WOMEN in SCIENCE and TECHNOLOGY in ASIA
The status of women in modern human societies has been of great concern for decades globally. The United Nation has a Standing Commission on the Status of Women, which held its fifty-ninth Session at the UN Head Quarters in March 2015. A major landmark in these efforts was the Fourth World Conference on Women, held at Beijing in 1995, which led to the Beijing Declaration and Platform for Action. The conference has been termed “Beijing+20”, which deliberated on the status and challenges in implementation of gender equality and the empowerment of women as well as the present status.

The international organizations of science, IAP, ICSU and IAC have been deeply concerned about the low level of participation of women scientists in research, development and education in science and technology. Several deliberations and scholarly reports have been brought out. An important example is the IAC Report “Women for Science: An Advisory Report”, published in 2006 (IAC, 2006). The ICSU Regional Office for Latin America and the Caribbean had co-sponsored a Symposium on Women for Science, promoted by the Mexican Academy of Sciences and the Inter American Network of Academies of Sciences (IANAS), with the support of the Inter Academy Panel and National Council for Science and Technology (CONACYT) Mexico in 2009. Its main objective was to discuss the IAC report. There are other initiatives worldwide, including those in the Asia-Pacific Region. The InterAcademy Partnership (IAP) has identified this as an important theme and all the four Regional Networks of IAP, including the Association of Academies and Societies of Sciences in Asia (AASSA) have been actively engaged on deliberations relevant to their regions.

The Asian-Australasian region covers a huge land area and includes nearly sixty percent of the world population. It is highly diverse in more than one way. Some of the scientifically and economically most developed countries of the world are located in this region. Its role in generation of new scientific knowledge, evidenced by peer-reviewed publications, is very remarkable. Nevertheless the extent of involvement of women scientists, including mathematicians and engineers is far from satisfactory. AASSA places great importance and emphasis on this problem. Therefore, the need for understanding current status in our region and trends and policy initiatives by governments, science organizations and national science academies is of great value. In the recent past AASSA sponsored Workshops on this topic have been organized at Baku, New Delhi and Izmir. These deliberations underlined the point that in spite of great variations in social, political, and S&T infrastructure, the overall situation of women was remarkably similar across countries. Therefore, there is a need for continuous deliberations to develop innovative strategies to improve the situation. It will take strong sustained efforts, time and adequate resources but it is doable.

The present report is based on the analysis of the results of a survey of the current situation in AASSA member countries. The authors succeeded in receiving data from only ten of the 32 member countries: Australia, Bangladesh, India, Korea, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka and Turkey. This document summarizes the collected data, its analysis, comparisons and the conclusions drawn. The report specifically details the general situation of women scientists in Asia-Pacific and summarizes challenges and approaches, including examples of best practices.
Within these broad topics are discussed the status of women in science, technology, engineering and mathematics education, the challenges of balancing of professional duties and family obligation, issues of employment opportunities and salary gaps and leadership positions attained by women, and the underlying problems of education of girls, women empowerment and governmental policies. The role of governments, R&D institutions, universities, academic societies and women scientist organizations has been considered, and recommendations made to each sector. The widely different cultural backgrounds in different countries covered make the challenges even more formidable.

The chair of the AASSA Special Committee for Women in Science and Engineering, professor Doe Sun Na is one of the respected science leaders in AASSA, and is particularly a champion of the cause of women scientists. She and her colleagues have made a lot of efforts to collect data, analyze it, to draw conclusions and to frame recommendations. The world is in a dynamic situation and many changes are continuously taking place. This gives us hope that the plight of women in our region may change rapidly. Even though the representation of women scientists in academy membership/fellowship is low at present but if one looks at the recognitions for young scientists their share is increasing significantly. In India for example a new scheme, DISHA, focused on women scientists has been launched. This enables women to take breaks from their jobs for taking care of the family responsibilities and return to scientific work at any age.

I take this opportunity to thank Professor Doe Sun Na and her colleagues on behalf of AASSA and on my own behalf for their hard work and great commitment in preparing this document. I am confident that this will be recognized as a valuable contribution.

Krishan Lal, President
The Association of Academies and Societies of Sciences in Asia
Utilizing women’s talent in science and technology is crucial for sustainable development. Many countries have implemented policies to foster and empower women in science and technology. Despite these efforts, gender bias in science and technology is still prevalent everywhere, with Asia being the worst. In Asian countries women make up a much lower percentage (18.9%) of the scientific workforce compared to other regions of the world: 45.2% in Latin America and the Caribbean; 34.0% in Europe; 34.5% in Africa; 39.2% in Oceania (UIS, 2015). Improving this situation is crucial to the sustainable development of Asia.

When the Association of Academies and Societies of Sciences in Asia (AASSA) was inaugurated in January, 2012, by the merger of the Associations of Academies of Sciences in Asia (AASA) and the Federation of Asian Scientific Academies and Societies (FASAS), one of its urgent tasks was finding ways to empower women in science and technology in Asian countries. In order to develop methods for empowering women scientists, it is essential to study the local situation of women in areas such as science education, employment, government policies, and cultural challenges. In May, 2012, AASSA and Azerbaijan National Academy of Sciences (ANAS) co-organized a Regional Workshop on Women in Science in Baku, Azerbaijan to discuss these topics.

The Indian National Science Academy and the Turkish Academy of Sciences hosted two more workshops on this issue, the INSA-AASSA Joint Workshop on Women in Science, Education and Research and the TÜBA-AASSA Regional Workshop on Women in Science & Technology in September 2013 in New Delhi, India, and in May 2014 in Izmir, Turkey, respectively.

This report is the results of the first project of the AASSA Special Committee on Women in Science and Engineering, which was suggested by Dr. Won Hoon Park, the former president of AASSA. The AASSA secretariat asked all 34 members to submit a country report, and ultimately we were able to collect 10 reports, one for each committee member’s country, as well as the Philippines.

Although this report covers only 10 of the 60 countries in Asia, we believe it will serve as a valuable guideline for diagnosing the current status in the region as well as strategic planning to empower women scientists. This would serve as the beginning of a pioneering project to study the problem of women in science in other Asian countries and eventually the entire world.

There are many people who deserve appreciation. Firstly, we want to recognize Dr. Won Hoon Park, the former president of AASSA who inspired us from the beginning of this project and supported whatever he could. We are also very grateful for Professor Krishan Lal, the current president of AASSA, who encouraged us tremendously and provided continuous support to finish this project. Secondly, the academies of four countries, Azerbaijan, India, Turkey, and Korea deserve credit for organizing the AASSA Regional workshops on women in science and technology, which provided us with the opportunities to meet each other and discuss the critical questions. Sang Chul Kim of the AASSA office, Kyongmin Lee of Bummoon Publishing Co. and Sun Ock Park deserve much credit for their devoted assistance.

Finally, the individuals who wrote the country reports are: Jennifer Graves of Australia, Shamima Choudhury of Bangladesh, Rohini Godbole and Ramakrishna Ramaswamy of India, Doe Sun Na...
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AASSA Special Committee on Women in Science and Engineering
August 2015
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■ Acronyms

AAS
Australian Academy of Science

AASSA
Association of Academies and Societies of Sciences in Asia

AAUW
American Association of University Women

AIIMS
All Indian Institute of Medical Sciences

ARC
Australian Research Council

BAEC
Bangladesh Atomic Energy Commission

BANBEI
Bangladesh Bureau of Educational Information and Statistics

BARC
Bhabha Atomic Research Centre, Mumbai

BARI
Bangladesh Agricultural Research Institute

BBS
Bangladesh Bureau of Statistics

BINA
Bangladesh Institute of Nuclear Agriculture

BJRI
Bangladesh Jute Research Institute

BPS
Bangladesh Physical Society

BRRI
Bangladesh Rice Research Institute

CONACYT
National Council for Science and Technology (Mexico)

CSIR
Council for Scientific and Industrial Research

CSIRO
Commonwealth Scientific and Industrial Organization

DAE
Department of Atomic Energy

DBT
Department of Bio Technology

DOD
Department of Defence

DRDO
Defence Research and Development Organization

ICAR
Indian Council of Agricultural Research

ICMR
Indian Council for Medical Research

DEEWR
Department of Education Employment and Workplace Relations

DEST
Department of Education, Science and Training

DISHA
Direct Initiative for Social and Health Action

DOST
Department of Science and Technology

DST
Department of Science and Technology

DRDO
Defense Research and Development Organization

EU
European Union

FASTS
Federation of Australian Scientific and Technological Societies

HEC
Higher Education Commission

IAC
InterAcademy Council

IAP
InterAcademy Partnership

IANAS
InterAcademy Network of Academies of Sciences

IASC
Indian Academy of Science

ICSU
International Council for Science

ICT
Information and Communication Technology

IEEE
International Electrical and Electronics Engineers
<table>
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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<td>IISc</td>
<td>Indian Institute of Sciences</td>
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<td>IIT</td>
<td>Indian Institute of Technology</td>
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<td>INSA</td>
<td>Indian National Science Academy</td>
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<td>IOPWE</td>
<td>International Organization of Pakistani Women Engineers</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>IWSA</td>
<td>Indian Association of Women Scientists</td>
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<td>KAST</td>
<td>Korean Academy of Science and Technology</td>
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<td>KOFST</td>
<td>Korean Federation of Science and Technology Societies</td>
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<td>KOFWST</td>
<td>Korea Federation of Women's Science and Technology Associations</td>
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<tr>
<td>MD</td>
<td>Doctor of Medicine</td>
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<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<td>MS</td>
<td>Master of Surgery (Sri Lanka)</td>
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<td>NASI</td>
<td>National Academy of Sciences India</td>
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<td>NAST</td>
<td>National Academy of Science and Technology</td>
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<td>NIAS</td>
<td>National Institute of Advanced Studies</td>
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<td>NHMRC</td>
<td>National Health and Medical Research Council</td>
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<td>NGO</td>
<td>Non-Governmental Organization</td>
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<td>NST</td>
<td>National Science and Technology</td>
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<td>OWSD</td>
<td>Organization for Women in Science for the Developing World</td>
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<td>PAS</td>
<td>Pakistan Academy of Sciences</td>
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<td>PCST</td>
<td>Pakistan Council for Science and Technology</td>
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<td>R&amp;D</td>
<td>Research and Development</td>
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<td>SAGE</td>
<td>Science in Australian Gender Equity</td>
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<td>STA</td>
<td>Science Technology Australia</td>
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<td>STI</td>
<td>Science Technology and Innovation</td>
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<td>S&amp;E</td>
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<td>Science and Technology</td>
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<td>STIP</td>
<td>Science, Technology and Innovation Policy</td>
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<td>UIS</td>
<td>UNESCO Institute for Statistics</td>
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<td>United Nations</td>
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<td>UNDP</td>
<td>United Nations Development Program</td>
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<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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<td>VC</td>
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<td>WIE</td>
<td>Women in Engineering</td>
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<td>Women in Science Enquiry network</td>
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<td>WISET</td>
<td>Center for Women in Science, Engineering, and Technology</td>
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<td>Women in Science and Technology</td>
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Women in Science and Technology in Asia

1. Executive Summary

Despite many efforts by the UN and other international and local organizations, gender inequality and disparity in science and technology are still very prevalent all over the world. These issues are of great importance particularly in Asia as the percentage of women employed in research and development (R&D) is much lower compared to other regions. Moreover, due to the so-called 'glass ceiling' effect, there are even fewer women employed in higher level positions, and they are scarce in the top executive positions.

The Association of Academies and Societies of Sciences in Asia (AASSA) is a network of science academies and societies in 32 countries in Asia. From 2012 to 2014, AASSA organized a series of regional workshops in Azerbaijan, India, and Turkey, on women in science and engineering. These three workshops revealed that, despite the diversity present in Asian countries, the overall situation of women is very similar across countries. This realization prompted us to study the situation in each Asian country, and its policies for women in science and technology, in a more organized way, which resulted in this report.

Although we aimed to collect data on women in science and technology from all 32 AASSA member countries, we were able to collect data from only ten countries: Australia, India, Korea, Malaysia, Nepal, Pakistan, the Philippines, Sri Lanka, Bangladesh, and Turkey. We used a standardized format to investigate the current status of women scientists in each country. In this report, the following areas are covered: 1) general situations such as science education, employment and salary gaps, leadership roles, and women scientist organizations; 2) challenges that have to be overcome to achieve gender equality with respect to culture, educational opportunities, and hiring/promotions; 3) recommendations for the government, universities and research institutions, and academic societies.

In all countries except Pakistan, primary and secondary educations have reached near gender parity. In Pakistan, primary education is much more restricted for girls than for boys: the dropout rate among girls is almost 50%. The percentage of women in higher education varies among Asian countries. In 7 (Australia, Bangladesh, Korea, Malaysia, Philippines, Sri Lanka, and Turkey) of the 10 countries, more women than men are enrolled in undergraduate degrees overall. However for science and technology majors, in only 4 countries (Australia, Malaysia, Philippines, and Sri Lanka) women account for more than 50%. In the other 6 countries (Bangladesh, India, Korea, Nepal, Pakistan, and Turkey), approximately 28~48% of the degrees in these areas were granted to women. The percentage of women in engineering is much lower than in natural sciences: in most countries except the Philippines and Malaysia, women’s participation in engineering is less than 30%. Similarly, except for the Philippines and Malaysia, the percentage of women in graduate education (especially doctorates) is less than that in undergraduates.

There are obstacles arising from cultural and societal values in most of the countries, which result in biased perceptions, such as regarding

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most science subjects as inappropriate for girls and assuming that females simply cannot compete with their male colleagues. In addition, women are expected to spend more time looking after the family than advancing their studies or careers. Across the world, in developed and developing countries alike, women take on a major share of domestic duties even when they have a career.

In most of the Asia-Pacific countries except Malaysia and the Philippines, women’s participation in the S&T workforce is much lower than men. Marriage and childbirth are important factors that cause educated women to leave their jobs. In Korea, although marriage has no effect on the work participation of men, the work participation of married women in science and engineering (52%) is much lower than that of unmarried women (85%). In India the percentage of women drops steeply between the doctoral and professional stages and this is considered to be partly due to the social pressure on women to get married and then choose their families over professional careers. In the Philippines, the percentage of women in S&E decreases sharply from 60% among PhD graduates to 33.5% in Outstanding Young Scientists, which may be associated with a young woman’s decision to focus on starting a family and not devote as much time in developing her scientific career.

In most Asian countries, societal situations discourage women from continuing their career in science. Even for highly qualified women scientists, traditional roles pressure them to be responsible for the majority of household work. As women give up their research and careers, their talents go to waste.

Despite some progress, women scientists are under-represented, paid and promoted less, win fewer grants, and are more likely to leave the research field than equally qualified men. Men and women have equal access to education in most of the countries. However, the equality in education does not lead to equality in employment. In general, female college graduates find it difficult to be employed as permanent rather than temporary workers. In the countries that were surveyed, although there is no salary gap between men and women in the public sector, income disparity exists in private corporations. In addition, there is serious disparity in hiring and promotion, and therefore income: the situation in all 10 countries is very similar. In Australia women graduates earns 9.4% less than men with the same qualifications. Although women are equally and even over-represented in natural and physical sciences at the undergraduate, PhD and postdoctoral levels and even junior staff, this falls off dramatically in the senior ranks of universities and research institutions. Women make up only 17% of positions in associate Professor and above. In Bangladesh, only 22.6% of professors are women. Women make up 35.6% of researchers at the Bangladesh Atomic Energy Commission, however there are many more women in junior positions (66.6%) and the percentage of women decreases with increasing rank, reaching 24.4% at the Chief Scientist level. In India, the majority of grade school and college science and mathematics teachers are women. However, the percentage of women faculty in high profile institutes like Tata Institute of Fundamental Research (TIFR) and Indian Institute of Technology (IIT) is about 10-12%, and even lower in the higher ranks. Women make up 18.9% of all scientists in Korea, occupying 33.0% of the non-regular positions and 13.7% of the regular positions. Also, women make up only 8.6% of principal investigators and 7.1% of the executive positions. The participation of women in the S&T workforce in the Philippines is larger than men in almost all types of organizations: higher educational institutions, government R&D, and private non-profit organizations. However, there are much fewer women in the higher ranks. In Turkey 43% of academic positions in all fields are occupied by women, with the percentage of lectures and of full professors being 62% and 29%, respectively. Serious disparity can also be seen in administrative/team leader positions, and only a few percent of the top executive positions are filled by women.
The National Academy of Sciences in each country represents the most prestigious society of scientists and engineers and has great influence on science policy. The inclusion of women in the Academy is an important factor to consider when evaluating gender equality. The percentage of women in each academy is very low, being less than 8% except in the Philippines (23.8%), Sri Lanka (19.1%), Malaysia (16.8%), and Nepal (11.3%). This is far smaller than the representation at the professor level in each country. It is crucial to establish appropriate policy to increase the number of women in senior positions in both the public and private sectors.

Women scientist associations are instrumental in providing opportunities to develop academic abilities and leadership roles. As the number of women scientists is much smaller than their male counterparts, the same is true of women scientist organizations in each country. In Australia, India, and Korea, women scientist associations are well established and have played important roles by providing a forum for women scientists to share their experiences and receive mutual support, as well as by acting as lobby groups to suggest policy changes. It is encouraging that similar groups are being established in developing countries as well.

A common cultural challenge across the region includes issues that stem from innate prejudice and bias, as well as patriarchal attitudes in the workplace. Another common issue is that the traditional role of women as homemakers still gets priority in people’s minds. This is what most women scientists face when they look for pathways back into science after a break for family reasons. It is important to implement policies to help them negotiate this period without losing contact with cutting edge research.

During the past few decades most Asian countries seem to have recognized the roadblocks that prevent active engagement of women in science and technology. Therefore, some countries have made a conscious effort to follow best practices to promote the success of women in science. For example, governments have taken steps to legislate and implement policies which favor gender equality and promotion of female participation in science. In Bangladesh, the National Science and Technology Policy 2011 emphasizes the participation of women in science and technology, promoting higher education for women. The South Korean government legislated an Act on Fostering and Supporting Women Scientists and Engineers in 2002 with the aim of helping women scientists and engineers develop their skills in research and technical positions.

Gender should be taken into account when making decisions regarding policies and priorities, for example by performing gender impact analysis. Attraction, recruitment, promotion, retention and recognition are key points, where effective strategies are needed to increase women’s participation in S&T in academia and in the public and private sectors.

