

INDIAN SCIENCE CONGRESS
99th



Reaching the unreachable



99th INDIAN SCIENCE CONGRESS

A BRIEF REPORT AND RECOMMENDATIONS



THE INDIAN SCIENCE CONGRESS ASSOCIATION, KOLKATA



Dr. Manmohan Singh, Hon'ble Prime Minister of India being received by the Dr. Chandra Shekar, Director, NISER and Dr. Geetha Bali, General President, ISCA



Shri Naveen Patnaik, Hon'ble Chief Minister of Odisha arriving at the venue of Science Congress



Hon'ble Prime Minister presenting the Excellence in Science Award to Dr. H.S. Savithri, IISc



Prof. Geetha Bali, General President, ISCA presenting a memento to Dr. Manmohan Singh, Prime Minister of India.



Prof. Geetha Bali, General President, ISCA delivering the Presidential Address.



Invocation song at the inaugural ceremony



Prof. Geetha Bali, General President, ISCA presenting a memento to His Excellency The Governor of Odisha Sri M.C. Bhandare at the valedictory function of the 99th ISC



Prof. Geetha Bali, General President, ISCA delivering presidential remarks at the valedictory function of 99th Indian Science Congress.



Delegates attending the inaugural ceremony of 99th ISC



Dr. P.K. Patsani, Hon'ble MP, Bhubaneswar addressing the gathering during the valedictory function of the 99th ISC



Handing over Vigyan Jyoti



Reaching the unreached

99th INDIAN SCIENCE CONGRESS

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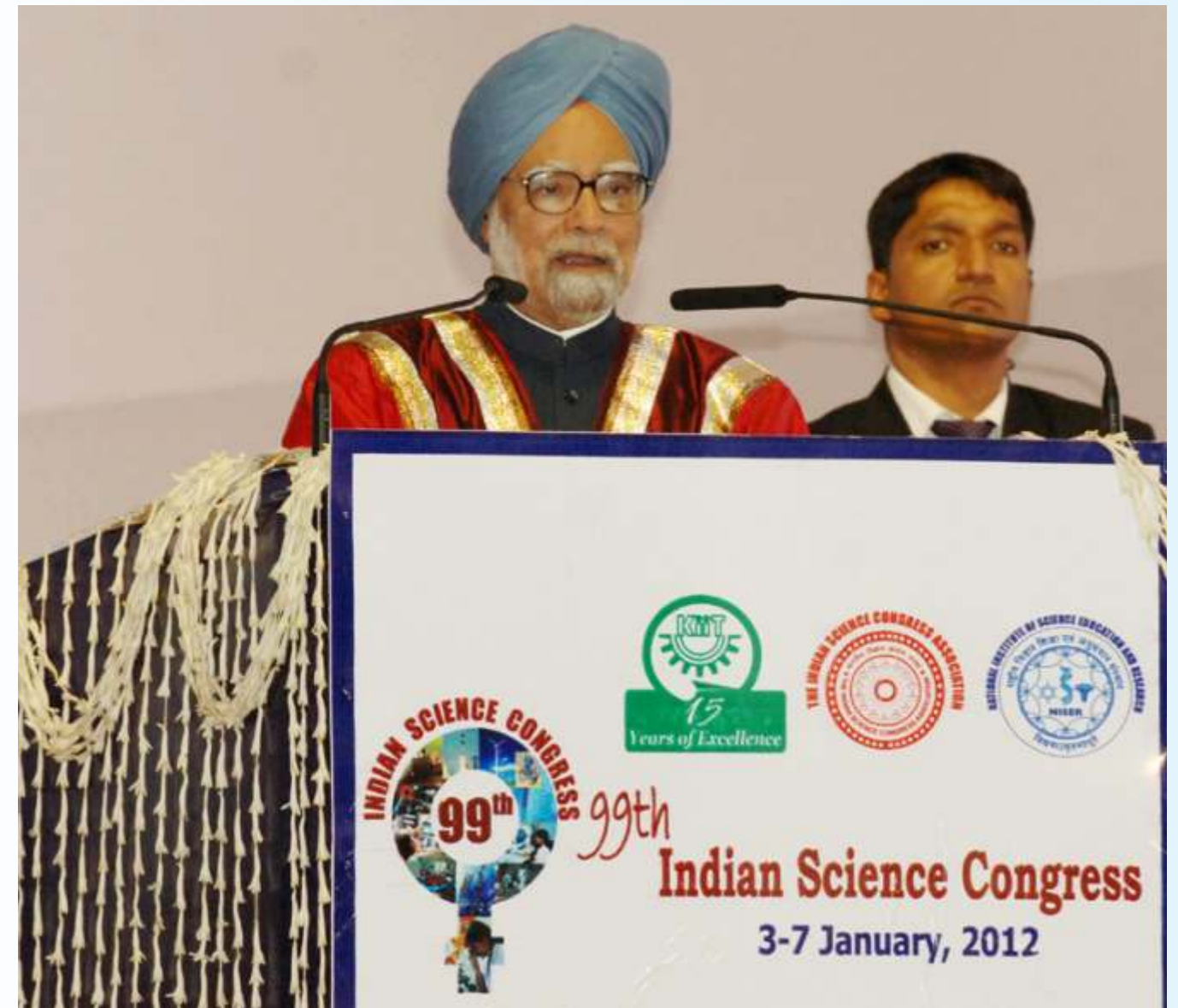


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A BRIEF REPORT ON THE 99TH INDIAN SCIENCE CONGRESS



1.1 Inauguration of the 99th Indian Science Congress

The 99th Indian Science Congress was held at Bhubaneswar after a gap of 35 years, under the auspices of Kalinga Institute of Industrial Technology (KIIT) and National Institute of Science Education and Research (NISER), Bhubaneswar. from January 3rd to 7th, 2012. **Dr.Manmohan Singh, Hon'ble Prime Minister of**

India, inaugurated the Congress on 3rd January, 2012. General President of 99th ISC Prof. Geetha Bali, while welcoming the dignitaries delivered her address on the Focal Theme “Science and Technology for Inclusive Innovation: Role of Women”. She said “Achieving inclusive development through innovations and unfettered involvement of women in the development process in the country” was the main focus during the 99th Indian Science Congress.



Shri Naveen Patnaik, Hon'ble Chief Minister of Odisha Delivering his Speech.



Shri. Vilasrao Deshmukh, Hon'ble Union Minister of Science and Technology and Earth Sciences exchanging pleasantries with Prof. Geetha Bali, General President, ISCA.



A tribal woman representing the tribal communities of Odisha receiving a plaque of recognition by FAO from Hon'ble Prime Minister of India.

Hon'ble Union Minister of Science and Technology and Earth Sciences, Shri Vilasrao Deshmukh, Government of India and Hon'ble Chief Minister of Odisha Shri Naveen Patnaik addressed the august gathering. His Excellency Governor of Odisha Shri M. C. Bhandare, Hon'ble Union Minister of State for Science and Technology Shri Ashwani Kumar graced the occasion, Dr. Vijay Laxmi Saxena, General Secretary (Scientific Affairs), and Dr. Manoj Kumar Chakraborti, General Secretary

(Membership Affairs) were also present. Nobel Prize winners Dr. Richard R Ernst, Dr. Rolf M. Zinkernagel and Dr. Kurt Wuthrich were amongst the eminent scientists present. Hon'ble Prime Minister of India, Dr. Manmohan Singh, delivered his inaugural address and presented ISCA Awards to a number of eminent scientists from the country and abroad for their outstanding scientific contributions. Prof. A S Kolaskar, Vice Chancellor, KIIT University delivered the Vote of

Thanks. **Over 18,000 registered delegates, the highest recorded so far, participated in the 99th science congress** including a large number of scientists from Germany, France, Italy, UK, The Netherlands, Sweden, USA, Canada, Kenya, Australia, Korea and other countries.

The 99th session of ISC, held during the decade of Innovation (2010-20) was historical in not only ushering in the centenary year of Science congress but also the "Year of Science in India" as declared by the Hon'ble Prime Minister of India. The year 2012 was also declared by the Hon'ble Prime Minister of

India as the "Year of Mathematics" commemorating the celebration of the 125th birth anniversary of the mathematics wizard Srinivasa Ramanujan.

In his inaugural speech Hon'ble Prime Minister expressed his appreciation of the focal theme of the 99th Indian Science congress and cited the precedence set by Madam Marie Curie as the most outstanding woman scientist. Dr. Singh also congratulated the tribal communities of Koraput for the global recognition they have received from FAO and extolled the knowledge base available with the tribal communities of Kharia, Santhals, Gonds and Kolhas of Odisha on medicinal use





1.2 CHILDREN'S SCIENCE CONGRESS

of locally available plants and also exhorted the scientific community to explore and rejuvenate traditional knowledge available in different parts of the country.

While making a mention of various initiatives taken by the Government of India for boosting the science and technology sector in the country and focusing on inclusive development through programmes like INSPIRE of the DST, stressed the importance of increasing investment in R & D by industry and various strategic sectors and creation of a new innovation ecosystem in the country. He also stressed the importance of aligning S & T sector with the inclusive development needs of the nation, expanding basic science infrastructure and encouraging extensive research collaboration between institutions within the country and abroad. Dr. Singh made a mention of setting up of INDIA INCLUSIVE INNOVATION FUND by the National Innovation Council to drive and catalyze enterprise, entrepreneurship and venture capital while targeting solutions for the bottom of the pyramid. Dr. Singh lauded the achievements of outstanding women scientists in India and hoped that these women will motivate women to take up careers in science where women are underrepresented.

Hon'ble Union Minister of Science and Technology and Earth Sciences, Shri Vilasrao Deshmukh, referred to the dramatic success in science and Technology, India has achieved since independence and the efforts made by the Ministry of Science and Technology, Government of India, implementing a number of innovative and important programmes such as INSPIRE, "Science Express" the 16 coach train that has travelled 70,000 km covering 24 states that has witnessed 65 lakh visitors, and many other such programmes that have contributed for promotion of S & T in the country, He stressed the need to look at alternate models of innovation to address the societal issues like health care. He also expressed that there is a need to come out with a new and well enunciated science, Technology and Innovation policy that promotes innovation ecosystem for achieving inclusive and sustained growth.

Diamond Jubilee celebration of UNESCO-Kalinga Prize for popularization of science:

The 99th Science Congress was special in many more ways. The event coincided with the **Diamond Jubilee Celebration of UNESCO-Kalinga Prize for Popularization of Science**, a prestigious programme that was started with the initiative of Shri Biju Patnaik, former Chief Minister of Odisha and the founder of Kalinga Foundation. A dedicated programme celebrating the event which included honouring of all the past Kalinga awardees and lectures by eminent personalities was held in the same venue as a parallel programme that attracted its own participants. The programme held on 4th and 5th January was inaugurated by Hon'ble chief Minister of Odisha, Sri Naveen Patnaik. Former Kalinga Awardees including Prof. Yash Pal, were honoured on the occasion. Ms. Gretchen Kalonji, ADG (Natural Sciences), UNESCO participated in the programme as the chief guest.

Recognition of Tribal Communities of Odisha by FAO

It was also a proud moment for India getting global recognition for conserving and encouraging traditional knowledge in agricultural practices and traditional ecological prudence while promoting food security, preserving biodiversity and cultural diversity for sustainable and equitable development. Tribal communities of Odisha, the venue of science Congress, won recognition as one of the FAO's globally important Agricultural Heritage systems (GIAHS). **Representatives of two tribal communities hailing from Koraput, one of Odisha's most backward districts, were presented by the Hon'ble Prime Minister of India with plaques of honour sent from Rome, during the inauguration in recognition of the contribution of these tribal communities for conserving bio-diversity and developing climate resilient farming systems.** These tribes are known for producing several varieties of rice, wheat and cumin seeds.



On 4th January, 2012, His Excellency, Dr. A.P.J. Abdul Kalam, Former President of India inaugurated the Children's science congress in the presence of Dr. P. K. Patasani, Hon'ble MP, Bhubaneswar. ISCA Young Scientists' Awards were presented on this occasion by Dr A P J Abdul Kalam. **Over Eighty thousand children, the largest number witnessed so far,** participated in the science congress and their participation in a most organized and fruitful way won the appreciation of one and all. The "Science for School Children" which was organized with support from NCSTC, DST was a highly successful programme. Following the inauguration of the Children's Science congress, Dr. Kalam inaugurated the children's Science Exhibition where children from 125 selected institutions displayed their prize winning science projects.

