PROCEEDINGS

of

The National Conference on 'Technological Empowerment of Women'

Commemorating the International Women's Day

March 8-9, 2018

Venue: Vigyan Bhawan, New Delhi

The National Academy of Sciences, India (NASI)

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A BRIEF REPORT

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Edited by:

- **Prof. (Mrs.) Manju Sharma**
- **Prof. Chandrima Shaha**
- **Prof. Paramjit Khurana**
- **Ms. Archna Pant**

For further information, please contact:
The National Academy of Sciences, India (NASI)
5, Lajpat Rai Road, Allahabad, Uttar Pradesh-211002
Phone: +91 (0532) 2640224, Fax: +91 (532) 2641183
Email: nasi.allahabad1@gmail.com
Website: www.nasi.nic.in

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सत्यमेव जयते

प्रधान मंत्री

Prime Minister

MESSAGE

It is a pleasure to know that a National Conference on Technological Empowerment of Women is being organized by the National Academy of Sciences, India (NASI) at New Delhi on the occasion of International Women's Day.

I hope that the Conference will give opportunity for all the participants to benefit from the insights and experiences of the eminent speakers and share their visions to leverage the empowering potential of technology.

Best wishes for the successful organization of the Conference.

(Narendra Modi)

New Delhi
01 March, 2018

एन. युवराज, भा. प्र. से.
N. YUVARAJ, IAS

सत्यमेव जयते

भारत के उप-राष्ट्रपति के निजी सचिव
PRIVATE SECRETARY
TO THE VICE-PRESIDENT OF INDIA
नई दिल्ली/NEW DELHI 110011
TEL. : 23016344 / 23016422 FAX : 23018124
ps-vps@nic.in

MESSAGE

The Hon'ble Vice President of India is happy to learn that the National Academy of Sciences, India is organizing a National Conference on Technological Empowerment of Women on March 8 – 9, 2018 at Vigyan Bhawan, New Delhi on the occasion of International Women's Day.

The Vice President extends his greetings and congratulation to the organizers and the participants and wishes the event all success.

(N. YUVARAJ)

New Delhi
6th February, 2018.

डॉ. हर्ष वर्धन
DR. HARSH VARDHAN

सत्यमेव जयते

मंत्री
विज्ञान और प्रौद्योगिकी एवं पृथ्वी विज्ञान ;
पर्यावरण, वन और जलवायु परिवर्तन
भारत सरकार
नई दिल्ली - 110001
MINISTER
SCIENCE & TECHNOLOGY AND EARTH SCIENCES ;
ENVIRONMENT, FOREST AND CLIMATE CHANGE
GOVERNMENT OF INDIA
NEW DELHI - 110001

MESSAGE

I am glad that the National Academy of Sciences, India is holding a National Conference on Technological Empowerment of Women during March 8-9, 2018 at Vigyan Bhawan, New Delhi to commemorate the International Women's Day.

The Conference would discuss issues such as Frontiers in S&T; Agriculture, Nutrition and Food Security; Health Care and Sanitation (Swastha and Swachh Bharat); Skill enhancement and development; Entrepreneurship development; Employment Generation – Avenues, Opportunities and Challenges; and concluding,into the Plenary Sessions and Panel Discussion. Focus will remain on mentoring, encouraging and guiding women for advancement of their career in S&T.

I extend my greetings to the fellows and members of the Academy and the participants to the Conference.

(Dr Harsh Vardhan)

सत्यमेव जयते
त्रिलोचन महापात्र, पीएच.डी.
एफ एन ए, एफ एन ए एस सी, एफ एन ए ए एस
सचिव एवं महानिदेशक
TRILOCHAN MOHAPATRA, Ph.D.
FNA, FNASc, FNAAS
SECRETARY & DIRECTOR GENERAL

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली 110 001
GOVERNMENT OF INDIA
DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION
AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
KRISHI BHAVAN, NEW DELHI 110 001
Tel.: 23382629; 23386711 Fax: 91-11-23384773
E-mail: dg.icar@nic.in

MESSAGE

I am happy that the National Academy of Sciences, India (NASI) is organizing a National Conference on "Technological Empowerment of Women" during 8-9 March, 2018 at New Delhi.

Generation of scientific knowledge especially in the field of women empowerment and transfer of the same to the working women including the farm women by the academicians and scientists deserve appreciation. Our efforts should be directed towards the all-round development of each and every section of Indian women, not confining the benefit to a particular section of women in society, by giving them their due share. It is a must to protect their dignity and ensure that they are respected in the society. Without removing social stigma, enduring progress and development could not be achieved. The task is not too difficult to achieve. The honesty and sincerity on the part of those involved is a must. If the lots of women change, definitely it will have a positive impact on society. Hence, the women's empowerment is the need of the hour, and I should credit NASI for this timely topic of discussion for the Conference.

I do hope that the Conference will provide an excellent opportunity to highlight the problems in the field and also to chart out a visionary road map implemented to be undertaken in the coming years, such that India emerges as a leading developed nation in the World.

I wish memorable success for the said National Conference.

Dated the 12th March, 2018
New Delhi

(T. MOHAPATRA)

प्रो. अजय के. सूद
अध्यक्ष
Prof. Ajay K. Sood
President

भारतीय राष्ट्रीय विज्ञान अकादमी
बहादुर शाह ज़फर मार्ग, नई दिल्ली-110 002
INDIAN NATIONAL SCIENCE ACADEMY
Bahadur Shah Zafar Marg, New Delhi-110 002

1 February 2018

MESSAGE

I am very happy to note that The National Academy of Sciences, India is holding a conference on "Technological Empowerment of Women" on 8-9 March 2018 at New Delhi, to commemorate the International Women's Day. I understand that the focus of the conference will be on mentoring, encouraging and guiding women for advancement of their career in S&T.

On behalf of Indian National Science Academy, I extend my best wishes for the grand success of the conference.

Yours sincerely,

Ajay Kumar Sood

(Ajay K Sood)

भारतीय विज्ञान अकादमी
डाक पेटी सं. 8005, सी.वी. रामन अवेन्यू, बेंगलूरू – 560 080, भारत
Indian Academy of Sciences
P.B. No. 8005, C.V. Raman Avenue, Bengaluru - 560 080, India

Professor **RAMAKRISHNA RAMASWAMY**
President

MESSAGE

I am delighted to learn that The National Academy of Sciences, India, is organizing a *National Conference on Technological Empowerment of Women* during 08 -- 09 March 2018, at Vigyan Bhawan, New Delhi, to commemorate the International Women's Day.

In this rapidly changing global environment, when nations are realigning their scientific strengths and goals, gender parity and inclusiveness remain a global issue demanding immediate attention. While contributing to almost 50% of the valuable human resource, it is alarming to observe that women account for only 30% of the world's researchers, and even lower percentages at higher decision-making levels. This disparity is despite the fact that women researchers in the past years have demonstrated an enormous strength of knowledge and technical skills contributing to national and global progress. Women researchers are also known to bring in unique scientific perspectives while solving many pressing problems, making their contributions indispensable and unparalleled. This holds especially true for a nation like ours, where women constitute 48% of the population and where there is a need to address challenges at grassroot levels and resolve them with the innovation potential available.

The underrepresentation of women in STEM is a complex challenge which requires us to adopt a multipronged approach. It is heartening to state that the Inter-Academy Panel representing the three National Academies of India is moving in this direction with the 'Women in Science' programme. The Academies are also engaged in various activities in their institutional capacities to encourage inclusiveness and increase the participation of women in science. In this context, the scope of the National Conference is truly relevant.

I appreciate the decision of The National Academy of Sciences to conduct this National Conference with the objective of bringing together scientists, technocrats, stakeholders, and policymakers to introspect and deliberate on mentoring, encouraging and guiding women for scientific careers.

I wish the organizers and participants of the Conference all success and congratulate The National Academy of Sciences, on this timely initiative.

Ram Ramaswamy

टे न. / Tel : (080) 2266 1203, फैक्स / Fax : (080) 2361 6094
ईमेल / Email : president@ias.ac.in वेबसाइट / Website : www.ias.ac.in

भारतीय राष्ट्रीय इंजीनियरी अकादमी
Indian National Academy of Engineering

604–609, छठी मंजिल, टॉवर ए, स्पेज़ आई–टैक पार्क, सैक्टर 49, सोहना रोड, गुड़गाँव–122018 (भारत)
Unit No. 604-609, 6th Floor, Tower A, SPAZE I-Tech Park, Sector 49, Sohna Road, Gurgaon-122018 (INDIA)
दूरभाष/Ph: (91)-0124–4239480, फैक्स/Fax: (91)-0124–4239481, ई–मेल/Email: inaehq@inae.in, वैबसाइट/Website : www.inae.in

डॉ. बी.एन. सुरेश/Dr. B.N. Suresh
एफ.एन.ए.ई., एफ.एन.ए., एफ.ए.ई.एस.आई., एफ.ए.एस.आई.,
एफ.एस.एस.आई., एफ.आई.एस.एस.ई.,एम.आई.ए.ए. (पैरिस)
FNAE, FNA, FAeSI, FASI, FSSI, FISSE, MIAA (Paris)
अध्यक्ष/ President

Chancellor, Indian Institute of
Space Science & Technology (IIST)
Honorary Distinguished Professor, ISRO
(Former Member, Space Commission)
(Former Director, Vikram Sarabhai Space Centre, Trivandrum)
ISRO Headquarters, Antariksh Bhawan,
New BEL Road, Bangalore-560 231
Tel.: 080-23417294 Fax: 080-23415409
E-mail : byranasuresh@gmail.com

Feb 15, 2018

MESSAGE

I am delighted to know that the National Academy of Sciences, India is organizing a National Conference on "Technological Empowerment of Women" on Mar 8-9, 2018 at Vigyan Bhawan, New Delhi.

The empowerment of women scientists, engineers and technologists is an important factor for ensuring the technological advancement and socio-economic progress of the nation. Women no doubt are innovative, sincere, dedicated, and motivated towards their scientific work. One of the major challenges in the Country is to ensure equitable working conditions for women with their male counterparts and also increasing the number of women in the scientific and technological workforce. The number of women in S&T is increasing in the recent past and this is an opportune time to create an ecosystem which is conducive to their growth and empowerment.

The initiative of the National Academy of Sciences, India in organizing a conference with a view to focus on the importance of S&T interventions and greater involvement of women in scientific and technological endeavours is laudable and appreciable. The emphasis on areas such as agriculture, food and nutrition, healthcare, IT and Biotechnology will indeed give a fillip to the involvement of more and more women in these special fields of interest. I am certain that the technical sessions on important areas of S&T covered under the various missions of the Government, such as Swastha and Swachh Bharat; Skill Development; Entrepreneurship and Employment Generation programmes make the deliberations more relevant, fruitful and impactful to all delegates.

I sincerely hope that the Conference shall be of immense benefit to all participating women scientists and delegates from academia, R&D institutions and industry and all other stakeholders. I hereby convey my best wishes for the grand success of the National Conference on "Technological Empowerment of Women".

Dr BN Suresh
President, INAE

राष्ट्रीय विज्ञान अकादमी, भारत
The National Academy of Sciences, India
5, लाजपतराय मार्ग, इलाहाबाद – 211002 / 5, Lajpatrai Road Allahabad- 211002

प्रो. अनिल काकोडकर
एफ.एन.ए.एससी.,एफ.एन.ए.इ.,एफ.ए.एससी.,एफ.आई.ई.
अध्यक्ष
Prof. Anil Kakodkar
FNASc,FNAE,FASc,FIE
President

वेब : www.nasi.nic.in
दूरभाष : 0532-2640224
फैक्स : 0532-2641183
ईमेल : nasi.allahabad1@gmail.com
kakodkaranil@gmail.com

Foreword

Creating a forum for the Indian scientists to address the challenges of a changing society and also to provide novel scientific solutions for them was Prof. Meghnad Saha's brain child; and led to creating the science and society mission for NASI. This actually fuelled the scientific community with a great encouragement towards disseminating science for the cultural development of society. As a part of such an effort, NASI has been executing a major programme on women in science for the last decade to empower the fifty percent of human resource towards development of Indian society.

Capacity building and deployment of human capital is a critical element of economic growth and hence social inclusion becomes a key factor in country's overall progress. In this context, we need to pay a much greater attention to the gender disparity in India. This is a multifaceted issue and affects many aspects in the lives of women including career development and realisation of their full potential. Despite the Indian constitution granting men and women equal rights, India is still ranking low in Global Gender Gap index. The indicators for low ranking include economic participation and opportunities for women. Their technological empowerment is therefore, a critical aspect of achieving gender equality.

NASI, after organizing 25 sensitization programmes on 'Technological Empowerment of Women' in about 15 states of the country in last 5 to 6 years, strongly felt the need to have abroad-based interaction among the women scientists, teachers, researchers, academicians as well as tech-entrepreneurs of repute on various related issues, on a single platform.

I am proud to say that NASI could successfully accomplish this target by organizing a National Conference in Delhi and bringing together a wide range of national and international experts and enabling them to share their views.

The conference was a significant moment for all of us, especially, because the day of its inauguration coincided with the International Women's Day. We commemorated the day by recognizing the extraordinary qualities and accomplishments of women in science and tech-entrepreneurship and strive for a greater momentum and opportunities to stand together as a united force towards gender equality.

An anthology of powerful insights was shared by the doyens in the diverse streams of science and leading industries from India and abroad during the event. A panel discussion was held and all this has been encapsulated in the form of these Proceedings. I expect, it would certainly benefit the policy makers and would draw the attention of various government agencies and science departments towards the current burning issues facing women scientists.

My special thanks go to Dr. (Mrs.) Manju Sharma for her concerted efforts to steer this initiative for a scientific and social cause and her very eminent team of women scientists.

I am confident that our strong and shared interest in this important topic will help us develop an effective strategy towards developing appropriate policy decisions and implementing them.

With all my good wishes!!!

Anil Kakodkar

राष्ट्रीय विज्ञान अकादमी, भारत
The National Academy of Sciences, India

Phone : 011-26134608
Mob. : 09810702411
Fax : 011-46063722
Email : manjuvps@gmail.com

Prof. (Mrs.) Manju Sharma
Ph.D., F.N.A.Sc., F.N.A.A.S., F.T.W.A.S., F.I.A.W.S.
Distinguished Woman Scientist Chair
Past President, NASI
Former Secretary to Govt. of India

5, Lajpatrai Road, लाजपतराय मार्ग
New Katra, नया कटरा
Allahabad-211 002, इलाहाबाद

PREFACE

Women constitute half of the human resource. Spectacular advances are taking place in Science and Technology world over; for this we need adequate number of trained, skilled human resource. Women can contribute immensely in the progress of science and technology provided they are given opportunity. Critical issues, which need to be addressed, are mentoring, ensuring inclusiveness of women; giving them proper chance for education, research and also in decision making positions. The present Conference on "Technological Empowerment of Women" has been organized to offer a platform for large number of women scientists, senior and the young ones to participate. There is very enthusiastic response from women scientists belonging to various organizations. Several eminent scientists and technologists, both men and women will be addressing some of the key issues relating to the development and progress of women. There will be emphasis on reducing the drudgery from the rural areas, farmwomen and landless labourers. Panel discussion would also focus on important recommendations emerging from the discussions to strengthen the role of women scientists and technologists in nation building. Utilizing the talents of women in the scientific progress would certainly be a holistic and diversified approach towards the welfare of the society. There are a large number of well directed programs of the government which were started during the sixth five year plan, these have fructified giving visible results, yet one has to ensure that information reaches every strata of the society, then only this precious human resource would benefit. The present schemes need to be multiplied and strengthen to really bring out an impact. We are extremely grateful to Hon'ble Minister for Science and Technology, Earth Sciences, Environment and Forests, Dr. Harsh Vardhan for all the encouragement and support he gave us for organizing this Conference. Of course the women scientists of this country would always look upon Prof. M S Swaminathan, Chairman of the Advisory Committee of the Conference for guidance and encouragement. I am confident that given the opportunity, women would excel and perform sincerely with dedication and perseverance for the socio economic progress of the Nation through scientific and technological endeavors.

The articles included in this Proceeding have been provided by some speakers. All of them have not given detailed articles but have given a brief version. The Proceedings will be circulated to all the concerned departments and agencies who could consider using them for future Roadmap and Way forward.

Manju Sharma

(Dr. Manju Sharma)

Audience during the session

THE EVENT AT A GLANCE

- The National Academy of Sciences, India (NASI) organized a two-day National Conference on 'Technological Empowerment of Women' on March 8-9, 2018 at Vigyan Bhawan, New Delhi to commemorate the International Women's Day under the convenership of Dr. (Mrs.) Maju Sharma, Distinguished Women Scientist Chair, NASI; Chairperson, NASI's New Initiatives, Past President, NASI; and Formerly Secretary, Government of India, Department of Biotechnology.
- The Advisory and the Organizing Committee constituted for meticulous planning and managing the event tasks (Annexure-1).
- Around 1,000 participants including women academicians, scientists, tech-entrepreneurs, faculty members, post-graduate students and researchers from various academic and research institutions and NGO's participated in the conference. Besides, the event was also graced by the distinguished fellows of NASI, representatives of the NASI-local chapters as well as the distinguished members of the NASI Council.
- The event inaugurated by Dr. Harsh Vardhan, Hon'ble Minister, Science & Technology, Earth Sciences and Environment, Forests and Climate Change, Government of India also witnessed the presence of eminent dignitaries viz. Dr. Anil Kakodkar, Hon'ble President, NASI, Prof. Ashutosh Sharma, Secretary, Department of Science & Technology, Government of India, Prof. M.S. Swaminathan, Chairman of the Advisory Committee of Conference; and some renowned international dignitaries.
- The themes/ key issues selected by the eminent scientists/speakers included Biotechnology and Biomedical Research, Frontiers in Science & Technology, Agriculture, Nutrition and Food Security, Health Care and Sanitation (Swastha and Swachh Bharat), Technology and Innovations, Skill Development and Enhancement, Entrepreneurship development, Employment Generation– Avenues, Opportunities and Challenges.
- In addition to presentation of the papers and discussion, foreign fellowships of NASI were conferred to the distinguished scientists Prof. Karen Nelson, J. Craig Venter Institute, Rockville, USA by Hon'ble Minister, S & T, for her outstanding contribution to the field of human microbiome and Prof. Dean E Brenner, University of Michigan, USA by President, NASI and Dr. (Mrs.) Manju Sharma for his contribution to Cancer Prevention Research.
- The National Women Bio-scientists Awards were also conferred to Women Bio-Scientists under Senior (to senior women biologists for life time contributions, who have done excellent research in the country and has applied the results for benefit of students and society) and Young (to young women scientists for their outstanding contributions in basic and applied research in the areas of Biosciences and Biotechnology including Agricultural, Biomedical and Environmental Sciences with potential for application/product and technology development) Categories for their contribution to the field of science and biotechnology by Hon'ble Minister S&T (Annexure-2).

