

RECORD NOTE OF
DIRECTIVES, DELIBERATIONS
AND
MAJOR RECOMMENDATIONS

Emanating from the
96th Indian Science Congress



Organized at
North-Eastern Hill University
Shillong

January 3-7, 2009

List of Acronyms

ABS	:	Anthropology and other Behavioural Science
AFS	:	Agriculture and Forestry Sciences
AVFS	:	Animal, Veterinary and Fishery Sciences
BARC	:	Bhabha Atomic Research Centre
CSIR	:	Council of Scientific and Industrial Research
DRDO	:	Defence Research and Development Organisation
DST	:	Department of Science and Technology
ENGS	:	Engineering Sciences
ENVS	:	Environmental Sciences
ESS	:	Earth System Sciences
FAIR	:	Facility for Antiproton and Ion Research
GDP	:	Gross Domestic Product
GM	:	Genetically Modified
ICST	:	Information and Communication Science and Technology
ISRO	:	Indian Space Research Organisation
LHC	:	Large Hadron Collider
MAS	:	Mathematical Sciences (including Statistics)
MATS	:	Materials Science
MEDS	:	Medical Sciences
NER	:	North-East Region
PLS	:	Plant Sciences
R&D	:	Research and Development
S&T	:	Science and Technology

Directives from the Address of the Hon'ble Prime Minister Dr. Manmohan Singh

- ❖ Modern Science and Technology must be used to convert natural endowments into economic benefits of the North Eastern Region
- ❖ The challenge before us is to ensure that the light of modern education touches all, and at the same time the pursuit of excellence is encouraged and cherished.
- ❖ The leadership for qualitative development of the S&T sector must come from the S&T community. We need a new generation of models and leaders. He urged that scientific institutions must be led by intellectual leaders irrespective of age.
- ❖ Our Universities must do more to foster a research environment. We need strengthening of institutional leadership in Universities and research institutions.
- ❖ The S&T community must contribute to the gigantic national effort to build a truly knowledge based society and a science-based economy.
- ❖ Industry must invest into R&D so that young people will be encouraged to seek career in science
- ❖ Partnership with the corporate sector must be encouraged to promote privately funded research.
- ❖ The congress must come forward with new ideas for promotion of science in the region



Directives from the Address of the Hon'ble Union Minister of Science and Technology and Earth Sciences Shri Kapil Sibal

- ❖ A liaison office the Ministry of Science and Technology for linking the programmes of the Government of India to the development of the NER will be set up at Shillong
- ❖ Support to Basic research must be strengthened further
- ❖ De-bureaucratization of scientific management is essential to create a favourable innovation eco-system. Science and Engineering Research Board (SERB) must form such a vehicle
- ❖ The evolving knowledge economy should provide for constant up-gradation of knowledge and skills
- ❖ Schools, Universities and training institutes should anticipate and prepare curricula to suit the needs of the day
- ❖ We must integrate human dimensions of global changes with the physical-chemical-biological dimensions.
- ❖ We need to invest more in education to ensure that we can avail of a critical mass of educated human resource to meet the complex challenges confronting us.
- ❖ My constant attempt has been to create a favourable innovation ecosystem where scientific management is practiced in a de-bureaucratic ambience.



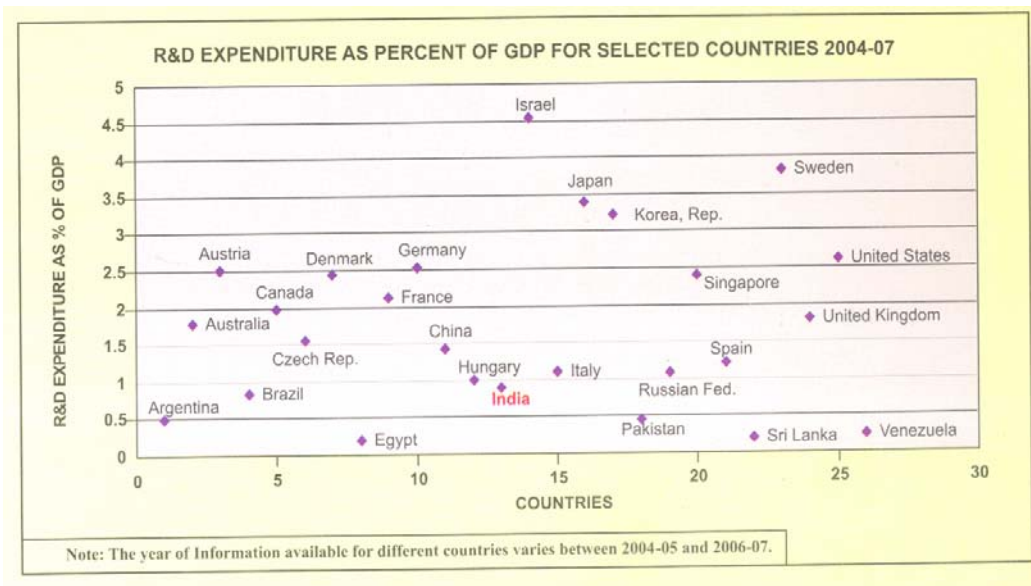
- ❖ It is my belief that government acts as a facilitator in institutionalizing knowledge acquisition, but the locus of learning rests in enterprises, both public and private.
- ❖ The teaching of science also needs to be refined substantially. We must help students develop skills of procuring information and its analytical examination.
- ❖ Researchers in basic sciences need to be respected and valued just as their counterparts in industrial research. Society needs them.
- ❖ Issues of environmental pollution, climate change have assumed alarming proportions. We require investing hugely in research and finding solutions to environmental problems.
- ❖ We should organize a few frontline mega international science programmes and draw participation of scientists from around the world.
- ❖ Public investment in science as well as allocations of resources must be tied to expected outcomes that are beneficial to society.
- ❖ A new social contract conducive to establishing an egalitarian society is needed that helps to tackle and solve the monumental problems of society such as climate change, health, energy, food and terrorism.
- ❖ We should be doing much more in order to proliferate scientific literacy widely and pervasively about certain complex issues as GM foods, stem cell research, cloning, and nuclear energy.