Government policies should encourage scientific organizations to create standing committees on women in science, and workplaces to increase the percentage of women as per the United Nations advisory on gender equity. We recommend that governments establish gender audit systems.

Organized efforts should be made in at least 4 areas to increase the involvement and innovation of female scientists. These are 1) at the educational level from the earliest grades, continuing on through graduate study, 2) at the public and social level, to create an environment in which women feel comfortable about becoming involved in science and technology and feel supported by the social ecology that surrounds them, 3) at the policy level, to implement policy changes that support the role of women in science and technology, and 4) at the academic and professional career level, to help women scientists mature in their careers and fulfill their potential.

The tragic underutilization of women in science has received attention from many international and national agencies all around the world, and strategies that make a difference are in place in many institutions in developed countries.
However, progress remains slow. Obviously the problem is deep-seated and hard to change.

This report was prepared based on data collected from ten countries in the Asia-Pacific region. It details common problems of access to education, competing demands from family, problems of discrimination for jobs and advancement, and the absence of women from senior and influential positions in science. This report also describes some examples of achievements and good practices in supporting women in science and provides recommendations to promote women’s participation in science and technology in Asia. The authors think that this report will serve as a valuable guideline for diagnosing the current status in the region, as well as strategic planning to empower women scientists. We also hope it will be the beginning of a pioneering project to study other countries, not limited to Asia.

2. Introduction

The inequalities and disparities of women are subjects of extensive discussion worldwide. Over the past 40 years, the United Nations has played a major role in championing gender equality and the empowerment of women through the declaration of the International Women’s Year (1975), the UN Decade for Women (1976–1985), the Nairobi Forward-looking Strategies for the Advancement of Women to the Year 2000 (1985–2000), and the Millennium Development Goals (2000–2015). Gender bias in science and technology has been one of the most prominent issues in each of these initiatives.

Despite many such efforts by the UN and other international and local organizations, gender inequality and disparity in science and technology are still very prevalent all over the world. Empowering women in science and technology is a challenging task and requires continued and collaborative efforts by the government, academic institutions and societies, and industry. Associations of women scientists can play important roles by influencing the government and academic societies, and sharing experiences with younger generations.

Asia is home to 4.4 billion people, accounting for 60% of world population. Asia varies greatly across and within its regions with regard to ethnic groups, cultures, environments, economics, historical ties and government systems. This broad diversity can provide a wide range of experiences that Asian countries can use to learn from each other. It can also be a hurdle to collaboration, which Asian countries will have to overcome in order to achieve sustainable development of the region.

The Association of Academies and Societies of Sciences in Asia (AASSA) is a network of science academies and societies in 32 countries in Asia and the Pacific. Each science academy serves as an authority on science in that country, and as a science advisory group for the government. AASSA represents Asia in the InterAcademy Partnership (IAP), a network of world academies. AASSA has continuously been organizing conferences, symposia and workshops on global and regional issues on science and technology, and has published several reports on the sustainable development of Asia on several globally important topics; Energy, Environment and Climate Change, Green Transition and Innovation, Natural Resources, The Cultural Perspectives, (AASA, 2011a-e).

In Asian region percentage of women in science and technology research is only 18.9%. Moreover, due to the so-called ‘glass ceiling’ effect, of which AASSA provides one of the worst examples, women in the top ranks are rare. Participation of women scientists in AASSA is at a very low level, because of the few women in each science academy.

Until recently AASSA paid little attention to the status of women in science, technology, and engineering. In 2012, AASSA organized a regional workshop on women in science and engineering in Baku, Azerbaijan and held similar workshops in 2013 and 2014 in New Delhi, India and Izmir, Turkey respectively. From these three workshops we found that, despite the diversity present in
Asia, the overall situation of women was very similar across countries.

These workshops also made clear that discovering effective ways to empower women scientists to perform as major players for sustainable economic development is a challenging task which requires prolonged and concerted effort by the government, academic institutions and societies, and industry. Since countries have different experiences with various types of policies, sharing knowledge and information will help them learn from others’ successes and mistakes and propose innovative policies, programs and implementation methods. In order to clear obstacles for women pursuing careers in science and technology, it is urgent to raise awareness of gender inequality in science and technology at multiple levels, such as education, employment, advancement, recognition and income.

Ideally we would like to study the situation in each country in the region, in order to compare their policies for women in science and technology in detail. However collecting the relevant data across countries is very difficult. The data are not in the same format, and some countries only have data about women in general, not specifically on women in science and engineering.

There have been several reports on the current status of women scientists covering topics such as education, academia, and the role of the government. In 2011, the Massachusetts Institute of Technology (MIT) released a report on the Status of Women Faculty in the Schools of Science and Engineering at MIT, showing that the percentage of women faculty in science and engineering increased from 10.8% in 2000 to 17.3% in 2011 (MIT, 2011). The American Association of University Women (AAUW) published an analysis and recommendations on female STEM faculty in the United States (Hill et al., 2010). In the study, the percentage of tenured female faculty in engineering was 7.2%, and that in biological, agricultural, environmental, and life sciences was 22.2%. The Canadian government issued a report on the statistics on women scientists in Canada (Research Council of Canada, 2010). A recent commentary in Nature showed that the grant funding success rate of women scientists in Europe was on average 10%, lower than the 12% for men (Vernos, 2013). A report from the Parliament of the United Kingdom analyzed government funding and support for diversity in STEM, and provided recommendations on the role of government in enabling women scientists to stay and progress in STEM careers (2014).

All of the above reports were limited in scope: they focused on individual universities, countries, or governments. Very recently, there have also been international collaborations in this area. While the present report was being prepared, UNESCO published a report titled A Complex Formula: Girls and Women in Science, Technology, Engineering and Mathematics in Asia (2015). This report mainly dealt with the female participation in STEM education in seven Asian countries; Cambodia, Indonesia, Malaysia, Mongolia, Nepal, Korea, and Vietnam.

For the present project, we initially aimed to collect data on women in science and technology from all 32 AASSA member countries. Over the period of nine months we were able to collect data from ten countries: Australia, Bangladesh, India, Republic of Korea, Malaysia, Nepal, Pakistan, the Philippines, Sri Lanka and Turkey. We used survey questionnaires and templates to investigate the current status of women scientists in Asia. To our knowledge, this is the first attempt to compare the information in a consistent format. The comparisons reveal each country’s successes to empower women in science and technology, as well as areas to be improved on. This report will thus serve as a valuable resource not only in diagnosing current status, but also in tailoring programs for improving the status of women scientists in each country of AASSA.

In this report, we will cover the following areas. First of all, we will describe the general situation of women scientists in Asia. This includes the current status of women in science and engineering, education, the employment and salary gaps, women in leadership positions, and
women scientists’ organizations. Secondly, we will highlight good practices for educating and empowering them. This section will include the role of government in fostering women scientists and the progress of women scientists’ roles in research institutions, universities, and academic societies. Thirdly, based on the current status and achievements of women scientists in Asia, this report will highlight the major challenges from various perspectives such as education, government policy, and sociocultural aspects. Finally, this report provides recommendations for the science educators, government, universities and research institutes, and Academies of sciences and academic societies.

3. General Situation of Women Scientists in Asia-Pacific

In this chapter the general situation of women scientists in the Asia-Pacific region is discussed based on the reports provided by ten countries. This chapter is divided into five parts: basic education, STEM education, employment and salary gaps, work versus family, and leadership.

3-1. Basic education

It is essential for a society that both men and women have equal opportunities for education. Unfortunately this is not the case in some countries, resulting in a lower literacy rate in women. In Nepal and Pakistan, female literacy rates of the 15~24 age group are much lower than their male counterparts (Figure 1).

In these countries, the mean years of schooling, for both genders are lower than those of other Asian countries (Figure 2). Even though the mean years of schooling in Bangladesh, India, Nepal and Pakistan range from 3.2 to 5.1 years, the situation seems to be improving dramatically: for children the expected years of schooling is over 10 years except in Pakistan, where it is only 7.7 years. Very few girls in Pakistan progress beyond grammar schools: almost 50% of girls drop out of school, even though they do well in school. There are various reasons which play a significant role in this, starting from early in life, up to higher levels of education.

Poverty, marriage and motherhood emerge as common obstacles in these countries. For less fortunate girls/women, scholarships and grants
can be the only options, but they are either not available for them or available only in small numbers. Because it is considered normal to prioritize the education of boys, in families with limited resources, girls are expected to stay at home and help with household chores while the boys in the family go to school. Furthermore, the majority of girls and young women cannot continue their education beyond grade school because they are married off early and are expected to devote their lives to their children, husband and family.

In contrast to Pakistan, women’s literacy rates are higher than those of men in four countries: Bangladesh, Philippines, Sri Lanka and Turkey, with 99% literacy for women except Bangladesh (86%). Bangladesh country report (Annex 2) shows that in 2012, 98.1% of girls enrolled in primary education which is higher than boys (95.4%). This data suggests that socio-cultural background plays an important role, though a better economic situation may create an enabling environment. In Sri Lanka, there is a lot of emphasis on educational achievements even within lower social class families. Children are required to attend school up to 15 years of age, schools do not charge tuition, and textbooks and uniforms are provided free of charge.

3-2. STEM education

In order to study the present status of female higher education in science and technology in the 10 countries included in this report, data were collected from the UIS (2015b). Data from China and Japan were included for reference. As shown in Figure 3, in 5 countries including Australia, China, Malaysia, the Philippines, and Sri Lanka, women occupy more than 50% of the undergraduate students in science and technology. In Australia and Philippines women occupy 51% and 60% of doctoral students, respectively. However, among career scientists, in all countries except the Philippines and Malaysia, the proportion of women is much lower than the doctoral student levels, displaying pipeline leakage in career ladders. Pipeline leakage is especially

![Figure 3. Percentage of women in science education and research in Asia.
Source: UIS. 2015b.
Note: Some of the data are not available from UIS. The following data are extracted from respective country reports: Australia, researchers; India, BS, PhD, and researchers. Numbers are percentage of women in all graduates and researchers.](image-url)
serious in Australia, Bangladesh, India, Japan, and Korea. For example, women in Korea receive 41% of BS degrees and 37% of PhD degrees, however make up only 17% of the research workforce (Figure 3). Women in Nepal and Pakistan have much fewer opportunities for graduate education than their male counterparts. In summary leakage in scientific careers happens all over the Asia-Pacific region, except the Philippines. Needless to say maintaining current data is of central importance for establishing policies. Unfortunately, the data presented in the Korea county report (Annex 4) is inconsistent with the UIS data: 30.2% for BS, 21.3% for PhD, and 18.9% for researchers. The discrepancy may come from the differences in how ‘science and technology field’ is defined. Since it is not clearly described in the UIS data, this is difficult to verify.

3-2-1. Australia
In Australia, women make up more than half of natural and physical sciences (52%), management and commerce (48.5%) and creative Arts (63.2%) students, but only 15.5% and 18.9% of Engineering and Information Technology (Table 1).

3-2-2. Bangladesh
In Bangladesh, there are 37 public and 80 private universities. Although admissions are determined only by merit regardless of gender, gender disparity in colleges is quite severe, with only 28.3% of students being female (Table 2). Similar disparity exists in the fields of science and technology. In 2010 only 19.2% of students in Bangladesh University of Engineering and Technology and 35.6% in Bangladesh Agricultural University were women (Table 3). In spite of the disparity the number of women students increased in the period from 2002 to 2010 at both universities.

3-2-3. India
In Indian universities and colleges in the 2012-2013 year, 43.28% (9,306,403) of the total enrollment of 21,501,154 individuals were women. Of the 9.3 million female students, 34.6% are in science and technology fields: science (19.1%), engineering/technology (10.6%), medicine (4.2%), agriculture (0.3%), and veterinary science (0.1%) (Table 4). The numbers do not represent the percentages in women to men scheme but represent those among all women enrolled in the universities. For example 19.1% of women in science do not mean...
80.9% of men in science. Since the number of men in each field is not available, it is not possible to deduce the women/men ratios from the data in Table 4.

Figure 4 shows the percentage of women among all students for each discipline in the 2000/2001 academic year in India. Although women make up about 40% of the undergraduate student body, only 20% of the students in engineering are women. It is even lower at the more prestigious institutes such as the Indian Institutes of Technology (IIT). The fiercely competitive nature of the admission process requires one to spend money and time to prepare for these examinations. Parents, on average, tend not to spend this for daughters. Similarly, while the fraction of women medical students is about 45% in total, at the more prestigious institutes such as All Indian Institute of Medical Sciences (AIIMS) the percentage of women tends to be somewhat lower, for much the same reasons.

Figure 5 indicates that the numbers of women do not fall off steeply as the level of education increases. As many as 35% of the total PhD awardees in science are women, and this is not very different between arts (humanities and social sciences), science, and medicine.

### Table 4. Fraction of women in various fields among all women enrolled in universities in India.

<table>
<thead>
<tr>
<th>Fields of study</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts</td>
<td>42.7</td>
</tr>
<tr>
<td>Science</td>
<td>19.1</td>
</tr>
<tr>
<td>Commerce/Management</td>
<td>16.2</td>
</tr>
<tr>
<td>Education</td>
<td>4.8</td>
</tr>
<tr>
<td>Engineering/Technology</td>
<td>10.6</td>
</tr>
<tr>
<td>Medicine</td>
<td>4.2</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0.3</td>
</tr>
<tr>
<td>Veterinary Science</td>
<td>0.1</td>
</tr>
<tr>
<td>Law</td>
<td>1.24</td>
</tr>
<tr>
<td>Other</td>
<td>0.97</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Government of India. 2014.

#### Figure 4. Percentage of women in university enrollment by field in India (2000).

Source: Country report of India.

#### Figure 5. Percentage of female student enrollment by field of study and by degree in India (2000).

Source: Country report of India.

### 3-2-4. Korea

In Korea, men and women have equal access to educational opportunities. In 2013 74.5% of female high school students entered college compared to 67.4% of males. In 2013, women received 53.7% of the bachelor’s degrees in natural science majors but only 18.9% of those in engineering (Table 5). Women accounted for 28.1% of all university education in science and engineering. Fewer women progress to graduate level education. Women receive 51.2% of master’s degrees but only 36.7% of the doctoral degrees for natural sciences. This tendency is also true for engineering majors. However it is notable that during 2006-2013, the percentage of women receiving master’s and doctor’s degrees increased in both science and engineering majors (Table 6).
WOMEN IN SCIENCE AND TECHNOLOGY IN ASIA

Table 5. University degrees in S&T by gender in Korea (2013).

<table>
<thead>
<tr>
<th>Fields</th>
<th>Natural science</th>
<th>Engineering</th>
<th>Total</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degrees</td>
<td>Total</td>
<td>Women (%)</td>
<td>Total</td>
<td>Women (%)</td>
</tr>
<tr>
<td>Associate</td>
<td>13,387</td>
<td>7,614 (56.9)</td>
<td>45,873</td>
<td>6,820 (14.9)</td>
</tr>
<tr>
<td>BS</td>
<td>37,098</td>
<td>19,905 (53.7)</td>
<td>77,232</td>
<td>14,580 (18.9)</td>
</tr>
<tr>
<td>MS</td>
<td>6,613</td>
<td>3,383 (51.2)</td>
<td>13,856</td>
<td>2,573 (18.6)</td>
</tr>
<tr>
<td>PhD</td>
<td>2,251</td>
<td>827 (36.7)</td>
<td>3,163</td>
<td>328 (10.4)</td>
</tr>
<tr>
<td>Total</td>
<td>59,349</td>
<td>31,729 (53.5)</td>
<td>140,124</td>
<td>24,301 (17.3)</td>
</tr>
</tbody>
</table>

Source: WISET. 2015.
Note: The numbers are headcount of graduates from 272 universities who have received degrees in each level.

Table 6. Women received university degrees in S&T in Korea (2006-2013).

<table>
<thead>
<tr>
<th>Degrees</th>
<th>Women in Natural Sciences (%)</th>
<th>Women in Engineering (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>Associate</td>
<td>Bachelor</td>
</tr>
<tr>
<td>2006</td>
<td>54.8</td>
<td>54.6</td>
</tr>
<tr>
<td>2007</td>
<td>54.8</td>
<td>53.7</td>
</tr>
<tr>
<td>2008</td>
<td>55.3</td>
<td>53.8</td>
</tr>
<tr>
<td>2009</td>
<td>56.5</td>
<td>53.7</td>
</tr>
<tr>
<td>2010</td>
<td>56.1</td>
<td>54.6</td>
</tr>
<tr>
<td>2011</td>
<td>54.7</td>
<td>54.7</td>
</tr>
<tr>
<td>2012</td>
<td>57.0</td>
<td>54.5</td>
</tr>
<tr>
<td>2013</td>
<td>56.9</td>
<td>53.7</td>
</tr>
</tbody>
</table>


3-2-5. Malaysia

In Malaysia, women accounted for 63.6% of all university enrollments in 2014 (Table 7). In science and engineering, there were a total of 20,770 (48.1%) men and 22,456 (51.9%) women. Specifically, 64.8% of science/computer majors and 44.5% of engineering graduates are women. The percentage of women drops slightly in graduate school, with women making up 43% of PhD students in science and technology (UIS data in Figure 3).

3-2-6. Nepal

Undergraduate enrollment for each field of study in 2005–2010 is shown in Figure 6. The enrollment in all of the science and technology and related fields such as agriculture, engineering, medicine,

Table 7. Female enrollment in public universities by fields in Malaysia.

<table>
<thead>
<tr>
<th>Fields of study</th>
<th>Women (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>9,594 (76.0)</td>
<td>12,621</td>
</tr>
<tr>
<td>Arts and Humanities</td>
<td>6,684 (63.7)</td>
<td>10,491</td>
</tr>
<tr>
<td>Social science, Business, Law</td>
<td>31,503 (70.5)</td>
<td>44,714</td>
</tr>
<tr>
<td>Science, Mathematics, Computer</td>
<td>10,294 (64.8)</td>
<td>15,894</td>
</tr>
<tr>
<td>Engineering, Manufacturing, Construction</td>
<td>12,162 (44.5)</td>
<td>27,332</td>
</tr>
<tr>
<td>Agriculture and Veterinary</td>
<td>1,884 (58.4)</td>
<td>3,226</td>
</tr>
<tr>
<td>Health and Welfare</td>
<td>5,142 (73.0)</td>
<td>7,041</td>
</tr>
<tr>
<td>Services</td>
<td>2,833 (60.8)</td>
<td>4,663</td>
</tr>
<tr>
<td>General programs</td>
<td>12 (34.3)</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>80,108 (63.6)</td>
<td>126,017</td>
</tr>
</tbody>
</table>

Source: Ministry of Education, Malaysia. 2014.
Women in Science and Technology in Asia

and S&T is very low, whereas it is much higher in education, humanities, and management (UGC Nepal, 2012). The increasing trend in the enrollment is evident in every discipline.

