

## 107<sup>TH</sup> INDIAN SCIENCE CONGRESS, BANGALORE, RECOMMENDATIONS FROM THE SECTION

The 107<sup>th</sup> Indian Science Congress was organized with the Focal theme; “*Science and Technology: Rural Development*”. The recommendations from different sections on the discussion related to the above focal them are given below:

### AGRICULTURE AND FORESTRY SCIENCES

The theme of the Agriculture and Forestry Sciences was “*Integrated Agriculture and Rural Bio-entrepreneurship*” for Agricultural Sciences and for Forestry Sciences. Within the framework of 107<sup>th</sup> Indian Science Congress “Farmers Science Congress” was organized on 06.01.2020 with the theme “*Farmers Innovation Driving Integrated Agriculture and Rural Bio-entrepreneurship*”. Recommendations are as follows:

- 1. Integrated Agriculture for bringing self-reliance in Rural India:** Integrated Agriculture can be considered as renewable agriculture and an important pathway to nutritional security. It is the need of the hour for Indian agriculture. Integrated agriculture needs to be promoted in order to reduce the massive use of industrial inputs, which has broken the chain of the interaction in farming systems, contributing to climate change due to low carbon footprint and leading to unsustainable agriculture.
- 2. Doubling Farmers Income:** Integrated Farming Systems is considered as the potential tool and master plan for the development of small & marginal farmers in the country for doubling the farmer’s income. Policy support is needed in terms of promoting Farm Development Card and Developmental Farm Model at the ground/farming system level.
- 3. New India:** “New India” one of the important vision of Prime Minister. In-order to contribute for this mission, a Student Ready Programme is launched by ICAR for Experiential Learning Programme, which can be properly implemented for the skill development of the students & promoting large scale entrepreneurship.
- 4. Holistic and system approaches** in agriculture needs to be promoted. The component and disciplinary approaches dominant in Indian Agriculture needs to be replaced by holistic and system approach for sustainable agriculture and sustainable development of small & marginal farmers.
- 5. International Year of Integrated Agriculture:** Proposal to UNO to celebrate international year of Integrated Agriculture by UNO is an Important strategy and recommendation for promotion of Integrated Agriculture systems in national and international agriculture.
- 6. Convergence and Collaboration:** Convergence of line department & other organizations at ground/farming system level for synergy is important. Through holistic and system approach such synergy can be achieved. More output from the available infrastructure in agriculture is possible through bringing convergence on various programmes and institutions.
- 7. Imbalanced fertilizer use and heavily depending on industrial inputs like fertilizers is causing micro-nutrient deficiency.** This is also affecting the human and animal health. Zinc deficiency

has become a major issue in Indian agriculture which can be addressed through integrated nutrient management.

8. **Natural Farming and Zero-budget Natural Farming:** Natural Farming and Zero-budget Natural Farming are important agricultural practices are not yet explored properly. There practices are important for efficient use of local resources, which is not happening due to influence of industrial agriculture. There is need of systemic research to develop viable and replicable protocol is needed.
9. Bamboo-based products making provides opportunity for rural youth for entrepreneurship development and rural income generation. There is need of skill development of rural youth and farmers for value added products of bamboo. Such programme can be intensified in NEH region where bamboo bioresources are readily available.
10. **Ecotourism:** Ecotourism in rural areas can attract the tourists and contribute to rural economy. Community managed nature tourism which is unique and Odisha model is an example. It is managed by local villagers. **Vana Surakshy Samit (VSS)** consisting of rural youth and women manage the same by performing various activities and get employment. This reduces dependency on forest resources including fire wood and small timbers by the villages. This is very important for sustainable livelihood of villagers.
11. Integrated agriculture system (IAS) is an important pathway to bio-diversity conservation. Integrated agriculture, promotes a rich culture of biodiversity through maintaining a multi-enterprise production systems of flora and fauna. There has been an ever increasing dominance of economically-driven highly intensive farming systems over ecologically-oriented traditional agricultural systems all over the globe. Such a shift is rapidly reducing the diversity of cropping systems and diminishing the quality of available habitats for various organisms associated with agricultural landscapes, and hence adversely affecting the existing biodiversity. Promotion of IAS is important strategy world over for the biodiversity conservation.

## **ANIMAL, VETERINARY AND FISHERY SCIENCES**

With a view to promote more livelihood in rural India, Govt. should initiate a detailed programme to train rural youth with Pisciculture, Apiculture, Duckery, Piggery, Lac culture, Prawn and pearl culture, etc., so that they can earn money and contribute to the national economy.