Deliberations from the Presidential Address of Dr. T. Ramasami, General President, Indian Science Congress Association

- ❖ Science, Technology and Innovations have emerged the main mantra of the modern world and knowledge economies.
- ❖ During the last quarter of the twentieth century, technology and innovations have entered the center stage of global Research & Development sector.
- ❖ Investments into Research and Development have started assuming an important benchmark for calibrating the National preparedness for meeting the emerging challenges of the global knowledge economies. International comparison of Indian Investments into R&D as percentage of GDP with other countries is given below.



(source: Research and Development Statistics at a Glance 2007-08, Department of Science & Technology, page 12)



- ❖ Most developed economies invest about 2-5% of GDP in research and development. Indian spending on R&D is nearly 1% but the government has proposed to invest about 2% of GDP into Research and Development.
- ❖ Correlations are also feasible between investments into R&D and outputs in the form of patents and PhD students trained. Qualitatively such correlations reveal that the return on dollar invested into Indian R&D system is relatively high.
- ❖ However, on absolute terms, Indian competitiveness as a Nation is low in the world of science.
- ❖ The relatively weaker competitiveness of India in the world of Research and Development can be traced to the sub critically smaller size of the R&D base. Our R&D base may need to be at least trebled within the next five years.
- ❖ Data on S&T output indicators reveal the essentiality of planned interventions for promotion of education and research in areas like mathematics, computer science and social sciences. A concerted effort to couple natural and social sciences is called for.
- ❖ Comparison of global data on S&T professionals, per million population reveals a grossly mismatched size of our R&D base. With a ratio of well under 150 per million, we do not compare favorably with either emerging or developed economies in the size of our R&D base. Corresponding ratios for most competing economies are in the range of 800-4500.
- ❖ The realization of our Vision 2020 calls for a planned expansion of the National R&D base as well as the development of a new educational and research system. This would call for
 - a) attraction of talent to study science and careers with research,
 - b) review and revisit systems of science education,

- c) expansion of the R&D base through both policy interventions and programme initiatives, and
 - d) a more active engagement of Public-Private Partnerships in Research and Development Sector.
- ❖ The Government has initiated several enabling and proactive measures during the last four years.
 - ❖ Honorable Pradhan Mantriji launched on 13th December 2008 a new Scheme, “Innovation in Science Pursuit for Inspired Research” called INSPIRE. It is a proactive initiative for attracting talent to study science through a long term programme.
 - ❖ Most developed countries are constantly reviewing their systems for imparting science education and reformat them to suit changing needs.
 - ❖ Students express lack of excitement in our science education. They seem to feel an overload of syllabus and content. Different approaches to teaching science for promotion of excellence in research may well be required in comparison to building scientific approaches to learning as a whole.
 - ❖ Among the students of science in the current generation, there are some apprehensions that science education is divorced from the realities of life. Inadequate practical experience in learning fundamental principles is considered a limitation by the youth.
 - ❖ While our education system trains our youth to answer questions, questioning answers is the most fundamental step for excellence in research. In order that questioning mindset is promoted and curiosity is awakened, the education system may need to review the emphasis on the quantum of the content and recital of known information as against the promotion of analytical strength amongst our youth.

