they have both male and female reproductive organs can mate with any other adult worm (within its own species).

Earthworms will mate any time if the conditions are favourable such as temperature and soil moisture that will determine the reproduction.

KINDS OF EARTHWORMS

Scientists so far have discovered and named more than 4400 species of earthworms in this planet, they can be grouped into three basic categories based on their ecological niche and habitat

- 1) Epigeic earthworms
- 2) Endogeic earthworms
- 3) Anecic earthworms



1. Epigeic earthworms: Epi=top, Geic=earth

Epigeic earthworms are surface dwellers and feed only on decaying organic material not on soil (phytophagous). They are not usually powerful burrowers; instead they prefer to live in loose organic litter or very loose top soil rich in organic matter. They are small, usually darkly pigmented and can able to reproduce at a high rate in ideal conditions. Epigeic earthworms will not survive in most garden soils unless there is a good layer of organic matter on the top.

Epigeic earthworms produce castings that contain higher amounts of nutrients than that of material they originally consumed. These species of earthworms can have the natural ability to consume large amount of organic waste with high rates of consumption, digestion and assimilation of organic matter, tolerance to a wide range of environmental factors, short life cycle, high reproductive rates, and show good potential for vermicomposting.

Examples: *Eisenia fetida*, *Lumbricus rubellus*, *Perionyx excavates*, *Eudrilus Eugeniae* and *Dendrobaena rubidus*.



Epigeic earthworm: *Eudrilus eugeniae*

2. Endogeic earthworms: Endo= inner, Geic= earth

Endogeic earthworms live in the upper layer of soil, much of these worms live in the rhizosphere, the area immediately around plant roots, and they help in exchange of nutrients. Endogeic earthworms are geophagous capable of providing rich nutrients supply with high content of minerals and proteins as food source and medicinal values. They make complex temporary horizontal burrow through the soil to move around and to feed, but they are very important for aerating soil, allowing moisture and nutrients to move through the soil.

Endogeic earthworms are the least recognizable to most of the people since they rarely comes to the surface especially during rainy season.

Examples: *Octolasion cyaneum*, *Allobophora chlorotica*, *Pheretima postuma*.



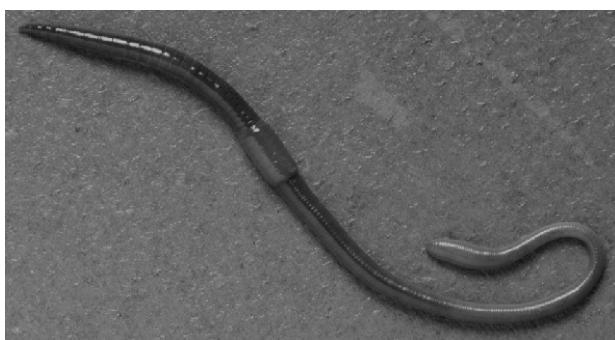
Endogeic earthworm: *Allobophora chlorotica*

3. Anecic earthworms:

Anecic earthworms build permanent deep vertical burrows (about 6 feet) in the soil, and come to the surface at night in search of food. They often pull leaves or other decaying matter into their burrows to feed, but they eat soil along with organic matter hence they are called as geophytophagous. Anecic earthworms often leaves little rounds of castings along the sides of a top of the opening of their burrows and are important for aerating soil and helping water retention capacity.

These are usually large worms have long life span sometimes may go up to 6 years and they mature and reproduce slowly. These worms are greatly used in fish baiting. They require stable burrows and low population density to survive for longer time.

Examples: *Lumbricus terrestris*, *Apporectodea longa*.



Anecic earthworm: *Apporectodea longa*

SIGNIFICANCE OF EARTHWORMS

Earthworms are sometimes known as ecosystem engineers because of their significant role in modifying the physical, chemical and biological properties of soil profile, and these modifications can influence the habitat and activities of other organisms within the soil ecosystem.

Earthworm influences much more on soil ecosystem in a number of ways such as

1. Improving soil structure: Earthworms burrows and alter physical structure of the soil by making small pores, their burrowing activity can lead to increase in water infiltration rates (up to 10 times the original amount). This brings

water and soluble nutrients down to plant roots. Burrowing also improves soil aeration important for both plants and other organisms living in the soil system and enhances plant root penetration, hence, they are known as 'nature's plough man'.

- 2. Recycling of organic materials:** Epigeic and Anecic earthworms along with bacteria, fungi decompose large amount of organic material in the nature and recycle them into valuable vermicompost in the form of biofertilizer.
- 3. Enrichment of nutrient availability:** This process happens in two ways: by incorporating organic materials into the soil and by unlocking the nutrients held within dead and decaying plant and animal matter. Nutrients like nitrogen (N), phosphorous (P) and potash (K) become more readily available to plants after digestion by earthworms, being excreted in the form of vermicasts.
- 4. Providing food for predators:** Earthworms are part of food web like all other organisms. Birds are well known predators even some native earthworms are food for land snails, ants etc.
- 5. Earthworms benefit to humans:** Earthworms provide several ecosystem services to humans.
 - a. Increase in productivity:** Once the earthworms become established, the crop productivity increases by 25-30 % by removing the surface thatch material that can block water from entering the soil.
 - B. Facilitating and accelerating soil profile restoration:** Earthworms can increase soil fertility, recycling of waste products, providing food resources for predators, hence, earthworms helps in restoration and functioning of ecosystem both above and below the ground.

EARTHWORMS IN VERMITECHNOLOGY

Earthworms are essential detritus feeders and play a vital role in bio-processing of composting of organic matter and soil metabolism. They are referred to as 'indicators of soil health'. The complex process of partial breakdown of organic matter,

mixing with mucus and gut microbial flora leads to the formation of earthworm cast that results in the enhancement of soil fertility status. The significance of earthworms has resulted in development of vermitechnology that uses the surface (epigeic) and subsurface (anecic) varieties of earthworms in organic waste management. Thus, the organic waste can be excellently recycled by vermicomposting process, there by resulting in the production of vermicompost and vermiwash that have been proved as an essential component in plant growth and productivity.

SCOPE OF EARTHWORM RESEARCH

Earthworms are very much useful for research in various fields like

- ä Recycling of available plant nutrients by earthworms within short period
- ä Usage of earthworms in organic waste management
- ä Earthworms can be used in various toxicological research as this animal is a bio indicator
- ä Vermiwash as stimulator of growth hormone in agriculture, horticulture etc.
- ä Extraction of vermiwash and their utilization in various research
- ä Earthworm biomass as supplementary feed for various fields like aquaculture, poultry etc.
- ä Extraction of various enzymes and other bio molecules from earthworms for human use

FACTS ABOUT EARTHWORMS

Here, there are 9 interesting facts about earthworms:

1. There are more than 4400 species of different kinds of earthworm exists in the World.
2. Of these, more than 180 earthworm species found in the U.S. and Canada, 60 are invasive species, brought over from the Old World, including the night crawler.
3. Lacking lungs or other specialized respiratory organs, earthworms breathe through their skin.
4. The skin exudes a lubricating fluid that makes

moving through underground burrows easier and helps to keep skin moist. One Australian species can shoot fluid as far as 12 inches through skin pores.

5. Each earthworm is both male and female (hermaphrodite), producing both eggs and sperm.
6. Tiny juvenile worms emerge from the eggs, they grow sex organs within the first two or three months of life and reach full size in about a year. They may live up to eight years, though one to two years is more likely.
7. Full size for an earthworm varies among species, ranging from less than half an inch long to nearly 10 feet.
8. The earthworm's digestive system is a tube running straight from the mouth, located at the tip of the front end of the body, to the rear of the body, where digested material is passed to the outside.
9. Worm movements within the earth create burrows that encourage the passage of air and a loosening of the soil.

CONCLUSION

Earthworms major macro invertebrates of soil having more than 4400 species are known to be nature's gifted animal because of their important role in soil fertility and organic waste management, hence, earthworms are recognised by different names such as 'farmer friend', 'nature's plough man', 'biological engineers' and 'Cinderella of organic farming' etc. due to their significant role in the nature.

ACKNOWLEDGEMENT

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CONCEPTUALITY OF RESEARCH METHODOLOGY: SOME INTRODUCTORY REMARKS

B.B. Singh and C. N. Guled

This paper deals with the conceptuality of the research methodology e.g. the meaning of the research, objectives of research, motivation in research and types of research. The basic approaches to research; research methods versus methodology; research process i.e. formulation of the research problem, extensive literature survey, development of working hypotheses, preparing the research design, execution of the project, analysis of the data, hypothesis- testing, generalizations and interpretations and preparation of the report have also been described along with the criteria of good research and problems encountered by researchers in India.

INTRODUCTION

All the progress in the society is born of inquiry. Doubt is often better than over confidence, for it leads to inquiry and inquiry leads to invention. Thus an increased amount of inquiry makes research possible. Research inculcates scientific and inductive thinking. Research also promotes the development of habits of logical thinking and organization. It provides the basis for nearly all government policies in our economic system. As a matter of fact, the role of research in several fields of applied economics, whether related to business or to economy as a whole, has greatly increased. Research has its special significance in solving various operational and planning problems of business and industry. Research is equally important for social scientists in studying social relationships and in seeking answers to various social problems. Likewise, in every field of science, the research plays a significant role in providing the intellectual satisfaction of knowing a few things just for the sake of knowledge and also has practical utility for the scientists and engineers to know for the sake of being able to do something better or in a more efficient manner.

On account of the afore-mentioned facts,

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authors have given their contributions in order to improve the concepts of research methodology. Researchers have laid emphasis on the challenges which the present research methodology is faced with towards the maintenance and sustenance of its quality², implementation aspect of any research by way of proposing a heuristic and working taxonomy of eight conceptually distinct implementation outcomes such as acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration and sustainability³, multiple qualitative studies for enhancing transparency in reporting the synthesis of quality research by way of generating new theoretical and conceptual models⁴.

Research is an academic activity that comprises defining and redefining problems; formulating hypotheses; collecting, organizing and evaluating data; making deductions and reaching conclusions; and at least carefully testing the conclusions to determine whether they fit the formulating hypotheses. They have defined research as manipulation of things, concepts or symbols for the purpose of generalising to extend, correct or verify knowledge¹. Research is thus an original contribution to the existing treasure of knowledge. It is the pursuit of truth with the help of study, observation, comparison and experiment

Research refers to the systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the facts or data, analyzing the facts and reaching certain conclusions in the form of solutions towards the concerned problem. In fact, research is an art of scientific investigation leading to a systematic search for pertinent information on a specific topic.

OBJECTIVES OF RESEARCH

The purpose of any research is to discover answers to questions through the application of scientific procedures. The main objective of research is to find out the truth which is hidden and which has not been discovered as yet.

The main objectives of the research fall into the following groupings:

1. **Exploratory or Formulative Research Studies**

The main objective of this kind of research is to gain familiarity with a phenomenon or to achieve new insights into it.

2. **Descriptive Research Studies**

The main objective of this kind of research is to portray accurately the characteristics of a particular individual, situation or group.

3. **Diagnostic Research Studies**

The main objective of this kind of research is to determine the frequency with which something occurs or with which it is associated with something else.

4. **Hypothesis – Testing Research Studies**

The main objective is to test a hypothesis of a causal relationship between variables.

MOTIVATION IN RESEARCH

The motivation behind any research is of fundamental significance. Some of the motives for doing research may be one or more of the following:

1. Desire to get a research along with its consequential benefits ;
2. Desire to face the challenges in solving the unsolved problems ;

3. Desire to get intellectual joy of doing some creative work ;
4. Desire to be of service to society ;
5. Desire to get respectability ;
6. Directives of the government ;
7. Employment conditions ;
8. Curiosity about new things ;
9. Desire to understand causal relationships, social thinking and awakening.

However, this is not an exhaustive list of motives to undertake research, there may be many more such motives which may motivate or at times compel people to undertake research.

TYPES OF RESEARCH

The basic types of research are:

i) **Descriptive Vs. Analytical**

Descriptive research includes surveys and fact finding enquires of different kinds. The main objective of a descriptive research is the description of the state of affairs as it exists at present. The main characteristic of this kind of research is that the researcher has no control over the variables. The researcher can only report as to what has happened or what is happening. This kind of research is also called Expost facto research in social science or business research. In this kind of research, the researchers also try to find the causes even when they cannot control the variables. In descriptive research, the researchers use survey methods of all kinds, including comparative and correlational methods. In analytical research, on the contrary, the researcher has to use facts or information already available. The researcher analyses the information to do a critical evaluation of the material.

(ii) **Applied Vs. Fundamental**

The research can either be applied or fundamental. An applied research aims at finding a solution for an immediate problem facing a society or industrial/business organization. The fundamental research, on the other hand, is mainly concerned with the formulation of theory. The fundamental research is also called 'pure' or 'basic' research.

According to the researcher gathers knowledge for knowledge's sake⁵. Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research. The research studies concerning human behaviour to make generalizations about human behaviour are also the examples of fundamental research. The research aimed at certain conclusions or solutions facing a concrete social or business problem is an example of applied research.

(iii) Quantitative Vs. Qualitative

The quantitative research is based on the measurement of quantity or amount. It is applicable to phenomenon that can be expressed in terms of quantity. Qualitative research, on the otherhand, is concerned with qualitative phenomena e.g. reasons for human behaviour, motivation research, etc. Motivation research aims at discovering the underlying motives and desires. This kind of research uses in-depth interviews, word association tests, sentences completion tests, story completion tests and similar other projective techniques. The qualitative research is specially important in the behavioural sciences where the aim is to discover the underlying motives of human behaviour. The qualitative research is relatively a difficult job and therefore one should seek guidance from experimental psychologists while doing research.

(iv) Conceptual Vs. Empirical

The conceptual research is related to some abstract ideas or theory. It is generally used by philosophers and thinkers to develop new concepts or to interpret existing ones. On the otherhand, empirical research relies on experience and observation alone. This does not give due regard for the system or theory. It is a data-base research. This research comes up with conclusions verifiable by observations and experiments. This is infact an experimental type of research in which it is necessary to get at facts first hand, at their source, and actively to go about doing certain things to stimulate the production of desired information. Empirical research, on the otherhand, is appropriate when proof is sought that certain variables affect other variables

in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

RESEARCH APPROACHES

The afore-mentioned types of research bring to light the fact that there are two basic approaches to research, viz., quantitative approach and qualitative approach. The former involves the data in quantitative form which can be subjected to rigourous quantitative analysis in a formal and rigid fashion. This approach can further be classified into inferential, experimental, and simulation approaches to research. The purpose of inferential approach to research is to form a database from which to infer characteristics or relationships between various parameters affecting the quality of the product, process and service. Experimental approach is characterized by much greater control over the research environment, and in this case some variables are manipulated to observe their affect on other variables. The analytical approach is used specially in science and engineering to find out solutions of the problems. Simulation approach⁶ involves the construction of an artificial environment within which relevant information and data can be generated. This permits an observation of the dynamic behaviour of the system under controlled conditions. Simulation approach can also be useful in building models for understanding future conditions.