- Dr. Kiran Mazumdar–Shaw, Chairperson and Managing Director, Biocon Limited, Bangalore was conferred upon Honorary Fellowship of NASI by the President, NASI & Dr. (Mrs.) Manju Sharma on this occasion.
- Biotech WInER (Women in Entrepreneurial Research) (BIRAC-TiE) Awards were also presented to the women scientists involved in S&T based entrepreneurship by Dr. Kiran Mazumdar-Shaw (Annexure-3).
- An Exhibition on 'Women – Impacting Technology Application and Commercialization', displaying scientific models/exhibits and showcasing Women's work in Science and Science for Women by women-tech entrepreneurs was inaugurated by Hon'ble Minister, S&T; a booklet about various enterprises and their innovation and product development was also circulated during the event, which is a source of inspiration for the budding women entrepreneurs (Annexure-4).
- The conference witnessed an Interaction & High-level Panel Discussion among the women scientists/ tech-entrepreneurs/ Women Nobel Laureates/ dignitaries from India and abroad to formulate long-term initiatives and evolve a strategy towards technological empowerment of women. The session was coordinated by Dr. Renu Swarup and Prof. Paramjit Khurana.
- The event was supported by the reputed governmental and non-governmental agencies viz. DST, DBT, CSIR, MoES, DRDO, ISRO, DAE, ICAR, ICMR, Wellcome Trust, MAHYCO and other Industries.

INAUGURAL SESSION

Lightening of the Lamp by the Dignitaries

Welcome & About the Conference

Prof. (Mrs.) Manju Sharma

Distinguished Women Scientist Chair, NASI
and former Secretary, Department of Biotechnology
Government of India; Convener

The event commenced with an opening note by Prof.(Mrs.) Manju Sharma, Distinguished Women Scientist Chair, NASI; Convener of the conference and the Chairperson, Organizing Committee for the conference.

Dr. Sharma started with acknowledging the presence of the women scientists from India and abroad and heartiest greetings to all on International women's day, "When a man is educated, an individual is educated, when a woman is educated, a family and a country are educated as quoted by the father of nation Mahatma Gandhi".

It has been globally recognised that increasing participation of women in business enterprises, welfare activities and academic endeavours require more women scientists and technologists. For this both education and research activities must be tailored an expanded in a way when more and more girls are attracted to take up science as a career; mentoring and nurturing girl students interested in science from the early stage is essential. Mentoring has to be for confidence building, choosing and sustaining career, employment opportunities, livelihood security, administrative and social responsibilities. Utilization of the talent of women should not be viewed only from the prospective of gender equity; it is essential for rapid economic progress and sustainable happiness and brings a newer dimension to development. Our honourable Prime Minister has said that one should work towards women led development; he has emphasised this in so many conferences recently.

Today's conference is commemorating the international women's day. In 1909, on 28th February, the first National Women's Day was celebrated in United States. In 1910, in Copenhagen, there was an international meeting. In 1911, again at Copenhagen, the first International Women's Day was celebrated and simultaneously in the countries like Austria, Denmark, Germany and Switzerland. More than 1 million men and women participated. In 1975, United Nations began celebrating International Women's Day on 8th March. So, we are here today, also celebrating the International Women's Day.

Separate Ministry for women and child development was initiated by Prof. M.S. Swaminathan who was the member of the Planning Commission and Deputy Chairman; we have a very big scheme of the Department of Science and Technology and also now the Department of Bio Technology. There is a National task force for women. A Technology Park setup in Chennai is an exclusive Women Tech Park known as Golden Jublee Park for Bio Technology. It is entirely run by women entrepreneurs.

There has been emphasis on inclusiveness of women in the Science and Technology policies statement of

the country. The first scientific policy statement 1958 states, "To ensure creative talent of men and women is encouraged and finds full scope in scientific activity". The science and technology policy 2003 again emphasizes to promote empowerment of women in all science and technology activities and ensure their full and equal participation. The latest Science and Technology Innovations Policy 2013 clearly mentions about encouraging women in science and technology. Gender parity and participation of women in STI activities is important. New and flexible scheme to address the mobility challenges of employed women scientists and technologists it will be put in place. A broad scope of reinterring of women in R&D and facilitation mechanism for special career paths in diverse areas will be sought. These are the latest science and technology policies which are being implemented by the Department of Science and Technology.

There is a National Mission announced by the Prime Minister, 'Beti Bachao, Beti Padhao'. This means save girl child and educate girl child.

NASI has organised 25 workshops in different parts of the country towards involvement of women in the S&T endeavours. Efforts are being made to implement the major recommendations from these workshops. Technological empowerment of women at grass root level is very essential. Several measures have been taken e.g., training of the trainer, motivating students in their free time, setting up of knowledge centres, institutional framework to reduce drudgery, generating a cadre of women scientists and engineers and empowering women at grass roots and community based projects. These are all for the empowerment of women especially in the rural areas.

The basic philosophy must be to advocate S&T application, which is job oriented and leads to economic growth and social happiness. Academies all over the world being the global professional bodies must lead the way for facilitating the women scientists and engineers to play pivotal role in ensuring overall progress. These should include gender issues on their agenda, widen the nomination pool; continuously data monitoring, increasing women's participation and visibility, sponsoring and evaluating research. It is important to understand and take into account the multiple roles women have to play; and provide sustainable support systems to reduce their drudgery and strain. Networking among women scientists and technologist, academic and research institutions, NGOs, International bodies and Government is called for to accelerate the pace.

The dawn of 21st century has been marked by a clear message- sustainable transformation through knowledge as a driving force for human development specially science leading to industrial revolution and important technological capabilities driving and opening up new production avenues. The third Millennium Development Goals also call for gender equality and empowering women.

The present conference will focus many of these and additional issues. The purpose of the panel discussion will be to listen to a larger group which would also focus on S&T interventions for women in rural areas, training, demonstrations of technologies, mobilizing the work force to adopt for economic progress and aim towards better living standards. It would be expected from the conference to get well directed, focussed recommendations on both short term and long term basis for implementation.

Remarks

Prof. Ashutosh Sharma
Secretary, Department of Science & Technology
Government of India

Technological empowerment is one of the aspects of overall women empowerment. So, dimension of this issue are much larger than the technological.

China's per capita income is 2.5 times that of India but per person income is 1.7 times than that of India. Now, some of this is accounted by income structure, by mechanization and so on. But most of it is related to the fact that our work force includes much less number of women than in China. Statistics reveals 25% working women in India against 60% in China. So clearly, there is a huge cost associated with not having women working or contributing to the economy. So as they say, society is selfish, people are selfish, even if we are selfish, it is clear that we are not being sufficiently selfish in empowering women to be part of effective work force.

In a tri lateral meeting with UK, Australia and India, many issues related to women not contributing in the economy were flagged off. All the way from Far East to Far West, we need to address some of the very same issues and therefore, it is important to have international exchange of ideas on these issues. We can learn about what works and what does not and what needs to be done. There are different stages from school education to college education to university, getting jobs, holding jobs and career advancement; all of these have different issues associated with women and require different thinking and interventions.

There are different domains of work with varying participation of women in workforce. These domains range from academia to corporate sector, to agriculture, to medium and small industries and so on. Furthermore, there are certain thematic areas where women are highly under-represented, e.g., in mathematics, computer sciences etc. In fact, in the areas related to mathematical sciences, theoretical physics, traditional areas of engineering (civil and mechanical engineering), the participation of women is very low. In leading institutions of engineering, it's less than 10%. So, it is fairly clear that there are certain cultural issues, lack of role models, opportunities, break in the career, challenging work place etc. responsible for lower number of women in workforce.

There are three programs of the Department of Science & Technology, exclusively for women scientists that address the issues of relocation, break in career because of family reasons and many others.

- Women Scientist Scheme (WOS A): The program allows women scientists to get a fellowship and research support for continuing to do a research while they are looking for a permanent job. So, this is a time gap arrangement in between jobs. Often it happens that if there is a clear break for a couple of years in women's career, it gets much harder to get full time work.
- Women Scientist Scheme (WOS B): The program allows women scientists to get a fellowship and other expenses where they use their scientific training to work for societal needs. This could be related to water conservation, appropriate technology development and transfer to grass root levels, education etc.
- Women Scientist Scheme (WOS C): This program provides training to women scientists for managing intellectual property (IP) rights. On successful completion of this program women scientists are able to work in IP sector such as patent office, attorneys, S & T labs and departments. It is an upcoming growing area with increasing job market.
- Consolidation of University Research for Innovation and Excellence in Women Universities (CURIE): This program supports women only universities to create scientific infrastructure to improve the quality of education and research. Till now about half a dozen universities have been supported under this scheme.

In addition to above programs, in the innovation space there are women incubators/technology incubators which are being supported, e.g., in IIT Delhi. There are women incubators which give huge opportunities to network. The rate of success is much higher than other technology incubators which are not gender specific.

Another policy decision taken under Ministry of Science and Technology is that every committee of the DST will have at least 25% representation of women members. In future, science camps are being planned to provide fellowship to 50,000 girl students selected from various boards every year and out of these more than 5000 may find themselves in top educational institutions.

Special Address

Prof. M S Swaminathan
Chairman
Advisory Committee Conference

Science and Technology can be used or abused and that is why in case of gender relation; the male and female ratio is adverse to women in several parts of the country.

Malnutrition figures are higher in case of female child. Malnutrition is a big problem and it affects young children. Malnutrition before 1000 days can affect child's cognition ability. There are many adverse effects. The students of home science and agriculture must come forward with initiatives to reduce malnutrition.

There are at least five areas to work upon:

- Under nutrition/calorie depreciation: This has fortunately overcome as the Government has announced distributing 5 kg grains at very concessional price.
- Diversification of diet: Only wheat and rice has been distributed in a public distribution centers, but now Government has announced that millets should be propagated. This year has been declared as national year of millets because of its number of advantages both in terms of climate resilience and nutritive properties.
- Protein Hunger: We are number one milk producer of the world. The egg and poultry production is also very high. Aqua culture has also increased. Therefore, protein malnutrition can be overcome if we have economic access to the protein sources both from animal and plant origin.
- Micro Nutrient Deficiency: This is also known as hidden hunger and very small quantities are needed; but if they are absent, then it becomes a problem. By marrying agriculture nutrition and health in an integrated way, we can overcome the problem. This can be achieved by establishment of genetic garden with bio fortified plants, in all the colleges and public institutions.
- Drinking water sanitation, primary health care and above all nutrition literacy is a problem to be addressed. For this a program called community hunger fighter has been established.

Presidential Address

Dr. Anil Kakodkar
President, NASI

Greetings on the International Women's Day!

National Academy of Sciences, India (NASI), the oldest and the largest science academy in the country, has been pursuing its mission in a comprehensive way. This includes in addition to nurturing a high-level peer group, several activities to take science and scientific temper to people. In fact, science and society constitutes a key mission of NASI right since its inception.

Scientific temper and technological empowerment are the key to progress in today's competitive world. For any country to be able to realise its full potential, full participation and contribution of women, who constitute 50% of human resource, is essential. Women need to be able to explore their full potential. Equity and inclusiveness for women in all areas is the key factor for this to happen. In a way this is a worldwide phenomenon with deep socio-cultural connotations. NASI has been giving a special focus on technological empowerment of women in this context.

NASI has organised 25 programmes on technological empowerment of women in 15 states of our country in last 4 to 5 years and has come across several grim realities that need to be addressed. Elimination of gender inequality, inclusive approach in participation of women in major developmental activities and getting more women in Science and Technology are the issues discussed in United Nation conferences and other national and international events. Greater participation of Women in Science and Technology is a key enabler for enhanced human capability and could thus become a game changer.

I am very happy to see such a large response to this national conference on Technological Empowerment of Women and would hope that the discussion here would significantly contribute to making positive progress in this very important matter.

Inaugural Address

Dr. Harsh Vardhan
Hon'ble Minister, Science & Technology, Earth Sciences and Environment, Forests and Climate Change
Government of India

I appreciate Dr. (Mrs.) Manju Sharma and her team as well as the members of NASI for their efforts to organize such an event. This gave the women scientists a new platform to get recognized for their skills and talents.

Women of India have ventured into Science and Technology from the very beginning of 20th century or even earlier. Dr. Anandi Bai Joshi was the first Indian woman doctor who qualified for practicing Western medicine in 1880's; India has also produced a large number of such illustrious women scientists.

Women empowerment is a key focus area of our Honourable Prime Minister Shri Narendra Modi ji who has taken a goal to create a new India by 2022; the budding women scientists will have a great role to play in that dream. This has also been stated by our Honorable Prime Minister, Narendra Modi ji that we not only want development of the women but by the women. India has recognized women empowerment and hence India is moving from women development to women led development.

There are various policies in this regard:-

- Beti Bachao Beti Padhao Scheme
- Maternity leave has been increased
- Ujjwala scheme where free LPG has been given to women below poverty line
- Crèche facilities, mandated work from home wherever it is possible.
- The Sukanya Samriddhi Scheme
- Working women hostel has come up in the metro cities
- Mahila-e-Haat to showcase the business products
- Swadhaar Grah helpline and Centre for Women under distress
- Triple Talaq bill has been introduced for Muslim women

The scientific fraternity must take into consideration the under-representation of women in the field of Science and Technology; and steps must be taken to expand funding to research in Science and Technology by women scientists, which is still less. Women are not just home-builders, but are nation-builders. There are various schemes and initiatives of the government for the empowerment of women; involvement of women in major achievements helps the GDP to increase by 16 per cent.

A celebration with a magnitude of this level, in comparison to last year's event is so grand, and it is the first time in 30 years that I am witnessing such an event which has given emphasis to women scientists which is an overwhelming response all over the country; and justify the objective of the conference which has been organized to empower women which is the need of the country.

Vote of thanks

Prof. Paramjit Khurana
General Secretary (OS)
NASI

Good morning everyone. On behalf of The National Academy of Sciences India, and my own behalf, it is my privilege to deliver the Vote of thanks at the conclusion of this inaugural function. I would first like to congratulate all the awardees who received the prestigious BDT awards. I am sure conferment of this honor will serve as a catalyst and motivate them to perform even better in future.

I would like to express our sincere gratitude to the **Chief Guest, Dr Harsh Vardhan,** Honorable Minister for Science & Technology Minister for Earth Sciences and Environment, Forests and Climate Change, for gracing the occasion and delivering the Inaugural Address. Sir, your presence on this occasion itself means a lot to us and especially for the awardees; your words of wisdom were indeed inspiring.

We would like to express our gratitude to **Dr MS Swaminathan,** Chairman, Advisory Committee, for guiding us in this endeavor. Sir we are deeply indebted to you for your time to time suggestions. Your insightful thoughts and concerns have set the tone of this conference.

NASI is fortunate to have the counsel and support of its **President, Dr Anil Kakodkar.** Thank you very much Prof. Kakodkar for presiding over this function. We immensely value your down to earth approach and insightful remarks very much Sir.

It is my pleasure to thank **Dr Ashutosh Sharma, Secretary DST,** for being with us on this occasion. We are indeed honored by his presence today and greatly appreciate the support for this endeavor.

Special mention of **Dr Manju Sharma, Convener** and the driving force behind this event. NASI shall remain forever indebted to you Madam for your leadership and dedication to the cause of Women Empowerment and other Science and Society Flagship programs of NASI. Madam your vision, passion, insight and attention to detail is to be imbibed by one and all. I cannot thank you enough for your efforts right from the outset of this Conference. We look forward to your continued counsel, advice, support and encouragement.

Besides Madam Manju Sharma, NASI is fortunate to have the counsel and support of many past Presidents and Council Members, as well as the Fellowship of the Academy. We have several Invited Guests in this hall

Vote of thanks

today - Prof. Asis Datta, Prof Tandon, Prof. Ashok Mishra, Prof. Akhilesh Tyagi. We immensely appreciate your presence in this function. Thank you very much for joining us this morning.

We are especially grateful to participants from other states of India and those coming from abroad for joining us today for this Conference.

We have been fortunate to have support in various kinds from various governmental and non-governmental agencies in supporting this event. Chief amongst these are the Department of Biotechnology, the Wellcome Trust-India Alliance, and Mayco. A special thanks to Dr Shahid Jameel for compiling the book on 'Listening to Women and their viewpoints'. This reflects the positivity at various level for the cause of empowering Women through S & T.

Lastly, but not the least, let me also take this opportunity to thank each and every member of the Advisory Committee, Organizing Committee and staff of NASI, without whose support and efforts this program would not have been possible.

Thank you everyone for your presence and solidarity to the cause of this conference.

INVITED LECTURES

Plenary Session-1

Biotechnology and Biomedical Research

Chair: Prof. P N Tandon

President, National Brain Research Centre, Manesar and National Professor

Co-Chair: Dr. Smita Mahale

Director, National Institute for Research in Reproductive Health, Mumbai

Prof. P N Tandon

Professor Tandon emphasized that there is no limit of opportunities for both sexes, but women have to play dual responsibilities, and therefore, it is extremely creditable if they are working with real success. Attempts have certainly been made in this regard to motivate them to work. There are now many opportunities to take part in work after a career break.

Dr. Smita Mahale

Dr. Smita Mahale, referring to issues on reproductive health, indicated that during pregnancy, the burden of giving birth to a healthy child and raising a family comes more on women. The choice for having a child does not always rest with woman, although she bears the burden of childbirth and care. The contraceptives, available in the Government program NUC, are mainly targeted for and used by women. There is hardly any program now targeting male contraception; so, there is a need for all the Government agencies to further invest some kind of dedicated funds for the development of male contraceptives and also revamp the basic research to understand more about male reproductive biology so that male contraceptives become a reality.

Plenary Session underway

How different are women and men biologically and does it matter for gender equity in technology?

Dr. Jenny Graves
Distinguished Professor, School of Life Science
La Trobe University, Melbourne, Australia

Dr. Graves spoke about the biological differences between men and women. She summarised the manifold genetic and physiological differences between the sexes, and urged women to stop debating the issue, and work instead to ensure that biological differences are not used as a basis to block moves toward gender equity. In summary:

- Men and women posses different numbers and types of genes borne by sex chromosomes. Women have two copies of an X chromosome that contains over 1000 genes, whereas men have a single X and a tiny Y chromosome. The Y bears the gene (SRY) that makes a baby male.SRY affects at least 30 others in a pathway that results in differentiation of a testis in the baby; the testis makes hormones, which turn on and off many genes in many embryonic tissues.
- There are another 26 genes on the Y, and these are missing from the genomes of women. Many of these are concerned with making sperm, but some are active more widely in the body and may produce male-specific traits.
- Women have two copies of the X chromosome and men only one, so more than 1000 genes are present in two copies in females and a single copy in males. Although most of these genes are inactivated on one X in females to equalize gene dosage, at least 150 escape silencing, so are more active in females than males. This, too, may produce differences in traits between men and women.
- There are startling differences in how active other genes are in men and women. Comparing the activity of all 20,000 genes in the genome by measuring how much they are made into RNA in men and women shows that more than 6000 are much more active in one sex than the other. Some of these are differently expressed in organs like heart, liver and brain. This may explain why many diseases are more common in one sex than the other, and why there are many sex differences in drug efficacy and toxicity.

It is, therefore, pointless and quite dangerous to insist that men and women are almost biologically identical. They are clearly not.

This must not weaken our case for gender equity in science and technology. Biological differences may limit some roles (like making eggs, milk or sperm), but are not relevant for others, like understanding complex issues, making and testing hypotheses, creative thinking and innovation. Understanding the biological differences between the sexes is the key for progress in gender equity, in science and technology, as in everything else.