- ❖ Inspiring youth in learning to learn and learning to create appears to be the main challenge ahead of our educational system today.
- ❖ Rejuvenation of research in Universities is a critical step for accelerating the development of the S&T systems. We need to strengthen the coupling between science education and excellence in research in the University sector through planned interventions.
- ❖ A recent study has shown that 35 institutions have contributed to about 47% of publications from India during 1996-2006. From amongst them, 14 are universities.
- ❖ The Ministry of Science and Technology has mounted a special scheme for Promotion of University Research and Scientific Excellence, (PURSE). The Scheme provides incentive grants to Universities based on research performance.
- ❖ Our private sector needs to play a more proactive role rather than being a beneficiary of the education system. They will have to play the role of a partner in educating the youth of the Nation for meeting future challenges.
- ❖ Recently, the Ministry of Science and Technology has mounted special Fellowship Schemes for promoting doctoral research in computer sciences and medical electronics in association with NASSCOM and medical electronics industrial sector, respectively. India may need more such initiatives under Public Private Partnerships.
- ❖ Policy interventions are required to scale up successful examples of Public Private Partnerships for creating innovations and technology leaderships.
- ❖ Knowledge economies depend on the strength of Research and Technology systems. Innovations, as first application of concepts, form differentiating strength in competitive world. Ability to innovate and access innovations with commercial

advantages will determine the future growth potentials of Nations.

- ❖ The world has selected a technocratic-push model for promoting innovation systems. The process of innovation seems the most focused priority in the global competition.
- ❖ Quality science education and attraction of talent to careers with research are critical requirements for promoting excellence in research.
- ❖ The Annual session of the Indian Science Congress has been convened in the salubrious location of Shillong, for the first time in the North Eastern Region.
- ❖ I owe my contributions to my teachers and mentors. I thank them all on this special occasion.

OUTCOMES OF MISSION MODE R&D AGENCIES

- ❖ The national outcomes of CSIR have been showcased through a special session at the science congress
 - Importance of some initial research results from CSIR laboratories and CSIR 800 programmes has been stressed.
- ❖ The public face of DRDO as an organization with a commitment to deliver applications of science in a time bound manner has been highlighted.
- ❖ Details of Chandrayaan I exploration have been presented. Some Initial data from the moon mission revealing the surface morphology of moon hitherto unobserved has been shared



CSIR Adapting to Changing Needs

- ❖ **Glorious Past**
 - ◆ Foundation of R&D in the country
 - ◆ Making country self-sufficient in key sectors
 - ◆ Solution to some basic nagging problems
- ❖ **Challenging Present**
 - ◆ Making India proud in High Science
 - ◆ Catalyzing industrial growth
 - ◆ Nurturing Human Resource in S&T
 - ◆ Pioneering India's Intellectual Property Movement

❖ **Promising Future**

- ◆ S&T intervention for inclusive growth through: potable water for all, low cost nutrition alternatives, affordable drugs, diagnostics and biomedical instruments, wealth from waste and sustainable energy
- ◆ Unleashing Indian S&T programme through innovative public-private partnership models for meeting global challenges

Public Face of DRDO

- ❖ Public face of DRDO as focused research organization has been presented
 - Ensuring peace in non conventional environment
 - Building strength in extreme environment (high altitude, vector control and water quality)
 - Key Technologies (NBC, SATCOM, Fuel cell, Biodiesel, health, water and food)
 - Biomedical and technological applications (New materials and methods)
 - Societal missions in NER development- Ecofriendly technologies)
 - Water, health, energy and food security

Accomplishments and Path forward of ISRO

- ❖ Special session on Chandrayaan 1 presented by theme leaders of ISRO
 - Some images received were presented
 - Space mission and plans of ISRO up to 2025 were revealed. This included
 - Manned moon mission and Mars mission
 - Connecting moon mission to applications for societal programmes

Recommendations from Panel on Climate Change



- ❖ In view of the complexity of the climate change , the responses are required on the three aspects (High resolution climate modeling, Innovative energy technologies (hydro, renewable, nuclear) and Adaptation strategies
- ❖ Building of large computing power and needs for plan for low carbon future, policy frame work for insurance and financing adaptation, public awareness and education on food security, Job expansion programs in rural area to combat urban inflow, Renewable energy sources for rural development (solar) have been stressed.
- ❖ A School on BARC model for developing human resource on adaptation and mitigation of climate change and changes in life style pattern recommended

Recommendations from Public lectures



- ❖ Passion for pursuit of science is essential. Excitements in learning and teaching science must be rekindled through active programmes.
- ❖ Space research is exciting. Human Resource building for accomplishment of India's space objectives is essential.

- ❖ Establishment of a center for promotion of biovillage concepts and HRD initiatives in the NER
 - 2000 fellowships for MSc and PhD level education of youth from NER is recommended for sustaining the research establishments in the NER
- ❖ Composite culture of learning science with art may be promoted for linking passion and joy of learning science
- ❖ Indian Science Congress should develop a road map for developing mission mode research programmes in consultation with agencies and universities
- ❖ A mentoring programme for 50 school children with young scientists and for 200 teachers with 200 scientists may be arranged

Recommendations from the Frontiers in Science Seminar

- ❖ Institution of Post doctoral fellowships with flexibility as a National initiative
- ❖ Improved access to R&D facilities for doctoral students even at the fear of frequent breakdown to be promoted
- ❖ Easier facilitation for accessing the provisions of ongoing national programmes through management support systems
- ❖ Need for some institutional level cultural changes for academic pursuit has been stressed.