As shown in Table 8, women earned 44.2%, 31.4%, and 11.4% of the BS, MS, and PhD degrees in all fields (UGC Nepal, 2012). According to UIS data of Nepal (Figure 3), in science and technology, 48% of the BS degrees and 10% of the PhD degrees were earned by women, which is similar to the percentages of women in all fields shown in this table. Women have little opportunity to advance to the PhD studies.

Table 8. Percentage of degrees earned by women in Nepal.

<table>
<thead>
<tr>
<th>Degrees in all fields</th>
<th>Women (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor</td>
<td>146,542 (44.2)</td>
<td>331,768</td>
</tr>
<tr>
<td>Master</td>
<td>23,570 (31.4)</td>
<td>75,034</td>
</tr>
<tr>
<td>Doctorate</td>
<td>58 (11.4)</td>
<td>508</td>
</tr>
</tbody>
</table>


Figure 6. Number of undergraduate enrollment by field of study in Nepal (2005–2010).

3-2-7. Pakistan

Although the educational achievements of female students are higher than males at each level of education, the drop-out rate among girls is almost 50%. Women have much less opportunity to continue their education to graduate school. According to the UIS data of Pakistan (Figure 3), 48% of students in science are women at the BS level but only 29% at the PhD level, displaying serious gender disparity in the graduate educations. Gender disparity in the government fellowships is even more serious. Women only received 487 of 2,900 (16.8%) of government supported PhD fellowships until June 2013 (Table 9).

3-2-8. Philippines

In most of the universities in the Philippines female students are dominant in natural science degrees. Unlike other Asian countries, women in engineering account for 42.8%, 39.5% and 58.0% in the BS, MS and PhD level, respectively (Table 10). The proportion of women is lower in some fields: physics (27.3%), applied physics (39.3%), electrical engineering (11.1%), and mechanical engineering (15.4%) (Table 11). Overall, these numbers are still
much higher than those of other countries, and the reason for this is worth investigating further.

3.2.9. Sri Lanka
In Sri Lanka, women make up 47% of natural science and 18% of engineering majors in undergraduates (Table 12). Studies such as law, arts and social sciences, indigenous medicine and agriculture are popular among women. At postgraduate level women make up 41% of science/IT and 23% of engineering (Table 13). Percentage of women in postgraduate diploma-level studies (59%) was higher than in professional-level degrees like Doctor of Medicine (MD), Master of Surgery (MS) or Doctor of Philosophy (PhD) (40%) (Table 14).

Table 9. PhDs produced by government fellowships in Pakistan.

<table>
<thead>
<tr>
<th>Scholarships</th>
<th>Gender</th>
<th>Agriculture and Veterinary Sciences</th>
<th>Biological and Medical Sciences</th>
<th>Physical Sciences</th>
<th>Engineering and Technology</th>
<th>Business Education</th>
<th>Social Sciences &amp; Arts and Humanities</th>
<th>PhDs Completed by June 2013</th>
<th>PhDs Completed in 2012-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign</td>
<td>Male</td>
<td>1,412</td>
<td>220</td>
<td>194</td>
<td>211</td>
<td>555</td>
<td>443</td>
<td>72</td>
<td>157</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>220</td>
<td>194</td>
<td>211</td>
<td>555</td>
<td>443</td>
<td>72</td>
<td>157</td>
<td>1,632</td>
</tr>
<tr>
<td>Indigenious</td>
<td>Male</td>
<td>1,001</td>
<td>267</td>
<td>227</td>
<td>247</td>
<td>505</td>
<td>129</td>
<td>44</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>267</td>
<td>227</td>
<td>247</td>
<td>505</td>
<td>129</td>
<td>44</td>
<td>116</td>
<td>1,268</td>
</tr>
<tr>
<td>Total</td>
<td>Male</td>
<td>2,413</td>
<td>487</td>
<td>421</td>
<td>458</td>
<td>1,060</td>
<td>572</td>
<td>116</td>
<td>273</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>487</td>
<td>421</td>
<td>458</td>
<td>1,060</td>
<td>572</td>
<td>116</td>
<td>273</td>
<td>2,900</td>
</tr>
</tbody>
</table>

Source: HEC Pakistan. 2014.

Table 10. Degrees earned by women (%) in Philippines in 2011–2014.

<table>
<thead>
<tr>
<th>Degrees</th>
<th>Natural science (%)</th>
<th>Engineering (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>54.3</td>
<td>42.8</td>
</tr>
<tr>
<td>MS</td>
<td>52.5</td>
<td>39.5</td>
</tr>
<tr>
<td>PhD</td>
<td>53.8</td>
<td>58.0</td>
</tr>
</tbody>
</table>

Source: Country report of Philippines.

Table 11. Women in UP Diliman degrees in Philippines.

<table>
<thead>
<tr>
<th>Study fields</th>
<th>Year</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008-2011</td>
<td>2011-2014</td>
</tr>
<tr>
<td>Chemistry</td>
<td>64.4</td>
<td>57.8</td>
</tr>
<tr>
<td>Mol. Biol. &amp; Biotechnol.</td>
<td>60.5</td>
<td>56.2</td>
</tr>
<tr>
<td>Biology</td>
<td>58.3</td>
<td>59.7</td>
</tr>
<tr>
<td>Geological Sciences</td>
<td>55.6</td>
<td>52.2</td>
</tr>
<tr>
<td>Mathematics</td>
<td>52.6</td>
<td>55.9</td>
</tr>
<tr>
<td>Physics</td>
<td>45.7</td>
<td>27.3</td>
</tr>
<tr>
<td>Applied Physics</td>
<td>–</td>
<td>39.3</td>
</tr>
</tbody>
</table>

Source: Country report of Philippines.
Note: UP Diliman is the BS course by Metro Manila.


<table>
<thead>
<tr>
<th>Undergraduate fields</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law</td>
<td>82</td>
</tr>
<tr>
<td>Arts</td>
<td>77</td>
</tr>
<tr>
<td>Agriculture</td>
<td>63</td>
</tr>
<tr>
<td>Dentistry</td>
<td>60</td>
</tr>
<tr>
<td>Veterinary Science</td>
<td>60</td>
</tr>
<tr>
<td>Food Science/Animal Science</td>
<td>57</td>
</tr>
<tr>
<td>Medicine</td>
<td>55</td>
</tr>
<tr>
<td>Management &amp; Commerce</td>
<td>55</td>
</tr>
<tr>
<td>Fisheries &amp; Marine Sciences</td>
<td>51</td>
</tr>
<tr>
<td>Science</td>
<td>47</td>
</tr>
<tr>
<td>Computer/ICT/MIT</td>
<td>40</td>
</tr>
<tr>
<td>Engineering</td>
<td>18</td>
</tr>
</tbody>
</table>

As shown in Table 15, in Turkey, more than half of the students in professional disciplines such as architecture, pharmacy and dentistry are women, and 43% of those in medicine. However women in engineering are much less than the professional fields, 29%. Table 16 shows percentage of women with BS, MS, and PhD degree, however this data is for all fields not specific for science and engineering.


<table>
<thead>
<tr>
<th>Postgraduate fields</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>69</td>
</tr>
<tr>
<td>Law</td>
<td>61</td>
</tr>
<tr>
<td>Indigenous medicine</td>
<td>56</td>
</tr>
<tr>
<td>Veterinary Medicine</td>
<td>51</td>
</tr>
<tr>
<td>Arts</td>
<td>51</td>
</tr>
<tr>
<td>Agriculture</td>
<td>48</td>
</tr>
<tr>
<td>Medicine &amp; Dental</td>
<td>42</td>
</tr>
<tr>
<td>Science/IT</td>
<td>41</td>
</tr>
<tr>
<td>Architecture</td>
<td>36</td>
</tr>
<tr>
<td>Management &amp; Commerce</td>
<td>32</td>
</tr>
<tr>
<td>Engineering</td>
<td>23</td>
</tr>
</tbody>
</table>

Note: The percentages are average of two years 2011 and 2012.

### Table 14. Female students by graduate degree enrollment in Sri Lanka (2011&2012)

<table>
<thead>
<tr>
<th>Type of Degree</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post graduate diploma</td>
<td>59</td>
</tr>
<tr>
<td>Masters/MPhil</td>
<td>41</td>
</tr>
<tr>
<td>PhD/MD/MS</td>
<td>40</td>
</tr>
</tbody>
</table>

Note: The percentages are average of two years 2011 and 2012.

### Table 15. Percentage of Female students in various fields in 2012 (Turkey).

<table>
<thead>
<tr>
<th>Faculty (College)</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>142,324 (63)</td>
</tr>
<tr>
<td>Architecture</td>
<td>9,028 (61)</td>
</tr>
<tr>
<td>History &amp; Geography</td>
<td>150,350 (60)</td>
</tr>
<tr>
<td>Theology</td>
<td>28,096 (59)</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>4,515 (59)</td>
</tr>
<tr>
<td>Dentistry</td>
<td>6,280 (56)</td>
</tr>
<tr>
<td>Fine Arts</td>
<td>12,977 (55)</td>
</tr>
<tr>
<td>Law</td>
<td>22,969 (48)</td>
</tr>
<tr>
<td>Medicine</td>
<td>23,579 (46)</td>
</tr>
<tr>
<td>Communication</td>
<td>15,703 (43)</td>
</tr>
<tr>
<td>Economics</td>
<td>220,482 (41)</td>
</tr>
<tr>
<td>Business Administration</td>
<td>311,450 (38)</td>
</tr>
<tr>
<td>Engineering</td>
<td>58,679 (29)</td>
</tr>
<tr>
<td>Veterinary science</td>
<td>2,510 (25)</td>
</tr>
</tbody>
</table>

Source: Turkish Republic Measuring, Selection and Placement Centre. 2014

### Table 16. Women in BS, MS, and PhD degrees in 2013 (Turkey).

<table>
<thead>
<tr>
<th>Degrees</th>
<th>Total</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate</td>
<td>3,377,794</td>
<td>1,546,807 (45.8)</td>
</tr>
<tr>
<td>MS</td>
<td>265,853</td>
<td>111,376 (41.9)</td>
</tr>
<tr>
<td>PhD</td>
<td>66,989</td>
<td>28,826 (43.0)</td>
</tr>
</tbody>
</table>

Source: Turkish Republic Measuring, Selection and Placement Centre. 2014

3-2-10. Turkey

As shown in Table 15, in Turkey, more than half of the students in professional disciplines such as architecture, pharmacy and dentistry are women, and 43% of those in medicine. However women in engineering are much less than the professional fields, 29%. Therefore, women in engineering are much less than the professional fields, 29%. Table 16 shows percentage of women with BS, MS, and PhD degree, however this data is for all fields not specific for science and engineering.

3-3. Employment and salary

Even in the countries where men and women have equal access to education, equality in education does not lead to equality in employment. In general, female college graduates have difficulty finding employment as regular rather than non-regular workers. In addition, even women in the regular positions receive smaller salaries and have less opportunity for promotion than their male colleagues.

As shown in Figure 7, female participation in the labor market in India (27%), Pakistan (25%), Sri Lanka (31%), and Turkey (29%) are low compared to other countries. It is interesting that female participation in Nepal (80%) is very high.

Table 17 shows the participation of women in science and technology according to the organization types and various disciplines in science deduced from the UIS. Despite this data do not provide values...
WOMEN IN SCIENCE AND TECHNOLOGY IN ASIA

3-3-1. Australia

The employment for men and women are 68% and 54%, respectively. The number of women employed has grown steadily from about 40% in 1980, although much of this growth is in part-time jobs. There is also a wage gap between men and women graduates over all careers. A recent study by Graduate Careers Australia found that male graduates earn 9.4% more than females with the same qualifications. The salary gap means the promotions gap in Australian universities and research organizations, and it also explains the dearth of women staff.

Although women are equally, even over-represented in natural and physical sciences at the undergraduate level, PhD and even postdoctoral and junior staff, their representation falls off dramatically in the more senior strata (Associate professor equivalent ranks) of universities and research institutions, making up only 17% of Professor/Associate Professor (Figure 8a, 8b).

3-3-2. Bangladesh

In 2009, of the 14,873 professors in the 37 public and 80 private universities in Bangladesh, only 3,357...
Women in Science and Technology in Asia

(22.6%) were women (Table 18). The percentage of women professors was also quite low (25.3%) in Dhaka University (Table 19), Bangladesh University of Engineering and Technology (19.7% in 2010), and Bangladesh Agricultural University (11.3% in 2010) (Table 20). These numbers are smaller than the percentage of female students (28.3%, Table 2). The percentage of women professors in engineering (15.9%) and earth science (18.9) are lower than other fields such as biological sciences (36.2%).

Table 18. Percentage of women professors in Bangladesh in 2009.

<table>
<thead>
<tr>
<th>University type</th>
<th>All Professors</th>
<th>Women (%)</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>9,163</td>
<td>1,656 (18.0)</td>
<td>6,507</td>
</tr>
<tr>
<td>Private</td>
<td>5,710</td>
<td>1,701 (29.8)</td>
<td>4,009</td>
</tr>
<tr>
<td>Total</td>
<td>14,873</td>
<td>3,357 (22.6)</td>
<td>10,516</td>
</tr>
</tbody>
</table>

Note: The numbers are the total of the 37 public and 80 private universities.

Table 19. Women Professors of Dhaka University (Bangladesh).

<table>
<thead>
<tr>
<th>Schools</th>
<th>Full Professor</th>
<th>Associate Prof.</th>
<th>Assistant Prof.</th>
<th>Lecturer</th>
<th>All Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Women (%)</td>
<td>Total</td>
<td>Women (%)</td>
<td>Total</td>
</tr>
<tr>
<td>Science</td>
<td>72</td>
<td>19 (26.3)</td>
<td>26</td>
<td>4 (15.4)</td>
<td>29</td>
</tr>
<tr>
<td>Eng Sci</td>
<td>34</td>
<td>3 (8.8)</td>
<td>19</td>
<td>3 (15.8)</td>
<td>29</td>
</tr>
<tr>
<td>Earth Sci</td>
<td>25</td>
<td>5 (20.0)</td>
<td>11</td>
<td>1 (9.1)</td>
<td>8</td>
</tr>
<tr>
<td>Bio Sci</td>
<td>108</td>
<td>29 (26.9)</td>
<td>27</td>
<td>12 (44.4)</td>
<td>38</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>29</td>
<td>5 (17.2)</td>
<td>8</td>
<td>1 (12.5)</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>268</td>
<td>61 (22.8)</td>
<td>91</td>
<td>21 (23.1)</td>
<td>121</td>
</tr>
</tbody>
</table>

Source: Dhaka University, 2014.
The percentage of female faculty tends to decrease with increasing rank: 31.8% for lecturers, 25.6% for assistant professors, 23.1% for associate professors, and 22.8% for full professors. Despite this trend, the difference is not large, and may reflect the fact that more women are available in the workforce at junior levels. This observation is very different from universities in Australia (Figure 8), the US, and EU countries (UNESCO, 2007). It is possible that the disparity is due to the available pool of women and not a bias in promotion, at least in Dhaka University.

Although the percentages of women professors in Bangladesh University of Engineering and Technology and Bangladesh Agricultural University are still low, there are increasing trends during the past 10 years in both universities.

As shown in Table 21, of 1,008 total researchers at the four major agricultural research institutions, 192 (19.0%) are women.

Women make up 35.6% of researchers at the Bangladesh Atomic Energy Commission (BAEC). However there are many more females in the Junior Scientist positions (66.6%) and the percentage of females decreases with increasing rank, reaching 24.4% at the Chief Scientist level (Table 22).

### 3-3-3. India

In India research positions rarely have undergraduate teaching responsibilities. The majority of science and mathematics teachers are women in grade schools as well as colleges. However, the percentages of women on the faculty of the high profile institutes like Tata Institute of Fundamental Research (TIFR), IIT, or IISc are about 10-12%, and lower in the higher ranks.

Tables 23 and 24 display the percentage of women in government laboratories and high profile teaching and research institutes. Though the situation has improved from 2004 to 2008, the percentages of women scientists in various organizations were still between 14% and 29% in 2008, with an average of 19.5%. Table 24 also shows the percentage of women faculty in Indian universities is disproportionately low, particularly in higher positions.
While women occupy 18.9% of all scientists they have a disproportionately higher number of non-regular positions (33.0%) than regular positions (13.7%) (Table 25). In the years from 2006 to 2013 the percentage of women scientists increased from 16.1% to 18.9%. Comparison of the data of 2006 and 2013 reveal that the disparity has improved during the 8 year period: the increase for regular positions (9.4% to 13.7%) was larger than the increase for non-regular positions (31.8% to 33.0%) (Table 26).

Table 27 shows the percentage of women in various positions in natural science and engineering in 272 universities. Women make up 24.4% of the 78,761 total positions, accounting for 40.1% and 13.7% of

3-3-4. Korea

While women occupy 18.9% of all scientists they have a disproportionately higher number of non-regular positions (33.0%) than regular positions (13.7%) (Table 25). In the years from 2006 to 2013 the percentage of women scientists increased from 16.1% to 18.9%. Comparison of the data of 2006 and 2013 reveal that the disparity has improved during the 8 year period: the increase for regular positions (9.4% to 13.7%) was larger than the increase for non-regular positions (31.8% to 33.0%) (Table 26).

Table 27 shows the percentage of women in various positions in natural science and engineering in 272 universities. Women make up 24.4% of the 78,761 total positions, accounting for 40.1% and 13.7% of
the positions in natural science and engineering, respectively. Women in the regular positions were strikingly low: only 12.5% of the 28,265 regular faculty positions, accounting for 25.6% and 5% of the positions in natural science and engineering, respectively.

Table 25. Employment of women researchers in S&T in 2013 (Korea).