1. Bio-resources are the wonderful gift of nature to mankind whose sustainability can be effectively linked to rural livelihood and economic development, so science education should aim at attracting students for proper management, sustainable utilization and innovative idea of bio-resources.
2. The assemblage of species with which we share the planet represents a vast untapped genetic library, with undiscovered pharmaceuticals and other beneficial substances. So programmes needed to be initiated for the exploration of other less known potential varieties of the forms with a view to ensure rural livelihood, food, health and financial security for future.
3. Ensuring dangers of climate changes to biodiversity be recognized and integrating measures be undertaken on priority to conserve the biodiversity.

4. Biotechnological tools and innovative ideas should be used for the conservation, management and restoration of all types of habitats.
5. Checklist of local fauna be prepared to know the status of biodiversity and submit the same to the concerned agency to undertake conservational measures.
6. Emphasis must be enhanced in the form of major research findings to harnessing more animal protein from the aquatic resources to ease out the pressure on land resources.
7. Basic Biology should be made an integral part of undergraduate and postgraduate studies in biotechnology, microbiology, bioinformatics and other modern biology disciplines
8. With a view to conserve biodiversity, emphasis on strengthening of classical zoology in the syllabus of undergraduate and postgraduate programmes be given which is not reflected in new UGC syllabus. UGC may be requested to restructure the syllabus in the light of this recommendation with special reference to minor phyla.
9. National funding agencies should provide sufficient funding for research on animal taxonomy as classical taxonomy has gone on backfoot during the last 2 decades and proper identification of species of biodiversity importance has become a problem for young researchers.
10. There is an urgent need to increase researches to maintain and manage better health of terrestrial and aquatic animal resource for providing energy-rich protein and other resources to the human being.
11. In order to augment the inland fishery production, there is a direct need for investigating mortality among the early life history stages of fishes and to develop innovative methods to increase the year class strength under prevailing conditions.

### **ANTHROPOLOGICAL AND BEHAVIOURAL SCIENCES (INCLUDING ARCHAEOLOGY, PSYCHOLOGY, EDUCATION AND MILITARY SCIENCES)**

Before India got independence, some 72 years ago from today, it was said that “The real India live in village”. This ideas seem to hold till today as more than double the size of Indian Urban population live in rural area and almost 10times the size of the urban area constitute rural area. With this fact in the backdrop, our country can become a developed nation only when the rural areas are fully developed through application of science and technology. But the real application of science and technology cannot be accomplished without understanding the social, cultural , life style, behavior and psychology of the people.

Keeping this in view the following recommendation are made from the deliberations made by the paper presenters.

1. Before taking up any policy programme for development of any area/region, the socio –cultural and psychological aspect of the people / inhabitants should be take into consideration.
2. Policy makers should seek the suggestion and comment of the social scientist, anthropologist , psychologist and behavioral scientist before implementation of any policy programme.

3. In order to get the knowledge of the behavioral and social scientist, anthropologist and psychologist should be coped up as a member of drafting of any policy programme.

## CHEMICAL SCIENCES

To meet the challenges of the twenty first century it's essential to have collaboration between academic institutions and Research and Development divisions of industries which is the key of innovation. These collaborations pave the way to create pathways to knowledge and technology transfer from academia to industries or vice-versa. One of the most important outcomes of such collaboration is the development of highly skilled human resource. The panel discussion was held on Jan 5th, 2020 in the Chemical Science Section and discussion was centred on the following topics:

1. Current scenario of academia industry relationship
  2. Industry needs and trends in research
  3. Knowledge Transfer from academia to industry and job opportunities
  4. Joint R&D projects with government support and joint doctoral programmes
  5. Curriculum development, a joint venture of academia and industry
- Panel Discussion on Partnership/Collaboration between Academia and Industry was held . After detailed discussion following recommendations were made:

- It was agreed upon that industry academia relationship need to be strengthened.
- The panel recommended that IIT/IISc/IISER model of bureaucratic system should be implemented in each academic institute of the country.
- The panel recommended that there is need to involve the industry in framing the curriculum of the University and experiments should be designed in such a way that it solves the local/ industrial problems.
- The panel recommended that industry should come forward to involve students for internship.
- A joint PhD program between academia and industry should be started.
- Government of India should encourage the Industry and Academic institutes to undertake projects that can help in making novel processes for the AIP's which is procured from China at the moment. So, funding on such proposals should be made available.