Recommendations from special Sessions

❖ Mega science

- India must actively participate in global mega science projects like LHC and FAIR and lead the establishment of Indian Neutrino Observatory (INO) in India

- Engagement in the International dialogue on mega science projects must continue more aggressively

❖ **Astronomy and Astrophysics**

- Parallel effort to develop indigenous capacity for large facilities for astronomy in India and participate as a member in international projects on mega telescopes namely Giant Segmented Mirror Telescope and Square Kilometer Array must be made. The initiatives of DST for the preparation of Detailed Project Report for the participation of India in large and global telescope facilities must be supported.

❖ **Teacher mobilization**

- Project based learning for relating education to real life experience must be promoted. Educators must be enabled with local examples. Some carefully designed in service training programmes will be gainful.
- PPP initiatives for teacher mobilization have been stressed

Women in Science

- ❖ Measures for Global capacity building: Gender equity, Access to information, Retention of girls in leaky pipeline, specially at the tertiary and mid-career level
- ❖ Technological Empowerment of Women at the grass-roots essential: Training of the trainers, setting up Knowledge Centres, Institutional framework, Generating a cadre of women scientists and engineers, empowering women at the grass-roots, Community base projects

- ❖ Skill empowerment: to ensure livelihood at the grass root level, identification and development of appropriate technologies, establishing training and mentoring centres, promoting entrepreneurship development, ensuring financial assistance and setting up knowledge centres
- ❖ National Data Bank and Road map: on women in Science and implementation of gender auditing recommended

Recommendations from special Sessions

Children Science Congress and Science Communication:



❖ Science Exhibition from Children Science Congress and other streams

- There is a need to enhance the content of scientific principles embedded in the project exhibits.
- Review of the children science congress modalities and possible mentoring support for about 10-15 successful teams with young researchers through institutional arrangements
- Present effort on science communication could be reshaped to address theme based science communication(for e.g climate change, S&T measures for combating terrorism)



S&T Issues of North Eastern Region:

Biodiversity Conservation and Traditional knowledge

- ❖ Biodiversity of India mapped. India being one of the 12 global hotspots in Biodiversity, all measures for conservation and protection to be undertaken. Frame work on global agreements on biodiversity conservation detailed, goal accelerated research on biodiversity of NER recommended
- ❖ Parasitic infections on life forms particularly in livestock highlighted. Vermicidal and Vermifungal and Medicinal values of some plants from NER and actions against parasites were stressed.
- ❖ Plants endemic to the region stressed. Critically endangered species of bamboos were mentioned. Wild ornamentals offer an opportunity. More than 450 of 960 medicinal plants in trade originate from NER. Conservation of plants in high trade should be ensured. Capacity building in Taxonomy stressed. Establishment of forest gene banks and data bases proposed.
- ❖ Ecosystems of NER offer rice cultivation. One crop per year is practiced. Productivity per hectare in various states has been presented. 3967 rice germplasm have been collected. Tallest rice plant of the world is reported in NER. In-farm conservation of rice varieties recommended
- ❖ Traditional Knowledge Systems (TKS) of agro forestry and livelihood highlighted. Disease management of betel in Meghalaya without pesticide highlighted. Roles of traditional knowledge and modern management of resources stressed.
- ❖ TKS specific to Meghalaya stressed. Return of natural remedies is indicated. Benefits of Diversity of knowledge

systems are emphasized. Formation of Scientific Advisory committee to the state is recommended.

- ❖ A nodal center for conservation and protection of biodiversity along the models of bio-village to be established in Shillong
- ❖ National Commission on Indigenous knowledge to be established
- ❖ Formation of State level Scientific Advisory Councils for all the states in the NER
- ❖ Capacity building programmes in science education and introduction of project based learning on biodiversity to be strengthened

Natural Disaster management, clean energy and the Panel discussion on S&T for NER states

- ❖ Disaster management
 - Applications of space technology in management of natural disasters stressed. Remote sensing in observation, information for decision and decision for action systems could play an important part. R&D requirements of drought-like situations in NER to be connected to weather patterns under changing circumstances stressed. Landslide linkages between rain and earthquake have been related. Facilities for forewarning of natural disasters in NER have been created in the space applications center.
 - Technological frame work and insurance systems to back disaster management and mitigation as well as fiscal policy instruments like tax-exemption for investments made in insurance suggested

Recommendations from Sectional Committees

Environment and Climate Change:

- **Climate change** will have serious adverse effects on Indian agriculture. Resource-conserving technologies involving zero- or minimum tillage, laser aided land leveling, crop residue management and crop diversification can help in mitigation and adaptation to climate change. (AFS)
- **Water Management:** Water is already a scarce resource and is going to be scarcer in future. To solve this impending crisis there is an urgent need to increase water use efficiency, prevent wasteful and ecologically harmful use of water and harness the benefits of the technologies such as laser-aided land leveling and drip irrigation through their rapid transfer. The productivity of rain-fed areas could be enhanced through integrated watershed management. (AFS)
- **Goals of Environmental Integrity:** For environmental integrity it was suggested to set following goals: (ENGS)
 - a. 24/7 Water supply
 - b. 100 % access to sanitation
 - c. Zero open defecation
 - d. SWM – collection, treatment and disposal
 - e. Eco-friendly industrial processes
 - f. Reduction in travel need
 - g. Restoration of habitat for all living being, and
 - h. Mass Societal Awareness to Consciousness to make all technological inputs creditworthy/bankable, financially stable and inclusive
- **Collaboration in Environmental Management:** Universities and National institutes be encouraged to collaborate with NGOs, Environmentalists and Mass media personnel to generate awareness for Environmental management especially to replace the use of chemical fertilizers, pesticides and other toxic compounds with more eco-friendly bio-fertilizers and bio-pesticides etc. (ENVS)
- Active environmentalists be involved to train Rural mass depend more on the locally available bio-resources to generate their livelihood. (ENVS)

Biodiversity:

- **Biodiversity:** Mechanism needs to be developed for regular monitoring of the status of all types of biodiversity in the country with a view to conserve and ensure sustainable utilization for rural livelihood. Bio-resources are the wonderful gift of the nature to society, whose sustainability can be effectively linked to rural livelihood and economic development, so science education should aim at attracting talent for proper management and sustainable utilization of bio-resource. Steps should also be taken to mitigate looming dangers of climate change. (AVFS)
- **Exploration:** Programmes needs to be initiated for the exploration of other less known potential varieties of life forms with a view to ensure livelihood and food security. (AVFS)
- **Horticulture:** Scientific work on introduction of temperate fruits on right varieties/healthy bud wood shall be carried out for introduction in N.E. region. The possibility of cultivating wild edible mushroom shall be explored for helping the prosperity of farmers through plants and adding to food and nutritional security. NE region has very rich biodiversity, hence, rare and beautiful orchids shall be exploited for commercial production. (PLS)

Education, Training and Attraction of Talents:

- **Revision of Syllabi:** Emphasis on strengthening of classical zoology in the syllabus of UG and PG programs, as it is not reflected in the new UGC syllabus. (AVFS)
- **Attraction of Talent:** In order to make India a science based society urgent steps need to be taken to avoid early exclusion of talent from science stream at 10 + 2 level, instead be given comprehensive science education encompassing all the streams of sciences till graduation level. Science policies to need to be developed with the objective of attracting young talents. (AVFS)
- **Earth Science** education should be introduced at Pre-university level. (ESS)
- **Curriculum:** The young children should be attracted with the capabilities of science through their school curriculum. In order to allow matching of the inclination of students we should introduce more flexibility of choice of subjects. We also need to introduce Flexible and multi choice higher education system in science. Fundamental science studies have to be made more remunerative in order to strengthen the foundation of core science education. (ENGS)

- **Education:** A compulsory paper of Environmental Economics is introduced in the Universities at Degree level to impart training in cost effective eco-friendly environmental management using local resource. (ENVS)
- To attract talent in the field of Research on Materials, sufficient publicity should be given among the institutions. (MATS)
- Woman scientists/Research Scholars must be given due encouragement providing incentives. (MATS)
- **Training Programme:** Government should set up a cell/unit to organize and monitor special training programmes for
 - School teachers to improve their skills to teach mathematics in a more rigorous manner.
 - College teachers to be given training in various identified thrust areas of mathematics.
 - University teachers to take up new and challenging research problems to meet the expectations of international research community. This gains more importance in view of the fact that India shall host the forthcoming ICM (International Congress of Mathematicians) in 2010.
 - College / University teachers to help them in preparing proposals to organize various kinds of activities during “India Mathematics Year 2009 as pre-ICM 2010 activity”. (MAS)
- Liberal funding be made available to research scholars and young researchers to participate in International Conferences. Participation in a conference should be given equal weightage even if paper has not been presented. Such participation should be considered as a part of training programme. (MAS)
- **Examination:** Examination pattern of secondary level should be modified in a way so as to highlight their knowledge and understanding of real life applications of mathematical sciences. (MAS)
- **Curriculum:** Efforts must be made to develop suitable courses in integrated Botany both at U.G. and P.G. levels to foster scientific development in Botany on the lines of modern biology. (PLS)

Health:

- **Awareness about general health:** Although during the last few decades, the general health situation of the population has been improved but, there is still a large gap in general health between the privileged and underprivileged group (be it gender, caste and class). Imparting education and bringing awareness among the people can bridge this gap. (ABS)

- **Awareness on obesity:** Researches reveal that in India, obesity is emerging as a major health problem of the urban population. A changed lifestyle (measured in terms of food habit, work pattern, stress and so on) of the urban people is one of the major concomitants to this problem. More in depth researches are needed to address this issue. (ABS)
- **Preservation of medicinal plants:** In the wake of rise in price of western medicine, the poor people of this country are finding difficulty in treatment of diseases. Since India has tremendous floral reserve and has a history of using medicinal plants for therapeutic purpose, it is essential to promote such use. In the last five year plan, the government of India has also recognized the importance of promoting and preserving medicinal plants. Thus, future researches should attempt to develop strategies by which the indigenous people of this country can be educated and made aware about the importance of preserving the medicinal plants. (ABS)
- **Research:** Recommended to give emphasis on the research on developing affordable vaccines, remedial measures to combat different public health problems. Also researches on lifestyle changes particularly dietary management and nutraceutical interventions be encouraged. (MEDS)
- **Work Place:** Recommended to have suitable designs of work place and work environment along with tools and equipment for making the work place humane healthy and productive. (MEDS)