<table>
<thead>
<tr>
<th>Organization type</th>
<th>Inst. (#)</th>
<th>Total</th>
<th>Women (%)</th>
<th>Total</th>
<th>Women (%)</th>
<th>Total</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;E dept. in colleges</td>
<td>272</td>
<td>28,265</td>
<td>3,522 (12.5)</td>
<td>50,496</td>
<td>15,719 (31.1)</td>
<td>78,761</td>
<td>19,241 (24.4)</td>
</tr>
<tr>
<td>Public research institutes</td>
<td>184</td>
<td>24,763</td>
<td>3,646 (14.7)</td>
<td>10,541</td>
<td>4,563 (43.3)</td>
<td>35,304</td>
<td>8,209 (23.3)</td>
</tr>
<tr>
<td>Private research institutes</td>
<td>2,755</td>
<td>116,627</td>
<td>16,035 (13.7)</td>
<td>897</td>
<td>177 (19.7)</td>
<td>117,524</td>
<td>16,212 (13.8)</td>
</tr>
<tr>
<td>Total</td>
<td>3,211</td>
<td>169,655</td>
<td>23,203 (13.7)</td>
<td>61,934</td>
<td>20,459 (33.0)</td>
<td>231,589</td>
<td>43,662 (18.9)</td>
</tr>
</tbody>
</table>

Note: Data were collected from 272 universities, 184 public research institutes, and 2,755 private research institutes (more than 100 employees.)

Table 26. Employment of women researchers in S&T in 2006~2013 (Korea).

<table>
<thead>
<tr>
<th>Year</th>
<th>Regular (%)</th>
<th>Non-Regular (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>9.4</td>
<td>31.8</td>
<td>16.1</td>
</tr>
<tr>
<td>2007</td>
<td>9.8</td>
<td>28.2</td>
<td>15.4</td>
</tr>
<tr>
<td>2008</td>
<td>10.4</td>
<td>32.0</td>
<td>17.4</td>
</tr>
<tr>
<td>2009</td>
<td>10.6</td>
<td>31.1</td>
<td>17.3</td>
</tr>
<tr>
<td>2010</td>
<td>11.4</td>
<td>30.8</td>
<td>17.3</td>
</tr>
<tr>
<td>2011</td>
<td>11.2</td>
<td>31.2</td>
<td>17.4</td>
</tr>
<tr>
<td>2012</td>
<td>13.0</td>
<td>33.3</td>
<td>19.0</td>
</tr>
<tr>
<td>2013</td>
<td>13.7</td>
<td>33.0</td>
<td>18.9</td>
</tr>
</tbody>
</table>

Note: Numbers are percentage of women of the total personnel in the same positions.

3-3-5. Malaysia

The country report of Malaysia does not provide the data for the female professors or researchers. The data on the registered professionals is shown in Table 28: the percentage of women engineers, and especially professional engineers (4.7%), is much lower than other professions.

3-3-6. Nepal

The country report of Nepal does not provide the data for the female professors or researchers in S&T. Table 29 shows the percentages of women in various S&T related positions. Only 16.2% of the total positions in science and technology are occupied by women, with the percentage of researchers being the lowest at 7.8% (Table 29). This may reflect the scarcity of women with the PhD degree (Table 8).

Women account for only a small portion of the government positions (10.9%), compared to higher education (25.4%) or private/non-profit...
organizations (42.4%) (Table 30). Interestingly in microbiology field women account for 47.0% of all researchers (Table 31). Unfortunately the country report of Nepal does not provide the data for other fields of S&T (Table 31).

3.3-7. Pakistan

In Pakistan, women scientists and engineers accounted for only 18.4% of regular positions in the public sector (Table 32). Atypically, the percentages are higher among faculty and researchers (28.6%) compared to technicians (7.5%) and supporting staff (6.6%). Women account for only 17.0% in all fields of science and technology: the percentage is strikingly small in R&D (4.8%). Much more women are working in higher education (25.2%) (Table 33). The participation of women in S&T in Pakistan is one of the worst in the world.

Table 28. Registered professionals by profession and gender in 2013 (Malaysia).

<table>
<thead>
<tr>
<th>Professions</th>
<th>Total number</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional engineer</td>
<td>15,884</td>
<td>754 (4.7)</td>
</tr>
<tr>
<td>Graduate engineer</td>
<td>70,613</td>
<td>15,274 (21.6)</td>
</tr>
<tr>
<td>Medical doctor</td>
<td>29,153</td>
<td>14,106 (47.8)</td>
</tr>
<tr>
<td>Dentist</td>
<td>4,921</td>
<td>3,166 (64.3)</td>
</tr>
<tr>
<td>Lawyer</td>
<td>15,253</td>
<td>7,698 (50.5)</td>
</tr>
</tbody>
</table>


Table 29. Women in various levels and positions in S&T in Nepal.

<table>
<thead>
<tr>
<th>Positions</th>
<th>Total</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager</td>
<td>1,477</td>
<td>229 (15.5)</td>
</tr>
<tr>
<td>Researcher</td>
<td>5,123</td>
<td>399 (7.8)</td>
</tr>
<tr>
<td>Technician</td>
<td>12,053</td>
<td>1,839 (15.3)</td>
</tr>
<tr>
<td>Teaching staff</td>
<td>3,568</td>
<td>641 (18.0)</td>
</tr>
<tr>
<td>Supporting staff</td>
<td>19,690</td>
<td>3,695 (18.8)</td>
</tr>
<tr>
<td>Total</td>
<td>41,911</td>
<td>6,803 (16.2)</td>
</tr>
</tbody>
</table>


Table 30. Women in various types of organizations in Nepal.

<table>
<thead>
<tr>
<th>Organization types</th>
<th>Total</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>24,946</td>
<td>2,727 (10.9)</td>
</tr>
<tr>
<td>Higher education</td>
<td>6,852</td>
<td>1,745 (25.4)</td>
</tr>
<tr>
<td>Business</td>
<td>6,639</td>
<td>950 (14.3)</td>
</tr>
<tr>
<td>Private and nonprofit</td>
<td>3,071</td>
<td>1,304 (42.4)</td>
</tr>
<tr>
<td>Others</td>
<td>403</td>
<td>77 (19.1)</td>
</tr>
</tbody>
</table>


Table 31. Percentage of women researches in microbiology by gender in Nepal.

<table>
<thead>
<tr>
<th>Fields of microbiology</th>
<th>Women (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>139 (49.6)</td>
<td>280</td>
</tr>
<tr>
<td>Agriculture</td>
<td>8 (42.1)</td>
<td>19</td>
</tr>
<tr>
<td>Environment</td>
<td>28 (38.9)</td>
<td>72</td>
</tr>
<tr>
<td>Food</td>
<td>19 (45.2)</td>
<td>42</td>
</tr>
<tr>
<td>Total</td>
<td>194 (47.0)</td>
<td>413</td>
</tr>
</tbody>
</table>

Source: Central Department of Microbiology, Tribhuvan University, Nepal. 2014.

Table 32. Percentage of women in S&T in the public sector by positions (Pakistan).

<table>
<thead>
<tr>
<th>Position type</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporting Staff</td>
<td>6.6</td>
</tr>
<tr>
<td>Technician and Equivalent</td>
<td>7.5</td>
</tr>
<tr>
<td>Faculty Members/ Researchers/Engineers</td>
<td>28.6</td>
</tr>
<tr>
<td>Total</td>
<td>18.4</td>
</tr>
</tbody>
</table>

Source: PCST Pakistan. 2012.

Table 33. Percentage of women in S&T organizations (Pakistan).

<table>
<thead>
<tr>
<th>Organization type</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonprofit NGO</td>
<td>23.5</td>
</tr>
<tr>
<td>Education and Training (Non degree)</td>
<td>2.9</td>
</tr>
<tr>
<td>Higher Education (Degree awarding)</td>
<td>25.2</td>
</tr>
<tr>
<td>S&amp;T Information/Services</td>
<td>12.4</td>
</tr>
<tr>
<td>Research and Development</td>
<td>4.8</td>
</tr>
<tr>
<td>Total</td>
<td>17.0</td>
</tr>
</tbody>
</table>

Source: PCST Pakistan. 2012.
3-3-8. Philippines
The Philippines is an exception among Asian countries. The participation of women in the R&D workforce in the Philippines is larger than males in almost all types of organizations; higher educational institutions, government R&D, and private non-profit organizations (Table 34).

<table>
<thead>
<tr>
<th>Year</th>
<th>Gov. R&amp;D Inst.</th>
<th>Public</th>
<th>Private</th>
<th>Private NGO</th>
<th>Private Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>56.5</td>
<td>56.4</td>
<td>55.7</td>
<td>52.7</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>54.5</td>
<td>55.1</td>
<td>61.6</td>
<td>51.4</td>
<td>45.0</td>
</tr>
<tr>
<td>2005</td>
<td>55.3</td>
<td>57.1</td>
<td>63.0</td>
<td>53.0</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>55.6</td>
<td>56.1</td>
<td>55.6</td>
<td>55.0</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>56.9</td>
<td>58.3</td>
<td>54.8</td>
<td>55.1</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>55.8</td>
<td>56.6</td>
<td>56.1</td>
<td>53.4</td>
<td></td>
</tr>
</tbody>
</table>

Note: Columns from the left represent, government R&D institutes, public higher educational institutes, private higher educational institutes, private non-profit organization, and private Industry, respectively.

3-3-9. Sri Lanka
In Sri Lanka, the majority of women are employed in the informal rather than the formal sector. Work conditions and wages are far less satisfactory in the informal sector. Traditionally and culturally, because women are supposed to contribute to housework without payment, their labor is considered as inherently inferior.

Table 35. Percentage of women in S&T research in Sri Lanka.

<table>
<thead>
<tr>
<th>Fields</th>
<th>year</th>
<th>Women in research (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2006</td>
<td>2008</td>
</tr>
<tr>
<td>Natural science</td>
<td>48</td>
<td>38</td>
</tr>
<tr>
<td>Agriculture</td>
<td>40</td>
<td>44</td>
</tr>
<tr>
<td>Engineering</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>Medical science</td>
<td>46</td>
<td>50</td>
</tr>
<tr>
<td>Social science</td>
<td>47</td>
<td>42</td>
</tr>
</tbody>
</table>

Note: The percentages are retrieved from the head count of the women and men.

3-3-10. Turkey
In Turkey, percentage of women in the workforce is 28% (29% by UIS data; less than half the European Union average) and far less than most other countries in Asia, resulting in serious disparity of income. Percentage of women in scientific research is not specified in the country report of Turkey and is 36% from UIS data (Figure 3). Figure 9 shows that the percentage of female teaching staff at higher education institutions has increased over the last 90 years, from less than 10% to over 40%. Several factors influenced this progress towards gender equity, such as a) a positive discrimination policy in education which was implemented in 1914, b) women have gained the right to lecture in universities since then, providing role models, c) a favorable shift in...
attitudes to regarding academia as career option for women and d) family support for women who are in academic careers.

Although 42.8% of academic positions in all fields are occupied by women, disparity becomes greater at higher levels: 61.8% of lectures, 39% of assistant professors, 34% of associate professors and 28.8% of full professors are women (Table 36). Even though there is no salary gap between men and women for the same positions, disparity in the hierarchy creates a disparity in income. Data for professors specifically in S&T fields is not available in the country report. Still the percentage of female professors in Turkey is higher than that in other countries in Asia.

Table 36. Percentage of women in university positions in 2013 (Turkey).

<table>
<thead>
<tr>
<th>Position type</th>
<th>Total in all fields</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>20,164</td>
<td>5,804 (28.8)</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>13,042</td>
<td>4,438 (34.1)</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>31,376</td>
<td>12,230 (39.0)</td>
</tr>
<tr>
<td>Instructor</td>
<td>19,392</td>
<td>8,343 (43.0)</td>
</tr>
<tr>
<td>Specialist</td>
<td>3,648</td>
<td>1,775 (48.7)</td>
</tr>
<tr>
<td>Lecturer</td>
<td>9,917</td>
<td>6,130 (61.8)</td>
</tr>
<tr>
<td>Research Assistant</td>
<td>44,099</td>
<td>21,870 (49.6)</td>
</tr>
<tr>
<td>Total</td>
<td>141,638</td>
<td>60,590 (42.8)</td>
</tr>
</tbody>
</table>

Source: Turkish Republic Measuring, Selection and Placement Centre. 2014.

3-4. Work versus family

Across the world, in developed and developing countries alike, women take on the majority of domestic duties even when they work to advance their careers. In most Asian-Pacific countries excluding the Philippines, women’s participation in the S&T work force is much lower than 50%.

Table 37 shows that in Korea marriage dramatically influences work participation for female but not male scientists. Before marriage, work participation is nearly equal between men and women. In natural science and engineering, the work participation of women exceeds 84%. However, the average participation of women decreases drastically after marriage to 52%, sharply contrasting with 93.1% for men.

In India the percentage of women steeply drops between the doctoral and professional stages, and it is considered partly due to the social pressure on women to get married and then choose family over professional career (data not shown). The proportion of women scientists who never married (14%) is higher than that of similar male scientists (2.5%) suggests marital status affects more negatively on women than men in their career. The study by the Indian Academy of Science (IASC) and National Institute of Advanced Studies (NIAS) on the women who could not continue in Science after a PhD showed that they quitted because they did not find appropriate job or support. The normal perception that marriage and family is responsible for leaky pipe line needs some discussion and the leak may also have to do with other biases and effects than family reasons, such as patriarchal attitudes especially for married women in hiring practices.

Table 38 shows a science career development in the Philippines from a young science graduate to the National Scientists. Percentage of women
steeply decreases from 51~56% in BS graduate to 33.5% in Outstanding Young Scientists, which often associated with a young woman’s decision to focus on starting a family and not devoting as much time in developing the scientific career.

### 3-5. Leadership

Women scientists in leadership positions play a key role in increasing diversity of mentorship, and perspective for planning and decision making. Also having female scientists in leadership positions, such as deans, chancellors, and Academy members, as role models is also important for young women when they are making career choices. Among 10 countries in this report, percentage of women in each academy of science is very low: less than 8% except Philippines (23.8%), Sri Lanka (19.1%), Malaysia (16.8%), and Nepal (12.2%).

In Australia, women scientists and engineers are not in very high percentage but they had played significant roles as Vice Chancellor of Universities, Dean of Science/Engineering Faculties, Chairperson of various Science Departments, Head/Director of different Division/Institutes etc. Australian women have moved increasingly into University Administration since 1990s, and occupy the highest positions at the present. There are 16% female Vice chancellors (VC), and 34% in supporting positions like Deputy VC and pro-VC (Table 39). However, the positions for female scientists in universities and institutions are concentrated in supporting roles, and also there is a paucity of senior positions for women in science-linked companies (Table 40).

In the Bangladesh Academy of Sciences only 4 (6.7%) of the 56 Fellows are women. Women in Bangladesh very often face discrimination in every field of science and engineering. Especially in higher academic and scientific leadership positions, women are substantially underrepresented. At the top research or academic institutions, less than

---

### Table 38. Percentage of women along a science career path in the Philippines.

<table>
<thead>
<tr>
<th>Career Path</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS Science graduates</td>
<td>51~56</td>
</tr>
<tr>
<td>Outstanding Young Scientists</td>
<td>33.5</td>
</tr>
<tr>
<td>NAST Academicians</td>
<td>23.8</td>
</tr>
<tr>
<td>National Scientists</td>
<td>26.8</td>
</tr>
</tbody>
</table>


### Table 39. University leadership positions by gender (Australia)

<table>
<thead>
<tr>
<th>Leadership positions</th>
<th>Women (%)</th>
<th>Men</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCs</td>
<td>6 (15.8)</td>
<td>32</td>
<td>38</td>
</tr>
<tr>
<td>DVCs</td>
<td>60 (33.9)</td>
<td>117</td>
<td>177</td>
</tr>
<tr>
<td>PVCs</td>
<td>25 (33.8)</td>
<td>49</td>
<td>74</td>
</tr>
<tr>
<td>Deans/Executive Deans</td>
<td>76 (30.0)</td>
<td>177</td>
<td>253</td>
</tr>
<tr>
<td>Total</td>
<td>167 (30.8)</td>
<td>375</td>
<td>542</td>
</tr>
</tbody>
</table>

Source: FASTS. 2009.

### Table 40. Deans and executive deans by field and by gender (Australia).

<table>
<thead>
<tr>
<th>Fields</th>
<th>Women (%)</th>
<th>Men</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural and Physical sciences</td>
<td>5 (15.2)</td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>Information technology</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Engineering and related technologies</td>
<td>1 (6.3)</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Architecture and building</td>
<td>1 (16.7)</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Agriculture, environment and related studies</td>
<td>0</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Health</td>
<td>14 (30.0)</td>
<td>33</td>
<td>47</td>
</tr>
<tr>
<td>Education</td>
<td>15 (60.0)</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Management and commerce</td>
<td>10 (27.0)</td>
<td>27</td>
<td>37</td>
</tr>
<tr>
<td>Society and culture</td>
<td>24 (36.9)</td>
<td>41</td>
<td>65</td>
</tr>
<tr>
<td>Creative arts</td>
<td>4 (40.0)</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>2 (50.0)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>76 (30.0)</td>
<td>177</td>
<td>253</td>
</tr>
</tbody>
</table>

Source: FASTS. 2009.
1% of the top executive positions are occupied by women. There are only two female Vice-chancellors and one female Pro Vice-chancellor (among 37 public universities and 80 private universities) even though there are many qualified and experienced women (Choudhury, 2009, 2010). Women’s leadership in professional societies, for example, Bangladesh Physical Society (BPS), is low: 7.57% of women are Fellows whereas that in other categories is about 15%. There has been no female president in the history of the society (Table 41).

In India, 31.0% (1,334 of 4,304) of the government funded research projects were led by women in 2010. During the 10 year period up to 2010, the portion of women increased from 13.0% to 31.0% (Figure 10). However percentage of women fellows in the three Academies of Science in India, the Indian National Science Academy (INSA), Indian Academy of Sciences (IASc) and the National Academy of Sciences (NASI) is only about 5%.

Table 42 shows the percentage of women in leadership positions in science and engineering, such as team leaders and administrators, in the years 2006~2013 in Korea. In 2013, 7.1% of positions were filled by women: 11.3% in S&E universities, 8.6% in public research institutes, and 5.2% in private research institutes. Although the numbers are small, there is a small increasing trend in both public and private research institutes.