Qualitative approach to research is concerned with subjective assessment of attitudes, opinions and behaviour. Research in this situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-qualitative form or in the form which are not subjected to rigorous quantitative analysis. In qualitative approach, the techniques of focus group interviews, projective techniques and depth interviews are used.

RESEARCH METHODS VERSUS METHODOLOGY

There is a difference between research methods and research methodology. Research methods may

be understood as those methods/techniques that are used in the conduct of the research. Research methods or techniques thus refer to the methods the researchers use in performing research operations. In this way, all those methods which are used by the researcher during the course of studying the research problem are termed as research methods.

Research methodology, on the other hand, is a wider concept. It is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it, we study the various steps that are generally adopted by a researcher in studying his research problem alongwith the logic behind them. It is, therefore, necessary for the researcher to know not only the research methods/techniques but also the methodology. Researchers need to understand the assumptions underlying various techniques and they need to know the criteria by which they can decide that certain techniques and procedures will be applicable to certain problems and others will not. All this means that it is necessary for the researcher to design his methodology for his problem as the same may differ from problem to problem.

Thus the scope of the research methodology is wider than that of research methods. In research methodology, the researcher not only talks of the research methods but also considers the logic behind the methods he uses in the context of his research study and explains as to why is he using a particular method or technique.

RESEARCH PROCESS

Research process consists of a series of actions or steps necessary to effectively carry out research and desired sequencing of these steps.

A brief description of the research process is as follows:

(1) Formulating the Research Problem

At the very outset, the researcher must single out the problem he wants to study; i.e., he must decide the general area of interest or aspect of subject matter that he would like to inquire into. Initially, the problem may be stated in a broad general way and then ambiguities, if any, relating to the problem be

resolved. Then, the feasibility of a particular solution has to be considered before a working formulation of the problem can be set up. Essentially two steps are involved in formulating the research problem; viz., understanding the problem thoroughly and rephrasing the same into meaningful terms from an analytical point of view.

(2) Extensive Literature Survey

Once the problem is formulated, the brief summary of it should be written down. It is compulsory for a research worker writing a thesis for a Ph.D. degree to write a synopsis of the topic and submit it to the necessary Committee or Research Board for approval. At this juncture, the researcher should undertake extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go. Academic journals, conference proceedings, government reports, books, etc. must be tapped depending on the nature of the problem.

(3) Development of Working Hypothesis

After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses. Working hypothesis is tentative assumption made in order to draw out and test its logical or empirical consequences. Research hypotheses are developed to provide the focal point of the research. The hypotheses also affect the manner in which the tests must be conducted in the analysis of the data, and indirectly the quality of the data which is required for the analysis. The hypotheses should be very specific and limited to the piece of research in hand because it has to be tested.

(4) Preparing the Research Design

The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design; i.e., he will have to state the conceptual structure within which the research would be conducted. The preparation of such a design facilitates research to be as efficient as possible yielding maximal information. In other words, the function of the research design is to provide for the collection of relevant evidence with

minimal expenditure of effort, time and money. But how all these can be achieved depends mainly on the research purpose. The research purposes may be grouped into four categories; viz. (i) Exploration, (ii) Description, (iii) Diagnosis and (iv) Experimentation. A flexible research design which provides opportunity for considering many aspects of a problem is considered appropriate if the purpose of the research study is that of exploration. But when the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be the one that minimizes bias and maximizes the reliability of the data collected and analysed.

(5) Execution of the Project

The execution of the project is a very important step in the research process. If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable. The researcher should see that the project is executed in a systematic manner and in time.

(6) Analysis of Data

After the data have been collected, the researcher turns to the task of analyzing them. The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences.

(7) Hypothesis Testing

After analyzing the data as stated above, the researcher is in a position to test the hypotheses, if any, he had formulated earlier. Do the facts support the hypotheses or they happen to be contrary is the usual question which should be answered while testing the hypotheses.

(8) Generalisations and Interpretation

If the hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalization; i.e., to build a theory. As a matter of fact, the real value of the research lies in its ability to arrive at certain generalisations. If the researcher has no hypothesis to start with, he might seek to explain

his findings on the basis of some theory. It is known as interpretation. The process of interpretation may quite often trigger of new question which in turn may lead to further researches.

9) Preparation of the Report or the Thesis

Finally, the researcher has to prepare the report of what has been done by him. Writing of the report must be done with great care keeping in view the following:

- (a) The layout of the report should be as follows:
 - (i) the preliminary pages ; (ii) the main text and (iii) the end matter. In the preliminary pages, the report should carry title and date followed by acknowledgements and foreword.

The main text of the report should have the following parts :

 - (i) **Introduction:** It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part.
 - (ii) **Summary of findings:** After introduction there would appear a statement of findings and recommendations in non-technical language. If the findings are extensive, they should be summarized.
 - (iii) **Main reports:** The main body of the report should be presented in logical sequence and broken down into readily identifiable sections.
 - (iv) **Conclusion:** Towards the end of the main text, the researcher should again put down the results of his research clearly and precisely. In fact, it is final summing up.

At the end of the report, appendices should be enlisted in respect of all technical data. Bibliography, i.e. list of books, journals, reports, etc. consulted, should also be given in the end. Index should also be given specially in a published research report.

- (b) The report should be written in a concise and

objective style in simple language avoiding vague expressions such as 'it seems', 'there may be', and the like.

- c) Charts and illustrations in the main report should be used only if they present the information more clearly and forcibly.

CRITERIA OF GOOD RESEARCH

Whatever may be the types of research works and studies, one thing that is important is that they all meet on the common ground of scientific methodology employed by them. One expects scientific research to satisfy the following criteria⁷.

- (i) The purpose of the research should be clearly defined and common concepts be used.
- (ii) The research procedure should be defined in sufficient detail.
- (iii) The procedural design of the research should be carefully planned to yield results that are as objective as possible.
- (iv) The analysis of the data should be sufficiently adequate to reveal its significance and the methods of analysis should be appropriate. The validity and reliability of the data should be checked carefully.
- (v) Conclusions should be confined to those justified by the data of the research and limited to those for which the data provide an adequate basis.

In other words, the qualities of a good research⁸ are as under:

- (i) **Good research is systematic:** It means that the research is structured with specified steps to be taken in a specified sequence in accordance with the well defined set of rules.
- (ii) **Good research is logical:** This implies that the research is guided by the rules of logical reasoning and logical process of induction and deduction are of great value in carrying out research. Induction is the process of reasoning from a part to the whole whereas deduction is the process of reasoning from

some premise to a conclusion which follows from that very premise. In fact, logical reasoning makes research more meaningful in the context of decision making.

- (iii) **Good research is empirical:** It means that the research is related basically to one or more aspects of a real situation and deals with concrete data that provides a basis for external validity to research results.
- (iv) **Good research is replicable:** This characteristic allows research results to be verified by replicating the study and thereby building a sound basis for decisions.

CONCLUDING REMARKS

Researchers in India are facing several problems while pursuing their research. The lack of scientific training in the methodology of research is a great impediment for researchers in our country. There is a paucity of competent researchers in our country. Many researchers take a loop in the dark without knowing the research methods. Also there is an insufficient interaction between the university research departments on one side and industrial/business/government departments and research institutions on the other side. So, efforts should be made to develop satisfactory liaison among all concerned for better and realistic researches. The library management and functioning is not satisfactory at many places and much of the time and energy of researchers are spent in tracing out books, journals, reports, etc. So, for quality research, all these problems are required to be eliminated from our research organizations.

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COST-EFFECTIVE CONNECTIVITY SOLUTIONS FOR RURAL EMPOWERMENT: THE AIRJALDI EXPERIMENT

Pradeep Nair

The article deals with a case study of technically and economically viable connectivity solution for geographically complex rural hill areas developed by AirJaldi, a social enterprise which established an advance and cost-effective community based wireless fidelity (Wi-Fi) networks at the foothills of the Himalayas at Upper Dharamshala, spread over 70 acres, more than 7,000 ft. above sea level. Since the available knowledge about these cost-effective communication technologies is highly fragmented and difficult to access, the study provides a comprehensive account of the strategic and operational framework required to practice these technologies and their further scope.

INTRODUCTION

High speed internet connectivity is being hailed as a panacea for a host of development challenges and is regarded by some as an essential element of a region's infrastructure. While living up to its promise in areas where it reaches, technical and economic challenges have hampered its spread to rural areas of many developing countries, leaving their residents on the sidelines of the development highway⁵.

In this golden age of Twitter and Facebook, the internet is taken for granted. Urban India is constantly logged in-be it on their phones, tabs or those tragically outdated things called desktops. But for AirJaldi, a social enterprise working in the field of rural broadband and wireless connectivity solutions, all this was a rarity in the areas they first ventured into.

Many villages in India remain beyond the ambit of connectivity simply because erecting a big telecom tower isn't suitable in terms of costs and returns¹. The idea that this void can be filled through a network akin to Dharamshala-low-cost, environmental-friendly and durable-has spawned interest in other parts of India, Sir Lanka, Pakistan,

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Bangladesh and Africa. Even the big telecom operators are evincing interest.

Dharamshala, the Himalayan hill town, home of the Dalai Lama and his Tibetan government in exile, is a global node of the counterculture Diaspora that blends its Tibetan heritage with pilgrims, hippies and travellers coming to study Tibetan art and culture. Drawn here by the inscrutable wisdom of the Dalai Lama and scenery straight from the leaves of fantasy, the eclectic crowd that throngs upper Dharamshala has made this sleeping hill town a unique ecosystem- a cosmopolitan town of espressos and web-surfing monks, condensed into two streets along a Himalayan ridgeline.

Today the wireless internet network deployed by AirJaldi is covering a population of 20,000 and is an ideal laboratory for rural broadband research and design. The initiative uses a unique combination of low-cost indigenous communication technology options and an economic support model of delivery that exploits the ability of rural communities to respond and adapt these efforts according to their local needs.

THE AIRJALDI EXPERIMENT

A social enterprise that provides affordable, wireless connectivity in remote areas, AirJaldi was founded by Yahel Ben-David, an Israeli, who came to

Dharamshala to work with the Tibetans in exile. The network was started from a room in a local school for Tibetan children, by a core team of around 11 people in February 2005, shortly after the Indian government deregulated Wi-Fi.

AirJaldi is now known as an innovator and implanter of technically and economically viable connectivity solutions for rural areas. It has built one of the largest and most advanced community-based Wi-Fi networks in Asia, is developing affordable networking devices and network management systems, and operates a training centre where network operators and activists can acquire the skills to build and manage community-based wireless networks.

In this digital age of networking, where everyone wants to be connected 24x7, rural India is still struggling to get connected with the technically changing outer environment⁹. When most of the telecommunication giants were interested in big cities and metros to earn profits through various value added services, rural communication was an area where AirJaldi first ventured into and their efforts have brought hundreds of rural communities online.

AirJaldi was born out of a need for a network that connected local institutions and the Tibetan community via the Internet. However, at the initial stage, the infrastructure wasn't available. But things began moving in 2005, when two bandwidth ranges (2.4 ghz/5.8 ghz), known as Wi-Fi ranges, were delicensed by the Government of India⁸. The enterprise then started interconnecting the Tibetan in exile without having to procure a licence.

AirJaldi purchases huge bandwidth from Internet service providers like Airtel and distributes it to its clients, offering speed ranging from 256 kbps to 6 mbps for now, though it is capable of offering speeds as high as 60-70 mbps. The philosophy and business model centres on creating networks that by design are meant to reach out to all potential clients at a reasonable price. Each relay is built to reach specific clients but at the same time, each client is also potentially a relay to other clients. This allows

networks to grow organically and quickly respond to demands, thereby contributing to the ultimate goal of reaching out to all users in rural areas.

The networking infrastructure for the Tibetan in exile and other communities residing in and around upper Dharamshala is set up by a team of technical experts from AirJaldi based on physical and online surveys and planning. Interestingly AirJaldi do not outsource any part of their work.

While identifying a rural area for connectivity, AirJaldi follows the definition of rural areas given by Government of India on rural vs. urban areas, although the demarcation is sometime far from clear. As a rule, AirJaldi people determine rural to be an area that is not a big city, is relatively sparsely populated and has need for networking services. Although the priority of AirJaldi is mostly the rural hill areas but some time they focus on semi-urban also if there is a specific demand for Internet and if the area falls adjacent to the rural deployment.

At the beginning, AirJaldi started providing broadband internet connectivity to schools, local communities and monasteries in the Dharamshala area and also the technical knowledge and basic computer and wireless networking know-how. Eight years since these early steps, AirJaldi now operates in rural areas of three states in India – Himachal Pradesh, Uttarakhand and Jharkhand, mostly in areas where viable internet connectivity was considered a far-fetched dream.

The operation-plan of AirJaldi is simple – optimising available resources. Their six-foot tall relays are mostly solar power based as these areas of Dhauladhar hill ranges don't have reliable power grids. AirJaldi put up two or three low-cost relays instead of one expensive tower and thus connect more people. With some links as long as 50 km, multiple users were connected via the network of AirJaldi. This business strategy is all about economising the available resources. The vision is that the telecommunication giants have a lot more resources to waste, because their financial strength can afford, but for AirJaldi the optimum usage of resources is the only way to bring the cost down.

The economic support models of providing broadband services to the people of rural areas, where the terrain is difficult, the population is sparse, and financial resources are less; success depends on keeping overheads to an absolute minimum budget for costly proprietary software⁶. AirJaldi operates its networks with free, open-source software Ubuntu server. To further reduce the operating costs, AirJaldi uses Ubuntu on its workstations, where its simplicity and ease of use has great benefits for the people who are taking care of the operations.

Another effort made by AirJaldi to reduce the cost of networking is to switch their energy resources to solar. AirJaldi made the move because they realized that the cost of maintaining the power grid with backup diesel or batteries was comparatively very high. On an average a telecom tower consumes approximately 20-25 litre diesel per day costing near about INR1000 to INR 1500 Per day and the average power demand is 2.52 kW per hour and the unit cost of electricity per hour is INR 6.00. On average, electrical grid power is available for 12 hours a day only. The average maintenance cost of a conventional telecom tower per month is INR 1,00,000 to INR 1,50,000 out of which only energy costs INR 47,694 to INR 54,106 per month. The solar costs nearly 70% less than diesel or electricity. A telecom tower operated by solar energy costs nearly INR 10,000 to INR 15,000 per month³. Often the networking team of AirJaldi was forced to travel for many hours through the monsoon rains or in other extreme weather conditions to take care of the operations in those areas situated at an average height of 8000 – 10,000 ft where the grid failed. All these were eliminated by switching to solar powered broadband systems.