Dr. Jenny Graves delivering her lecture at the session

The Importance of Diversity and Inclusive Leadership in Science and Innovation

Prof. Geraldine Richmond
Member, U.S. National Academy of Sciences
Presidential Chair in Science and Professor of Chemistry,
University of Oregon, USA
and Past President, American Association
for the Advancement of Science, US

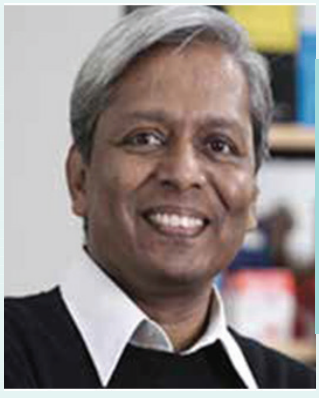
Solving the complex problems that we face in our world today requires a more talented workforce than we have ever needed before. Such a workforce must be comprised of a wide range of diverse talents and creative insights. No segment of the population can be ignored or overlooked in this talent search. Recent research demonstrates the positive impact that social and informational diversity has on science and innovation, the reasons for this impact and the importance of committed leadership in achieving a strong and inclusive workplace where creativity and productivity is maximized. There are many examples where a limited perspective on a technology development has led to failure including initial car airbags and heart valves that were designed by men with little thought to how they would be inapplicable for women due to their smaller size. However, achieving success in creating a diverse and inclusive work environment in science and engineering requires strong leadership and also active participation and voices of all involved. Discussed in this presentation was what the highly successful organization called "COACh" is having in this area (http://coach.uoregon.edu). Since its founding in the field of chemistry in 1997, this grass-roots organization based in the U.S. has been working diligently to create and advance programs that provide guidance and career building opportunities to increase the success of women entering and progressing up the career ladder in STEM fields. COACh career development workshops on leadership, negotiation, effective scientific and workplace communication, mentorship, networking, entrepreneurship, career launch, publishing and grant writing have helped to galvanize and empower over 20,000 women scientists and engineers around the globe. Over the years its impact has moved beyond chemistry to include the fields of medicine, biology, mathematics, computer science, physics, engineering and geology. More recently COACh has been working with women scientists in over 25 developing countries in Africa, Asia and South America including a number of workshops in India.

Specific to India, from my many visits to this country where I have had the opportunity to meet with hundreds of women scientists and engineers I am convinced that there is no shortage of female science

and engineering talent in this country. However, the family challenges and responsibilities are significant and often lead to women taking many years off from any scientific profession while they raise their families. Once they try to enter the workforce after a 3-10 year gap, they are no longer competitive for the highly prized jobs relative to those who go directly from their training to the workforce. I therefore, recommend that academic institutions, industry and the federal government be more aggressive in developing programs that allow women to continue their professional work, even if it's on a part-time basis, while they start to build their families.

Prof. Geraldine Richmond delivering her lecture at the session

Computer Science, Mathematics and Communication: Women achievers of the past and of the future



Dr. K VijayRaghavan
Principal Scientific Advisor
Government of India, New Delhi

Women are not highly represented in the area of Computer Science and Mathematics for variety of reasons including certain perceptions. Despite many efforts by the Government and various agencies, gender parity has not been achieved. If we need to have exponential change, then women as a huge work force need to take charge of the change in leading the use of science and technology in many aspects. There are good examples of incredible women at leadership positions, who have been inspiring women in the space program for one and in some other fields as well.There are many examples of individuals who broke barriers and became what they are today. With the participation of both men and women, we can achieve the goal of increasing women in the leadership positions to 50%. To make it happen, our Science Agencies, Scientists, Science Academies and Women in Science and Technology already looked at the tools available to execute methods of inspiring girl students in core areas. Specially, Mathematics and Computer Science are considered men's purview and much effort is needed to inspire women to take up the areas in addition to other areas of Science and Technology.

Dr. K VijayRaghavan delivering his lecture at the session

Session-I

Frontiers in Science and Technology

Chair: Dr. A S Kiran Kumar
Vikram Sarabhai Professor
ISRO, Bengaluru

Co-Chair: Dr. Rohini Godbole
Centre for High Energy Physics
Indian Institute of Science, Bengaluru

Dr. A S Kiran Kumar

What really needs to be done is to recognize the activity not the gender which is very important aspect. Today, we are happy to organize this event on very important issue. We had the first session on 'Frontiers in Science &Technology' which itself conveys a lot of information.

Prof. Kiran Nelson reminded us that the rejection in many aspects of what one does is in reality which we need to face, but I am sure that rejection and dealing with rejection is a necessary thing if one has to succeed, whether it is male or female; but, as a female you may have to face the situation much more than what otherwise people will do. We need to learn from other's mistakes and others experiences, because, in one human life, it is impossible for us to achieve everything if we are to learn all of that from our own mistakes and our own rejection.

Empowering technology for the progress and what is needed is study of microbial population and its impact on genetic diversity. This is one area where science always finds every new thing discovered, reminds us of the vast majority of lack of knowledge we have on the events or the happening in this

universe and everything discovered makes this universe much more difficult to comprehend rather than more easy to comprehend.

Another important aspect she mentioned was importance of mentorship. I am sure that as the time progresses and as time passes the life that evolves in society, we will have less and less of inequality coming up.

Dr Ritu in her talk emphasized that there are few places where at least for some time they think of their work contribution only and not environment which does not remind them of their gender.

We need to create more such opportunity all across and events like this, where we are able to bring people together, address the issues and we'll be able to achieve a better life on earth, whereas Dr Rohini mentioned that it is the work that becomes more important than who did it.

Dr. Rohini Godbole

To begin with let me thank the speakers, not just from this session but from all the sessions, for making a combination of their scientific work with a discussion about women in STEM in their talks. The similarity in the experiences across different countries, in spite of the great cultural differences, was striking. However, there are some places where things are also a little different. I would like to share a piece of information where I believe things are different in India.

In India, we have a large number of women students who graduate out of colleges and universities in sciences, that too at the top of their class. Women's participation decreases from 40% at the undergraduate level to 30% at the Masters level to 25% at Ph.D. level. Our real drop out comes after Ph.D, that is at the post doc level and women form only about 10% of the practitioners of scientific careers in India. If one looks at positions of authority, the percentage dwindles even further. The last two stages are similar to the experiences that have been described in this conference.

In fact, the Women in Science Panel of the Indian Academy of Sciences (IASc) along with the National Institute of Advanced Sciences (NIAS) in Bangalore, conducted a survey with about 800 women scientists and 250 men scientists from a data base of about 2400 scientists: 2000 women and 400 men. We found that from among the respondents, about 50% of those who had left science AFTER doing their Ph.D. and were now essentially homemakers responded that they did not continue because of the difficulty of balancing family and career. About 20% said, they could not continue because the

L-R: Dr. Rohini Godbole and Dr. A S Kiran Kumar addressing the session

L-R: Prof. Kiran Kumar, Prof. Karen Nelson, Prof. Rohini Godbole and Ms. Ritu Karidhal felicitating the speakers

society as well as the Institutional structures was not supportive. For interested readers, the survey report is available on the website of the academy.

Thus, in some ways the challenges are different in India. This said, there are many other aspects, where the experiences are indeed very similar. Hence, going international and discussing these issues, is really the way forward to arrive at concrete action plans.

I, once again, thank all the speakers for this nice combination of a discussion of Women in Science and Science by women.

Genomic applications to Personalized Medicine

Prof. Karen Nelson
J. Craig Venter Institute
Rockville, USA

Dr. Nelson shared her knowledge on Genomics and Synthetic Biology. She spoke about reading and writing the genetic code to the young audience and encouraged them to look at the genomics sciences as a viable career option which has lots of opportunity. Emphasizing on proper mentoring, she recommended on pursuing the opportunities coming on one's way.

She referred to the Human Microbiome Project, a research initiative by NIH, United States, to improve understanding of the microbial flora involved in human health and disease. Similar research programs are now being developed globally. In addition there is the Indian Microbiome Project in which scientists at Pune and Delhi are starting to sample thousands of different people in India to look at the microbial combinations associated with primarily the gastrointestinal tract of various cohorts, and how this microbiota is influenced by the diet and environment. It is because of major technological advances that Biology has become one of the most rapidly growing fields.

The improvement in sequencing technology and changes that have happened over the years in terms of accelerating the capability of the genome data have led to:

- Exponential growth in genome data
- Greater use of patient records
- Range of new apps for health allowing better personalized tracking
- Tools for bio marker identification
- Study of microbial populations and their impacts on Genetic diversity

Speaking about women in science in general, she emphasized that in order for women to be successful as a community down regulating the disparity between males and females, women really need to pay attention in making science of funding a priority. There might not be an immediate result or impact, however, in the long run, this will generate results. The following are important:

- Investment in human capital, infrastructure and research
- Development of ways to maintain careers and programs
- Addressing challenges of sustaining a life in basic to translational research
- Need for more mentors and a continuous feeding of the pipeline of mentors
- Need for improved public understanding on Science and Technology

She recommended that there is a need to increase the number of women in health related professions globally. She further expressed, "Diseases impacting women do not get attention as general diseases. This is because of lack of vision in advocating for women's health. Therefore, we need the proponents who work on diseases that have long term impact on women's health. It is a cultural change that needs to be done. Issues like childbirth, autoimmune diseases, diseases of vaginal tract, cancer, diseases of urinary tract, emerging infectious diseases, depression, overall women health etc. need to be addressed; in fact, women themselves need to push these issues. Giving opportunities and role models to the next generation of scientists is required. Investment in human capital, infrastructure and research are important".

Studies believe that women dropouts in the science stream are very high. There is lot of data, which supports and we all know that at early stages of education, number of boys and girl students are equal but the percentage drops significantly over time. There are problems women encounter at workplace. They do not get enough support at workplace as well as from family and friends. As of today, only 17 women have won a Nobel Prize in STEM area as compared to 580 men. As a community, we need to take initiative to overcome these challenges and do a better job in terms of mentoring women and making them strong if they want to get into this field.

Prof. Karen Nelson delivering her lecture at the session

Challenges women in technology face:

(a) Inequality and discrimination- The IT sector reports gender inequality at higher rate than the overall average among employed women. Networking opportunity and promotion go to men in tech courses at a higher rate than to women. (b) Not fitting in- Women in male dominated field such as IT, lack self-confidence, suffer from feelings of inferiority and often feel as if they do not fit in. (c) Lack of support and understanding-Female employees often report as though they don't have the full support of their co-workers. A lack of support at home in cases where family members and friends still embrace cultural bias regarding women in the work force is a deterrent.

We have several programmes on global scale to overcome the problems. For example, the University of Technology, Petronas in Malaysia have enrolled 60% female Computer Science Students. Chang Gung University in Taiwan and Mahidol University in Thailand have close to 50% women in the Computer Science Courses. There are many examples if we look at different parts of world through which we can learn as a community. Australia is very good at putting women in higher positions. But in the past 20 years, women enrolling in STEMM have dropped to 94%. So, there are some issues, which need to be focused upon. If we look at Latin America/ South America, software development is the fastest growing careers for women, where they are trying to get more females into this field.

There are multiple careers in Science which are under-represented by women and should be encouraged as a scientific community:

- Biologist
- Journalist
- Editor
- Pharmacist
- Informatics
- Geneticist
- Lawyers
- Policy Analyst
- Genetic Counsellor
- Bioethics
- Teachers
- Engineers
- Ethicist
- Healthcare Professionals

We have a world with a bunch of problems; therefore, there is a need to get more people into science, especially, women doing basic research. As a community, we should definitely make more efforts to get women into science education starting from the early stages that will eventually affect society.

ISRO's Giant Leap from Earth to Mars – Accomplishments of a Challenging Mission

Ms. Ritu Karidhal
ISRO Satellite Centre (ISAC), Bengaluru

Ms. Karidhal shared the achievement of Mars Orbiter mission where women scientists worked almost in equal numbers with men to bring this mission to a great success. This was the first mission in world to succeed in the very first attempt. This was the most economical interplanetary mission in the world with the budget of Rs.450 crores as compared to other missions costing approximately Rs.6000 crores. The Project was realized in the shortest time of 18 months. It was the first Indian satellite having full-scale on-board autonomy. This exemplifies a great team work shared equally between men and women, providing an equal opportunity for creative work without a gender bias.

Ms. Ritu Karidhal's talk was based on 'ISRO's Leap to Mars Accomplishments of a Challenging Mission'. Mentioning about India's vision of using space technology to solve the real problems of man and society, Ms. Karidhal expressed that India had great ancient civilization with medical texts dating to 800 BC. Indian astronomy reached its peak in the 5th century under the great astronomer and mathematician, Aryabhatta, who figured out that the earth revolved around the sun 1000 years before Europeans did it. But Waves of invasion and colonization led to the decline of science in India. Not until independence in 1947 India could make a fresh start. For Indian Space programme the story goes right back to the 1960's under the vision of great physicist Dr. Vikram Sarabhai. Describing ISRO's achievements she said that innovation by its very nature involves risk. There are more challenging goals for the scientists. ISRO worked more systematically, in the process leading a series of significant projects like the INSAT 2 and PSLV. She referred to the India's Space programme during the early days explaining, how interestingly, India's space odyssey began on a bicycle. Depicting the photograph of a technician carrying the sounding rocket from the assembly line to the launch pad on a bicycle, she showed yet another picture, a bullock cart ferrying the satellite. Over the decades, the country developed heavy lift launch vehicles and communication satellites making telephones, mobile phones, satellite television, tele-medicine and tele-schools, part of our daily life. Listeners of All India Radio may remember the weather forecasts of the 1960s and 1970s. Her talk included a detailed description of the first satellite Aryabhata, launched on April 19, 1975 using Russian launch vehicle as well as first mission to Moon in 2009. She portrayed the hurdles and challenges occurred

in completing the entire project of MOM within a very short and stipulated period of time explicating how the system (with extensive amount of on board autonomy) was capable of doing self–diagnostics and self-recovery, simultaneously executing all the loaded instructions with the highest precision needed to be built up as well as simultaneously accomplish all the activities in such a short span of time. Narrating the story behind successful Mars mission, she told that the entire team of women and men scientists worked tirelessly for making this historic mission successful. After meticulous process of brainstorming sessions with all engineers (mechanical, electrical, electronics), a network of autonomy was drafted with different levels of fault detection and recovery. Thousands of lines of new code were implemented on onboard computers followed by extensive reviews and then testing.

Ms. Ritu Karidhal delivering her lecture at the session

The main element was the Propulsion System where the Liquid Engines used are same as used for Geo Synchronous Communication Satellites being perfected in performance in deep space by extensive testing. Propulsion System provides the thrust to the vehicle to come out of the gravity well of Earth and to enter the gravity well of Mars. Her talk reflecting the influence of the space technology inspired and ignited a consciousness of social responsibility among the young minds, the leaders of tomorrow.

Session-II

Agriculture, Nutrition, Food Security

Chair: Prof. R S Paroda
Chairman, Trust for Advancement of Agricultural Sciences (TAAS), New Delhi

Co-Chair: Prof. J P Khurana
Director, University of Delhi South Campus, New Delhi

Dr. R S Paroda

Agriculture is the backbone of Indian economy and women do play a crucial role in agricultural growth. Over the years, there is greater realisation of the role of women towards household, food and nutritional security. Their role in horticulture, livestock, fisheries, food processing, sericulture and allied sectors is indeed substantial. They continue to play a vital role towards sustainable agricultural development. Also, women have helped in conserving the basic life support systems such as land, water, flora and fauna. They have not only protected our soils, but have helped in accelerating the process of conservation of valuable genetic resources.

Despite their role, they continue to have lesser access than men to modern agricultural technologies. As a result, their labour intensive efforts invariably yield meagre economic returns. In the overall farm production chain, women's average contribution is estimated at 55 - 66 per cent of the total labour. Women farmers are known to produce over 50 per cent of the world's food and share 43 per cent of the agricultural labour force. Also, women invest almost 10 times more of their earnings than man on the well-being of the family, including family health, child health, education and nutrition. Yet, they have less access than men to agricultural related assets, legal rights, inputs and services. Realising this, out of the 17 sustainable development goals, one goal (SDG 5) is mainly to 'achieve gender equality and empower all women and girls'.

Empowering women is extremely necessary to achieve inclusive agricultural growth. For this, it is important to ensure their greater participation, drudgery reduction, and improve their health and nutritional

status. These issues are to be addressed through gender-friendly technology assessment, refinement and extension methodologies. Linking women, agriculture and nutrition requires multi-sectoral thinking and common societal action. Obviously, it requires institutionalization of research and extension. Empowering women or girls deserves a high priority in our national development agenda. It also needs sustenance by radically reorienting agricultural research agenda to overcome existing gaps and face emerging challenges of sustainable development and livelihood of poor small holder farmers, especially women farmers depending on available resources. Since the past decade, there has been a significant growth in women self-help groups (SHGs) and enrolment of girls in agricultural education system. These two significant socioeconomic changes in the developing countries can play an important role in empowering women and transforming rural areas. There is an urgent need to engender agriculture and also to ensure support for women professionals, entrepreneurs and farmers. In India, about 40 per cent girl students are currently studying in varied courses of the State Agricultural Universities. In some, the ratio is upto 70 per cent. Hence, they need to be trained and motivated to act as service providers as well as to become entrepreneurs in their own right through enabling policy environment. They should also be encouraged to form self-help groups.

Investments in women and overcoming their drudgery are perhaps the best actions for future development. Improving the knowledge and status of women would, therefore, deliver significant outcomes in terms of agricultural production, food security, child nutrition, health and education; and thus, would be contributing significantly towards Sustainable Development Goals (SDGs).

In view of this, the following specific recommendations need priority attention:

- There is a need for collective advocacy to raise awareness of women's needs in agriculture and ensure their visibility in terms of valuable contribution towards agricultural development.
- Women need to be educated and empowered to make their own choices for better farming options and responding to new opportunities for diversified agriculture and better living.
- Women's ability needs to be increased in order to enable them to actively participate in the development processes by changing their perceptions and increasing awareness for greater social responsibilities.
- There is a need for encouraging collective action and leadership among women to develop programmes that directly address women's needs; and to make agricultural support systems gender-sensitive.
- Sincere efforts need to be made for removing drudgery of farm women by ensuring access to new tools and implements that increase efficiency and higher productivity. Also, reorient agricultural research for development (AR4D) agenda to be pro-women and gender-sensitive.
- An urgent attention is needed to address the discrimination through appropriate policies, legislation, enforcement mechanisms and establishing women's rights (e.g. access to markets, ownership of land).
- It must be ensured that the institutions and legal support mechanisms are in place to promote women's ownership and control of resources (e.g. land, bank accounts, and farm implements).
- Social, educational and cultural institutions also must change to create an environment where women realize their full potential. Engendering farm-women, thus, is a high national priority. For this, investment in women's human capital through education and training for skill development is very critical for productive use of their abilities, time and energy.

- A special fund, "Women Empowerment Fund" must be created at the national level to support gender-specific welfare associated programmes. Banks and microcredit services can play a pivotal role in such initiatives.

Prof. J P Khurana

India has attained green revolution with the efforts of Dr. M S Swaminathan and Dr. B P Paul. In 2000, when Dr. R S Paroda was the Director General, ICAR, a Programme on 'Plant Genome Sequencing' was initiated to asses how the latest tools of genomics are helpful to meet the demands of population.

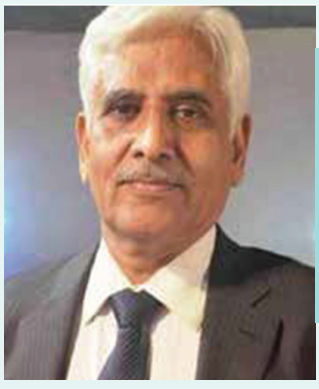
A joint initiative was taken by India during 2000 (when Dr. Paroda was DG, ICAR and Dr. (Mrs) Manju Sharma, the then Secretary, DBT) to push a programme on plant genome sequencing; and human genome draft sequence became available. We all, including myself, Dr. Mohapatra, Prof. Akhikesh Tyagi, Dr. N K Singh and Prof Paramjit Khurana worked as a team towards developing a model plant system. We participated in sequencing of tomato later and also contributing to the sequencing of wheat genome.