Similarly, Korea still has a long way to go in regards to female principal investigators. In 2013, only 8.8% of the principal investigators in the science and engineering departments of Korean universities were women, while this number was 10.2% and 7.3% in public and private research institutes, respectively (Table 43). Part of the reason that Korea is doing so poorly in the area of female representation in leadership is that women only account for 13.7% of all regular positions and 33% of non-regular positions at these organizations (Table 25).

### Table 41. Number and percentage of female physicists in the Bangladesh Physical Society.

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fellow</td>
<td>66</td>
<td>5 (7.57)</td>
</tr>
<tr>
<td>Honorary Fellow</td>
<td>7</td>
<td>1 (14.28)</td>
</tr>
<tr>
<td>Foreign Member</td>
<td>14</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Life member</td>
<td>847</td>
<td>131 (15.46)</td>
</tr>
<tr>
<td>Member</td>
<td>457</td>
<td>70 (15.31)</td>
</tr>
</tbody>
</table>

Source: BPS, 2015.

### Figure 10. Number of R&D projects supported by central S&T agencies by gender (India).

Source: DST of India, 2012.

### Table 42. Percentage of women leaders and administrators in years 2006–2013 (Korea).

<table>
<thead>
<tr>
<th>Year</th>
<th>S&amp;E univ. (%)</th>
<th>Pub. res. Inst. (%)</th>
<th>Priv. res. Inst. (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>11.7</td>
<td>4.9</td>
<td>3.8</td>
<td>6.3</td>
</tr>
<tr>
<td>2007</td>
<td>11.8</td>
<td>4.8</td>
<td>3.9</td>
<td>6.2</td>
</tr>
<tr>
<td>2008</td>
<td>12.1</td>
<td>5.2</td>
<td>3.0</td>
<td>6.1</td>
</tr>
<tr>
<td>2009</td>
<td>11.9</td>
<td>6.0</td>
<td>4.3</td>
<td>6.6</td>
</tr>
<tr>
<td>2010</td>
<td>10.6</td>
<td>6.0</td>
<td>5.0</td>
<td>6.8</td>
</tr>
<tr>
<td>2011</td>
<td>11.3</td>
<td>5.9</td>
<td>5.0</td>
<td>6.9</td>
</tr>
<tr>
<td>2012</td>
<td>11.9</td>
<td>6.7</td>
<td>4.8</td>
<td>7.0</td>
</tr>
<tr>
<td>2013</td>
<td>11.3</td>
<td>8.6</td>
<td>5.2</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Note: The numbers are percentage of women in leadership positions which include team leaders and executives.
As shown in Tables 42 and 43, Korea has experienced a slow but steady increase in female leadership roles. The change may also reflect implementation of affirmative action policies.

The Korean Academy of Science and Technology (KAST), established in 1994, has 484 members, of which only 26 members (5.5%) were women in 2015. In 85 associations in science, engineering, medical sciences, agriculture, fisheries, food, and environment, there have been 1,646 presidents up to 2012, and only 8 (0.5%) of them were women (Table 44). The dearth of female leaders is partly due to the fact that there are fewer women scientists in older age groups than in younger groups.

In Malaysia, despite a high percentage of female professionals across S&T disciplines (~50%), the number of women at levels above Associate Professor is far from satisfactory. In the Academy of Sciences Malaysia, 47 (16.8%) of 280 members are women. Majority of 47 women are in the field of biology and related fields: biological sciences 15, medical and health sciences 15, environmental sciences 2, chemistry 9, physics 3, S&T 3.

In Nepal, there are very few women at the leadership level in academia, with the exception of Tribhuvan University, where 20% of the deans and 25% of the department chairs are women in 2014. Although progress is slow, women’s leadership is improving in Nepal. In the Nepal Academy of Science and Technology 6 (12.2%) of the 49 members are women, which is low but better than many countries.

In Pakistan, though the percentage of women in science and engineering is small, they had played significant roles as Vice Chancellor of universities, dean of science/engineering colleges, chair of science departments, and head/director of Institutes. Pakistan Academy of Sciences (PAS) established in 1953 has only 6 (6.8%) women fellows out of 88.

In the Philippines, although women received more than half of the PhD degrees (53.8% in natural science and 58.0% in engineering), women make up only 33.5% of Outstanding Young Scientists awardees, 23.8% of NAST Academicians and 26.8% of National Scientists. Still the situation is much better than other countries.

The status of women in the National Academy of Sciences, Sri Lanka is better than most other countries: 25 (19.1%) of 131 members are women.

### Table 43. Women principal investigators in years 2006–2013 (Korea).

<table>
<thead>
<tr>
<th>Year</th>
<th>S&amp;E univ. (%)</th>
<th>Pub. res. Inst. (%)</th>
<th>Priv. res. Inst. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>7.9</td>
<td>6.0</td>
<td>6.2</td>
</tr>
<tr>
<td>2007</td>
<td>7.5</td>
<td>6.5</td>
<td>8.9</td>
</tr>
<tr>
<td>2008</td>
<td>7.2</td>
<td>5.9</td>
<td>3.6</td>
</tr>
<tr>
<td>2009</td>
<td>7.3</td>
<td>6.3</td>
<td>4.6</td>
</tr>
<tr>
<td>2010</td>
<td>7.6</td>
<td>7.6</td>
<td>6.5</td>
</tr>
<tr>
<td>2011</td>
<td>7.3</td>
<td>8.8</td>
<td>5.8</td>
</tr>
<tr>
<td>2012</td>
<td>7.7</td>
<td>9.9</td>
<td>6.7</td>
</tr>
<tr>
<td>2013</td>
<td>8.8</td>
<td>10.2</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Note: The numbers are percentage of research projects led by women.

### Table 44. Women leaders in science and engineering associations in 2012 (Korea)

<table>
<thead>
<tr>
<th>Fields</th>
<th>Associations (#)</th>
<th>Total presidents in history (#)</th>
<th>Female presidents in history (#)</th>
<th>Female board members (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>15</td>
<td>336</td>
<td>1</td>
<td>4.47</td>
</tr>
<tr>
<td>Engineering</td>
<td>32</td>
<td>646</td>
<td>0</td>
<td>3.13</td>
</tr>
<tr>
<td>Medicine, Health</td>
<td>21</td>
<td>396</td>
<td>6</td>
<td>7.0</td>
</tr>
<tr>
<td>Agriculture, Fisheries, Food, Environment</td>
<td>17</td>
<td>263</td>
<td>1</td>
<td>2.76</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>1,646</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Note: Unpublished data by Na DS, Cho EH and others (2012).
Turkey is no exception in women’s leadership. Only 17 (8.3%) of 205 members of the Turkish Academy of Sciences are women, whereas they account for 29% of professors. The numbers include social science field and the percentage in science and technology is 4%. There are some women at higher levels as well: 11 university rectors, 3 of which are engineers, and 12 deans in engineering.

4. Good practices

4-1. Government policies

Promoting increased participation of women in science and technology is a multi-faceted task, which involves changing of attitudes from the family level up to the policy making at national or international level. Thus government involvement plays a crucial role. Governments of several Asia-Pacific countries have actively introduced policies and implemented legislation to ensure gender equality and promote female participation in science. But practical moves are required to make these legislative changes meaningful. For instance, constitution of Pakistan provides that “there shall be no discrimination on the basis of sex”, ensuring gender equality. Yet it is no secret that there is heavy gender bias favoring males in formal employment, illustrating the ineffectiveness of government edicts without concrete plans to back them up.

Many countries in Asia-Pacific region including Australia, Bangladesh, and Korea, there is no quota in government employment, but there are strict procedures for hiring and promoting, as well as maternity and carer leave provisions. The Malaysian government implemented a policy in 2011 ensuring that 30% of women are at the decision making level in the private sector. The interim constitution of Nepal also includes a section requiring 33% of women in every sector of the government services, but this has not yet been achieved in every area.

The government of Bangladesh recently formulated The National Science and Technology Policy 2011, which emphasizes participation of women in science and technology, promoting higher education for women, and ensuring their proper recognition in science organizations. Likewise, the Korean Government has taken steps to overcome the cultural concept of male dominance and to establish gender equality by legislation. The Government of Bangladesh envisages building a Digital Bangladesh by 2021, an e-state with e-governance, e-banking and e-commerce, e-learning, e-agriculture and e-health. Women’s participation in this sector has been given special importance. Women are increasingly involved in ICT industries and ICT based government and non-government organizations, and this has already increased confidence among the female community.

The Government of India announced in 2003 Gender Equity in Science and Technology to be the goal of its S&T policy. In 2013, the National Science, Technology and Innovation Policy (STIP) explicitly stipulated a goal of gender parity. Most Indian governmental programs, as well as programs of the private sector, provide a re-entry into working career for those who have had to take a mid-career break. Other programs provide an enabling and supportive framework for women in science, including scholarships for research in science, and internship for self-employment. In addition, there are government funded programs to increase the awareness about the issues of women in science. Also, the Ministry of Women and Children formulated National Women’s Development Policy in 2011. This includes providing special incentives to women in research and development (R&D), ensuring participation and empowerment of women in all areas of science education and research, providing opportunities to women in higher studies, research and fellowship under National Science and Technology (NST) programs.

The Korean government legislated an Act on Fostering and Supporting Women Scientists and Engineers in 2002, with the aim of promoting women scientists and engineers. The government also established the Centre for Women in Science, Engineering and Technology (WISET) to implement the...
objectives of this Act according to the consecutive 5-year master plans since 2004. Those policies ensure at least 30% participation of women in every government committee. WISET has many programs funded by the government to support and foster women scientists and engineers. WISET is responsible for collecting gender segregated data in science, technology, and engineering. In 2013 WISET collected headcount data of the male/female employees from 3,211 S&T related institutions: 272 colleges and universities, 184 public research institutes, and 2,755 private research institutes. This gender specific data, specific to S&T, related to higher education, employment positions and marriage, is rarely available in other countries, and provides detailed knowledge which is very useful for planning and establishing the empowerment policies and programs for women in S&T.

Perhaps the most effective of these legislative changes has been in the Philippines, where the empowerment of women was institutionalized in 1975, and the country established the National Commission on the Role of Filipino Women (renamed the Philippine Commission for Women in 2009). One of the main functions of the Commission is to ensure further equality between women and men. After the People Power Revolution in 1986, followed by the election of Corazon Aquino as the first woman president of the Philippines, a new Philippine Constitution was ratified, which stipulates that The State recognizes the role of women in nation-building, and shall ensure the fundamental equality before the law of women and men. The Magna Carta for Women, or Republic Act 7910 was established in 2009 to specify Filipino women’s rights, and it is an exemplar for governmental policies. It promises equal access and elimination of discrimination in education scholarships, and training and women’s participation in the formulation, implementation, and evaluation of policies, plans, and programs for national, regional and local development. This Act provides for affirmative action, including the incremental increase in the number of women in managerial and executive positions to achieve a 50-50 gender balance, and the inclusion of at least 40% membership of women in all development councils from the regional, provincial, city, and municipal levels.

Sri Lanka has been actively involved in trying to achieve the Millennium Development Goals adopted at the Millennium Summit of the United Nations in 2000. Sri Lanka has been an example of a success here, almost reached gender parity in education.

4-2. Women scientist organizations

Associations of women scientists are an instrumental tool to provide vast opportunities to develop academic abilities and training fields for female scientists. As the number of women scientists is much smaller than that of male counterparts, the same is true of women scientist organizations in each country. In many countries, associations of science and technology specifically for women have started establishing.

In Australia there are 5 organizations for promoting women in science: Australian Gender Equity (SAGE) Forum, a high profile group established by the Australian Academy of Science, Women in Science Enquiry network (WISENet), WiN Australia, Women in Educational Leadership (WIEL), and L’Oreal for Women in Science. The organizations are to support and encourage women to work in nuclear science, engineering and technology, or to provide support to women in and aspiring to educational leadership, or to make awards $25,000 fellowships to three outstanding young women scientists each year.

India also has several active organizations for women in science and technology. The Indian Women Scientists Association (IWSA), founded in 1973, has activities of socially oriented schemes and science based projects especially for girls, including programs to nurture young talent, as well as refresher courses for young school and college students. The DST Task Force, established in 2005, served as a focal point for Women in Science, its major achievement being the research
and interviews with many women all across India; and The WiS (Women in Science) Panel of IASc, established in 2003, acts as a source of relevant material and research, and maintains a data base of more than 2,500 Indian women scientists.

Korea Federation of Women’s Science and Technology Associations (KOFWST) was founded in 2003. At the start, it had only 4 member associations, but now it has grown to 48 members, spanning the full spectrum of science and engineering fields from basic sciences to industry and playing its role quite effectively. The major activities of KOFWST include conferences, forums, award programs, and publications. It facilitates networking and strengthens the leadership skills of the next generation of women scientists and engineers. KOFWST has played a leading role in organizing various international meetings, such as Asia-Pacific Women Science Leader’s Forum, Korea-China-Japan Women Leader’s Forum for Science & Technology, and Asia Women Eco-Science Forum, etc.

In Nepal, the women scientist organization called Women in Science and Technology (WIST) has 445 members working in the field of science and technology. Its motto is to empower women in science and technology and to provide knowledge to the people in rural and urban areas in Nepal.

In Pakistan there are several women scientist associations such as the Women in Engineering Forum of the Institute of Electrical and Electronics Engineers, and the International Organization of Pakistani Women Engineers which are trying to help women to develop scientific careers to their full potential. Some of the services provided/ sponsored and lobbied include the establishment of childcare centers, implementing flexible working hours and carrying out mentoring programs.

4-3. Academies and academic societies of sciences

Academies and academic societies of sciences can contribute immensely to encouraging and supporting women scientists to pursue science careers. They can boost the numbers and profiles of female leaders and role models in the field of science and technology, and provide opportunities for women scientists to develop their leadership skills.

Academies of science have a special responsibility to ensure that the talents of women are not lost. The Association of Academies and Societies of Sciences in Asia (AASSA) is in a pivotal position to encourage its member academies to do much more to promote and nurture women in science. AASSA held three joint workshops on Women in Science, and has established the Special Committee for Women in Science and Engineering to promote women in the region. Yet AASSA itself is a bastion of patriarchal privilege and expectations. It has never had a female office bearer, and at present does not have even a single female Board member. All but one country representative at the last AASSA meeting were male. It would be good to see AASSA set an example by promoting women leaders in the region.

Out of the national academies in the region, the Australian Academy of Science (AAS) takes the lead in measures to increase the participation of women in science and technology. AAS has traditionally had a very low percentage of women fellows (4% in 1999), but is making practical changes to remove conscious or unconscious bias against women in consideration of election to the Academy. The proportion of women elected in the last two years has trebled, to near parity with men. The academy also hosts an Early-Mid career Researchers Forum, which has a very high proportion of young women researchers, who have been very effective in lobbying for change in Australia. Also, the Academy offers many prestigious prizes that have been fairly equally distributed between women and men, which is very encouraging for young female scientists.

The Bangladesh Academy of Sciences held an international workshop on a mentor-mentee program in Dhaka in 2012 with the theme Challenges of Young Women Scientists (YWS) in New and
Emerging Sciences. The workshop, comprising 60 young women scientists as mentees (age less than 40 years) and 8 mentors from home and abroad, focused on technical and scientific challenges along with the social barriers that women face in pursuing a career in science & engineering.

The three Academies of Sciences in India have taken measures separately and jointly to redress the scarcity of women membership (~5%) in the Academies. INSA conducted a serious study and discussion of science as a career choice for women in India, and this led to the important report on Science Career for Indian Women: an examination of Indian women’s access to and retention in Scientific Careers. A series of workshops were held by NASI with a resultant report. IASc has a Panel on Women in Science (WiS) with a number of activities. Workshops are held all over the country in women’s colleges to encourage young women and to educate them and their families about the various options that are available today.

The Korean Academy and Science and Technology (KAST) established the Women Scientist Committee in 2014 to promote women’s leadership in science. KAST organized a workshop on the Gendered Innovation in Science and Technology and published the Voice of KAST on this issue. In 2015 6 (18%) of the 33 newly elected KAST members are women, resulting in the increase of percentage of women from 4.4% in 2014 to 5.5% in 2015.

Pakistan Academy of Sciences has only 6.8% female fellows, but it also has projects to help their women members.

Academic societies can also contribute to women in science, through giving women scientists access to academic networks. In Korea 13 academic societies in various fields, including Korean Chemical Society and Korean Physical Society, have the Women Scientist Committee.

Many international societies are specifically instituting policies to attract the talents of their women members. It is standard nowadays for the organizers of international conference to balance the platform by inviting women keynote and plenary speakers. Several international societies now provide support for women participants; for instance, the International Society for Molecular Biology and Evolution provides bursaries to cover childcare during conferences. It would be a simple matter for national and regional bodies in the Asia-Pacific region to emulate this support.

5. Challenges

A career in science is a life-long endeavor. For women it is much more difficult due to a patriarchal culture that considers the woman responsible for taking care of the family. This section describes major hurdles that women must overcome.

5-1. Culture

The biggest challenge to increasing the numbers and status of women in science and engineering in Asia, and one that underpins all others, is undoubtedly the subservient status of females in many Asian societies. From childhood, priority is given to males in all significant areas such as education, employment, and decision making. Traditionally, women are viewed as home-makers who shoulder household chores and raise children. This status quo still remains in traditional households, particularly among low income groups and those with low educational levels. These traditional views create social pressure for women to accept the responsibility for caring for the home and family. This ‘dual career’ is a burden on women as they are responsible for a major share of household chores and raising children while engaging in fields of their choice, including science. It is crucial to change these socio-cultural attitudes, and break down gender bias and stereotypes in families and the workplace.

5-2. Barriers to education

In some countries such as Pakistan, girls have much fewer opportunities for grade school education. In Pakistan almost 50% of girls drop out of school and few girls progress beyond the primary
schools. Poverty, marriage and motherhood emerge as common obstacles. The problem will only be completely solved when poverty is defeated. However, a number of schemes to improve the attendance of girls have been very successful in some countries. For example, the Parliament of Malaysia legislated a new policy for education of children in 2002. Under the provision, all Malay children that are eligible must be sent to school, and if they default, the parents will be fined RM 5,000 or imprisoned for up to 6 months or both. Sri Lanka and Bangladesh have also achieved gender parity in education promoting government-funded education of all its citizens.