The move to solar also allowed AirJaldi to focus on their core operations that is to buy the wholesale bandwidth which is then distributed through economic Wi-Fi relays that optimize traffic without degrading the user's experience. Nearly all the relays of AirJaldi are solar-powered. The server room which handle the networking traffic and optimize it is also converted to solar.

Connecting rural areas with ICTs is a costly affair⁴. In order to provide affordable access to technology and connectivity to the rural masses², cost-effective business models like AirJaldi which very well took the advantage of open source networking products and alternative energy sources like solar is much required. These innovative approaches had helped AirJaldi to sustain with a social entrepreneurial spirit. The training support provided by AirJaldi to the community people helps these rural hill communities to develop solution and small business models suited for their environment and needs. The networking support to the schools, health centres, and small businesses helped the communities to perform better and to compete with the outer worlds.

POTENTIAL BENEFITS FOR THE RURAL COMMUNITY

The efforts of AirJaldi have helped the schools, monasteries and hospitals of Tibetan in exile and other communities at Upper Dharamshala to harness the power of the Internet. The patients at the De Lek Hospital in Mcleodganj were used to wait for days to receive their medical reports by post from the pathologies of Palampur, Kangra, Lower Dharamshala and Pathankot. But now because of the free internet connectivity available at the hospital, the medical reports are received within hours through e-mail. The poor people from the Tibetan in exile who mostly came here for their medical treatment now realize that they are also connected with the outer world. Small village entrepreneurs, micro-banking outfits, schools in Mcleodganj all are now well connected.

The community centres now has computer literacy classes; tiny guest houses have online booking portals; tourists visiting to upper Dharamshala have free Wi-Fi; the Buddhist monks at the Krito Japa monastery are facebook addicts and everyone is on e-map. The small sleeping hill town known as the place of the Dalai lama now has a high speed low-cost Wi-Fi network spread over 70 acres, more than 7,000 ft above sea level.

The 50-node wireless mesh network

interconnects around 3,000 computers providing broadband internet services, video conferencing, off-site backups and playback of videos from remote archives. Schools, hospitals, NGOs have benefitted and many BPOs are interested to start their operations here to promote the trade. The Norbulingka Art Institute is now on the world map and the Tibetan art works like Thangka paintings and statues are for sale on the Net. Children and young people are using Internet at schools/colleges and are logging on to sites like hi5, chatting with people at small cafés.

The Dharamkot government school located in the upper part of McLeodganj, nearly at a height of 9,000 ft. on the top of hill where no telecommunication companies provide an Internet connection, is now well connected with the help of AirJaldi. The small school with about 100 students aged 5-13 is funded by the government. Now the students along with the teachers have an access to affordable and sustainable Internet. The connectivity helped the school to get connected with the outer world. Because of the wireless connectivity, the religious teachings of Dalai Lama are now broadcasted as video streaming in multiple languages over the web over multiple platforms.

CONCLUSION

It is a fact that most of the government policies are helping the big telecommunication and networking companies to earn billion of rupees by the sake of spectrum but at the same time these policies are not providing much scope to provide some kind of network access to the ones who certainly cannot afford and access the services of paid spectrum even today in this age of digital revolution⁷.

In the context of cost-effective connectivity solutions like Very Small Aperture Terminal (VSAT), cable and microwave, small-scale digital exchange, Wireless Local Loop (WLL), initiative like AirJaldi is a grass-root innovation for the modern rural India with an aim to provide good internet connectivity in remote, rural areas so that the young people residing in these remote places can work and

connect themselves with the outer world from the comfort of their homes. This also helps to discourage the migration of young people to overcrowded cities, as by improving the connectivity, money is now coming to villages, enabling all round development. The advantage of rural connectivity is that it creates more local jobs, increases literacy, help the rural people to expose them to the outer digital world and thus it is reshaping the whole rural communication landscape.

The response in the form of new clients both non-profit and commercial has helped AirJaldi in last eight years to operate in rural areas of tough terrains, where viable internet connectivity was considered as a far-fetched dream. While facing the challenges of deployment and economic sustainability, the social enterprise AirJaldi has learned to effectively address the challenges both operational and economical and turned them into advantages. Combating the problem of electricity with solar power provisioning, for example, was considered to be an uneconomical source by many, but it turned out to be one of the main business differentiators – enabling initiatives like AirJaldi to provide consistent internet connectivity with minimal down-time. Similarly, using open-source software also helped the enterprise to not only reduce the costs but also to select and adapt new technical tools suitable for a rural internet provider.

It is an appropriate time to understand that the radio waves or the spectrum is limited resource. No matter if one use all of the bandwidth available, it will not solve the problem of delivering content. This could be solved only by more efficient use of the existing bandwidth. The success of the Wi-Fi rural broadband initiatives in the 5.8 GHz range is due to the cost-effective availability of the network and equipment and the absence of license fee. Rural broadband initiatives like AirJaldi are committed to provide beneficial, sustainable, cost effective and reliable broadband connections to organizations and individuals in remote rural areas of India. The whole connection for an entire village costs only INR 20,000 which is very less than the conventional telecom set-up which costs nearly INR 1,50,000.

This connectivity is enhancing livelihoods, widening horizons and is helping the rural communities to expand their world intellectually, economically and culturally.

The broadband initiatives of AirJaldi has helped the Tibetan in exile and other rural hill communities of Dharamshala to deploy license free wireless networks and in building the capacity of network operators and users in rural areas to maintain networks through training and capacity building where required. The initiative had made connectivity a reality for communities which were excluded from the emerging knowledge-based global economy due to geographical complexities. By improving the access to Internet, these communities are now really on the roads of empowerment.

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NANOTECHNOLOGY IN AGRICULTURE: AN EMERGING VISTA

Anamika Verma

Nanotechnology deals with the matter at nanoscale (1-100 nm). It is a technology that offers safer, long-lasting, cost-effective and smart products that will find wide applications in agriculture. Nanotechnology applications in agriculture include nanofertilizers, nanoherbicides, nanopesticides, nanosensors, detection of nutrient deficiencies etc. This fast growing technology is already having a significant commercial impact, which will certainly increase in the future. While nanotechnologies offer many opportunities for innovation, the use of nanomaterials in agriculture has also raised a number of safety, environmental and regulatory issues.

INTRODUCTION

The term "Nanotechnology" has been defined as the branch of the science that deals with the understanding and control of matter at the dimensions of about 1-100 nm where unique phenomenon enables novel applications. The term nano derived from Greek word "dwarf". The concept of nanotechnology was first given by Nobel Laureate physicist Richard P. Feynman in Southern California in 1959. In 1986, K. Eric Drexler introduced the term nanotechnology. Nanotechnology is related to materials, systems and processes which operates at 100 nanometers (nm) or less. Nanotechnology has been extensively used in plant protection, processing, packaging transportation of agricultural products and quality control and environmental management. It has great potential to make agriculture more efficient by using nano sensors and nano agricultural chemicals.

Nanotechnology came only in recent years but the seeds of research in this field start growing nearly half a century ago¹. The uses of nanomaterials specifically for the agricultural purposes are required for improving the fertilization process, increase in yields through nutrient optimization and minimized the requirements of plant protection products². The Department of Science and Technology (DST)

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launched the Nano Science and Technology Initiative (NSTI) in 2001 which commenced from 2007 to 2012 (Eighth-five year plan) under the leadership of Prof. C N R Rao. Nanotechnology research and development barring a few exceptions is largely being ensued at publically funded universities as well as research institutes. The Indian Council of Agricultural Research (ICAR, New Delhi), Indian Agriculture Research institute (IARI, New Delhi), Tamil Nadu Agricultural University (TNAU, Coimbatore), Central Arid Zone Research Institute (Cazri, Jodhpur), Defence Research and Development Organization (DRDO, Kanpur), Center for Nano science and Engineering (Bangalore) etc. are currently involved in various projects related to nanotechnology in India. Major challenges of agriculture to be addressed by nanotechnology are:

- 1) Food security for growing numbers
- 2) Low productivity in cultivable areas
- 3) Lower agricultural input efficiency
- 4) Unsustainable farm management
- 5) Large uncultivable areas
- 6) Shrinkage of cultivable lands
- 7) Wastage of products
- 8) Perishability/ low shelf life
- 9) Post harvest losses (processing & packaging)
- 10) Diseases and vulnerabilities to climate change due to global warming³.

NANOTECHNOLOGY APPLICATION IN AGRICULTURE

Nanotechnology application in agriculture can make farming more targeted and scientific. As we know in precision farming there is use of latest technologies like- Geo-informatics (GIS), remote sensing devices etc. We can get accurate information through applications of nanotechnology for monitoring of soil conditions, environmental changes, plant diseases and plant health issues by targeted use of the inputs (fertilizers and pesticides), precise management of soil, new formulation of pest control etc. Water treatment been cited as the third most critical area where nanotechnology applications might aid developing countries. Nanotechnology intervention including nanomembranes for irrigation, water purification, desalination and detoxification, nanosensors for the detection of contaminants and pathogens, nanoporous zeolites and attapulgite clays for water purification, magnetic nanoparticles for water treatment and remediation and TiO₂ nanoparticles for the catalytic degradation of water pollutants can improve the quantity and quality of water. Some recent breakthroughs in nanotechnology in agriculture are listed in Table I⁴.

Nanotechnology may be used in agriculture in the form of nanosensors for monitoring crop growth and pest control by early identification of plant diseases. These nanosensors can help enhance crop production and improve food safety. The effectiveness of pesticides may be improved if very small amounts are enclosed in hollow capsules with a diameter in the nanometer range which can be designed to open only when triggered by the presence of the pest to be controlled. Nano sensors may detect contaminants, pests, nutrient content, and plant stress due to drought, temperature, or pressure. They may also potentially help farmers increase efficiency by applying inputs only when necessary⁵.

Nanoparticles like nanoforms of carbon, silver, silica and alumino- silicates are used for controlling plant diseases. Pesticides inside nanoparticles are being developed that can be timed-release or have release linked to an environmental trigger which is in contrast to our present system where either pesticides are applied or sprayed previously for prevention or after the onset of diseases and pests. One of such effort is use of alumino-silicate nanotubes with active ingredient. Pesticides containing nano-scale active ingredients are already on the market, and many of the world's leading agrochemical firms are

Table1. Recent breakthroughs in nanotechnology in agriculture⁴.

Product	Application	Institution
Nanofertilizers	Fertilizers encapsulated in nanoparticles, cheap cost and increased nutrient use efficiency.	J.C. Tarafdar, CAZRI under ICAR, New Delhi, India
Nanocides	Pesticides encapsulated in nanoparticles for controlled release	BASF, Ludwigshafen, Germany
Nano emulsions	Nanoemulsions for greater efficiency	Syngenta, Greensboro, NC, USA
Packaging	Airtight plastic packaging with silicate nanoparticles	Bayer AG, Leverkusen, Germany
Use for agricultural wastes	Nanofibers from cotton waste for improved strength of clothing	Cornell University, Ithaca, NY, USA
Nanosensors	Pathogen detection	Cornell University, Vevey, Switzerland
Precision farming	Nanosensors linked to a global positioning system tracking unit for real-time monitoring of soil conditions and crop growth	US Department of Agriculture, Washington, DC, USA

conducting research on the development of new nano-scale formulations of pesticides. Nano pesticide formulation of carbofuran, thiram, imidacloprid, azadirachtin-A and beta-cyfluthrin are available in the market. According to a study nano silica silver was found to be effective on 100% growth inhibition of many fungi and bacteria at 10 nm and 100 nm concentration respectively⁶.

Weeds are menace in agriculture. Since two-third of Indian agriculture is rainfed farming where usage of herbicide is very limited, weeds have the potential to jeopardize the total harvest in the delicate agro-ecosystems. Improvement in the efficacy of herbicides through the use of nanotechnology could result in greater production of crops. The encapsulated nano-herbicides are relevant which acts only when there is a spell of rainfall, which truly mimics the rainfed system. Developing a target specific herbicide molecule encapsulated with nanoparticle is aimed for specific receptor in the roots of target weeds, which enter into roots system and translocated to parts that inhibit glycolysis of food reserve in the root system. This will make the specific weed plant to starve for food and gets killed⁷.

Nano-fertilizers with quick absorption and optimized release of nutrients to the plant are likely to replace conventional fertilizers in future. Using nano-fertilizer to control delivery of nutrients can be a powerful tool towards attaining sustainable agriculture and environment. Nano fertilizers could be used to reduce nitrogen loss due to leaching and emissions. They could allow for selective release linked to time or environmental condition. Encapsulation or coating and binding of fertilizer (envelope forms of semi-permeable membranes coated by resin-polymer, waxes and sulphur) within nano particle are able to regulate the release of nutrients from the fertilizer capsule to match the uptake pattern of crop. Nanosized formulation of mineral micronutrients may improve solubility and dispersion of insoluble nutrients in soil, reduce soil absorption and fixation and increase the bio-availability. These formulations might increase fertilizer efficiency, save fertilizer resource, extend

effective duration of nutrient supply of fertilizers into soil and can reduce leaching. The nanoscale carriers i.e. nanotubes, for this purpose, can be used for delivering pesticides, fertilizers, plant growth regulators etc., efficiently to the target site¹¹.

Phosphate, zinc, nitrogen, iron, aluminum, silver, copper and titanium-based nano particles are used as fertilizers. Nano particles are used to coat micronutrients or immobile elements, in order to get diffused and soluble form. For example, in order to supply the requisite amount of Zn to the plants, a protocol has been developed to coat the seeds of maize, soybean, pigeon pea and ladies finger with zinc at nano scale (<100nm) ZnO powder @ 50 mg zn/g seed. Nano scale ZnO can also be used as a source of zinc and can also effectively be supplied through seed coating⁸. Similarly, iron chelate nano-fertilizer can be recognized as a rich and decisive source of bivalent iron for plant because of its high stability and slow release of iron in a broad pH range (3-11). Silver nano-particles have antimicrobial properties to control various phyto-pathogens. Urea-fertilized zeolite chips, can be used as slow release nitrogen fertilizers. Ammonium-charged zeolites have shown their capacity to raise the solubilization of phosphate minerals and thus go to improved phosphorus uptake and yield of crop plants. Nano-fertilizers increase yields by an average of 20%, and for some crops even more. Studies so far conducted have shown an increasing effect of about 10% in both protein and sugar content of treated plant for most types of crops plant. Sunflower grain yields increased by 50% and in cucumber trials yield increases up-to 25% have been observed⁸. In India, Bansiwala in 2006 developed a surface modified zeolite as a carrier of slow release phosphatic fertilizer. The Tamil Nadu Agricultural University is one of the pioneering institutes that initiated research in nano-fertilizers in India⁹.

