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* Available in the Book "The Shaping of Indian Science" Published by University Press (India) Pvt. Ltd., 3-5-819 Hyderguda, Hyderabad 500 029.

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

EDITORIAL

Mitochondrial Genome

Mitochondria play a central role in cellular energy provision. The organelles contain their own genome with a modified genetic code. The mammalian mitochondrial genome is transmitted exclusively through the female germ line. The human mitochondrial DNA (mtDNA) is a double-stranded, circular molecule of 16569 bp and contains 37 genes coding for two rRNAs, 22 tRNAs and 13 polypeptides. The mtDNA-encoded polypeptides are all subunits of enzyme complexes of the oxidative phosphorylation system. Mitochondria are not self-supporting entities but rely heavily for their functions on imported nuclear gene products. The basic mechanisms of mitochondrial gene expression have been solved. Cis-acting mtDNA sequences have been characterised by sequence comparisons, mapping studies and mutation analysis both in vitro and in patients harboring mtDNA mutations. Characterization of trans-acting factors has proven more difficult but several key enzymes involved in mtDNA replication, transcription and protein synthesis have now been biochemically identified and some have been cloned.

Mitochondrial gene structure and gene organization of mtDNA is highly conserved among mammals. human mitochondrial genome is a closed circular, double stranded DNA molecule of about 16.6 KB. Strand of the DNA duplex can be distinguished on the basis of G=C buoyant densities of each strand (heavy and light) in denaturing caesium chloride gradient heavy strand encodes 2 rRNAs 14 tRNAs and 12 polypeptide and light strand codes for eight tRNA and a single polypeptide of the enzyme complex of the oxidative phosphorylation system. In mitochondrial protein sequence revealed divisions from the standard genetic code and later

Structure of Mitochondrial

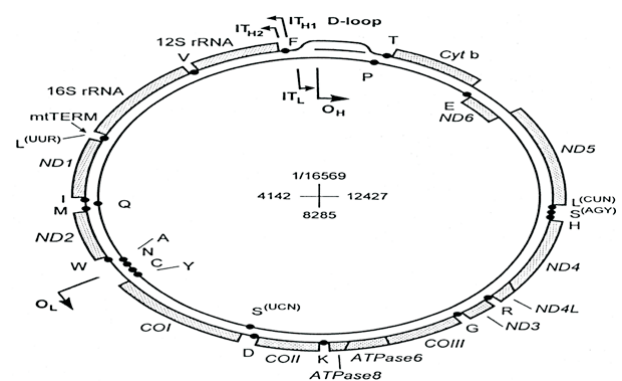


Fig.1. Map of Human Mitochondrial DNA. The outer circle represents the H-strand, containing the majority of the genes; the inner circle represents the L-strand. The D-loop is shown as a three-stranded structure. The origins of H-strand (OH) and L-strand (OL) replication and the direction of DNA synthesis are indicated by long bent arrows; the initiation of transcription sites (ITL, ITH1, ITH2) and the direction of RNA synthesis are denoted by short bent arrows. The binding site for the mitochondrial transcription terminator (mtTERM) is indicated. The 22 tRNA genes are depicted by dots and the single letter code of the amino acid (isoacceptors for serine and leucine are distinguished by their codon sequence). The genes coding for the two rRNA species (12S and 16S) and the 13 protein coding genes are depicted by shaded boxes. ND, CO and ATPase refer to genes coding for subunits of NADH: ubiquinone oxidoreductase, ferrocyclochrome c: oxygen oxidoreductase (cytochrome c oxidase) and F1F0-ATP synthase, respectively, whereas Cyt b encodes apocyclochrome b of ubiquinol: ferricytochrome c oxidoreductase.

even variation in codon usage were found in mitochondria from different species in mtDNA of most phylogenetic groups TGA is used as a tryptophan codon rather than as a termination codon on the other hand AGR (R=A, G) specifies a stop in mtRNA of vertebrates codes for serine in mtDNA if echinoderms and codes for arginine in mtDNA of echinoderms and codes for arginine in mtRNA of yeast as in the standard genetic code. Another surprising feature of the mitochondrial genetic system is its use of a simplified decoding mechanism, allowing translation of all codons with less than the 32 tRNA species required according to Crick's wobble hypothesis. This reduction in the number of tRNA species is achieved by the use of a single tRNA with U in the first anticodon (wobble) position to recognize all codons of a four-codon family. Fungal mitochondria use a modified U in the wobble position to read two codon families with a purine in the third position of the codon, In vertebrate cells that are metabolically active, a large proportion of the mtDNA duplexes contain a short three-stranded structure, called the displacement loop or

D-loop [23], in which a short nucleic acid strand, complementary to the L-strand, displaces the H-strand. The D-loop region is bounded by the genes for *tRNAPhe* and *tRNAPro* and has evolved as the major control site for mtDNA expression, containing the leading-strand origin of replication and the major promoters for transcription. Mitochondria are not self-supporting entities in the cell. Replication and transcription depend upon trans-acting nuclear-encoded factors. Mitochondrial tRNAs are charged by imported aminoacyl-tRNA synthases and, in vertebrates, all mitochondrial ribosomal proteins are coded and synthesized outside the organelle. Enzymes of the various catabolic pathways located in the mitochondria, as well as the components of the mitochondrial import machinery, are encoded by nuclear DNA. Even the enzyme complexes of the oxidative phosphorylation system are of hybrid genetic origin. All nuclear-encoded polypeptides destined for mitochondria are synthesized on cytosolic ribosomes, usually with a cleavable, N terminal pre-sequence for mitochondrial targeting and are subsequently imported into mitochondria.

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Kanpur*

*Chance is the only source of true novelty.
- Francis Crick*

EMERGING APPROACHES TO COMBAT OBESITY

Rajat Varshney^{1*} and Ritu Varshney²

Obesity cases are increasing day by day due to limited exercise and intake of unbalance diet. Anti-obesity drugs based control of obesity and surgical approaches are becoming unsatisfactory due to high cost and various side effects. Probiotic and Prebiotic based therapy or modification of intestinal microflora composition may be more promising methods to control the obesity. *Akkermansia muciniphila*, *Lactobacillus gasseri*, *Lactobacillus rhamnosus*, *Bifidobacterium lactis*, *L. casei* strain Shirota may help in controlling obesity without any side effect and maintenance of good intestinal health.

INTRODUCTION

Health is wealth. A healthy person has sound body, sound mind and physically fit body. "A Sound mind is in a sound body" is an old proverb. In fact, we cannot expect a healthy mind without a healthy body. The future of nation depends upon healthy citizens. In the modern age people's life is busy and full of worries. We are becoming increasingly dependent on computers and machines. Outdoor games and activities are replacing with computer and video games. Obesity cases are increasing day by day due to limited physical activity. Consumption of poor quality adulterated food, excessive intake of food with irregular frequency or pattern and unbalance diet may lead to obesity and other health complications. Obesity is one of burning problems of the present times in the world. Obesity increases risk of heart disease, type 2 diabetes, non-alcoholic fatty liver disease, cancer, osteoarthritis, infertility, neurological disorders, obstructive sleep apnea¹ etc.

Common causes of obesity are excessive food energy intake, low physical activity, disturbances in gut microbial ecosystem, genetic factors, endocrine disorders, medications, psychiatric illness and irregular pattern of sleep. A shorter sleep time is related with increased circulating ghrelin level and

decreased leptin level². This irregular hormonal pattern leads to decrease energy expenditure and increase appetite and obesity. Leptin, the "satiety hormone," is a hormone produced by adipose cells that helps to regulate energy balance by inhibiting hunger. Leptin is opposed by the actions of the hormone ghrelin, the "hunger hormone". In obesity, a decreased sensitivity to leptin occurs, resulting in an inability to detect satiety despite high energy stores.

APPROACHES TO COMBAT OBESITY AND CONTROL OF OBESITY

Various approaches are being used nowadays to control obesity by consumption of low energy rich food, high fiber intake, dieting, exercise, anti-obesity drugs, surgical approaches. Excessive dieting, unbalance and irregular pattern of food intake may lead to nutritional deficiency and other health complications. Nowadays, regular exercise is becoming a limiting factor due to busy life style. Anti-obesity drugs include appetite suppression drugs (e.g. catecholamine, phentermine, amphetamine etc.)³, drugs inhibiting digestion and absorption of nutrients via intestine (e.g. Orlistat)⁴ and drugs increasing body metabolism etc., are being used in control of obesity. But high cost, requirement of regular use of drugs and side effects of drugs make anti-obesity drugs therapy unsatisfactory. Surgical approach to control the obesity is also costlier and unsafe. Other alternative approaches to control obesity may be through the development of probiotic

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treatment⁵, alterations in gut microbial ecosystem of obese individual, the development of ribonucleic acid interference (RNAi), deletion or silencing of the RIP140 gene⁶, by regulating the molecular interaction between nuclear hormone receptors and their regulatory cofactors, and normalization of obesity associated insulin resistance through immunotherapy⁷.

INTESTINAL MICROFLORA: PROBIOTICS

The development of intestinal microbiota in the human gastrointestinal tract depends on the original inoculum at birth, living environment and the early feeding practices. Microbial composition is determined by mutual interactions between the host and the microorganisms, and also among different microorganisms. These factors are designated as autogenic⁸. On the other hand, pH in the stomach, digestive enzymes, intestinal peristalsis, nutrients and immunity of the host are termed allogenic factors⁸. The predominance of beneficial species of microorganisms over pathogens is essential for stability of the immune system of the intestine and consequent of the entire body⁹. The intestinal microbiota forms a physical and immunological barrier between the host and the environment. The barrier function of microbiota appears to support the intestinal health and protect the host by a healthy micro-ecology in the gut.

The composition of the microbial communities of an obese individual completely differs from the composition of the microbial communities of a slim person. Obesity affects the diversity of the gut microbiota. Firmicutes are relatively high in proportion in obese person as compared to lean person. Relative proportion of Bacteroidetes remains low in obese people by comparison with lean people. Intake of a low-fat or low-carbohydrate diet by obese persons lead to decrease in proportion of firmicutes and increase in proportion of Bacteroidetes in their colon but never reach up to the proportion that present in lean person¹⁰. Feeding habits and type of feed may alter the microbial ecosystem up to some extent.

Indigenous gut microbes may regulate body

weight by influencing the host metabolic, neuro-endocrine and immune functions. Specific probiotics, prebiotics and related metabolites may exert beneficial effects on lipid and glucose metabolism, the production of satiety peptides and the inflammatory tone related to obesity and associated metabolic disorders¹¹. The bacterial metabolism of nutrients in the gut is able to drive the release of bioactive compounds (including short-chain fatty acids or lipid metabolites), which interact with host cellular targets to control energy metabolism and immunity¹². Manipulation of the composition of the microbial ecosystem in the gut might be a novel approach in the treatment of obesity. Such treatment might consist of altering the composition of the microbial communities of an obese individual by administration of beneficial microorganisms, commonly known as probiotics. Probiotic therapy may be cost effective strategy to control obesity. Probiotics are viable microbial food supplements, which confer health benefit to host when administered in adequate quantity. It is not necessarily part of normal microbiota. It causes TLR activation, cytokine induction, immuno-stimulatory effect, beneficial to normal microbiota and suppression of pathobiont and pathogen. A prebiotic is a non-digestible component which beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of colonic bacteria, thereby improving the health of the host.

Akkermansia muciniphila is a mucin-degrading bacterium present in abundance in the guts of healthy adults, but numbers are reduced in the intestines of obese humans and in patients with Crohn's disease or ulcerative colitis or type 2 diabetes. It is oval-shaped, strictly anaerobic, non-motile, non-spore-forming Gram-negative bacteria¹³. Mucus can serve as a barrier to protect the underlying epithelium from the attachment of pathogens and also as a source of nutrients for commensal bacteria. *Akkermansia muciniphila* provides nutrients to commensal bacteria by degrading mucus. Treatment with live *A. muciniphila* may be alternative strategy to control obesity because it reverses high-fat diet-induced

metabolic disorders, including fat-mass gain, metabolic endotoxemia, adipose tissue inflammation, and insulin resistance. Administration of *A. muciniphila* increases the intestinal levels of endocannabinoids that control inflammation, the gut barrier, and gut peptide secretion. Prebiotic feeding normalizes *A. muciniphila* abundance, which correlates with an improved metabolic profile¹⁴.

Lactobacillus gasseri, *Lactobacillus rhamnosus*, and the combination of *L. rhamnosus* and *Bifidobacterium lactis* may reduce adiposity, body weight, and weight gain⁵. *Lactobacillus* is Gram-positive, facultative anaerobic or microaerophilic, rod-shaped, non-spore-forming bacteria. *Lactobacillus gasseri* is part of the vaginal flora and normal inhabitant of the lower reproductive tract in healthy women. *Lactobacillus gasseri* BNR17, a type of probiotic strain isolated from human breast milk is supposed to be inhibitor of obesity and diabetic complications in the human body. Some strains of *L. rhamnosus* bacteria are being used as probiotics, and are particularly useful in treating female-related infections such as bacterial vaginosis. *L. rhamnosus* sometimes is used in yogurt and dairy products such as fermented and un-pasteurized milk and semi-hard cheese. *Lactobacillus casei* is found in the human intestine and mouth. Yakult is a popular probiotic dairy product made by fermenting a mixture of skimmed milk *Lactobacillus casei* Shirota. *L. casei* strain Shirota may be effective in alleviation of gastrointestinal pathogenic bacterial diseases such as helicobacter infection, antibiotic-associated diarrhea (AAD) and *Clostridium difficile* infections (CDI). *Bifidobacterium lactis* can help fight lactose intolerance and boost the immune system. In addition to these benefits, *B. lactis* may also support healthy cholesterol levels, ease ulcerative colitis, and even combat the effects of celiac disease.

CONCLUSION

Probiotic and prebiotic based therapies in obesity are gaining more popularity over anti-obesity drugs, surgical and other approaches as it provide beneficial species of microorganisms which in turn lead to fine

tuning of immune system, suppression of pathobiont and restoration of good intestinal health without any side effect. Treatment with *Akkermansia muciniphila*, *Lactobacillus gasseri*, *Lactobacillus rhamnosus*, *L. casei* strain Shirota, *Bifidobacterium lactis* may be alternative strategy to control obesity.

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INTEGRATED FARMING SYSTEMS: LIVELIHOOD SECURITY FOR MARGINAL AND SMALL FARMERS

Alok Kumar Patra

Integrated farming system is focused around a few selected, inter-dependent, inter-related and often inter-linking production systems based on crops, livestock and related subsidiary enterprises. The entire philosophy of farming system revolves around better utilization of time, money, resources and family labour. A combination of one or more enterprises with cropping, when carefully chosen, planned and executed, gives higher dividends than a single enterprise, especially for small and marginal farmers. The rationale of integrated farming system is to minimise the wastes from the various subsystems on the farm and thus it improves employment opportunities, nutritional security and income of the rural people.

INTRODUCTION

Integrated farming system is a multidisciplinary whole farm approach, which enables the farmers to identify opportunities and threats and act accordingly. It is a dynamic approach which can be applied to any farming system around the world. It is very effective in solving the problems of small and marginal farmers. The approach aims at increasing income and employment from small-holding by integrating various farm enterprises and recycling crop residues and by-products within the farm itself. Integrated farming combines the best of modern tools and technologies with traditional practices available at a given location and situation. Preserving and enhancing soil fertility, maintaining and improving a diverse environment and the adherence to ethical and social criteria are indispensable basic elements of integrated farming systems.

CONCEPT AND DEFINITIONS

'Farming' is a process of harnessing solar energy in the form of economic plant and animal products. "System" implies a set of interrelated practices and processes organised into functional entity, i.e. an arrangement of components or parts that interact

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according to some process and transforms inputs into outputs¹.

Integrated farming system (IFS) is a commonly and broadly used word to explain a more integrated approach to farming as compared to monoculture approaches. In this system an inter-related set of enterprises are maintained and by-products or wastes from one production system becomes an input for another production system, which reduces cost and improves production and/or income. Thus, IFS works as a system of systems². Food and Agriculture Organisation stated that 'there is no waste', and 'waste is only a misplaced resource which can become a valuable material for another product' in IFS³. The farming system is essentially cyclic, organic resources–livestock–land–crops. Therefore, management decisions related to one component may affect the others. Combining ecological sustainability and economic viability, the integrated livestock-farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.

Different scientists have defined a farming system differently. However, many definitions, in general, convey the same meaning that it is the strategy to achieve profitable and sustained agricultural production to meet the diversified needs of farming community through efficient use of farm

resources without degrading the natural resource base and environmental quality. Farming system is a decision making unit comprising the farm

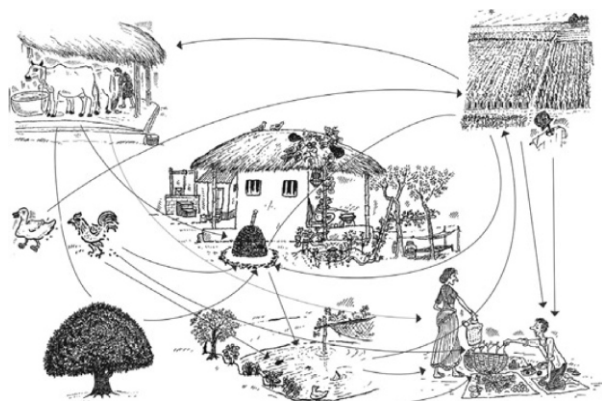


Fig. 1. Integration of several components on the farm- a schematic representation⁴.

household, cropping and livestock system that transform land, capital and labour into useful products that can be consumed or sold¹. Thus, a farming system is the result of complex interactions among a number of inter-dependent components, where an individual farmer allocates certain quantities and qualities of four factors of production, viz. land, labour, capital and equipments to which he has access⁵. Enterprises in the integrated farming system are mutually supportive and depend on each other. The integration is made in such a way that the product i.e. output of one enterprise/component should be the input for the other enterprises with high degree of complementary effects.

CHARACTERISTICS OF FARMING SYSTEM RESEARCH

The farming system research activities are to be farmer oriented, system oriented, problem solving approach, inter-disciplinary, compliments mainstream disciplinary research, test the technology in on-farm trials and provides feedback from the farmers. The farming system core characteristics may be summarised as below⁶.

1. **It is problem solving:** As an applied problem solving approach, it emphasizes on developing and transferring appropriate technologies to

overcome the production constraints through the diagnosis of biophysical, socioeconomic and institutional constraints that influence the technological solutions.

2. **It is holistic:** The whole farm is viewed as a system encompassing interacting subsystems; and no potential enterprise is considered in isolation.
3. **It acknowledges the location specificity of technological solutions:** Recognizing the location specific nature of agricultural production problems, it emphasizes on testing and adaptation of technological solutions based on agro-ecological and socioeconomic specificities.
4. **It defines specific client groups:** Emphasis is made on the identification of specific and relatively homogeneous groups of farmers, with similar problems and circumstances for whom the technology is to be developed, as the specific client group. On the basis of common environmental parameters, production patterns and management practices, relatively homogeneous recommendation domains need to be identified.
5. **It is farmer participatory:** It revolves round the principle that successful agricultural research and development efforts should start and end with the farmers. Farmer participation is ensured at different stages of technology generation and transfer processes such as problem diagnosis, design and implementation of on-farm trials, and providing feedback through monitoring and evaluation.
6. **It gives weightage to ITK system:** The indigenous technical knowledge (ITK) which is time-tested at the farmer's level for sustainability through a dynamic process of integrating new innovations into the system as they arise, has to be properly understood by the scientists and utilized in their research activities.
7. **It is concerned with 'bottom-up' research strategy:** It begins with an understanding of the existing farming systems and the identification

of key production constraints.