Dr. A. P. J. Abdul Kalam appealed to school children to be unique and work dedicatedly in the field of science and

technology. He exhorted the potential scientists to give wings to their dreams, fly high and make their own mark. "Children are a big force. The ignited mind of youth is the most powerful resource on the earth. We have got large youth power which no other democratic country has. If you have great aim in life and acquire the knowledge, it does not matter who you are, you will definitely achieve your goal," he said. He said the young students should work on their dreams and take calculated risks in life. "The culture of excellence is not achieved by accident, but through a process in which a nation, an individual and an organization constantly tries to get better." He said. He advised the young scientists to be friends with great books, great human being and great teachers. "Critical thinking gives a path to achieve success. A creative mind has the uniqueness of discovering anything and imagination is the beginning of the creation. Invention and discovery come from creative minds," Dr. Kalam said. He urged the students to have a



Dr. A.P.J. Abdul Kalam, Hon'ble Former President of India., releasing the proceedings of the Children's science congress., Hon'ble MP, Dr. P.K. Patasani, Bhubaneswar , Prof. Geetha Bali, General President, ISCA and Dr. Vijayalakshi Saxena, General Secretary (Scientific Affairs), ISCA are seen



Dr.A.P.J. Abdul Kalam, Hon'ble Former President of India delivering inaugural address during Children's Science Congress



Dr.A.P.J. Abdul Kalam, Hon'ble Former President of India, inaugurating the children's Science Exhibition

mission in life to achieve higher standards. "You have to challenge your brain with difficult thinking and idea. Science is a life time mission. You have to acquire knowledge and work hard to realize your dream."

Hon'ble MP , Bhubaneswar., Dr. P. K. Patasani delivered a motivating speech addressing the children urging them to imbibe the qualities of several role models India has produced. Dr. B. P. Singh addressing the gathering stressed the need to sensitize and popularize scientific methods among masses. Dr. Kalam gave away young scientist awards to 14 aspiring scientists. A number of eminent scientists including Nobel laureates addressed and interacted with children on 4th and 5th January. The children's science congress concluded on 6th January afternoon. Children were presented with awards at the valedictory function of Children Science Congress. Ms. Dharitri Patnaik from Bernard van Leer Foundation, Dr. Hemant Dwivedi from UNFPA graced the occasion.

1.3 WOMEN'S SCIENCE CONGRESS



Her Excellency, Ambassador of India to the United States Mrs. Nirupama Rao releasing the proceedings of the first women's science congress. Others seen are (from L) Dr. Gretchen Kalonji, ADG (Natural Sciences), UNESCO , Dr. D. Purandeswari Hon'ble Minister of State (Education), MHRD, GoI., Prof. Geetha Bali, General President, ISCA., Dr. Vijayalakshmi Saxena, General Secretary (Scientific Affairs), ISCA .

For the first time in the history of Indian Science Congress, a Women's Science Congress was organized on 5th January 2012 on the theme "Women in Science and Science for Women". This programme motivated the participation of a large number of women scientists from various institutions across the country. The women's science congress, was inaugurated by Her Excellency, the Indian ambassador to USA Mrs. Nirupama Rao. In her inaugural address Mrs. Rao opined that the Women Science Congress will provide an excellent platform to celebrate the achievements of Indian women in science and also deliberate on ways to enhance their participation in science, research and development and decision making processes relating to science. She expressed that taking new initiatives for encouraging the participation and retention of Indian women in science and technology and making them equal partners in all processes of development and governance is not only desirable but

essential for all round national development and progress. Expressing her concern over the fact that the number of women scientists in our country was still minuscule , science streams remain largely male dominated and there are very few women in national science academies or in decision-making positions in science establishments, she said efforts must be made to overcome this disparity. She stressed the need for crating mid-career opportunities for women scientists who quit profession immediately after marriage and self-employment opportunities for women in the ever-expanding field of science and Technology.

Hon'ble Union Minister of State for Human Resource Development (Education) Dr. D. Purandeswari delivering the key note address said women's empowerment cannot be complete without their equitable participation in science and technology as they have special role to play. "Given scope, they can bring a



Her Excellency Smt. Nirupama Rao, Hon'ble Ambassador of India to the US delivering inaugural address at the Women's Science Congress.



Dr. Gretchen Kalonji, ADG for Natural Sciences, UNESCO speaking on the occasion.



Dr. D. Purandeswari, Hon'ble Minister of State (Education), MHRD, GoI., Delivering Key Note Address during Women's Science Congress

wave of creative and generative energy in the field of science and technology," she opined. She expressed her appreciation for organizing the first Women's Science congress and quoting a study by International Labour Organization she said women who represent 50 percent of the world adult population, and one third of the official labour force, and perform nearly 2/3rd of the working hours, receive only one tenth of the world's income and own less than one percent of the world property. She was of the opinion that the gender disparity which is palpably evident in the education sector hits inclusive growth very adversely. She expressed that Science and Technology brings economic growth and well-being to people, not only because of the empowerment of women through science and technology, but also because of the enrichment of science and technology through women's participation. Engagement of women at the grass root level is inevitable for worldwide science and technology capacity building she added. In order to expedite the process of development and take our country towards new heights of excellence, it is essential that we take to a process of massive application of science and technology in the realm of womankind," she pointed out. She urged the scientist community to come out with appropriate inputs for policy prescriptions in the realm of human progress and growth through the application of science and scientific methods for correcting gender disparity.

Assistant Director-General for Natural Sciences, UNESCO Dr. Gretchen Kalonji, graced the occasion as the chief guest. Interpreting the challenge of greater involvement of women in science within the context of rapidly changing landscapes of science and technology, Dr. Gretchen said that the highly evolving field of science has helped in increasing the participation of women

This programme served for showcasing the contributions of outstanding women scientists of India

such as Dr. Tessy Thomas of DRDO, Padmashree Dr. Indira Nath and others and also there were deliberations on how latest developments in S & T can be employed for empowering women including rural women.

1.4 FIFTH VIGYAN SANCHARAK SAMMELAN



The **fifth Vigyan Sancharak Sammelan** was conducted on 4th and 5th January, with support from NCSTC, DST, New Delhi, where science communicators selected from different chapters of ISCA participated. Dr. D. Balasubramanyam of L.V. Prasad Eye Institute, Hyderabad inaugurated the Science Communicator's meet programme and Dr. Richard Nader, Vice Provost, University of North Texas was the guest of Honour. Dr. B.P. Singh, Head NSTC, DST addressed the gathering. During this programme, Dr. B.C. Deb Memorial Award was presented to Mr. Irfan Human, editor, Science Times News Views. The programme consisted of 4 technical sessions where 20 speakers selected from 12 ISCA chapters from across the country delivered lectures other than poster presentations. The valedictory address was delivered by Prof. Chitta Ranjan Das, Chairman, State Environment Impact assessment Authority, Odisha on 5th January, 2012.



1.5 RASHTRIYA VIGYAN CHALCHITRA MELA



The 99th Indian Science Congress featured a two-day National science film festival, Rashtriya Vigyan Chalchitra Mela (RVCM). The programme which also included a competition on science films was inaugurated by Hon'ble Food and Civil Supplies Minister, Govt. of Odisha, Niranjan Pujari on January 4. The RVCM is the creation of Vigyan Prasar, a national institute under Department of Science and Technology, to encourage science film makers and enrich the contents of science programmes. Inaugurating the four-day event, Mr. Pujari said film is an effective medium to promote science. "Today, everybody takes interest in watching television. So, film can be an effective way to popularize science," he said. Founder of KIIT & Chief Patron, 99th ISC, Achyuta Samanta, Chairman of Bharatiya Jan Vigyan Samiti, R N Ray and Coordinator, RVCM 2012, Arbind C. Ranade were present. Organising the RVCM concurrently with the annual session of Indian Science Congress has added value and strength to the event,

Samanta said in his brief speech. "It has created a platform for RVCM to reach a large number people having interest in science," he added.

Talking about the objectives of RVCM, Ranade said the science film festival is a common platform for all - professors, scientists, film makers and students and it would help in developing knowledge in science. Mr. Ray said that the participation of students in the event as film makers was a good sign. "Students in greater numbers are showing interest in making short films on science and they are focusing on local issues, which is a good sign," he added.

Films from across the country in the categories of documentary on science, health, education, awareness and animation were screened. The animation film 'I love you human' by M Rajkumar, with the message of peace, won applause of the audience. The bitter war between

the Tamils and Singhalese inspired him to make the film. The film, 'To be a smoker or not to be a smoker' made by a group of class nine students of Indus International School, was also appreciated by the audience. These students were on the anti-smoking campaigns within their cities besides sponsoring community education to the terminally ill patients' children. 'Thalassemia, Ek Chunoti' directed by Manisha Sharma exhibited the plight of the child patients of Thalassemia Major, a genetic blood disorder. It depicted how it passes to an unborn child from the parents and discussed about the precautionary measures to prevent it. Among other films, 'The Dream Fulfilled' by Satish Pande focused on Delhi Metro Rail Corporation, its making and challenges faced by the engineers who had completed the Metro train within four and half years and as well to encourage the future engineers in the upcoming projects. Some of the other films including Refraction by Tabish Anwar, Magnet Part -I by Deepak Verma, Home our Garden of Eden by Suresh Elamon, The Darwin Puzzle by Arjun Bhagat, Hatyare Kee Hatya, The story of vaccines by Seema Murlidhara and India's targeted drug delivery system, Fungisome by Dr. Matiuar Rahman were also screened.

1.6 SCIENCE EXHIBITION: PRIDE OF INDIA EXPO-99TH ISC



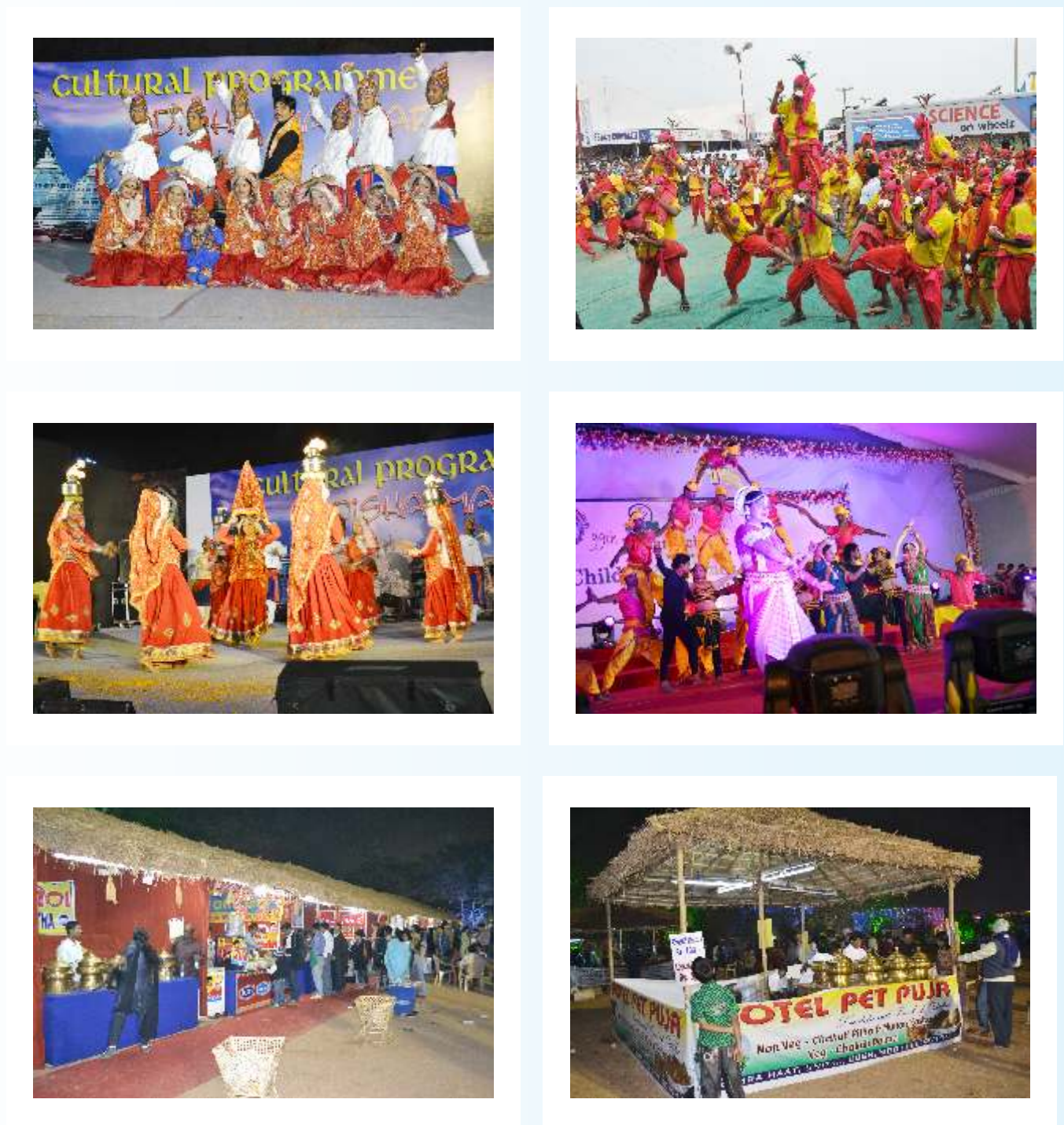
Following the inauguration of Science congress on 3rd January, Hon'ble Union Minister of Science & Technology and Earth Sciences, Shri Vilasrao Deshmukh inaugurated the **Science Exhibition** in the presence of other dignitaries. The Hall of Pride in the exhibition was dedicated to Archarya Prafulla Chandra Ray, father of modern chemistry in India showcasing his contributions. The exhibition was organized in an area of 7000 square meters where more than 700 exhibitors and 150 organizations participated. Some of the chief pavilions were DRDO, ISRO, CSIR, ICMA etc. Replicas of Prithvi, Agni and Brahmos missiles were major attractions. **Mobile lab for teaching science in rural areas developed by AGASTHYA Foundation was another attraction.**

There was also a science and Sanskrit Exhibition put up in the venue of the 99th ISC which was inaugurated by **Dr. Janaki Ballabh Patnaik**, His Excellency, The Governor of Assam & Chancellor, RSVP, Tirupati, A.P on 3rd January 2012.