Nano biotechnology can also enhance the pace of progress in molecular marker assisted breeding for crop improvement through DNA sequencing in nano fabricated gel free systems and genetic analysis. For each quantitative trait there are several markers that

are linked to some agronomical traits which need to be identified for the successful breeding programme and developing new hybrids with disease and pest resistance and high yield potential.

APPROACHES TO SAFE NANO TECHNOLOGY

Certain nanoparticles may penetrate cell membranes through inhalation, skin contact or ingestion and may cause damage to intracellular structures and cellular functions. The potential for nanomaterials to pose health hazards is greater if the nanomaterials are easily dispersed (such as in powders, sprays, or droplets). The safety measures includes the identification of all the hazards associated with use and manipulation of nanomaterials, prevention or adequately controlled exposure, assess and control risks associated with the identified hazards, by wearing and using any personal protective equipment as required, by developing written standard operating procedures to outline how all processes with nanomaterials will be performed and the employer should provide information and training to their workers. Prepare plans and procedures to deal with accidents, incidents and emergencies.

CONSTRAINTS AND FUTURE PROSPECTS

Since there is no standardization for the use and testing of nanotechnology, products incorporating the nanomaterials are being produced without checking. Using nanomaterials is not inherently risky for instance, traditional foods contain many nanoscale materials but the use of certain engineered nanoscale materials in agriculture, water, and food may have risks for human use and consumption, for the environment, or for both¹⁰. The success of the nanotechnology is most probably dependent on many factors such as the market demand, risk assessments and supervisions, profit margin, environmental benefits in the background of many other technologies that are competing with this technology.

CONCLUSION

Nanotechnology applications in agriculture, value addition and preservation of crop can bring a sea change in the agriculture scenario of India. Nanotechnology offers a plethora of user friendly option in the agricultural world. Despite of many potential applications, before the introduction in the various fields, the new applications must be examined and regulated carefully. There are several issues on the safety to the human beings, environment, and ecosystem that are still needed to be addressed. The exposure of human beings to the nanomaterials may cause adverse impacts on health and environment due to attack of nanoparticles on the non-target sites. Thus, effective and practical risk management strategies should be practiced during the technological developments.

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MILLETS: A SUSTAINABLE MIRACLE CROP FOR FUTURE

Santosh Jain Passi¹ and Akanksha Jain²

Millets are the small-seeded crops that can grow well in dry zones and rain-fed areas under marginal conditions of soil fertility/moisture. Millets are rich sources of various nutrients, particularly the micro nutrients. Despite numerous qualities, utilization of millets in our Indian dietaries is confined to the traditional consumers. There is a dire need to create public awareness regarding the benefits of millets as well as promoting the production and consumption of these miracle crops.

INTRODUCTION

“**M**illets are one of the oldest foods known to humans; and possibly the first cereal grain to have been used for domestic purposes”.

Millet is a collective term that refers to a number of small-seeds belonging to gramineae family. These are the hardy crops that grow well in rain-fed regions under marginal conditions of soil fertility and moisture. Millets are also unique due to their short growing period; these can develop from planted seeds to mature, ready to harvest plants in as little as 65 days. This feature of the millets is of great importance for the heavily populated areas. If properly stored, whole millets can keep well for two years or beyond¹.

Millets are highly nutritious, non-glutinous and non-acid forming foods. Hence, they are soothing and easy to digest. Being free from gluten, millets are least allergenic and are therefore, most suited for the individuals suffering from gluten enteropathy (celiac disease). Compared to rice, especially polished rice, millet ingestion leads to a slower release of glucose over a longer period of time; thus, their habitual consumption lowers the risk of diabetes.

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Millets are particularly high in minerals like iron, calcium, magnesium, zinc, phosphorous and potassium. Finger millet (*Ragi*) is the richest source of calcium and *bajra* is rich in iron. Millets also contains appreciable amounts of various vitamins like β - Carotene, niacin, vitamin B₆ and folic acid. Unlike rice and wheat that require numerous inputs in terms of soil fertility and water, millets grow well in dry/arid as well as rain-fed regions. By incorporating millets in our dietaries, we will be encouraging the farmers in dry land regions to grow crops that are best suited for their prevailing conditions. This will not only be a step towards sustainable cropping practices but will also help in introducing diversity in our diets. In this way, we shall be able to help in maintaining biodiversity of the nature rather than forcefully changing the cropping patterns by growing wheat and rice everywhere.

India is the largest producer of many kinds of millets, which are often referred as *coarse cereals*. However, realizing the nutritional richness of these grains they are now called as the '*nutria-cereals*'. Though, they occupy relatively a lower position among food crops in Indian agriculture, they are quite important from the point of food and nutrition security at the national, regional and the household level.

TYPES OF MILLETS

A wide variety of millets are grown all over the

world including India which is a home to large number of millets. Fig 1 indicates the common species include pearl millet (*Bajra*), sorghum (*Jowar*), finger millet (*Ragi*), Proso/Common millet (*Barri*), Foxtail millet/Italian millet (*Kangni*), Barnyard millet (*Jhangora*), Little millet (*Kutki*) and Kodo millet (*Kodra*).

Millets can not only grow in poor soil/climatic conditions; owing to their short growing period, these can very well fit into the multiple cropping system both under irrigated as well as dry farming conditions. Thus, these crops can provide nutritious grain and fodder in a short span. Further, their long storability under ordinary conditions has accorded them the status of "famine reserves". In Indian context, this attribute is crucially important as our agriculture suffers from the vagaries of monsoon.

BENEFITS OF GROWING MILLETS

à Millets are drought resistant crops needing



Bajra



Jowar



Ragi



Barri



Kangni



Kodra

Fig 1. A variety of commonly consumed millets

fewer external inputs. They can be grown under harsh circumstances such as arid/semi-arid regions; and require far lesser water than many other cereals. Further, these crops are often able to cope with poor soil conditions.

à Millets provide food and livelihood security to millions of households, particularly to the small/marginalised farmers and the inhabitants of rain-fed regions, especially the remote tribal populations. Millets are usually cultivated as dual-purpose crops providing both food grain (for human consumption) and fodder (for the animals), contributing to economic efficiency in mixed farming systems.

à Numerous varieties of millets including hybrids, improved/ local varieties exist; however, their cultivation and taste characteristics vary. This especially applies to the local varieties.

à As part of the mixed farming system, various millets are frequently cultivated along with other type of millets, pulses, beans, oilseeds, etc. Richness of the crop and varietal diversity of millet based cropping systems foster and enrich agro-biodiversity of the ecosystems.

à Besides being water efficient, millets are C₄ carbon sequestering crops contributing to the reduction of atmospheric CO₂. Due to this highly beneficial attribute, these crops deserve to be lauded; and possibly in the near future, they may become entitled for various benefits under (international) climate change mitigation schemes.

à Rice cropping is one of the major contributors

to climate change while wheat is liable to reduced productivity with the rising temperatures as part of climate change.

à Millets have been cultivated for around 3,000 years making them an integral part of our Indian culture; these are intricately woven in the socio-cultural fabric of various regions in our country².

à Millet production is not dependent on the use of chemical fertilizers. Mostly the farmers use the farmland manure, and in recent times, even the bio-fertilisers produced at household level. As a result, millet farming can significantly reduce the burden of fertilizer subsidy being borne by the nation.

- à Grown under traditional methods, millets do not attract pests; and a majority of them are not affected by the storage pests either. Therefore, the need for pesticides is almost negligible. As a result, the millets are a great boon in protecting the agricultural environment.
- à Millets are amazing in their nutrient content (Table 1). Nutritionally, in terms of proteins, minerals, vitamins and dietary fibre, each of the millets is three to five times superior to the widely used rice and wheat.

Millets are the Climate Change Compliant Crops.....

The corollary "Climate change" signifies less rain, more heat and reduced water availability ultimately resulting in heightened levels of malnutrition.

The qualities of millet farming system make them the Climate Change Compliant Crops.

The way rice is grown under standing water, with the changing climatic conditions, it becomes a dangerous crop since methane emanating from the water-drenched rice fields (the green-house gas)

severely threatens our environment. It is important to note that with the projected rise in temperature, wheat - an extremely thermal sensitive crop, might disappear in the times to come. Further, millets are all-season crops whereas wheat is season specific, and we are able to harvest only two crops in a year – *rabi* and *kharif*.

While wheat and rice provide only food security, millets provide multiple securities (food, fodder, health, nutrition, livelihood and ecological) making them the crops of agricultural security.

In view of the above attributes, millets are sometimes called '*the miracle grains*' or '*crops of the future*'³.

Millets symbolize the food and knowledge sovereignty of Indian farmers by ensuring a life of dignity and self-reliance. Mostly, the millet fields are inherently bio-diverse, as in practice, none of the farmers grows millets as a mono crop; rather these are grown in combination with a host of pulses, legumes, vegetables and oil seeds.

Despite numerous qualities, utilization of millets as food is confined to the traditional

Table 1: Nutrient Content of Various Millets vs Rice and Wheat

Crops	Protein (g)	Crude Fibre (g)	Total Minerals(g)	Iron (mg)	Calcium (mg)
Rice	6.8	0.2	0.6	0.7	10
Wheat	11.8	1.2	1.5	5.3	41
Finger millet	7.3	3.6	2.7	3.9	344
Pearl millet	10.6	1.3	2.3	16.9	38
Foxtail millet	12.3	8	3.3	2.8	31
Kodo millet	8.3	9	2.6	0.5	27
Little millet	7.7	7.6	1.5	9.3	17
Proso millet	12.5	2.2	1.9	0.8	14
Barnyard millet	11.2	10.1	4.4	15.2	11

(Source: www.swaraj.org/shikshantar/millets.pdf)³

consumers, especially the tribal populations. This is mainly due to the non-availability of consumer friendly, ready-to-use/ready-to-eat millet based products. Recently, millets have gained attention and efforts are under way to obtain their convenient and value added processed products⁴. Although, millets are rich in phytochemicals (polyphenols, tannins, phytosterols) and antioxidants, they also contain certain anti-nutritional factors such as phytates, tannins etc., however, these can be minimised by appropriate processing/treatments.

Millets (in different proportions) along with rice, wheat and pulses/oilseeds can be used to produce various nutritious food items such as porridges, pastas, biscuits, cakes, cookies, tortillas, bread, probiotic drinks, *laddoos*, flakes and several fermented foods including probiotic drinks⁵. After dehulling, all millets can be cooked as rice and their flour can substitute the rice/wheat flour in various snack foods. Since, hulling is a tedious and time-consuming process, it is proposed that the millet grains after proper hulling and roasting, can be made available in the market for an efficient use. Fermented batters prepared using millets and black gram (3:1), can be used for making *idli*, *dosa* or *uttapam*. The traditional (popping/flaking) and contemporary (roller drying/extrusion cooking) methods of cereal processing could be successfully applied to the millets for preparing ready-to-eat/ready-to-cook (RTE/RTC) food products.

NEWER AVENUES IN MILLET PROCESSING

The conventional millet processing methodologies commonly employed include: milling (decortication/size grading), popping, malting, fermentation and manual extrusion. In recent years, the contemporary food processing technologies such as extrusion cooking and advanced methods of baking are becoming popular. In India, in the next few years, 'ready to eat' food market is expected to grow tremendously; therefore, there is a great potential for the food products prepared using millet/millet-cereal-pulse blends.

Convenience foods are flooding both the urban and the rural markets, however the type is dependent on demands of the respective consumers⁶. In view of the current agricultural scenario and our changing life styles, there is a need to revive production and consumption of millets for bestowing the multiple benefits. If made available in convenient RTE/RTC forms, the nutritional/nutraceutical benefits of the millet can easily be reaped by the masses. In human nutrition, millets have considerable potential as a food and beverage. Cakes, cookies, pastas, snack foods and rice-like products have been successfully produced from sorghum/other millets. Production of leavened breads out of sorghum/millet (without using wheat) yet remain a challenge⁷.

Breakfast cereals are gaining popularity among the health-conscious populations, however, the traditional processes (roasting/popping/puffing) have seldom been used for millets which could even enhance their nutritional quality. However, processing technologies like extrusion, flaking and toasting need to be evaluated for their suitability/efficacy in preparing novel foods using millets in combination with other food items⁸. Extrusion processing lowers the anti-nutritional factors while it enhances digestibility of the proteins and starches, therefore, such a processing is well suited for the millets. In extrusion process, the starches are partially solubilised; thus, the extruded.

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Further, there is a substantial scope for preparing innovative value added millet based food products such as *Bajra lassi* (having nutritional supremacy of the millets; positive attributes of the probiotics; enhanced mineral bio-availability as well as excellent consumer acceptability).

In case of the fermented millet products like dosa, idli, uttapam, lassi etc, certain lactobacilli species with phytase activity can effectively reduce the phytate content, thereby enhancing the bioavailability of various minerals.

Milletts act as the food substrate for probiotics resulting in improved flavour, texture and overall acceptability of the product^{9,10}.

As per WHO (2001), probiotics are the live micro-organisms which, when administered in adequate amounts, confer a health benefit on the host¹¹.

Addition of millet or malt components to milk/milk products is another opportunistic window in functional foods. Keeping in mind the high incidence of malnutrition and food insecurity in our country, millet based low cost nutritious foods should be developed for the poorer sections of our society. Malted flour/malt extract from millets can be incorporated in a wide range of processed health foods. Millets also serve as a suitable base for gluten-free food products including bakery items⁸. In order to meet nutritional needs of the infants/children, production of millet based nutritious value added products should be accorded an extremely high priority; coupled with this should be the simultaneous efforts in creating a demand for these products through awareness generation among masses. In addition, various challenges - both at production and processing level, need to be addressed through R & D initiatives.

'Diversification' is the key for sustainability, however, for viability, it needs to attain commercial significance. There is a wide scope for optimizing the technologies for processing millets, especially the novel foods with unique nutritional/therapeutic value. Newer technologies in millet processing can be developed and the existing ones can be upgraded.

Currently, in the 12th plan, our Government has recognized the role of millets in the food chain. Under the National Food Security Mission (NFSM, Action Plan 2014-15), of the preliminary targets for enhancing food grain production by an additional

25 MT, the share allocated for millets is 2MT, making it 8% of the enhanced food grain production.

HURDLES IN MILLET PROCESSING

In millet processing, a number of hurdles are being faced. The most common ones include absence of appropriate primary and secondary processing technologies to prepare ready-to-eat/ready-to-cook products; poor popularity and limited adoption of the millet based foods among the non-traditional urban populations. Therefore, efforts are needed for increasing the popularity and wider adoption of the millet based food products for diversified utilization among the non-traditional urban populations⁶.