8. **It is interdisciplinary:** It lays greater emphasis on interdisciplinary co-operation among the scientists from different areas of specialization to solve the agricultural problems that are of concern to farmer.
9. **It emphasizes extensive on-farm activities:** It involves problem analysis through diagnostic surveys, on-farm testing of the developed technologies, and providing feedback through evaluation to influence the research agenda of the research stations. It provides a structural framework for the farmers to express their preferences and apply their evaluation criteria for selecting technologies suiting to their circumstances.
10. **It is iterative:** Instead of trying to know everything about a system at a time, it requires step-by-step analysis of only key functional relationships.
11. **It is dynamic:** It involves recurrent analysis of the farming systems, permitting continuous learning and adaptations.
12. **It recognizes interdependencies among multiple clients:** The generation, dissemination and adoption of relevant technologies to improve the productivity and sustainability of agriculture require productive and interactive linkages among the policy planners, scientists, developmental agencies and farmers. The approach attaches more importance for this critical factor.
13. **It focuses on actual adoption:** It is to be judged by the extent to which it influences the production of socially desirable technologies that diffuse quickly amongst specified groups of farmer clients.
14. **It focuses on sustainability:** It seeks to harness the strengths of the existing farming practices, and to ensure that the productivity gains are environmentally acceptable. Towards preserving the natural resource based and strengthening the agricultural production base, it attempts to

develop technologies that are environment friendly and economically viable.

15. **It complements experiment station research:** It only complements, but does not substitute, the on-station research. It has to draw upon the scientific knowledge and technologies generated at research station. It has to be kept in mind that approach is not being promoted as panacea for all e maladies of local agricultural production systems.

COMPONENTS OF IFS

Integrated farming system involves the utilization of primary and/or secondary produce of one system as raw material for other system, thus making the entire system mutually interdependent as one whole unit. There is a need for effective linkages and complementarities of various components to develop holistic farming system. Important components of the farming system include field crops, vegetable crops, fruit crops, floriculture, livestock (cow, buffalo, sheep, goat, pig, etc), fishery, poultry, duckery, agroforestry, bee keeping, mushroom cultivation, bio-gas, vermicompost, etc.

The crop activities in the IFS consist of grain crops (rice, wheat, maize, sorghum, pulses, soybeans), oilseeds (groundnut, sesame, rapeseed and mustard, linseed, niger, sunflower, castor), vegetable crops, plantation crops (coconut, arecanut), short duration fruit crops (papaya, banana, citrus, pineapple), root crops (cassava, sweet potato), sugarcane, tree crops (moringa, mulberry, teak, acacia, sissoo) and fodder crops. The selection of crops is dependent on preferences based on family consumption, market, soil type, and rainfall and type of animals raised.

Integrated farming system comprising crop and livestock has been sustainable over the centuries. In this system animals are raised on agricultural wastes and animal power is used for agricultural operations and animal excreta are used as manure and fuel. In coastal areas, the rice + fish system can stabilise the productivity and profitability in rice production areas. Cereal based crops in combination with

livestock (poultry, dairy, sheep and goat) systems can improve the profitability of the farmers along with the sustenance of natural resources.

The livestock activities in IFS consist of cows, goat, sheep, poultry, ducks, pigs and small ruminants. The selection of livestock is also dependent on preference based on family consumption, potential market and availability of resources. The livestock component acts as a stabilising factor in the system, thus needs strengthening of the crop and livestock linkage to enhance the economic viability and sustainability of the farming systems.

Crop livestock integration involved the natural resources (crops, animals, land and water) in which these subsystems and their synergetic interactions have a significant positive and the greater total effect than the sum of their individual efforts. These systems increase crop yields and soil fertility and improve the livelihoods with promotion of stable households and increased economic output. The livestock farming systems can be grouped into small holder livestock production with little and low land and commercial livestock production dominating with poultry and dairy. The livestock production in IFS should conserve the natural resource base and raise the productivity through efficient utilization, optimised allocation and rational management of available of resources.

Agroforestry systems like agri-silvicultural, silvi-pastoral, horti-silvicultural, horti-silvi-pastoral, agri-horti-silvipastoral, aquaforestry, etc. can be integrated to farming systems. Besides timber and fuel wood, agroforestry systems offer lot of other products like gum, resin, fibre, oils, medicines and other non-forest timber products depending upon the tree/shrub species covered in the system.

Mushroom cultivation can also be integrated to farming system to augment the overall household income. Besides some of the homestead vocations like *khali /patravali* making, bamboo/cane work, chalk/candle making, tailoring, embroidery, food processing, doll making, carpentry, hand paper, packaging, paper packet, spice making, *papad*

making, composting, marketing agricultural produce, etc can be considered in the farming system.

ADVANTAGES OF IFS

The IFS is part of the strategy to ensure sustainable use of the natural resources for the benefit of present and future generations. The major benefits of integrated farming system can be summarised as below.

1. **Productivity:** IFS improves space utilization and increase productivity per unit area. Thus it provides an opportunity to increase economic yield per unit area per unit time by virtue of intensification of crop and allied enterprises.
2. **Profitability:** In IFS waste materials of one component are used as inputs of another component at the least cost. Thus cost of production is reduced and interference of middleman in procuring most of the inputs is eliminated. Therefore, return per rupee invested or benefit to cost ratio in the farming is increased.
3. **Sustainability:** In integrated farming systems, organic supplementation through effective utilisation of by-products of linked components as a measure is possible and this provides opportunity to promote soil health and to sustain the potentiality of the soil for much longer periods.
4. **Balanced food:** In IFS, components of different nature are linked enabling production of different sources of nutrition, namely, protein, carbohydrates, fats, minerals, vitamins, etc. from the same unit. It provides opportunity to mitigate malnutrition problem of the farm family.
5. **Pollution abatement:** In crop based activity, some of the organics are left as waste materials which in turn pollute the environment on decomposition. Application of huge quantities of fertilisers, pesticides, herbicides, insecticides, etc. pollutes soil, water and air. Much of the wastes could be converted/ recycled to some other forms of economic / ecological /social value, under the integrated farming system. Integrated farming will also help in

environmental protection through effective recycling of waste from animal activities like piggery, poultry and pigeon rearing.

6. **Recycling:** Effective recycling of waste materials (crop residues and livestock wastes) is possible in IFS. Therefore, there is less reliance to outside inputs like fertilizers, agrochemicals, feeds, energy, etc.
7. **Income rounds the year:** IFS provides diversified products. It provides flow of money to the farmer round the year due to integration of enterprises like crops, birds, animals, mushroom, honey, fish, etc. Thus it provides opportunities as crop insurance cover as money round the year is obtained from different farm produces.
8. **Adoption of new technology:** Money flow in IFS round the year gives an inducement to the small/ marginal farmers to go for the adoption technologies. IFS promotes technology infusion through Research and Development integrated with indigenous/traditional knowledge.
9. **Saving energy:** IFS provides an opportunity to identify an alternative source to the fossil energy. Effective recycling technique of the organic wastes available in the system can be utilised to generate biogas.
10. **Meeting fodder crisis:** Every piece of land area is effectively utilized. Plantation of perennial legume fodder trees on field borders and farm boundary will greatly relieve the problem of non-availability of quality fodder to the farm animals. This practice also improves soil fertility through atmospheric nitrogen fixation.
11. **Solving fuel and timber crisis:** The production level of fuel and industrial wood can be enhanced by integrating suitable perennial tree species in farming system (agroforestry) without affecting the crop productivity. This will also greatly reduce pressure on forest resource, thus it preserves the natural ecosystem.
12. **Employment generation:** Integrating crop with livestock enterprises would increase the labour requirement significantly and would help in reducing the problems of unemployment to a

great extent. IFS provides enough scope to employ family labour round the year.

13. **Agro-industries:** Integrated farming also provides opportunities for agri-oriented industries, tourism and related tourism based activities. When produce of any component of the IFS is increased to commercial level there will be surplus for value addition, leading to development of allied agro-industries.
14. **Increasing input efficiency:** IFS provides good scope to use inputs in different components with greater efficiency and benefit cost ratio.
15. **Improving/ maintaining soil health:** IFS improves soil fertility and soil physical structure through practice of appropriate crop rotation, cover crop, green manuring, composting farm organic wastes and recycling crop residues. Soil erosion can also be checked by agroforestry and proper cultivation of each part of land by integrated farming.
16. **Reduction of pests:** Adoption of appropriate crop rotation in the farming system can reduce the infestation of weeds, insect pests and diseases.

CONCLUSION

Integrated farming system is often less risky and, if managed efficiently, benefits from synergisms among enterprises, diversity in produce, and environmental soundness. It has the advantages of increasing economic yield and profitability per unit area per unit time. The overall objective of integrated farming systems is to evolve technically feasible and economically viable farming system models by integrating cropping with allied with a view to generate income and employment from the farm.

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HYDRO-POWER- A CLEAN AND RENEWABLE ENERGY SOURCE

Th.Gomti Devi

Hydropower is the most important and widely-used renewable source of energy and India is one of the pioneering countries in establishing hydro-electric power plants. Hydroelectric power is the electricity obtained by harnessing the power of flowing water that rotates the turbine. It is a clean, timeless and renewable energy resource. This article discusses about the hydropower, its working principle, types and its potential in India and North-Eastern states of India.

INTRODUCTION

Since time immemorial, human beings need power in or another form for their well beings. Human beings used different mode and means to generate power from different sources like Coal, Solar, Wind, Biomass, Bio-fuels, and Water etc. for their needs. Among these, Hydropower refers to the energy produced by the power of running or falling water that rotates turbine to convert the Potential energy into mechanical energy to drive the generator thus producing Electrical Energy (electricity). It is a clean and renewable energy resource as it doesn't pollute the air because no fuels are burned; it simply uses earth's water cycle to generate electricity. Since the 19th century, hydropower is used to generate electricity. In due course of time, turbines replaced open water wheels and engineering progress enabled the construction of dams which maximized the efficiency of hydropower¹⁻⁴.

Today hydropower is the largest source of renewable energy in the world, providing approximately 16% of the electricity consumed. Countries like China, Brazil, Canada and the US produce large quantities of hydroelectric energy⁵. The largest hydroelectric power station in the world is China's Three Gorges Dam in Yichang, Hubei province. This dam on the Yangtze River has an instant generating capacity of 22,500 MW. India is also blessed with immense amount of hydro-electric potential and ranks 5th in terms of exploitable hydro-

potential on global scenario. As per the assessment made by Central Electricity Authority (CEA), India is endowed with economically exploitable hydro-power potential to the tune of 148700 MW of installed capacity. Only Arunachal Pradesh, a North Eastern state has an untapped hydropower potential of more than 50,000 megawatts (MW), but till date, only 415 MW has been developed. The 2,000 MW Lower Subansiri Hydroelectric Power Project (LSHEP) developed by NHPC Limited located on Subansiri River on the border of India's two north-eastern states, Arunachal Pradesh and Assam will be the single largest hydroelectric plant in India when completed. However, the project has been inundated by delays due to stiff opposition over its potential environmental impact as well as its location in the Seismic Zone V⁶⁻¹⁰.

Hydroelectric power which is among the first and simplest of the technologies that generate electricity, was initially developed using low dams of rock, timber, or granite block construction to collect water from rainfall and surface runoff into a reservoir. The water funneled into a pipe (or pen-stock) was directed to a turbine (or waterwheel) where the force of the falling water on the turbine blades rotates the turbine and its main shaft. This shaft is connected to a generator, and the rotating generator produced electricity. One gallon (about 3.8 liters) of water falling 100 feet (about 30 meters) each second produced slightly more than 1,000 watts (or one kilowatt) of electricity, enough to power ten 100-watt light bulbs. In today's scenario, hydroelectric power is used to power homes, streets, offices, factories, hospitals and schools.

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HYDROPOWER CALCULATION

A hydropower resource can be evaluated by its available power. Power is a function of the hydraulic head and rate of fluid flow. The head is the energy per unit weight (or unit mass) of water. The static head is proportional to the difference in height through which the water falls. Dynamic head is related to the velocity of moving water. Each unit of water can do an amount of work equal to its weight times the head.

The power available from falling water can be calculated from the flow rate and density of water, the height of fall, and the local acceleration due to gravity¹¹.

In SI units, the power is $P = \eta \rho Q g h$

Where

- | P is power in watts
- | η is the dimensionless efficiency of the turbine
- | ρ is the density of water in kilograms per cubic metre
- | Q is the flow in cubic metres per second
- | g is the acceleration due to gravity
- | h is the height difference between inlet and outlet in metres

HISTORY OF HYDRO POWER PROJECTS

The World's First Hydroelectric Power Plant began operation on September 30, 1882 on the Fox River in Appleton, Wisconsin, United States. India is the 7th largest producer of hydroelectric power (China being the world's largest producer of hydroelectricity) and India's hydroelectric power potential of 84,000 MW at 60% load factor is one of the largest in the world⁵. The present installed capacity as on 31 March 2016 is 42,783 MW which is 14.35% of total utility electricity generation capacity in India.

The 4.5 megawatt hydroelectric power station near Sivasamudram falls of the Cauvery in Karnataka was the first major power station in India. It was commissioned in 1902. But much smaller power plants started functioning earlier in different parts of India. The first small hydro power plant, a 130 kilowatt plant, started functioning in 1897 at Sidrapong (Darjeeling)⁷⁻⁸.

TYPES OF HYDRO-ELECTRIC INSTALLATIONS

Hydropower plants are often classified in three main categories according to operation and type of flow which is also according to quantity of water available. Thus, here are three types of hydroelectric installations. All installations vary from the very small to the very large scale, depending on the hydrology and topography of the watershed. In addition, there is a fourth category called in-stream technology, which is a young and less-developed technology.

Run-of-River: Run-of-River (RoR) hydro power project (HPP) uses available natural flow of the river to operate the turbine for electricity production. In a RoR HPP, a portion of the river water might be diverted to a channel or pipeline (penstock) to pass on the water to a hydraulic turbine, which is connected to an electricity generator. If the conditions are right, this type of project can be constructed without a dam or with a low diversion structure to direct water from the stream channel into a penstock.

Storage (Reservoir) Hydropower: Hydropower projects with a reservoir are also called storage hydropower since they store water for later consumption. The reservoir reduces the dependence on the variability of inflow. The generating stations are located at the dam toe or further downstream, connected to the reservoir through tunnels or pipelines. The type and design of reservoirs are decided by the landscape and in many parts of the world are submerged river valleys where the reservoir is an artificial lake. In these types of settings, the generating station is often connected to the lake serving as reservoir via tunnels coming up beneath the lake (lake tapping).

Pumped Storage: Pumped-storage facilities, an innovation of the 1950s, have specially designed turbines. In this system, water is pumped from a lower reservoir into an upper reservoir usually during off-peak hours, while flow is reversed to generate electricity during the daily peak load period or at other times of need. During the daytime when

electricity demand suddenly increases, the gates of the pumped-storage facility are opened and stored water is released from the reservoir to generate and quickly deliver electricity to meet the demand. At night when electricity demand is lowest and there is excess electricity available from coal or nuclear electricity generating facilities the turbines are reversed and pump the water back into the reservoir.

In-stream technology using existing facilities:

Small turbines or hydrokinetic turbines can be installed for electricity generation to optimize existing facilities like weirs, Barrages, canals or falls. These basically function like a run-of-river scheme. Hydrokinetic devices being developed to capture energy from tides and currents may also be deployed inland in both free-flowing rivers and in engineered waterways.

Categories of Hydro-Power Projects: Hydro-Power Project classification by head refers to the difference between the upstream and the downstream water levels. Head determines the water pressure on the turbines that together with discharge are the most important parameters for deciding the type of hydraulic turbine to be used. Generally, for high heads, Pelton turbines are used, whereas Francis turbines are used to exploit medium heads. For low heads, Kaplan and Tubular turbines are applied. Classification according to size has led to concepts such as 'small hydro' and 'large hydro', based on installed capacity measured in MW as the defining criterion.

Depending on the capacity, hydro power plants are divided into the following categories

- (a) Large Hydro Plant – having capacity more than 100 MW which is used in large cities.
- (b) Medium Hydro Plant- having capacity 25 MW to 100 MW
- (c) Small Hydro plant –having capacity 1 MW to 25 MW which is used in small cities to towns.
- (d) Mini Hydro Plant – having capacity 100 KW to 1000 KW which is used in towns.
- (e) Micro Hydro Plant- having capacity less than 100 KW which is used in Rural Community.

- (f) Pico Hydro Plant- having capacity less than 5 KW which is used in individual home.

Hydro Power plants have an efficiency of 75%. The power delivered is given by the following expression
Power Delivered = $7 \times H \times dQ/dt$ kilowatts,

Where H= Head in meters

dQ/dt = Rate of discharge in m^3/s

COMPONENTS OF HYDRO POWER PROJECTS

There are six major components of hydroelectric power plants¹⁻¹⁰.

(1) **Dam and Reservoir:** Dams are built over rivers to stop the water flow thus forming the reservoir. The reservoir stores the water flowing down the river. This water is diverted through pipes or penstock to turbines in power stations. The dams collect water during the rainy season and store it, thus allowing for a steady flow throughout the year. Dams are also used for controlling floods and irrigation in multipurpose projects. There are different types of dams such as arch dams, gravity dams and buttress dams. The height of water in the dam is called *head race*. It should be seismic proof structure especially in zone IV and V regions. It should be water-tight and should be able to withstand the pressure exerted by the water on it to avoid the catastrophe of the downstream areas.

(2) **Spillway:** As the name suggests it could be called as a way for spilling of water from dams. It is used to provide for the release of flood water from a dam and to prevent over topping of the dams which could result in damage or failure of dams. Spillways could be controlled type or uncontrolled type. The uncontrolled types start releasing water upon water rising above a particular level. But in case of the controlled type, regulation of flow is possible.

(3) **Penstock and Tunnel:** Penstocks are pipes which carry water from the reservoir to the turbines inside power station. They are usually made of steel and are equipped with gate systems. Water under high pressure flows through the penstock. A tunnel serves the same purpose as a penstock. It is used when an obstruction is present between the dam and

power station such as a mountain.

(4) **Surge Tank:** Surge tanks are tanks connected to the water conductor system for the purpose of reducing water hammering in pipes which can cause damage to pipes. The sudden surge of water in penstock is taken by the surge tank, and when the water requirements increase, it supplies the collected water thereby regulating water flow and pressure inside the penstock.

(5) **Power Station:** Power station houses a turbine coupled to a generator. The water brought to the power station rotates the vanes of the turbine producing torque and rotation of turbine shaft. This rotational torque is transferred to the generator and is converted into electricity. The used water is released through the *tail race*. The difference between head race and tail race is called gross head and by subtracting the frictional losses we get the net head available to the turbine for generation of electricity.

(6) **Tail Race and Draft Tube:** The channel into which the turbine discharges is called a tail race. The suction pipe or draft tube is nothing but an airtight tube fitted to all reaction turbines on the outlet side. It extends from the discharge end of the turbine runner to about 0.5 metres below the surface of the tail water level. The straight draft tube is generally given a flare of 4 to 6 degrees to gradually reduce the velocity of water.

PROS AND CONS OF HYDROPOWER

Hydropower has become a key source of energy. But there are both pros and cons to hydroelectric energy. Advantages to hydropower:

- | **Green:** Hydropower is renewable and clean. The process for generation of electricity does not pollute and water can later be used for irrigation, human consumption, etc.
- | **Flexibility:** The water flow and, thus, the energy output can be regulated to adapt to the consumption needs and storage capacity.
- | **Durability:** Once constructed dams and power house can produce energy for decades, and require little further investments.
- | **Low Power Costs:** The major advantage of hydroelectricity is elimination of the cost of fuel.

Hydroelectric stations have long economic lives, with some plants still in service after 50–100 years. Operating labor cost is also usually low, as plants are automated and have few personnel on site during normal operation.

- | **Reduced CO₂ Emissions:** Since hydroelectric plants do not burn fossil fuels, they do not directly produce carbon dioxide.

DISADVANTAGES TO HYDROPOWER

- | **Environmental impact:** Construction of dams for water storage changes water level thus submerging large upstream areas and dewatering large downstream areas. It is also necessary to build roads and high power transmission lines. All these give a strong impact on wildlife and the ecosystem.

- | **Displaced people:** The construction of a large dam often requires many villages or entire towns move out of the area. In the construction of the Three Gorges Dam (China) it is estimated that 1.2 million people were displaced.

- | **Expensive:** Building a dam and its associated power house requires a very big initial investment.