There were more than 30 public lectures and special lectures delivered by eminent scientists including Nobel Laureates, technocrats, policy makers from India and abroad as well as representatives from industries, focusing on current issues, latest developments in Science and Technology addressing the focal theme of the congress "Science and Technology for Inclusive Innovation-Role of Women" from different perspectives.

1.7 CULTURAL PROGRAMMES

Cultural programmes were held from 3rd to 6th January every evening. These programmes, showcasing traditional art and culture of Odisha were greatly appreciated by the delegates.





1.8 ODISHA MANDAP



Odisha mandap was put up showcasing the rich culture, traditions and sightseeing places of Odisha. This mandap with an ambience of a rural Odisha with stalls made up of thatched roof, selling handloom, handicrafts and other artifacts Odisha is famous for attracted a lot of delegates. The sand art created in the venue was an added attraction.

1.9 BIGYAN RATH



The hosts of the 99th ISC, KIIT and NISER took an innovative initiative to popularize science among the youth and common people of the State of Odisha by bringing out Bigyan Rath. Held as a prelude to the 99th Indian Science Congress, the Rath was flagged off from Khandapada, the birthplace of Pathani Samanta, a renowned scientist of Odisha, by Shri M. C. Bhandare, His Excellency the Governor of Odisha on 14th November 2011. The Rath went round the state traveling 4000 kilometers, covering more than 1000 educational institutes and more than 100 towns in all the 30 districts of Odisha reaching a large population of children, students, scientists and common public, the Rath concluded its state-wide journey in Cuttack, the birthplace of renowned scientist Prana Krushna Parija, another famous scientist of Odisha, on 3rd December 2011. The closing ceremony of the Bigyan Rath, held at Ravenshaw University, Cuttack, was graced by Dr. P. K. Patasani, Hon'ble MP, Bhubaneswar; Shri Bhartruhari

Mahtab, Hon'ble MP, Cuttack; Shri Pravat Ranjan Biswal, Hon'ble MLA, Choudwar-Cuttack; Shri Manmohan Praharaj, IPS, Director General of Police, Odisha; Girish S. N, Collector, Cuttack; Dr. R. N. Ray, Chairman, National Children Science Congress; Prof. B. C. Tripathy, VC, Ravenshaw University, Cuttack. Dr. A. Samanta, Founder, KIIT & KISS; Prof. A. S. Kolaskar, VC, KIIT University; and Dr. A. K. Naik, Registrar, NISER; Lalatendu Parija, the son of Late Prana Krushna Parija and Shrikant Parida, President of Ravenshaw University Students union also spoke on the occasion. The rath served the dual purpose of popularizing science and Technology amongst public and also creating awareness about the event of science congress attracting their participation in the 99th ISC.

1.10 VALEDICTORY FUNCTION



The Valedictory Function was held on January 7th, 2012. Prof. T. Ramasami, Secretary, DST delivered the welcome address. His Excellency the Governor of Odisha Shri M. C. Bhandare, graced the occasion as chief guest and Dr. P. K. Patasani, Hon'ble MP, Bhubaneswar participated as the guest of honour with Prof. Geetha Bali, General President presiding over the function. In his address, His Excellency, Shri Bhandare said that modern research should address basic needs like food, shelter and healthcare of which a sizeable population in India are deprived of he said, science must have innovativeness, foresight and vision to make it a boon for the society. Quoting Pandit Jawaharlal Nehru, he said, "Science alone can solve the problem of hunger and poverty, insanitation and illiteracy, of superstition and dreading customs." Among others, Dr. A. Samanta, Founder, KIIT & KISS and Chief Patron, 99th ISC, Prof. A. S. Kolaskar, VC, KIIT, Dr. Vijay Laxmi Saxena, General Secretary (Scientific Affairs), 99th ISC, Dr. Manoj Kumar Chakraborti, General Secretary (Membership Affairs), Dr. A. K. De, Executive Secretary, Mr. N. B. Basu, Treasurer and Dr. A. K. Naik, Registrar, NISER were present on the occasion. Shri M. C. Bhandare, H.E. the Governor of Odisha presented awards and certificates to the winners of the Best Poster awards from each of the 14 sections and also to representatives of institutions for outstanding participation in the exhibition. The host institution KIIT also took the initiative of conducting district wise in the state of Odisha and nationwide science quiz and essay competitions for school children as well as college and university students on the topic "science and society". The programme was formally inaugurated by Shri Vilasrao Deshmukh, Hon'ble Union Minister of Science & Technology and Earth Sciences during his visit to KIIT on 19th October 2011. Prize money for the winners in various categories was presented by His Excellency the Governor of Odisha Shri M. C. Bhandare during the valedictory session.

2.0 SCIENTIFIC PROGRAMMES

2.1 Public Lectures and Special Lectures

SL.No.	INVITED SPEAKER	TITLE OF THE TALK
1	Rolf. M. Zinkernagel, University of Zurich, Zurich Nobel Laureate	Why do we not have a Vaccine against HIV or TB?
2	Dr. Kurt Wuthrich Scripps Research Institute USA Nobel Laureate	Basic Research and Human Daily Life
3	Dr. Richard R. Ernst, ETH, Zurich Nobel laureate	Academic Opportunities for Shaping a Better Future
4	Dr. K. Kasturirangan Member, Planning Commission	Science and Technology Policy making
5	Dr. M.S. Swaminathan Chairman, MSSRF, Chennai	Commemorating the Year of Science
6	Dr. Parviz Koohafkan Director of Land & Water Division, FAO	Heritage and Food Security in an era of Climate change
7	Dr. S. K. Brahmachari Director General, CSIR	Open Source Drug Discovery for Affordable Healthcare
8	Dr. R. Chidambaram, Principal Scientific Adviser to Government of India, New Delhi	Research and Innovation: Many Dimensions
9	Dr. N. Chandrashekhara CEO & MD, Tata Consultancy Service	ICT- A Tool for achieving Vision 2020
10	Dr. S. Ayyappan, Director General, ICAR and Secretary, DARE, New Delhi	Feeding Crores for Ever
11	Dr. Harish Pant, NINDS, NIH, USA	Biology of Neuronal Cytoskeleton Regulation, Neurodegeneration and Dementia
12	Dr. Peter Thalau J.W. Goethe University, Germany	Magneto reception in Birds
13	Dr. G. V. Ramaraju Dept. Information Technology, GoI	'Assistive Technologies for Differently Abled'
14	Dr. Polly Roy, LSHTM, London, UK	From Atomic Structure to safe vaccines for a viral disease



SL.No.	INVITED SPEAKER	TITLE OF THE TALK
15	Dr. Vijay Bhatkar Chairman, ETH Research lab, Pune	National Mission on Exascale Supercomputing
16	Dr. Vinay Nagaraj Shepard Pratt, Baltimore, USA	Treatment of individuals with mental illness and drug use disorders
17	Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences, GoI	Knowing Earth Systems for a Better Life :
18	Dr. Tessy Thomas, DRDO, GoI	Long Range Missile Systems-Technology Breakthrough
19	Dr. Lindsay Brown, Univ. Southern Queensland, Australia	Functional Foods in Health and Diseases
20	Dr. Indira Nath, AIIMS, New Delhi	The Enigma of Human Leprosy
21	Dr. H.S. Savithri, IISc, Bangalore	Functions of viral encoded intrinsically disordered domains/proteins
22	Dr. G. Rohini Devi, PDAS L, DRDO, GoI, Hyderabad,	Development of High Temperature Composites for Strategic Applications
23	Dr. Vijayalakshmi Ravindranatha, IISC. Bangalore	New Approaches to disease modifying therapies for Alzheimer's disease
24	Dr. S.V. Raghavan NKN, New Delhi	NKN-An instrument of Social Change
25	Dr. Sarah Dunlop, President, Australian Neuroscience Society, Australia	Basic Science to clinical trials for spinal chord injury; Physician-scientist interactions at a number of levels
26	DR. K.Naryana Gowda, Vice Chancellor, University of Agricultural Sciences, Bangalore	Role of Women in Agricultural Development
27	Dr. Hari S. Sharma' Department of Pathology V.U, University, Amsterdam, The Netherlands	Molecular Mechanism of Angiogenesis-Pathology
28	Dr. Gerta Fleissner J.W. Goethe University, Frankfurt, Germany	Why we must Sleep?
29	Dr. Shashi Bala Singh, DIPAS, DRDO, GoI	Low cost sustainable Technologies for cold arid desert

SL.No.	INVITED SPEAKER	TITLE OF THE TALK
30	Dr. Chitra Rajagopal, CFEES, DRDO, GoI	Towards an Integrated Systems approach to safety management
31	Dr. S. R. Rao DBT, GoI	Genetic Products and Regulatory authority
32	Dr. Ashok Kumar Vice Chancellor, CSJM University, Kanpur	Broccoli can prevent cancer
33	Dr. V.C. Goyal NIH, Roorkee	Science & Technology for Water Security in Indian Context



2.2 PANEL DISCUSSIONS AND PLENARY SESSIONS

There were 20 plenary sessions and 7 panel discussions on topics of importance especially in the context of India's achieving inclusive development. Some of the topics such as maternal and child health care and nutrition, Rural livelihood and livestock management, Assistive Technologies etc. found place as thematic topics in science congress for the first time.