More recently, a term Ever Green Revolution was also coined, which is so necessary for meeting the demands of population in terms of green revolution and overall productivity.

In the venture of genome sequencing, more than 50% women students contributed, who really need to be appreciated.

Session II underway

Empowerment of Women for Improving Livelihood and Quality of Life



Dr. Narayan G Hegde
Trustee and Principal Advisor,
BAIF Development Research Foundation, Pune

Problem of rural poor: India is Agrarian country; however, we have 85% farmers with marginal or small land holding, with an average holding of one hectare. With deprivation of fertile soil and water; and as a result, these families are suffering from food insecurities. Food insecurity leads to nutrition insecurity, unemployment, so on and so forth.

Although, women play a significant role in building their family and the nation, majority of them are deprived of their basic needs and rights, particularly in rural India.

Why women empowerment?

- Women contribute 65 to 75% of labour in agriculture and animal husbandry; and share 85% participation in all income generation activities.
- Women play a major role in grooming children and the next generation.
- They bear the burden of climate change as well as scarcity of water, food, fuel and fodder.
- Women also suffer from malnutrition in health and neglect in rural areas.

In rural areas/ villages, there is a poor access to maternal nutrition and child care services. They are deprived of their rights and decision-making power. Hence, women empowerment is important.

For women empowerment there is requirement of:

- Hardship reduction
- Gender equity - As soon as we start being little active, lot of suppression from family members and society starts coming up. We need to tell that women have same status as well as equal brains.
- Need for involvement in Planning and Development - Most of the time when we speak about employment and empowerment, we think about lot of non-farm activities. In rural scenario, it's better

to start with agriculture. Create a base because of the need of market and opportunities. Women have traditional knowledge. Apart from agriculture, they could also spare time for other agriculture-based activities like livestock and tree-based farming, because they have skills and also easy access to input of villagers. With low capital investment and risk, availability of market and infrastructure, the target could be achieved by promoting these activities and application of good technology with new infrastructure for creating and organizing backward and forward linkages of service sectors in terms of income generation and employment support. The farmer income can be increased by 50%.

- Capacity building
- Field visit for awareness and demonstration of new technology
- Self-help group to mobilize savings and credit services
- Functional literacy and training for skill development
- Planning for promotion of micro Enterprises
- Linking with government scheme for sanitation, development assistance and insurance
- Appointment of local volunteers/ field guides for providing various services and mentoring
- Promotion of infrastructure for value chain development. Linkage with Financial Institutions
- Leadership development for good governance
- Support for credit facilities

Impact of women empowerment can be seen in food security, sustainable development, improvement in quality of life, improved health status, increasing rate of literacy, control on child marriages, better status of women in society, etc. Women empowerment in rural areas should focus on ensuring food security, improved health status and increased literacy through People's Organizations which can also facilitate access to credit, linkage with Development Agencies and involvement of women in PRI activities, leading to good governance and better quality of life. As motivation and mentoring are critical for empowering illiterate and poor women, active women within the community having leadership may be recognized as 'Champion farmers' to support other women members.

Dr. Narayan G Hegde delivering his lecture at the session

Important steps recommended towards women empowerment are:

- Hardship reduction through provision of safe drinking water, maternal and child health, introduction of labour saving devices
- Awareness and facilitation for gender sensitization; and
- Capacity building through exposure visits, micro-credit through Self-Help Groups and promotion of income generation activities.

Women's work in agriculture and nutrition: prospects and challenges for gender equality

Dr. Nitya Rao

LANSA's Gender cross-cut Lead and Professor of Gender and Development University of East Anglia, UK

Women agricultural workers have nutritional needs, control over resources, earning and decision-making. Even though women are working in agriculture, earning income, they have control over income and to that extent, they exercise decision-making in terms of consumption choices; but then, there is very heavy burden of work. This seems to lead to improved nutritional outcomes. They are working for 13 to 14 hours a day and this has negative effects in terms of time available for care, particularly for child care and feeding of young child, because nutrition is very important for the growth and cognitive development of the child. Lot of women's work involves drudgery both in terms of farm work as well as domestic task and this again has an effect on maternal nutrition and health.

'Leaving no one behind for sustainability' was the idea of Professor Swaminathan. A farming system for nutritional approach with different ecological contexts across different land types, crops, livestock, fisheries, agro-forestry etc. based on sustainable agricultural practices and livelihood security entailing social and gender equity may be harnessed to meet the needs of local populations, since working of our overburdening women is not going to pay off in terms of nutritional dividends.

Policy priorities

- Recognition of women as farmers and agricultural workers (as per national policy on farmers-NPF, 2007).
- Removal of inequalities in rights to own assets and wages, better working conditions and access to technology.
- Decentralization mechanism for implementation and monitoring to panchayat as suitable local bodies.

Issues in value in women's labour

Agricultural policies and programs need to be gender sensitive. Women labour needs to be valued in calculating cost of cultivation (not just household helpers). Agriculture extension worker to engage with women controlled crop/ live stocks. Attention to drudgery reduction in post-harvest processing and storage and related time/ resource demand for the poorest. Forums for consultation with women farmers/ agricultural workers on policy changes affecting their time burden need to be established.

Dr. Nitya Rao delivering her lecture at the session

Social protection and public investment

- Existing social protection such as PDS to increase women's choices (food basket example - Ragi in Karnataka).
- Public goods innovations to reduce drudgery, time expenditure, clean cooking energy and drinking water.
- Anganwadi to respond to the needs of women farmers by providing adequate quality and time for child care (feeding services), particularly in the planting season. It also needs to provide crèche facility required for the young child, so that women farmers can work in the field.

Health Care and Sanitation (Swasth Bharat and Swachh Bharat)

Chair: Dr. P K Seth

NASI Senior Scientist, Former Director IITR, & former CEO, Biotech Park, Lucknow

Co-Chair: Prof. Pramod Garg

All Indian Institute of Medical Sciences, New Delhi

Dr. P K Seth

I have great pleasure in introducing Mrs. Bincy Baby Director, ERAM Scientific Solutions. Sanitation is crucial for good health. Many diseases occur due to unhygienic living conditions. I am glad Mrs. Bincy Baby will share her experience regarding this with this audience.

Sanitation and hygiene are the major important and integral component of health care. In fact, in ancient India, lot of emphasis on the sanitation and hygiene has been given, as it is well known that unhygienic conditions are a major cause of infections and illness. The government has launched campaign for a Swachh Bharat and Swasth Bharat and in this context this a very important session.

Prof. Balram Bhargava in his talk entitled Value Conscious Innovations, talked about the need for focused innovation which is affordable and based on the needs of society. He discussed about some of the innovations made under the International Bio-design Centre, at AIIMS in his guidance and leadership.

Mrs. Bincy Baby in her very interesting presentation highlighted about the various aspects of the technology innovations particularly, for the toilets for the women and their maintenance.

Dr. Jugnu Jain, who after several years of stay in US, on return to India, founded a company Sapien

Biosciences, which is building a pan India Biobank. In her talk she highlighted the need of the biobank and how it is a valuable asset in conducting clinically relevant research into understanding the basis of diseases in India, validating new molecular diagnostics, and treatment response markers for improving patient outcomes, a field known as personalized medicine. She mentioned that her company based on the samples from biobank has developed diagnostic tests like myPlatelet and assist-Breast which are of immense clinical use.

Concluding the session, Dr Seth said that the speakers have provided valuable information that how India is moving forward with the challenges in the healthcare and hygiene. There is a constant need of innovations in these sectors to realize the vision of our Prime Minister for a Swachh and Swasth Bharat.

On behalf of Prof. Pramod Garg Co Chair, and myself, I thank all the three speakers for keeping the time and their talks focused on the theme of the session and also to Dr. (Mrs.) Manju Sharma and Dr. Anil Kakodkar for giving the opportunity to participate in this important session.

Prof. Pramod Garg

I have great pleasure to initiate this session and also in inviting the first speaker Dr. Balram Bhargava, who is Professor of Cardiology in the All India Institute of Medical Sciences, in Delhi. He has done extensive innovative work on Biomedical instrumentation, which is recognized internationally now. He is a recipient of several national and international awards including Padma Shri and has large number of well cited publications.

Session III underway

Value Conscious Innovation

Prof. Balram Bhargava
DG, Indian Council of Medical Research and
Secretary, Department of Health Research
Ministry of Health & Family Welfare, New Delhi

Prof. Bhargava spoke about Value Conscious Innovation. Referring to various achievements he stated, "Green revolution, white revolution, healthcare revolution and pharma revolution are unsung heroes of our 70 years of independence. Since independence, various medical institutions have been set up. We have made up our health care significantly independent. Post graduate medical education has also become independent. We have been able to set up Super Specialty Medical Centers in our country. At the All India Institute of Medical Sciences about 3.5 million people are treated every year. The institute provides low cost medical care for the needy".

The Yin & Yang of Indian Health Care

Having glorified that we treat so well and have 4 million medical tourists in India, we also remember that 40 million patients are below poverty line, because of health related expenditure and that remains a problem. Out of pocket expenditure in India is about 86%, as per the healthcare indices of all countries from west to east. The GDP on Healthcare spent is only 4% in India, whereas it is 8, 9, 10% in the Nordic and other advanced countries viz. Denmark, Sweden, UK, Germany, France, Japan having socialist health care systems; while in the US, it is 18 to 19 %. We have done well in healthcare, but the frontiers that need to be overcome include:

- Emergency medicines and universal health coverage for our population- the current Government is trying to cover a population of 50 crore with National Health Scheme which is the ambitious program; and
- Imported Technology- 80% of technology in our country is imported and is able to benefit only 20% of those patients.

India has tremendous strength. We have enormous opportunities and there is a need to fulfill large unmet need. We have large pool of Engineering services, InfoTech and Science industry. Government is also realizing the relevance of healthcare and medical industry and technology industry as such. As Indians, we have naturally innovative mindset (we are genetically endowed) and come up with simple solutions. We see more problems than any physician or any individual anywhere else in this world, but our waiting time for application is much more. We wait till the problem reaches to its critical mass and then we solve it in a cheaper, better, faster and scalable manner.

Our struggle for independence, green revolution, white revolution, our space missions, nuclear mission, mass transport system (Delhi Metro train), resilient banking system, Government policies and generic drugs are some of the ideal examples.

Prof. Balram Bhargava delivering his lecture at the session

Innovation in India has to be value conscious, because it is based on the parameters of affordability, availability and accessibility as a primary goal. All India Institute of Medical Sciences started a program 10 years ago in collaboration with IIT, Delhi and Stanford University and now there are several partners. The program is to identify unmet healthcare/ medical needs in India and develop solutions which are frugal and predominantly concentrating on medical devices and frugal med tech innovations.The philosophy behind this is bedside to bench and bench to bedside. One has to innovate and translate to the patients. This is a collaboration with AIIMS, which is providing the Med Tech Innovation Centre, clinical access/ mentoring/ training. Rapid prototyping facilities are there in AIIMS. IIT, Delhi, which is just 3 km from AIIMS, provides engineering support, training, designing, students and faculty housing and fabrication.

The BCIL (Biotechnology Consortium of India Limited) has provided tremendous support in technological activities of this program, creation of startup and there are international partners where the collaboration is done on a need basis to identify the existing problems. For example, if there is a problem in doing large animal studies, then the collaboration is done with Queen's University in Australia. For precision Engineering, collaborations have been done with the universities in Japan. When there is a clinical need and there are students including doctors, engineers, designers, entrepreneurs, basic scientists working as a team, output is notable. There are four to five such teams with four students each. These teams visit Rural Health Centres and Intensive Care Units in India. They visit the developed state of the art medical facilities at AIIMS and some private hospitals and come out with 500- 600 unmet clinical needs. These clinical needs are then filtered, based on what is available in the market, what is feasible and what is practical; and hence, they come up with the solution.

In case of medical devices, it takes almost seven years from generating an idea to actually translating it by developing a market/ business strategy. India has come a long way in Entrepreneurship since independence, but it still needs to be nurtured and fostered, so that people are able to develop solutions which our country needs. The west will also accept them as they are low cost and frugal. Some of the innovations are:

- A mechanical device that can hit the bone in 7 to 8 seconds and can be used to give fluid or drugs to stabilize the patient. The device is easy to handle and thrown away after the use.
- Soft tissue biopsy needle – Dr. Pramod Garg was the mentor in collection of the sample from the body chamber in a way without damaging the tissue and the instrument is electronically powered.
- World's first foot operated newborn resuscitator for Asha workers, which is suitable for National Health Mission.
- Cardio pulmonary resuscitator device that has not taken off yet, but can save a patient after 45 minutes from the current 15 minutes time duration. It's not commercialized yet and we are looking for partners.
- The device we created, 'Accu-feed' ensures that the food supply goes into the back of the esophagus and not a 50-50 chance that it may go into the air pharynx by the traditional methods.
- During the 10 years of program, AIIMS has set examples by training 125 young innovators and developing 11 start-ups and 13 innovative devices. Several patents have also been filed. The philosophy is Noble, Affordable and Need Driven Health Innovation following Gandhian practice of innovation and cost effectiveness.

Access to safe sanitation spaces – Right for every Indian woman to clean sanitation and livelihood opportunities

Mrs. Bincy Baby
Director, Business, ERAM Scientific Solutions
Thiruvananthapuram

India's first patent was filed in 1903 by Sir Jagdish C Bose. Dr. CV Raman had started TCM Limited in 1943 as Travancore Chemical Manufacturing Company Limited. So, the entrepreneurship was there in India, but not promoted. Therefore, the entrepreneurial skills further need to be nurtured and fostered, so that people are able to develop solutions which the country needs.

Health and sanitation have been playing cross-cutting role and it is such a critical area that we cannot afford to ignore. Our honorable Prime Minister Mr. Narendra Modi has rightly said that the time of women empowerment is over and now it is going to be women led development. I believe that proper sanitation has not been provided to a large percentage of women across the globe.

Sanitation has a lot of areas that we have neglected upon, but there are areas that definitely need to be taken up, thought about and also debated. We need more innovative ideas to come in. Some of the important points are:

- Lack of safe places to go for sanitation.
- Increased awareness to women about sanitation and hygiene.
- Livelihood awareness with sanitation sector as an emerging area.
- Lack of hygienic public toilets exclusively for women cutting across every strata of the society.
- Equal rights for sanitation
- Dignity and honor.

With the announcement of Swachh Bharat, we, being a company working for the sanitation sector over the past decade found that Indians have started talking about sanitation and this need to be encouraged.

We have to make sure about safety and hygiene for women. Safety is important as toilets in secluded places raise security concerns, which prohibits women to use them. There is a trade-off between safety and privacy for any women and that needs to be ensured. Sound hygienic practices needs to be ensured and taught. This will also include the need for menstrual hygiene.

- Studies conducted on women's safety depict cases of rape and assault, when women go out in the open for defecation. It is one of the prime concerns and unless we ensure safety, especially in public locations, it is very difficult to take women to the toilet. In a country where 60% of population defecate openly and half of them being women, it is very important to ensure that you drive them to toilets and give safety and privacy.
- Privacy - It is psychologically very important as providing privacy barrier increases the use of public toilet.
- Sustainability - Even after providing safety and privacy, these toilets still need to be provided with sustainability of operation. Toilets have opened up in public places, but if there is no water, electricity or no safe disposal of waste, public will not use them. Such toilets inaugurated with much fanfare and even endorsed by celebrities are closed now. Toilets need to be reliable. Public sanitation is also important because a large number of women may have these as their primary toilet. They might not have one at home.

The women, considered to be illiterate, but have come forward with bold initiatives and started the sanitation revolution have really set examples for others to follow. Chhattisgarh's Swachh Bharat Abhiyan mascot, Kunwar Bai Yadav who sold her goat to make her village open defecation free, was felicitated by Prime Minister for her efforts. Today, in a district at Chhattisgarh, every house has a toilet.

Public sanitation facility - features and functionalities

- Need to ensure the right/optimum dimensions for a toilet. Maintenance of cleanliness and hygiene with possibility of another person entering the toilet or turn around space for individuals are important concerns in this study. Designing a toilet which requires less consumption of water and that is where research and development goes.
- Aesthetics is also important. Example being SHE toilets launched in Municipal Corporation in Hyderabad, exclusively for women which can be accessed by inserting coin. The toilets have accessories required to support woman during her menstrual period like napkin incinerator, napkin vending machine or any other disposal system, so that women feel comfortable during these days.
- SMART SHE is a toilet with a restroom located at Navi Mumbai. This has seen a dramatic usage of toilet where we provide a rest room with diapers and napkin-changing station. A rest room is equipped with the chair and bench where you can sit in and mostly used by women who come for work.

Menstrual hygiene is another dimension where we need to speak openly today. It is a moment naturally occurring to women across the world. The school dropout rates for adolescent girls are high during these seven to eight days period of menstruation. So, the women should be sensitized and made understood about its natural occurrence. 'Are you comfortable going on the road when you are menstruating? Do you

have access to accessories and disposal?' are the questions that need to be asked and answered. Such issues need to be thought about while setting of any sanitation facilities for women. It has been observed that the most important requirement for sanitation has been the napkin vending machines and destroyers or incinerators. It has been experienced that these facilities are availed extensively by the adolescent girls in schools, if offered. Building a sanitation ecosystem is another very important dimension as it cuts across the generations. A woman, the mother of today is building the society for tomorrow. So, she has to be an active partner, a stakeholder increasing awareness among the peers, the right use of sanitation keeping in view the worth of health and hygiene. They need to lead the development with women led institutions at the local level keeping them linked to livelihood programs.

SHE toilets, where women open shops near the toilets as vending station has also been set up where the women act as sellers of the shop and caretakers of the toilets.

Mrs. Bincy Baby delivering her lecture at the session

We also need to create skilled women technicians. As manufacturers of electronic toilets, we do not have workers, cleaners or scavengers, but the service engineers doing electronic troubleshooting. So, developing women technicians who can troubleshoot the toilets will also help empower them.

Today, we are also looking at the concept of Internet Of Things (IOT), into a toilet and the sanitation program. The usage of toilets can be tracked using technology and it helps to make decisions about the usage and placement of toilets.

These are some of the action points:

- Involve women in decision-making in sanitation system.
- Have policy directions set towards intergenerational effects on sanitation.
- Encourage research and development innovations and increase effort in sanitation, as it is a huge unexplored area.

Creation of a comprehensive pan-India biobank to drive the development of personalized diagnostics for Indian patients

Dr. Jugnu Jain
Co-founder & CEO, Sapien Biosciences & Saarum Sciences
Hyderabad

Sapien Biosciences is building India's largest, most diverse biobank, carefully preserving and cataloguing a variety of human biospecimens following ICMR guidelines. The vision behind the formation of the biobank is to utilize this valuable asset in conducting clinically relevant research into understanding the basis of diseases in India, validating new molecular diagnostics, and treatment response markers for improving patient outcomes, a field known as personalized medicine.