- | **Accidents:** Old dams often suffered breaches which led to floods and deaths in the downstream areas.

- | **Methane emissions from reservoirs:** It has been noted that the reservoirs of power plants in tropical regions produce substantial amounts of methane.

- | **Failure risks:** Large conventional hydro dam hold back large volumes of water, a failure due to poor construction, natural disasters or sabotage can be catastrophic to downstream area settlements and infrastructure. Dam failures have been some of the largest man-made disasters in history.

HYDROPOWER IN NORTH-EASTERN STATES

North Eastern States including Sikkim has around 62,604 MW of hydro potential. Out of which around 1920 MW has been harnessed, 5357 MW is under construction and others are under survey and investigation stages¹⁰. The operational hydro projects in North-Eastern states are given in Table 1.

Table 1. Operational Hydro Projects in North-Eastern states.

States	Projects in operation over 25 MW
Sikkim	60MW Rangit III, 510 MW TeestaV
Assam	225MW Kopili, 50 MW Khangdong, 100MW Karbi Langpi
Manipur	105 MW Loktak
Meghalaya	36 MW Umiam Stage I, 36 MW, 60 MW Umiam Stage III, 60 MW Umiam Stage IV, Myntdu Leshka 124 MW
Arunachal Pradesh	405 MW Ranganadi Stage I,
Nagaland	75 MW Doyang

CONCLUSIONS

In India, the conventional alternatives to hydroelectric power are diesel, coal or natural gas. There is less talk of nuclear energy as a major alternative after the full impact of Chernobyl nuclear disaster became known. Natural gas has the limitation as its reserves are low. Thermal plant using coal produces a lot of carbon dioxide, a green house gas. But it may be noted that a Thermal:Hydro mix in the ratio of 60:40 is considered as ideal in India. Several non-conventional alternatives to hydroelectric power are emerging fast. Many countries in the world have wind potential. Experience both in India and abroad has shown that wind energy is technically and economically viable. But many are yet to turn to that. Solar energy is becoming an attractive option with drop in prices of solar arrays. It has the advantage that it is totally non-polluting. However, Non-conventional alternatives would take time to arrive on the scene in a big way. Hydroelectric power still reigns supreme as a source for peaking purposes. Thermal and nuclear plants would need long start up times to begin generation. However, construction of hydro power projects has to overcome a lot of hindrance as the project location is of site specific nature (mostly in remote area). Therefore, all possible options should be explored before a state is considered together to arrive at a

choice. During the time of construction and operation, the developer has to face problem in transportation of materials and equipment as well as deployment of manpower as employees do not prefer to work at remote site throughout their life time. Good liaison with the local populace and state agencies are to be maintained.

Technological innovation and material research can further improve generation capacity, environmental performance, reduce construction and operational costs. Though it is claimed that hydropower technologies are mature, ongoing research into variable-speed generation technology, fish-friendly turbines, efficient tunnelling techniques, integrated river basin management, hydrokinetics, silt erosion resistive materials and environmental issues may ensure continuous improvement of future projects.

"Clean Power for Every Home" is a very popular slogan for hydro-developers.

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PLANT DIVERSITY DATABASES CAN HELP IN CONSERVATION OF BIODIVERSITY

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Biodiversity protection is recognised globally as its loss has reached at a critical label. Documentation is foremost requirement for biodiversity conservation and databases on plants diversity are extremely important for documenting the biodiversity. World database of over 19000 legumes is pioneer global database and authors have developed database of 2030 taxa of legumes of South Asia as part of world database. This database is useful in upgrading taxonomy of herbarium specimens, living collections in botanical gardens, gene sequences databanks and phyto-chemical databases on legumes.

INTRODUCTION

Biodiversity can be define as "all living things on earth and embraces all species and all genetic variation on earth. There is growing recognition that we need to protect our global biodiversity, and a growing realization that species loss is accelerating. We have moved into a period when the speed of species loss has reached a critical level. Biodiversity databases store taxonomic information, which provides the information on the biodiversity of a particular area or group of living organisms. They may store specimen-level information, species-level information, information on nomenclature, or any combination of the above¹.

The massive development of biodiversity related systems over the World Wide Web (WWW) has created much excitement in recent years. These arrays of new data sources are counter balanced by the difficulty in knowing their location and nature. However, biologists and computer scientists have started to pull together in a rising tide of coherence and organization to address this issue. The upcoming field of biodiversity informatics is expected to deliver major advances that could turn the WWW into a giant global biodiversity information system.

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The first step in biodiversity conservation is documentation based on the availability of information about each species with data starting from its systematic position to molecular aspects. In many biodiversity databases, data is held either about species or specimens such as (1) nomenclature-species name, geographical data and status scale; (2) descriptive data- morphology, anatomy, chemistry, ecology etc.; (3) economic importance; (4) conservation status; (5) images; (6) bibliography sources of data used in the database.

Leguminosae (or Fabaceae) contains approximately 700 genera in 41 tribes in three subfamilies (Caesalpinoideae, Mimosoideae and Papilionoideae) and about 19,000 species. Legumes are widespread in all the continents as herbs, shrubs and trees. In purely quantitative terms, the family lies in second place to cereals (Gramineae) in importance to man but in the number of diversity of uses of man, in contribution to the vegetation and agriculture of all continents (excluding Antarctica) and in biological diversity and interest, the family is second to none. Legumes are used to provide very many foods, as fodder, kindling, household materials, ornamentals, poisons, pharmaceutical sources and blood-testing reagents. Their root nodules make a major contribution to the world's nitrogen fixation and they contribute richly to some

of botany's most remarkable observations, examples being the occurrence of phyto-haemagglutinins in seeds, and the rapid leaf-movements of some species¹.

The digital treatment for legume diversity over eight years has resulted in the development of the first ever-accurate taxonomically reviewed database of 2030 leguminous taxa from eight countries of South Asia. The database contains information on most recent nomenclature (accepted name, and synonyms) and the latest information on geographical distribution in South Asian countries - India (1561 species (77%)), Pakistan (691 species (34%)), Myanmar (607 species (30%)), Sri Lanka (512 species (25%)), Nepal (469 species (23%)), Bhutan (324 species (15%)), Bangladesh (255 species (12%)) and Maldives (45 species (2%)).

Besides nomenclature and geography, the database contains information on life form details, conservation status, common names, description, economic uses and bibliography etc. Thus database with recent legume taxonomy, distribution and descriptive data for legumes of South Asia, is unique in a level of detail and authenticity that cannot be found in any of the previously published sources from the South Asia region¹.

Scientifically validated database on South Asian Legume was merged into world database on legumes and thus the efforts made on development of South Asia database on legumes became complimentary and supplementary to world database³. A sample of retrieval of information on *Cassia fistula* is presented in Table 1.

Table 1.

Accepted name	<i>Cassia fistula</i> L. ^{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16}
Synonyms	<i>Bactrylobium fistula</i> Willd. ^{2, 5, 9} <i>Cassia bonplandiana</i> DC. ^{2, 5} <i>Cassia excelsa</i> Kunth ^{2, 5} <i>Cassia fistuloides</i> Collad. ^{2, 4, 5} <i>Cassia rhombifolia</i> Roxb. ^{5, 9, 11} <i>Cathartocarpus excelsus</i> G. Don ^{2, 5} <i>Cathartocarpus fistula</i> Pers. ^{2, 5, 9, 11} <i>Cathartocarpus fistuloides</i> (Collad.) G. Don ^{2, 5} <i>Cathartocarpus rhombifolius</i> G. Don ^{5, 9}
Taxonomy	Tribe: Cassieae; Genus: <i>Cassia</i>
Vernacular names	Aehaela-gaha (Sinh) ¹¹ ; Ahalla-gass (Sinh) ¹¹ ; Amaltas (Hi) ¹² ; Amaltas (Hi) ¹⁷ ; Bandarlauri (Hi) ¹⁵ ; Butor ⁷ ; Bfton Casse ¹⁸ ; Caneficier ¹⁹ ; Caneficier ⁷ ; Can, fice ⁴ ; Casse ⁴ ; Casse ¹⁸ ; Casse Espagnole ¹⁸ ; Casse M, dicinale ²⁰ ; Casse M, dicinale ²⁰ ; Casse -habitant ⁴ ; C assia Stick Tree ⁴ ; Cassia Stick Tree ²¹ ; Cassia -Stick Tree ²¹ ; Cassie ⁷ ; Cacafistola ²² ; Cacaf & #237; stol ¹⁸ ; Cacaf & #237; stula ⁴ ; Cacaf & #237; stula ¹⁸ ; Cacaf & #237; stula Mansa ¹⁸ ; Ch cara ¹⁸ ; Ekela (Sinh) ¹¹ ; Girimaloah (Hi) ¹⁷ ; Golden Rain ²³ ; Golden Shower ²⁴ ; Golden Shower ²⁵ ; Golden Shower ²⁶ ; Golden Shower ⁹ ; Golden Shower ¹² ; Golden Shower ²⁷ ; Golden Shower ¹³ ; Golden Shower ²³ ; Golden Shower ¹⁵ ; Golden Shower ²⁸ ; Guayaba Cimarrona ¹⁸ ; Indian Laburnum ²⁹ ; Indian Laburnum ²⁶ ; Indian Laburnum ⁷ ; Indian Laburnum ⁹ ; Indian Laburnum ¹² ; Indian Laburnum ¹⁷ ; Indian Laburnum ¹⁵ ; Indian Laburnum ²⁸ ; Indian Laburnum ³⁰ ; Kaisai ³¹ ; Kas ⁴ ; La Casse ³² ; Pudding -pipe Tree ³³ ; Pudding -pipe Tree ⁹ ; Purging Cassia ²⁵ ; Purging Cassia ¹⁵ ; Purging Fistula (En) ¹⁷ ; Purging Fistula (En) ²⁸ ; Rohrenkassie ¹⁹

The legume database is validated scientifically and as reference attached to each information

Descriptors	Perennial non-climbing tree
Uses	Chemical products ¹² ; Chemical products ¹⁵ ; Chemical products ³⁴ ; Domestic ³⁰ ; Environmental ⁷ ; Environmental ¹⁰ ; Environmental ¹¹ ; Environmental ¹² ; Environmental ¹³ ; Environmental ³⁵ ; Environmental ²³ ; Environmental ¹⁵ ; Environmental ³⁰ ; Food and Drink ³⁶ ; Food and Drink ³⁷ ; Medicine ⁸ ; Medicine ⁹ ; Medicine ¹⁰ ; Medicine ¹¹ ; Medicine ³⁵ ; Medicine ³⁸ ; Medicine ¹⁷ ; Medicine ³² ; Medicine ¹⁵ ; Medicine ²⁸ ; Medicine ³⁰ ; Miscellaneous ⁸ ; Miscellaneous ¹⁰ ; Miscellaneous ¹¹ ; Miscellaneous ¹⁷ ; Miscellaneous ³⁷ ; Miscellaneous ³⁹ ; Miscellaneous ¹⁵ ; Miscellaneous ²⁸ ; Wood ²⁴ ; Wood ⁹ ; Wood ¹⁰ ; Wood ¹¹ ; Wood ¹⁷ ; Wood ³⁹ ; Wood ¹⁵ ; Wood ²⁸ ; Wood ³⁰ ; Chemical products ⁴⁰ ; Environmental ⁴⁰ ; Medicine ⁴⁰
Notes	Probably native of India, Sri Lanka and Malaysia. At an early date spread to ⁹ ; China, Egypt and later through the tropics for medical purposes, but mainly ⁹ ; as ornamental. ⁹ ; There is a note on the label (K) Lakshnakara 1375: "Bark used for tannin". ³⁴ ; Native of Sri Lanka/India. ⁴¹ ; Native to S.E. Asia. ²⁶ ; Commonly cultivated. ³
Geographical records	Africa: Angola-ISO(I) ⁴² , Ethiopia (I) ⁴³ , Kenya (I) ⁴⁴ , Malawi (I) ⁴⁴ , South Africa(I) ⁴⁰ , Tanzania(I) ⁴⁴ , Uganda(I) ^{29, 44} , Zimbabwe(I) ⁴⁴ Asia ^{3, 8, 9, 10, 11, 13, 14, 16, 26, 28, 30, 36, 39, 43, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74} : Bangladesh(N) ³⁹ , Bhutan (I) ⁸ , Brunei(I) ⁷⁴ , Cambodia (I) ³⁶ , China (I) ^{9, 16, 36} , East Timor (I) ³⁰ , India(N) ^{3, 8, 9, 28, 47, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73} , India-ISO(N) ⁴⁰ , Indonesia -ISO(N) ^{9, 30, 36, 51} , Iran (I) ⁴⁶ , Iraq (I) ⁴⁶ , Java(N) ³⁰ , Kalimantan (N) ⁵¹ , Laos (I) ³⁶ , Lesser Sunda Is (N) ³⁰ , Malaysia-ISO(N) ^{9, 30} , Moluccas (N) ³⁰ , Myanmar (N) ¹⁰ , Nepal (N) ^{14, 63} , Pakistan(I) ¹⁰ , Peninsular Malaysia (N) ³⁰ , Philippines (I) ³⁰ , Ryukyu Is(N) ¹³ , Singapore(I) ⁵² , Sri Lanka (N) ^{3, 9, 11, 40} , Sulawesi (N) ³⁰ , Sumatra(N) ³⁰ , Taiwan(I) ^{45, 50} , Thailand(U) ⁹ , Vietnam(I) ³⁶ Australasia ^{3, 75} : Australia(I) ⁷⁵ , Papua New Guinea(I) ³ Australia: Queensland ⁷⁵ Caribbean ^{18, 22, 33, 76, 77} : Antigua-Barbuda(I) ⁷⁷ , Barbados (I) ⁷⁷ , Cayman Is (I) ⁷⁶ , Cuba (I) ²² , Dominica (I) ⁷⁷ , Dominican Republic (I) ¹⁸ , Grenada(I) ⁷⁷ , Guadeloupe (I) ⁷⁷ , Haiti (I) ¹⁸ , Martinique (I) ⁷⁷ , Puerto Rico(I) ³³ , St Lucia(I) ⁷⁷ , St Vincent(I) ⁷⁷ Central America ^{2, 4, 78, 79, 80} : Belize(I) ⁸¹ , Costa Rica (I) ⁸² , El Salvador(I) ⁸⁰ , Guatemala(I) ⁸³ , Mexico (North & Central) (I) ⁴ , Mexico (South East)(I) ^{2, 4, 78, 79} , Nicaragua(I) ⁸⁴ , Panama(I) ⁵ India: Andhra Pradesh ⁷⁰ , Arunachal Pradesh ⁵⁶ , Assam ⁶⁴ , Bihar ⁷² , Dadra-Nagar-Haveli ⁵⁹ , Delhi ⁶⁵ , Goa ⁵⁹ , Gujarat ⁵³ , Haryana ⁶⁶ , Himachal Pradesh ⁶¹ , Jammu -Kashmir ⁷¹ , Karnataka ⁴⁷ , Kerala ⁶⁹ , Madhya Pradesh ⁶⁷ , Maharashtra ⁶⁰ , Manipur ⁶² , Meghalaya ⁵⁷ , Mizoram ⁶² , Nagaland ⁶² , Punjab ⁶⁸ , Rajasthan ⁵⁵ , Sikkim ⁸ , Tamil Nadu ⁵⁴ , Tripura ⁵⁸ , Uttar Pradesh ⁷³ , West Bengal ²⁸ , Yanam ⁶² Indian Ocean ^{7, 20, 21, 26, 62, 85, 86} : Andaman Is (I) ⁸⁶ , Laccadive Is (I) ⁶² , Maldives(I) ⁶² , Mauritius(I) ^{20, 21, 26} , Rodrigues(I) ⁸⁵ , Seychelles(I) ⁷ Indonesia-ISO: Bali ³⁰ North America ⁸⁷ : United States(I) ^{2, 87, 88, 89} Pacific Ocean ^{2, 12, 23, 27, 31, 90, 91} : Fiji(I) ^{12, 90} , Hawaii (I) ² , Niue (I) ²⁷ , Northern Marianas(I) ⁹¹ , Society Is(I) ²³ , Tonga(I) ³¹ South America ⁹² : Argentina(I) ⁸⁸ , Brazil (I) ² , Colombia (I) ² , French Guiana(I) ⁹² , Guyana(I) ⁹² , Peru(I) ⁹³ , Surinam(I) ⁹² , Venezuela (I) ² United States: Florida ⁸⁷ (N = native, I = introduced, U = uncertain status)

Habitats (for Africa only)	Cultivated ⁴⁰
Literature citations	Description ^{2, 3, 4, 7, 8, 9, 10, 11, 13, 15, 16, 18, 19, 30, 33, 36, 38, 40, 45, 52, 94,} Illustration ^{3, 8, 9, 15, 16, 18, 33, 36, 38, 45, 48, 95, 96}
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N.B.: Only some references are shown in the sample table

It may be mentioned that scientifically the above world database can be used to authenticate the taxonomic nomenclature of herbarium specimens, living plants growing in botanic gardens, gene banks, gene sequence data banks and phytochemical databases and thus this core database is immensely useful to dissemination of accurate information on plants species nomenclature, distribution, economic uses, genomic information, environmental aspects etc. A schematic model is presented in Fig.1.

State-of-the-art scientifically databases can be used thus in many ways i.e. as digitization of species diversity, displaying of data on distribution maps using GIS tools, upgrading of taxonomic nomenclature of herbarium collection, living collections of botanic gardens, seed gene banks and so on and all these studies are extremely beneficial for exploration of biodiversity and thus tremendously help in conservation of diversity.

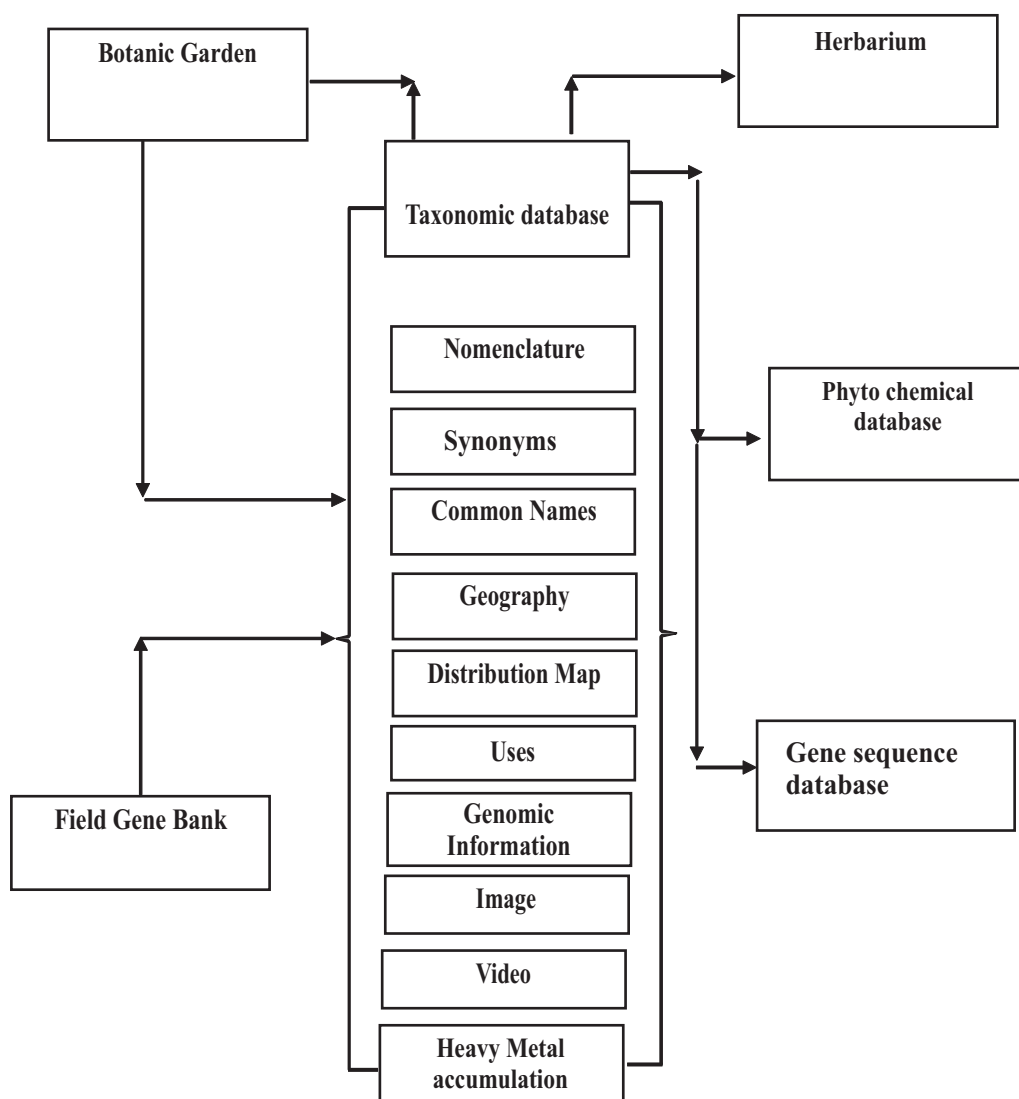


Fig.1: Showing schematic diagram how taxonomic database can be linked with key field i.e. species name common in data bank of herbarium specimen, botanic gardens, field gene bank, phytochemical databases and value additions to all 5 databanks.