## EARTH SYSTEM SCIENCES

Role of geosciences together with spatial information technology be involved for development of smart city and villages for Disaster Risk Reduction and Resilience measures.

1. To encourage researchers in structural manoeuvring of coal and shale with emphasis on organic petrology, organic, chemistry stable isotopes of coal, shale and gas as well as trace elements and Rare Earth Elements (REE) destruction in organic rich rocks.

2. Wider application of spatial information technology will provide impetus to rural development incorporating social role in scientific development in order to develop pragmatic policy.
3. Earth science education be extended to various levels and Geography/Geology departments of the universities and colleges be involved to collect weather information with support from IMD, Govt. of India.
4. Upper atmospheric data need to be collected through commercial aircraft by stalling weather station for improving science of climate change.
5. Setting up of 'Geo Science Education Research Institute of India' at the earliest to train the school teachers and teachers trainers and to carry out research on the teaching learning of Geospatial Information Technologies and Geo heritage in the country.
6. Initiating a project "Vasundhara" meaning Planet Earth in India as education tour for children, young and public simultaneously attracting domestic and international tourism.

## **ENGINEERING SCIENCES**

1. Considerable scope exists to improve Rural Economy by utilizing knowledge and skills of Engineering Science. For example, 8000 Biogas plant constructed by Bhagirath Gramvikas Pratisthan is a huge success in Sindhudurg district of Maharashtra. This could be replicated suitably across for longer economic gain to rural community. Other prospects of convert waste biomass to wealth e.g. biochar may also be emphasized for rural development.
2. There is a strong need to develop Indian Centric Innovation focus right from the University level so as to impart right socio-economic sensitivity to engineering students. Different means to harness knowledge and skills of Engineering Institute for rural development and solving societal problems may be accelerated. "Unnat Bharat Abhijan" being conducted by IIT Delhi may be further expedited to the entire Indian covering all engineering institutes.
3. For smooth commercialization of indigenous technology, there is an urgent need to fund the demonstration stage of technology development. It is felt that "Mission Oriented Approach" is required to develop a strong linked among industry and various academic and research organization. For this, it is recommended to create a "National Centre for Energy & Materials" to accelerate the commercialization and coordination of inhouse developed technologies in Energy & Materials sector, in line to the ISRO model for Space research.
4. Sustainable technologies e.g. waste plastic and biomass conversion, CO<sub>2</sub> capture and utilization and renewable energy are the few major areas where significant emphasis needs to be given right from university level.
5. Engineering education also needs to adapt the new areas of economic and environmental viability, start up culture, green chemistry, artificial intelligence and robotics, moral and ethical practices, leadership qualities etc to develop students with visionary and business skills.

## **ENVIRONMENTAL SCIENCES**

1. India is facing an acute problem of land degradation, including deteriorating soil health of agroecosystems; this calls for an urgent attention towards restoring the degraded lands, especially the soil health of agricultural landscapes, in mission mode and effective science & technology based interventions.

2. The rapid urbanization in the country is causing various environmental problems, including land abandonment in rural landscapes and related ecological and economic consequences. Therefore, greater attention is required to transform predominantly rural landscapes, such as the Indian Himalaya, with implementing concept of 'smart village' with effective use of science & technology.
3. Various R&D based agencies have developed and demonstrated pilot level success towards addressing issues of environmental deterioration in the country (i.e., air and water pollution, degradation of land, contamination of food, etc.). However, achieving scale remains an issue for all these success stories. This requires a concerted effort for scaling up all such pilots to benefit masses and bring impact on ground.
4. Despite availability of advance technology and know how, the benefits of space technology are yet to be realized fully. Therefore, more intensive use of available space based technology in assessment and monitoring of natural resources, designing and planning developmental projects, implementation and monitoring of success of programmes, etc., needs to be promoted across the country. This would require developing adequate skilled manpower.

## **INFORMATION AND COMMUNICATION SCIENCE AND TECHNOLOGY (INCLUDING COMPUTER SCIENCE)**

Current and future applications of ICT is needed in order to:-

1. Preserve, protect and promote social harmony.
2. Ensure the growth of economy in a sustained manner and more in a manner that generates employment so that each family is assured of a safe and viable livelihood.
3. Enhance the welfare and well-being of farmers, farm labour and workers, particularly those in the unorganized sector and assure a secure future for their families in every respect.
4. Empower women educationally and ecumenically.
5. Provide for full equality of opportunity to every sections of the society.
6. Unleash the creative energies of our entrepreneurs, businessmen, scientists, engineers and all other professionals and productive forces of society.