Agriculture and Forest Management:

- **Customized Fertilizers:** The development of site- and crop-specific customized fertilizers considering plant requirement and nutrient use efficiency in boosting yield is extremely desirable due to widespread deficiencies of micronutrients. (AFS)
- **Soil Resource Inventory:** Soil resource inventory using remote sensing and GIS tools at block/village/watershed levels and integration of this data-base with socio-economic scenario should be developed for sustainable land use management. (AFS)
- **Pesticides:** Judicious use of pesticides in accordance with the principles of integrated pest management (IPM) should be promoted. (AFS)
- **Farm Mechanization:** Farm mechanization is extremely important to increase agricultural productivity. The technologies which can be taken to farmers' field are zero-till drill, raised bed planter, rice transplanter, power weeder, aero-blast sprayer, vertical conveyor reaper, and harvester. (AFS)

- **Post-Harvest Awareness:** Creation of awareness on post harvest management and value addition in horticultural crops and capacity building should be promoted. Creation of post harvest infrastructure facilities (pack house, storage, primary processing) close to production site is needed. (AFS)
- **Forest Management:** A completely independent and autonomous cadre/ institution for focused forest research should be created. Forest management and research and development should be segregated from each other. (AFS)
- **Technology Transfer:** Promotion of field tested ecosystem specific production technologies and their speedy transfer to the potential user. (AVFS)
- **Post-Harvest Technology:** Post harvest technological advances and appropriate access to markets be developed to encourage local farmers/cultivators. (PLS)
- **Medicinal Plants:** Systematic assessment of important plants including medicinal plants shall be carried out on a holistic basis. (PLS)
- **Cultivation:** Cultivation of edible bamboo may be popularized in different parts of the country. Documentation of important plants from N. E. region producing non-edible oil may be undertaken to promote bio-fuel production. Then cultivation practices and seed stock be developed for large scale exploitation. Emphasis may also be given for utilizing the arid-zone and other waste lands for plantation of non-edible bio-fuel resources. (PLS)

Networking, Information and Communication Technology:

- **ICT Technologies:** Forecasting and early warning systems coupled with information and communication technologies and crop insurance schemes will be very useful in minimizing risks of climatic adversaries and in developing contingency plans. Strengthening of Govt. institutions, private sectors, NGOs and farmers' linkages should be expedited for enhancing agro-technology delivery. Application of ICT in Indian agriculture including satellite-based distance education could be a major step in this direction. (AFS)
- **Networking:** Networking of academic institutions dealing with animal science education for effective utilization and sharing of infrastructure facilities, expertise and experience. To harness the potential of regional expertise and experience of south Asia, it was recommended to form a network of professional societies of South Asia. (AVFS)
- **Green Computing:** The focus on Green Computing Concept in Academics and Business Environment, Plan necessary measures for implementation of e-waste management. Steps should be taken for

starting Green Computing as an additional subject at the school level and for building awareness towards energy saving and energy management amongst people in all walk of life. (ICST)

- **Research:** To promote research activity in the area of palm-vein authentication process for identification of human features for security purpose. More thrust is needed on research activity in the area of Electronics and Communication Engineering at post graduate level. (ICST)

Final Recommendations from the 96th Indian Science Congress

1. Science Education systems at various levels must be reviewed and special schemes for attraction of talent for excellence in research though the newly launched INSPIRE must be strengthened through the participation of the community.
2. HRD initiatives for space, agriculture, industrial research must be further strengthened
3. Further strengthening of ongoing Indian initiatives on mega science, astronomy and astrophysics, women in science is supported.
4. New models for PPPs in science education as well as research and development
5. Teacher motivation and enabling systems including in-service training, teaching tools from local examples, project-based learning systems and implementation of some recommendations of the Inter-academy panel on new educational models
6. Formation of scientific advisory councils to the states in the NER for promotion of science and technology in the region. ISCA recommends that such councils may be formed by other states as well.
7. A special package for relating science education and promotion of research in the NER may be developed and resources made available through a special grant
8. Approaches for an evidence-based budgeting and policy building
9. Right sizing and expansion of R&D base in both public and private sector
10. Increased career opportunities in S&T sector for the youth and
11. Introduction of Performance Related Incentive Systems for the S&T staff



Recommendations OF 96th Indian Science Congress **(as received from Sectional Presidents)**