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SCHOOL MEALS: LINKING TO HOME FOOD AND LOCAL FARM PRODUCE

Ruparao T. Gahukar*

This article draws attention of school authorities and government agencies as well as parents of school children. Consuming street/junk foods is common among students because this food is prepared as per choice, taste and paying capacity, looks attractive and tempting and therefore has gained momentum in all categories of students irrespective of economic and social strata. Awareness among students can play an important role by putting ban on outside snacks and serving it in school cafeteria. Also, parents should be vigilant and sensitize children while they are outside school. Home-made food prepared from local/seasonal farm produce not only provides community connection but also offers fresh, better quality and highly nutritious food than the market-purchased food.

INTRODUCTION

With adoption of Green revolution strategies in the late sixties, food production in India increased from 52.0 mt in 1950-51 to peak of 297.1 mt in 2012-13, and now, it is nearly stable at 252 mt since last three years. To achieve this target, private research institutions, government departments and the policy makers laid emphasis on increasing crop productivity and nutritional quality was not often considered.

Therefore, the food and nutritional security is in jeopardy particularly with ever-increasing human population currently reaching to >1.2 bn. This is evident from the number of malnourished and underfed persons, particularly the infants and women in the country. The Tendulkar Committee report released in January 2010 by the Planning Commission of the Government of India showed 37.2% population below poverty line (41.8% in rural areas and 25.7% in urban areas). Since a decade, suicide rate in the farming communities is on increase due to debt burden, crop failure, stagnant crop productivity and socio-economic problems¹.

CURRENT SITUATION

Street/junk/fast foods and restaurant mealshave become common in public places and

meeting points. This food is prepared as per choice, taste and paying capacity of the customer, looks attractive and tempting and therefore has gained momentum in all categories of students irrespective of economic and social strata. The street food contains no proteins or vitamins, is low in fibre but high in fat, salt, sugar and calories that cause obesity and hypertension. The fatty acids in junk food reacting with the brain hormones may reduce IQ level in children². Fructose in candies can lead to liver toxicity and other diseases. Food served in the hotels and restaurants can contain non-permitted adulterants and toxic contaminants³. Popular soft drinks contain caffeine, taurine, sweeteners and supplements without energy providers. It is proved that the obesity in the USA is increasing with decline of home-cooked food². Obesity is a complex disease with multifactorial aetiology. In India, it affects 5% of population and its incidence depends mostly upon age, gender, body mass index and blood pressure⁴. The incidence is increasing in urban and higher socio-economic groups because processed food, particularly fat-rich menus, has become much more accessible than nearly two decades ago^{5,6}. Considering current situation. Multidisciplinary approach is needed to manage this disease.

Another concern is the women's liberation. With provision of modern cooking kitchenware, time saving recipes and hectic life, women now spend about 40% less time cooking than in 1965 with

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married, employed women and working wives putting in less than a hour a day in the kitchen. Ultimately, the packed and fast food found the way to parent's home. This situation is reflected in the school meals which are non-nutritious and often non-consumable.

The great worry for school authorities and parents is that school children prefer fast food and school meals are pitted against powerful food business, convincing TV programmes and interesting advertisements in local media for certain products sponsored by the celebrities. The school canteens and cafeterias are supposed to provide nutritious food during school hours. Whether this is happening or not is yet to be confirmed. In certain states, policy makers have, however, made certain changes and the public health department is scrupulously supervising application of laws and regulations so that children get healthy energy food regularly. Some schools have started food-related programmes such as, yellow day and green day when the children are encouraged to eat yellow and green food items such as, whole or split grains (green gram, chick pea), vegetables, fruits, salad, sandwich with cucumber and tomato etc. with or without freshly squeezed fruit juice. Awareness among children can push this campaign further through putting ban or allowing outside snacks once a week or so. However, parents should be vigilant and should sensitize children while they are outside school. Central government introduced "Mid-day meal scheme" in schools but it is a failure due to supply of non-nutritious and adulterated/ contaminated food as evidenced from several reports in social media about illness of children after consuming food³. Also, teachers complained that the implementation of scheme hampered teaching process due to cutting into precious teaching time and the scheme becoming a liability. In the school, there are children with different needs of nutrients. Some of them need food while others do not, particularly those coming from well-off families. As per government mandate, every primary school child must be served with 100 g food and the secondary school child with 150 g food.

The situation in rural areas is different from urban areas. The nutritional information about all packaged food served is not clearly mentioned and malpractices are prevailing. Then, the food wastage is alarming if the food is served in excess or of poor quality or rigid rules are followed by teachers⁷.

There is urgent need to start a war on waste particularly in times when food prices are soaring and food access to poor becomes problematic. Introduction of the "Health card" in schools is expected for keeping health records of small children. Outsourcing mid-day meals and snacks with the consent of school management committees may be introduced in school cafeteria as learning process. The children and their parents should be convinced of advantages of home-cooked food. The Union Health Ministry also issues a notification calling for a ban on junk food. This system encourages team spirit among students, be prepared for disasters and would ask questions to their teachers. These initiatives have to be started at school level and science teachers should take positive and keen attitude towards the profession and responsibility of preparing students, For this purpose, teachers are capable of motivating at least a small group of children to pursue basic and natural sciences at a higher level are needed. Of course, teachers should be properly trained so that they can help students in a much better way⁸. In fact, poor families in rural areas get less food supply because of low purchasing power.

Women in households therefore had to decrease their own food intake but at the same time work harder to earn income through livestock rearing, manual work in farms, home food processing etc. In earlier days, food was a nerve-centre of homes and gender roles developed around cooking, subsequently, the elaborate social rituals and manners developed around meals. As life became more hectic, families began to spend less time around dining table. As a result, packaged and fast food found its way to homes or parents preferred to dine with children in restaurants. This led to change in traditional gender roles. Meanwhile private firms/

enterprises started cooking for all types of clients and found their ways in schools.

SOME PRACTICAL MEASURES

Education is a vital determinant of socio-economic development. Unfortunately, Indian students are drifting away from science education including agriculture⁹. Although India is an agricultural country, agriculture constitutes as a subject only after secondary education in agricultural schools and colleges. In future, farming education should be a part of curriculum at a young age starting from middle school up to matriculation. When children grow to 17-18 years, they will be interested in rural skills, business, craftsmanship, food marketing etc. The "School to farm" activity can be initiated through which school gardening, farming, compost/recycling of kitchen waste etc. can be demonstrated. In a series of "Know your farmer", farmers can explain their experiences to students who may later take up farming. By taking lessons from communities historically sourced and adapting healthy life can provide reasonably acceptable philosophy in the rural youth. This strategy provides a sustainable outlook for the future of local food. Farm experts/scientists should be asked to travel to rural schools as and when possible, to make students aware of recent farm technology particularly biotechnological advances in food production and preservation. This initiative can lead to competency based training system and rural youth may be trained and school authorities should recognize their skills. Abhisheka *et al.*¹⁰ suggested training programme for school children during vacation period. By this way, children are directly in contact with subject matter specialist and can learn practical and do experimentation in the fields on what they have learnt in classrooms through text books and lectures such as, bee keeping, vermiculture, collection and studying butterflies, knowing different types of pollinators, collecting beetles for home decoration etc. The groups formed within student community of different age group, culture, religion etc. may help to build/acquire team spirit¹⁰. In future, these students can aspire to be scientists or researchers in the fields

of their interest, specialization and choice. This will reduce rural youth migration to the cities reducing the city population burden while keeping social and community systems financially viable in rural areas where stemming rural poverty can only help to stabilize food security and reduce malnutrition and undernourishment.

Recently, agricultural growth has become critical for macroeconomic stability and sustained growth. It's time to strengthen the agricultural sector and make farming remunerative even for small and marginal farmers. This aspect is relevant to rural areas where food and nutritional security is still a major problem. Ideally, food served in schools should come from locally grown crops. According to Ramya *et al.*¹¹, the Systematic management of agricultural resources and technology (SMART) can be an option for nutritional security. This is an approach that includes management of available genetic resources of food crops and use of improved technologies for balanced use of chemical fertilizers to provide plant nutrients and integration of all available pest control measures to make crop production more efficient, and ecologically and economically viable for small and average farmers. Extension services being weak, SMART can help reduce the gap between scientists and farmers¹¹. It appears that the climate change is irreversible and rise in global temperature and sea levels would create havocs for human beings. School children should know these effects from their childhood so that they would do publicity for discouraging negative events (deforestation, over-use of chemicals in agriculture, CO₂ emission, waste management etc.) and for popularizing sustainable agriculture.

Roof top gardening in urban area and kitchen gardening in rural area are other endeavours where students can be interested and programmes implemented with participatory approach. The "Farm to school" programme is worthwhile to try. In this venture, school authority purchases farm fresh foods from local farmers and include them in school meal and snack menus. The basic idea behind these approaches is that fresh and healthy food can be

made available to schools whenever they need for preparing school meals. It is less burdensome to the environment because the amount of fuel used in transporting produce from near places to school is significantly less. There is also considerably less pollution generated by transportation vehicles and other resource-demanding inputs. When produce is brought from long distance, it is generally unripe or treated with chemicals for artificial ripening to increase shelf/storage life. Local octroi and toll taxes should also be waived. Since farm produce is brought directly to schools, middlemen are avoided who often supply good looking but unhealthy stuff.

In India, urban and rural areas are closely related with one helping the other but linkages rarely operate to the advantage of majority of the rural population. Whenever opportunity arises, the local groups can be the best trainers for local communities for explaining the importance of natural resources especially when effects of climate change are evident on agriculture in general and food crops in particular. Similarly, the Self-help groups (SHG) can help in women empowerment. Restaurants can offer ever-changing menus that are both unique and have a strong local connection (menu can be named after community, village etc.). Eating locally means eating seasonally since some food crops/plants will not be available throughout the year. Seasonal produce not only provides community connection but also offers fresh, better quality and highly nutritious food than the market-purchased food. The government and parents together can develop food and agriculture policy of the region, bring a diverse array of stakeholders, can educate farmers and convince policymakers about food, nutrition, farming and economic issues. The joint action possibly connects other farmers and community organizations to provide technical assistance, marketing information, financial and marketing skills and peer examples.

Local adaptive management of food-producing environment is needed primarily, to conserve natural resources and secondly, to provide food to locals. Traditional wisdom existing in village should be improved by building on local systems of knowledge and management¹². Although many unknown and

wild plants are traditionally understood and used as food in the period of food scarcity, accelerated process of modernization and globalization is leading to the erosion of traditional knowledge and cultural values of local foods. The challenge is how to integrate traditional foods into contemporary diets. After debates and procrastinations, the Food Security Bill and Food Security Act are in force. The modern information and communication technology would support locals to adopt sustainable and climate-resilient agriculture and to avail advantages of the emerging dynamic marketing strategies in order to fight against famine, hunger and the malnutrition. Local groups can also promote agriculture through education, training, community outreach and networking. Creating and enhancing local marketing can thus link farming, food, health and local economies. Likewise, government agencies, municipal councils, gram panchayats, local NGOs can facilitate the food access and distribution, and supervise food utilization and wastage.

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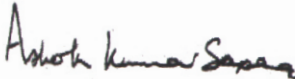
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An Overview of Science and Technical Education in India

D. S. Hooda

In the present communication a brief introduction of the topic has been given. Evolution and importance of the scientific age and temper have been discussed. Social and economic developments have been explained. Present status of Technical and Science education has been discussed in details.

INTRODUCTION

Science and technology have become the determinants of economic growth and developments. To achieve a position among the developed countries of the world, Government of India has taken right step to make a quantum increase in the infrastructure. But it is not sufficient as the quality of education is very important factor that should also be taken care of on priority.

A recent report^{1,4} in science speaks of excellence in space and nuclear science in India. However, despite of this excellence, our competitors like China and South Korea are progressing faster leading to overall gap in quality and competitiveness. Thus, the way these are forwarding ahead is difficult to compete, if not impossible.

A silent revolution has been taking place in India for the last many years. More than one hundred companies around the world have set up their R & D centers in India just during the last ten years. The biggest centre on completion would be R & D centre of General Electric (GE) at Bangalore.

There has been significant progress in the field of atomic energy, which is a movement towards achieving a fast breeder reactor. Thorium will be used as nuclear fuel and that will boost nuclear energy in a big way. India has made Nuclear Power Energy agreements with USA and other countries. That will boost the energy generation in abundance and hopefully new nuclear plants will meet growing needs of our country.

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India is at the threshold of a major power system expansion and planned to generate power energy to meet the need of the country. For that national grid is to be strengthened with at least 800 KV AC and DC lines.

There is need to have nationwide plan for automation so that human intervention is minimized and authentic information are available to manage the electricity distribution.

As automation has role in generation and transmission, so it should be mandatory in distribution sector also. Supervisory control, introduction of fuzzy logic based controllers, expert system application are not possible without automation.

However, standardization is to be kept in view while modernizing the existing and old system by introducing automation, Renewable energy sources which include solar, wind, biogas and small scale hydro projects are now offering opportunities to provide electricity to rural households and many disadvantaged people in cities and towns. This facilitates them to use and derive benefit from electrical light, television, computers, mobile phones, etc.

The commercial, educational, social and other benefits brought in by these technologies to the large population in the developing countries like India is a great hallmark in development of technology of the late 20th and the early 21st century.

It is noteworthy that the market penetration and cost reduction of renewable energy sources have

been helped by the investments made in several industrialized countries to reduce carbon emission from the production of electricity.

Late Prime Minister Lal Bahadur Shastri expressed his opinion about the development science as given below:

"Success in science and scientific work came not through the provision of unlimited or big resources, but in the wise and careful selection of problems and objectives. Above all, what Required is hard sustained work and dedication".

EVOLUTIONS OF SCIENTIFIC AGE AND TEMPER

Generally, it is believed that we are living in a scientific age and the basis of this belief perhaps is the accumulated mass of scientific knowledge and spread of technology to each household. High achievements have been made in the fields of space, medicine, biology, physics and chemistry. The progress made during the last 50 years is greater than the progress made since the infancy of mankind. It is a matter of pride that India is a leading country in the world with regard to the number of scientists.

However, it is not proper to call the present age as scientific only on the basis of the mass of scientific knowledge. Probably where it is said that we live in scientific age, it is meant that in our age there has been an intensification of inquiry and acceleration of discoveries and inventions.

Thus, the present age is an age of technology, but it does not qualify to be called a scientific age. A scientific age in my view is the one where the problems of the society are faced and handled by men and women with scientific temper and scientific attitude in their day to day lives.

The scientific attitude or more properly the scientific temper can be described as a frame of mind which has a thirst for knowledge. It recognizes that the knowledge can be acquired by observation, experience and experiment.

It is the frame of mind of a researcher or a student who enters the laboratory to set the hypothesis to test whether hypothesis is to be accepted or rejected on

the basis of the present scientific data and knowledge. In the process a hypothesis may be modified or in some cases may be replaced by another.

In other words, a scientist or a man with scientific temper or attitude does not cling to a proposition merely because it is attractive or because it is more convenient or because it is after his own heart's desire. You can't impose your own hopes or desires on the course of quest of knowledge.

A truly scientific mind will not accept anything as self evident truth because somebody has authoritatively laid it down. A scientific mind is an adventurous mind and is not afraid to speak truth even if it may not be consonant with established thoughts, beliefs and superstitions. It is the method of inquiry and experience that can lead us to the closer and closer approximation of truth.

The scientific mind, the scientific temper, and scientific attitude are not the monopoly of a scientist. Indeed not all scientists display scientific approach in their daily lives. One need not be surprised if a professor of Astronomy takes a bath after an eclipse, where it is desired in scientific age that every citizen should possess a scientific temper.

A statement on Scientific Temper prepared by a group of scholars and issued on behalf of Nehru Centre, Bombay, in July 1981, mentions that scientific Temper involves the acceptance of the premises amongst others:

- | The method of science provides a viable method of acquiring knowledge;
- | The Human problem can be understood and solved in terms of knowledge gained through the application of the method of science
- | The fullest use of the method of science in everyday life and in every respect of human Endeavour from ethic to politics and economics is essentially for ensuring human survival and progress.
- | One should accept knowledge gained through the application of the method of science as the closest approximation of truth at that time

A real age of science will be attained only when all spaces of thought and activity are filled by scientific temper as ethical metaphor of social discourse. Only then the society will be truly civilized and secularized.

SOCIAL AND ECONOMIC DEVELOPMENTS

New projects in science and technology in India are proving very useful to its quest to battle with poverty, ignorance and disease which afflict millions of our people. Presently, there are large-scale opportunities of employment in service sector as a whole and particularly in IT and BPO sectors. These are enabling young people with appropriate educational background to be part of the momentum that is taking India forward towards becoming a prosperous nation.

Science and technology are the greatest allies for the progress of the society. After independence, India had pursued vigorously a comprehensive program of employing modern science and technology for national development and social transformation. Development in science and technology has helped the country in area of food security as this has given a boost in agricultural production.

Consequently, the country has become not only self sufficient, but exporter in food grains also. This provided health security and disaster management. However, the government should keep in mind to achieve twin objectives of economic growth and social justice, while framing the science and technology policy.

Efforts are being made to develop a personalized agriculture advisory system by integrating both agriculture and information technologies. In this system, the agricultural experts generate the advice by collecting the latest information about the crop situation received in the form of both photographs and text. They deliver the same to each farm on regular basis from sowing stage to harvesting.

The system has helped the farmers in increasing crop yields and significant savings in the capital investment. It has been observed that data warehouse of farm histories has been developed and that is helping the agriculture experts in generating a

quality crop related advice in an integrated manner and providing the agro-related services to the farmer's door-step.

Pt. Jawahar Lal Nehru the first Prime Minister after Independence was of the view that a strong scientific base and a scientific temper are the most powerful catalysts of both economic performance and social progress.

If India wants to transform itself into a developed nation by 2020, for that it requires a major boost to science and technology, particularly, in frontier areas. This is because of the fact that science and technology profoundly influence human kind and society and also the progress for the future.

About fifty years ago, both houses of parliament passed a far-sighted science resolution underscoring the importance of Science and Technology in the developing country like ours. The resolution envisages.

"The key to national prosperity, apart from the spirit of the people lies in the effective combination of three factors: technology, raw materials and capital investment. Out of these the first is the most important, since the creation and adoption of new scientific techniques can, in fact, makeup for a deficiency in natural sources and reduce the demand in capital. However, it can grow out of the study of science and its applications".

A lot of things have been achieved since the adoption of this resolution. Now India has a considerable pool of scientific talent and several highly-rated scientific establishments in diverse fields.

STATUS OF SCIENCE EDUCATION

Innovation is the key for the production and processing of the knowledge. A nation's ability and capacity to convert knowledge into wealth and social good through innovation determines its progress and prosperity. So we need to examine science education in India because today 35 percent of Indian manpower is youngsters in the age group of 20-35 years, which is the highest young age profile in the world. However, 10.5 percent of Indian youths go for

higher education, while 72.6 percent of students go to higher education in USA.