A major problem in university education is gender disparity in science or engineering majors. In only 4 countries (Australia, Malaysia, Philippines, and Sri Lanka) women account for more than 50% of undergraduate students in these fields. In addition, the percentage of women in graduate schools, especially at the PhD level, is much less than among undergraduates. In most of the countries except Philippines, percentage of women in the engineering majors is far less than 50%. For example, in Korea in 2013 women account for 50.4% in natural science majors, but only 21.2% were in engineering at the bachelor’s degree level.

Another problem of educating girls in the grade schools is their avoidance of subjects necessary to pursue a career in science and engineering. Deeply-rooted gender biases and stereotypes reinforce the idea that women should not pursue careers in physical science and engineering, and this has a very real effect on the number of women in these fields. From young age, girls are often told that physical science and math are too difficult, and they should not enter such a competitive field. So females at all levels - from elementary school to professionals - often lack the confidence that their male counterparts possess.

Well trained teachers in science and technology, and innovative teaching methods which encompass day-to-day experiences, have been identified as important factors in encouraging girls to study science. In this respect, the introduction of IAP-sponsored inquiry-based (hands-on) science teaching methods in primary school such as *La Main à la Pâte* (from the French Academy) and *Primary Connections* (developed by the Australian Academy) demand active participation by all students, so removing some of the disadvantages faced by female students.

Mentorship of bright young women appears to be particularly effective in reversing this bias against studying physical science and technology. In Australia, India and Korea there are many outreach programs for encouraging female high school girls and college students to pursue their career in science and technology, such as mentoring workshops, tours to the research institutes, science fairs, and lectures by eminent women scientists.

5-3. Balancing work and family

Women typically take dual roles: a scientist by day and a homemaker and mother at night. The situation is hard to change without a real commitment by the government and institutions to mitigate the stress placed on working mothers. Scientific research is ever-demanding of time and attention and this is when the ‘dual career’ of science and families hit hardest. The challenge is not only to recruit sufficient numbers of talented women into science and engineering, but to retain them by treating them fairly, alleviating the burden of the dual careers and mitigating societal expectations. This responsibility falls most directly on the employing institutions, universities and research institutes, as well as funding agencies. There are many ways in which employing institutions can encourage and nurture the careers of their talented female employees. And there are some inspiring examples of best practice.

Policies on maternity leave and high quality childcare may help relieve women of their traditional workload and retain women in science as professionals. For example, India has a policy for women holding positions in governmental institutions, which entitles them to two years of support for childcare leave. Moreover, they can
take the leave at any convenient time until their children are 18 years of age.

The Australian system provides another example. The current government scheme provides 18 weeks of maternity leave paid at minimum wage of up to $570 per week. They have provisions that range from 12 to 26 weeks on full pay, and this can usually be taken for twice the time at half pay. Moreover, all universities in Australia guarantee a woman with a continuing position after maternity leave so that she will return to that position, or the nearest equivalent to it.

Bangladesh also has a favorable policy for maternity leave: six months leave with full pay and another six months without pay without losing the service seniority.

Korea has a similar system. One person of a couple can take up to one year of leave per child, any time before the child reaches age eight. Some universities operate ‘stop tenure clock’ system up to two years. There are childcare centers but good centers fall far short of demand. A factor that cannot be ignored is that the very competitive nature in schooling even before school age makes working mothers feel guilty and consider quitting their professions.

5-4. Leaky-pipeline and glass ceiling

Even in the countries where equality in education is achieved, equality in employment is quite distant. All over the world, women scientists are more likely to be employed in non-regular positions than regular positions, paid less, promoted less, and win fewer grants compared to their male counterpart.

The so-called leaky pipeline and glass ceiling phenomena are very serious in all Asian countries. The percentage of women in decision making positions is much less than that of all employees. Few women are in leadership positions in universities, research institutes, government, and governing or advisory bodies. Even in the Philippines where women’s participation in the S&T fields is larger than males, there are far fewer women in the leadership positions.

Women’s careers are often interrupted due to family reasons. Women are reluctant to apply for promotion and this contributes to a salary gap, whereby women are paid less for doing the same jobs as men. One recent study by Graduate Careers Australia found that male graduates earn 9.4% more than females with the same qualifications. The salary gap is closely related to the promotion gap in Australian universities and research organizations.

In Australia, there are several bodies carrying forward real action plans. Specific commitments have been made by major Australian funding bodies, such as the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC). Universities and research institutions, such as the Commonwealth Scientific and Industrial Organization (CSIRO), are also increasingly taking serious measures to eliminate discrimination in appointment and promotion, and to produce a family-friendly workplace. For instance, a leading medical research organization, the Walter and Eliza Hall Institute, has recently introduced a number of family friendly policies, including childcare support packages of $15,000 per annum, family and lactation rooms on site, technical support during maternity leave, and a stop-clock for contract renewal. A five-year start-up fellowship worth $1.25M has been established to attract new female laboratory heads.

6. Recommendations

Achieving gender equality and women’s empowerment in S&T is one of the major challenges in most countries in Asia. Many efforts have been made by the governments, universities, academic societies, and women scientist organizations. However we have a long way to go before gender equality and female empowerment become a reality. A list of recommendations from the 10 country reports and the discussions of the three AASSA workshops held in Baku, Azerbaijan,
Women in Science and Technology in Asia

New Delhi, India, and Izmir, Turkey, is presented below.

Recommendations for educators

1) Provide equal opportunities in science education for girls and boys and encourage girls in S&T education beginning at the grade school level.
2) Prevent gender bias by educating parents and teachers about gender stereotypes.
3) Encourage girls to study science and to pursue careers in science.
4) Adopt female friendly teaching methods for teaching grade school students.
5) Educate the public, parents and students that girls do equally well in mathematics and science.
6) Increase public awareness of science through programs such as Science Fairs.
7) Encourage female students to participate in research projects.
8) Organize workshops, planned visits, and meetings for female students with mentors.
9) Establish outreach programs to female students for career development.
10) Encourage women to pursue graduate studies, especially to the PhD degree.

Recommendations for policy makers

1) Create legislation to foster and support women in science and engineering.
2) Establish family friendly policies for women in the workplace.
3) Establish policies and procedures for ensuring equality in hiring & promotion.
4) Create measures to increase the percentage of women in research and academic positions, and the number of women in leadership positions in S&T.
5) Evaluate government programs in science and technology through a gender lens.
6) Collect and analyze the data necessary to design policy initiatives effective in meeting academic and professional needs of women researchers.
7) Establish funding mechanisms for the period immediately following family leave.
8) Establish funding for programs in academic organizations to support and foster women scientists.
9) Establish job-oriented technology education program for women.

Recommendations for universities and research institutes

1) Increase awareness that gender bias in the mindset of male leaders has great impact on cultivating women leadership.
2) Establish family-friendly policies, such as establishing child care centers on-site, and guaranteeing a return to a person’s original position after childcare leave.
3) Establish stop-tenure clock policies for female faculties.
4) Develop structured mentoring programs involving both male and female senior scientists.
5) Develop country specific outreach programs for female students, teachers, and science professionals.
6) Increase public communication efforts, especially for grade school students and their parents.
7) Promote more women into leadership positions.
8) Encourage flexible work schedules.
9) Establish part-time university education for women.

Recommendations for Academies and academic societies

1) Establish standing committees on women in science in Academies and academic societies.
2) Organize outreach programs and national and/or international meetings of female academicians and students and junior scientists.
3) Elect more female members and fellows, and increase women in all committees and programs.
4) Create a directory of women leaders who can be mentors and role models.
5) Establish funds for travel grants, short term
fellowships, and research grants for women at various levels.
6) Provide support for women participants to cover childcare expenses during conferences.
7) Organize a special session on women in science at scientific conferences.
8) Invite women as keynote and plenary speakers.
9) Nominate more women for committees, Academies, Awards/Honors and to other leadership positions.

These recommendations may seem overwhelming when taken all at once. Multiple countries with diverse issues have been discussed. In general the issues addressed by these recommendations are an attempt to cover all aspects of society, from the economic, social, psychological, to the political. Unfortunately, as presented here, the current system is tragically underutilizing the potential power of women in Science and Technology and thus crippling its own ability to succeed and create. In addition, it is clear that these recommendations will take effort, vision, and money to implement, and these resources are limited. However, as we look to the future it seems obvious that the benefits that they eventually accrue to Asia, and the world as a whole, will make those costs and efforts seem well worth it.

While not every reader may agree with all of the observations and recommendations made in this report, and certainly some entrenched institutions and organizations may even seem threatened, these observations and recommendations represent the start of a conversation which will have profound effects on humanity, both men and women.

We are pleased to begin this discussion.

7. Conclusions

The inequality of women, and the low participation of women in sciences, especially engineering and computer science, are worldwide concerns, as set out in the Introduction to this report and reiterated in other chapters. Not only does discrimination and lack of education deny women opportunities for economic security and a fulfilling career, but it robs the talent pool of a half of its potential in fields of endeavor critical for the development of modern nations. If Asia is to advance economically, technologically and socially, it cannot afford to waste half its brain power. As stated in the publicity for the L’Oreal-UNESCO prize For Women in Science, “The world needs science, and science needs women.”

A strong science and technology sector will alleviate poverty by promoting technological development, creating jobs, increasing agricultural and industrial productivity, and improving health; witness the remarkable developments in South Korea, and more recently in China. In addition, science and technology underpins our increasingly urgent attempts to manage unprecedented environmental threats by inventing clean and renewable energy sources, and understanding and monitoring biodiversity.

The tragic underutilization of women in science has received attention from many international and national agencies all around the world, and strategies that make a difference are in place in many institutions in developed countries. However, progress remains slow even in privileged societies. Obviously the problem is deep-seated and hard to change.

Asia and the Pacific represent a particular challenge. Home to more than half the people in the world, Asia includes both extremes of scientific development and social advancement. In many Asian countries, women have traditionally been excluded from education. Participation in the work force, and the status of women’s work, is much lower in Asia than in other parts of the world.

AASSA as a regional body of The InterAcademy Partnership, has responded to concerns about the dearth of women scientists in the region, and set aside resources for the first study of the status of women scientists in the region. As a body composed of science academies and with strong links to governments and international agencies (including the United Nations), AASSA is well
placed to tackle such complex and far-reaching questions.

This is the first time such a sweeping study has been attempted, and initially the members of the AASSA Special Committee on Women in Science and Engineering could not be sure whether it would even be possible to make meaningful comparisons between countries with such very different levels of development, educational access and attainment, and cultural norms. It is remarkable that the data and stories from ten different countries in Asia and the Pacific (chapter 3) should highlight the same systemic problems, despite the huge differences in development and in women’s cultural roles.

Data were collected from detailed country reports, prepared by representatives from ten different countries in the region; Australia, Bangladesh, India, Korea, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka and Turkey. These reports detailed common problems of access to education, competing demands from family, problems of discrimination for jobs and advancement, and the absence of women from senior and influential positions in science.

A theme that emerged strongly from the country reports was the exclusion, or discouragement, of girls and women from science education. This is different in degree, ranging from near illiteracy among women in some poor or rural regions to the preference for ‘softer’ non-science subjects in most countries. But the result in every country in the region is the smaller pool of women who are able to take on roles in science, and particularly senior positions where they might act as role models and mentors. Whether they are educated and independent women in Australia or Korea, or women living very restricted domestic lives in Pakistan or Nepal, they share the problems of lack of encouragement to tackle science from the earliest educational stage.

Thus a key requirement for advancement will be education of girls and women. Not only will a good science education prepare women for university studies and a career in science, but more generally it will alleviate their social situation. Educated women can contribute to the family finances, provide better care for their families, and encourage their daughters to go further in science and society. In addition, the education (in any field) of women is strongly correlated with falling birthrate globally, which means that with increasing educational opportunities, women will spend less of their lives being pregnant and caring for infants.

Discrimination against women in providing higher education, and appointing and promoting women in science remains a problem in most parts of Asia. Even in countries in which discrimination has been addressed, and even where positive discrimination programs operate, women remain at a severe disadvantage. This is apparent both from the low percentages of women in science overall, but particularly striking in the distribution of women in different fields. In every country women are strongly represented in health and social sciences, but are rare, or completely absent, in engineering, mathematics and computer sciences, fields which lead to more (and better remunerated) job opportunities.

The outstanding problems for women’s advancement, which underlie all the others, are the roles women are expected to play in all societies. Poverty is a critical factor in many regions of Asia, in which the education of girls is not deemed to be a good investment, but marriage and motherhood pose barriers in every country, rich or poor. Women share the problems of the expectations that they will be the homemakers and the child minders. In many countries this means they will be forever dependent on their husbands or fathers; in developed countries it means that they will suffer the burden of ‘two careers’, scientists by day and slaves to their husbands and families at night. These are universal and deeply entrenched problems for women.

Their effect is apparent as the ‘leaky pipeline’, which is remarkably similar across all countries and cultures, though starting at different base levels.
Even in countries in which there is no exclusion from education, the biological imperatives to bear and nurture children results in an inexorable drop-out of women in their thirties. In all countries, the proportion of women falls steeply after graduation, and declines inexorably with seniority so that the number of women professors and principal investigators is low in developed countries and vanishingly small in some developing countries. The reasons for this attrition have been studied in countries all over the world, with conclusions that are highly conserved between the most disparate situations. Marriage, motherhood and childcare emerge time and time again as an overwhelming cause of leakiness. Perhaps we can stop studying this problem, and instead do something to alleviate it.

Leakiness starts early, with interruptions to a career only just beginning to blossom, difficulties in securing and retaining a tenured position, and severe difficulties faced by women trying to re-enter the workforce after a period of family responsibility. This attrition continues throughout the careers of women, resulting in lower success in obtaining secure employment, lower rate of advancement, lower salary, lower grant success, and lower probability of election to Academies. The ultimate result is an extremely limited number of women leaders in scientific research and teaching, in scientific advisory committees, and university and scientific administration. It is recognized that women in leadership roles are important, not only to utilize the best talent available, but also as role models to extend the range of the possible for young women choosing careers.

There are many organizations of women professionals and women scientists in developed countries in the Asia-Pacific region, and these have played important roles both in providing a forum for women scientists to share their experiences and receive mutual support, as well as acting as lobby groups to suggest policy and practical changes. It is encouraging that similar groups are being established in developing countries in our region. They can encourage young women to enter the field and stick with it, and also to lobby for improvements in working conditions and a change in social expectations.

Against this depressing litany of discrimination and discouragement, it was good to seek out and celebrate examples of achievements and good practices in supporting women in science (chapter 4). Some of these moves have come from governments, some from individual institutions, Academies of sciences, and women scientist organizations.

Several countries in the Asia-Pacific region, for instance Bangladesh, Korea, Malaysia, Turkey, Pakistan, and the Philippines, have constitutionally enshrined anti-discrimination legislation. Other countries have recently enacted policies in line with the UN Millennium Development Goals to empower women. However, such legislation needs to be backed up by practical solutions. Some of the practical solutions adopted by governments include paid parental leave for new mothers (and fathers) and more flexible work practices, as well as guidelines for hiring and promoting science staff. Enacting such policies internally has seen changes in the participation of women on government boards and committees, whether by instituting a quota (for instance Bangladesh, Nepal and Malaysia have quotas of 33 and 30% for government employees) or by introducing stricter guidelines and surveillance for selection of candidates for government jobs (e.g. Australia and Korea).

An obvious opportunity for governments to make a difference is in education, which is largely under government control in most Asian nations. There are several ways that governments can readily remove barriers for the education of girls, beginning with the insistence that all children (boys and girls alike) must attend school (e.g. Malaysia). Free formal education for all children immediately removes the problem that in many poor or rural communities, families prioritize sending boys to school, whereas girls are considered a poor investment. This has promoted a tenfold rise in the female literacy rate in Nepal (though boys are
still well ahead), and has enormously increased the literacy of girls in Sri Lanka where nearly all children attend school. Some countries (e.g. Sri Lanka) have instituted part-time community-based education aimed at women, which has been enthusiastically adopted.

The governments in many countries all over the world have expressed alarm at the shrinking numbers of students (of either sex) opting for a science degree at university, and are actively exploring new methods of ‘inquiry-based’ primary school science education to change the attitudes of children to science from ‘hard and boring’ to ‘exciting and fun’. This benefits girls perhaps even more than boys, since it demands active participation of all students; the girls can’t just sit quietly at the back of the classroom.

Good, inquiry-based, engaging science education for children is, sadly, in short supply in our region, despite numerous calls to abandon the old-fashioned chalk and talk (that we know turn boys as well as girls away from science). IAP supports a Science Education Program (IAP SEP) that convenes education experts through four regional coordinators to share information and celebrate success stories. Two inquiry-based primary school programs are particularly outstanding: La Main la Pâte from the French Academy of Sciences, which is being trialed in several Asian countries, and Primary Connections from the Australian Academy of Science, which is now in 75% of Australian Primary Schools. A web-based high school program of the Australian Academy of Science is being modified for use in Indonesia. The success of these programs, and their take-up in other Asian countries, gives us hope that science academies can substantially help in engaging girls in science at young ages.

There are many examples of good practice in universities and research institutions in our region. Several universities now have policies that seek to eliminate or reverse gender discrimination. Setting goals for faculty appointments (e.g. 30% in South Korea) has been at least partially successful, as has been setting guidelines for the appointment and promotion processes, which are monitored by Gender Equity representatives (e.g. Australia and Korea). A longstanding problem for women has been the inflexibility of working hours and conditions, and these are beginning to be relaxed to admit periods of part-time work and flexible hours, which can greatly alleviate the two careers problem. A specific example is the institution of stop tenure clock programs, which take account of women faculty’s periods of absence for maternity and childcare leave. These changes are simple and obvious, and often quite cheap, and it is hard to understand the reluctance to adopt them.

Another strategy adopted by many universities is awarding scholarships and fellowships for women studying science, or young women staff who face career disruptions. While these are effective programs for a few lucky women, they are very small in comparison with the need. However, such scholarships and fellowships are increasingly seen as a win-win for the institution; for instance a prestigious 5 year PI program for young women to establish new laboratories in an Australian research institute attracts outstanding young women, and the presence of a new female principal investigator has an immediate ripple effect in encouraging young female PhD students and postdoctoral fellows.

Many universities, to bolster flagging enrollment in science, have instituted practices likely to be effective especially in encouraging women to study science, such as tours and science fairs (e.g. Korea), as well as support and mentoring of new students. As well as these policies, quite small changes have been instituted at several universities and research institutions that have made life for women staff and students less difficult. For instance, the provision of affordable childcare is a universal problem for women in science, staff and students. On-site childcare facilities and lactation rooms make a big difference to a woman caring for infants and young children.