It was concluded that in order to achieve the inclusive and sustainable development for a diverse nation like India, the power and potential of the computing, in general and Information and Communication Technologies (ICTs), in particular, need to be harnessed to its fullest, in all focal areas related to the development having special focus on the following 05 critical areas:-

1. Agriculture and food processing
2. Education & Healthcare
3. Reliable & Quality Electric Power
4. Hard & Soft Infrastructural Development
5. Seamless & effective last mile delivery of the services to the citizens.

Concluded that considering the present ecosystem, in which more than 800 million people in India alone and over 03 billion people globally are living in villages, any mission towards achieving sustainable global development will not generate fruitful result unless the applications

of computing reaches to the most underprivileged and deprived section of the society, living in the villages. The concept of PURA (Providing Urban Amenities in Rural Areas), conceptualized by our beloved former President of India; Late Dr. APJ Abdul Kalam, needs to strengthen in a big way, at all level.

## **MATERIALS SCIENCE**

1. Major focus to have on the Emerging field Nanomaterials fabrication especially for energy and health.
2. Importance to be given to Materials Science making it an important part of curriculum of higher education and research

## **NEW BIOLOGY (INCLUDING BIOCHEMISTRY, BIO PHYSICS & MOLECULAR BIOLOGY AND BIOTECHNOLOGY)**

1. The major focus of this section was to give emphasis on the basic understanding of various diseases like, cancer, viral infection and parasitic diseases to discover new drugs and cheap but sensitive diagnostic kit that can be used in remote villages without any sophisticated instrument and critical expertise.
2. Understanding basic problems of agriculture to solve the issues like pesticide and/or insecticide resistance, productivity, combat various infections using transgenic approach to reduce crop loss. Another important issue addressed was to develop drought and saline resistance variety of important crop by molecular and classical breeding approach.
3. All GOI funded research should have a mandate to present their work at least once in Indian Science Congress. Each JRF and/or SRF receiving fellowship from DBT, DST, ICMR, CSIR, ICAR etc. should present their work at ISC at least once during their fellowship tenure.

## **PHYSICAL SCIENCES**

Since one of the title of the symposium is “Photonic: An emerging Physical Science discipline for energy, environment, and health care in rural setting”, the recommendation is focused to Photonics and its future in our country. For a layman, photonics is the science and technology of light, with emphasis on applications. The birth of photonics as a physical science discipline coincided with the invention of the laser in 1960 followed, in the 1970s, by the development of optical fibers as a medium for transmitting large quantities of information through light beams which is responsible for the telecommunication revolution of the late 20<sup>th</sup> century.

Photonics technologies become an ever growing science and technology in the physical science discipline includes studies related to laser science and development, nanostructures and materials modifications, applications in the biological and chemical sciences, biomedical engineering and therapy, display and lighting technology, and optical computing. Other important disciplines are:

- (i) Medicine and biomedical engineering: Novel imaging technologies including Optical Coherence Tomography (OCT), Confocal Microscopy, and THz imaging, medical diagnostics and treatment, cancer detection and treatment ,DNA analysis, etc.

- (ii) Information Technology: Optical fibers and free space optical communications, Optical data storage and optical data processing, Optical interconnects Optical Integrated Circuits and in the future, optical computing including quantum computing and quantum encryption, etc;
- (iii) Metrology: Time and Frequency measurements, precise metrology and mechanical components, etc;
- (iv) Entertainment: laser shows, beam effects, holographic art.
- (v) Defence and Security: satellite surveillance systems, navigation, night vision and thermal, imagers, missile guidance, anti-missile systems, high-power directed-energy weapons, IR sensors, command and control, search and rescue, mine laying and detection, etc;
- (vi) Consumer Equipment : Energy-efficient LED illumination, barcode scanners, laser printer, CD/DVD/Blu-ray devices, remote control devices;
- (vii) Industrial manufacturing: Laser material processing including welding, drilling, cutting, and various kinds of surface modification, semiconductor chip manufacturing and inspection, printing, laser and fiber-optic sensors, etc;

In view of such synergy between basic research and applied sciences makes photonics an important topic of science and technology for our country's strategic aim of developing a dynamic knowledge-based economy. So, the importance of photonics makes it mandatory for a proper policy to be chalked out by the Department of Science and Technology, Govt. of India to ensure that there is enough support for photonics research and utilization of developed technologies to make a real impact on our nation's developmental goals in the scientific, industrial and societal realms.