Actually, the problem we are confronting is how to link economical poor people with modern institutions of science and technology, design, manufacturing and marketing to scale up their innovations. The department of science and technology set up the NIF in March 2000 as a communication channel between creative voices at the grass roots and policymakers, entrepreneurs, investors and stakeholders in the knowledge and innovative chain.

It would be appropriate if the 12th five year plan takes innovations and entrepreneurship as the national planning focus. Our science education must aim for exploiting natural resources, providing good living conditions to the masses, making us globally competitive and raising the quality of scientific manpower.

No doubt India is doing well in some diverse fields of science namely biotechnology, agriculture, pharmaceuticals and health care, IT, Space, etc. Lots of our young scientist from India are playing key role and are part of this boom; there is a distinct "Innovative India" buzz and many of those involved in science also believe that it is true.

More and more cities and towns of our country are attracting investment from knowledge companies to tap into our skilled manpower base. They span a wide spectrum of activities from research and development.

Consequently, India has become a popular destination for companies in the knowledge sector particularly software development. Dell computers, Wipro, HCL, Satyam, Quark, Infosys, DLF, etc. have ushered in a new era of prosperity and technological innovation in the country.

The difficulty with science is often not with new ideas, but in escaping old ones. Imagination plays a vital role in science and arts, but in science it has certain constraints. So a degree of irreverence is essential for creative pursuits in science. To promote irreverence in Indian science we need to change personal attitudes, funding pattern, creating new

organizational values and rewarding the risk-taker.

Now problem before us is how to sustain the present boom. It is a fact that all engineering sciences and technologies require a workable knowledge of basic sciences and that has also been realized by our present government. Consequently, knowledge commission was constituted and on recommendation of this commission basic science institutes are being opened at national level.

Essential ingredients of technological development are science and mathematics. Previously, good students prefer to join IT and Engineering Courses than science and mathematics courses, but now the trend has changed and there is dearth of good students who want study science at college and university levels. Therefore, there is urgent need of reforms in science and mathematics education. We should overhaul school curricula to make science and mathematics more career oriented.

As the world has entered in the era of biotechnology and nano-technology, so we need to introduce courses like biotechnology, bioinformatics, nano-technology, etc. at 10+2 levels. There are various flaws in teaching methodology of mathematics and science subjects. The teachers lack of conceptual clarity, because they seldom make efforts to update their knowledge. So there is urgent need to take some concrete steps to improve the quality of education in these subjects.

The universities that have created the most impact in the world have excelled both in teaching and in research. To excel in higher education the institutions must focus not just on teaching, but on research as well. At present we are lagging behind China, USA and other developed in research out measured by publications in quality and quantity.

One of the best ways to improve our performance in research is to develop research oriented curricula in science. We are to focus to cultivate habit of independent and critical thinking among undergraduate and post graduate students. Such a focus on analytical thinking and problem solving is extremely important in a country like India which is riddled with socio-economic and development challenges.

As industrial mathematics is the key of all technologies and an important tool for industries linkages, so the students should be encouraged to study some courses in industrial and computational mathematics. There is a need to improve undergraduate teaching in basic sciences across states, across universities, across institutions and colleges.

Although we have the best recommendations in terms of science policy and vision statements, yet there is an overall impression of static and inertia. The problem of mediocrity from school to the highest level in science education and research has been compounded by the archaic rules, regulations and bureaucracy².

TECHNICAL EDUCATION

Over the last six decades, the intake in undergraduate engineering programs has increased exponentially from 3700 in 1950 to over 65 million in 2012. Government of India has also formulated an ambitious expansion plan of higher and technical education that would provide vast access to many more aspirants.

Six more IIT's have been opened from academic year 2008-09 and Two more IIT's had also been started from 2009-10 academic sessions. In addition to these IIT's it has been planned to open the following institutions during next 12th five years plan:

- | Indian Institutes of Management (7)
- | Indian Institute of Science Education and Research (5)
- | Central Universities (20)
- | Indian Institutes of Information Technology (10)
- | National Institutes of Technology (20).

There are some other important issues which invite immediate attention from the government. The technical education system is facing a threat from aggressive marketing of the degrees of foreign institutions in India.

Globalization and industrialization are welcome, but these should not result in our young students aspiring for technical education being lured by

universities/institutes abroad and many of these are not recognized even in their own countries.

The Mushrooming of several universities under aegis of the states without even a threshold level of infrastructure and faculty is also a glaring problem.

It is disheartening to find that many new institutions set up under the self financing mode have not created adequate infrastructure or made available to the students even the minimum basic teaching and learning facilities.

The unprecedented expansion of technical education has created a large number of vacancies of teachers. But experience and qualified teachers are not available. Consequently, the untrained teachers who do not possess the requisite qualifications are employed.

These teachers are unable to impart technical education properly and effectively and that has detrimental effect on the standard of technical education. Our technical universities and institutes should not become slums where teachers lack of enthusiasm and motivation. In fact, teaching should be interactive, innovative and research based.

There is also scarcity of teachers in centrally funded universities and institutes, which are facing a shortfall of about 2000 teachers and IIT'S alone have 900 vacant posts. As per survey made by AICTE almost a third of faculty positions in technical institutes are unfilled. Main reason of this is that nowadays teaching is no longer a lucrative and glamorous profession. Industrial and corporate jobs carry salaries three or four times than teaching jobs even at the entry level.

No doubt we need to establish centers of excellence, but it is more important to nourish and strengthen of technical education and research in the present public and private universities. So there is no point in establishing new IIT's and deemed universities unless the quality of education and infrastructure is improved in the existing universities.

Government of India in the last few years has taken some initiatives to improve upon the teaching

process at various levels in engineering, science and management, but no success. Rural and semi urban colleges always face the problem in recruitment of good and capable faculty. The situation has further aggravated due to availability of good jobs in the industry, resulting in widening of gap between classroom learning and industry expectations.

The IIT'S produce 37% B.Tech., 53% postgraduate and 10% Ph.D. out of its total strength of students pass in respective programs in the country every year. Majority of postgraduates and PhD"s who pass from these premier institutions find jobs in international companies, industries and marketing as managers, engineers and researchers. The remaining lot gets jobs in R & D departments of big industries. So it is intriguing from where the qualified faculty would come to teach in these new institutions proposed to be set up in coming years.

The opportunities in the information technology sector have made postgraduate education in engineering less attractive and consequently, there is poor enrolment in postgraduate and research programs in science and technology not only in numbers, but also in the quality all of those who seek higher studies in these are not meritorious.

This has resulted scarcity of quality manpower for R & D in industries and technical institutes. This problem has further aggravated due to the fact that many multinational companies have set up R & D centers in India and have recruited many bright Indian professionals from industries and educational institutions on paying hefty salaries.

Another question regarding science and technical education in India is the role of private sector. There has been a mushrooming growth of self financing science and engineering institutions in the last ten years. Most of these private institutions are being opened and run by priority in profit making. However, there are a few institutions like BITS, JUET, BAMS, JSS, Amity, ITM, VIT, etc., which are doing equally good as IIT'S and NIT'S in imparting quality of education.

CONCLUSIONS AND SUGGESTIONS

In the view of the above mentioned facts the following suggestions are made for action plan urgently needed for implementation:

- | Teaching to create thinking with emphasis on active learning rather than passive or learning by rote.
- | Implementing students centric teaching methods, i.e., where every student participates in discussions (rather than simply listening to the instructor).
- | Emphasis on creative and critical thinking including inculcating the habit to question , develop opinions and the ability to think in a constructive way to improve upon the existing methods and designs.
- | Encouragements at the school level to try out new things , doing things in an unorthodox manner and whenever feasible the conventional methods should be replaced by computation methods
- | Introduction of an appropriate system of teaching and learning and evaluation.
- | Periodic "health check-up" of institutions by surveys on the opinion of the students, research scholars and faculty on the issues which affect their career and growth and all issues related to the cultivation of science.

Teaching science needs motivation, innovation and commitment rather than doing a routine job. The most crucial point which invites immediate attention is hiring or appointing faculty in schools, colleges and the institutions of higher learning. Raghavendra Sadagkar, a sociologist at IISc (refer to science reprint⁵) says:

"Scores of universities are deteriorating or riddled with corruption. They nurture few stars and are overburdened with dead wood. On a day-to-day basis, people are discouraged from doing breakthrough research. Our system creates followers, not leaders".

The merit alone should be criteria of selection of faculty and there be annually appraisal of performance. One of the ways to achieve the objective of hiring and nurturing quality faculty is American system of tenure track. Zare⁹ said. "In this Americans university system we engage faculty and then must decide within seven years whether Tenure is to be further extended or not".

Although it is a difficult decision as those faculty members who are given tenure determines the quality, characteristic of over department', yet this could be one of the most important steps toward achieving global competitiveness.

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INFANTS: FEEDING PROBLEMS

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Feeding is an important part of the everyday life of infants. Much parent-child interaction occurs at feeding times. Feeding problem is a situation, wherein young children are unable or unwilling to eat enough to maintain their nutritional needs. There is increased incidence of feeding difficulties in the infants. It is more prominent in the neonatal intensive care units due to survival of greater numbers of preterm and chronically ill infants. These problems are classified under structural abnormalities, neurodevelopmental disabilities, and behavioral disorders. The feeding difficulties can result in a wide array of persisting and devastating consequences to the infants.

INTRODUCTION

Feeding is an important part of the everyday life of infants and young children as much parent-child interaction occurs at feeding times. It is a process by which growing children accept and digest food in amounts required to fulfill their nutritional needs. It plays a central role in the parent-infant relationship. The developmental progression of food selectivity is primarily determined by a child's ability to manipulate, chew, and swallow food. Though it seems to be a simple intuitive act but actually it is a complex process requiring successful caregiver interaction, adequate oral motor skills, and intact gastrointestinal (GIT) motility and absorption. Functional, safe feeding requires coordination of sensory motor function, swallowing, and breathing. Children self-regulate and may vary their daily oral intake up to 30% with no ill effect on growth. Caregivers are responsible for what, when, and where their children eat. The child is responsible for how much and whether they eat. Normal feeding depends on the successful interaction of a child's health, development, temperament, experience, and environment. Altering any of these factors can result in a FP⁶.

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The term 'feeding problem(FP)' is applied to situations in which young children are unable or unwilling to eat enough to maintain their nutritional needs. More specifically pediatric FP are defined as "persistent failure to eat adequately as reflected in significant failure to gain weight or significant weight loss over at least one month". These problems are surprisingly common in children, and it has been reported that 25–35% of normal children exhibit mild FP and up to 70% of premature infants experience more severe ones. It is now well established that the FP are more severe in the children with neurodevelopmental disabilities as compared to normally developing children. About 25% to 40% of infants and toddlers are reported to have FP, mainly vomiting, selectivity, gagging, colic, slow feeding, swallowing difficulties and refusal to eat. Although some of these difficulties are transient, some problems, such as refusal to eat, are found in 3% to 10% of children and tend to persist.

The children with food allergy may have accompanying gastro esophageal reflux and motility disorders, which leads to food refusal. The medical conditions like metabolic disorders, cardiopulmonary and genetic reasons can lead to poor appetite and slow weight gain. Oral motor and/or swallowing problems are commonly seen in children with congenital and acquired neurologic conditions such as cerebral palsy, structural

abnormalities, or traumatic brain injury. Premature and medically fragile infants may miss sensitive periods of oral motor development resulting in delayed acquisition of feeding skills. This early interruption of feeding skills can lead to serious FP and food refusal due to lack of experience and impaired oral sensitivity¹.

Behavioral FP like food refusal are not always isolated disorders. They are witnessed when medical illness affects feeding patterns. If a child is failing to thrive it is necessary to immediately start nasogastric tube feeding. This results in a decrease in oral intake causing its impacts on hunger, experience, and endurance. The issues like reflux, cleft palate, etc. that occur very early in infancy can be the initial cause for food refusal. An early avoidance pattern is established for majority of infants with a FP. The parent-child interaction usually aggravates this pattern, when the parent tries to feed the child, it will often encounter severe refusal behavior, which leads most parents to terminate the meal prematurely. The child not only has associated food with pain but also has learned that by having severe food refusal the meal will be terminated. Even the reflux is medically managed, the child will have the learned history of pain associated with eating and also refusal behaviors help to escape the meal⁷.

NORMAL DEVELOPMENT OF FEEDING AND SWALLOWING

In order to understand FP and swallowing problems, it should be recognized that there are vigorously changing developmental skills and social abilities in the growing child. Progression through the normal stages of feeding requires the attainment of postural stability, oral motor coordination, and sensory awareness. Factors such as emerging cognitive skills and socialization play an important role in an effective caregiver-child feeding interaction. The relationship between diet, brain growth and behavior is complex. The diet alone may not be adequate in improving behavior and that attention must be paid to social and environmental factors that deprive infants of normal parental and emotional care. It is established beyond doubt that

even short periods of dietary manipulation affect infant behavior. Non-nutritional factors also affect behavior, and it is not easy to disentangle the effects of one from the other. The development is considered by some to be an important end point when long term outcome is assessed in infants².

MECHANISM OF SWALLOWING IN INFANTS

To understand why an infant is refusing to eat, it is imperative to know the mechanism underlying eating. The swallowing process involves three phases: oral, pharyngeal, and esophageal. In infants, all phases are driven reflexively by typical rooting and sucking behavior. As it grows, the oral phase of chewing and managing food comes under voluntary control, requiring cortical integration of sensory/motor input to coordinate the complex patterns of jaw, tongue, and oral movements. The sensory organs detecting smell, taste, and emotion happen to more important. After the chewing is completed, the tongue and soft palate propel the bolus toward the pharynx, initiating the pharyngeal phase of swallowing⁹.

As food passes the pharynx complex movements allows the safe passage of food around the airway into the esophagus. Closure of the mouth and laryngeal/nasal passages prevents aspiration while elevation and anterior displacement of the larynx opens the upper sphincter of the esophagus automatically generating a pressure gradient propelling the bolus toward the esophageal opening. The subsequent movements are almost entirely automatic and no longer subject to cortical control. After passing the sphincter, food enters stomach, beginning the gastrointestinal and absorptive phase of feeding. Food is emptied from the stomach based on the volume, nutrient composition, and caloric density of the meal².

CLASSIFICATION OF FEEDING PROBLEMS IN INFANTS

A single fundamental cause for refuse to eat enough to sustain normal growth is rarely evident, and therefore this problem presents a significant diagnostic and therapeutic challenge to clinicians

and parents. In view of the intricacy of the challenge, several attempts to classify FP have been attempted based on the apparent etiology, physical condition, or associated behaviors. These FP results from multiple factors viz. physical, motivational, skill, and parent/child relationships. A more practical classification is developed which differentiates patient types by symptoms rather than an arbitrary disease-based diagnostic approach⁴.

The FP are classified under three categories, as depicted in Table 1, although there is often overlap among these categories. The structural abnormalities affect 3 areas: the naso-oropharynx, the larynx and trachea, and the esophagus. Neuro-developmental disabilities disrupt the process of "learning to eat" and can result in oral hypersensitivity and oral-motor dysfunction. The third category is behavioral FP.

Table 1. Classification of infant feeding disorders⁴.

Structural abnormalities
Abnormalities of the naso-oropharynx: choanal atresia, cleft lip or palate, Pierre Robin sequence, macroglossia, ankyloglossia.
Abnormalities of the larynx and trachea: laryngeal cleft, laryngeal cyst, subglottic stenosis, laryngo-tracheomalacia
Abnormalities of the esophagus: tracheoesophageal fistula, congenital esophageal atresia or stenosis, esophageal stricture, vascular ring
Neurodevelopmental disabilities
Cerebral palsy
Arnold-Chiari malformation
Myelomeningocele
Familial dysautonomia
Muscular dystrophies and myopathies
Möbius syndrome
Congenital myotonic dystrophy
Myasthenia gravis
Oculopharyngeal dystrophy
Behavioural feeding disorders
Feeding disorder of state regulation (0-2 months)
Feeding disorder of reciprocity (2 -6 months)
Infantile anorexia (6 months -3 years)
Sensory food aversions
Feeding disorder associated with concurrent medical condition
Posttraumatic feeding disorder

APPRAISAL OF FEEDING, HEALTH AND GROWTH HISTORY OF INFANTS

The FP may be associated with any combination of the neurological deficits; anatomical/mechanical problems of the upper airway; congenital defects of the buccal cavity, larynx, trachea and esophagus; chronic illness; multiple food allergies; side effects of drugs and genetic or metabolic disorders. In addition, traumatically acquired conditioned dysphagia and post-traumatic FP have been described as possible causes of persistent FP. The prevalence of these types of FP may be on the rise because advances in medical technology enable more children with severe illnesses to survive. It is important to identify infants with swallowing dysfunction as they may have an inability to protect their airway during feeding, thus rendering oral feeding unsafe^{3,8}.

Symptoms of swallowing problems include slow feeding, oral or nasal regurgitation, recurrent pneumonia, respiratory illnesses, gagging, choking, or coughing before and/or during the swallow. The FP are not encountered exclusively in children with health problems. Improper quality of care giving, regulation of internal states, sensory integration and behavioral mismanagement play important role in development of FP in early childhood. Quality of care giving should be suspected as a possible contributing factor to the FP e.g., when the parent is angry with the infant, it is overwhelmed by the FP, has become indifferent towards the infant or complains that the FP are affecting other family members. An in-depth feeding history not only provides information about present feeding habits but also investigates feeding patterns from birth⁴.

ASSESSMENT OF THE FEEDING PROBLEMS IN INFANTS

It requires a multidisciplinary team whose members can bring their expertise to bear on the specific function that has gone awry. An accurate assessment of FP is a critical step in initiating treatment. The management of complicated FP requires a multidisciplinary team devoted to establish diagnosis, assessment of need, and

developing a thorough treatment plan. The activities supposed to be undertaken by the team members are narrated as hereunder⁵:

- | A psychodynamically informed psychiatrist or clinical psychologist to assess parental characteristics (*Viz.* mental status, attachment system, and temperamental characteristics in the context of relationship to partner and society) and to observe the parent-infant interactions to assess temperament and communication.
- | A pediatrician to assess the infant's physical health in terms of height, weight, head circumference.
- | A physician to record history and to assess for any conditions that would require treatment prior to the implementation of a therapeutic treatment program for the food refusal (Table 2). An observation of a feeding session between the child and primary caregiver will provide insight into the FP, especially from an oral motor and behavioral perspective. Physical examination of the child including a general survey to determine underlined medical disorders that may preclude safe feeding. This includes examining of tongue and jaw movement, dentition, airway sounds, speech, and oral cavity assessment. A complete physical examination including cardiac, pulmonary, and abdominal exams is mandatory.
- | An allergist will assess specific allergies to the mother and the infant. Allergy evaluation, including consultation for an appropriate skin testing may be necessary as well as appropriate RAST testing to search for response to food allergy.
- | A dietician/nutritionist dedicated to pediatric care is also essential in the diagnostic team functioning. It will assess the current nutritional status, anticipated growth, and recommended caloric intake as per the age and diagnosis.
- | A clinical psychologist to assess the developmental issues. It will provide detailed observation and analyse variables that may be contributing to food refusal behaviors,

performing an in-depth assessment of patterns with regard to eating. It will design a treatment plan oriented toward shaping new infant behaviors. It will teach the parents how to implement the strategies in the home environment.

- | A speech-language pathologist can evaluate and make recommendations for communication skills, if necessary.
- | An occupational therapist will evaluate fine motor, sensory motor, and visual motor function as well as positioning and the need for adaptive equipment.
- | A clinical social worker is essential for assessment and treatment of underlying familial interactions and support systems, which ensure continued success once the child has returned to the home environment.

DIAGNOSTIC TESTING

Diagnostic evaluations are warranted to better assess swallowing and anatomy (Table 3). The modified barium swallow study (MBS) is the procedure of choice to assess oral, pharyngeal, and upper esophageal phases of swallowing. Seat positioning, food texture, and rate and amount of food presented can be manipulated during the performance of the MBS to determine the safest method of feeding. Children with repetitive vomiting require endoscopic evaluation, and many will also need colonoscopy to rule out the possibility of IBD. Some children need cranial imaging or magnetic resonance imaging to search for evidence of intracranial mass lesions⁵.