1. General Recommendations to the Government

Agriculture and Forestry Sciences

- Climate change will have serious adverse effects on Indian agriculture. Resource-conserving technologies involving zero- or minimum tillage, laser aided land leveling, crop residue management and crop diversification can help in mitigation and adaptation to climate change. Forecasting and early warning systems coupled with information and communication technologies and crop insurance schemes will be very useful in minimizing risks of climatic adversaries and in developing contingency plans. However, the envisaged mitigation and adaptation of agriculture to climate change will require enhanced awareness and skills of the stakeholders and would need substantial financial support from national and international organizations.
- Water is already a scarce resource and is going to be scarcer in future. To solve this impeding crisis there is an urgent need to increase water use efficiency, prevent wasteful and ecologically harmful use of water and harness the benefits of the technologies such as laser-aided land leveling and drip irrigation through their rapid transfer. The productivity of rainfed areas could be enhanced through integrated watershed management.
- The development of site- and crop-specific customized fertilizers considering plant requirement and nutrient use efficiency in boosting yield is extremely desirable due to widespread deficiencies of micronutrients.
- Soil resource inventory using remote sensing and GIS tools at block/village/watershed levels and integration of this data-base with socio-economic scenario should be developed for sustainable land use management.
- Judicious use of pesticides in accordance with the principles of integrated pest management (IPM) should be promoted.
- Farm mechanization is extremely important to increase agricultural productivity. The technologies which can be taken to farmers' field are zero-till drill, raised bed planter, rice transplanter, power weeder, aero-blast sprayer, vertical conveyor reaper, and harvester.
- Creation of awareness on post harvest management and value addition in horticultural crops and capacity building should be promoted. Creation of post harvest infrastructure facilities (pack house, storage, primary processing) close to production site is needed.

- A completely independent and autonomous cadre/institution for focused forest research should be created. Forest management and research and development should be segregated from each other.
- Strengthening of Govt. institutions, private sectors, NGOs and farmers' linkages should be expedited for enhancing agro-technology delivery. Application of ICT in Indian agriculture including satellite-based distance education could be a major step in this direction.

Animal, Veterinary and Fishery Sciences

1. Emphasis on strengthening of classical zoology in the syllabus of UG and PG programs, as it is not reflected in the new UGC syllabus.
2. Networking of academic institutions dealing with animal science education for effective utilization and sharing of infrastructure facilities, expertise and experience.
3. Bio-resources are the wonderful gift of the nature to society, whose sustainability can be effectively linked to rural livelihood and economic development, so science education should aim at attracting talent for proper management and sustainable utilization of bio-resource.
4. Mechanism needs to be developed for regular monitoring of the status of all types of biodiversity in the country with a view to conserve and ensure sustainable utilization for rural livelihood.
5. Programmes needs to be initiated for the exploration of other less known potential varieties of life forms with a view to ensure livelihood and food security.
6. Promotion of field tested ecosystem specific production technologies and their speedy transfer to the potential user.
7. In order to make India a science based society urgent steps need to be taken to avoid early exclusion of talent from science stream at 10 + 2 level, instead be given comprehensive science education encompassing all the streams of sciences till graduation level.
8. Science policies to need to be developed with the objective of attracting young talents.
9. Steps should also be taken to mitigate looming dangers of climate change.
10. To harness the potential of regional expertise and experience of south Asia, it was decided to form a network of professional societies of South Asia entitled "South Asia Regional Association of Animal Science Societies". Initially the Zoological Society of India (ZSI) will work as convener to coordinate with similar societies of SAARC countries in the larger interest of the people of the region. Dr. Saifuddin Shah, Vice Chancellor, Khulna University has volunteered to work as nodal officer for Bangladesh.

Earth System Sciences

1. Earth Science education should be introduced at Pre-university level.

Engineering Sciences

1. The young children should be attracted with the capabilities of science through their school curriculum.
2. Flexibility of choice of subjects to be ensured to allow matching the inclination of the particular student.
3. Fundamental science studies have to be made more remunerative in order to strengthen the foundation of core science education.
4. We also need to introduce Flexible and multi choice higher education system in science.
5. For environmental integrity the goals set by different speakers together are as follows :
 - a. 24/7 Water supply.
 - b. 100 % access to sanitation
 - c. Zero open defecation
 - d. SWM – collection, treatment and disposal.
 - e. Eco friendly industrial processes.
 - f. Reduction in travel need.
 - g. Restoration of habitat for all living being.
 - h. Finally Mass Societal Awareness to Consciousness to make All Technological Inputs Creditworthy / Bankable, Financially stable and Inclusive.

Environmental Sciences

1. Universities and National institutes be encouraged to collaborate with NGOs, Environmentalists and Mass media personnel to generate awareness for Environmental management especially to replace the use of chemical fertilizers, pesticides and other toxic compounds with more eco-friendly biofertilizers and biopesticides etc.
2. A compulsory paper of Environmental Economics is introduced in the Universities at Degree level to impart training in cost effective eco-friendly environmental management using local resource.
3. Active environmentalists be involved to train Rural mass depend more on the locally available bio-resources to generate their livelihood.