There are now many organizations, both national and institution-based, that seek to increase communication and support among women
scientists. These organizations have been especially effective, at least on a local level, when they include senior women who can act as mentors. Specific examples of best, or at least enlightened, practices can be found within the science academies in the region, many of which have wrestled with the problem of how to boost the tiny proportion of women fellows. For instance, changes in the nomination process have greatly increased the pool of women nominees, and changes in the election rules have seen an immediate surge in the election of women to the Australian Academy of Science.

The main challenges to increasing the participation of women in science and technology in Asia are reiterated in chapter 5. These start with provision of educational opportunities for girls, which requires a very fundamental shift in attitudes to the role of women in society, as well as solutions of practical problems such as expense, safe transport to school, and suitable amenities for girls. In the workplace challenges are in recruiting and promoting qualified women, which require in addition to strong anti-discrimination policies, the will and means to enact them to balance genders in government, universities and research institutions, and reduce the gender pay gap. In order to plug holes in the ‘leaky pipeline’, the biggest challenge is to provide encouragement and support for women, particularly early in their careers when the demands of pregnancy and motherhood fall most heavily. Developing a high profile group of women leaders and role models in science and technology will require sustained support throughout the careers of talented women, as well as an attitudinal shift, both in society and in women themselves.

Each of these challenges has both an attitudinal and a practical aspect. The practical problems of attracting and supporting women in science are relatively easily solved, sometimes by the stroke of a pen, sometimes by funding specific local projects. Good progress has been made in many countries and there are now many success stories. However, changing entrenched patriarchal attitudes to the education of girls, and to the employment and advancement of women, will take a much longer and more sustained effort, and its success will depend on other factors such as alleviation of poverty. These social factors are inextricably intertwined, and plans to change one factor while paying attention to others can sometimes causes paralysis. Everything needs to happen at once.

The recommendations distilled from this report (chapter 6) recognize the interrelatedness of these factors, while separating recommendations directed to education, the public and society, policy makers, and academies and universities. Recommendation addresses the problems of inadequate education of girls at both practical and attitudinal levels. There are intensely practical suggestions for improving substandard education, and to beef up the science and technology content of courses even in primary school. The introduction of components such as computer science will pave the way for participation in the workforce. These are balanced with suggestions for increasing the confidence and raising the expectations of girls, as well as changing the value placed on girls’ education in the eyes of their families and communities.

Likewise, recommendations about women in the workforce include practical suggestions for creating women-friendly workplaces and equitable opportunities. This includes provision of affordable childcare and more flexible work practices, but also ensuring that women themselves are aware of their rights, and are eager to advance to leadership roles in their scientific and social communities. The potential role of policymakers in changing this landscape is addressed with demands for more investment in science in general, as well as for policies to increase the participation of women in decision-making bodies in both public and private sectors.

Importantly, these recommendations include a call to establish better data on women in science, and to monitor the success of new policies and projects. Since we are scientists, we recognize the value of evidenced-based decisions; we simply
have to know what works and what doesn’t.

The recommendations for universities and research institutes recognize the potential of these organizations as powerful forces for change. With the introduction of new policies for hiring and promotion, and simple measures to mitigate the double whammy of career and family responsibilities, they can nurture the careers of talented young women. Importantly, they can also provide examples of best practices, demonstrating the advantages to the institution as well as its female staff.

Academies, too, have huge responsibility for identifying and recognizing talented women. While some academies in our region need a shake-up and a wake-up, many are already taking their responsibilities very seriously, and have instituted new policies to seek and nominate women, and to include women in all their decision-making bodies. When these respected bodies truly value senior women, and encourage them to take on leadership roles in the institutions and in society, their respect and attention to outstanding women scientists will surely trickle down, and influence communities and families to value the eager, intelligent girls whose futures could enormously enhance the economic and social transformations that are happening in Asia and the Pacific.

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Women in Science and Engineering -
Australia Country Report

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1. Women in STEM education

Australia is a developed nation with a population of 23 million, largely urban. Literacy has been near 100% for both men and women for decades. Education is compulsory until the age of 15 (year 11), and 73% of students graduate from high school after 12 years of study. Performance indicators and retention rates are generally better for girls than for boys at all school levels.

The rate of university/college level enrolment is extremely high for both male and female students, such that 25% of the population holds an undergraduate degree (22% of boys, 27% of girls), and 5% a postgraduate degree (www.abs.gov.austats).

There have been many reports over the last decades highlighting the gender gap in professional employment, including science. There have been several reports specifically on problems of attracting talented women into science careers, and retaining them over the years. Largely these reports recommended gathering more information and figuring out ways to mitigate disadvantage. The practical outcomes have been rather marginal, although several universities undertook to provide scholarships (usually one or two) for women re-entering the workforce after caring for young children.

There is a persistent problem of retaining women in science. This is responsible for a dearth of women at higher levels of science, as well as on boards of science-linked companies.

This problem is typified by figures that show that, although women are equally, even over-represented in biological and physical science at undergraduate level, PhD and even postdoctoral and junior staff, their representation falls off dramatically in the more senior strata (associate professor equivalent ranks) of universities and research institutions, comprising only 17% appointments at the level of Professor/Associate Professor (Figure 1a).

The situation is much less propitious for engineering and IT, in which enrolments of female students is still pitifully low, and only about 15% of undergraduate degrees are awarded to females. The rate of attrition of these graduates is similar to that in the biological and physical sciences (Figure 1b).

This “leaky pipeline” has been acknowledged for decades. Many enquiries have been conducted at
all levels, and many recommendations made; but there has been little practical improvement. This is frustrating for women who have served on many committees over decades.

Women professionals account for about 40%, and science, engineering and information technology professionals about 20% of the Australian labour force.

CSIRO is even worse. The curve is similar; maximum employment of women is at initially very low, and falls off to zero (CSIRO) at the highest level.

The success of women in the prestigious Future Fellowship scheme is about 20% for both men and women. However, 36% of the awardees who receive the base salary level are women, while only 29% senior fellows are women.

Countless studies point to systematic barriers to females in science. These barriers are highest during the stage of a woman’s career when she must move from a junior position, usually in the lab of a senior scientist, and establish her own lab, with her own ideas and drive – and her own funding.

This stage is difficult for everyone, male and female, because there are far more trained scientists looking for stable positions than there are research positions. However, it is particularly pernicious for young women because this phase coincides with the stage of her life when she is very often caring for young children; hence there are inevitable breaks for maternity leave and child care and periods of part-time or sessional work, often teaching large classes.

2. Work verses family

Thus women typically juggle two careers; a scientist by day and a homemaker and mother at night. The realities of this dual role are hard to shake without a real commitment by government and institutions to mitigate the workload and stress placed on working mothers by these dual careers. Study after study recommends that the
burden can be mitigated by providing appropriate maternity leave and high quality childcare. Maternity leave is a need that is being addressed, while high quality childcare is still very limited.

**Maternity leave**

The current government scheme provides 18 weeks leave paid at minimum wage of $570 pw. The current government of Australia was elected on a platform that included very generous provisions for across-the-board maternity leave; six months replacement salary up to $75,000 (www.nsw.liberal.org.au/tony-abbott-coalitions-paid-parental-leave-scheme). This would over-ride all existing schemes. However, this move is unlikely to be passed into law, as it is seen to be too expensive ($5.5B), and too generous, particularly to high-earning women.

Most universities and research organizations have more generous maternity leave provision than the current government scheme, at least for women who have worked at the organization for a year or more.

Provisions at different universities and research organizations range from 12-26 weeks on full pay, and this can usually be taken for twice the time at half pay. In addition, unpaid leave can be taken for an additional 2 years. At some universities this leave can be shared between partners.

However, these provisions apply only to women with continuing positions, making the growing numbers of women on contracts and engaged in sessional employment a problem.

**Return to work**

Generous maternity leave is a two-edged sword because prolonged absence puts a woman at an insurmountable disadvantage in science. An ideal situation would be to provide women scientists with technical support to maintain their scientific program, and help with childcare so they can keep in touch with their laboratories even when their children are very tiny. Programs to assist women who leave the workforce can include fellowships for re-entry.

All universities in Australia guarantee a woman with a continuing position that she will return to that position, or the nearest equivalent to it. Some universities provide a “bonus” to mothers who return, usually of the order of 12 weeks’ pay. Several universities provide one or two re-entry scholarships for women returning after a long period of leave.

However, again, the may women on an expiring contract, or doing sessional teaching are generally not eligible for these provisions.

**Childcare**

The other essential ingredient to retaining women in science has been acknowledged to be the provision of high quality childcare. Yet childcare places have been in short supply in Australia for years, and women often have trouble organizing satisfactory day care reasonably close to home or work. Many reports have suggested the establishment of childcare onsite. Several hospitals, but few universities and research organizations, now offer onsite childcare for their workers.

### 3. Employment and salary gap

The overall rate of employment in Australia is also high for men and women (68% of men, 54% of women). The number of women employed has grown steadily from about 40% in 1980, although much of this growth is in part-time jobs (which have increased from 10% to 40%). Employment of women is highest among 20-24 year olds and 40-44 year olds, but continues to show a trough during child-bearing years (Australian bureau of Statistics 4102.0 Australian Social trends 2006).

There is also a lingering wage gap between men and women graduates over all careers. A recent study by Graduate Careers Australia found that male graduates earn 9.4% more than females with the same qualifications.

Regular pay at Australian universities is regulated
by enterprise bargaining across the whole sector, with very tightly defined expectations for each level, and increments between levels. Some staff members receive extra pay for “higher duties” (usually administrative), but bonuses are rare.

However, the concentration of women in at the lower ranks (Levels A and B) ensures a pay gap over the whole sector.

In the medical and biomedical sciences, a pay gap is also evident. Although base salary is regulated and uniform across the sector, salary loadings are not regulated and are highly gendered (www.griffith.du.audata/assets/pdf_file/oo3).

Thus the salary gap is really a promotions gap in Australian universities and research organizations. It reflects the historical paucity of women staff, and also their well documented hesitation to apply for promotions.

The success of men and women in the prestigious Future Fellowship scheme, is about 20% for both sexes. However, 36% of the awardees who receive the base salary level are women, while only 29% of senior fellows are women (science and technology australia.org.au/wp-content/uploads/2011/06/2009 report_wise).

4. Leadership roles

In every sector of the paid workforce in Australia, women are under-represented in leadership roles. In the Public Service, women comprise 57% of employees, but only 35% of board appointments. In federal Parliament, women occupy only 28% of elected positions in the lower house and 38% of the Senate. In law, 61% of graduates are female, but women occupy only 22% of senior positions and 16% of judges.

In corporations, only 8% of Board Directorships were women, and this had not moved for 10 years up to 2010, when the ASX Corporate Governance Council implemented a diversity policy that required targets to be set. A big effort to appoint women directors has led to an increase to 14% of directors, still rather short of the 40% target.

Since the 1990s, women have moved increasingly into University Administration, and are now represented in the highest positions. There are 23% female Vice-Chancellors, and 35% in supporting positions (Deputy VC, pro-VC). In 2002, only 21% of the VCs of the 38 Australian universities were women, and 36% of deputy and pro VCs. Women represented 37% of senior admin staff (Figure 2). Having women in senior positions makes a big difference to other women’s willingness to “put their hand up.” There are several female Deans of Science. However, as for academic positions, women are concentrated in supporting positions (sub-deans who add responsibility for students and courses to an already heavy schedule, and receive little extra remuneration).

In science-linked companies there is a dearth of women on boards.

There are many explanations for this. The road to promotion to leadership positions often requires multiple changes of location, which is often difficult to reconcile with the demands of husband and children. Women are also disadvantaged by a late start, and by reluctance to apply for high administration positions (half as many senior admin staff applied as men).

The career peak of a research scientist in Australia remains election to the Australian Academy of Science, modelled on the Royal Society of London. This Academy has been seen as a bastion of male privilege, with a mere 7% representation of women amongst its elected Fellows. However, a very major effort to rewrite the election procedures so that they do not intentionally or unintentionally disadvantage women has see a recent record of 9 female Fellows elected (out of 20) in the last two years. Between 2010 and 2014, the Academy Executive represented women almost equally, with (the first elected) female President, one of two Vice Presidents and the Secretary for Education and Public Awareness.
5. Women Scientist organizations

A report for FASTS (now Science Technology Australia, or STA) in 2009 (scienceandtechnologyaustralia.org.au/wp-content/uploads/2011/06/2009report_wise) recommended improving the evidence base by systematic reporting, and investigating “mechanisms that allow women to thrive and excel (not just survive)” in science, as well as identifying incentives for change, mapping career paths, eliminating barriers to women and advocated leadership from the government, but was rather vague about specifics.

In 2011, STA, with the Australian National Commission for UNESCO (UN Women Australia), ran a summit at Parliament House in Canberra on the issues of Women in Science and Engineering (WISE). This event was attended by scientists, engineers, university and research organization leaders, business leaders, research funders, policy makers and the media. Specifically they sought to address the female brain drain. Their communiqué (http://www.scienceinpublic.com.au/wise/detailedcommunique) includes a call to Australia’s leading research organizations and the major funding bodies to remove barriers to the promotion of highly skilled women and to increase incentives to encourage women to return to the workforce after maternity leave.

Organizations specifically promoting women in science

SAGE: The Science in Australian Gender Equity
Forum is a high profile group established by the Australian Academy of Science. Its brief is “to lead an effort to affect cultural change within the research community to better enable scientists, regardless of their gender, to thrive in our research community, and in that way, to help maintain the talent and highest standards for science in Australia.”

WISENet: Women in Science and Engineering network, established to increase women’s participation in sciences <www.mywisenet.com.au>

WiN Australia, local branch of WiN Global, an international organization that supports and encourages women working in applications of nuclear science, engineering and technology. <www.winaustralia.org>

WIEL: Women in Educational Leadership. To provide support to women in and aspiring to educational leadership <wiel.com.au>

L’Oreal For Women in Science, administered with the Australian Academy of Science <loreal.scienceinpublic.com.au>, awards $25,000 fellowships to three outstanding young women scientists each year. Each year there is an outstanding field of about 200 applicants, offering hope that the number of talented women in science is greatly increasing.

Organizations encouraging professional women in all fields, including science

WLA: Women and Leadership Australia. A national initiative to support the presence of women in business and community leadership roles. www.wla.com.au

Victorian Women’s Trust <vwt.org.au> was created by the Victorian state government, but became independent in 1993. Its role is advocacy, research, recognition. Here She Is is an online directory set up by Victorian Women's trust that recognises the talent and leadership of Victorian women <heresheis.org.au>

WEL: Women’s Electoral Lobby, national independent political organization to creating a society where women’s participation and potential are unrestricted, acknowledged and <www.wel.org.au>

6. Achievements and Best Practices

The issue of gender bias in science has received attention for decades in Australia, but there has been frustratingly little real action. It is very encouraging to see several bodies putting forward real action plans, rather than producing yet more reports about gender inequalities in Australia.

Research and funding bodies

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Specific commitments were made by major Australian funding bodies (eg ARC, NHMRC) and employers (CSIRO, Bureau of Meteorology, AIMS and the Australian Technology Network of Universities) and employers (IBM).

The National Health and Medical Research Council (NHMRC) has since conducted a study of women’s careers in health science (www.nhmrc.gov.au/research/women-health-science), and made several recommendations for research funding that goes some way to addressing the disadvantages to women applicants, including:

• part-time options
• allowing for career disruptions in grant assessment, permitting women to submit publications over any 5 year period, rather than the preceding 5 years
• gender equality on peer review panels
• monitoring institutional gender equity practices

Institutional action

Many reports recommended gathering more information and figuring out ways to mitigate disadvantage to women in science. The practical outcomes have been rather marginal, although several universities undertook to provide scholarships (usually one or two) for women re-entering the workforce after caring for young children.

Some science organizations in Australia have taken the lead in positive policies to recruit and support women scientists.

For instance, a leading medical research organization, the Walter and Eliza Hall Institute, has recently introduced a number of friendly policies (www.wehi.edu.au/about_us/gender) including:

• a five-year fellowship worth $1.25M for a new female laboratory head each five years
• childcare support packages of $15,000 pa; family and lactation rooms on site
• support for women to and attend meetings (with their children if necessary)
• technical support during maternity leave (essential for effective re-entry)
• stop-clock for contract renewal
• women in science lectures and mentoring

These policies have been immediately effective in attracting very talented women to the Institute, and supporting the development of their independent careers.

Academy action

The Australian Academy of Science has been concerned for many years. This problem was most obviously manifest by the poor representation of women among the elected Academy Fellows; up till 2013 it was about 7%.

The Australian Academy of Science, working with other stakeholders in Australian science, is committed to leading real change in recognition and support of women in the science sector.

Election to Academy Fellowship

Over many years, discussion swirled as to the appropriate measures to take, recognising that the problem lay, at least partially, in the small pool of senior women scientists in this country from which Fellows were chosen.

Many suggestions were debated, including making a quota of women fellows each year; this was vociferously opposed by the women Fellows, who asserted that a quota system would inevitably lead to two classes of Fellows, and that women fellows would be automatically assumed to be less strong.

A crisis came in 2013, when; not a single woman was elected, out of 20 new fellows. The Academy received very negative press, which may have helped us gain support among fellows for making changes in the way we nominate and elect fellows. This has been directed firstly at the problem of ensuring that the senior women in science are recognised and considered without gender bias.

The Academy has recently instituted measures aimed at removing conscious or unconscious bias...
against women in consideration of election to the Academy. This has necessitated many changes to the structure and the advice to sectional committees that consider nominations. These include:

- setting up a high level cross-disciplinary committee, chaired by the two Vice-Presidents, to identify potential women candidates
- charging this committee with identifying an appropriate Fellow to make the nomination, and ensuring that it is followed through
- changing the rule that each sectional committee can shortlist three candidates; now they can nominate three only if both genders are represented
- placing less emphasis on metrics such as h-index, noting that this disadvantages women who have had interrupted careers

These measures seem to have been immediately effective, greatly increasing the number of females nominated. This year and last the Academy elected 9 women fellows out of a total of 20, trebling the previous record.

Recognising excellence

The Academy of Science offers several prizes for early-career researchers as well as for more senior scientists. It is encouraging that the winners of these awards, for several years, have been fairly equally distributed between male and female scientists. Encouraging, too, are the numbers of applications, and their outstanding quality, for L’Oreal fellowships for young women in Science, co-sponsored by the Academy.