MANAGEMENT AND TREATMENT OF FEEDING PROBLEMS

The goal of all therapy is directed toward allowing parents to safely feed their children in an appropriate manner. When infants are growing and developing normally, physicians should reassure parents and explain that no investigations are indicated at this point. In cases of colic and occasional vomiting, dietary intervention is worth a trial. It should be advised to avoid allergenic foods

Table 2. Medical conditions associated with pediatric feeding disorders⁶.

Disorders of the oral and pharyngeal phases of swallowing	Disorders of the esophageal phase of swallowing
Anatomic lesions <ul style="list-style-type: none"> Cleft lip and/or palate Pierre–Robin sequence Choanal atresia Laryngeal clefts Macroglossia CHARGE association 	Anatomic lesions <ul style="list-style-type: none"> Esophageal atresia Cricopharyngeal achalasia Tracheoesophageal fistula Esophageal mass Esophageal stricture Esophageal web Esophageal rings Vascular rings/aberrant vessels Foreign bodies
Acquired structural abnormalities <ul style="list-style-type: none"> Dental caries Tonsillar hypertrophy Viral/inflammatory stomatitis Retropharyngeal mass Candida stomatitis 	Disorders of the lumen <ul style="list-style-type: none"> Peptic esophagitis Candida esophagitis Viral esophagitis “Pill” esophagitis Inflammatory bowel disease Behcet syndrome
Cardiopulmonary effects <ul style="list-style-type: none"> Chronic lung disease Complex congenital heart disease Reactive airway disease Tachypnea 	Motility disorders <ul style="list-style-type: none"> Achalasia Diffuse esophageal spasm Chronic pseudobstruction Systemic lupus erythematosus Polymyositis
Neuromuscular disorders <ul style="list-style-type: none"> Familial dysautonomia Cerebral palsy Pseudo-bulbar palsy Bulbar atresia or palsy Cranial nerve anomalies Muscular dystrophic disorders Arnold – Chiari malformation Myelomeningocele Intracranial mass lesions 	Metabolic disorders <ul style="list-style-type: none"> Urea cycle abnormalities Hereditary fructose intolerance Hypothyroidism
Genetic disorders <ul style="list-style-type: none"> Prader–Willi syndrome Trisomy 21 Cornelia de Lange syndrome Velocardiofacial syndrome Rett syndrome 	Miscellaneous <ul style="list-style-type: none"> Gastroesophageal reflux Constipation Gas- bloat syndrome Dumping syndrome Food allergies Sensory loss (visual/auditory impairment)

from the breastfeeding mother's diet or giving bottle-fed infants hypoallergenic formulas might reduce symptoms of colic. The physician must coordinate all the resources and direct care so that feeding therapy may proceed with minimal risk to the patient—keeping the infant safe from aspiration and other complications. The initial part of any therapeutic approach to introduce or increase oral food intake is to establish the safety of eating as well as the types and textures of food the child can consume most efficiently^{5,6,7}.

Table 3. Diagnostic evaluation for patients with feeding disorders.

Detailed history and physical examination
Upper gastrointestinal contrast radiography
Esophogram
Small bowel follow-through
Videofluoroscopic swallow study
Gastric emptying study
pH monitoring
Esophagogastroduodenoscopy with biopsies
Antroduodenal manometry
Fiberoptic endoscopic evaluation of swallowing
CBC
Comprehensive metabolic panel
Thyroid function
RAST analysis for food allergies
Skin test for food allergies
Plasma amino acids
Urine organic acids
Karyotype

Training the parents: In the FP termed “reciprocity,” the focus should be on training parents in sensitivity and responsiveness to infants' feeding cues. Complicated cases need a multidisciplinary approach where family physicians can play a key role in coordinating services. It is necessary to train the parents in use of various feeding techniques. It is critical in maintaining long-term treatment gains. Skill-based parent training involving step-by-step criteria-based training has been shown to be superior to didactic methodology. Parent training, including instruction, discussion, handouts, role-playing,

feedback, and the practice of techniques with a trained clinician, can result in increased parent treatment integrity.

Approaches to therapy are often described as nutritive or nonnutritive.

Nonnutritive approaches of therapy: It includes nonnutritive oral stimulation to decrease hypersensitivity, facilitate management of secretions, establish or retrain the swallowing mechanism, maintain coordination of breathing and swallowing, and develop oral movement for sound production and communication⁸.

Nutritive approach: It includes increasing oral intake, advancing food texture, transitioning to utensil use, and improvement of self feeding. Oral motor techniques to improve muscle tone and postural control as a foundation for feeding and swallowing are largely based on a neurodevelopmental framework.

Neurologically challenged infants: Children with normal neurologic function generally do well after surgical correction of anatomic abnormalities. Neurologically disabled children, however, need nasogastric feedings when they are unable to ingest adequate calories safely and when the time required to provide adequate nutrition by mouth consumes parents' and children's lives, leaving little time for nurturing activities. Coexisting medical problems should be addressed.

Infants with cystic fibrosis: Good medical management does not always alleviate FP adequately. For instance, young children with cystic fibrosis often have a pattern of eating slowly, having difficulty chewing, preferring liquids, refusing to eat solids, and having an aversion to new food. Retrospective and case-control studies have shown that, despite medical and surgical therapy, infants with GER have lower intake of energy-generating food, have fewer adaptive skills and less readiness for solids, are more likely to refuse food, and are more demanding and difficult at feeding time. Under these conditions, behavioral interventions should be considered.

Infantile anorexia: The mother-child dyad becomes involved in conflicting interactions. Therapy consists of helping parents understand their children's special temperaments, set limits, and structure mealtimes to facilitate the internal regulation of eating. Food rules are strongly encouraged. New foods should be introduced singly and not during illnesses, such as colds and diarrhea, and parents should persevere and present the new food day after day until children get used to it. Toddlers more easily accept a new food if they see their parents eating it.

Concurrent medical conditions: These may result from an interaction between intrinsic oral motor dysfunction, oral hypersensitivity, odynophagia, and learned aversive behavior. Parents should be taught management skills like setting clear time limits for meals, ignoring non-eating behavior, and using contingencies to motivate children to meet the food intake goals that have been set.

Infants with post-traumatic feeding disorder: They are generally receiving enteral tube feeding that interferes with their experience of hunger and development of oropharyngeal coordination. Treatment is aimed at eliminating tube feeding and overcoming the resistance to oral feeding, either through the behavioural technique of extinction, which was shown to be successful in a controlled study, or by gradual desensitization⁹.

Adaptive seating system: It is a key component to feeding a child with physical disabilities. It requires external devices to provide head, neck, and trunk support. Attention must be paid to how positioning affects the feeding process because a change in head and neck posture and oral motor structures may affect oral motor control. Once airway safety, positioning, and sensitivity have been controlled, a variety of treatment approaches have been suggested for children with pediatric FP. It ranges from individual child psychotherapy to interactional therapy between child and caregiver.

Behavioral interventions: Parents should first know the basic food rules that apply to all infants. They should control what, when, and where children

are being fed. Children should control how much they eat in order to learn internal regulation of eating in accordance with physiologic signals of hunger and fullness. The most widely employed treatments for FP are behavioral interventions i.e. interdisciplinary team approach addressing physiology, oral motor functioning, parent-child interactions, and community or social support. These interventions are the most common modality of therapy and are often a mixture of antecedent and consequence-based treatment packages.

Consequence-based treatments: It includes rewarding appropriate eating behavior and/or ignoring (i.e., escape extinction) or punishing food refusal behavior. Thus, if a child accepts a bite, he or she is rewarded with attention or an arbitrary reinforcer, such as a toy or music. If the child engages in food refusal behavior, such as batting at the spoon or turning its head away from the food, the consequence is to ignore or extinguish the food refusal behavior and continue to present the bite to the child until it is accepted. Sometimes it refuses food by holding the bite in its mouth, which can also be ignored or extinguished by moving or redistributing the food from between the child's cheek and teeth onto the tongue, where it is more likely to be swallowed¹⁰.

CONCLUSION

The FP affect one in three to four infants and young children but there is no universally accepted methods of its management. There is increased awareness of FP but simultaneously many challenges exist in implementing the specialized treatment protocols. The financial burden associated with diagnosis and therapy is most important challenge followed by early recognition of FP. The goal of safe oral feeding is attainable provided that the personnel involved in care understand the complexity of the problem. Helping these infants to eat will not only allow independence from artificial sources of nutrition but also reduce the total cost of health care. The interventions like behavior therapy, multidisciplinary approach nutrition counseling and occupational therapy should be used to treat FP needs

to be examined formally. More research is needed to understand appropriate treatment methods used to overcome FP.

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STEM CELL RESEARCH: MEDICAL APPLICATIONS, ETHICAL & LEGAL CONTROVERSIES

P. V. S. Kishore

Stem cells are special cells that have the ability to divide for an indefinite period and can give rise to a wide variety of specialized cell types. They may be isolated from embryos, umbilical cords and adult tissues. Stem cells from embryos can treat many diseases but they are extremely dangerous and unpredictable. However, this power and versatility of these cells to produce different cell types has medical applications in cell therapies. Embryonic stem cells are harvested but this requires the destruction of human embryos, which is considered immoral and unethical, thus becoming contentious and giving rise to ethical controversies. However, stem cells isolated from adult tissues and created from skin cells addresses these issues. Most recently, they have been produced by reprogramming skin cells, an advance revolutionizing this field. Stem cell therapies have great potential.

INTRODUCTION

Stem cells are special cells that have the ability to divide for an indefinite period and can give rise to a wide variety of specialized cell types. This ability, known as developmental plasticity, is a common feature of fertilized eggs and early embryonic cells (blastomeres). A fertilized egg is totipotent, has the highest degree of developmental plasticity and can give rise to all of the body cells. Blastomeres have decreased level of plasticity and can only give rise to a limited range of cell types and are therefore called pluripotent. As development progresses, individual cells can give rise to only a few cell types before assuming the final form of a specialized cell that can only give rise to other cells of its kind, hence are called multipotent.

Stem cells may be isolated from embryos, umbilical cords (pluripotent) and adult tissues (multipotent). Stem cells grow and divide indefinitely when placed in culture. This power and versatility of these cells to produce different cell types has applications in cell therapies viz. Parkinson's disease, Alzheimer's disease, cardiovascular disease, spinal cord disorders and some cancers. Leukemia, a cancer affecting white
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blood cells (WBCs), can be treated by replacing the cancerous cells with stem cells programmed to differentiate into healthy WBCs.

All cells in the animal body possess the powers of reproduction and differentiation but some lose the ability to divide soon after birth. The brain, spinal cord, muscles, heart and kidney possess this developmental pattern of active cell division during embryogenesis with loss of this ability in the adult to ensure a particular size and shape. Damage, if caused, may lead to loss of life or else a transplant has to be done to save life. However, skin, liver and bone marrow retain the power of division throughout the life span of the individual. Red blood cells (RBCs) with a life span of about 120 days are worn out regularly but the stem cells in the bone marrow divide and differentiate both into RBCs & WBCs to replace them.

This concept that the stem cells in the bone marrow replace the worn out RBCs is being applied to repair other organs such as brain and heart which are incapable of repairing themselves. Stem cells from embryos can treat many diseases but they are extremely dangerous and unpredictable. This is possible only when embryonic stem cells are harvested but this requires the destruction of human

embryos, which is considered immoral and unethical, thus becoming contentious and giving rise to ethical controversies. However, stem cells isolated from adult tissues and created from skin cells addresses these issues. Most recently, they have been produced by reprogramming skin cells, an advance revolutionizing this field. Stem cell therapies have great potential¹.

STEM CELL RESEARCH

Stem cell research is focused on embryonic stem (ES) cells, adult stem (AS) cells, therapeutic cloning and induced pluripotent stem (iPS) cells. The ultimate stem cell is the fertilized egg which can give rise to an entire organism consisting of hundreds of different kinds of cells. Human, mouse and amphibian blastomeres from two or four cell embryos also retain their totipotency and are good ES cells. Mammalian ES cells are obtained exclusively from the inner cell mass (ICM) of a blastocyst (with or without killing the embryo), and when placed in cell culture they can differentiate into many kinds of cells representing all three embryonic germ layers. However, once the association between the ICM and the trophoblast is disrupted, the ES cells cannot develop into an embryo¹.

Embryonic germ (EG) cells can also be collected from the gonadal ridge (located in the fetuses' lower mid-back) of 8-12 week old fetuses (killed during abortions). Cells in this area form the gonads of the adult, which produce the germ cells (eggs or sperms). However, these cells do not have the developmental plasticity of ES cells and hence are less desirable in stem cell therapies.

Adult stem (AS) cells are collected from adult tissues or organs. The first AS cell was found in the bone marrow. These are the hematopoietic stem cells which replenish blood cells. AS cells when cultured differentiate into a small range of cells representing one or two germ layers, in contrast to the ES cells which can differentiate into a wide variety of cell types, representing all germ layers. However, they can be stimulated *in vitro* into a wide variety of cell types representing mesoderm, neuroectoderm and endoderm, the three fundamental germ layers. The

AS cells, hence, can also be called multipotent adult progenitor cells.

Blood isolated from human umbilical cords is an excellent source of AS cells. Moreover, these umbilical cord stem cells have a developmental plasticity equal to that of ES cells. Umbilical cord blood banks are established by collecting blood from newborn infants in case the child should ever need stem cell therapy. The existence of AS cells is extremely important since they resolve the ethical problems that are associated with the harvesting of ES cells and it solves the problem of tissue rejection. AS cells can be obtained from other organs, such as the pancreas, liver, which allow the production of a wider variety of cell types.

Therapeutic cloning involves cloning the patient, isolating stem cells from the resulting embryos and using those cells to treat the same patient. The nucleus from a skin cell is introduced into an enucleated egg cell (oocyte). This procedure known as somatic cell nuclear transfer depends on the ability of the skin cell nucleus to sustain normal development and the production of a healthy embryo. Ian Wilmut cloned a sheep named Dolly in 1996 by transferring a nucleus from an ovine mammary gland epithelial cell to an enucleated egg. The cloned stem cells and any cells they give rise to, would carry the patient's unique cell-surface glycolyx and consequently would not be attacked by the immune system. It, however, involved killing of embryos, does not produce patient-specific ES cells, is controversial, and hence has bleak future.

Induced pluripotent stem (iPS) cells are easy to produce patient-specific cells which do not require human eggs or the killing of human embryos. A skin cell was converted by Shinya Yamanaka into an iPS cell equivalent to an ES cell. He reprogrammed skin cells by infecting them with viruses carrying four gene specific transcription factors and these cells responded to directed differentiation, indicating the embryo-like character. iPS cells with their infinite potential have the capacity to completely replace therapeutic cloning and human ES cell research².

MEDICAL APPLICATIONS

Stem cells can be used to treat and possibly cure a wide variety of diseases. Diseases are treated by introducing whole human cells into the body in order to restore the patient's health. The exception is iPS cells; stem cells produced using gene therapy.

CARDIO VASCULAR DISEASE (CVD)

CVD is caused by a chronic reduction in the blood supply to the heart leading to a cardiac infarction (heart attack)³. If the extent of damage is less, the heart could be weakened but still functional. Conditions like dilated cardiomyopathy, coronary syndromes, arrhythmias, hypertensive heart failure etc are reversible⁴. However, serious obstruction of the coronary arteries leads to the death of the cardiac muscle. At present, the only treatment for massive and normally irreversible cardiac failure, not leading to death, is an organ transplant. Scientists are trying to develop an alternative cell-based therapy using embryonic stem (ES) cells; adult stem (AS) cells and induced pluripotent stem (iPS) cells.

Autogenic (from the patient) AS cells isolated from their own bone marrow when injected into the heart of patients, develop a tissue consisting of some cardiomyocytes and vascular structures. However, most of the injected AS cells fail to differentiate into functional cardio myocytes but a very modest improvement of cardiac function is observed due to the secretion of growth factors and other substances from the AS cells. Moreover, the macrophages eat up the transplanted cells also as they try to clean up the damaged cardiomyocytes in the scar tissue after a heart attack⁵. Use of ES cells has ethical problems in addition to the problems of production of teratomas and the induction of graft-versus-host-disease (GVHD), since the ES cells would be allogenic (not from the patient). iPS cells usage also has problems as they must be induced to a partially differentiated state before being injected into the patient. More precise methods are needed for directed differentiation in order to produce very homogenous cell populations and also to screen and remove undifferentiated cells.

DIABETES

Diabetes is a chronic metabolic disorder that destroys the body's ability to utilize glucose, the uptake of which is regulated by a hormone called insulin that is produced by the β cells of pancreas. Patients with Type 1 diabetes (insulin-dependent diabetes) have complete lack of insulin, while patients with Type 2 diabetes (insulin-resistant diabetes) have too little insulin or their bodies do not use insulin effectively which may result in too high levels of insulin in blood⁶. In Type 1 diabetes, β cells lose the ability to manufacture and release insulin, leading to a buildup of glucose in the blood. A chronic elevation of blood glucose levels results in inappropriate glycosylation (addition of sugar to proteins) of many proteins in the blood, including haemoglobin. Diabetes is currently treated with daily injections of purified insulin but it does not cure the disease or remove the long term threat of kidney failure or the other associated complications. Stem cells are being used to cure the disease by directing the differentiation of cultured ES cells into β cells that secrete insulin. But unfortunately, teratomas develop and risk giving the patient cancer, which may not be treatable. AS cells and iPS cells are also being tried in this regard with the aim to return them to the patient in the hope that they will colonize the pancreas, thus curing the disease⁷.

IMMUNE DEFICIENCIES

The immune system combats invading microbes with its enormous population of white blood cells mostly in the form of B cells, T cells and macrophages. B and T cells are lymphocytes that develop in the bone marrow and thymus respectively. B cells attack microbes indirectly by producing antibodies. T cells control and coordinate the immune response by releasing cytokines that recruit macrophages and B cells. Macrophages are phagocytic blood cells that eat the invading microbes. A combination of stem cells and gene therapy is being used to cure immune deficiencies. The bone marrow from affected patients is extracted and transfected with hematopoietic stem cells and

then reimplanted into the patient with the aim of developing a functional immune system.

LEUKEMIA

Leukemia is a cancer of the blood cells. It affects white blood cells only and can arise in either lymphoid cells (lymphocytic leukemia) or myeloid cells (myelogenous leukemia). The disease has two forms: acute and chronic. Acute leukemia progresses very quickly and usually destroys the patient's immune system. Chronic leukemia progresses much more slowly and even though the leukocytes are transforming, they retain some of their normal functions, so the immune system is not destroyed so quickly or so completely. The standard treatment involves radiation and chemotherapy which kill the cancerous cells. Extreme forms of this therapy involve the complete destruction of bone marrow with radiation therapy, after which the patient receives new bone marrow from a suitable donor, which is very difficult to get. Stem cell therapy is now used to treat all forms of leukemia with autologous transplants, thus removing the need to find bone marrow donors. Stem cells, isolated from bone marrow of the affected patient are induced to differentiate into white blood cell precursors and then grown in culture to increase their numbers. Once these cells are collected, the patient's cancerous bone marrow is destroyed and the stem cell-derived blood cells are returned to the patient in order to reconstitute a healthy, cancer-free bone marrow³.

LIVER DISEASE

Liver converts ammonia to urea which passes out of our bodies as urine. The production of urea depends on the liver enzyme ornithine trans carbamylase (OTC). If OTC is defective, blood levels of ammonia increase rapidly, resulting in coma, brain damage and death. Hematopoietic stem cells isolated from the patient and stimulated to differentiate into liver cells can be reintroduced into the patient. These partially differentiated stem cells will colonize the liver and produce enough OTC to cure the disease. These bone marrow derived stem cells can effectively rescue experimental liver failure and contribute to liver regeneration³.