Currently, millets have been almost disappearing from our food basket. Declining State support (in terms of crop loans/insurance) has led to the poor status accorded to millets in Indian agriculture; and this needs to be halted urgently. Hence, there is a dire need for the Indian policy makers to refocus their attention towards millet farming systems and enact policies to create enabling environment for the farmers³. With respect to millets production/promotion, some of the existing Government schemes/ projects/programmes include:

- Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP) – a part of Rashtriya Krishi Vikas Yojana” (RKVY);
- Rainfed Area Development Programme (RADP) – again a part of Rashtriya Krishi Vikas Yojana” (RKVY); and
- Integrated Cereals Development Programmes in Coarse Cereals based Cropping Systems Areas (ICDP-CC) under Macro Management of Agriculture (MMA).

Of these, INSIMP is the only comprehensive initiative to support millet production. As regards millet promotion is concerned, there is a lot of state-wise variation. Most of the states usually focus only on sorghum, pearl millet and finger millet; ignoring other varieties of millets².

Millets are the ultimate true 'agricultural crops'

and the government should take all necessary steps to conserve and promote them. Such an action will acknowledge the services rendered by millet farmers to food and nutrition security of the nation. Therefore, the State should offer necessary support to the millet farmers which can be in the form of bonuses, subsidies and other financial help.

The urgent need for according top priority to millets is due to the decades of 'Climate Change' which has threatened the humanity with challenging scenarios. These include increasing global warming; water scarcity that will acquire frightening proportions; and the projected malnutrition that is likely to affect 70% of the Indian population, particularly the poor/vulnerable sections.

SUGGESTIONS FOR IMPROVING THE MILLET CULTIVATION

Since millets are predominantly grown by the poor farmers in marginal/sub-marginal dry lands, fluctuations in their production not only bring hardship to farmers but also create instability in the total millet production. Therefore, for improving the millets cultivation:

- ā Efforts such as mini-kit demonstrations/State Level Training Programmes can help in popularizing the newly released varieties among the farmers which can be distributed free of cost or at subsidized rates.
- ā The importance of line sowing, optimum row spacing, depth of seeding, optimum plant population/unit area, culturally appropriate practices which can result in higher productivity needs to be explained and demonstrated to the farmers at the field level.
- ā Agronomic research should bring out efficient, low-cost and easy-to-adopt technologies which are within the means of farmers.
- ā In ready-to-eat food products, use of millets needs to be encouraged for enhancing nutritive value at lower cost.
- ā Millets should be accorded high priority in the National Food Security Bill; and the

Government should allocate appropriate share of the budget to millet based farming and the food systems using millets as the major food component.

- ā Millets need to be integrated into the existing Public Distribution System (PDS).

Introducing millets in the ICDS and the midday meal menus (at least twice a week); other welfare/governmental schemes as well as in the school/college hostels can help in popularising these nutritious grains¹². In the year 2012, Centre had asked the States to introduce millets in MDMS so as to enhance the demand for these nutria-cereals. By doing so, the pressure on wheat/rice production gets reduced. Thus, millets are not only a boon for attaining food security (particularly in the conditions of droughts/poor rainfall) but these also help in overcoming under-nutrition and malnutrition owing to their high nutrient content. We need to launch massive awareness generation/education programmes including media campaign for promoting both production and consumption of the millets.

CONCLUSION

As the citizens of India, we need to grow more and more of the millets on our farmlands, since these are the future of food and farming for our country. In view of the ensuing global warming leading to adverse climatic changes, only millet farming will make it possible to continue our agriculture systems. Also, in the event of severe malnutrition, millets can help us to overcome the crisis. Millets can easily be grown by the poorest of poor farmers, without technological advancements and irrigation facilities.

In view of the benefits and advantages conferred by millets, our farmers should take necessary steps to grow millets and we as the consumers, should include millets in our daily food basket; and as citizens of our country, we should strive to bring more and more people under the ambient of millet family.

Apart from increasing the production (supply)

and consumption (demand) of millets, in today's fast moving world of modernization, industrialization, and urbanization, we need to adequately process these millets, to create a variety of value added nutritious products as per the taste, texture, flavour of the consumers. To address this issue, necessary R & D is an immediate need of the hour and the food processing industries need to take up large scale production and marketing of millet based food products.

Further, the masses need to be apprised of the benefits of millet consumption as well as ways and means of incorporating them in the diets. To achieve this, Home Science colleges, which are spread all over the country, can be tapped and made responsible for taking the message to the grass roots level. The strategies in this regard need to be decentralized for ensuring adaptation to the local conditions – both with respect to the production of various millets and their consumption as per the local food habits/cooking practices.

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SCIENCE AND ARTS: SHALL THE TWAIN EVER MEET?

Paromita Ghosh

The disciplines of science and arts have gradually moved apart. Though in the 14th century, liberal arts combined the study of both disciplines yet rapid scientific progress in the 20th century witnessed delinking of science and arts. Currently it has been realized that syncretic study of these two academic branches is imperative hence requires to be revived. Innovative courses are needed to be devised so that best of science and arts, in amalgam, enrich knowledge.

INTRODUCTION

The word science emanates from the Latin word *scientia* which means knowledge. The Compact Oxford Reference Dictionary defines science firstly as systematic study of structure and behaviour of physical and natural world through observation and experiment. Secondly it defines science as an organized body of knowledge on any subject¹. Authors Marx and Cronan-Hillix describe science as the enterprise by which human beings obtain ordered knowledge about natural phenomena by working with a particular methodology (viz. controlled observation and analysis) and set of attitudes (e.g. scepticism, objectivity etc.)². The Compact Oxford Reference Dictionary defines arts as subjects of study pertaining to human culture¹. Often the terms arts and humanities are used synonymously. The Compact Oxford Reference Dictionary defines humanities as studies related with human culture like Literature or History¹. The Merriam-Webster Dictionary says that the term humanities is plural for the word humanity which was coined in 14th century Europe. Humanities, according to the Merriam-Webster Dictionary, are branches of learning (e.g. Philosophy, Arts or Languages) that probe human constructs and concerns (as opposed to natural processes which are subject matters of disciplines like Physics and Chemistry) as well as social relation (as in Anthropology or Economics)³. This definition appears to include arts and social sciences under humanities but excludes sciences.

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LIBERAL ARTS: MEETING GROUND OF SCIENCE AND ARTS

The perceived divide between science and arts has sparked academic debate. This divide is more noticeable now than it was at the time of European renaissance and reformation. Movements such as renaissance and reformation promoted the philosophy of humanism and stressed the study of liberal arts⁴. Liberal arts comprised science and arts (or humanities). The Merriam-Webster Dictionary delineates liberal arts as college or university studies (e.g. in Language, Philosophy, Literature and Abstract Science) intended to primarily impart general knowledge and to develop general intellectual capacities (like reason and judgement) in contrast with professional or vocational skills. The term liberal arts came into limelight around 14th century in Europe. The word liberal originates from the Latin word *liber* that means free. Thus liberal arts referred to education meant for a freeman unlike that for a slave. This suggests that liberal arts were domains of the privileged. The subalterns could, at best, acquire skills. Universities in the Western world taught seven liberal arts during the medieval period. These were Grammar; Rhetoric; and Logic (the *trivium*) as well as Geometry; Arithmetic; Music; and Astronomy (the *quadrivium*). Even today one gets to hear of a few educational institutions offering courses of study in liberal arts especially in the United States of America. These days the liberal arts include the combined study of Literature; Languages; Philosophy; History; Mathematics; and Science⁵. Therefore liberal arts connect the chasm between science and arts. However, institutions

genuinely imparting education in liberal arts are rare in India.

GROWING DISCONNECT

Early twentieth century witnessed the slowly widened gap between science and arts. C. P. Snow expressed unhappiness at this disconnect. According to him, till the late nineteenth century an average educated person was equally conversant in both the disciplines. But phenomenal progress of science and technology in the twentieth century and rising trend of specialization in education detached arts from science. Scholars in science as well as those in arts appeared to begin to consciously mystify and zealously protect their disciplines. Consequently, most people were compelled to choose one discipline to the exclusion of the other. This gave rise to an artificial dichotomy between the two disciplines. It was opined that reducing specialization in education, embracing of interdisciplinary approach and propagation of scientific literacy among the populace could help shrink the gulf between science and arts⁶. However, in today's world with its emphasis on excellence, decrement of specialization in education does not seem feasible.

CURRENT SCENARIO IN INDIA

In India, institutes training engineers and technologists include instructions in both science and arts/humanities in their curriculum. Inclusion of science comes as no surprise since engineering or technology embodies application of science. But it intrigues why is arts (or humanities) taught to budding engineers or technologists? The argument is that unless one has wide worldview one can not function well as an engineer or technologist. For instance, in order to write an effective report one has to master the skill of writing. If one has to flourish as a team leader one has to have some understanding of human psychology and sociology. Verbal skills help one make successful presentations in front of potential clients and sell products in the face of stiff competition. Familiarity with economics helps engineers and technologists in attuning processes and products to market demands thereby garnering greater profits. Very few students are interested in

serious study of arts/humanities, majority of them generally consider study of these disciplines as wastage of time. They can not be blamed because often the rationale for inclusion of arts in engineering or technology courses is either not articulated properly or simply subverted. Students of engineering or technology must be clearly explained why study of arts forms a part of their curricula. Besides, the components of arts in engineering / technology curricula should be customized to aid engineering or technological education. For example, civil engineering students could be taught how to write persuasive reports on proposed construction projects in their English class. Agricultural engineers of the future need to be made aware of motivations, emotions, attitudes and prejudices of the farmers. Erudite lectures on Psychology and Sociology make no sense to engineers but linking psychosocial concepts to situations they are going to encounter in their professional lives is sure to stimulate interest. Oil technologists could be explained how market forces influence pricing of oil in their Economics class. Training in comfortably facing interview boards and delivering effectual presentations would help engineers and technologists across the board. In short, bespoke courses are needed; the prevalent generalized approach must be discarded. The cafeteria approach to higher education proposed by the University Grants Commission promises to let students in non-professional colleges and universities opt for courses of study they are interested in pursuing. This approach implies tailoring of learning experience by individual students. It holds the key to bring together of science and arts disciplines. For instance, a student can choose courses in Physics, Mathematics and Philosophy. Another one can combine Agriculture, Economics and Journalism. This approach, if implemented intelligently, may not only address learners' unique needs but also enhance their prospects in the job market. However, the approach failed to take off because of lack of logistics and the controversy surrounding its offshoot – the choice based credit system.

CONCLUSION

There is some effort to combine knowledge of science and arts. The disciplines - History of Science, Science Journalism, Gender Studies of Science, Medical Sociology etc. are cases in point. Many more innovative disciplines may be generated by twinning science and arts. Examples are Linguistics of Science; Physics of Music; Cognitive Science of Poetry Writing and Appreciation; Application of Statistics in History; Politics of Scientific Enterprise; Geography and Literature; and Mathematical Modeling in Psychology. Such courses, at present rarely offered in India, would cater to the niche and ensure better student-teacher ratios. However, interdisciplinarity should not become the excuse for dilution of academic standard; the quest for excellence must continue.

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AN OVERVIEW OF RICE DISEASES IN INDIA

Mouli Saha

Rice is one of the most important staple food crops of India. It is the principal cereal crop in India, which stands second in terms of production and consumptions in the world¹. Rice production in India crossed the mark of 100 million MT in 2011-12 accounting for 22.81% of global production in that year. The productivity has mainly affected by different diseases of rice. Rice diseases occur more or less constantly causing what would appear to be insignificant or occasional losses to individual growers, though making a substantial total in the aggregate in the country. Under favourable condition, some diseases occur as epiphytotic and cause considerable loss. It is stated that nearly 80% of crop was lost due to blast in 1920 in South India and one of the major causes of famine in Bengal in 1943 was due to an epidemic (brown spot of rice) caused by *Helminthosporium oryzae*.

INTRODUCTION

Rice is the most economically important staple food crop in India, China, East-Asia, South East Asia, Africa and Latin America catering to nutritional needs of 70% of the population in these countries². Worldwide, rice is grown on 161 million hectares, with an annual production of about 678.7 million tons of paddy³. About 90% of the world's rice is grown and produced (143 million ha of area with a production of 612 million tons of paddy) in Asia³. To meet the global rice demand, it is estimated that about 114 million tons of additional milled rice needs to be produced by 2035, which is equivalent to an overall increase of 26% in the next 25 years⁴. The possibility of expanding the area under rice in the near future is limited. Therefore, the need for extra rice production has to come from a productivity gain⁴. Maximum yields per unit area of land can be achieved and sustained only if indigenous as well as high yielding crop varieties of rice are properly protected against its pest enemies⁵. Amongst the various biotic factors affecting rice production and productivity, rice diseases are one of the most important ones. The annual losses due to rice diseases are estimated to be 10-15% on an average basis worldwide. Rice

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diseases are caused by wide variety of pathogens including fungi, bacteria, virus and nematodes⁷. However, with the increasing demand for world rice supplies and advent of green revolution resulting in use of improved varieties, high fertilization, irrigation and intensive cultural practices have resulted in great increase in the occurrence and severity of diseases infesting rice in India¹.

MAJOR DISEASES OF RICE IN INDIA BLAST DISEASE OF RICE

Blast is caused by a fungus *Pyricularia oryzae*, which damages the crop in nursery and vegetative stage. It affected the crops during the seasons, kharif and rabi⁶.

In some regions of our country, blast disease is endemic causing severe damage to the crop every year. In other parts, blast is seasonal in occurrence, severity of which depends upon prevailing weather factors. The high yielding varieties of rice approved for release in India such as *Adt, 27, Jagannath, Ratna, Cauvery* and *Hamsa* are susceptible to blast⁹. Leaf blast is favoured by the low night temperature (22-28°C), high relative humidity (>95%), dew deposit, leaf wetness for more than 10 hours and high nitrogen. The disease is a serious problem in upland, irrigated and hilly ecosystems. In high rainfall zones

(rainfall $>_{=}$ 1,500 mm) of North and North-Eastern India, the disease is prevalent during June-September. In Western and Central India (rainfall around 1,000 mm) the disease occurs during August-October. In Southern India blast mainly occurs in dry season during November-February. During Kharif season, the disease is prevalent throughout the rice-growing areas especially in Himachal Pradesh, Uttarakhand, Jharkhand, Madhya Pradesh, Chhattisgarh, Assam, Tripura, West Bengal, Orissa, parts of Maharashtra, Andhra Pradesh, Kerala, Karnataka and Tamil Nadu¹.