Biospecimens at Sapien span all non-communicable diseases such as cancer, cardiovascular, psoriasis and other inflammatory disorders as well as infectious diseases. Healthy control samples needed to compare disease vs. normal are also stored; these may come from margin tissues of cancers or from cosmetic elective surgeries, or left-over samples from health checks. Sample types comprise of formalin-fixed paraffin embedded blocks or flash frozen tissue or live cancer tissue which is cultured into mixed cell cultures, blood, plasma, serum, urine, sputum etc. depending on the requirement of the research project. Matched samples from the same patient such as a small amount of tissue and a blood sample is sometimes needed to detect biomarkers in blood reliably; and eliminating invasive biopsies in future.

A huge benefit of biobanking is the digitization of patients' medical records from across multiple centres. Most hospitals in India do not have comprehensive longitudinal electronic medical records. Physical files are usually incomplete and prone to being lost/ damaged. As part of biobanking, Sapien collates the associated demographic and disease data for all its specimens. To enable the vision of Digital India, more resources should be devoted to curate and digitize patients' data and analyze it using artificial intelligence and machine learning. Our rich datasets associated with matching samples are being used for epidemiological and drug response biomarkers studies in cancer patients.

Sapien develops new diagnostics itself as well as collaborates with diagnostic companies worldwide to enable them to develop / validate their novel assays rapidly by facilitating access to high quality patient samples and data needed for their projects. Examples include 'My Platelet' test developed by Sapien that helps customize the use of blood thinning or anti-platelet medications (clopidogrel, prasugrel and ticagrelor) for stent patients, and 'CanAssist-Breast' – a test that predicts the five-year risk of recurrence

of breast cancer in early stage hormone positive patients. Sapien is working on developing novel blood or urine-based tests for early screening of women's cancers e.g. cervical and breast cancer to catch disease early when it is still curable.

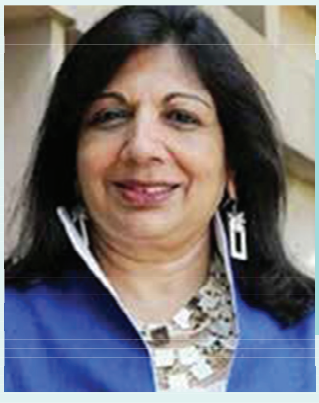
Looking forward the proof of concept of how an ethical, high quality, sustainable biobank can be built has already been demonstrated by Sapien in its partnership with Apollo Hospitals. Extending this biobank to public and private hospitals across India, in a PPP mode, has the potential to start turning the liability of high disease burden in a large population in India to an asset wherein large numbers of samples and data can be systematically catalogued and preserved to drive translational research into healthcare solutions needed for India.

Dr. Jugnu Jain delivering her lecture at the session

Evening session underway

Chair: Dr. Anil Kakodkar
President, NASI

Women in Science – Leveraging Technology for Social Impact



Dr. Kiran Mazumdar-Shaw
Chairperson and MD, Biocon, Bengaluru

Today we are living in an 'Ideas Economy' and the value of a country is today measured by its 'innovation quotient'. Innovation is the collective compound interest of human ingenuity. If we want non-linear growth in the Indian economy, we can achieve it only with the power of science and technology. Good science will drive innovation in the desired direction leading to exponential growth.

Taking ideas to market is not easy. What is most crucial in today's day and age is to create the innovation ecosystem that leads to a virtuous circle: academia generates ideas, especially those based on science and technology, which are incubated to proof of concept through public and private funding and then taken to market through business intervention backed by venture funding and capital markets.

India has no dearth of knowledge in basic sciences. Ayurveda is testimony to the kind of knowledge that can be created in pharma and herbal medicines. In Mathematics, Srinivasa Ramanujan made substantial contributions to the analytical theory of numbers. In Biological Sciences, no less a personality than Dr. Hargobind Khorana added to the understanding of the genetic code and how it works.

Evening Lecture

Dr. Kiran Mazumdar Shaw addressing the audience

We Indians are both curious and innovative. Somewhere along the line, however, we lost the ability to innovate and I believe that a large part of it has to do with the ecosystem that we failed to create. Today, managing innovation is what every competitive economy is trying to do better. Policy makers, the world over, are increasingly aware that innovation activities are the main drivers of economic progress and well-being of a nation. The knowledge economy has given rise to new ecology of competition where battles are increasingly being fought not for the control of markets or raw materials but for the edge to get new ideas and new innovations to market first.

Today, we have gathered to celebrate women's contribution to science and the social impact that they have created and can create. Women have been playing a crucial role in science for over a century and perhaps it is noteworthy that the word computer originated from a group of women who helped process astronomical data for the director of the Harvard Observatory in the late 19th century.

An analysis of 19th century women and innovations in the U.S. has shown that nearly 500 women patented more than one invention, impacting the world with their inventions/discoveries.

In India, too, women have had a presence in the sciences for well over a century. The first Indian woman to receive her degree as a medical doctor did so in 1885. An early Indian woman doctorate in basic sciences was Janaki Ammal (in 1931) and the first woman to get her doctorate from an Indian university was Ashima Chatterjee (in 1944).

The scientific community is realizing the diversity of thought, creativity and innovation that women bring to the table; and this is opening up more opportunities for women scientists. Women, today, are an integral part of the scientific community in India: from space technology to biotechnology, from high energy physics to mathematics. Women are changing the formula both in gender equations as well as scientific equations.

Evening session underway

We have travelled far. But there's still a long way to go. Research shows that while there are a significant number of women "studying" science in India, very few of them are "doing" science i.e. pursuing scientific research as a career. Today, there is a huge discrepancy between the number of PhD holders in India and the number of women faculty in Institutions of Higher Education or researchers in science.

One study found that while participation of women up to the Ph.D. level is about 20-25% in India, their representation among working science professionals for most of the institutes of science and technology in India is disproportionately low. In fact, the percentage of women on the faculty of high profile research institutes is about 10-12%.

There have been outstanding women scientists who have made important contributions to science, but by and large, only a small fraction of women with successful careers in science fill top positions in S&T research-led organizations in India.

Going by the trend of underrepresentation in the science it's not surprising that women's share of prestigious national awards or membership in the national academies is also low. The gender disparity in recognition is evident in the topmost scientific award given to scientists below the age of 45 in India, the Shanti Swarup Bhatnagar Award. The award has been given to more than 500 scientists since its inception in 1958. Only 15 of them went to women.

To get more women to study STEM subjects, we need more role models. Women in science need mentors that they can identify with. So, we need to create the next generation of women scientists.

Knowledge has no boundaries and no gender preferences. Both men and women are endowed with the same intellectual capabilities. The time is just right for women scientists and women entrepreneurs to flourish in India. All that is required for women is to be innovative and to use their instincts, intellect, resourcefulness and commitment to take ideas to the market to tap the enormous opportunity unfolding before them.

Women need to capitalize on their inherent qualities of sensitivity and above all the inner strength to excel. Science is about societal impact that can make the world a better place. Success is about making a difference and being proud of it.

Felicitation of Dr. Kiran Mazumdar Shaw by President, NASI and Dr. (Mrs.) Manju Sharma

Vote of Thanks

Prof. Veena Tandon
NASI Senior Scientist

Our most valued invited guests, ladies and gentlemen!

It's my privilege to have been asked to propose a vote of thanks on this special occasion.

I, on behalf of the NASI family, the entire team of NASI headed by our President DR. Anil Kakodkar, including the fraternity of NASI Fellows and members, even special guests in the audience here together, and on my own behalf extend a very hearty vote of thanks to our erudite speaker this evening-Dr. Kiran Majumdar-Shaw- for gracing the occasion and sharing with us your opinions today! We say "a big thank you Madam!". We are humbled by your kind gesture in accepting to give this invited special lecture. I express our profound and most sincere gratitude to you for honouring our invitation. Also, our heartiest congratulations on conferment of Honorary Fellowship of NASI to you!

I believe we have all profited from your wealth of learning and experience. The lecture has been quite educative, illuminating and most inspiring. Indeed, you are a pride to us and the entire women science fraternity as a role model woman empowerment personified!! Welcome to NASI family as Fellow of the Academy. We wish you God's protection in your continued services to the country with a flourishing entrepneurship. I have immense pleasure in extending our heartiest congratulations to all 'Biotech WInER (Women Entrepneurial Research (BIRAC-TiE) awardees.

I would like to take this opportunity to place on record our hearty thanks to Dr. Anil Kakodkar for presiding over this prestigious meeting. I also extend our thanks to the entire Organizing Committee of NASI- with a special mention of Ms Archana Pant- under the able guidance and leadership of our idol and revered Dr. Manju Sharma, Convener- for their enormous and untiring efforts in the organization of this event.

Prof. Veena Tandon proposing a vote-of thanks

President Sir, ladies and gentlemen, once again I want to state that we are all most delighted to have Dr Kiran Majumdar-Shaw; I'm sure you will all join me in thanking once again our esteemed speaker this evening.

We thank you all for being with us today – it has been a great pleasure that you all joined us in celebrating and rejoicing Technological Empowerment of Women.

Technology and Innovations

Chair: Prof. Pramod Tandon
CEO, Biotech Park, Lucknow

Co-Chair: Prof. Satya Deo
General Secretary (HQ), NASI

Prof. Pramod Tandon

In this session there were four speakers namely, Dr. Ram Gopal Rao, Director, IIT, New Delhi, Prof. Akhilesh Tyagi, University of Delhi, South Campus, New Delhi, Dr. Jennifer Ann Thomson, President OWSD, South Africa, and Dr. Shahid Jameel, CEO, Wellcome Trust, DBT-Alliance, Hyderabad.

The session was exclusively devoted to role of Technology and Innovations in Women Entrepreneurship and Empowerment. A need to strengthen women eco-system was highlighted so as to motivate women to choose entrepreneurship as a viable and fulfilling career option. In view of bio-economy becoming the next economic wave after the fossil economy, the involvement of women in research activities related to crops, biological products and processes was strongly recommended. For achieving this, a strong and viable plan must be drawn. Women biotechnologists by virtue of their excellent research have made a place for themselves and there is a need to utilize their research for creation of job opportunities. While women are taking up science as a career, there is still a need for a strong policy to enthuse more women participation in programmes related to Science & Technology Innovation and Entrepreneurship. This would require special dispensation of the Government for providing support to women scientists.

Plenary Session 2

Prof. Satya Deo

All the four lectures in the session on "Technology and Innovations" presented by the eminent speakers dealt with their own findings in biotechnology including the statistical data which were in conformity with the theme of the conference. The topic itself was an important part of the mega event organized for technological empowerment of women scientists. The innovative contributions with emphasis on Entrepreneurship by each of the speakers are already well-recognized and concretely adopted to the welfare of the society at large. As a result the audiences, particularly the women scientists present there, were clearly impressed and moved to take up the innovative works themselves and deliver concrete benefits to the mankind. They deserve all sorts of encouragements from the Department of Science and Technology.

Plenary Session 2

A Case of Women Empowerment through Entrepreneurship and Innovation
Women in Science and Technology - what needs to change?

Dr. V. Ramgopal Rao
Director, Indian Institute of Technology
New Delhi

In India, women account for only 20% of GDP as against the Global average of 44%. In Science and Technology areas very few women are performing at highest level as can be seen from National level awards/ recognitions. In the IIT UG program, girls are less than 10% and further decreasing. Women constitute less than 10% of faculty in Engineering Department in IIT, against an overall 20%. India is ranked 52nd, much lower than US (4th) and China (29th) in the list of 57 countries surveyed to ascertain parity for women entrepreneurs. Women entrepreneurs constitute only 10% of total number of entrepreneurs in the country. Even globally, only 20% of Google engineers are women, a statistic, matching roughly across all hi-tech companies.

Once women decide to do something, they give their 100%. There are programs which are exclusively led and done by women. One such example is started by IIT, Mumbai for sustainable development goal on energy. Part of this project is distributing solar lamps to women for their household work. The solar lamps are made by women in villages by outsourcing the parts for the solar lamp so as to build a small scale industry; and the program is run and led by women.

The missions like Sawaroj – Rojgar Yojana, Swabhiman Campaign etc. target to reach women throughout the country so as to train more women to start the enterprises.

PHD startup - PHD stands for Platform in Harnessing Deep Technology for startups; this year, it is going to start in five areas identified for the purpose:

S - Technology in Security area

H - Technology in Health area

A - Technology in Agriculture

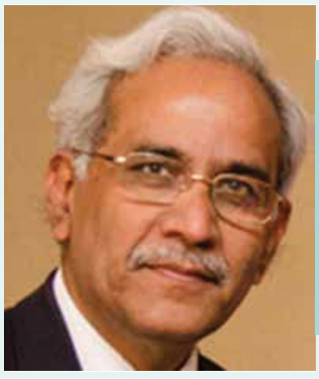
P - Technology in Pedagogy

E - Technology in Environment

In these five areas IIT, Delhi is hopeful to start 20 startups, where the focus will be on working on an innovative idea on harnessing deep-technologies like research/ innovative work on handheld and stand out detectors.

Dr. V. Ramgopal Rao at the session

Bioeconomy through Agri-Biotechnology



Prof. Akhilesh K Tyagi
University of Delhi, South Campus
New Delhi

In 2015, in Berlin, a meeting was held, where 700 participants from 80 countries were present. It turned out from the discussion that bioeconomy of the world would be huge and in tune of trillions of dollars; and this will help to create re-industrialization once again and wealth. It requires more systematic intersectoral and international approach and involves various sectors of human activity. To help it, we have to take innovative approach of connecting different domains and also establish good governance towards this. It will facilitate a dialogue in establishing bioeconomy and also help to attain the SDGs, established by United Nations.

To achieve these (SDGs), human resource is required and we can see half of the undergraduates as women. The number of women graduates declines, coming to 43% in Ph.D.; and when we look into jobs, the percentage declines to only 28%. This means half the human resources, which are being trained, are lost in the pipeline as we move from undergraduate to the research level and this is the world scenario. Indian scenario is also not different from this. In Indian academics, the number of female students is more than the number of male students in undergraduate and graduate levels. As we go higher i.e. to the Ph.D. level, the number of female students is less than male students; only 40% females are there and when look at university, the situation becomes even worse. When we consider agriculture, we can see 70% of our population is involved in agriculture in some way or the other, out of which if we look at women folks, 80% of them are working in agriculture; but out of it, 30% are cultivators and 50% of them are labourers. This kind of approach reflects that we need to do much more. More importantly, when we look at the Cooperative Movement in India, we find that members of our cooperative societies which are going into million are only 10 to 15% of females and almost 80% are males. It reflects that women are contributing major component to agriculture; but the activity which they are doing, needs to change from the input to the owner of the Enterprise.

With green revolution, we are able to produce five times more crop than what we used to grow at the time of independence. In another ten years, we have to produce 40 million tonnes of food grains more

than today and that would require creating a force not only in the field, but also in the institutions which can apply new technology and implement it in bioeconomy. This view is more important with respect to women in rural areas as there is an environmental degradation.

Prof. Akhilesh K Tyagi delivering his lecture at the session

When environmental degradation occurs, the jobs are lost in the rural areas and people move to cities; the majority of them are males and therefore, it leads to feminization of agriculture. From that point of view, in the cities we create slums and at the same time in the field, we create deficit of the labour which will work on the farm and implement new technology. Therefore, a balance has to be brought in this movement so that agriculture can contribute effectively. Women entrepreneurs must adapt to such technologies as micropropagation, hybrid/quality seed, GM crops, genomic-assisted breeding and genome edited crops, so as to contribute to the growing bioeconomy of our country.

These technologies will allow us to go for climate resilient crops and adopting 'more crop per drop' concept, which is the motive of the government also. Increasing nutrient use efficiency is also important. Green revolution has allowed us to use lot of fertilizers, but only 30% of fertilizers is utilized by the plant and 70% goes waste. So, if we want to save the fertilizers, we need to improve their use by crops and that will also improve the environmental conditions. We can have best pathogen and weed resistant plants; and assure the possibility of more yields per unit area as well as to reduce the post-harvest loss which is considered to be 40% of total produce. Fruits and vegetables being produced by utilizing the technologies would help ultimately to achieve a vibrant bioeconomy. Women entrepreneurs must come forward and be a part of this revolution which is for sure, going to come in the near future and will be remembered as the new industrialization. Participation of women entrepreneurs is, therefore, very important.

Women's Role in Biotechnology and Science Policy

Dr. Jennifer Ann Thomson
Department of Molecular and Cell Biology,
University of Cape Town, South Africa
President of 'Organization for Women in Science for the Developing World' (OWSD), South Africa

In planning a career as a woman biotechnologist, the most important step is to gain credibility within the scientific community. This can only be done by achieving research success, which must then be accompanied by a strategic plan for visibility of this success. In other words, the news of your success must be broadcasted. Once you have gained credibility as a scientist, capitalise on the fact that you are a woman and show how a gender lens can improve your output and productivity. Also show how women manage research teams differently from men and gain yet more credibility as a woman leader in research.

Highlighting the importance of being women in Biotechnology, Prof. Thomson shared her own story wherein she had to change professional directions, involved into other areas like writing into regulation; hence, worked very hard to gain credibility in her field. In spite of lot of opposition, she became the first woman Chair in science and gained recognition as a Head of the Department of Microbiology at University of Cape Town. She remained the Head for 12 years as virologist and bacteriologist.

She addressed the practical ways to combat gender inequality in STI Research environment:

- Hold important meetings during school hours.
- Extend cutoff for the young scientists from age limit of 35 years to 45 years.
- Gender representation is required at conferences, workshops, committees.
- Provide lab support during maternity leave.
- Pay for child care cost for women with preschool children.
- Provide family room at conferences.
- Establish gender equity committees at or research institutions.

Conclusion

- Women's approach in science and its management is different. Capitalized science has priority in funding; so white paper funding, which is an effort to create a pipeline of societal challenges, suitable for future funding opportunities of science, could be approached. Now funding in South Africa for science is run by the National Research Foundation. There is a need to capitalize and allow funding, if one diversifies one's career.
- A "gender lens", reflecting the aims, concerns, situations and abilities of both women and men, should be applied in all aspects of STI policy-making including promoting and leveraging science and technology (S&T) to support women's development in key sectors, such as agriculture, water, energy and transport, where they play a particularly important role. Policies also need to promote gender equality in S&T-related education, careers and leadership as well as encourage and support the role of women in innovation.
- Need to conduct a gender test in government's departments for science, technology and innovation to bring in mechanisms for achieving gender parity.
- Remember the practical ways to improve women's participation in STI.

Jennifer A Thomson delivering her lecture at the session

Women of science – Can we learn by listening to them?

Dr. Shahid Jameel
CEO, Wellcome Trust/DBT-Alliance
Hyderabad

India requires a policy push and changed mindset to have more women scientists. The Wellcome Trust/ DBT India alliance and the US Embassy, New Delhi put together a listening session on November 16, 2017, which was attended by over 50 women researchers from 30 different institutions including people from multiple streams and career levels. The discussion was very thematic, ranging from micro to macro level, going essentially from one's own laboratory to the country level. Six main concerns emerged from the discussion:

- Age and ageism- Many institutions have hiring age of 35 years and below. At this age, women have family responsibilities. It was suggested that the hiring age limit be increased up to 45 years.
- Entry/ re-entry- Women enter their career at multiple stages because of one or many reasons. This should be encouraged, instead of being considered a drawback.
- Mentoring, networking and leadership training- Mentoring is required for both males and females in the career ladder. It is found that compared to men, women don't have very good networks. So, networks for women led by women, should be encouraged and so should be their leadership and training.
- Institutional support- Most of the institutions do not stand behind people they hire in terms of solving their problems and making a friendlier workplace. There are issues of providing child care facility, not having mother's room at the institution, not having transportation facility, involving safety, especially in large cities that affect women in the work force.
- Bias and discrimination are very serious issues.
- Social issues, which hinder the growth of women in science.