Information and Communication Science and Technology (including Computer Sciences)

1. The focus on Green Computing Concept in Academics and Business Environment, Plan necessary measures for implementation of e-waste management.
2. To start Green Computing as an additional subject in the school level for building awareness towards energy saving and energy management amongst all walk of life.

3. To promote research activity in the area of palm-vein authentication process for identification of human features for security purpose.
4. Thrust to provide on research activity in the area of Electronics and Communication Engineering at post graduate level.

Material Science

- 1). To attract talent in the field of Researsearch on Materials, sufficient publicity should be given among the institutions
- 2) Irrespective of number of applicants, maximum number of students/Research scholars may be provided T.A/D.A and be waived the registration fee,
- 3) Woman scientists/Research Scholars must be be given due encouragemnet providing incentives.
- 4) There are few papers from National laboratories, reasons for it may be sorted out.
- 5) Engineering and Physics sections must see that there is no overlapping of topics being covered.

Mathematical Sciences (including Statistics)

1. Liberal funding be made available to research scholars and young researchers to participate in International Conferences.
2. Participation in a conference should be given equal weightage even if paper has not been presented. Such participation should be considered as a part of training programme.
3. Government should set up a cell / unit to organize and monitor special training programmes for
 - i) School teachers to improve their skills to teach mathematics in a more rigorous manner.
 - ii) College teachers to be given training in various identified thrust areas of mathematics.
 - iii) University teachers to take up new and challenging research problems to meet the expectations of international research community. This gains more importance in view of the fact that India shall host the forthcoming ICM (International Congress of Mathematicians) in 2010.

- iv) College / University teachers to help them in preparing proposals to organize various kinds of activities during “ India Mathematics Year 2009 as pre-ICM 2010 activity”.
4. The activities like “School Teachers” Training Workshop on Mathematics” organized at 96th ISCA session should be held more frequently with a wider publicity.
 5. Programmes should be organized/ liberally funded for interaction between secondary level teachers and graduate level teachers so as to fill up the gap between the curricula of two standards.
 6. Interdisciplinary projects should be encouraged and financially supported in order to promote research capabilities of researchers of various branches of science.
 7. Examination pattern of secondary level should be modified in a way so as to highlight their knowledge and understanding of real life applications of mathematical sciences.
 - 8.

Medical Sciences (including Physiology)

1. Recommended to have suitable designs of work place and work environment along with tools and equipment for making the work place humane healthy and productive.
2. Recommended to give emphasis on the research on developing affordable vaccines, remedial measures to combat different public health problems.
3. Recommended that researches on lifestyle changes particularly dietary management and nutraceutical interventions be encouraged.

Plant Sciences

1. Scientific work on introduction of temperate fruits on right varieties / healthy bud wood be carried out for introduction in N.E. region.
2. Work out the possibility of cultivating wild edible mushroom for helping the prosperity of farmers through plants and adding to food and nutritional security.
3. Systematic assessment of important plants including medicinal plants be carried out on a holistic basis.
4. Rare and beautiful orchids be exploited for commercial production.
5. Post harvest technological advances and appropriate access to markets be developed to encourage local farmers / cultivators.
6. Cultivation of edible bamboo may be popularized in different parts of the country.
7. Efforts must be made to develop suitable courses in integrated Botany both at U.G. and P.G. levels to foster scientific development in Botany on the lines of modern biology.
8. Documentation of important plants from N. E. region producing non-edible oil may be undertaken to promote bio-fuel production. Then cultivation practices and seed stock be developed for large scale exploitation. Emphasis may also be given for utilizing the arid-zone and other waste lands for plantation of non-edible bio-fuel resources.

2. Recommendations to the ISCA for internal review, assessment and implementation

Chemical Sciences

1. The sectional programs should be given two full days.
2. No parallel sessions should be allowed.
3. There should be only five invited speakers apart from the awardees.
4. TA/DA along with the local hospitality should be extended to the invitee by ISCA/ local host.
5. The overlap of lectures and parallel sessions should be avoided in order to maximize the attendance during the lectures.
6. In order to avoid inconvenience to the participants, the responsibility of registration/ accommodation etc. should be distributed among the local managing committee members by forming a subcommittee discipline wise.

Earth System Sciences

3. The contributed papers should be published in some journal of Earth Science.
4. More funds in form of travel grants or hospitality should be provided for academic activities for attracting Young Talent in the ISCA.
5. It has been resolved that the theme of Symposia of Earth System Sciences for the 97th Session of ISCA should be application of earth Sciences in relation to mineral & Energy resources and sustainable rural development.

Environmental Sciences

1. Looking into the interest of young generation scientists taking-up their career in different areas of environmental sciences, more awards be instituted by ISCA in this section, such as two Young Scientists Awards, two best Oral Presentations' Awards and four best Poster Presentation Awards

Medical Sciences (including Physiology)

It was proposed to have the following themes for the symposia during the next science congress :

1. Lifestyle changes in health and diseases
2. Communicable diseases and their remedial measures

3. Towards a torture free world