The symptoms appear first on the leaves as small bluish flecks (Fig-1A). The central portion of the lesion becomes dull greyish green and has water soaked appearance. Similar spots are formed on leaf-sheath, inflorescence and ears. The neck becomes shrivelled. The affected plants can very easily be identified by bluish patches on the neck or stem. Due to necrosis of neck tissues the ear tends to break and fall off.



Fig. 1A. Leaf blast disease.

BROWN LEAFSPOT DISEASE OF RICE

Brown leaf spot disease is caused by the fungus *Helminthosporium oryzae*, which affect the rice plant during vegetative stage. This fungus affected the crop in kharif as well as rabi season⁶.

Brown spot of rice was considered to be a major factor contributing to the Bengal famine of 1943 as it resulted in a loss in yield amounting to 50-90% of 1942 harvest due to its outbreaks⁷. It was found that the abnormal weather conditions (excessive rainfall in September, uniformly favourable temperature range of 25-30°C continuously for two month,

usually cloudy weather, rain in November and low sunshine hours) which prevailed in Bengal in 1943 had contributed towards the development of this disease⁷.

Brown spot is problem mainly during kharif season especially in uplands and hill ecosystem. The disease also assumes a serious proportion in irrigated ecosystem especially in ill-managed plots. The disease is predominant in Jharkhand, Eastern Uttar Pradesh, Bihar, Chhattisgarh, tarai region of West Bengal, Orissa, Assam, Tripura, Uttarakhand and Punjab. In boro season the disease has been recorded in the states of Assam, Bihar and eastern Uttar Pradesh⁹.

Irregular, rectangular brown spots appear on leaf blades and leaf sheaths (Fig-1B). In severely affected seedlings, the leaves dry out and die. Badly affected areas can be distinguished by their brown scorched appearance.



Fig. 1B. Brown leaf spot disease.

STEM ROT DISEASE OF RICE

This rice disease is caused by the fungus *Sclerotium oryzae*, during panicle initiation to booting vegetative stage. This fungus affected the crop mainly during kharif season⁶.

Stem rot of rice has become an important disease of rice causing substantial loss due to increased lodging. The disease is favoured by high N fertilizers, high relative humidity, high temperature and water logging conditions. The disease is more in early planted crop because of high temperature and relative humidity prevailing during the susceptible stage of the crop⁶. The disease is prevalent in

Haryana, Bihar, Uttarakhand and Andhra Pradesh⁹.

The disease is caused by a pathogen *Sclerotium oryzae*. The affected plants produce green shoots from the base and light ears, late in ripening stage (Fig-1C). The base of the stem shows discoloration and dark mycelium develops inside the Culm.

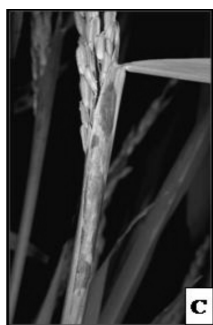


Fig. 1C. Stemrot disease.

SHEATH BLIGHT DISEASE OF RICE

Sheath blight disease of rice is caused by the fungal pathogen *Rhizoctonia solani*. This pathogen affected the rice crop during tillering, panicle initiation to booting stage, which damages the crop in both kharif and rabi season⁶.

Sheath blight is a serious problem in coastal and high rainfall areas. The disease is mostly prevalent in areas where the relative humidity is very high (above 95%), the temperature is moderate (28-32 0C) and N application is high. The disease is prevalent in moderate to severe form in states like Andhra Pradesh (coastal), Assam, Bihar, parts of Chhattisgarh, Orissa, eastern Uttar Pradesh, West

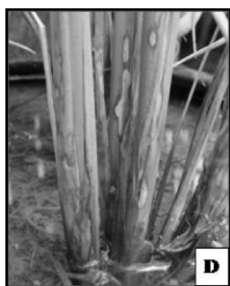


Fig. 1D Sheath blight disease.

Bengal, Kerala, Haryana and Punjab. In boro season

the disease has been observed regularly in moderate form in the states of Assam, Bihar and Eastern Uttar Pradesh⁹.

Lesions can sometimes be found on young plants under favorable conditions, but initial symptoms are usually lesions on sheaths of lower leaves when plants are in the late tillering or early internode elongation stage growth (Fig-1D). This lesion appear 0.5-3 cm below the leaf collar as circular, oblong, or ellipsoid, green-gray, water-soaked spots about 1 cm long.

SHEATH ROT DISEASE OF RICE

This disease is caused by the pathogen *Acrocyndrium oryzae*, which damages the crop in Post flowering stage. This fungus affected the crop mainly during Kharif season⁶.



Fig. 1E. Sheath rot disease.

In cytoplasmic male sterile lines (A lines) where the emergence of the panicles is poor, the incidence of sheath rot is very high. Sheath rot of rice has become a serious problem in recent years especially when there is post-flowering rain. These problems have become wide spread in states like Andhra Pradesh, Tamil Nadu, Kerala, Orissa, Jharkhand, Bihar, West Bengal, Assam, eastern Uttar Pradesh, Gujarat, Haryana, Punjab, Uttarakhand and Chhattisgarh⁹.

Rotting occurs on the leaf sheath that encloses the young panicles. The lesions start as oblong or somewhat irregular spots, 0.5-1.5 cm long, with gray to light brown centres surrounded by distinct dark reddish brown margins. As the disease progresses, the lesions enlarge and coalesce and may cover most

of the leaf sheath. Lesions may also consist of diffuse reddish brown discolorations in the sheath.

An abundant whitish powdery growth may be found inside the affected sheaths, although the leaf sheath may look normal from the outside. With early or severe infection, the panicle may fail to emerge completely or not at all; the young panicles remain within the sheath or only partially emerge. Panicles that have not emerged tend to rot and florets turn red-brown to dark brown. Most grains are sterile, shrivelled, partially or unfilled, and discoloured.

FOOT ROT OR BAKANAE DISEASE OF RICE

Foot rot disease of rice is caused by the fungus *Gibberella fujikuroi* (Syn. *Fusarium moniliforme*), which affected the crop plants mainly during vegetative stage. This fungus mainly damages the rice crop in Kharif season⁶.



Fig. 1F. Foot rot or bakanae disease.

Though the disease is of limited occurrence, it has potentiality to be highly serious. The disease is prevalent in Haryana, Tamil Nadu and Andhra Pradesh⁹.

The word *bakanae* is a Japanese word meaning 'foolish seedling' and refers to the abnormal elongation or hypertrophic growth of the seedling (Fig-1F) caused by the hormone gibberellin, which is produced by the infecting organism. Bakanae is also characterized by sterility of infected plants which is described in the Philippines as '*palay lalake*' (local terms for rice and man, respectively) or '*man rice*' in Guyana. This rice disorder is also referred to as white stalk in China and was described as a foot rot disease in India.

FALSE SMUT DISEASE OF RICE

This rice disease is caused by the fungus *Ustilaginoidea virens*, which affected the crop during post flowering stage and this pathogen affected the crop mainly in Kharif season⁶.

False smut of rice has emerged as a major disease in the recent years. The incidence of the disease is particularly more on hybrid varieties. The incidence of the disease is more in those years when spells of wet weather coincide with the heading stage. The disease is favoured by the prevalence of relatively low temperature and high humidity with moderate rainfall well distributed during the period of flowering. The incidence of the disease is more in states like Haryana, Punjab, Uttarakhand, Bihar, Chhattisgarh, Gujarat, Jharkhand, Orissa, Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir, Maharashtra and Tamil Nadu⁹.

The disease occurs in the field at the hard dough to mature stage of the crop. The fungus transforms individual grains of the panicle into greenish spore balls that have a velvety appearance (Fig-1G).



Fig. 1G. False smut disease.

The spore balls are small at first and visible in between glumes, growing gradually to reach 1 cm or more in diameter and enclosing the floral parts. They are covered with a membrane that bursts as a result of further growth. The colour of the balls becomes orange and later yellowish green, or greenish black. At this stage, the surface of the ball cracks. The outermost layer of the ball is green and consists of mature spores together with the remaining fragments of mycelium.

BACTERIAL BLIGHT DISEASE OF RICE

This disease is caused by the bacteria *Xanthomonas campestris* pv. *Oryzae*, which damages the crop during pre-tillering to mid-tillering and panicle initiation to booting stage. This bacterial disease affected the rice crop mainly in kharif season⁶.

Bacterial blight is essentially a monsoon season disease. The intensity of the disease is much influenced by rainfall, cloudy, drizzling and stormy weather and high nitrogen fertilizer. The disease is prevalent in moderate to severe form in almost all the rice-growing areas during the monsoon season. The disease is prevalent in coastal Andhra Pradesh, Tamil Nadu, Kerala, Punjab, Haryana, Uttarakhand, Uttar Pradesh, Gujarat, parts of Maharashtra, Chhattisgarh, Bihar, West Bengal, Orissa and Assam⁹.

Water soaked lesions move from tip downwards on the edges of leaves (Fig-1H). Gradually symptoms turn into yellow and straw coloured stripes morning in humid areas yellowish, opaque, turbid drops of bacterial ooze may be seen. In wilt phase, leaves roll completely, droop and plant die completely.

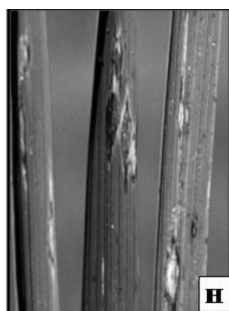


Fig. 1H Bacterial blight disease.

TUNGRO DISEASE OF RICE

This rice disease is caused by the Rice tungro baciliform virus (RTBV) and Rice tungro spherical virus (RTSV), which affected the rice crop during

nursery and tillering stage. The susceptible crop season is mainly kharif season⁶.

Tungro disease viruses are transmitted from one plant to another by leafhoppers that feed on tungro-infected plants. The most efficient vector is the green leafhopper.

Leafhoppers can acquire the viruses from any part of the infected plant by feeding on it, even for a short time. It can, then, immediately transmit the viruses to other plants within 5-7 days. The viruses do not remain in the leafhopper's body unless it feeds again on an infected plant and re-acquires the viruses.

Rice Tungro disease is the most important virus disease of rice. It has been reported from many rice-growing areas of India. The disease is prevalent in Tamil Nadu, West Bengal, parts of Andhra Pradesh and Orissa⁹.

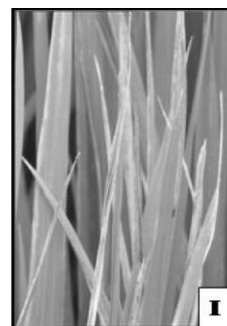


Fig. 1I Tungro disease.

Stunting and yellow or orange-yellow discoloration of the leaves (Fig-1I). Infected plants also have reduced number of tillers and may show rust-coloured spots on the leaves. Tungro may produce a mottling, striping or interveinal necrosis of the leaves. Panicle exertion of infected plants is delayed and often incomplete, and some panicles become short and produce sterile or partially filled grains⁶.

Table-1: Disease, causal organism, symptoms and control measure of major rice diseases in India.

Diseases	Causal organism	Symptoms	Control measure
Blast disease of Rice	<i>Pyricularia oryzae</i>	Initial symptoms appear as white to gray-green lesions or spots, with dark green borders. Older lesions on the leaves are elliptical or spindle-shaped leaves are elliptical or spindle-shaped and whitish to gray centers with red to brownish or necrotic border.	Adjust planting time, Sow seeds early, split nitrogen fertilizer application in two or more treatments, flood the field as often as possible.
Brown Leaf spot disease of Rice	<i>Helminthosporium oryzae</i>	Infected seedlings have small, circular, yellow brown or brown lesions that may girdle the coleoptile and distort primary and secondary leaves.	Monitor soil nutrients regularly, apply required fertilizers for soils, apply calcium silicate slag before planting.
Stem rot disease of Rice	<i>Sclerotium oryzae</i>	Lesions are initially small, circular, and dark brown to purple-brown. Fully developed lesions are circular to oval with a light brown to gray center, surrounded by a reddish brown margin caused by the toxin produced by the fungi.	Use resistant cultivars, burn crop residues after harvest, drain the field balance the use of fertilizer, chemicals, such as thiophanate-methyl, ferimzone and validamycin sprayed at the time of disease initiation,
Sheath blight disease of Rice	<i>Rhizoctonia solani</i>	oval or ellipsoidal greenish gray lesions, usually 1-3 cm long on the leaf sheath, lesions on the leaves usually have irregular lesions, often with gray-white centers and brown margins as they grow older	Use reasoned level of fertilizer, carefully control of weeds, drain rice fields relatively early in the cropping season, use fungicide to treat seeds, improve canopy architecture.
Sheath rot disease of Rice	<i>Acrocyldrium oryzae</i>	The typical sheath rot lesion starts at the uppermost leaf sheath enclosing the young panicles. It appears oblong or as irregular spot with dark reddish, brown margins, and gray center or brownish gray throughout.	Use healthy seeds, minimize insect infestation in rice field, remove infected stubbles after harvest, apply fungicide like carbendazim, edifenphos, or mancozeb as seed treatment and foliar fungicide like benomyl and copper oxychloride as foliar sprays.

Diseases	Causal organism	Symptoms	Control measure
Foot rot or Bakanae disease of rice	<i>Gibberella fujikuroi</i> (Syn. <i>Fusarium moniliforme</i>)	Early infection can cause seedlings to die at early tillering stage. Later infection results in plants that develop few tillers and have dry leaves. If the plants survive to maturity stage, they develop partially filled grains, sterile, or empty grains.	Use clean seeds, use salt water to separate lightweight, infected seeds during soaking, use fungicides as seed treatments.
False smut disease of Rice	<i>Ustilaginoidea virens</i>	Plants infected with false smut have individual rice grain transformed into a mass of spore balls. These spore balls are initially orange, and then turn greenish black when mature.	Keep the field clean, remove infected seeds, panicles, and plant debris after harvest, reduce humidity levels, perform conservation tillage and continuous rice cropping, use moderate rates of nitrogen, use certified seeds, resistant varieties have been reported.
Bacterial blight disease of Rice	<i>Xanthomonas campestris</i> pv. <i>Oryzae</i>	On seedlings, infected leaves turn grayish green and roll up. As the disease progresses, the leaves turn yellow to straw-colored and wilt, leading whole seedlings to dry up and die.	Use balanced amounts of plant nutrients, especially nitrogen, ensure good drainage of fields, keep fields clean, remove weed hosts and allow fallow fields to dry.
Tungro disease of Rice	Rice tungro baciliform virus (RTBV) and Rice tungro spherical virus (RTSV)	Yellow or orange-yellow discoloration is noticeable in tungro-infected plants. Discoloration begins from the leaf tip and extends down to the blade or the lower leaf portion. Infected leaves may also show mottled or striped appearance, rust-colored spots, and inter-veinal necrosis.	Grow tungro or leafhopper resistant varieties, practice synchronous planting, adjust planting times to when green leafhopper are not in season, plow infected stubbles immediately.