The strong recommendation points (for NASI, INSA, DBT, DST, Ministry of Science MHRD and other strong bodies) that emerged are:

- The age limit should be increased at least by 5 years for women to compete for faculty position.
- Providing un-biased training for all staff; and hiring fellowship committees.
- Providing lab management and leadership training to women.
- Adjusting regulation(s) to ensure the maternity leave.
- Establishment work for mentoring and leadership development.
- Establishing virtual platform to maintain contact with research.
- Providing transportation, mother's room, day care facilities and accommodation should be the basic amenities for women in the workplace.
- Facilitating discussion and sensitization on women's issues.
- Increasing representation of women in decision-making bodies.

Dr. Shahid Jameel delivering his lecture at the session

Session IV

Skill Enhancement and Development – Women Scientists and Technologists to be encouraged, mentored and supported for advancement of their career

Chair: Prof. V Durga Bhavani
Vice Chancellor, Sri Padmawati Mahila ViswaVidhalaya, Tirupati, Andra Pradesh

Co-Chair: Prof. Ajoy Ghatak
Meghnad Saha Fellow, NASI, Allahabad

Prof. V Durga Bhavani

I know women scientists progressing significantly and I congratulate all women scientists who are contributing to science innovations and enterprises. I acknowledge the contribution of women scientists to the Indian economy.This platform witnessed the discussion of multiple topics essential for the technological empowerment of women which includes inclusiveness of women, renewal of policy and procedures, transparency in appointments, recruitments, promotions, and awards. There is still a great need to network the women scientists to promote the contribution of women in S&T and to ensure their full and equal participation.

This conference would emphasize the importance of women in all verticals stating Business enterprises, Welfare activities, Academic endeavours; and need of more Woman Scientists and Technologists. For this, the education and research insight needs to be incorporated from the very early stage in such a way to inspire creativity and crucially for uptake of science as a career among girls and young women. This will require a different approach to education, with an emphasis on high-level skills, that considers the implications for employment and provides girls with sound technical training. The next generation of creators will embrace technology as their first language, learn by collaborating and communicating with anyone in the world, and create with touch, command with voice, and conceptualize in education.

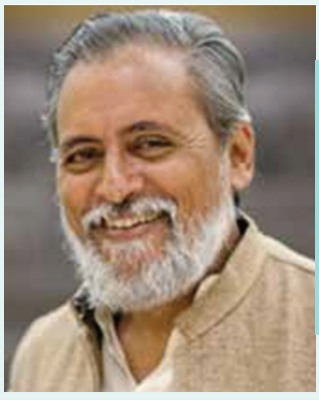
In order to achieve their goal, each higher education institution would develop an ecosystem to excel the young generation. For example, as part of this, our university has initiated several programmes to promote entrepreneurship activities, and technological empowerment among the students and women and in the community. Keeping in view, we have started training the students and setting up centres to popularize the activities rapidly. The support from governing bodies like Department of Science and Technology (DST) helped to start up prestigious centres like TePPOut Reach cum Cluster Innovation Centre (TOCIC), Technology Business Incubator (TBI) and Rural Women Technology Park (RWTP), SPMVV Innovation Society at university campus.

Prof. Ajoy Ghatak

On behalf of Delhi Chapter, I welcome all distinguished women scientists, who have come from long distance. I view this conference not just from women's point of view, but, important for scientific discussions. I see that very eminent speakers have been invited to share their vision at this moment.

Session IV in progress

Knowledge, Skills and Innovation for/by women: A Policy Plea



Dr. Anil Gupta

CSIR Bhatnagar fellow; founder, Honey bee Network and visiting Faculty, Indian Institute of Management, Ahmedabad and Indian Institute of Technology, Mumbai

Women scientists and technologists to be encouraged mentored and supported for the advancement of their career

Prof. Gupta started with the concept of autonomy and agency; and how it can be used in day to day life in identifying the problems, conceptualizing the ideas and fixing it by focusing on two points:

- Autonomy is freedom to take decision
- Agency is willingness to use their freedom

The concept of autonomy and agency was clearly shared by citing an example of 7-year old girl Chaya Thakur, who observed that a tap for drinking water fitted in her school, should be at the level/height easy approachable/ accessible to the school students; and proposed the agency for adjusting the same and tilting it forward a little bit, so that it can be used by everyone. She observed, analyzed, abstracted, assimilated and applied her thoughts for suggesting a way out. Hence, use of her skills of autonomy and agency made her the first youngest guest faculty in one of the premier institution, that is IIMA.

This also illustrates the fact that if we bring Science, Technology, Art and Culture together, perhaps leadership of women scientists will become more evident. How do we overcome the exclusion of women by bringing in those sectors, scales, spaces, social segments, skills and knowledge and structure of governance in which women will have better role to play.

If we look at the skills required to map cognitive function in any problem like neurobiological problem or information processing, we find that women have great advantage of mapping multiple domains as they live in those multiple realities.

We must try to get students assigned to the entrepreneur. This will reduce the task as well as cost of hiring the staff. The students may be facilitated towards doing their internship project. Some courses may be

designed if the student have to work with one startup or two, as a part the under graduate/ postgraduate discipline so that student could also learn risk-taking and there could be a Win-Win situation for both the sides. The students will learn how to set up an enterprise/venture; and the enterprise, in turn, will grow stronger by gaining the vigor from the young people.

There is a need to reduce the ex-ante and ex post transaction costs of connecting innovation, investment and enterprises. We must also encourage existing entrepreneurs to in-license the technology of women scientists and scholars so that every technology they have, may not be converted into a business or venture by them only.

Though, if they wish to set up their own enterprise, they must get all the encouragement. There should be no hesitation in in licensing out technology to other entrepreneurs, but the ecosystem must be developed slowly to help women scholars, innovators and scientists to become entrepreneurs themselves.

It may also help if mentoring platform for empathetic nurturance of women start-ups is also developed. The Honey Bee Network, gyti.techpedia.in and techpedia.sristi.org are very keen to join hands with NASI and other such science and technology associations to convert autonomy of women scientists into their agency for taking risky decisions ahead.

Dr. Anil Gupta delivering his lecture at the session

Woman, Scientist, Entrepreneur: Engendering Skills for the Changing Workplace

Dr. Pratibha Jolly
Principal, Miranda House
University of Delhi, New Delhi

These are exciting times for the young, and especially for women. Nations across the world are increasingly aspirational. Emerging economies, in particular, see a strong correlation between science, technology and socio-economic progress. On one hand there is greater investment in human and social capital; modern infrastructure and better quality of life. On the other hand, there is policy commitment to sustainable development goals, management of natural resources, and overcoming challenges posed by unrestrained growth to environment. There is increasing sensitivity on issues of equity and need for affirmative action along with manifold expansion of outreach programmes. The changing national goals, however ridden with contradiction and challenge, are providing many opportunities for participatory action and engagement at both local and global level.

The progression to a knowledge-based society is clearly discernible. Indian scientists are contributing to mega research projects on the frontiers of knowledge. The ubiquitous information and communication technologies have ushered new ways of knowing, learning and sharing, disseminating new skills in large populations. The concept of workplace is changing as organizations undergo rapid digital transformation and are increasingly networked. The demographics too is changing as the workforce is increasingly mobile and organizational flux is the new normal. Armed with new technological tools, the young are ready to carve a new identity in a bold world characterized by a completely new paradigm, the 6D framework of exponential transformation. The spectacular evolution of computing power and digital technologies developing at exponential rates have changed the structure of organizations and business alike. They are disrupting old industrial processes. Information technology based start ups dematerialize what was once physical, own no assets, employ very few and have the potential to generate large revenues. Powerful technologies are no longer only for the wealthy. Knowledge frontiers, be these in bioinformatics, biotechnology or artificial intelligence, are no longer only in the domain of institutions or large organizations. Demonetization of services has made available megapixels for free. The mobile phone can access a spectrum of softwares, apps and services at virtually no cost. Dematerialization has made technology freely accessible and led to Democratization, making technologies cheaper and cheaper, accessible to anyone, anytime, anywhere. Natural inhabitants of this new world, both men and women – the millennial to technology born – are

eager to carve a new identity for a smart future driven by the fourth Industrial Revolution, by Change 4.0.

In this process, the paradigmatic shift in ecosystems and benefits to society will accrue only if women become equal partners in formal development activities. That women are innovators and entrepreneurs par excellence is borne out by civilizational history, the richness of folk art, craft and culture. The growth of societies exemplifies how women nurture and scaffold communities in pioneering ways on all fronts. Women's ways of knowing, doing and sharing are different and enriching in unique ways. Then it is critical that the workplace should be inclusive.

Although young women from diverse backgrounds are progressively aspirational, they experience a multitude of barriers in carving successful careers, especially in the sciences.

Statistics show a huge differential in the foothold women having higher echelons in comparison to men. Bridging the gender gap are exemplary contributions by women scientists, women entrepreneurs and women leaders who are breaking the gender stereotypes, the so-called glass ceiling. This number is increasing but not fast enough. Inclusive growth mandates a level playing field. More importantly, it entails engendering skills and competencies commensurate with the needs of the continually changing workplace. It also entails enhancing women's' own belief in their capabilities –in bridging aspirational gender gaps. Women's' enterprise has to move far beyond the conventional micro hopes; micro ambitions; micro innovations; micro scale; micro finance; micro venture. The bold new world of exponential technologies beckons equally the women. The dematerialized and democratized –flexible and open workspaces can prove to be particularly advantageous. The digital has become a critical life skill with internet and communication technologies as key enablers. The challenge is in learning how to set up, how to interface, how to leverage the digital world. Then it is crucial to unlock early the digital power of women students, provide them equal access to technology and digital training. It is equally important to impart essential financial education and leadership opportunities for autonomous functioning.

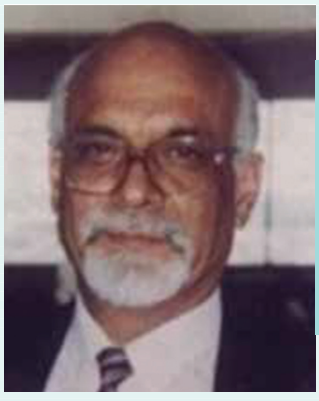
Dr. Pratibha Jolly delivering her lecture at the session

Lectures

Education and skill development is the new buzz word and viewed as the sunshine industry. However, it is the hardest sector to reform and reboot. The traditional examination syndrome and the mesmerizing power of a degree scroll tend to cast all learners in the same mould. The skills for the future, however, demand novel and adaptive thinking; a design mindset; moving from a fixed mindset to a growth mindset; understanding open-ended socio scientific issues in addition to gaining domain knowledge. Fortunately, institutions of higher learning are being infused with a new vocabulary. Relatively easy access to information and communication technologies and consequent access to the best pedagogic practices are gradually, but surely impacting teaching-learning. Widespread adoption of the constructivist framework of teaching-learning is promoting peer learning, co-operative problem solving, project-based learning, collaborative work and social learning. All this helps establish active learning that is hands-on, minds-on and hearts-on.

Miranda House, premiere college for women at University of Delhi, has put this to practice. Going beyond the boundaries of formal classroom, students are exceedingly being given opportunities to engage with challenging real world problem, to work with social communities and hone entrepreneurial skills. Funding agencies are promoting research on innovative projects by teams of students at all levels, catching them early. The presentation includes examples of key innovation projects with which the college aims to leap frog to the future of education and future of work.

Entrepreneurship Development (Start up and Make in India) and Employment Generation – Avenues, Opportunities and Challenges



Chair: Dr. V P Kamboj

Chairman, Board of Directors,
Biotech Consortium India Ltd. (BCIL), New Delhi

The chairman in his opening remarks commented that Entrepreneurship is highly challenging, risky but a rewarding preposition. Any person intending to venture into start up and Make in India should be totally committed, passionately motivated and willing to undertake risks and ready for failures. He must do his home-work thoroughly in identifying the product, consider the investment needed, manpower requirements, market of the product and turn-around time. The technical/managerial capability of the entrepreneur in the area of start-up venture should be critically analysed. The chairman then invited the speakers, one by one, for presentation.

Dr. Renu Swarup spoke on "Women entrepreneurs: Driving scientific development". She told that women are on the move to progress and are leading scientific developments to be equal partners in economic growth.

Dr. Sudha Nair from Golden Jubilee Park for Women spoke on "Women and Biotech: Success stories from Siruseri". She added that "Golden Jubilee Biotech Park for Women, Chennai is a successful first of its kind women centric life sciences ecosystem contributing to the 100 Billion-Biotechnology sector".

Prof. Sabah Almomin then presented the "Biotechnology in Kuwait: an overview". The Kuwait government since 1982 realized the importance of biotechnology and constituted a committee which formulated a plan in 1985 to promote biotechnology and genetic engineering sciences in the country by capacity building.

Session V

All the speakers highlighted the social and cultural environment which is still hindering the growth of women in decision taking positions and women entrepreneurship. They desired that the respective governments should empower women and channelize their intuitive and innovative thinking by placing more of them in key positions and to facilitate a conducive environment for attracting them to entrepreneurship. The session concluded by appreciating the presentations.

Session V

Women Entrepreneurs: Driving Scientific Development

Dr. Renu Swarup
Secretary, Department of Biotechnology,
Ministry of Science & Technology
Government of India, New Delhi

"Let her Sleep For when she wakes,
She will move Mountains
– *Napoleon Bonaparte*

Women are on the path of progress. The theme for the current year is 'press for progress'. Today we are seeing the important role being played by women in driving scientific development. Science and technology are the key drivers of any economic and developmental change and women need to be firmly grounded in this whole area of science and development.

Women have revolutionized science and technology for years, we do have role models- women who have contributed to the growth and those 15 women have received Nobel Prize in Science from 1901-2016. Women have played an important role in entrepreneurship since 17th century and with time we see more women-led enterprises. Since 2000 there has been an increase in small and big ventures by women.

Women have exhibited their strength as business leaders - more than 20% of financial performers have shown that they have more than 27% women leaders with them. However, at the decision-making levels we have very minimal percentage of women on the boards, CEO, Director and Head of organizations.

Women are gifted with much inherent strengths:

- Ability to process and understand the situation
- Strong sense of dedication and commitment
- Multitasking ability
- Passion for work

- Working in teams

But, there are certain barriers also which women entrepreneurs have to face:

- Socio-cultural environment
- Social customs
- Cast restrictions
- Cultural restraints
- Traditional gender roles
- External finance
- Lower personal financial assets
- Stereotypical attitudes

In recent years, the engagement of Women Entrepreneurs and Startups in the Biotech Sector is growing. In the last 5 years, 1022 Biotech companies have been formed, BIRAC (Biotechnology Industry Research Assistance Council), a Public Sector of Department of Biotechnology, Government of India was setup for scaling up bio-entrepreneurship.

BIRAC's role is to basically try and facilitate right from an implementing an idea to the market. More than 1000 Startups have been supported, which includes nearly 200 women startups.

The innovative ecosystem is being promoted:

- Supporting early and late stage innovation research which includes Biotech Ignition Grant (BIG) to facilitate ignite new ideas, partnership with industry for high risk discovery led innovation (BIPP, SBIRI) facilitating technology validation and through Contract Research and Services Scheme (CRS).
- Enabling services for promoting the innovation ecosystem such as IP management, Technology transfer and acquisition, access to research resources, providing bio-incubation space, mentorship and capacity building, i.e. trying to see how to connect with investors and how to help in product innovation and commercialization through partnership.
- Product innovation and commercialization through national and international strategic partnership, SPARSH-social innovation.
- Access to market not only within the country but globally as well.

Incubation centers are supported by government across the country. The effort is now to have Pan India presence. There are also schemes for supporting young students/ college students and researchers through these incubation schemes. Biotech sector faces certain challenges - financial, regulatory and market access for which efforts are being made to find new challenges.

Women entrepreneurs driving biotech growth

Women scientists and entrepreneurs have demonstrated their strong presence, and we have many success stories. We should now work to:

- Create policies and partnerships which empower women.
- Harness the economic potential of women for sustainable and inclusive growth.
- Scale up women entrepreneurial activities to take it from the informal to formal sector.

Dr. Renu Swarup delivering her talk at the session

- Improve the competitiveness of women entrepreneurs through access to business development services, technology and finance.
- Overcome internal and social barriers to market access to bring women entrepreneurs to center stage of economic development.

Women scientists and entrepreneurs are today's game changers who drive the growth of Indian economy.

As Jamie Farsnel a leading Women Entrepreneur said

"Don't let being a women hold you back from the leader that you're destined to be"

Women and Biotech: Success stories from Siruseri

Dr. Sudha Nair
CEO, Golden Jubilee Biotech Park
for Women Society, Chennai

Golden Jubilee Biotech Park for Women is a successful first of its kind women centric life sciences ecosystem contributing to the 100 Billion-Biotechnology sector - A pioneer in the area.

The Golden Jubilee Biotech Park for Women Society is a 'not for profit institution' concpetulised in 1997 with a Mission of providing opportunities for professionally qualified women to take to a career of remunerative self-employment through the organization of environment friendly biotechnological enterprises. The first phase of the park became operational in May 2001 with a seed funding Rs. 4 Cr from the Department of Biotechnology. Tamil Nadu State Government allotted 20 acres land. TIDCO implemented with the concept and technical inputs from the M S Swaminathan Research Foundation under the stewardship of Dr. M S Swaminathan.

The Park has 20,000 sq ft of built up area as modules of 1,000 sq ft earch and land modules given on long-term lease. Since its inception the Park has turned over 500 skilled women entrepreneurs, technocrats and workers; presently the park has close to 200 women entrepreneurs & technocrats and workers with 40% of them being skilled. The Women workforce is at 60%.

Over the years, 38 entrepreneurs have been associated with the Park. Presently, it houses 13 companies inclusive of 5 start-ups and three incubates. Over the last few years, the Park has had more than 500 interns who have benefitted from the Park and there is an increasing interest among faculty and students who desire refresher programmes and internships. The aim is to target at a 100 incubatees by 2020 and increase the overall turnover of the Park and its occupants to Rs.200 Cr by 2020.

The new addition to the Park is the establishment of a 5,000 sq ft Incubation centre with support from BIRAC under its BIONEST programme. Dr. Harsh Vardhan, the Hon'ble Union Minister, launched this new Incubation Facility at the recently held International India Science Festival in Chennai.This facility can incubate 15 incubatees at a given point of time. There is also a state of the art common instrumentation facility, work benches and office space. Other utilities include trianing halls, business halls and plenty of open spaces.

The Governing Board of the Park believes that this concept can be replicated across India with this Park serving as the Centre of Excellence in Women Entrepreneurship; and hopes to build the requisite infrastructure around this vision and step up its activities.

In a recent report published by the Boston Consulting Group, women now control about $39.6 trillion – 30% 0f the worlds wealth. By 2020, women will have the potential to control $ 72 trillion, globally expected to grow to $112 trillion by 2025 and a strong work force of 47%. Investing in women headed enterprises and its ecosystem, is therefore, a sound long term growth strategy for India and the Golden Jubilee Biotech Park for Women is a unique model that has demonstrated success; and worth replicating.