SL.No.	TOPIC OF PANEL DISCUSSION	PANELISTS
1	Science Policy making	Dr. K. Kasturirangan Member, Planning Commission Dr. V.M. Katoch, ICMR Dr. T. Ramasami, DST Dr. S.K. Brahmachari, CSIR Dr. S. Ayyappan, ICAR. Dr. Shailesh Nayak, MoEF, Dr. M. Rajashekaran Pillai Dr. Balakrishna Pisupati Dr. S.R. Rao, DBT Dr. R.Ramamurthi, Tirupati, India
2	Year of Science –Role of Science Academies	Prof. M.S. Swaminathan Chairman, MSSRF, Chennai Dr. Kishan Lal, NASI, Dr. Asis Datta, NAAS Dr. Baldev Raj, INAE Dr. N. Mukunda, IAS Dr. R. B. Singh, NAAS
3	Physician -Scientist Interaction and training in India	Dr. V.M. Katoch DG, ICMR Dr. Jagadeeswaran Pudur, UNT, Tx. USA Dr. Ananda Kumar, UIC College of Medicine, Chicago, USA Dr. Warren Bruggen, Provost, UNT.,TX, USA Dr. Srinias Pentyala, SBMS, NY.,USA Dr. K.K. Talwar, BOG, MCI, New Delhi Dr. G. Subramanyam, NMCH, Nellore Dr. R. Ramamurthi, Tirupati, India

4	Biodiversity Governance-Role of Communities and Women	Dr. Balakrishna Pisupati, Chairman, NBA Dr. Ahmed Djoghlaif, Montreal Dr. Chidambaram, New Delhi Dr. Lucy Mulenkei Dr. Pierluigi Bozzi, Rome Ms Ann Marie Khan, Montreal Dr. Faizi, CBD CSA, Kerala Dr. R. Ramamurthi, Tirupati, India
5	Science Education in Rural areas	Prof. N.R. Shetty, Former Vice Chancellor, Bangalore University Dr. Latha Pillai, NAAC Dr. S. Pattanayak, Bhubaneswar Dr. Ajit Basu, Agasthya Foundation Dr. K.E. Radhakrishna, Bangalore Dr. K. Muralidhar, New Delhi
6	Education for sustainable Development	Prof. M.S. Swaminathan Chairman, MSSRF., Chennai Dr. P.C. Kesavan MSSRF Dr. Rajiv Tandon, New Delhi Dr. Kartikeya V. Sarabhai Founder Director Centre for Environment Education- (CEE), Ahmedabad
7	S & T Policy Making and Ethical Issues and Concerns	Dr. Y.S. Rajan Dr. Yogeswar Rao Dr. Miltos Ladikas, UK Dr. Michael Decker, Germany Dr. Jan Staman, Netherlands Dr. Zhao Yandong, China Dr. Ma Ying China Dr. K. Ravi Srinival Dr. Ron Herring, USA Dr. C.S. Prakash, USA Dr. Sachin Chaturvedi, RIS, New Delhi



Plenary Sessions

SL.No.	THEMATIC TOPIC OF PLENARY SESSION	CHAIRPERSONS
1	Healthcare without borders-The Telemedicine way	Dr. V.M. Katoch, Mr. L.S. Satyamurthy & Dr. B.N. Mohanty
2	Maternal and Child Health Care - Nutrition Security	Dr. S.S. Parmar, USA & Dr. V. Prakash, Former Director, CFTRI, Mysore
3	Climate change and Food Security	Prof. M.S. Swaminathan, Chairman, MSSRF, Chennai
4	Frontiers in Atmospheric Sciences	Dr. Shailesh Nayak, Secretary, Department of Earth Sciences
5	Women in Science	Dr. Polly Roy, UK & Dr. Indira Nath, AIIMS, New Delhi
6	Science for Women	Dr. Nirupama Prakash, JUIT, HP. Dr. Anushya
7	Tackling Neurodegenerative Diseases	Dr. Harish Pant, NINDS,NIH, , USA
8	India's Public Health challenges-Reconfiguring the Health system for universal health coverage	Dr. Sreenath Reddy, PHFI, WHF
9	NBC Technologies for Armed Forces and Civilians	Dr. W. Selvamurthy, DRDO,GoI
10	Green Building Technologies-Alternate Building Materials	Prof. K.S. Jagadish, Scientist, IISc. Visiting Faculty, R.V.C.E. Bangalore
11	Nanoscience and Diagnostics	Dr. H.S. Sharma, Uppsala Univ. Sweden
12	Animal Alternatives in Teaching and Testing	Dr. Akbarshah, Dorencamp Chair
13	Clean Energy from Renewable Sources	Dr. Y.B. Ramakrishna, Bio-fuel Board, GoK
14	Cancer Stem Cells	Dr. Shrikant Anant, USA
15	Agricultural Biotechnology-Scientific, Regulatory and Social Challenges	Dr. C.S. Prakash, USA
16	Recent Advances in Pharmaceutical Sciences	Dr. Chandradhar Dwivedi, USA
17	Energy and sustainability for greener tomorrow	Dr. Navrati Saxena, Korea
18	Rural Livelihood and Livestock management	Dr. M. Rajashekar, PD-ADMAS, ICAR
19	Water scarcity to water Security	Mrs. Sunita Nadamuni, Arghyam, Bangalore
20	Assistive Technologies for the differently abled	Dr. G.V. Ramaraju

DISTINGUISHED SPEAKERS



Dr. K. Kasturirangan, Member, Planning Commission



Rolf M. Zinkernagel, University of Zurich, Zurich Nobel Laureate



Dr. M.S. Swaminathan, Chairman, MSSRF, Chennai



Dr. Kurt Wuthrich, Scripps Research Institute, USA. Nobel Laureate



Dr. S. K. Brahmachari, Director General, CSIR



Dr. Richard R. Ernst, ETH, Zurich Nobel laureate



Dr. R. Chidambaram Principal Scientific Adviser to Government of India, New Delhi



DISTINGUISHED SPEAKERS



Dr. Peter Thalau, J.W. Goethe University, Germany



Dr. N. Chandrashekarhan, CEO & MD, Tata Consultancy Service



Dr. Polly Roy, LSHTM, London, UK.



Dr. S. Ayyappan, Director General, ICAR and Secretary, DARE, New Delhi



Dr. Shailesh Nayak, Secretary, Ministry of Earth Sciences, GoI



Dr. Harish Pant, NINDS, NIH, USA



Dr. V.M. Katoch, Secretary, Dept of Health Research and DG, ICMR, Govt. of India, Dr.L.S.Satyamurthy, Vice-President, Telemedicine Society of India and Dr.B.N. Mohanty, Prof. of Surgery, SCB Medical College, Cuttack

DISTINGUISHED SPEAKERS



Dr. Hari S. Sharma, Department of Pathology V.U, University, Amsterdam, The Netherlands



Dr. Lindsay Brown, Univ. Southern Queensland, Australia



Dr. Gerta Fleissner J.W. Goethe University, Frankfurt, Germany



Dr. Sarah Dunlop President, Australian Neuroscience Society, Australia



Dr. Shashi Bala Singh, DIPAS, DRDO, GoI



Dr. K.Naryana Gowda, Vice Chancellor, University of Agricultural Sciences, Bangalore



Dr. Chitra Rajagopal, CFEES, DRDO, GoI



DISTINGUISHED SPEAKERS



Dr.A.N.Singh WHO Professor, Queens University, Canada.



Dr. Qamar Rahman from Department of biological Sciences, University of Rostock.



Dr. Ronald J Herring, Cornell University, New York.

DISTINGUISHED SPEAKERS



Mr.V.K.V.Ravichandran, Farmer, Tamil Nadu.



Dr. Ghanshyam Pandey, Professor of Psychiatry, University of Illinois, Chicago.



Dr Lindsay Brown, Australia.



Dr.M A Akbarsha, Dorencamp Chair, BDU, Tiruchirapalli.



Dr.C.S.Prakash, Director, Center for Plant Biotechnology Research, College of Agricultural, Tuskegee University.



Dr. K. Muralidhar, Professor, Delhi University



Dr. Hoysall Chanakya, Centre for Sustainable Technologies, IISC, Bangalore.



Dr.W.Selvamurthy, Distinguished Scientist & Chief Controller, Research & Development, Govt. of India, New Delhi.



Prof. P.K.Seth, CEO, Biotech Park, Lucknow



Dr.Jiri Gryagar, Institute of Physics, Czech Academy of Science.



Dr.Kartikeya Saabhai of Centre for Environment Education.



DISTINGUISHED SPEAKERS



Dr. Ramamurthy Rallapalli, Former Vice-Chancellor, SV University, Tirupati.



Dr. Y.B. Ramakrishna, Chairperson, Bio-fuel Board, Govt. of Karnataka.



Dr. Nabanita R. Krishna, Director, Directorate of Management Information System and Technologies DRDO Bhawan.



Dr. M. Rajashekar, ICAR, Bangalore



Dr. K.S. Jagdish, R.V College of Engineering, Bangalore.



Dr. Tessy Thomas, DRDO, GoI

2.3 PANEL DISCUSSION ON SCIENCE POLICY MAKING

This is the most appropriate time to deliberate on the most important issue of science policy making since we are on the threshold of adopting the 12th five year plan said Dr. K. Kasturirangan, Member, Planning Commission who was the chairperson of this panel discussion. We need to bring a paradigm change in science policy making in that Science and Technology Systems are to be mapped with respect to social needs. Science and Technology and Social sciences together is becoming a stronger tool to reach to the society he said. Any policy must factor societal issues and needs and it is more so with Science and Technology policy he said. India being a diverse country what is good depends on When, Where and for Whom. He said the twelfth plan has identified that Science and Technology can and should occupy the centre stage in the process of development which is a challenging goal. The new S & T Innovation policy will have to be enunciated to bring in public funding of R & D for socially relevant projects and mainstreaming innovation related activities with a focus on affordable innovations. This S & T policy must be supported by an ecosystem that addresses the national priority of inclusive and accelerated growth said Dr. Kasturirangan. Emphasizing the role of science he said rapid developments are taking place in science and technology and implementation of developments in S& T is assuming new dimensions and society must be kept informed of these developments in order to ensure their cooperation and participation in implementing new policies since acceptance of the policies can become a daunting issue otherwise, he added referring to the recent developments in relation to nuclear plant.. In a fast growing nation like ours, the policies will not achieve their target, if a society is not kept informed. Any policy made for the country must address these issues in a holistic manor He said the planning commission has addressed this question through involvement of a large S & T Innovation community to align S & T with developmental needs especially with respect to science service areas such as energy, water, food and health. The critical issues need to be identified and critical decisions need to be taken to address these issues. The planning commission has identified and prioritized several such

issues he said. The twelfth five year-plan will encourage the development of India's agriculture, education, health and social welfare through government spending and is also expected to create employment through manufacturing sector and harness the young talent pool, encourage participation in research and increase industry-academia interaction," he said. Dr. Kasturirangan emphasized that the 12th plan would focus on transforming India from Poor Economy Status to Middle Economy Status country and by the end of the plan period it aims to achieve remarkable growth in per capita income. He said in future in this type of programme, we should be able to discuss on what percentage of GDP came from S & T rather than what percentage of GDP came for S & T. When that happens, we can feel assured that India has matured into a nation where science holds primacy in the context of development he said.

Dr. V. M. Katoch, Director General, ICMR., said 'Health for All' has been the objective since a long time and the twelfth plan has been named health plan he said. But we need to do some novel things to address this issue. Other than communicable diseases, and non-communicable diseases, now water-borne non-communicable diseases due to environmental pollution such as arsenic contamination etc. are becoming increasingly important issues he said. Under the current context, trauma has taken central stage he added. While we have done fairly well in health care especially addressing communicable diseases, we need to provide affordable health care. "A strong interdependent policy should be implemented which will bring about a structural reform," he said. He stressed the need to synergize various technologies developed. Good infrastructure in medical colleges can help in translating developments. While developing technologies can be done and its translation can be achieved, reaching the benefits of the newly developed technologies to masses can become the bottle neck he said. He also opined that state systems much pitch in to facilitate reaching the developments in health sector to people with special focus on tribal and other marginalized communities.



Dr. Ayyappan, Director General, ICAR said the current focus is on providing 'More From Less for More in different forms. Pointing to the need for people's participation, he said any policy evolved must not only be appreciated by the people but adopted. Working out implementation strategies is as important as evolving a policy itself he said. Knowledge, skill, attitude and partnerships are important components for implementation of new policies he said. We have a tendency to take many things for granted and are not forth coming in recognizing achievements, the hardships and challenges overcome in making these achievements and this mid set must change he said. Public expectations from scientists are very high and it is very challenging to meet the changing needs of the society in a rapidly growing country like India. There is a need to bring youth back to science he said. Indian science has dwelled for long on global problems much more than on local problems. Think global and act local is the slogan we need to adopt he said. He also said that our system is not ready to accept any failure which discourages taking any risk. In science not all projects can end in success. In India, considering the number of people and issues that need to be addressed, one can not expect advancements in agriculture sector in leaps and bounds always. Advancements take place in small quanta he said.

Dr. Shailesh Naik, Secretary, Department of Earth Sciences, Government of India., said we are faced with the important of challenge of climate change which has tremendous impact on various aspects. HE said, while we know what changes are taking place, we are yet to evolve strategies of addressing these issues effectively he said. Water will be a critical issue he added. He admired Prime Minister Manmohan Singh's comment on monsoon launching system and said that major emphasis should be given to address issues related to climate change and earth system. Mineral resources in the ocean will become increasingly important in future and we need to harness them even though it is going to be very challenging requiring multi-disciplinary approach. Earth quake is another major area requiring attention. India is gearing

up to address this issue he said. Building technologies for getting water from ocean are worth developing. National GIS will integrate information generated from various corners he said. We need to have a strong interdepartmental collaboration he added citing the example of the collaboration between Agricultural and Earth Science departments. More flexibility autonomy and means of rewarding excellence, continuing education are some steps that can enrich scientific pursuit in the country he added.

Dr. Samir K. Brahmachari, Director General, Council of Scientific and Industrial Research (CSIR) said though a lot of plans and policies have been made, they lack people's support as the latter want their implementation and execution in ground level. There is a need to evolve a fool proof mechanism to Implement a policy since any incentives to promote S & T can be misused and curtail the true pursuit of knowledge he said. He cited the example of how adopting the policy of having process patent instead of product patenting during the time of former Prime Minister of India Mrs. Indira Gandhi enabled Indian industries to flood the market with drugs for diseases like typhoid drawing the attention to how right policies can have significant impact.