Table-2: Major Rice diseases of India show their susceptible and resistant varieties.

Diseases	Susceptible varieties	Resistant varieties
Blast disease of Rice	Barkat, N22, Surekha, MTU-1006	Jagannath, IR-28, IR-64, Sabari, Pooja
Brown Leaf spot disease of Rice	Basmati-386, MTU-1006	N-8, IR-64, Pusa-677
Stem rot disease of Rice	Swathi, Surekha, Mahsuri	IR-50, Satabdi, Swarnamukhi
Sheath blight disease of Rice	Jaya, Pankaj, Surekha	Hamsa, IR-20, N-8, Jagannath, IR-36
Sheath rot disease of Rice	Swarna, Jaya, Annapurna	IR-50, Satabdi,
Foot rot or Bakanae disease of rice	Swathi, MTU-7029	IR-20, IR-50, Birsa dhan-104
False smut disease of Rice	Swarna, Ratna, Mahsuri	IR-8, IR-20,
Bacterial blight disease of Rice	Jaya, N22, Panaj, Tawi	IR-20, Sita, Satabdi
Tungro disease of Rice	IR 8, Jaya, Swathi	IR-20, IR-64, Pusa-44

DISCUSSION

The major rice diseases that often cause great economic losses are rice blast, sheath blight, bacterial blight and tungro virus disease especially in South and South East Asia⁷. Rice blast and brown spot were the major diseases noticed during pre independent India and before introduction of high yielding varieties. After introduction of High Yielding Varieties, bacterial leaf blight, tungro and sheath blight have become major diseases. Recently diseases like sheath rot, false smut, stem rot and grain discolouration which were minor and occurring sporadically are emerging and causing considerable yield loss¹. This is primarily due to climate change, crop intensification and changes in practice. Out of the total yield loss due to diseases in rice, 35% is by blast, 25% by sheath blight, 20% by bacterial leaf blight, 10% by tungro and remaining 10% by other diseases⁹. The various methods used for managing rice disease includes, use of resistant varieties, cultural practices, biological and chemical control. All these methods have varied degrees of success in managing rice diseases. The most important control tactics used worldwide includes use of resistant

varieties and chemical control. Breeding for disease resistant varieties has been long used for managing the rice diseases and is one of the most economical methods which contributed immensely to world's rice productivity². But, most varieties are resistant only to a few major diseases that are the subjects of intensive breeding efforts. The rice production environments, particularly in the tropics, are habitats of many rice pathogens causing varying degrees of damage. Even the "minor" diseases collectively could pose a significant threat to production¹⁰. Moreover, the pathogen often develops new biotypes resulting in breaking down of resistance in the resistant varieties. Therefore, chemical control provides great opportunity for controlling rice diseases and over last two decades a lot of focus has been shifted towards developing new molecules that can be used for controlling rice diseases. The most destructive rice diseases prevalent across the globe are caused by fungus⁷.

CONCLUSION

In the light of the discussion, it may be mentioned that rice suffers from a number of diseases in India, of which blast and bacterial blight are the

most important ones. Disease damage can greatly reduce rice yield. They are mainly caused by fungi, bacteria or virus. Planting a resistant variety is simplest and often the cost effective management for diseases.

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KNOW THY INSTITUTIONS



NATIONAL INSTITUTE FOR RESEARCH IN TRIBAL HEALTH, JABALPUR

Regional Medical Research Centre for Tribals (RMRCT) started functioning in 1984, at Jabalpur, from three rooms in Medical College with a handful of staff. The centre continued functioning from Medical College till 1990 to address mainly to the study of the health and nutritional problems of the tribal populations, including nutritional disorders, common communicable diseases, environmental health problems, etc. The State Health has utilized the expertise of the scientists in planning, monitoring and evaluation of tribal health and other developmental programs in tribal areas of Madhya Pradesh and Chhattisgarh and also in training health functionaries of the states. This Centre is also attempting simultaneously to estimate the magnitude of health problems posed by other common diseases such as malaria, tuberculosis, leprosy, diarrhoea, filariasis, venereal diseases, poliomyelitis, measles, etc. Further, the Centre also studies the blood groups, abnormal haemoglobins and other genetic health problems to stratify areas and to suggest control measures including interventions. Socio-economic, demographic and cultural profile of the tribal population gives an insight about how they play an

important role in complicating and enhancing the magnitude of the problem. The centre was shifted to the main building of RMRCT in April 2002 and now establishing laboratories for Molecular Genetics, Immunology, Microbiology and Clinical Epidemiology in full swing. RMRCT has been designated as National Institute for Research in Tribal Health (NIRTH) in the year 2015.

OBJECTIVES

- 1 To plan, conduct and coordinate research in order to bring out the specific health problems and health needs of the tribal of the country.
- 1 To conduct epidemiological studies of communicable and non-communicable diseases among the tribal.
- 1 To investigate haemoglobinopathies in tribal and other communities.
- 1 To advise and assist the Government in planning, executing, monitoring and evaluation of tribal health programmes and in training of health functionaries.

THRUST AREAS

The following are the thrust areas of RMRCT

- | Haemoglobinopathies and malaria.
- | Work on the genetic disorders by mapping the genetic traits/ diseases.
- | Work on bio-medical and behavioural aspects of malaria using technology driven laboratories developed by it over the years.

INTERNATIONAL RECOGNITION

- | RMRCT, Jabalpur is designated recently as WHO Collaborative Centre for Research on the Health of Indigenous People.
- | RMRCT, Jabalpur works in close coordination with many international organizations in collaborative research or organizing symposia, etc. e.g. Centre for Disease Control, London School of Tropical Medicine, Liverpool School of Tropical Medicine and Hygiene, UNICEF, WHO, DFID, USAID, US Embassy, etc.

HUMAN RESOURCE DEVELOPMENT

- | RMRCT, Jabalpur jointly with NIMR-Field Station, Jabalpur organises from time to time training workshop for medical officers on malariology.
- | RMRCT, Jabalpur also organizes various national/international symposia, workshops and trainings.
- | Students from various universities such as Rani Durgawati Vishwavidyalaya, Jabalpur, etc. have completed their M.Sc dissertation work under the guidance of scientists of the centre.

RECOGNITION FOR DOCTORATE/MASTERS BY A UNIVERSITY

- | Rani Durgawati Vishwavidyalaya, Jabalpur through a memorandum of understanding in 2008 has recognized the centre/ scientists for guiding bio-medical and socio-behavioural health research students for the degree of Ph.D.
- | The centre is also recognized for Ph.D work by Jiwaji University, Gwalior.

MAJOR ACHIEVEMENTS

Significant achievements of RMRCT, Jabalpur are the following:

- | Tuberculosis laboratory of the Centre is recently recognized as Intermediate Referral Laboratory (IRL) beside State Referral Laboratory for HIV.
- | The Centre has established the H1N1p testing laboratory and is receiving samples from different parts of Madhya Pradesh.
- | Establishment of a Sickle cell clinic at the NSCB Medical College, Jabalpur where regular diagnosis, counseling and treatment is given to the patients mostly from the rural areas.
- | Malaria clinic at the NSCB Medical College for prompt diagnosis.
- | Round the clock malaria clinic at Jagdalpur in Chhattisgarh (CG) to cater to the need of the rural tribal population.
- | On fluorosis, the nutritional supplementation and safe drinking water model of the centre has been accepted by the programme for prevention of the disease.
- | Important research projects undertaken on prevalence of pulmonary tuberculosis in tribal population of Madhya Pradesh. The prevalence of pulmonary tuberculosis amongst Saharia primitive tribe was found to be 1,518 per 100,000 against the national estimate of 299 in 2006. This requires urgent intervention.
- | Malaria in Baiga Chak of Dindori district The slide positivity rate was 27% with 87 % *P. falciparum* and 47% spleen rate which is highest in the state. The drug and insecticide policy is changed on the basis of recommendations.
- | Comparative evaluation of commercially available rapid diagnostic tests (malaria Pf/Pv Kit) Vs. traditional and molecular techniques for malaria (Ongoing) Out of five commercially available RDTs, first response malaria antigen pLDH/HRP2 combo test was 95.8% sensitive and 58.8% specific for malaria. The bivalent kits are being introduced in the national programme on the basis of recommendations.
- | Preparation of a field site for malaria vaccine trial in and around Jabalpur *Anopheles culicifacies* (Sporozoite rate = 0.42) and An

fluviatilis (Sporozoite rate = 0.9) are playing an important role in the malaria transmission. The prevalence of *P. falciparum* and *P. vivax* was highest in 6-8 year and 4-6 year age group indicating that these age group needs to be vaccinated.

Genetic polymorphism analysis of merozoite surface protein-1(Msp1) gene of *Plasmodium falciparum* (Ongoing)

The overall allelic prevalence was found higher in RO33 (40%) with 9 types of variants followed by K1 (36%) with 21 types of variants and MAD20 (24%) with 17 types of variants. No information is available on temporal variation and extent of polymorphism in MSP-1 gene from this region, which is the potential information for development of MSP-1 based multivalent malaria vaccine.

Prevalence of haemoglobinopathies in tribes of Madhya Pradesh (Ongoing) Sickle haemoglobin and G-6-PD deficiency are very common (range: 10% to 30% and 1% to 9% respectively), reported for the first time, among the various tribes and scheduled caste population of tribe dominated Districts of Madhya Pradesh.

Fluorosis mitigation: Assessment, intervention and impact of intervention in fluorosis affected villages of Seoni district of Madhya Pradesh (Ongoing) About 12-15 % population is suffering from nonskeletal fluorosis and 3-4% population is suffering from skeletal fluorosis.

Fluorosis Skeletal deformities due to fluorosis are reversible in children by simple intervention i.e. safe drinking water and nutrition supplementation. This has been incorporated in the national programme for fluorosis prevention and control.

Health and nutritional profile of Baiga tribe of Balaghat district, Madhya Pradesh Acute respiratory infection (25%) and malaria (15%) are the major morbidities in Baigas of Balaghat

district with high prevalence of malnutrition (<-3SD) 10.7% among pre-school children. This data has been generated for the first time in Baigas of Balaghat district.

Behaviour and vulnerability to reproductive morbidity among the tribal youths: A study among the Sahariyas of Gwalior district of Madhya Pradesh About 17% of the Sahariya youths of Gwalior district in the age group 15-24 years reported STI symptoms with poor knowledge and practice of various reproductive safeguards and safe sexual health behaviour.

Newborn care among tribes of Madhya Pradesh: A case study among the Bhils of Dhar district of Madhya Pradesh (Ongoing) Utilization of MCH services has considerably improved with antenatal care during the last pregnancy (89%), institutional deliveries (64%), and colostrums to newborn (59%) among the Bhils of Dhar district of Madhya Pradesh.

The Centre/scientists are recognized for PhD by Rani Durgawati Vishwavidyalaya, Jabalpur.

Establishment of close linkages with the Tribal Welfare Department, Government of India as well as Government of Madhya Pradesh for providing technical assistance/evaluation of programmes and for receiving financial support for the research studies.

CONTACT :

National Institute for Research in Tribal Health (NIRTH) Formerly: Regional Medical Research Centre for Tribals (RMRCT) (Indian Council of Medical Research) Department of Health Research, Ministry of Health & Family Welfare NIRTH Complex, Nagpur Road P.O. - Garha, Jabalpur - 482 003 Madhya Pradesh, **Phone:-** +91 -761-2370800, 2370818, 2673807, 3204738 **Fax:-** +91-761-26722 39, 2672835, **Email:** nirthjabalpur@gmail.com

CONFERENCES / MEETINGS / SYMPOSIA / SEMINARS

NCUEMI 2017 — National Conference on Urban Environmental Management in India: Problems and Prospects, 20 - 21 Jan 2017, Jaipur, India

Topics:

- | | |
|--|---|
| Environment and Urbanization | Disaster Resilient Development |
| Approaches & Concept for Appropriate Development | Urban landscapes and Open spaces |
| Development & Environment Interactions | Planning and Management of Urban Infrastructure |
| Environmental Indices & Monitoring | Planning and Design of Urban Space |
| Environmental Planning Governance & Management | Green Buildings and Construction |
| Sustainable Development | Affordable Housing/Slum Upgradation |

Contact :

Dr. Satish Pipralia; Phone: 9549658126; Email: conference.arch@mnit.ac.in, Event website: http://mnit.ac.in/news/news.php?news_id=1692

11th Asia Pacific Conference on Sustainable Energy and Environmental Technologies, March 6-10, 2017, Patna-Rajgir, Bihar

Topics:

1) Comprehensive Sustainable Measures

- | Philosophy, Economics, Strategies of sustainable Society (technology view)
- | Evaluation of energy, ecology & environmental technologies
- | Energy and Environmental Education, Law, Politics and Policy

3) Sustainable Ecological Technology

- | Adaptation, forecasting & mitigation of technologies for climate change
- | Sustainable food production technologies
- | Rehabilitation Technologies for Arid areas
- | Technologies for sustainable ecosystem conservation

2) Sustainable Energy Technology

- | Clean technologies for fossil fuels
- | Renewable Energy Technology & Smart-grid
- | Sustainability of atomic energy
- | Energy storage and transportation
- | Life cycle and strategies for Sustainable Energy Technology

4) Sustainable Environmental Technology

- | Air and water pollution and toxicity control
- | Waste recovery, recycling, treatment & management
- | Greenhouse gas mitigation technology
- | Clean production and ISO 14000
- | Environmental impact analysis & Risk analysis

Contact :

Dr. Sanjay Kumar, Organising Secretary, University Department of Physics, B.R.Ambedkar Bihar University, Muzaffarpur, Bihar, E-mail: apcseet2017@gmail.com; URL: www.apcseet2017.in

Automation & Robotics Expo -2016 , 18 - 20 May 2017, Noida, New Delhi, India

Topics:

- | Process Automation
- | Industrial Automation
- | Factory Automation
- | Industrial robots
- | Field Automation and Instrumentation
- | Industrial valves
- | Control and Instrumentation
- | Surface technology
- | Lab instruments
- | Hydraulics and Pneumatics
- | Building Automation

Related subject(s)

Mechanical engineering, Electrical Engineering

Contact :

Ajay Kumar; Phone: 9702961888; Email: ajay.kumar@automationexpo.net, Event website :<http://www.automationexpo.net>

S & T ACROSS THE WORLD

DISCOVERY OF A NOVEL GENE FOR HEREDITARY COLON CANCER

The formation of large numbers of polyps in the colon has a high probability of developing into colon cancer, if left untreated. The large-scale appearance of polyps is often due to a hereditary cause; in this case the disease can occur in multiple family members. Under the leadership of human geneticists of the University Hospital Bonn, a team of researchers discovered genetic changes in the MSH3 gene in patients and identified a new rare form of hereditary colon cancer. The results have now been published in "The American Journal of Human Genetics".