Dr. Sudha Nair delivering her talk at the session

Biotechnology Research in Kuwait: Overview

Prof. Sabah Almomin
Co-Chair, TWAS Gender Advisory Panel
Kuwait

Prof. Almomin gave glimpses of development of Biotechnology in Kuwait, a small developing country that is still struggling to put up fingerprint and their reach in at least in Middle East countries.

The presentation shed a light on the role of Kuwait government in recognizing the importance of the relatively new science of biotechnology where a National Committee of Biotechnology was established in 1982. The main objective of the committee is to promote biotechnology and genetic engineering sciences in the country starting with capacity building and allocation of resources. In 1985, a national plan was formulated and the main areas of research were defined including applications of biotechnological tools in agriculture, environment and food security issues. Biotechnology in Kuwait started with several pioneer research elements such as animal embryo transfer and cloning, soil bioremediation, tissue culture of important plants and stock assessment of fish. The first embryo transfer in awassi sheep was reported along with the first genome sequence of the local pomfret fish. The limitations and obstacles in biotechnology and women issues were also presented. Women are to be discouraged by neither culture nor social issues in pursuing their scientific careers and moreover, not to let their expectations to be a burden on their future.

National challenges:

Kuwait has a unique (fragile) environment. It has very unstable agriculture assistance and very high environmental stress. Kuwait is scarce of water and so probably has largest desalination plant in the world as they don't have river or any underground water reservoir. So, they have very limited natural resources. Kuwait has its native plants (desert plants) which are very small and do not have any economic importance; however, they are of environmental importance. One of the examples is date palm which can survive in hot weather. For the plant tissue culture of date palm trees, establishment of genetic markers to authenticate and distinguish the date palm, they need to develop markers from the native plants to look for the genes which are drought as well as soil tolerant.

For increasing agriculture they opted for production of pathogen free potatoes, to facilitate its marketing. For promoting bio products, they have developed sulphur- based bio fertilizer for soil amendment and also to improve plant growth.

Sea is the main source of food; but, due to many activities of neighboring countries, the fish stock is in jeopardy. The activities include:

- Construction of several Dams on the Euphrates in Turkey, Syria and Iraq resulted in reduction of 51% of fresh water flow of Shat Al Arab.
- Changes in ecosystem.
- Recent construction of 'Third River' in Iraq.
- Changes in salinity, nutrients level and turbidity levels.

After the 1991 Gulf War, the crude oil contamination in Kuwait damaged hundreds of oil wells; 5.8 million barrel of oil released in the environment was considered as one of the biggest disasters in history. Therefore, a cost effective remediation program was started so as to treat the soil (left with oil) using physical, chemical and biological methods for the treatment of contaminated soil. Bio remediation of 15000 cubic meter of oil contaminated soil based upon microbial degradation of hydrocarbons was carried out. The development of cost effective bioremediation using physical, chemical and biological technologies for the treatment of contaminated soil and oil sludge was done.

Limitations of biotechnology like any other developing countries include:

- Shortage of trained human resource
- Funding for research
- Limited access to natural data
- Lack of awareness of the benefit of biotechnology in economy and Society
- Limitation and delays in importing necessary equipment and reagents
- Market demand and marketing strategy
- Ethical issues

Population genetics including development of molecular markers for Silver Pomfret fish stock for Kuwait and neighbouring countries; and the first draft sequence of silver Pomfret fish, one of the threatened species was also mentioned by Prof. Sabah who illustrated about culturing of potential species for production of animal feed and high value bioactive natural colours i.e. astaxanthin, towards the success of emerging biotechnology in Kuwait.

She stressed on mentoring and networking of women scientists and providing them a good platform to pursue their career for empowering them.

PANEL DISCUSSION

Panel Discussion

Moderators:
Dr. Renu Swarup and Prof. Paramjit Khurana

Panel discussion underway

Panel Discussion was initiated on the following points:

- Technological empowerment for women is a critical gap which needs to be addressed for technological development of women.
- What measures are needed to bring in our education system to help women especially the girl students to get empowered.
- The quality of delivery of education as well as of teachers should be taken into consideration.
- Teachers are supposed to be trained properly as the primary education plays a vital role in making the fundamental base of knowledge.
- As the number of dropouts of female students is high, what measures can be taken to engross more girls to take science as a career.

The panelists shared their views as follows:

Dr. Bimla Buti

Director, Centre for Science & Society, New Delhi
Formerly, Senior Professor, PRL, Ahmedabad

I congratulate NASI for organizing such an event for technological empowerment of women. Government is initiating many schemes and programmes for women. Besides the efforts that the government is putting in, we as the scientists should persuade the people, especially the women to come forward and opt for science and technology. The biggest difficulty the women face right from their early childhood is that they are not motivated or inspired to opt for science. They are rather discouraged to be involved in science. So, we need to change the mindset or the perception of the parents about the females' incapability/ incompetence for pursuing science as career. We need to attract them for pursuing their career in science. It is essential for women to appreciate the wonders of science and technology. This can make their lives better and they can improve the living conditions of their family as well as the society.

I may quote the day to day applications of plasma technology. The plasma root to nanotechnology is playing an important role, leading to some revolutionary application in Oncology or Dentistry. Nanotechnology holds enormous potential for overcoming many of the problems associated with conventional methods, faces difficulties in the detection, treatment, and diagnosis of cancer. So the women must be made aware about this application of science, particularly nanotechnology, gifts various applications for scientific knowledge from multiple disciplines in science for overcoming such problems.

Panel Discussion

Dr. Asha Juwarkar
Chief Scientist & Head, Eco-System Division
NEERI, Nagpur

This issue states that due to social insecurity, people are hesitant to go for field training which is required in some of the disciplines of Science while pursuing doctorate.

Now a days, people are more focused on publication of research paper rather than quality of research and those candidates who are not well versed in their communication skills find it very difficult to express their view and are not able to raise their point also. Due to lack in communication skills during the assessment they find it humiliating and leave their courses in between. This is also one of the issue of increasing numbers of drop out. For higher studies specially for research, IIT and UGC are offering lot of fellowship programs, but the drawback is that the funds are not released on time therefore the students who are not economically sound are not able to sustain their studies. The grants being delayed is also one reason of dropout.

To combat the issue of fellowship, there is a provision of DBT (Direct Benefit Transfer) foreground; and because of that, an annual fund is released to the institutes. For R&D projects and schemes also, the government is trying to transfer funds through DBT.

To enhance the communication skills of the PhD students, UGC has made mandatory certain programs for improving the soft skills through presentation and other disciplines as it is very important to retain students who have come into science stream. The day they finish their PhD, they feel that this is the end of the road which actually is not; and at this point mentoring comes into play. It is required to mentor the girls and boys at this stage to make them understand that this is a beginning of their scientific research career and for which they have just qualified or obtained a degree. It needs to take off from there. Through mentoring, the youngsters need to be made sensitized/educated that research is a lucrative career.

Dr. Jatinder Kaur Arora
Executive Director, Punjab State Council
for Science and Technology, Chandigarh

She addressed Skill development and Mentorship giving specific examples. She shared that under a project supported by DBT, with a small grant of about 30 lakh, a Bioresource Processing Facility was set up in Shivalik foothill region of Punjab with involvement of a local cooperative. The innovative approach followed in its development & operationalization has not only made this endeavour self-sustainable but is generating more than 1 lakh mandays employment per annum for local population specially women through annual processing of about 1000 MT bioresources. The local cooperative society empowered through this project now has turnover of more than 10 crores. The Facility also has export licence and its products have found inroads into domestic and international markets.

She further exhorted that while developing projects, an end-to-end approach, integrating the forward and backward linkages, need to be followed. If robustness of technological intervention is not there, then technology goes in a half-baked manner to the rural masses, especially the women and if it does not yield the expected benefits, it becomes very difficult to gain back their confidence.

In this regard, she shared that many a times, the Principal Investigators of projects involving food processing related interventions are not well conversant with FSSAI's requirements. Thus, the projects tend to end up without generating tangible financial benefits for the target population. She shared that recently DBT's Task Force on Biotechnology Programmes for women development has urged her to organise a workshop on FSSAI regulations & guidelines for the benefit of Principal Investigators of relevant projects supported by DBT.

Dr. Arora also suggested that NASI could consider creating a panel of women scientists who could provide mentorship for effective implementation of projects aimed at women empowerment. She also urged the senior professionals present in the conference, to volunteer for this cause.

Dr. Shashi Bala Singh
Director General, Life Sciences,
Defence Research and Development Organisation
New Delhi

She shared her vision on **How to retain women scientists in their career; and use them in capacity building** expressing that a lot of policies need to be implemented; the key points are as follows:

- She mentioned the cases where the study leaves are being provided by DRDO.
- There is a provision of mentorship in DRDO and the young scientist can choose her mentor. All the human resource group assign mentor for the new comers.
- Courses in management and advanced leadership are customized for women not only in DRDO, but also with Pan India as well as globally. They have been tied up with several international universities.
- There are courses for health and finance.
- DMC- Defense Management Council is there for women representation. 33% of women representation is there which happens once in a year.
- Husband and wife could be transferred in same city or place.
- Accommodation Facility/hostel for women.

Prof. Kasturi Datta
NASI Senior Scientist,
Jawaharlal Nehru University, New Delhi

It is my great privilege to express my comments and to make recommendation as a panelist in this National Conference on Technological Empowerment of women. I recall in this hall in the year 2001, as announced by the then honorable Prime Minister of India Shri Atal Bihari Vajpayeeji as the year of empowerment of women, a symposium was held under the leadership of Dr. (Mrs.) Manju Sharma, Secretary, Department of Biotechnology (DBT) at that time and a recommendation note was prepared. Few initiatives were taken e.g. extension of child care leave and availability of crèche in the vicinity of workplace, which is implemented now. Afterword all three Academies made several attempts to address the question regarding Science Career for Indian Women. Earlier reports show the poor percentage of Women Scientists' participation. However, in 2003, LeelaVati's daughter's book, we have seen many scientists in the area of different disciplines which cannot be ignored who have encountering the glass ceiling and broken them.

Even yesterday and this morning we heard the achievement of few women scientists in different scientific areas which is possible for their passion of science, their commitment to work and their determination to keep science as their mission in life. Thanks to all the initiatives taken by government and making the changes in society. However, there is only a handful in upper echelons of scientific research, development administration and policy making which has to be modified.

To promote more participation of women scientists and their successful growth in career and having a leadership role in development, I suggest the following recommendation for career development:

- Special effort to use the modern technology as teaching and learning medium which will be accessible to remote area so that unreached can be reached.
- Accommodate husband/wife at least in the same city if not same university.
- For rural women, science and technology may be empowered with the help of mobile/ social media.
- Age relaxation only at the entry levels (not for promotion/recognition) so the competent women scientists are allowed to initiate their career.
- Special and conscious effort is needed to include competent women scientist in decision making bodies.
- Removal of gender bias and mental blockage (even from sub conscious mind) during the assessment or promotional review.
- Lastly though not least to encourage the young entrepreneurs programme financially as well as deliberate propaganda if the programme is attractive.

In addition to the current several programmes funded by the government, some of the other comfortable arrangements are made, there will be more and more front-line women scientists visible.

Dr. Kiran Katoch
Former Director
JALMA, Agra

Dr. Katoch spoke about capacity building.

In ICMR, there is fellowship associated with summer and winter training courses which entail signing of MOU's with the universities, so that the girl students, for whom the fellowship is to be awarded, could be approached. It is an online program for both Junior and Senior Research Fellowship.

The women scientists (in job) are provided six months' maternity leave, declared by Government of India. For other crisis, they are allowed to avail a leave for the period of two years, after which they can resume their duties; for some hours they can also work from home on the permission of individual Directors on the basis of completion of certain portion of work from home.

Post-Doctoral Fellowship is available for men and women. Several departments of the Union Government like CSIR, DBT etc, autonomous bodies like UGC as well as ministries of Human Resource Development, women and child as well as individual State government have several policies to scale up women entrepreneurship and facilitate them.

Dr. Sadhna Relia

Advisor, Department of Science & Technology
Ministry of Science and Technology New Delhi

Dr. Relia stressed on women's involvement in the area of International cooperation and participation in Science and Technology.

The Department of Science and Technology is building international science and technology partnership, where gender balance in research team is being favored.

There are multi-country collaborative research and development projects under the India's Science and Technology Cooperation frameworks with ASEAN, BRICS, EU. These are providing collaborative opportunities involving research teams of males and females.

The international scientific evaluation panels have been set for better representation of women; and their perspectives are being taken on board and valued Gender dimension in evaluation and/or in the project outcomes is an important element for the review process in the translational research portfolio.

Value of young talent in science, engineering and other allied sciences is being recognized. To illustrate, BRICS Young Scientist Forum/Conclave, ASEAN participation in India's National Children Congress are striving for favorable gender balance.

Government of India has set out a Vision on Artificial Intelligence for Economic Transformation and at present is engaged in formulation of a Roadmap. It is pertinent to ensure that the AI research road map does not marginalize the women in STEM (Science, Technology, Engineering, Mathematics and Medicine)."

Dr. Namita Gupta
Director, Department of Science &
Technology, Ministry of Science and Technology
New Delhi

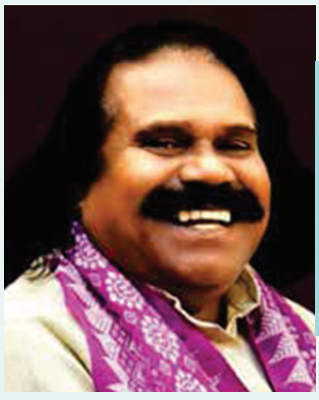
She spoke about intervention of DST (Department of Science and Technology) in mentorship area.

Many programs have been introduced from time to time for the benefit of women scientists since the launch of Women Scientists Scheme of DST. In December 2017, a new Fellowship program for women scientists – "Indo-US Fellowship for Women in Science, Technology, Engineering, Mathematics and Medicine" called WISTEMM Program was launched. The fellowship program is for the bright Indian women scientists and technologists who are either pursuing PhD or completed PhD or working in regular positions in various universities or departments or in other S&T organizations. They will get an exposure in Premier institutions in USA to undertake international collaborative research for the duration of 3 to 6 months.The program has two modules:

Women Overseas Students' Internship - For the women who are between age group of 21 to 35 years. Under this module, women who are pursuing PhD or completed PhD will get an exposure to the S&T infrastructure in various US universities and institutions for 3 to 4 months duration.

Women Overseas Fellowship - For the women having age between 27 to 50 years. This is for those women who are working in regular positions in the Indian Universities/institutions. They can join the Research and Development laboratories of various Universities and Institutions in USA and get exposure by working there for 4 to 6 months duration.

This Fellowship Program is open in all the S&T subject areas starting from Agricultural Sciences to Physical Sciences.



Dr. Nand Kumar Sai
Chairman, Commission for Schedule Tribes
Government of India

He spoke on improved teaching qualities for primary school which need to be focused; and requirement of infrastructure management basically in the rural and Naxalite belts. He wanted some more programmes by NASI for Bastar region for the welfare of scheduled tribes.

VALEDICTORY SESSION

Valedictory Session

Chairman: Dr. (Mrs.) Manju Sharma
Distinguished Women Scientist Chair, NASI

Co-Chair: Prof. Akhilesh K Tyagi
University of Delhi South Campus,
New Delhi

Cancer Prevention and Women

Prof. Dean E Brenner
University of Michigan
USA and Guest of Honour

My discussion at the recent National Academy of India focused upon how priorities are set to reduce cancer mortality with special emphasis upon the situation in India.

First, I identified a priority of collecting data that identify the population epidemiology of cancer in India. Since India is a huge, diverse, rapidly changing country, the shifts in burdens of cancers are likely to reflect environmental and behavioural changes in the population. The Government cancer registry system based

in geographically representative regions of the country is providing a much better data set to allow for improved policy initiatives. However, additional investment to capture accurate mortality data is essential for future policy decisions for cancer control.

Prof. Brenner delivering his lecture

Second, since this meeting was focused upon empowerment of women in India, I focused upon cancer prevention initiatives that reduce women's mortality from cancer. Cervix cancer has long been a model of a preventable cancer, yet in India, it remains at high incidence. Considering the costs and infrastructural barriers for universal screening, early detection, treatment of pre-cancers and early stage invasive cancers, health authorities of international organizations as well as many governmental organizations in other countries have approved and supported national HPV vaccination programs. The vaccine is accessible, safe and effective. The USA Centers for Disease Control now recommends use of the 9-valent vaccine and has recently published data demonstrating reduced incidence of Cervical Neoplastic Disease with the use of population-based vaccination. Cost and cultural taboos are the key barriers to universal vaccination. The Indian government can play a leading role in bringing down the cost of effective cancer mortality reducing treatments such as the HPV vaccines. By virtue of India's massive population base, large financial resources and intact, functioning legal system, the Government has the power and credibility to force industrial companies to provide the vaccine as a fair price. That price should ensure cost-effective availability of HPV vaccine to the Indian population. The Government may recognize that companies receive a fair return for their research and manufacturing costs, but prioritize the ethical imperative of the health of its citizens while respecting the rule of law and international commitments. Should agreements with industrial vendors become impossible, the Indian government has the power and the authority to petition World trade organizations such as the WTO for relief from patent protection citing the priority of health of the population over the profits of large industrial organizations. Such precedent setting negotiations would result in incalculable contributions to global health and stability.

Third, I cited the rapidly emerging threat of obesity. In the USA, obesity accounts for a quarter of all cancers, is a risk factor for poor treatment outcome, and is increasingly the primary cause of reduced life span and morbidity in the population.

In India, the rapidly increasing middle class is shifting their diet from a classical high quality vegetarian diet to a less healthy, Western diet full of refined sugars, fat, and prepared foods with many additives. The availability of large varieties of accessible, inexpensive (for middle class incomes) food is driving a rapidly emerging epidemic of obesity and shifting the cancer incidence data. I outlined some of our emerging science that is identifying the molecular mechanisms by which obesity drives the development of cancer. Research into mechanisms of obesity driven inflammation is likely to identify new tools that can reduce the risk of cancer and cardiovascular disease. To reverse or blunt this

rapidly emerging epidemic in India, I suggested policy initiatives that Indian society might undertake. These initiatives include:

- Prospective Ongoing Population Based Data Collection to Track Obesity—the USA NHANES study, a high quality sample of the USA population on a rolling basis tracks diet and health of the population. An Indian-based NHANES will provide policy makers with invaluable data upon which to make resource allocation decisions—education, regulation of food supply, importation of foods to improve the health of the country.
- Educational initiatives—to teach principles of nutrition at all levels of the educational system, from elementary to the university level. An educated population will make better nutrition choices as adults.
- Control of fatty acid content in prepared foods—as more Indians achieve middle class incomes, they will turn to prepared foods in place of the higher quality cooked diets using fresh ingredients. The government can mandate the use of high nutrition value fatty acids such as omega-3 fatty acids in prepared foods as opposed to the less expensive, but nutritionally lower value omega-3 fatty acids or saturated fatty acids. Similar regulations and control of foods in eating establishments might improve the diet quality of the average citizen.