He said, "We need a new way of University system with excellence and high value. Indian Science is divisive. So we should integrate science with technology," he stated adding that special programmes should be initiated for school drop-outs.

Dr. M. Rajasekharan Pillai, Vice Chancellor, IGNOU, New Delhi dwelled upon the challenges of science policy making and said that unbalanced innovation will be of no use for any society and the potential of science and technology still remain untapped for a common man.

Dr. Balakrishna Pisupati, Chairman, National Biodiversity Authority (NBA) in his presentation said that there should be a link between 'sciences of biodiversity with policy of biodiversity'. He also advocated that policy should be made through public private partnership.

Dr. T. Ramasami, Secretary, Department of Science and Technology (DST), Govt. of India focused on the policy that should stand for the people. "Time has come for a shift from public policy for science to science policy for public," he said. He opined that there is a need to create the right atmosphere to realize the potential of youth and to facilitate implementation of innovative policies and re-writing the audit rules is one such pre-requisite he added. Dr. Ramasami was also of the opinion that youth should be in focus while making science policy and hoped that it would be implemented before the Indian Science Congress meets at Kolkata on its centennial edition next year.

Dr. S.R. Rao, Department of Biotechnology, Govt. of India stressed the importance of empowering the youth and attracting them to pursue science. Prof. R. Ramamurthi was convener of the Panel Discussion.



2.4 PANEL DISCUSSION ON BIODIVERSITY GOVERNANCE-ROLE OF COMMUNITIES AND WOMEN

The special Panel discussion on the above topic began with a welcome note from Prof. Geeta Bali, General President, 99th Session of the Indian Science Congress who highlighted the relevance of the Panel to the main theme of the Congress. The Convenor of the Session, Prof. R. Ramamurthi of Sri Venkateshwara University, Tirupati, introduced the theme and welcomed the panelists and discussants to the event. He identified the need to focus on governance issues from a sustainability perspective.



Opening the technical session, Dr. Balakrishna Pisupati, Chairman, National Biodiversity Authority (NBA) outlined the current national and international discussions on the topic of governance from international environmental management and bio-resource _ystematic_ perspectives. Focusing on the history of discussions related to biodiversity governance he highlighted the role of women, science and policy linkages in moving forward the governance agenda. He further focused on the key elements of the proposed Special Report being prepared by NBA on biodiversity governance and opined that issues such as International Environmental Governance (IEG) and Institutional Framework for Sustainable Development (IFSD) has much to learn from on-the-ground activities in how communities and women have managed and governed the natural resources.

Presenting the salient features of bioresource management through conservation, sustainable use and equitable sharing of benefits, Dr. Pisupati drew attention to changing paradigm of governance from 'old

governance' model that is State controlled to 'all governance' that is multi-stakeholder facilitated. He stressed the need for biodiversity conservation program to be also pro-poor. Presenting the characteristics of biodiversity governance in the ambit of participatory decision making, rule of law, transparency, equity, accountability and strategic vision, Dr. Pisupati recollected the issues related to both inter-generational and intra-generational equity. He subsequently explained the principles that underpin biodiversity governance, namely the precautionary principle, polluter pays principle, principle of global commons, principle of equity and justice, principles of access to information, technologies and capacities, principle of community rights and principles of local governance.

Discussing the role of women in biodiversity governance, he spelt the need to focus on rights-based approaches for women, empowerment, providing opportunities, timely support and scope for decision-making. He outlined the initiatives of National Biodiversity Authority to address the issues of national, regional and

local biodiversity governance, including development of People's Biodiversity Registers (PBRs), development of Community Protocols as a component of rights-based approach and others. He called for the _ystematic and discussants to come up with some innovative ideas to move forward the discussion on governance at national level.



Dr. R. Chidambaram, Principal Scientific Advisor, Government of India, made a presentation on 'Biodiversity, Climate Change and Development'. He articulated the importance of biodiversity for human well-being and development. Relating the current development paradigm with ecological sustainability, he called for steps to minimize the differentials within and between economies. Citing the experiences from India on the role and relevance of issues such as indigenous knowledge and role of women in societal development both in the past and currently, he highlighted the need to ensure continued and better use of data in policy and decision making. He stressed the need to focus on the issue of agrobiodiversity conservation citing the low per-capita cultivable land holding in India (1.2 hectares) and decreasing focus on local agriculture due to industrialization. He cautioned that the future of agriculture not only depends on technology but also the genetic base.

Focusing on the issue of 'Role of Women in Biodiversity', Dr. Lucy Mullenkei, Executive Director, Indigenous Information Network, Kenya cited several examples of how local custom, practice and knowledge have contributed to enhancing and managing our biodiversity globally. Highlighting the common approaches at community level in countries such as Kenya and India, she suggested creation of network of practices for local

and indigenous communities (ILCs) in India. Taking example from the negotiations under the Convention on Biological Diversity (CBD) on the role and participation of women and ILCs, she drew attention to the forthcoming CBD meeting in India (Eleventh Conference of Parties – COP 11) as an opportune moment for India and the world to show-case better commitment to cause of ILCs and women as managers and custodians of biodiversity and associated traditional knowledge. She acknowledged contributions of NBA in recognising the equitable principles of access and benefit sharing as well as governance. In conclusion, she requested stronger collaborations between ILCs and government.

Mr. Arun Kumar Bansal, Additional Director General of Forests, Ministry of Environment and Forests (MOEF), Government of India made a presentation on 'Conserving Forest Biodiversity in India: Challenges and Opportunities'. Detailing the salient features of biodiversity in India, he stressed the experience of India in community participation which has been the age old tradition in India. He added that such actions warrant global attention. He elaborated the experiences of Participatory Ecological and Livelihood Assessment (PELPA) in Joint Forest Management (JFM) areas and suggested the use of such methods for micro-planning at local levels. Citing examples from the state of Odisha, he mentioned how JFMs could be good resources for PBR



2.5 PLENARY SESSION ON ANIMAL ALTERNATIVES IN TEACHING AND TESTING

processes and be linked to activities through the Biodiversity Management Committees (BMCs) under the Biological Diversity Act.

Discussants Dr. S Subramaniam, Member, NBA and Dr. Sanjay Deshmukh, Professor, Mumbai University made presentations on various aspects of Biodiversity conservation in India especially coastal biodiversity and participation of community.



Dr. Perluigi Bozzi, Coordinator, International University Network on Cultural and Biological Diversity, University of Sapineza, Italy made a presentation under the title, ' Genetic resources: Lessons from implementing actions linking education, research, policy and society' and called for better society based approaches in decision-making.

Dr. Elumalai, Professor, Madras Law College, in his brief intervention highlighted the need to have inclusive approaches to policy and rule making as well as the implementation. He opined that, if effectively implemented, the Act in India could be the best possible facilitative and legal framework to combine the needs of conservation and development.



Dr. S. Faizi of the CBD Civil Society Alliance made an intervention focusing on the intricacies of international policy and rule making and called for better approaches to decision making at national and international levels. He cited amply from the emerging dynamics of negotiations under the CBD and requested more participatory approaches at the COP 11 meeting. He also outlined the challenges to implement an Act such as the Biological Diversity Act with limitations of capacities, funding and awareness. He called for better participatory approaches for ensuring between conservation and development.

The session ended with a vote of thanks by Dr. S Sudarsanam of S V University to all the panellists, discussants and participants for their time and enthusiasm.

For the first time, a session on alternative methods was held in the ISC. The session was conducted with Dr. Mohammad Abdulkader Akbarsha, Director, Mahatma Gandhi-Doerenkamp Center (MGDC) as the chair and Dr. R. Ramamurthi, former Vice-Chancellor, S.V. University, Tirupati, India, as the convener. Dr. Ramamurthi introduced the theme of the session and stressed the need for inculcating and practicing 3Rs in scientific pursuits namely Reduction, Refinement and Replacement. Dr Akbarsha, thanked the ISCA for recognizing the science of 3Rs as an area of active research and nurture.

Dr. Thomas Hartung Doerenkamp-Zbinden Chair for Evidence-Based Toxicology, Johns Hopkins University, USA explained citing the example of Aspirin, how animal testing that has been considered as a gold – standard for any kind of toxicity testing can be misleading giving false positive or false negative results making such tests unreliable. He said about 70 million chemicals have been synthesized and only a negligible number have gone through toxicity evaluation and about 100,000 of them are found in consumer products, If all these chemical entities were to be tested, an astronomical number of animals would need to be sacrificed and each test would cost about US\$ 1.5 million. He pointed out that modern toxicological tools and approaches, including in vitro and in silico methods, can largely substitute or complement traditional animal tests. One such approach is mapping the human pathways of toxicity (PoT), which will possibly lead to a better understanding of pathway perturbations and give insights into the mode of action of a drug or toxicant. He is leading a team of scientists towards this pursuit in the NIH-sponsored "Human Toxome" Project.

Dr Marcel Leist, Doerenkamp-Zbinden Chair for in vitro toxicology and biomedicine, University of Konstanz, Germany, elaborated upon validation of alternative methods for toxicity testing. Taking the example of research in cosmetics, he said the validation process well planned for ensuring reproducibility, relevance, and hypothesis – generating potential of the test method have found OECD acceptance bu OECD and

European Pharmacopoeia, substituting corresponding animal experiments. He said more than 82 methods have been validated thus, of which 50 are in vitro tests, 10 use isolated organs, and the others are refined in vivo methods in which the test modalities have been improved so as to be more humane to animals. Referring to the huge gap in developmental neurotoxicity he stated, "The available data regarding the developmental neurotoxicity of industrial chemicals is rather limited. For some compounds developmental neurotoxicity is the most sensitive of all toxicity endpoints evaluated in a broad safety evaluation battery. Thus, although developmental neurotoxicity appears to be an important domain of safety evaluation, test capacity is limited and test costs are extremely high. This puts pressure on the development of faster and cheaper in vitro systems that can predict developmental neurotoxicity, give information comparable to behavioral readouts, and facilitate screening or at least prioritization of relevant drugs and chemicals for further testing."

Dr Albert P. Li, CEO, AP Sciences Inc., Columbia, USA, spoke on the novel toxicity testing system known as Integrated discrete Multiple Organ Co-culture (IdMOC), which he invented and patented. The IdMOC system mimics the interaction between different cell types within an organ or between cells from multiple organs in a plastic dish. He stated, "IdMOC is a valuable experimental system for multiple cell type drug metabolism studies." For example, the cancer chemotherapy drug cyclophosphamide does not directly affect the target organs/tissues but it does so after liver metabolism. On the other hand, liver metabolism can be different between species and the toxicity evaluation done in the rat and mouse system may not produce data that could be extrapolated to each other or to humans. The IdMOC system makes use of human cells and so the data can be applied immediately to humans. Numerous studies have shown that IdMOC produces results similar to the human system and is an apt modality for making xenobiotic toxic assessments. "IdMOC allows the evaluation of biological effects of chemicals in an easy, accurate, and controlled manner," he stated. IdMOC is an example of a physiologically relevant "in vitro-in vivo"



human model for evaluation of chemical toxicity and has the potential to replace and/or reduce animal use in the drug development process.

Dr Hossein Hosseinkhani, Associate Professor, National Taiwan University of Science and Technology, Taiwan, explained the utility of tissue engineering in the development of in vitro alternative models in toxicity testing. This interdisciplinary research merges biomaterials science, nanotechnology, and biological principles to generate 3D in vitro living organs called “human-on-chip”. In this miniaturized cell culture system, a 3-dimensional hydrogel scaffold is produced on microslides. This can be populated by cells from two or more organs, developed from stem cells, to grow separately as 3-dimensional systems. The test compound is first metabolized by one cell system/organ and the metabolite/secretory product then can interact with the other cell system(s)/organs through microchannels in the hydrogel. This 3D model mimics human organs/tissues and aims to reduce the extent of in vivo animal testing. He envisioned that his group's study will be useful for in vitro diagnostics and drug screening applications.