NEUROLOGICAL DISORDERS

Alzheimer's Disease

Alzheimer's Disease (AD) is a neurological disorder/neurodegenerative disease affecting the central nervous system (CNS) which leads to a progressive loss of memory, language and the ability to recognize friends and family. It is often related to a biochemical or neurotransmitter defect believed to be caused by a combination of genetics, lifestyle and environment. With this disease the brain actually shrinks as more of the brain cells die off. The CNS is divided into the cerebrum, cerebellum and the brain stem. A special area of the cerebrum called the hippocampus is important for coordinating memory functions. AD mostly begins in the hippocampus/cerebral cortex and also in certain subcortical regions⁸. During the early stages some damage occurs to the brain but not enough to produce outward signs of the disease. Over a period it spreads to many areas of the cerebrum leading to the confusion and loss of memory that accompany the disease. Defects in the genes associated with the disease lead to the extensive death of neurons that is characteristic of AD. Stem cells stimulated to differentiate into neurons and glia cells, and injected directly into the brain are thought to repair the damage to the brain.

Parkinson's Disease

Parkinson's Disease (PD) is a neurodegenerative disease affecting neurons in the area of the brain called the substantia nigra that results in tremors, muscular stiffness, and difficulty with balance and walking. Dopaminergic neurons (neurons producing a neurotransmitter called dopamine) in the substantia nigra are damaged in PD. Since the neurological damage caused by the PD is restricted to one region of the brain, stem cell therapy may be successful in treating this disease. Preclinical research has shown that it is possible to isolate stem cells that can be stimulated to differentiate into dopaminergic neurons. Injection of these neuronal stem cells into affected mice relieved some of the disease symptoms, particularly the loss of motor control that is characteristic of this disease. However, nonmotor

symptoms viz. olfactory dysfunctions, cognitive impairments, sleep disorders and urinary disorders, independently or dependently along with motor symptoms have also been reported⁹.

Spinal Cord Injury

Damage to the spinal cord caused by automobile accidents or falls from high places can make it impossible for the brain to control the extremities and internal organs such as heart and lungs. The severity of the damage depends on how close to the brain the spinal cord injury is. If the individual's neck is broken, he or she may end up being a quadriplegic (a person unable to move the arms and legs) and may not be able to breathe properly. If the damage to the spinal cord is near the middle of the neck the patient will be paraplegic (unable to move the legs) but will retain control over the arms and lungs. Stem cell therapy aims to repair the damage by providing neurons to re-establish the circuit and oligodendrocytes for insulation. Adult stem cells usage would make it possible to treat patients without the fear of immune rejection^{1,10}.

Stroke

A stroke occurs when the blood supply to the brain is interrupted, leading to the death of brain cells. As a result the affected part of the brain is unable to function, leading to partial or complete paralysis of various parts of the body. A stroke can lead to permanent neurological damage and is often fatal. Research has shown that it is possible to activate the body's own stem cells by injecting transforming factor α (TF- α), to repair neural damage caused by stroke.

ETHICAL CONTROVERSIES

Stem cells offer the hope of curing disease and repairing a damaged nervous system. But the strategies require the destruction of human embryos and in its most controversial form (therapeutic cloning), the creation of human embryos for the sole purpose of providing stem cells. This gives rise to many ethical problems in biomedical research.

JUSTICE AND BENEFICENCE

Beneficence refers to acts of kindness or charity.

In biomedical research, this means never injuring one person to benefit another. Justice should ensure that researchers should never enlist subjects in an experiment if those subjects do not stand to reap any benefits. Researchers can enroll human subjects in a clinical research trial only if the procedure is carefully explained and the researchers receive written consent from the prospective subjects. A patient advocate also needs to be present in this process to ensure that the full disclosure of the background research is provided, results that may suggest the subjects will be harmed by the experiment informed and finally ensure that there is no attempt to coerce prospective subjects into joining the trial.

HIGH-TECH CANNIBALISM

Opponents of ES cell research, particularly in the form of therapeutic cloning, believe it is wrong to use human embryos for any kind of research or medical therapy and have called this as high-tech cannibalism. The issue of ES cell research is extremely complex and involves the very emotional and highly politicized issue of human abortion. Researchers want unlimited access to human embryos left over from in vitro fertilizations to use as a source of stem cells. Scientists want to use therapeutic cloning to create human embryos using nuclear transfer for the sole purpose of providing stem cells and ultimately culture grown kidneys and other organs. Embryos do not survive the harvesting of the stem cells; indeed, the stem cells are embryos.

Critics argue that since neither the embryo nor the foetus is recognized as a person, in the legal sense, there is no obligation for ES cell researchers to abide by any research policies. However, the absence of legal status does not preclude an ethical policy, as evidenced by the fact that abortion is only permissible up to the fifth month and not beyond (except in very rare cases where the mothers' life is at risk), even though the foetus does not attain the legal status of a person until after birth. With this in mind, opponents of therapeutic cloning and ES cell research maintain that at the very least, a human embryo or foetus, incapable of giving informed

consent, should be afforded the benefit of an advocate. Resistance to this notion centres on the question of when an embryo or a foetus becomes human¹.

ON BECOMING HUMAN

The question of when an embryo becomes human is still debated. Public perception and dialogues ever since believe that an embryo did not become human until after birth. Science ethicists state that cloned human embryos, destined for therapeutic research, are not really human. Some scientists, following the logic of genomes, state that an embryo is human from the day of conception. The *in vitro* fertilization embryos are produced for the purpose of creating life i.e. they are all intended for implantation and subsequent development and hence can be allowed with tight regulations. Therapeutic cloning creates embryos for the sole purpose of harvesting stem cells, thus killing the embryo in the process and hence it is inherently unethical and should be banned.

LEGAL CONTROVERSIES

ES cell research may provide powerful new methods for treating a variety of medical disorders. However, it also introduces many ethical problems that require legislation to control its use and spread. The legal issues deal with stem cells that are harvested from three-to-five day-old human embryos, donated by IVF clinics, or produced by therapeutic cloning. There are no legal issues associated with the use of AS cells, iPS cells, or stem cells isolated from umbilical cord blood (UCS). Therapeutic cloning represents a fusion of cloning technology and stem cell research, and its regulation is an extremely difficult problem.

The regulation of stem cell research in the United Kingdom is governed by the Human Fertilization and Embryology Act of 1990. Under this act, research on embryos older than 14 days is prohibited. This time period was set to coincide with the appearance of the primitive streak, an anatomical feature of an embryo that indicates the beginning of neurulation and the formation of the central nervous system. Research on nonhuman embryos or by other

means is preferred. Research is allowed only for promoting advances in the treatment of infertility, increasing knowledge about the causes of congenital diseases and miscarriages, creation and development of embryos, development of contraceptives, for developing methods for detecting the presence of gene or chromosome abnormalities in embryos before implantation and in developing medical therapies. However, reproductive cloning, whereby an embryo is produced by nuclear transfer and then carried to term by a surrogate mother is banned.

In the United States, human stem cells research is funded only for the ES cells isolated from embryos created at IVF clinics for reproductive purposes with the consent of the donor. Funding is not provided for ES cells isolated from other sources such as therapeutic cloning, IVF embryos created specifically for research purpose, development of an unfertilized egg, and human-animal hybrid embryos¹.

CONCLUSION

Studying stem cells has great social issues associated with it. Scientists are interested in using stem cells to grow whole organs in the laboratory that could be used to replace defective organs. It is feasible to do this and it will go a long way towards relieving the chronic shortage of organ supplies for transplant surgery. However, it is extremely difficult and would take more than 20 years to produce a functional organ. Stem cell therapy holds the potential for curing terrible diseases. It offers hope to those paralysed by a spinal cord injury and someday it may be used to reverse the ageing process.

ES cells are isolated from two-to-five day-old human embryos which do not survive the harvesting of the stem cells, and many people believe that it is highly immoral to kill a human embryo for its cells. Scientists prefer ES cells for medical therapies because they possess a high degree of developmental plasticity and when injected into experimental animals the damage is repaired best. However, it is difficult to control the growth of these cells and these may form cancerous tumors called teratomas. Immune rejection is a very serious problem with ES

cell therapy, since these cells are not related to the patient. AS cells are isolated from adult tissues such as bone marrow and from umbilical cord blood. iPS cells are produced in the laboratory by reprogramming skin cells taken from the patient needing treatment, and thus there is no threat of immune rejection with these cells or with AS cells. The use of ES cells is very controversial, whereas the use of AS or iPS cells is not.

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KNOW THY INSTITUTIONS**DESERT MEDICINE RESEARCH CENTRE (DMRC), JODHPUR**

Desert Medicine Research Centre (DMRC), is one of the permanent institutes of the Indian Council of Medical Research (ICMR), a Government of India's apex autonomous organization for bio-medical research in the country. Realizing the importance of research needs of existing and emerging health problems of desert, ICMR decided to establish a Centre in Rajasthan with a definite mandate to undertake and promote research on health problems specific to desert areas, study the changing patterns of health problems especially in view of various developmental activities taking place in the region and strengthen the scientific and technical expertise of state as well as local health agencies.

The Centre, established on 27th June, 1984, started functioning in the form of three co-ordinating units located at Jodhpur, Bikaner, and Jaipur. The positioning of the three units in three areas of Rajasthan, represented a desert health study unit at Jodhpur, a unit representing desert area with developmental activity (Indira Gandhi Nahar Priyojna) at Bikaner and a non-desert area

represented by the Jaipur unit. A comprehensive baseline health survey in three units was undertaken to have scientifically generated observations on the health profile of the region and factors associated with the morbidity pattern. With the completion of baseline health survey, all the units of the Centre were merged to form a unified research Centre at Jodhpur in the year 1992.

During two decades of its existence, DMRC has contributed to generate baseline data on nutritional problems faced by the population of desert areas, understanding of transmission dynamics of vector borne diseases (malaria & dengue) in the changing ecology of desert areas, other health problems like silicosis, hypertension, renal stones, specific maternal-child health issues, elimination of guinea worm disease, etc. The Centre has several ongoing programmes on dengue, malaria, vector bionomics, insecticide resistance, novel herbs with potential as insecticides as well as anti-infective agents, hypertension, and various nutritional deficiencies in vulnerable populations aiming to establish itself as centre of excellence on these problems with special

reference to desert ecology. With its transformation into a research, teaching and training centre (e.g. already recognized for a PhD programme), DMRC has now grown up to undertake opportunities and challenges in human health research with more vigour and enthuse to fulfill its overall mandate of the new charter of duties meeting national and international goals in this area.

Two decades of R & D effort, a journey towards technical excellence in desert health management has led DMRC to emerge as a nodal centre undertaking research activities of a National Institute on Desert Health. Centre's programmes in areas like human physiology, geographical genomics, nutritional diseases, operational research, vector-borne diseases, medicinal and insecticidal plants, infectious diseases, noncommunicable diseases, advanced functional biomaterials, noncommunicable diseases, nano-bio interface, health problems associated with desert environment, famine, floods, opium addiction, dehydration, water borne diseases, radio isotopic applications, NBC threats and post disaster management provide DMRC the platform for leadership both at national and international level as arid zones constitute about one-seventh of the earth's land surface. In India, the desert encompasses 8.7% of the total land area.

MANDATE

- | To undertake and promote research on health problems specific to desert areas.
- | To study the changing patterns of health problems especially in view of various developmental activities taking place in the region.
- | To strengthen the scientific and technical expertise of state as well as local health agencies.

CURRENT THRUST AREAS

- | To study maintenance mechanism of dengue virus in nature, determine regional risk factors of Dengue & DHF and develop surveillance design capable of forecasting impending epidemic situations for their prevention and management in Rajasthan.

- | To study vector bionomics and transmission dynamics of desert malaria, identifying local risk factors to develop a strategic action plan for its prevention and control.

- | To study magnitude and distribution of nutritional deficiencies and develop locally sustainable intervention programme for their management.

- | To undertake longitudinal studies for estimation of burden of communicable and non-communicable diseases and their transition across time and space for policy planning.

- | To study epidemiology of life-style diseases, identify local risk factors and demonstrate intervention measures for their effectiveness.

ACHIEVEMENTS

- | Baseline survey in the initial phase and subsequent rapid drought survey were undertaken to understand the health problems in the region. Short and long-term malnutrition, anemia and diet deficient in calories, vitamin-A and vitamin-B complex were found to be common prevalent problems. Information on the occurrence and distribution of vector species and socio-demographic profile were other important outcomes of these surveys. *Culex pseudosvishnui* and *Culex tritaeniorhynchus* vector of JE hitherto considered to be abounding in rice growing areas, were reported for the first time from Rajasthan.

- | Camp approach was demonstrated to be a useful approach in tackling the vitamin-A deficiency and health problems of the salt workers.

- | Developed expertise, which proved useful for National Guinea-warm Eradication Programme in Rajasthan. One of the DMRC scientist nominated by the ICMR participated as member of National Commission for Guinea-warm Eradication Certification.

- | Explained the mechanism of dengue virus retention in nature through demonstration of Trans Ovarial Transmission (TOT) of dengue

virus in *Aedes aegypti* up to seven generation under laboratory conditions & dynamics of desert malaria.

- | Demonstrated the utility, feasibility and affordability of wet-drilling as well as use of face masks for prevention of silicosis in sand stone quarry workers.
- | A compendium on indigenous plant medicines from tribal areas of Rajasthan has been prepared.
- | Demonstrated 200 KD protein mid-gut of mosquitoes refractory to dengue virus.
- | Investigated opium addiction associated susceptibility to pulmonary tuberculosis, problem of silico-tuberculosis in stone quarry workers, nutritional deficiencies and associated morbidities, urolithiasis & hypertension in rural areas.

VISION-A PROSPECTIVE STRIDE

Based on the needs and expectations, the centre will use conventional clinical, epidemiological and laboratory methods as well as modern biological tools of genomics, proteomics and bioinformatics to focus on human physiology, geographical genomics nutrition and associated morbidities/ diseases, operational research, vector-borne diseases, medicinal and insecticidal plants, infectious diseases & non-communicable diseases. Physiological adaptation of man to desert environment , to standardize physiological variables in desert population, Integration of basic and clinical sciences using modern biotechnological tools, proteomic maps of body fluids in healthy individuals and its alteration under various conditions of physiological stress and diseased state, immune-modulators &

Operational/ Behavioral needs are being envisioned as future research programmes.

The Centre has several ongoing programmes on dengue, malaria, vector bionomics, Insecticide resistance, novel herbs with potential as insecticides as well as anti-infective agents, hypertension, and various nutritional deficiencies in vulnerable populations aiming to establish itself as centre of excellence on these problems with special reference to desert ecology. With its transformation into a research, teaching and training centre (e.g. already recognized for a Ph.D programme), DMRC has now grown up to undertake opportunities and challenges in human health research with more vigor and enthusiasm to fulfill its overall mandate of the new charter of duties meeting national and international goals in this area.

DMRC has developed linkages with other ICMR research institutes, Indian Council of Agricultural Research (ICAR) and its agencies, regional universities, medical colleges, defence organizations, Council of Scientific and Industrial Research (CSIR), oil and natural gas organizations located in the region. These provide opportunities for amalgamating knowledge in the fields of geography, medicine and health issues, linked with defence-related areas to strategic benefits.

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CONFERENCES / MEETINGS / SYMPOSIA / SEMINARS

World Cancer Congress – 2017, 20-22 September, 2017, Kolkata.

Theme : Cancer in a New Way: Innovation, Prevention, Diagnosis & Cure

- | Cancer Stem Cells
- | Cancer Basic & Applied Research Tumor
- | Anti-Cancer Drug Discovery
- | Clinical Oncology
- | Personalized Cancer Medicine

Contact :

Dr. K. J. Das, CEO, Raytheon Healthcare, Convenor, World Cancer Congress–2017, Website: www.worldcancercongress2017.org

Third World Congress On Disaster Management, November 6-10, 2017, Visakhapatnam, Andra Pradesh.

Plenaries and workshops.

Disaster Risk Reduction

- | Risk and vulnerability assessments, PDNA (Post Disaster Needs Assessments)
- | Disaster specific approaches: Floods Cyclones, Earthquakes, Nuclear and chemicals disaster, heatwave, snow avalanches, cloud
- | Strengthening disaster risk governance to manage disasters better
- | Investing in disaster risk reduction for resilience
- | Enhancing disaster preparedness for effective response (Build Back Better)
- | Early Warning Systems and New Technologies
- | Urban Disaster Risk Reduction/ Resilience
- | Crowd Management
- | Local planning and monitoring

- | Public Private Partnerships in enhancing Resilience

Climate Change Adaption

- | Assessing climate change impacts among communities, case studies, pilot, learnings and scalable/replicable models
- | CO₂ Emissions and climate agreements - implications for least developed and developed countries, communities
- | Climate change Agenda in education and school curriculum
- | Adaptive villages / Adaptive Towns / Adaptive and resilient cities - state of the issue, Modelling and innovations
- | Partnerships for Adaptions
- | Economics of Climate Change and investments in Prevention and Mitigation
- | Corporate Social Responsibility and ECO systems
- | Urban Climate Change Adaption initiatives and Research

- | Clean and Renewable Energy research and solutions
- | Child Centred Community Based Adaptation (CCCBA)
- | Drought and its impacts on children, communities and implications for policy and practice -
- | case studies good practices, research and innovation

Sustainable Development Goals

- | SDG Targets, indicators and Accountabilities of governments and other stakeholders
- | Mainstreaming DRR and climate change adaptation into development agenda (Governments, corporates, MNCs, PSUs, Other stakeholders)
- | Inclusive development approaches and linkage with DRR and CCA

- | Climate Resilient Development / clean development Agenda
- | New Urban Agenda and its relation to DRR, CCA and SDG
- | Resilient and Adaptive Infrastructure Growth (Building Standards / Codes, etc) Landuse planning and implementation
- | Health, Nutrition, Protection and Education targets for Children and other marginalized sections
- | Exclusion, Marginalisation, Vulnerabilities Water and soil conservation - policies and practices
- | Food Security and Livelihoods - markets and sustainability vis-a-vis droughts, disasters and climate vulnerabilities

Contact:

120/3RT/10-3-640, 4th Floor, Vijaya Nagar Colony, Hyderabad - 500057, India, E-mail: convenor@wcdm.info, drsananandababu@wcdm.info, dmics.future@gmail.com Phone: +91-40-23305263, +91-40-23305265

International Conference on Composite Materials and Structures, 27-29th December 2017, Hyderabad.

Topics:

Material Science

- | Polymer matrix composites
- | Ceramic matrix composites
- | Metal matrix composites
- | Fiber reinforced composites
- | Green composites
- | Nano composites
- | Bio composites
- | Textile based composites
- | Hybrid composites
- | Steel Concrete composites
- | Auxetic materials and structures
- | Porous and cellular materials

Structural Analysis and Design

- | Structural Analysis and optimization
- | Multiscale modeling of materials
- | Damage tolerance of composite structures
- | Structural design criteria, safety and reliability
- | Sandwich structures and materials
- | Joint in composite structures
- | Composite structures
- | Analysis of composite beams, plates and shells
- | FRP and Historic Masonry Structures
- | FRP reinforced concrete and steel structures
- | Steel concrete composite structures

Computational Methods and Mechanics

- | Nonlocal theories
- | Damage mechanics
- | Generalized continuum theories
- | Multiscale Analysis of Natural Fiber Composites
- | Advanced Numerical Techniques
- | Micromechanics
- | Modelling and Characterization of CNT-Polymer Composites
- | Nano-Composites
- | Optimization techniques and methods
- | Plate and Shell finite elements
- | Stability of Nano, Micro and Macro Composite Structures
- | Failure of Composites
- | Analysis of Wood and Natural Fiber Composites
- | Laminated composites with material uncertainties
- | Thermal problems on Composite structures
- | Delamination and fracture

Experimental Methods

- | Ultrasound and acoustic emission
- | X Ray computed tomography
- | Thermography
- | Micro and nano scale methods
- | Experimental analysis of laminated plate and shell structures
- | Health Monitoring Techniques in Composite Structures
- | Image correlation techniques

Mechanical Properties

- | Constitutive models for composite materials
- | Fatigue behavior of composites

Contact :

Dr. Amirtham Rajagopal, Organizing Secretary, ICCMS 2017 Conference, Associate Professor, Structural Engineering, Indian Institute of Technology Hyderabad, Kandi (V), Sangareddy(M), Hyderabad-502285, E-mails: iccms2017@iith.ac.in, rajagopal@iith.ac.in, Phone: 040 2301 6094 Mobile: 08985156490.