Concluding Remarks

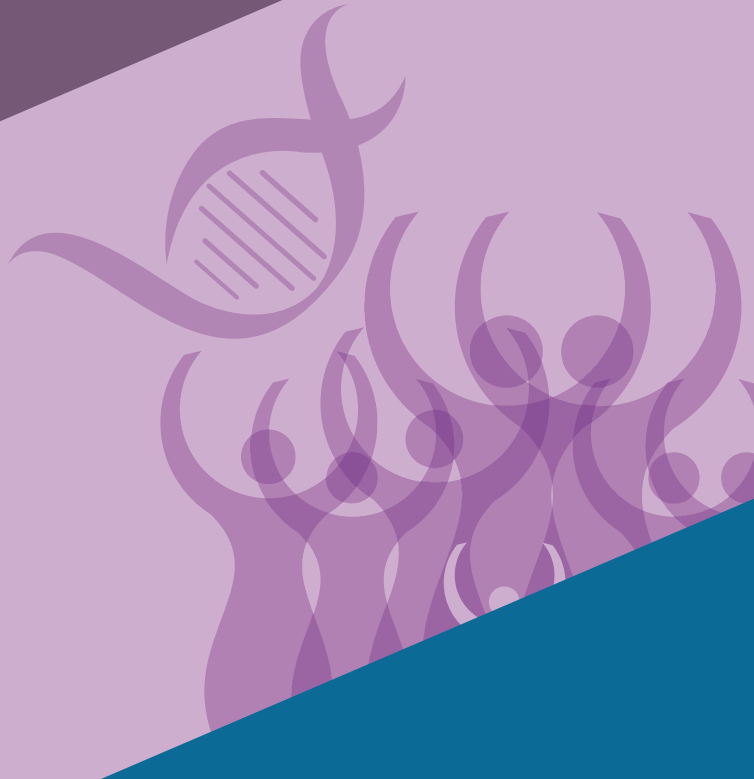
Dr. (Mrs.) Manju Sharma
Distinguished Women Scientist Chair
NASI, Convener

Dr. Sharma concluded the conference by focusing on the various discussion outcomes; and shared her vision by summarizing the important issues as:

- Science and Technology education is very important for young women and if we want to involve them in science we need to do it from the beginning of their career.
- Education is a common problem which needs to be addressed.
- Mentoring should be emphasized at various stages of the women's career.
- Training for the entrepreneurship is required.
- Health of a woman and awareness on communicable/non-communicable diseases are of prime concern.
- Health intervention and malnutrition are two important issues/challenges which need to be taken seriously and worked upon.

Further, this type of gathering should be continued in the form of workshops, seminars and conferences so as to sensitize and spread awareness among the people on various issues and challenges for empowerment of women.

RECOMMENDATIONS



Session-wise Recommendations

Biotechnology and Biomedical Research

- Recognition of women and girls for their access to, as well as participation and leadership in research and innovation is essential for achieving gender equality.
- STEM culture needs to be inculcated, for which the girls must be nurtured and inspired from the early stages for their participation in the STEM education for filling the larger STEM human resource deficit.
- There is a need for the Government agencies to invest some kind of dedicated funds for the development of contraceptives and promote the career development programme on Male Reproductive Health Research (MRHR).

Frontiers in Science &Technology

- Efforts are required to conquer gender disparity by involving more women in science with proper mentoring.
- More opportunities for women's participation in health-related professions need to be explored; they also need to be made aware of diseases such as autoimmune diseases, diseases of vaginal and urinary tract as well as infectious diseases, cancer and depression.

Agriculture, Nutrition, Food Security

- Gender disaggregated information/data on the contribution of farm women as well as to support their efforts for local development must be obtained.
- There has to be strong commitment of the government/ policymakers towards the recognition of women's roles. Therefore, it is required to empower women not only by technology, but also by policy for promotion and protection of their legal rights.
- There is a need for technological empowerment of women in all spheres viz. research into biotechnology, nanotechnology, GIS, land use planning, post-harvest technology etc.
- Capacity building in the areas of sales and marketing is required for enhancing economic empowerment of women.
- There has to be more access to information, technologies and opportunities for knowledge and skill acquisition as well as decision-making to produce and market agricultural commodities to foster agricultural development.
- There must be ownership and capital resources available to Women Self-help group/ Milk Cooperatives to facilitate the process of milk collection and distribution.
- Hands-on training is must for awareness and demonstration of new technologies.
- Functional literacy and training for skill development and planning for promotion of micro Enterprises are required.
- Appointment of local volunteers/ field guides for providing various services and promotion of infrastructure for value chain development; linkage with Financial Institutions.

- Need to have women leadership for good governance.
- Recognition of women as farmers, agricultural workers - All the women who undertake any agricultural activity should be recognized as agricultural workers/farmers.
- Remove inequalities in right to own assets and also wages, working conditions and access to technology.
- Agricultural policies and programs should be gender sensitive.
- Women labour needs to be valued in calculating cost of cultivation (not just household helpers).
- Agriculture extension worker to engage with women controlled crop/ live stocks.
- More attention to be paid towards drudgery reduction of women in post-harvest processing and storage, and for reducing post-harvest losses.
- Forums for consultation with women farmers/ agricultural workers on policy changes affecting their time burden need to be created.
- Public goods innovations are required to reduce drudgery, time expenditure, clean cooking energy and drinking water.
- Anganwadies to respond to the needs of women farmers- provide adequate quality and time for child care (feeding services), particularly in the planting season and also provide crèche facility for the young child so that women farmer can work in the field.

Health Care and Sanitation (Swasth Bharat and Swachh Bharat)

- To strengthen the 'Swachh Bharat' initiative announced by the Prime Minister, a mechanism to create awareness and encourage industry participation needs to be developed and network be extended.
- Awareness is required for enhancing livelihood and development outcomes in the sanitation sector which is an emerging area.
- More efforts are to be devoted; and effective approaches needed towards creating and developing safe sanitation, particularly hygienic public toilets exclusively for women in rural areas ensuring their security/ safety and privacy.
- Need to create increased awareness among women about safe sanitation and hygiene; sound hygienic practices including menstrual hygiene.
- More women to be involved in decision-making process.
- Provide funding to collect and digitize long-term data and match samples for cancers for women e.g., cervical cancer, breast cancer, oral and ovarian cancer.
- Funding to sequence large numbers of patient samples to create a reference database for Indian breast cancer.

Session-wise Recommendations

Evening lecture

- More women to be involved in leadership roles in research organizations / institutions and recognized with scientific awards. Mentorship is required to create the next generation of women scientists.
- Women to be encouraged for utilizing resources as well as their potential by being innovative to propagate the ideas to the market and excel in the competitive world of entrepreneurship.

Technology and Innovations

- Since women comprise a major portion of agriculture labour force and significantly contribute to agriculture development and allied fields, there is need to engage more women and train them to start their own enterprises.
- Women entrepreneurs must adapt to the technology to contribute to the growing bioeconomy of our country.
- There is a need for capacity building of women entrepreneurs for technology utilization (towards commercialization of horticultural crops production and processing with modern production, post harvest and marketing management techniques) in horticulture.
- There is need for gender representation at conferences and workshops, committees. Women employees to be provided with more facilities such as providing lab support during maternity leave, paying for child care cost for women with pre-school children and providing family room at conferences.
- Committee on gender equity needs to be established to monitor women's equity including scholarships/ funding for promoting their career in diverse streams of science.
- The age limit should be enhanced at least by 5 years for women to compete for faculty position.
- Mentoring and training for leadership in Science and lab management must be provided to women.
- Women must be provided with the basic amenities such as transportation, mother's room, day care facilities and accommodation in the workplace.
- Need to increase representation of women in the decision-making bodies.

Skill Enhancement and Development – Women Scientists and Technologists to be encouraged, mentored and supported for advancement of their career

- There is a need to encourage the active participation of women by bringing in the social segments, skills and knowledge to which women may contribute more effectively.
- The young minds aspiring to be an industry owner need to be in touch with the professionals/ entrepreneurs and exposing to different aspects of entrepreneurship.
- The Science and technology based research of women scientists and scholars must be financially supported to be applied for developing an enterprise.

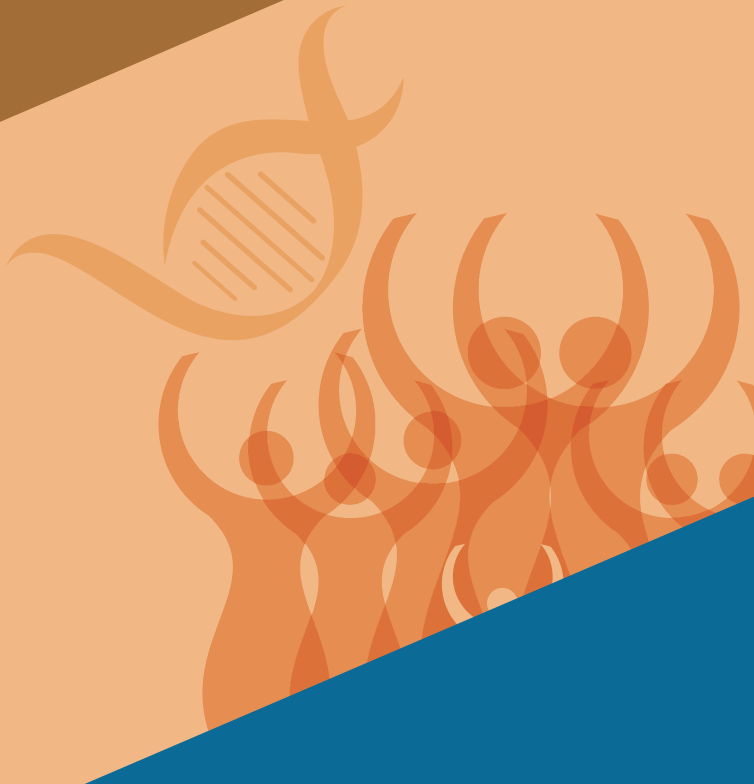
Entrepreneurship Development (Start up and Make in India) and Employment Generation – Avenues, Opportunities and Challenges

- Need to create policies and business partnership for creating job opportunities and strengthening/ empowering women's entrepreneurship.
- The economic potential of women should be harnessed for sustainable and inclusive growth. There is a need for transition of women entrepreneurs' activities from the informal to formal sectors. Advancing women's economic empowerment is essential for inclusive and sustainable development.
- Women entrepreneurs must have access to business development services, technology and finance for improving their performance and competitiveness.
- Need to create an enabling environment by overcoming the internal and social/traditional barriers of women entrepreneurs to have equitable access to the labour market and control over economic resources and entrepreneurial opportunities, hence creating avenues for women's economic independence.
- Technical enterprises could bridge the gap between rural and urban divide in our country if the things are worked out on policy level.

Conclusion

- Science and Technology education is very important for young women right from their early stage if we want to involve them in science.
- Mentoring to be emphasized at various stages for women pursuing science as a career.
- Training programme is required for developing the entrepreneurial abilities and skills as well as to make the possible transformation of an individual into an entrepreneur.
- Since, women's health is important issue, awareness on health-related issues particularly nutrition, communicable as well as non-communicable diseases needs to be increased.

ACKNOWLEDGEMENTS



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We would also like to extend our most sincere thanks to the NASI officials. Thanks are also due to Biotech Consortium India Limited (BCIL) for the publication of the Proceedings.

Editors

PICTORIAL GLIMPSES OF THE EVENT

Glimpses of the Event

L-R: Hon'ble Minister, S&T inaugurating the Conference; Invocation by the students of Miranda House, Univ of Delhi

L-R: Prof. Karen being honoured with the foreign fellowship of NASI by Hon'ble Minister, S&T; Hon'ble Minister greeting Prof. M S Swaminathan

Dignitaries releasing the souvenir

President, NASI welcoming the Hon'ble Minister Dr. Harsh Vardhan

President, NASI felicitating the Hon'ble Minister, Dr. Harsh Vardhan; Dr.(Mrs.) Manju Sharma felicitating Prof. Swaminathan

Biotech WInER Awardees

Women Bioscientists Awardees with Hon'ble Minister & President, NASI

Some participants with Prof. Swaminathan

Glimpses of participants

Glimpses of the Event

Inauguration of the Exhibition by Hon'ble Minister

Minister interacting with the entrepreneurs

L-R: President, NASI and Dr. (Mrs.) Manju Sharma conferring NASI Fellowship on Dr. Kiran Majumdar Shaw; Women entrepreneurs with Hon'ble Minister

L-R: Prof. Dean E Brenner being conferred upon the foreign fellowship of NASI by President, NASI and Dr. (Mrs.) Manju Sharma; Panellists with the Chairperson Dr. (Mrs.) Manju Sharma

Registration of the participants underway

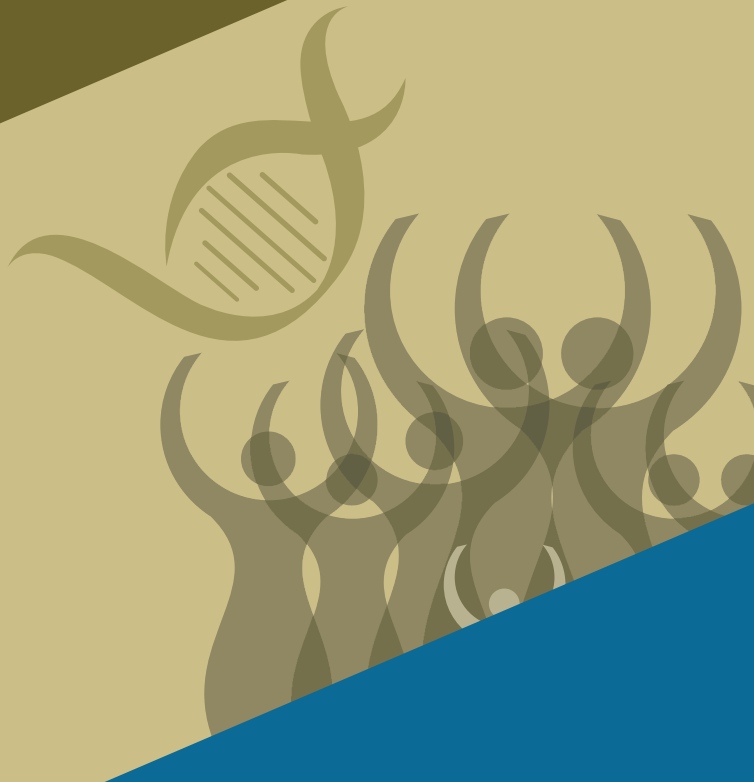
Women entrepreneur awardees

Hon'ble Minister felicitating Dr. (Mrs.) Sarla Maheshwari

Participants interacting with the experts

National Anthem

ANNEXURES



Annexure-1

Advisory Committee

Chairperson : Prof. M. S. Swaminathan

Co-Chairpersons : Prof. (Mrs.) Manju Sharma and Prof. Anil Kakodkar

Members :

- Dr. Soumya Swaminathan, DG, ICMR
- Dr. Renu Swarup, Sr. Advisor, DBT
- Dr. Rohini Godbole, IISc, Bangalore
- Dr. Sudha Nair, CEO, GJBP,Chennai
- Dr. Jatinder Kistwaria, Director, CIWA, Bhubaneswar
- Dr. Shashi Bala Singh, DG, Life Sciences, DRDO
- Dr. Madhu Dikshit, Director, CDRI, Lucknow
- Prof. V. Durga Bhawani,VC, SPVMM, Tirupati

Member Secretaries: Dr. Veena Tandon, Formerly GS, NASI and Ms Archna Pant, YWS, NASI

Organizing Committee

Chairperson : Prof. (Mrs.) Manju Sharma

Co-Chairpersons : Dr. Chandrima Shaha and Dr. Renu Swarup

Members :

- Dr. Shelly Parveen, IARI
- Dr. Alka Sharma, DBT
- Dr. Pratibha Jolly, Principal, Miranda House
- Dr. Purnima Sharma, CEO, BCIL
- Dr. Vinita Sharma, Former Advisor, DST
- Dr. Suchitra Banerjee, CIMAP, Lucknow
- Prof. Madhoolika Agarwal, BHU, Varanasi
- Dr. Shubhra Chakraborty, NIPGR
- Dr. Bindu Dey, TDB, DST

Member Secretaries: Prof. Paramjit Khurana, UoD, New Delhi and Dr. Niraj Kumar, ES, NASI

National Women Bio-scientists Awardees under Senior and Young Category

- Dr. Nahid Ali, Indian Institute of Chemical Biology, Kolkata (Senior Category)
- Prof. Rentala Madhubala, Jawaharlal Nehru University (JNU), New Delhi (Senior Category)
- Prof. Chitra Sarkar, All India of Medical Sciences (AIIMS), New Delhi (Senior Category)
- Prof. Nandini Chatterjee Singh, National Brain Research Centre, Manesar (Young Category)
- Dr. Mamta Chawla Sarkar, ICMR- National Institute for Cholera and Enteric Diseases, Kolkata (Young Category)
- Dr. Annapoorni Rangarajan, Indian Institute of Science, Bangalore (Young Category)
- Dr. Chaaya Iyengar National Institute of Pharmaceutical Education and Research, Mohali (Young Category)
- Dr. Ashverya Laxmi, National Institute of Plant Genome Research, New Delhi (Young Category)
- Dr. Kakoli Bose, Advanced Centre for Treatment Research and Education in Cancer, Tata Memorial Centre, Navi Mumbai
- Dr. Sharmistha Banerjee, University of Hyderabad (Young Category)
- Dr. Debasree Dutta, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram (Young Category)

Annexure-3

Biotech WInER (Women in Entrepreneurial Research) (BIRAC-TiE) Awardees

- Pratyusha Pareddy, Nemocare Wellness Pvt. Ltd.
- Dr. Nusrat J M Sanghamitra, CyCa Onco Solutions
- Susmita Chaudhuri, Tritek Innovation Pvt. Ltd.
- Geethanjali Radhakrishnan, Adiuvo Diagnostics Pvt. Ltd.
- Dr. Livy A. Shivraj, S.L.S Cell Cure Technologies Pvt. Ltd.
- Kumari Priyanka, Bionic Hope Pvt. Ltd.
- Supriya Kashikar, Genext Genomics Pvt. Ltd.
- Shilpa Malik, Bioscan Research Pvt. Ltd.
- Sudeshna Adak, OmiX Research and Diagnostics Laboratories Pvt. Ltd.
- Shivi Kapil, Empathy Design Labs Pvt. Ltd.
- Shivani Gupta, Inochi Care Pvt. Ltd.
- Neelam Dwivedi, NeelAgil Technologies Pvt. Ltd.
- P N Shilpa, Virtis Bio Labs Pvt. Ltd.
- Geetha Manjunath, Niramai Health Analytix
- Dr. Sneha Maria M, Ariken Labs Pvt. Ltd.

Women Entrepreneurs

- Dr. Shivani Gupta, Inochi Care Pvt. Ltd., Assam
- Dr. Tripti Bhatnagar, Codon Biotech Pvt. Ltd., Noida
- Ms. Anuradha Agarwal, Multibhashi
- Sudeshna Adak, Omix Labs
- Dr. Vanita Prasad, Revy Environmental Solutions, Gujrat
- Mrs. Madhuri Ladkat, Sanjeevani Disaster Equipment
- Ms. Umang Shridhar, KhaDigi
- Ms. Ekta Jaju, ONganic Food
- Ms. Swati, Arcturus Business Solutions
- Ms. Seema Sudha Prem, FIA Technologies Services
- Ms. Geethanjali Radhakrishnan, Adiuvo Diagnostics
- Dr. Vibha Tripathi,Swajal Water
- Dr. Gayathree Mohan,Rite Products
- Dr. Shital Somani, Science for Society Techno Services

Group Photograph of the participants

The National Acdemy of Sciences, India (NASI)
5, Lajpatrai Road, Allahabad-211002, India