### **What is to be done?**

In order to facilitate focused, multidisciplinary, inter-institutional research in photonics, it is proposed the following:

1. To establish a **Photonics Mission** with large funding like that a **Nano-mission** by DST
2. Organising regular schools and workshops to undergraduate and graduate students, and college and university academic personnel.
3. Fund has to be made available to state level universities and well recognized post graduate colleges (where a majority of the bright talents study) having research environment.
4. Allocating research funding on the basis of high-level peer review
5. Regular monitoring of approved projects.
6. Creating awareness of, and facilitating the safeguarding of intellectual property rights arising out of photonic R&D activity within the country.
7. Facilitating regular interactions between laboratories such that resources in various institutions are utilized to the optimum.



## PLANT SCIENCES

Realizing the SSR initiative in rural perspective following recommendations emerged:-

1. Efforts should be made to identify economically important plants occurring in waste- / polluted- / inhospitable- lands to explore their prospects for plantations as secondary crops in the native habitats as a scientific social responsibility
2. Necessary emphasis be laid to community empowerment through employment generation to rural communities in greening of green energy through conservation of natural resources (water, soils, green cover) for optimum utilization and promotion of native crops as a subsystem of ecosystem without destroying the ecosystem.
3. In order to prioritize and shortlist species for medicinal plants cross cultural ethnobotany be started.
4. Educational institutions in the given phytogeographical areas may be entrusted to educate local communities to conserve select species based on the information made available through science of floristics, environmental botany, chemical ecology, plant-insect-animal interaction biology.
5. To combat imminent threat of invasive species to natural flora, awareness programmes need to be undertaken to educate local communities to get rid of alien plants vis-à-vis conservation of natural flora.
6. Necessary research programmes be strengthened for development of non-conventional agro-technologies both by development of new varieties as well as use of innovative cultural practices based on biological fertilizers, microbial stimulants etc. relevant to rural India.
7. Basic studies need to be undertaken on prospecting of trait specific genes, tissue and cell specific localization of useful bioactive principles, therapeutic potential of endophytes, exploration of phytochemicals for suitable formulations and product development under Make in India in rural India.

## RECOMMENDATIONS

### CONCLAVE OF THE VICE CHANCELLORS:

1. E -Governance should be adopted in all the Universities leading to paper less administration as early as possible.
2. The Vice Chancellor to be appointed in the Universities should be a Visionary, an inspirer of Faculty and a Chief Fund raiser to the university.
3. There is a need to bring in the system of Accountability at all levels in the University.
4. Evolve a system of appointing the best faculty in the University.

5. University should enjoy more autonomy with proper Accountability.
6. Universities should adopt extension activities to address societal problems with the involvement of all the students. The spirit of these activities should meet the aspirations of PURA concept given by the earlier President of India late Dr APJ Abdul Kalam.
7. In order to get good students to science stream to Higher Education the Universities may adopt programs to have intervention at lower levels like Secondary and higher secondary levels.
8. A seminar to be organized by FVCK with the involvement of all stakeholders to suggest for comprehensive amendments to the KSU Act.

### **FARMERS SCIENCE CONGRESS**

1. Farmers Science Congress should be a regular feature in the every Indian Science Congress event to facilitate farmers-scientists interaction and mainstreaming of farmers innovations.
2. ICAR may create a corpus fund in the name of Farmers Innovation Fund to felicitate farmers' innovations and extend financial support to test, validate and upscale the innovative ideas of farmers.
3. Scientific validation of farmers' innovations may be taken up by the ICAR/SAU research system on a regular basis.
4. Integrated farming system models identified by ICAR and SAUs and those being practiced by farmers need to be replicated with focus on reducing farmers distress and inducing sustainability to the farming systems.
5. Impact of climate change on agriculture and allied activities is a reality which needs to be understood in totality and has to be addressed in a multidisciplinary approach.

### **WOMEN SCIENCE CONGRESS**

- To meet the Climate Change Challenges in Urban and Rural areas / Building of Environmental Infrastructure for preserving forest and biodiversity at higher altitudes
- Identification of Unexploited Citrus diversity of Manipur
- Geotextile and Nano Science from plant & plant products
- Mulberry cultivation –Environmental Safe Guard
- User friendly Semi-automatic bioreactors for tissue culture to increase plantlets
- Women friendly environmental policy
- Women and nutrition- for better women health.