- | Fracture and Damage in composites
- | Dynamic Fracture in composites
- | Dynamic Behavior of composites
- | Impact behavior of composites
- | Tribology and Wear of composites
- | Interfaces and Interphases
- | Durability creep and aggressive environment

Multifunctional and Smart Composites

- | Self-healing and Bio inspired designs
- | Energy Harvesting and Storage
- | Smart Structures
- | Coupled Properties and Multiphysics models
- | Acoustic meta composite
- | Electro-thermal properties of composite materials
- | Functionally graded materials and structures

Processing and Manufacturing

- | Experimental methods for process characterization
- | Manufacturing, upscaling and Automation
- | Machining of composites

Applications

- | Aerospace, Automotive and Rail applications of composites
- | Bio and Medical applications of composites
- | Civil and Structural applications of composites
- | Composite Repair techniques, self-healing composites
- | Composites in Innovative applications
- | Offshore structures and Marine Applications of Composites

The Dynamic Cell: Molecules and Mechanics to Form and Function, International Congress of Cell Biology 2018 , January 27 – 31, 2018, Hyderabad

Topics

- | | |
|---|---|
| Cell membrane- organization & function | Microbes & host cell interplay |
| Receptors- Growth factor receptors/ GPCRs/ intracellular/ nuclear receptors | Microenvironment |
| Signaling intermediates | Modeling human disease |
| Regulation of and by the Cytoskeleton | Metabolic control |
| Nuclear dynamics | DNA damage & repair |
| Molecular motors and other cellular machines | Translational cell science |
| Intra-cellular traffic/ transport | |
| Post-translational modifications & their regulation | Special topics/ sessions: |
| Nuclear matrix, chromatin & the Genome | GPI anchors (30th anniversary special session) |
| Control by RNA/ non-coding sequences and their functions | New methods (single cell biology / novel model systems/ Imaging advances) |
| Cellular processes in Development | Emerging trends in cell biology |
| Studying cells in 3 and 4 dimensions | Physics and engineering in cell biology |
| Cell fate determinants /Stem cell biology | Evolution of cellular functions |
| Organelle biology: Golgi/ primary cilium/centrosome/mitochondria | Systems biology/ networks in cells |
| Biology of single cell organisms | Genome editing and cell biology |
| | Special sessions on cell biology education/scientific writing /ethics/careers in cell biology |

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S & T ACROSS THE WORLD

INGREDIENT OF LIFE FOUND AROUND INFANT SUN-LIKE STARS

Two teams of astronomers have harnessed the power of the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile to detect the prebiotic complex organic molecule methyl isocyanate [1] in the multiple star system IRAS 16293-2422. One team was co-led by Rafael Martín-Doménech at the Centro de Astrobiología in Madrid, Spain, and Víctor M. Rivilla, at the Osservatorio Astrofisico di Arcetri in Florence, Italy; and the other by Niels Ligterink at the Leiden Observatory in the Netherlands and Audrey Coutens at University College London, United Kingdom.

"This star system seems to keep on giving! Following the discovery of sugars, we've now found methyl isocyanate. This family of organic molecules is involved in the synthesis of peptides and amino acids, which, in the form of proteins, are the biological basis for life as we know it," explain Niels Ligterink and Audrey Coutens.

ALMA's capabilities allowed both teams to observe the molecule at several different and characteristic wavelengths across the radio spectrum. They found the unique chemical fingerprints located in the warm, dense inner regions of the cocoon of dust and gas surrounding young stars in their earliest stages of evolution. Each team identified and isolated the signatures of the complex organic molecule methyl isocyanate. They then followed this up with computer chemical modelling and laboratory experiments to refine our understanding of the molecule's origin.

IRAS 16293-2422 is a multiple system of very young stars, around 400 light-years away in a large star-forming region called Rho Ophiuchi in the constellation of Ophiuchus (The Serpent Bearer). The new results from ALMA show that methyl isocyanate gas surrounds each of these young stars.

Earth and the other planets in our Solar System formed from the material left over after the formation of the Sun. Studying solar-type protostars can therefore open a window to the past for astronomers and allow them to observe conditions similar to those that led to the formation of our Solar System over 4.5 billion years ago.

Rafael Martín-Doménech and Víctor M. Rivilla, lead authors of one of the papers, comment: "We are particularly excited about the result because these protostars are very similar to the Sun at the beginning of its lifetime, with the sort of conditions that are well suited for Earth-sized planets to form. By finding prebiotic molecules in this study, we may now have another piece of the puzzle in understanding how life came about on our planet."

Niels Ligterink is delighted with the supporting laboratory results: "Besides detecting molecules we also want to understand how they are formed. Our laboratory experiments show that methyl isocyanate can indeed be produced on icy particles under very cold conditions that are similar to those in interstellar space. This implies that this molecule -- and thus the basis for peptide bonds -- is indeed likely to be present near most new young solar-type stars."

Notes

- (1) A complex organic molecule is defined in astrochemistry as consisting of six or more atoms, where at least one of the atoms is carbon. Methyl isocyanate contains carbon, hydrogen, nitrogen and oxygen atoms in the chemical configuration CH₃NCO. This very toxic substance was the main cause of death following the tragic Bhopal industrial accident in 1984.
- (2) The system was previously studied by ALMA in 2012 and found to contain molecules of the simple sugar glycolaldehyde, another ingredient for life.
- (3) The team led by Rafael Martín-Doménech used new and archive data of the protostar taken across a large range of wavelengths across ALMA's receiver Bands 3, 4 and 6. Niels Ligterink and his colleagues used data from the ALMA Protostellar Interferometric Line Survey (PILS), which aims to

chart the chemical complexity of IRAS 16293-2422 by imaging the full wavelength range covered by ALMA's Band 7 on very small scales, equivalent to the size of our Solar System.

(4) The teams carried out spectrographic analysis of the protostar's light to determine the chemical constituents. The amount of methyl isocyanate they detected -- the abundance -- with respect to molecular hydrogen and other tracers is comparable to previous detections around two high-mass protostars (i.e. within the massive hot molecular cores of Orion KL and Sagittarius B2).

(5) Martín-Doménech's team chemically modelled gas-grain formation of methyl isocyanate. The observed amount of the molecule could be explained by chemistry on the surface of dust grains in space, followed by chemical reactions in the gas phase. Moreover, Ligterink's team demonstrated that the molecule can be formed at extremely cold interstellar temperatures, down to 15 Kelvin (-258 degrees Celsius), using cryogenic ultra-high-vacuum experiments in their laboratory in Leiden.

(Source : *Monthly Notices of the Royal Astronomical Society*, 2017; 469 (2): 2230)

PLASTIC MADE FROM SUGAR AND CARBON DIOXIDE

Some biodegradable plastics could in the future be made using sugar and carbon dioxide, replacing unsustainable plastics made from crude oil, following research by scientists from the Centre for Sustainable Chemical Technologies (CSCT) at the University of Bath.

- | Polycarbonate is used to make drinks bottles, lenses for glasses and in scratch-resistant coatings for phones, CDs and DVDs
- | Current manufacture processes for polycarbonate use BPA (banned from use in baby bottles) and highly toxic phosgene, used as a chemical weapon in World War One
- | Bath scientists have made alternative polycarbonates from sugars and carbon dioxide in a new process that also uses low pressures and

room temperature, making it cheaper and safer to produce

- | This new type of polycarbonate can be biodegraded back into carbon dioxide and sugar using enzymes from soil bacteria
- | This new plastic is bio-compatible so could in the future be used for medical implants or as scaffolds for growing replacement organs for transplant

Polycarbonates from sugars offer a more sustainable alternative to traditional polycarbonate from BPA, however the process uses a highly toxic chemical called phosgene. Now scientists at Bath have developed a much safer, even more sustainable alternative which adds carbon dioxide to the sugar at low pressures and at room temperature.

The resulting plastic has similar physical properties to those derived from petrochemicals, being strong, transparent and scratch-resistant. The crucial difference is that they can be degraded back into carbon dioxide and sugar using the enzymes found in soil bacteria.

The new BPA-free plastic could potentially replace current polycarbonates in items such as baby bottles and food containers, and since the plastic is bio-compatible, it could also be used for medical implants or as scaffolds for growing tissues or organs for transplant.

Dr Antoine Buchard, Whorrod Research Fellow in the University's Department of Chemistry, said: "With an ever-growing population, there is an increasing demand for plastics. This new plastic is a renewable alternative to fossil-fuel based polymers, potentially inexpensive, and, because it is biodegradable, will not contribute to growing ocean and landfill waste.

"Our process uses carbon dioxide instead of the highly toxic chemical phosgene, and produces a plastic that is free from BPA, so not only is the plastic safer, but the manufacture process is cleaner too."

Dr Buchard and his team at the Centre for Sustainable Chemical Technologies, published their work in a series of articles in the journals *Polymer Chemistry* and *Macromolecules*.

In particular, they used nature as inspiration for the process, using the sugar found in DNA called thymidine as a building block to make a novel polycarbonate plastic with a lot of potential.

PhD student and first author of the articles, Georgina Gregory, explained: "Thymidine is one of the units that makes up DNA. Because it is already present in the body, it means this plastic will be bio-compatible and can be used safely for tissue engineering applications.

"The properties of this new plastic can be fine-tuned by tweaking the chemical structure -- for example we can make the plastic positively charged so that cells can stick to it, making it useful as a scaffold for tissue engineering." Such tissue engineering work has already started in collaboration with Dr Ram Sharma from Chemical Engineering, also part of the CSCT.

The researchers have also looked at using other sugars such as ribose and mannose. Dr Buchard added: "Chemists have 100 years' experience with using petrochemicals as a raw material so we need to start again using renewable feedstocks like sugars as a base for synthetic but sustainable materials. It's early days, but the future looks promising."

(Source : *Polym. Chem.*, 2017; 8 (13): 2093)

VOLCANIC 'PLUMERANG' COULD IMPACT HUMAN HEALTH

A new study has found a previously undetected potential health risk from the high concentration of small particles found in a boomerang-like return of a volcanic plume.

A team of scientists, led by Dr Evgenia Ilyinskaya at the University of Leeds, traced the evolution of the plume chemistry from the 2014-2015 Icelandic Holuhraun lava field eruption and found a second type of plume that impacts air quality.

This second plume had circled back to Icelandic cities and towns long after the health warning about the initial plume had been lifted.

Lead author, Dr Ilyinskaya from the Institute of Geophysics and Tectonics at Leeds, said: "The return

of this second, mature, plume, which we referred to as a 'plumerang', showed that the volcanic sulphur had undergone a gas-to-particle conversion by spending time in the atmosphere. This conversion meant that the sulphur dioxide (SO₂) levels of the plumerang were reduced and within the European Commission air quality standards and therefore there were no health advisory messages in place.

"However, our samples showed that the mature plume was instead very rich in fine particles which contained high concentrations of sulphuric acid and trace metals. The concentrations of these trace metals did not reduce as the plume matured and included heavy metals found in human-made air pollution that are linked to negative health effects.

"On at least 18 days during the 6-month long eruption the plumerang was in the capital city of Reykjavík, while the official forecast showed 'no plume'."

The fine particles found in the plumerang are so small they can penetrate deep into the lungs, potentially causing serious health problems such as exacerbating asthma attacks.

It is estimated that short and long-term exposure to this type of fine particles, from both human-made and natural sources, cause over three million premature deaths globally per year and remains the single largest environmental health risk in Europe.

Dr Ilyinskaya is currently researching the possible health impacts of the plumerang in collaboration with the University of Iceland. However there is already anecdotal evidence suggesting adverse effects.

Dr Ilyinskaya said: "We spoke to people living in Reykjavik who described a burning sensation in the throat and eyes when the SO₂ levels would have been well within air quality standards but the particle-rich plumerang would have been over the city."

During the six-month-long eruption, the Icelandic Meteorological Office's daily forecasts of the plume dispersion accounted only for SO₂ concentrations in the young plume. The mature plume was not forecast as part of volcanic air pollution monitoring.

The study, published in *Earth and Planetary Science Letters*, recommends that in future gas-rich eruptions both the young and mature plumes should be considered when forecasting air pollution and the dispersion and transport pattern of the plume.

Co-author Dr Anja Schmidt, from the Institute of Climate and Atmospheric Science at Leeds, said: "The Holuhraun eruption caused one of the most intense and widespread volcanogenic air pollution events in centuries. It's estimated that the amount of sulphur dioxide released into the atmosphere was roughly two times that of a yearly total of SO₂ emissions generated by the European Economic area.

"It gave us a rare opportunity to study volcanism of this style and scale using modern scientific techniques. The data we have gathered will be invaluable to preparing for a potential future event and its impacts on air quality and human health."

(Source : *Earth and Planetary Science Letters*, 2017)

7.2-MILLION-YEAR-OLD PRE-HUMAN REMAINS FOUND IN THE BALKANS

The common lineage of great apes and humans split several hundred thousand earlier than hitherto assumed, according to an international research team headed by Professor Madelaine Böhme from the Senckenberg Centre for Human Evolution and Palaeoenvironment at the University of Tübingen and Professor Nikolai Spassov from the Bulgarian Academy of Sciences. The researchers investigated two fossils of *Graecopithecus freybergi* with state-of-the-art methods and came to the conclusion that they belong to pre-humans. Their findings, published today in two papers in the journal *PLOS ONE*, further indicate that the split of the human lineage occurred in the Eastern Mediterranean and not -- as customarily assumed -- in Africa.

Present-day chimpanzees are humans' nearest living relatives. Where the last chimp-human common ancestor lived is a central and highly debated issue in palaeoanthropology. Researchers have assumed up to now that the lineages diverged

five to seven million years ago and that the first pre-humans developed in Africa. According to the 1994 theory of French palaeoanthropologist Yves Coppens, climate change in Eastern Africa could have played a crucial role. The two studies of the research team from Germany, Bulgaria, Greece, Canada, France and Australia now outline a new scenario for the beginning of human history.

Dental roots give new evidence

The team analyzed the two known specimens of the fossil hominid *Graecopithecus freybergi*: a lower jaw from Greece and an upper premolar from Bulgaria. Using computer tomography, they visualized the internal structures of the fossils and demonstrated that the roots of premolars are widely fused.

"While great apes typically have two or three separate and diverging roots, the roots of *Graecopithecus* converge and are partially fused -- a feature that is characteristic of modern humans, early humans and several pre-humans including *Ardipithecus* and *Australopithecus*," said Böhme.

The lower jaw, nicknamed 'El Graeco' by the scientists, has additional dental root features, suggesting that the species *Graecopithecus freybergi* might belong to the pre-human lineage. "We were surprised by our results, as pre-humans were previously known only from sub-Saharan Africa," said Jochen Fuss, a Tübingen PhD student who conducted this part of the study.

Furthermore, *Graecopithecus* is several hundred thousand years older than the oldest potential pre-human from Africa, the six to seven million year old *Sahelanthropus* from Chad. The research team dated the sedimentary sequence of the *Graecopithecus* fossil sites in Greece and Bulgaria with physical methods and got a nearly synchronous age for both fossils -- 7.24 and 7.175 million years before present. "It is at the beginning of the Messinian, an age that ends with the complete desiccation of the Mediterranean Sea," Böhme said.

Professor David Begun, a University of Toronto palaeoanthropologist and co-author of this study,

added, "This dating allows us to move the human-chimpanzee split into the Mediterranean area."

Environmental changes as the driving force for divergence

As with the out-of-East-Africa theory, the evolution of pre-humans may have been driven by dramatic environmental changes. The team led by Böhme demonstrated that the North African Sahara desert originated more than seven million years ago. The team concluded this based on geological analyses of the sediments in which the two fossils were found. Although geographically distant from the Sahara, the red-colored silts are very fine-grained and could be classified as desert dust. An analysis of uranium, thorium, and lead isotopes in individual dust particles yields an age between 0.6 and 3 billion years and infers an origin in Northern Africa.

Moreover, the dusty sediment has a high content of different salts. "These data document for the first time a spreading Sahara 7.2 million years ago, whose desert storms transported red, salty dusts to the north coast of the Mediterranean Sea in its then form," the Tübingen researchers said. This process is also observable today. However, the researchers' modelling shows that, with up to 250 grams per square meter and year, the amount of dust in the past considerably exceeds recent dust loadings in Southern Europe more than tenfold, comparable to the situation in the present-day Sahel zone in Africa.

Fire, grass, and water stress

The researchers further showed that, contemporary to the development of the Sahara in North Africa, a savannah biome formed in Europe. Using a combination of new methodologies, they studied microscopic fragments of charcoal and plant silicate particles, called phytoliths. Many of the phytoliths identified derive from grasses and particularly from those that use the metabolic pathway of C4-photosynthesis, which is common in today's tropical grasslands and savannahs. The global spread of C4-grasses began eight million years ago on the Indian subcontinent -- their presence in Europe was previously unknown.

"The phytolith record provides evidence of severe droughts, and the charcoal analysis indicates recurring vegetation fires," said Böhme. "In summary, we reconstruct a savannah, which fits with the giraffes, gazelles, antelopes, and rhinoceroses that were found together with *Graecopithecus*," Spassov added."

The incipient formation of a desert in North Africa more than seven million years ago and the spread of savannahs in Southern Europe may have played a central role in the splitting of the human and chimpanzee lineages," said Böhme. She calls this hypothesis the North Side Story, recalling the thesis of Yves Coppens, known as East Side Story.

(Source : PLOS ONE,; 12 (5), 2017)



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

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

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

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

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

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

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

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

5. **Institutional Member** : An Institution paying a subscription of ₹ 5,000/- (for foreign** U.S.\$ 2,500) only, can become an Institutional Member of the Association for that financial year. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy each of the Associations journal Everymans Science.
6. **दाता** : कोई भी व्यक्ति जो एकसाथ ₹ 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 एकसाथ ₹ 50,000/- (विदेशियों के लिए U.S. \$ 25,000) मात्र दें, सदा के लिए इस संस्था के संस्थान दाता बन सकते हैं, जिसे वह एक व्यक्ति को नामांकित करके उसे अपने संस्थान के प्रतिनिधि के रूप में विज्ञान कांग्रेस के वार्षिक सत्र में भेज सकते हैं। एक संस्थान/व्यक्तिगत दाता वार्षिक विज्ञान कांग्रेस के कार्यविवरण और संस्था के रोज़नामचा "एवरीमैन्स साइंस" की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



भारतीय विज्ञान कांग्रेस संस्था

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

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

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

फैक्स/Fax : 91-33-2287-2551

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

ई-मेल/E-mail : iscacal@vsnl.net

es.sciencecongress@nic.in

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

सेवा में/To

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

भारतीय विज्ञान कांग्रेस संस्था/The Indian Science Congress Association

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

कोलकाता - 700 017/Kolkata - 700 017

महोदय/Dear Sir,

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

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

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

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

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

विभाग/Sections

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

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

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

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

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

कुलनाम/Surname

प्रथम नाम/First Name

मध्य नाम/Middle Name

शैक्षणिक योग्यता/Academic Qualifications :

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

पदनाम/Designation

सम्पर्क का पता/Address of communication :

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

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

स्थायी पता/Permanent Address :

टिप्पणी (अगर कोई)/Comments (if any)

दिनांक/Date :

भवदीय/Yours Faithfully

हस्ताक्षर/Signature

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

- Note :** (i) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association* Payable at any branch in Kolkata.
- (ii) सभी सदस्यता और सदस्यता के नवीकरण के लिए आवेदन-पत्र आवेदकों को अपने खुद के पते उपलब्ध कराके करने चाहिए न कि देखभाल के पते प्रस्तुत करने चाहिए।
- (ii) All Application Forms for Membership and the renewal of Membership must be submitted by providing the address of the applicants themselves only and not any care of address.
- (iii) भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रूरी है। यह सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रूरी नहीं है।
- (iii) Admission fee of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.
- (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.