Dr Shiranee Pereira, Senior Scientist, Central Institute of Brackish-water Aquaculture (CIBA), Indian Council of Agricultural Research (ICAR), Chennai, highlighted the advances in molecular biology, biotechnology, and bioinformatic tools, which, if adopted, can replace and/or reduce animal use in toxicity testing. Tox-21 and ToxCast initiatives by US EPA where thousands of chemicals are being tested for their safety using in vitro methods points towards acceptance of alternate methods she said. The AXLR8 and SEN-SI-TIV programs funded by the EU will also help revolutionize toxicity testing. At this juncture she summarized the principles of Ahimsa and urged the scientific community to be sensitive to the philosophy of the Great Mahatma. Mohandas Karamchand Gandhi who abhorred animal use in scientific discoveries and as proud Indians we should incorporate the principles of Ahimsa in our scientific endeavors. “The science of alternatives is to know that humane science is better science, giving a

three-fold advantage of being precise, predictive, and pain-free,” she said.

Dr Balakrishna Murthy, Director, International Institute of Biotechnology and Toxicology (IIBAT), Padappai, India, was of the opinion that if validated in vitro test systems are not available, animal testing remains unavoidable in the context of regulatory requirements. Under such circumstances only the minimum number of animals should be used (reduction alternative), and the experimental procedure should be improved such that the animals are dealt with in a humane manner. He outlined that Indian regulators still require old modalities of tests for registering a chemical entity. He cited the example of an agro-chemical entity which has passed all animal testing before being licensed for marketing and use. He stressed that risk assessment should be made with already available data instead of insisting on repeated tests.” Registration guidelines in India should be modified to reduce animal testing.

Dr Surendra Ghaskadbi, Head, Division of Animal Sciences, Agharkar Research Institute, Pune, stated that when animal use is unavoidable, instead of using animals with higher sentience, such as monkeys, rabbits, rats, mice, and guinea pigs, simple, less sentient organisms should be used for toxicity testing, provided these animals also manifest the same/similar endpoints. Hydra, a much simpler aquatic organism, is being developed as a model for aquatic toxicity testing in his lab, in collaboration with MGDC.

Dr Krishan K. Sharma, Dean – Postgraduate Studies, Maharshi Dayanand Saraswati University, Ajmer, called for the removal of wild animals from display in museums and from use for identification purposes and systematic studies. Adopting Molecular Systematic which needs small samples of DNA and which can be more accurate needs to be promoted. Moreover, sound-producing animals can be accurately identified from the uniqueness of their calls. Thus, a new branch of science called sonotaxonomy is emerging. He demonstrated the calls of closely related species of frogs.

Dr Mukkara C. Sathyanarayana, Visiting Faculty, MGDC, was critical of the outdated practice of animal dissection as laboratory exercises. The removal of animals from their habitat for dissection can potentially affect the biodiversity. With the advances in information and communication technology, anatomy can be learned better by using humane digital alternatives. He also emphasized the concept of “Live Zoology” wherein students learn about animals in the field by observing rather than dissecting them in the laboratory.

Dr Akbarsha closed the session by stating that “Alternatives is no more a philosophy of ethics; it is no more even the concept of 3Rs; it has come to be science – core science. It has come to be an arena of scientific research applying the latest developments in science and technology towards finding newer alternatives to animal use in teaching, research, testing, and drug development. Thus, 'alternatives' is no more a practice to adopt but a cutting edge science of research to discover and also validate alternative methods.”

The 99th ISC witnessed vibrant sectional activities in all the 14 sections. Keeping up the past tradition, symposia on different interesting topics complementary to the main focal theme were organized in the 14 sections besides the Platinum Jubilee Lectures in each section. Invited Lectures and Paper Presentations organized in different sections were highly applauded. Endowment lectures constituted a vital part of the programme. These apart, endowment lectures and award lectures were organized in respective sections.



3.0 HIGHLIGHTS OF 99TH INDIAN SCIENCE CONGRESS AND MAJOR RECOMMENDATIONS:

Overall impression of all the participants and public was that the 99th congress was a grand success with respect to the scientific deliberations as well as logistic arrangements.

A major highlight of the 99th ISC was addressing important issues highly relevant for India, not dealt with in the earlier sessions of science congresses such as “Maternal and Child Health Care – Nutrition Security, Health Care without Borders –The Telemedicine Way, NBC Technologies for Armed Forces and Civilians, Green Building Technologies, Rural livelihood and Livestock Management, Assistive Technologies for the Differently abled” to mention a few. Panel discussions held on equally important issues evinced keen interest amongst delegates as well as the general public.

Some of the ideas generated and recommendations made during the 99th ISC were as follows:

3.1 Recommendations from the address of Hon'ble Prime Minister of India Dr Manmohan Singh:

- There is a need to strengthen the supply chain of the science sector. There is a need to motivate talented youth to pursue education and career in science.
- Must ensure a major increase in investment in R & D including by industry and strategic sectors. There is a need to incentivize private R & D investment under Indian Conditions. The public sector undertakings especially in the energy sector should play a major role in this expansion.
- Must achieve greater alignment of the Science and Technology sector with the inclusive development needs of the nation.
- There is a need to expand the basic science infrastructure
- Greater research collaboration among universities and national laboratories must be encouraged.
- International collaboration needs to be expanded
- There is a need to make scientific output more relevant to the basic needs of our society. Research should be directed towards providing 'frugal' solutions to our problems of providing food, energy and water security.

- Must ensure creation of a new innovation ecosystem. The knowledge generated by research should be used productively for social benefit through innovation.
- It is necessary to explore and rejuvenate traditional knowledge systems found all over the country such as agriculture, architecture, handicrafts and textiles.
- Public private partnerships must increase.
- Gender budget audits should be practiced and steps must be taken to promote participation of women in science.

3.2 Recommendations from the address of Hon'ble Minister of Science and Technology Sri Vilasrao Deshmukh

- There is need to look at alternate models of innovation to address the societal issues like health care
- The science and Technology policy was enunciated in 2003. There is a need to frame a new and well enunciated science, Technology and Innovation policy.
- Both Innovation and gender equality on which poverty reduction and human development are dependent, require “out of the box” thinking and acting beyond existing predefined parameters and traditional interventions.
- Identify a well-defined pathway that connects innovation to empowerment of women
- Use the pathway to assess powerful innovations that can change women's lives in technology use, social norm change and economic resilience
- Identify the core levers that are essential for innovation to empower women and transform gender relations.

3.3. Recommendations from the address of the General President of Science Congress Prof. Geetha Bali

- There is a need to integrate science with social sciences to achieve inclusive development.
- Promote innovation driven research to bridge the divide that exists in various forms.
- Design and effectively implement special skill training and educational programmes for honing agricultural skills in women who share most of the burden in agriculture.

- Involve women in the design, testing and use of agricultural technologies and innovations
- Encourage development, manufacture, accessibility and affordability and adoption of drudgery reducing implements in order to enable them engage themselves in farming independently.
- Take steps to transform agriculture as an entrepreneurship for women rather than labour
- Support women in agriculture and women entrepreneurs through policy support.
- Redesign selection criteria to facilitate entry of women into premier institutions in the country.
- Extend Tele-education and virtual class room teaching throughout the country specially focusing on rural and remote areas to promote universal education taking the benefit of India's capabilities in IT and Space Technology.
- Incorporate training in rehabilitation of the disabled, developing equipment and machinery for the disabled in the curriculum for professional courses that are training architects, urban planners, engineers, public health and medical personnel.
- Establish a number of women's only educational and technical training institutions to promote their active participation as administrators, trainers and trainees and enable adoption of special policies including incentives and positive discrimination to bridge gender divide.
- Improve linkage between technology development and technology application by strengthening the ties between basic research and business.
- Encourage and harness innovative capabilities of communities at the grass root level by establishing linkage between marginalized population and industries.
- Convert traditional knowledge into value added products or technologies which are also likely to be more acceptable in order to achieve inclusive development
- Liberally support research in energy producing and saving technologies with a focus on improving energy availability in rural areas.
- Encourage every R& D Institution, private or government, every educational institution and every organization in the country to design its own policy to achieve inclusive development.

3.4 Recommendations from the address of Prof. M.S. Swaminathan, Chairman, MSSRF, Chennai on “Commemorating the Year of Science”

- Year of Science should focus on traditional knowledge for health care and conservation and on transformational technologies.
- Encourage participatory research with local communities as primary stakeholders as well as partners in order to benefit from traditional knowledge.
- Encourage, provide support and incentives to local communities in various parts of the country which have been conserving indigenous knowledge at their own cost.

3.5 RECOMMENDATIONS FROM SOME OF THE PUBLIC LECTURES

3.5 A. Recommendations from the Address of Dr. R. Chidambaram, Principal Scientific Advisor to Government of India, on “Research and Innovation – Many Dimensions”

- India's science and technology programme must balance basic and applied research with innovation, commercialization and societal reach.
- The nation's technology needs range from nuclear to rural, and all these must be addressed.
- Adopt policies to encourage early introduction of new advanced technologies.
- Enhance academia-industry interactions for industrial development and improve systems for technology delivery for rural development, in order to achieve inclusive growth.
- Encourage the highest intellects to work on fundamental problems of their choice and, as an additionality, also pursue what can be called 'Directed Basic Research' related to our technology priorities.
- Utilize the National Knowledge Network, linking the country's knowledge institutions, to promote national and international collaboration in research and innovation and to strengthen our science and technology initiatives.



3.5B Recommendations from the address of Dr. S. Ayyappan, Director General, ICAR 'on "Feeding Crores Forever"

- There is a need to look differently at our priorities in food and this is an opportune time to re-think about the food production and research methods system. Maintenance of the system can be carried out at the village level itself.
- Strengthen Information systems in rural areas such as Kisan Mobile Sandesh and Agropedia which can also create indirect employment
- Promote consultancy services in the fields of education, research, training and dissemination of information in Agriculture, Agro-forestry, Animal husbandry, Fisheries, Home Science and allied sciences in order to focus on broader issues of rural development.
- Rejuvenate technology transfer programmes in rural areas.
- Facilitate participation of people in designing and implementing Science policy
- Further strengthen the capabilities developed in India for drought accessing monitoring, which will be upgraded for drought proofing agriculture, improved productivity in dry land farming, bio-engineering measures for soil-conservation, integrated nutrient management, integrated farming system and water budgeting to address the basic needs of people and to transform India into food-secured nation

3.5C Recommendations from the lecture of Dr. Dr.K. Narayana Gowda, Vice-Chancellor, University of Agricultural Sciences, Bangalore Administration and Governance

- Land ownership should be vested with rural women who are actively involved in farming.
- Gender experts may be included in all the technical committees of the Government
- Gender data base should be generated and documented at all levels.
- Enhance recruitment of Women Extension personnel/ Researchers
- Provide better facilities/incentives to Rural Women field workers.
- Implement equal wages for men and women who

- are working in rural development programmes.
- Revise labour wages rules to take into consideration percent human capacity also rather than quantity of work carried alone while fixing wages.
- Research and Development
- Establish Rural Women centres in State Agricultural Universities (SAUs) to undertake R&D activities.
- Strengthen budgetary support to Women studies.
- Assess farm technologies, programme, institutions and policies with gender perspective.
- Evaluate Gender role in different agro-ecological and production systems and its linkage with agricultural production.
- Develop women friendly drudgery reducing farm tools to strengthen women's participation in agriculture and allied activities.
- Identify income generating subsidiary enterprises for different agro-ecological regions.
- Adopt Women-centric IFS models for farms managed by women, integration of enterprises that can be taken care by women to ensure sustainable income.
- Establish Incubation and processing units for agricultural and allied sectors in villages particularly for rural women and Organize a number of women entrepreneurial programme at taluk level.
- Set up small production units at community level to Promote health based traditional foods with good shelf life. Establish small agro based enterprises complex utilizing locally available grains, fruits and vegetables and developing linkages with Khadi village industries, sales counter of State Government institutes, food bazaars etc.
- Promote research on topics addressing nutritional and health security to women, Impact of climate change on women in agriculture, occupational health hazards of farm women etc in order to design and adopt appropriate policies and mechanisms to face the challenges.
- Conduct extensive off-campus outreach programmes keeping in mind the convenient time of rural women, employing agricultural universities and R & D institutions in the sector.
- Provide assistance for women agricultural graduates for setting up agri-clinics, agri-business centres and food processing centres.

- Patronize and Institutionalize women farmer producers associations
- Strengthen Self Help Groups by providing technical training, marketing advices and opportunities

3.6 Recommendations Emanating from Women's Science Congress:

It was unanimously accepted that no society can claim to be a part of modern civilization unless it provides an enabling environment for empowering women and gives them equal opportunities. Hence, all efforts must be made for bridging the gender divide and facilitating participation of women in nation building and encouraging women to pursue science. A number of recommendations were generated in various sessions some of which are as follows:

- There should be more women-oriented programmes to encourage women to take up science as a career.
- There is a need to increase mid-career opportunities for women scientists who quit their jobs after marriage and provide self-employment opportunities for women.
- Widespread discrimination at basic education level and lack of opportunities for pursuing higher studies being major contributors for gender divide, appropriate policies must be adopted to ensure basic education for girls.
- Accessibility to and affordability of education including higher education must be promoted immediately by establishing dedicated institutions for females especially in rural areas and also in urban areas providing basic education, technical and professional training at subsidized cost.
- Education about health, nutrition, communicable diseases, personality development and such topics especially significant for women must be part of training in all institutions dedicated for women.
- Empowerment and welfare of rural women must be achieved with integrated approach involving various departments of the Government.
- Industries, R & D institutions and private organizations must be encouraged to promote training and employment of women by suitable policies that provide government incentives.