Colon polyps form like mushroom-shaped growths from the mucosa and are several millimeters to several centimeters in size. They are benign and generally do not cause any symptoms – however, they can turn into malignant tumors (colon cancer). Physicians refer to the development of a large number of polyps in the colon as "polyposis." Scientists have already discovered several genes associated with a polyposis. "However, about one-third of families affected by the disease do not have any abnormalities in these genes," says Prof. Dr. Stefan Aretz, head of the working group at the Institute of Human Genetics at the University of Bonn Hospital. Therefore, there would have to be even more genes involved in the formation of polyps in the colon.

Together with pathologists from the University Hospital Bonn, scientists from the Yale University School of Medicine in New Haven (USA), and the Frankfurt University Hospital, the team working with Prof. Aretz investigated the genetic material (DNA) of more than 100 polyposis patients using blood samples. In each patient, all of the about 20,000 protein-coding genes known were simultaneously examined. In this process, the scientists filtered the rare, possibly relevant genetic

changes out of the gigantic quantity of data, like the proverbial needle in a haystack. In two patients, genetic changes (mutations) were discovered in the MSH3 gene on chromosome 5.

Proof of Causes is Like a Trial Based on Circumstantial Evidence

"The challenge is proving the causal connection between the mutations in this gene and the disease," says Prof. Aretz. The process is similar to that of a trial based on circumstantial evidence. Family members also play a role here: The siblings with the disease have to have these same MSH3 mutations as the patient who was first examined, but not the healthy relatives. That was the case. In addition, the scientists investigated the consequences for patients resulting from the loss of function of the MSH3 gene. "It involves a gene for the repair of the genetic material," reports Dr. Ronja Adam, one of the two lead authors from Prof. Aretz's team. "The mutations cause the MSH3 protein to not be formed." Since the protein is missing in the cell nucleus of the patient's tissues, there is an accumulation of genetic defects. The mutations which are not repaired then predispose to the more frequent occurrence of polyps in the colon.

The newly discovered type of polyposis, in contrast to many other forms of hereditary colon cancer, is not inherited dominantly, but instead recessively. "This means that siblings have a 25 percent chance of developing the disease; however, the parents and children of affected persons only have a very low risk of developing the disease," explains Dr. Isabel Spier from the Institute of Human Genetics, who was also very involved in the study.

Opportunities for Better Diagnoses and New Drugs

The annual colonoscopy is the most effective cancer screening method for polyposis patients. As a result, the development of colon cancer can be effectively prevented. By investigating the MSH3 gene, a clear diagnosis can be made prospectively in some other, previously unexplained polyposis cases. Afterwards,

healthy persons at risk in the family can be tested for the mutations. "Only proven carriers would need to take part in the intensive surveillance program," says the human geneticist. In addition, science would gain new insights into the development and biological foundations of tumors through the identification of mutations in the MSH3 gene. Prof. Aretz: "The knowledge about molecular mechanisms which lead to cancer is also a precondition for the development of new targeted drugs."

(Source : 01 Aug 2016, Universität Bonn)

NOVEL STATE OF MATTER: OBSERVATION OF A QUANTUM SPIN LIQUID

A novel and rare state of matter known as a quantum spin liquid has been empirically demonstrated in a monocrystal of the compound calcium-chromium oxide by team at HZB. What is remarkable about this discovery is that according to conventional understanding, a quantum spin liquid should not be possible in this material. A theoretical explanation for these observations has now also been developed. This work deepens our knowledge of condensed matter and might also be important for future developments in quantum information. The results have just been published in Nature Physics.

Based on our everyday experience, we expect matter at low temperatures to freeze solid with the atoms fixed in a regular arrangement. The magnetic moments arising from the spins of the electrons on the atoms in magnetic materials, also come to rest and become rigidly oriented as temperature falls. However, there are some rare exceptions. In what are referred to as quantum spin liquids, the orientations of the electronic spins do not remain fixed even at temperatures near absolute zero. According to conventional understanding, if the interactions are isotropic (where all spin directions are possible), this phenomenon can occur if the spins are arranged in triangular geometries and the interactions between them are antiferromagnetic favouring antiparallel alignment of the spins. For three atoms forming the corners of a triangle, the electronic spin of one atom

cannot simultaneously be oriented antiparallel to those on both the other two atoms. In real materials that contain triangular units coupled by antiferromagnetic interactions this "frustration" can prevent the spins from coming to rest in a particular orientation even at absolute zero temperature, instead they move collectively like atoms in a liquid. By contrast, ferromagnetic interactions do not give rise to frustration in isotropic magnets because mutually parallel alignment of the spins can always occur. For these reasons, only a few isotropic materials have been proposed as spin liquid candidates.

Monocrystals with Complex Magnetic Interactions

Now a team headed by Prof. Bella Lake has produced and investigated the first monocrystals of calcium-chromium oxide ($\text{Ca}_{10}\text{Cr}_7\text{O}_{28}$). Calcium-chromium oxide is made up of what are known as Kagomé lattices – reminiscent of the pattern of triangles and hexagons woven in Japanese basketry. As a result, a complex set of isotropic magnetic interactions develop in this material, consisting of not only anti-ferromagnetic interactions but also much stronger ferromagnetic interactions that according to conventional understanding should prevent the existence of spin liquid behavior. Magnetic and Neutron scattering experiments conducted in Germany, France, England, and the USA, as well as muon spectroscopy experiments performed in Switzerland have however shown that the spins in these samples retain their collective motion even at temperatures as low as 20 millikelvin and behave like a quantum spin liquid.

Competition is Key

Theoretical physicist Prof. Johannes Reuther of HZB has now been able to extend the theoretical model of spin liquids with the help of these experimental clues. He has used numerical simulations to show how the different magnetic interactions in calcium-chromium oxide compete with one another and keep the spins dynamic.

More Candidates Für Spin Liquids Expected

“We have proved empirically that interesting quantum states like spin liquids can also occur in considerably more complex crystals with different constellations of magnetic interactions”, says Dr. Christian Balz, lead author of the work. Lake also explains: “The work expands our understanding of magnetic materials, and also shows us that there are potentially far more candidates for spin liquids than expected. This could be important for the advancement of quantum computers in the future because spin liquids are one of the possible building blocks for carrying the smallest unit of quantum information, known as a qubit.”

(Source : 26 Jul 2016, Helmholtz-Zentrum Berlin für Materialien und Energie)

LEARNING THE SECRETS OF SURVIVAL

A new study of the demographic structure of contemporary killer whale populations reveals complex interactions between social evolution, adaptation and genetic diversification in these marine mammals.

Orcas (*Orcinus orca*) are the largest members of the dolphin family and are found in virtually all of the world's oceans - from the Arctic to the waters surrounding Antarctica. They are generally referred to as killer whales, but that name tends to obscure the fact that these mammals live in complex communities and display a rich repertoire of social behavior. An international team of biologists led by Professor Jochen Wolf, who was recently appointed to the Chair of Evolutionary Biology at LMU, has now taken a closer look at the population genetics of the orca. The species has evolved into several distinct ecotypes, which differ from each other – often quite significantly – in morphology, behavior and feeding habits, and exploit specific ecological niches. The primary aim of the study was to gain insights into ecotype evolution and assess the roles of genomic, environmental and sociobiological factors in this process. The findings have just appeared in the online

journal “Nature Communications”.

In the study, Wolf (who currently also holds a professorship at the University of Uppsala in Sweden) and his collaborators determined the complete genomic sequences of 50 orcas representing several different ecotypes, and compared them with one another. Detailed analysis of these data enabled the investigators to reconstruct the recent genetic history of the species. The results indicate that the adaptive radiation which gave rise to the different ecotypes began a little over 200,000 years ago. Moreover, the genetic data reveal that the evolution of new variants was preceded by a relatively sudden reduction in the range of genetic variation present in the population. This so-called bottleneck effect implies a contraction in the size of a breeding population due to the emergence of physical, genetic or behavioral barriers between previously interbreeding groups. This process promotes genetic diversification and –in the case of persistent reproductive isolation owing to social cohesion, for instance – the evolution of specific adaptations to the local environment. Indeed, the analysis of genomic evolution in orcas confirms that the different ecotypes adapted rapidly to their new environments and the food sources they offered. Thus, the researchers detected characteristic genetic differences between orcas from different habitats, including variations in genes involved in the development of adipose tissue, skin regeneration and amino acid metabolism.

These findings reveal that the various ecotypes reacted in a flexible manner to changing environmental conditions and were able to exploit the available ecological niches. The animals developed sophisticated collective hunting strategies, and the formation of stable kinship groups also favored social learning. However, the very fact that each ecotype became better adapted to its particular habitat inevitably altered the prevailing selection conditions. According to the authors of the study, orcas reveal “at the genomic level” how the factors population history, ecological adaptation, evolution and cultural development interact in

shaping a species. – In this case, of course, the term culture is used in its broad evolutionary sense to mean the intergenerational transmission of adaptive behavioral strategies by means of social learning.

(Source : 06 Jun 2016, LMU Munich - Ludwig-Maximilians-Universität München)

OLFACTORY RECEPTOR DISCOVERED IN PIGMENT CELLS OF THE SKIN

Researchers at Ruhr-Universität Bochum were the first ones to prove the existence of an olfactory receptor in pigment-producing cells in human skin, the so-called melanocytes. The team headed by Prof Dr. habil. Hanns Hatt demonstrated that the violet-like scent Beta-Ionone can activate the receptor.

Together with colleagues from Friedrich Schiller University Jena and the university hospital in Jena, the researchers at Bochum's Department for Cellphysiology reported their findings in the Journal of Biological Chemistry.

Cause of Black Skin Cancer

The group identified the olfactory receptor 51E2 in cell cultures of melanocytes from human skin. Those cells produce the black melanin which renders the skin tan. Excessive growth of melanocytes may cause too much pigmentation and possibly trigger black skin cancer.

Signalling Pathways in Cells Identified

The researchers identified the signalling pathway in detail that is activated by the 51E2 receptor. If a fitting odorant binds to the receptor, a reaction cascade is triggered similar to the one occurring in olfactory cells of the nose: the concentration of calcium ions increases.

This, in turn, activates the signalling pathways at the end of which phosphate groups are transferred to specific enzymes, such as MAP-kinases. The newly detected receptor uses this mechanism to regulate enzyme activity and, consequently, cell growth and melanin production.

Starting Point for Melanoma Therapy

“The receptor and its activating odor molecule might constitute a new starting point for a melanoma therapy,” says Hanns Hatt. If healthy melanocytes turn into tumour cells, they strongly increase the proliferation rate, but they focus less efficiently on their actual functions. The Beta-Ionone odorant appears to affect these properties using the relevant receptor. Hanns Hatt's team is currently analysing the causes and effects in melanoma cells gained through biopsies.

The scent researcher from Bochum expects the newly detected receptor to have other potential applications: “With its help, we might be able to treat pigmentation disorders of the skin, and they might also be used in tanning products,” says Hatt.

(Source : 03 Jun 2016, Ruhr Universität, Bochum)

CONFIRMATION OF SUPERNOVA EXPLOSION IN THE NEIGHBORHOOD OF OUR SOLAR SYSTEM

Approximately two million years ago a star exploded in a supernova close to our solar system: Its traces can still be found today in the form of an iron isotope found on the ocean floor. Now scientists at the Technical University of Munich (TUM), together with colleagues from the USA, have found increased concentrations of this supernova-iron in lunar samples as well. They believe both discoveries to originate from the same stellar explosion.

A dying star ends its life in a cataclysmic explosion, shooting the majority of the star's material, primarily new chemical elements created during the explosion, out into space.

One or more such supernovae appear to have occurred close to our solar system approximately two million years ago. Evidence of the fact has been found on the earth in the form of increased concentrations of the iron isotope ^{60}Fe detected in Pacific ocean deep-sea crusts and in ocean-floor sediment samples.

This evidence is highly compelling: The radioactive ^{60}Fe isotope is created almost exclusively in supernova explosions. And with a half-life of 2.62 million years, relatively short compared to the age of our solar system, any radioactive ^{60}Fe originating from the time of the solar system's birth should have long ago decayed into stable elements and thus should no longer be found on the earth.

Lunar Samples From The Apollo Mission

This supernova hypothesis was first put forth in 1999 by researchers at the Technical University of Munich (TUM) who had found initial evidence in a deep-sea crust. Now their claim has received further substantiation: Physicists at the TUM and their colleagues from the USA have succeeded in demonstrating an unusually high concentration of ^{60}Fe in lunar ground samples as well.

The samples were gathered between 1969 and 1972 during Apollo lunar missions 12, 15 and 16, which brought the lunar material back to earth.

It's also conceivable that ^{60}Fe can occur on the moon as the result of bombardment with cosmic particles, since these particles do not break up when colliding with air molecules, as is the case with the earth's atmosphere. Instead they directly impact the lunar surface and can thus result in transmutation of elements. "But this can only account for a very small portion of the ^{60}Fe found," explains Dr. Gunther Korschinek, physicist at TUM and scientist of the Cluster of Excellence Structure and Origin of the Universe.

Deposits of Newly Produced Stellar Matter

We therefore assume that the ^{60}Fe found in both terrestrial and lunar samples has the same source: These deposits are newly created stellar matter, produced in one or more supernovae, says Dr. Korschinek. Since the moon generally provides a better cosmic record than the earth, the scientists were also able to specify for the first time an upper limit for the flow of ^{60}Fe that must have reached the moon. Among other things this also makes it possible for the researchers to infer the distance to the supernova event: "The measured ^{60}Fe -flow corresponds to a supernova at a distance of about 300 light years," says Korschinek. "This value is in good agreement with a recently theoretical estimation published in 'nature'."

The lunar samples were investigated using the high-sensitivity accelerator mass spectrometer of the Maier-Leibnitz Laboratory near Munich. In addition to the TUM's physicists, US scientists from Rutgers University and the Planetary Science Institute in Los Alamos were also involved in the publication. Financial support for the research was provided by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) via the Excellence Cluster Universe.

(Source : 14 Apr 2016, Technische Universität München)



भारतीय विज्ञान कांग्रेस संस्था

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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.

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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 जरूरी 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.
- (iv) 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 समय अवश्य करें।
- (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.