- Empowerment of rural women should be aimed towards bridging rural-urban divide.
- A well defined positive discrimination for women in education and opportunities is necessary for reducing the wide gender divide that exists and to resist the increasing insecurity of women in modern times.
- Gender auditing must be made compulsory in all S & T institutions encompassing recruitment, promotion in addition to taking other gender enabling measures.
- Gender budgeting must be effectively implemented across the country.
- One of the members should be a trained Gender expert (not limited to women) in all selection committees



4.0 RECOMMENDATIONS FROM PLENARY SESSIONS AND PANEL DISCUSSIONS

4.1 Recommendations from the Panel Discussion on Science Policy Making: Chairman of the session: Dr. K. Kasturirangan, Member, Planning Commission of India.

- There is a need to integrate Science and Technology with Social Sciences
- Social Scientists must be taken on board right from the beginning of science policy making in order to be able to address factors that inhibit success when implemented.
- Match strategies of S & T for public social and strategic good and more gainful use of Public and Private Partnership for R & D.
- Create programs nurturing students to pursue science as carrier. Consolidate the gain achieved under INSPIRE program and such other programs implemented during the last five-year plan in this direction.
- Initiate grand challenge programs and launch Pan India missions to address national priorities in various developmental sectors through bottom-up approach, particularly in the areas of health, energy, water, food through a consortia of multi-institutional and multi-agency, cutting across public and private sectors.
- Build technology partnership with states through new models of technological solutions, design, development and delivery. Invigorate state S & T councils to contribute in this direction.
- Increase R& D expenditure to 2% of the GDP from the current level of 0.9% . Significantly increase corporate sector's R & D expenditure to at least 1% of GDP by encouragement of investment and engage corporate sector in R & D through policies and profound approaches.
- Encourage large Indian Industries to establish their R & D centers and support technologies to provide a mission means to leap frog to contribute to inclusive growth.
- Develop and deploy and integrate innovative technologies in strategic and non-strategic sectors for social good.
- Increase full time researchers and scientists by two times in both volume and quality to pursue basic

research, achieving an increase at least by a factor of three.

- Create a set of new inter-university and inter-institutional research centers with state of the art facilities to create a vibrant academic ambience in the universities and institutions.
- Bring in structural reforms in science sector for matching national aspirations through creating new appraisal and audit mechanisms and personal practices with best practices and seamless mobility of S & T personnel. Create graphical representations of institutions and support systems.
- Evolve effective implementation strategy along with the new policy, adopt good and transparent mechanisms to enhance quality nation is looking for.
- Educate and involve public extensively in implementing policies in order to achieve transformation at grass root level.
- Synergize various technologies developed.
- Strengthen infrastructure in medical colleges to promote translation of technologies.
- Employ state systems to reach the developments in health sector to people with special focus on tribal and other marginalized communities.
- Science policy should be encompassing and overlapping with interdepartmental involvement since any issue has multiple facets of influence
- Create Interdepartmental platforms to adopt holistic approach in addressing an issue.
- Install agri-incubators that could be made use of by young researchers who would turn into agriculturists rather than migrate to cities.
- Youth to be kept in focus while making science policy.
- Initiate necessary steps to improve the currently existing governance procedures to facilitate implementation of new policies effectively.
- Established Institutes of policy making on the lines of IIT and IIM providing a platform for young scientists and social scientists as well as bureaucrats to work collectively and undertake highly focused, sustained advanced research at the grass root level, examining important issues from various angles and from all perspectives and gaining expertise on region

specific problems and environment – social, cultural and economical and monitoring them in space and time. The information so generated can be invaluable for policy makers at all levels in designing policies, developing strategies for implementation as well as monitoring and evaluating societal impact.

4.2 Recommendations from the Panel Discussion on Biodiversity Governance-Role of Communities and Women

- Collate, analyse and use biodiversity information effectively.
- Employ 'e-science infrastructure' in the country for conservation and promotion of biodiversity
- Carry out a "Biodiversity Foresight Analyses" in India to predict components of biodiversities that must be preserved while recognizing the inevitable demands of technological development.
- Identify, incubate, adopt technologies relevant to biodiversity, focussing on issues of access to resource and benefit sharing.
- Involve local communities closely in activities related to eco-development and eco-tourism
- Involve coastal communities in conservation and sustainable management of coastal biodiversity.
- Provide special protection and management of sacred groves and explore the possibility of declaring such sacred groves as Biodiversity Heritage Sites under the Act.
- Evolve appropriate policies to link local action to national and global policy making in securing coastal and marine biodiversity for development purposes and adopt society based approaches.
- Encourage participation of women in conservation of biodiversity since women play a vital role in preserving and protecting which is a part of biodiversity conservation.
- Strategic resource mobilization for promoting biodiversity activities integrating women's participation.

4.3 Recommendations of the Panel Discussion on Science Education in Rural Areas:

Poor status of science education is the root cause of the wide rural-urban divide that exists. It is also responsible

for the challenges faced in successful implementation of policies and programmes of the government intended for the welfare of rural people. A paradigm shift is required in our framing of policies for rural science education. Extensive discussion held by a panel of experts and participants lead to the following recommendations:

- Teaching and training in rural areas must focus on achieving socio-economic development of the rural population by adopting the following objectives:
 - a) Gainful employment
 - b) Individual emancipation
 - c) Socio-cultural well being
 - d) Environment protection
 - e) Biodiversity conservation
- Right to Education should focus on rural areas.
- Establish common schools admitting everyone in the neighbourhood.
- Invest liberally in creating necessary infrastructure for teaching science in rural educational institutions.
- Link rural schools, colleges and post-graduate institutions in a given rural area through policies which can be followed up with district, state and national level networking in a phase-wise manner.
- Ensure stable and reliable electric power supply for 20 hours a day throughout the year to academic institutions in rural areas.
- Science education must also focus on teaching applications of science
- Prioritize teaching of women.
- Provide primary education in mother tongue/regional language.
- Incorporate health education, education on the environment and ecosystem in the curriculum at all levels.
- Initiate a drive to educate 0.8 million panchayat body elected women members through adult science education programmes to make them technically literate.
- Establish primary health centres in the proximity of schools in rural areas.
- The National Innovation Council should focus on rural problems of education.
- A village education officer, preferably a woman should create, train master teachers exclusively for rural areas for teaching science.



- Set up Community colleges in rural areas based on IGNOU model.

4.4 Recommendations from the Plenary Session on “Health Care Without Borders-The Telemedicine Way”

Telemedicine can have tremendous impact in reaching health care to rural and remote areas of the country and also making quality health care accessible and affordable by people across the society. Telemedicine can thus be an important tool for inclusive development. The following recommendations emanated from the deliberations that took place during the 99th session of the Indian Science Congress Association

- Link different Taluk hospitals/Community Health centres in each district to the District Hospital and different District hospitals to Specialty Hospitals in the major cities for prioritizing rural and semi-rural health care to the masses..
- Involve medical graduates/PG’s in tele-medicine programme during their internship for providing clinical support for the local Telemedicine centres
- Adopt cost effective technologies including Mobile Phone Technology for enhancing Telemedicine service and to make it affordable.
- Acquire a dedicated Communication Satellite for the country for Health and Medical education/Training for telemedicine service covering the whole country.
- Make budgetary provision for implementing Telemedicine programme country wide in the 12th five year plan.
- Telemedicine thematic session should be a part of a public lecture/panel discussion or a plenary session in all the Indian Science Congress sessions in order to provide a forum to popularize this programme, strengthen participation of people and draw attention of scientists, policy makers and public.

4.5 Recommendations of the Plenary Session on Animal Alternatives in Teaching, Toxicity Testing and Medicine

- The 3Rs (Reduction, Refinement and Replacement) principle, must be given recognition, emphasis, and importance in national scientific deliberations, funding and planning

- Create awareness that the science of alternatives to animals besides being a progressive and better science and pedagogically superior, is legally binding on the Indian scientific/teaching community, bureaucrats and policy makers as enunciated in the Prevention of Cruelty to Animals Act 1960 section 17(d).
- "The Bologna Declaration" of 1999 should be the guiding criterion in all scientific planning and funding in India. All national and central institutes and university portals should display the declaration.
- National funding agencies must make it mandatory that in the allocation of funds for projects/schemes the investigators should exhaust all possible in vitro and in silico approaches before embarking on research using animal models and encourage research using in vitro and / or in silico methods by earmarking at least 50% of funds for such research.
- All life science, medical, and paramedical educational programmes should actively incorporate alternatives to use of animals for both pedagogical and ethical reasons. Alternatives foster better teaching, learning and empathy for life and our environment.
- Incorporate topics of animal ethics / science of alternatives / 3Rs in undergraduate as well as postgraduate life science / medical / paramedical courses.
- Establish In vitro and in silico facilities in all laboratories/institutions which use animals / animal models in research and/or testing providing appropriate funding for the same in the 12th Plan.
- Constitute a high level committee to review internationally validated alternative tests (for drugs, agro-chemicals, cosmetics and vaccines) and design new and more appropriate and efficient Indian test guidelines for drugs, cosmetics, agrochemicals, medical appliances, household products etc
- The spirit of AHIMSA, which is the guiding principle of Indian culture and espoused by Mahatma Gandhi, the Father of our Nation, should percolate in our national policies and science planning.

4.6 Recommendations from the Plenary Session on Nanotechnology and Diagnostics:

- Propagate nanotechnology education at all levels
- Establish industry-academia partnership in Nanotechnology
- Facilitate capital investment in new nanotechnology ideas for start-up companies

4.7 Recommendations from the Plenary Session on Maternal and Child Health Care –Nutrition Security:

- Adopt National Policy for ensuring maternal care and fetal nutrition.
- Initiate a special drive to address anemia in women
- Focus on Low Carbon Food Print Diet
- Implement special programmes to create awareness amongst women especially those from lower socio-economic strata regarding maternal and fetal nutritional needs.
- Programmes involving subsidizing or free distribution of health foods for women and children must be compulsorily twinned with nutrition awareness creating programmes.

4.8 Recommendations from the Plenary Session on Assistive technologies for differently-abled:

- Identify, recognize and promote innovations addressing empowerment of people with different and diverse abilities.
- Integrate various technologies in addressing the needs of differently abled Incorporate Training in rehabilitation of the disabled, developing equipment/facilities for disabled in professional schools that are training medical personnel, engineers, architects, urban planners.

4.9 Recommendations from the Plenary session on “Rural Livelihood Security-Livestock Management”

- Prioritize control of diseases that impact the livelihoods of poor farmers (eg: Swine fever, Peste des petites in ruminants, Foot and mouth disease)
- Implement programmes to Control of zoonotic diseases that predominately affect human health

(Like Brucellosis, Anthrax) in rural areas.

- Evolve efficient vaccine delivery technologies specific to rural communities.
- Some of the New generation vaccines developed by various R&D institutes should be taken up by the Government of India for further validation and Initiatives should be made to convey these technologies from R&D labs to the poor farming community (Eg: FMD vaccine) for livestock management.
- Importance should be given for the development of multi-component vaccines targeting more than one disease.
- Development of advanced Diagnostic technologies like DIVA (Differentiation of Infected from Vaccinated Animals) has to be considered for disease monitoring.
- Steps should be taken towards the development of thermo-stable vaccines as maintenance of cold chain is a serious constraint in rural areas.
- For the control of PPR which is a very important disease in ruminants, pulse vaccination programme has to be initiated before the disease outbreak for effective sanitization of the virus.
- Importance has to be given for epidemiological studies that enable the planning of vaccination programmes for effective disease management.
- Regulatory issues have to complement the rapid and easy transfer of R&D efforts to the rural areas for their use/practice.
- Some of the disease-resistant animal breeds in rural areas have to be identified and special breeding programmes have to be initiated.
- Integrative management programmes that comprise disease diagnosis, control, prevention and eradication have to be implemented for important livestock diseases that impact livelihood of poor like FMD, Bovine Brucellosis, PPR, Classical swine fever, Ranikhet disease and Avian Influenza.



5.0 RECOMMENDATIONS OF SECTIONAL PROGRAMMES

5.1 Animal, Veterinary and Fishery Sciences

1. Along with the production of food grains through new technology, level of pharmaceutically produced proteins should be tested on human digestibility.
2. Promotion and protection should be given to small scale farmer (Agro and Aqua) for sustainable development in respective fields.
3. Production of animal and dairy products should be promoted through small scale farmers for sustainable development and food security.
4. Technologies should be developed in veterinary medicine for the sustainable development of livestock for food security.
5. Special program should be formulated for the development of riverine fisheries and freshwater aquaculture for food security.
6. New innovations are required to control different diseases in farming fisheries and other aquatic products for the sustainable development.
7. Public awareness should be made regarding "Genetically Modified Organism" (GMOs).
8. Fish production technology should be introduced at school level to create interest and enthusiasm amongst children.
9. Science awareness programs should be introduced at various schools and colleges.

5.2 Anthropological and Behavioural Sciences (including Archaeology, Psychology, Educational Sciences and Military Sciences)

1. There should be networking of Psychological counseling and guidance centre to be totally managed and staffed by woman Psychologists.
2. It should be mandatory for secondary and higher secondary institutions to have service of counselors who are trained in the problems of adolescents especially girls.

5.3 Engineering Sciences

Strategic and Long-term:

- An exclusive budget for technical education, like the budget for railways.
- The National Mission for Engineering Education to prepare Road Map

- A new service cadre- Technical Education Service through UPSC and State PSCs

Action Items for Immediate Implementation:

- There is an urgent need for a change to bring in a system that gives importance to students' capabilities. By creating such an environment, innovations and breakthroughs happen. The open labs concept be introduced and "tolerance for failure" culture be inculcated to promote experimental learning in students and young faculty in order to encourage innovation.
- Younger faculty should be given opportunities for research, while senior professors given undergraduate classes to improve quality of teaching.
- There is urgent need to make teaching and research a lucrative career option to address an acute shortage of faculty.
- Universities must be provided budgetary support for ICT-enabled teaching-learning.
- The ASSOCHAM, CH, MAIT, NASSCOM, TiE and others should take path-breaking initiatives to support academia and to network with community of practice.
- Early identification of entrepreneurs and establishment of industry supported project development and innovation centres could be the first steps in the right direction.
- To reduce learning curve and improve employment potential of students, industry-oriented extension programmes can be offered jointly by academia-industry-professional societies. The systems engineering and trans-disciplinary engineering design methodologies should find place in curricula.
- The acute shortage of faculty can be partially addressed by inviting experienced professionals from Govt./R&D and industry (not withstanding with their academic qualifications) to become an extended arm of academia.
- Faculty development institutes or centres should be established by universities or autonomous institutes for training new faculty.

- The recommendation of Knowledge Commission for establishing 1,500 universities should be acted upon to provide education opportunities to all strata of society. However, universities must be benchmarked/assessed regularly. Regulatory agencies and professional societies should co-evolve quality standards.
- Industry – academia partnership in technical education should be institutionalized. Industry Faculty exchange programmes should be encouraged.
- Evaluation of the faculty by the students should be done for all the engineering colleges in the country as a matter of policy.
- Industries must spend part of their income to train faculty and students which may be compensated via tax incentives for any expenditure that may be incurred on this training.
- Acquisition of additional skills concerning the core professional value such as creativity, clean environmental sustainability – cum – development, societal benefits, etc. is essential for all engineering professionals before they can start practicing their profession. These aspects should find a place in the universities curricula.
- For award of Research projects by Government Institutions, preferences should be given for research grants to bright and budding engineers with research ideas irrespective of their affiliation to Government/private organization.

5.4 Environmental Sciences

- People's participation is the need of the hour for Conservation of Environment, Natural Resources and issues pertaining to Mitigation of the climate change. Added emphasis should be given to action oriented environmental awareness generation programmes.
- Waster water management is required to be given added emphasis particularly in areas of utilization of waster for increasing agricultural productivity.
- Research on Identification of Macrophytes and Microbes for Bioremediation of Industrial effluents needs to be promoted for removal of toxic substances from the human environment.

- Assessment of the impact of coal and black stone mining on the local environment needs to be done as scientific research on the topic is lacking.
- Measures are required to be undertaken to prepare an inventory and initiate actions to conserve the Fossils of Rajmahal.
- Assessment of the potential of biochar in increasing Carbon-sequestration in the soil needs to be made.
- Encourage studies on isolation of pesticide degrading microorganisms, their growth behavior and their potential in remediation.
- Invasive species are a threat to Biodiversity and Bio-resources. Steps must be taken to mitigate the threat.
- Large areas of country are affected with ground water contamination with toxic elements. There is need to mitigate the impact of toxic elements viz., cadmium, arsenic, fluoride etc. in order to ensure the availability of safe drinking water.
- Wetlands provide immense ecosystem services and are in great threat due to land use change and encroachment. There is an urgent need to take action for conservation of wetlands.
- For conservation of environment and biodiversity, the traditional and religious practices need to be scientifically assessed documented.
- Institutional arrangements of traditional societies can be used as model for building of modern institutions for management and conservation of natural resources.
- Alternative sources of energy to be explored for reducing dependence on conventional sources of energy.
- Possible models to be developed to mitigate the ill impact of climatic change.

5.5 Information and Communication Science and Technology (including Computer Science)

- Lack of consistent and affordable electricity is the single greatest challenge in designing a computing infrastructure for rural health informatics (or any other application for that matter). The vast majority of health facilities in remote parts of the country have no mains power and, where available, such power is usually extremely unreliable or so unstable that it poses a threat to unprotected electronic equipment. Ending the decade's long process of



extending stable, grid power to remote communities or the advent of an entirely new computing paradigm, the logical immediate answer to this challenge lies in low-power-consuming hardware. Fortunately, hardware now exists that is cost-effective to run on solar (or other renewable) or in partial-grid power.

- Just as in many other areas of development (e.g., agriculture, health, and education), women face enormous challenges to use ICT for their own economic empowerment. Using and benefiting from ICT requires learning, training, affordable access to the technology, information relevant to the user and a great amount of support (to create enabling environments).
- In addition to being used as effective ICT for development, radio and television should be considered and used as a means to educate populations on the benefits of using ICT for development.
- Language and content limitations: Lack of local and community related content as well as content in local languages continues to be a major barrier in women's use of ICT for economic empowerment. ICT can only be useful and meaningful, particularly to rural and poor women, if they provide relevant information and the tools needed to address women's needs and demands
- Creating business and employment opportunities with women as owners and managers of ICT access projects, as well as employees of the new business ventures
- Creating an environment where women feel welcome and comfortable learning with others, getting trained on using ICT and participating in community development activities, including community advocacy efforts
- Developing ICT based programs that address women's specific needs and that are run by women (e.g., literacy programs, business planning courses, ICT training, access to health information and services, access to market and trading information services and e-commerce initiatives) and providing the skills necessary for members of the community to develop their own businesses and business applications.

- With the advancement of Communication and Computing Technology in the digital era there is a need to focus on Spiritual Science. There is a need to educate everybody about Computer Ethics and its impact on the Society, in our education systems to prevent misuse of Computer Technology.
- Science is perceived as a tool for promoting the well-being of humanity as well as planet, for Social and economic transformation and hence efforts must be made to connect Information, communication and Technology with Spiritual Sciences (cognition).
- We need to take concrete action while framing curricula and development and adaptation of innovative methods to inculcate values and ethics in children.

5.6 Materials Science Section

- The following research areas in Materials Science have immense scope and potential and hence it is recommended that intense focused research be conducted in these areas:
Materials for automotive applications, nano materials for various structural and functional applications, energy materials, bio materials advanced materials processing for developing engineered materials, materials modeling including materials genome and multi-scale modeling, materials characterization at the atomic scale for better understanding of the advanced materials. All these studies can lead to design of materials with better performance for the future.
- Funding agencies should support research in both top-down and bottom-up modes. The bottom-up mode is the usual way projects are funded, wherein a researcher approaches a funding agency with an idea. Such projects help in improving the research base in the country. However, the top-down approach, wherein the funding agencies identify certain focused areas and identify the groups that can work together in a mission mode from the design to the system development level and funds such mega networked projects with clear cut deliverables for each group with regular monitoring in order to make India a leader in certain specified areas.

5.7 Mathematical Sciences (including Statistics)

- Multidisciplinary research must be enhanced for intra and inter academic institutions involving Mathematical Sciences to solve emerging issues of national importance and impact. Academic, Government and Private sectors should be encompassed in this effort.
- Specific workshops should be conducted to expose researchers to the techniques of applications of various tools from Methodical Sciences to target topics of real-life applications. Such applications should include health and work issues related specifically to women and to the sensitive sectors of our population, using scientifically and objectively collected data.
- In the Master's curricula for Mathematical Sciences at academic institutions, a "Project on Analyses of National Data" should be introduced. This project work will expose students to the difficulties, as well as methods to overcome those, for such data and implement their textbook knowledge for solving real-life problems. The outcome of this plan would be a new and young generation of "Problem Solvers" from Mathematical Sciences ready to face many practical challenging issues from our national scenario.

5.8 Medical Science (including Physiology)

- Adequate preventive measures should be advocated to prevent occupational hazards.
- Safety rules should be instituted to reduce the incidence of trauma.
- All medical, paramedical staff, ambulance drivers, police and school children should be trained for primary care to trauma victims.
- Chronic pain can be treated successfully, but people should be made aware about the options.
- More research in the field of nanotechnology may be helpful to treat cancer by creating nano particles of chemotherapeutic agents.
- More research related to genetics may help to identify persons prone to develop certain debilitating diseases such as diabetes.
- Young scientists should be encouraged to take up such studies.

5.9 New Biology (including Biochemistry, Biophysics & Molecular Biology and Biotechnology)

- Natural products from the various diversified places in India needs to be explored for the treatment of genetic diseases prevalent in our country and diseases emanating from changed life style.
- Research involving isolation and characterization of microorganisms to identify newer bioactive compounds should be encouraged.
- Research on the use of new chemical entities for the inhibition of drugs targets for various types of diseases such as hypertension, cardiovascular diseases, Alzheimer's, diabetes, Asthma, obesity etc should be augmented.
- Basic research on the understanding of the drug – drug interaction and use of nano technology for the betterment of human life and poverty alleviation should be given preference.
- Research on the bioactive compounds from natural products, microbes as well as chemically synthesized ones for combating disease may be accelerated for the betterment of human life.

5.10 Physical Sciences

Universities should have a substantial component of research so that they become centers of knowledge generation along with knowledge dissemination. To achieve these objectives, the following steps should be taken-up on priority basis:

- A strong national mechanism for research collaborations between Universities and National Research Institutes must be set up. This will improve research and teaching at Universities, and in turn will help generate quality manpower as input to National Institutes.
- Several new Inter University Consortia should be set up in carefully chosen areas of research and they should be funded adequately. They should be given sufficient autonomy to decide their programmes and collaborate with appropriate research centres in India and abroad.
- Considering the impact of Accelerator Physics and Technology in the contemporary research and societal applications, the subject of Accelerator Physics and Technology must be taught at the



university level. In addition, teaching institutes like Indian Institutes of Technology must be funded to develop accelerator centres. This will generate the much needed quality manpower for the ambitious future. This initiative can be worked out in collaboration with National Institute, IITs and Universities together.

- Photonics and Metamaterials is one area which has tremendous technological potentials in areas such as solar energy, lasers, low cost lighting and also strategic applications. The current level of research is not sufficient to lead in the international context, and countries like China and Korea together with US and European countries are making giant strides. In order that the country does not miss more opportunities in this particular area, a strong programme at various institutes and universities must be initiated. Such a programme should be configured with collaborations among Physicists, Chemists, Material Scientists and Electrical/Electronic Engineers. This is important for development of frontline science and its translation into technology products. In view of the above, a National Centre for Photonics and Metamaterial Research may be formed in the country

5.11 Plant Sciences

- Farmers should be educated about the use of bio-pesticides in their farms, their utility and soil protection.
- Bio-pesticides and Bio-fertilizers should be subsidized by the government as it is done for the chemical fertilizers.
- Registration of these pesticides should be done by the government and the government should follow the same policy as it is followed, through TIFAC of DST.
- Tissue culture techniques should be widely used for mass propagation of elite species.
- People should be educated about the use of GM plants to release much stress on the earth and soil. The results of the use of BT – cotton plants, similar commercial crops of GM crops can be used widely. Second green revolution could be attained by using biotechnological techniques.