The Academy in keeps contact with the winners of all these awards, ensuring they are connected with the Early and mid-career research Forum that it supports, and inviting them to its annual meeting, to participate in Thinktanks and conferences.

Supporting women in science – SAGE

The Australian Academy of Science has recently established the Science in Australian Gender Equity (SAGE) Forum Steering Committee, to examine strategies that could address gender imbalance in the science sector.

The Forum is composed of key research stakeholders, including University leaders and directors of research institutions, representatives of funding bodies and professional science and education sectors. This very high profile committee is led by mathematician Professor Nalini Joshi and Nobel Laureate in physics Professor Brian Schmidt, and is strongly supported by Australia’s Chief Scientist Professor Ian Chubb.

The brief of this group is “to lead an effort to affect cultural change within the research community to better enable scientists, regardless of their gender, to thrive in our research community, and in that way, to help maintain the talent and highest standards for science in Australia.” Its plan of action is to:

- monitor and assess gender diversity in Australian scientific research organizations
- create and revise a code of Best Practice
- Guide the Academy and Forum stakeholders on how to best implement this code
- Motivate and scrutinize research organizations to adhere to best practice

The SAGE Forum held a workshop in July attended by representatives of many organizations, to identify critical issues, gauge sector interest, and explore how SAGE could operate in Australia. A follow-up workshop will be held this November, supported by the Australian Chief Scientist.

One of the models being seriously considered by SAGE is the Athena Swan initiative of the UK, which vets the policies of institutions according to women-friendly criteria, and awards Gold, Silver or Bronze ratings according to their performance (http://www.ecu.ac.uk/equality-charter-marks/athena-swan). Good ratings are now being hotly pursued by institutions in view of the necessity to satisfy funding bodies on equity issues.
Supporting women in science – Wikibomb

The Australian Academy of Science hosted an event in August aimed at improving the recognition of women scientists in Australia. Called a “Wikibomb,” scientists from many fields and institutions gathered at the shine Dome to increase the profile of women in science by writing or improving Wikipedia entries on Australian women scientists. 144 people are now writing or rewriting entries (Twitter at @Science_Academy, or hashtag #ozwomensc).

Supporting women in science – involving younger scientists

The Australian Academy of Science supports an Early and Mid-career Researcher Forum, composed of young scientists within 15 years of PhD completion (www.science.org.au/emcr-forum). The EMCR Forum has more than 3000 members Australia-wide, at least half of whom are female; women are also well represented in the leadership of this group.

Noting that the problems of women in science are most keenly felt by younger women scientists, EMCR has recently produced an excellent paper on “Gender equity: current issues, best practice and new ideas” (https://www.science.org.au/emcr-forum), in particular suggesting that major funding agencies “put in place a policy mandating that every administering institution (which includes all universities and most other research institutes) must have an effective gender equity program in place within three years, based on national benchmarks.” This is essentially the core of the Athena Swan strategy being investigated presently by SAGE.

Thus awareness of gender issues in science is very high in Australia, although performance somewhat lags behind.


Australian Department of Empyment, Education, and Work Relations (DEEWIR) selected higher education statistics. DEST special report FTE staff in AOU groups 2007.

Women in Science and Engineering in Bangladesh – Status and Future

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1. Executive Summary

Science & Technology serves as the engine of development of a country and an engine of change for the society. There is a direct correlation between development of a country and its practice of science and technology. For this purpose, women - along with men - should be given ample opportunities to enter into and excel in science, technology, and related professions. While women constitute half of humanity, even in countries where they have ready access to higher education, the number of women in education and particularly in science and more particularly studying mathematics, physical science, and engineering remains drastically below parity with that of men. The Inter Academy Council (IAC) report on Women for science and technology emphasized the role of women at all levels of advancement of the society and for sustainable development.

Among the developing countries of the Southeast Asia, Bangladesh has made visible progress and has recently attained the status of low-medium developed country from the level of least developed country. Women representing 49.4% of 158.5 million populations (47.5 million young) are marching ahead in many sectors for last few years. Young female literacy rate (ages 15-24) has increased from 27.15% in 1981 to 81.91% in 2012. In Bangladesh 57% of women (15 years and up) are economically active. In the Ready Made Garment industry which is the prime export of the country, 80% employees are women. At present 20% seats are held by women in National Parliament. In spite of such recent achievements, Bangladesh is still a medium human developed country with HDI of 0.554 with a low Adult literacy rate (59%). Science education in general is less popular compared to business studies because of demand in job market.

Percentage of women in science (30%) in Bangladesh is comparable with many of the developed countries.
The advancement of women in many sectors is quite satisfactory but enhancement of woman’s participation in Science and Engineering is still far from satisfactory. Women scientists and researchers in spite of hard work, sincerity and intellectual capability are still underrepresented in the policy making and scientific leadership positions in academic and research organizations. Scientific and technological advancement of a nation can only be achieved through equal participation of men and women. However, despite many disadvantages, women in Bangladesh are showing their excellence in many of the professional lives as scientists, engineers and medical professionals. Lower representation of women in academic faculty and scientific leadership positions in these fields and especially in policy making is a reality even though highly unjustified. The drive and motivation of women in science is demonstrated by those women who persist in academic careers despite all obstacles.

Enrolment of women (98.1%) in primary education in Bangladesh is higher than that of men (95.4%) and in secondary education 63.6% women compared to 51.6% men (UNDP, 2012). The enrolment of women increased as the education is free for women up to secondary level from. From high school to the highest academic positions, the representation of women in science declines substantially (Table 1). However at the university levels enrolment is purely on merit basis. In the 37 public Universities, seats are limited and for enrolment, the competition is open to both sexes. The gender distribution in teaching staff and the student’s enrolment shows an alarming disparity in male versus female ratio (Choudhury, 2009 C). Number of female students in both the public and private universities is less than 30% of the male counterpart. Many girls drop out after HSC and are not allowed to go to the University as there is no sex-segregated University. Teachers and students of different universities shows that Govt. universities had 6921 teachers with 15.1 % women teachers and 116397 students with 25.3% girls in 2005 which gradually increased to 18.1% and 31.2% respectively in 2009 (Table 2). The percentage of women teachers - as Professors in Bio-science is highest (26.9%) and lowest in engineering faculty (8.8%) while in case of Lecturer women represent 52.55% in Bio-science and 21.9% in engineering science (Table 3) of Dhaka University, the topmost university of the country. In the Bangladesh University of Engineering and Technology the percentage of female faculty has been gradually increasing since 2002 (BBS, 2010 and UGC Annual report 2010), rising from 14% in 2002 to 20% in 2010 (Figure 3). It is obvious from all the data presented in these tables & figures that the percentage of female teachers is significantly less than that of male teachers (Choudhury, 2010). The female student enrolment in agricultural sciences increased from 20% (2002) to 36% (2010) and also the teachers from 6.8% (2002) to 12.7% (2010) for women as shown in Figure 5 & Figure 6 [statistical yearbook, 2010, BBS].

The presence of women scientists in research organizations also shows significant disparity in terms of male female ratio in these organizations. Bangladesh made tremendous progress in food production. From a country with chronic food production deficiency, it has reached a stage where it has become self-sufficient in food production, with 40 million tons of food production in 2014. The contribution of women scientists in the agriculture research is very significant. However their numbers in the research system is far below the male counterparts. Table 4 shows the total number of scientists and women scientists (9.7% to 24.8%) in top four agricultural research organizations.

Another survey was carried out on the number of women scientists in the Bangladesh Atomic Energy Commission, a highly sophisticated R&D organization dedicated to research, promotion and application of nuclear science and technology for peaceful uses of atomic energy to achieve self-reliance for overall socio-economic development. The scientists are engaged in conducting nuclear science and technology based fundamental and applied as well as advanced research programmes in various fields of physical, biological and
engineering disciplines; implementation of nuclear power programme; and transfer of nuclear technology based services to various stakeholders. Total number of scientists in BAEC is 460 of which 124 are women scientists. The percentage of women scientists at the top of the ladder in BAEC i.e. Chief scientists is 24.5% and in the lower category beginner scientist is 66.6 as shown in Table 5 [BAEC, 2014].

There are about 13% Women Ministers in the cabinet (Choudhury, 2009). The Prime Minister and Leader of the Opposition in the Parliament are both women for last 2 decades (Choudhury, 2010). Moreover Speaker of the parliament, deputy leader of the house and parliament whip are all women. Some of the Parliamentary Standing Committees Chair, few judges of High court and Supreme Court and few Secretaries are also women. At present 20% seats in the Parliament are occupied by women. Women representation in civil administration and other professional sectors in Bangladesh are better than that in scientific profession (Table 6). Women in civil service administration were 15% in 2006 and 20% in 2010. In the higher rank (secretary) women representation is only 5% whereas women in lower rank (assistant secretary) is 33% (BBS, 2010).

Women scientists in Bangladesh participate in professional societies and Table 7 represents status of women physicists in Bangladesh Physical Society (BPS). Only 7.6% are Fellows and average participation in other categories is about 15%. Woman physicist will get an executive post like vice-president or secretary occasionally but never the post of president even though qualified. In the Bangladesh Academy of Sciences out of 56 Fellows only four are women Fellows. The Constitution of the Peoples’ Republic of Bangladesh ensures equal rights for women in all spheres of state and public life and also has stated special provision ‘in favor of women or children or for the advancement of any background section of citizen’. However in practice women in Bangladesh very often face discrimination in career in every field of science and engineering. A study undertaken to see the barriers limiting the appointment, retention, and advancement of women faculty in some of the universities, administration and other academic institutions (Choudhury, 2009, 2010) conclusively proved this situation.

In recent years government of Bangladesh has formulated some policies to reduce the discrimination against women in general and science and technology in particular. The National Science and Technology Policy 2011 has given special emphasis on participation of women in science and technology, promoting higher education for women at home and abroad ensuring their proper recognition in different scientific organizations. The Ministry of women and Children has formulated National Women’s Development Policy 2011 and has identified serious gap of women’s place in professional life. It has been identified that although quota system has been introduced in government jobs to empower women, women’s participation in government policy making positions has not been commensurate. An analysis of the statistics of male and female officials working in different organizations under the Ministry of Agriculture in 2014-15 fiscal year shows that only 5 percent of officers and 4.5 percent of staffs are women; Women’s participation in agriculture management is low and they also lag behind in the areas of management of agricultural inputs and its access.

The present Government has set the vision of building a “Digital Bangladesh” by 2021. Digital Bangladesh aims at an e-state combining with e-governance, e-banking and e-commerce, e-learning, e-agriculture, e-health, and so on. The vision encompasses much more and takes into account a strong correlation between economic and social development of a country and its proficiency in science and technology. Women’s participation in this sector has been given special importance. A knowledge based society, efficient management and skilled human resources for both male and female as well calls for extending ICT facility to every nook and corner of the country. In Bangladesh women’s involvement in
ICT industries and ICT based government and non-government organizations has increased and has changed the behavioral aspect of Girl’s & Women’s lifestyle resulting in confidence building in the female community.

Mentoring and guiding aspiring researchers is a way to inspire women to stay in science. Role models and mentors can provide objective counsel, and help a young woman scientist with her career choices. To that end an international workshop on “Mentor- Mentee” program was organized at Dhaka by the Bangladesh Academy of Sciences in 2012 with the author as Coordinator. The theme of the workshop was Challenges of Young Women Scientists (YWS) in New and Emerging Sciences. The workshop comprising with 60 young women scientists as ‘mentees’ (age less than 40 years) and 8 ‘mentors’ from home and abroad focused on the technical and scientific challenges along with the social barriers that women face in pursuing a career in Science & Engineering.

The workshop made some specific recommendations such as YWS should be inspired to achieve success in their research in their organizations and to create positive impact in their communities; for YWS who reach higher education and launch their careers, institutional policies such as mentoring, childcare and funding can influence their advancement along with the male colleagues and women scientists should be sensitized for self-actualization and self-realization of potentials. The interaction between mentor and mentees can help to promote young women scientists.

There are many challenges for women right from the beginning of education to the career development level at home and at working place. It needs concerted efforts on the part of all to break down biases about women scientists, ensure that young girls have the freedom and confidence to pursue careers in science, support students through every academic stage, encourage women at home and at working place create environment to attract women to professional lives, balancing family life, ensuring their security and help them in confidence building. Government should take specific steps to provide special incentives to women in the profession of research and development (R&D) activities that has been spoken in the National Science and Technology policy 2011 and ensuring women’s participation as well as empowering them in every sphere of science and technology related education and research. Efforts should be taken for International research collaboration, networking and the ability to communicate science among fellow women scientists and exchange of opinions among young female scientists and engineers in Bangladesh in order to develop their leadership through AAASA special committee for WISE; OWSD; WIP and other organizations. Government and Science Academies should come forward to initiate this kind of collaboration. Women succeed in science as a result of their own merit, initiative and drive. Family support, institutional support and most importantly government support are very important for women to succeed in their professional career.

2. Introduction

Recent advances in science and technology and a large number of scientists with a wide spectrum of skills, dedicated to new and innovative developments, have given a great hope for alleviation of hunger, poverty, malnutrition, unemployment and unhealthy living conditions of the teeming millions of the developing world. A productive life and a quality life for all irrespective of developed or developing country is a rightful demand of this science and ICT century. For this purpose, women—along with men— should be given ample opportunities to enter and excel in science, technology, and related professions. While women constitute half of humanity, even in countries where they have ready access to higher education, the number of women studying mathematics, physical science, and engineering remains drastically below parity with that of men. Talented and capable women are essentially turned away from these and other fields, and
the few who persist typically find themselves isolated and marginalized. As a result, the overall participation of women scientists and engineers in the workforce continues to be very limited, and these professional women seldom reach the top of the hierarchy—at universities, research organizations or policy making institutions in the government and private sectors and Bangladesh is no exception in this regard (Choudhury, 2009).

According to Inter Academy Council (IAC) report on Women for Science, science and technology—essential to the survival, development, and prosperity of humankind in the 21st century—are being deprived of the vibrancy that would result from the inclusion of a wider range of abilities, experiences, viewpoints, and working styles. Particularly on creating a strong foundation of science and technology in each of the developing countries, the report emphasized on the participation of women at all levels to this end. According to the report to achieve the goal of sustainable agriculture (Meyer, 2010), the current practitioners in developing countries, mostly rural women urgently need to become partners for introduction of modern scientific methods and technologies. Similarly, as women provide so much of the education and family care in the cities of the developing world, progress cannot be made without enhancing their skills and resources. Meanwhile, the full range of talents, perspectives, experiences, and skills of women scientists and engineers must be utilized to advance the science and technology enterprise itself, as well as to act as a channel for inspiring and teaching the huge number of less formally educated ones at the grass root levels.

Realizing that the low representation of women in science and engineering is a major hindrance to global capacity building in science and technology, the Science Academies and Scientific bodies initiated short-term project/workshops since 2006, for helping to remedy the situation. Women’s participation in science and technology professions must be encouraged to strengthen their role in the development of the country free from hunger, malnutrition and unhealthy environment, also gender discrimination where all people will share and use resources in a sustainable way through proper education involving men and women together is a must. Women’s participation must be encouraged both as educators and researchers for addressing different issues.

Bangladesh is often cited as a global model for sustainable economic development. Despite being one of the world’s largest in terms of population, and most prone to natural disasters as a result of global climate change, the country has maintained an impressive 6% plus annual economic growth trajectory during the past decade. Also worth consideration is the fact that Bangladesh’s economic rise has been steady despite its tenuous transition towards a stable democratic system and the bleak global economic climate. The government of Bangladesh has been commended worldwide for improving the lives of the poor, and particularly women. It has been recognized by the UN as being one of the few countries that is on track and has made “remarkable progress” towards meeting its Millennium Development Goals by 2015.

According to a number of reports, the country’s focus on giving women better health and more economic autonomy has had a significant impact on rural household incomes, poverty reduction and increased educational enrolment, particularly for females who usually lag behind males in the Global South. The Economist (Nov 3, 2012) notes that “both the boom in the textile industry and the arrival of microcredit have, over the past 20 years, put money into women’s pockets—from which it is more likely to be spent on health, education and better food.” The textile industry, as mentioned above in Bangladesh, is regarded as the key to its economic growth, employs nearly 4 million people, most of whom are women. There is an abundance of literature supporting the relationship between women’s empowerment in the economic sector in Bangladesh and the country’s sustained economic development trajectory. Women representing 49.4% of 158.5 million populations (47.5 million young) are marching ahead in many sectors for
last few years. The net enrolment rate of girls in primary education is 98.1% (2012) compared with 95.4% men and in secondary education 63.6% women compared to 51.6% men. 57% of women (15 years and up) are economically active. In the Ready Made Garment (RMG) industry which is the prime export of Bangladesh, 80% employees are women.

3. Status of Women in Science and Engineering

The development of a country is a continuous process and there is no easy formula for a magic transition. Men and Women must work hand in hand and must work hard. The status of women in science and education at the primary, secondary and higher levels in our country and ways and means of improving the methods of science education, status of women scientists in different sectors, their problems in career building in professional lives are prerequisites for improving the present situation. Overall a global comparison with our women in scientific profession has been included in the present study.

Despite many disadvantages, women in Bangladesh are showing their excellence in many of the professional lives as scientists, engineers and medical professionals. Lower representation of women in academic faculty and scientific leadership positions in these fields and especially in policy making is a reality even though highly unjustified. The drive and motivation of women in science is demonstrated by those women who persist in academic careers despite all obstacles.

Science Education

The state of science education in schools and colleges in Bangladesh is far from satisfactory. Science, what once used to be the most sought after subject at secondary, college and university levels in the country, is losing its appeal in an alarming shift of choice. Now-a-days science education is losing its importance, quality and priority to non-productive activity. The teaching methodology and teachers cannot inspire the serious and meritorious students to take up science for their higher studies. The status of women in science education in the country at different levels for the last couple of years are presented. At each stage of the academic ladder, from high school to highest academic positions, the representation of women in science declines substantially. As they move from high school to college, more women than men who have expressed an interest in science or engineering decide to major in something else; in the transition to graduate school, more women than men with science and engineering degrees opt into other fields of study.

Women Enrolment at SSC and HSC Levels

Enrolment of women (98.1%) in primary education in Bangladesh is higher than that of men (95.4%) and in secondary education 63.6% women compared to 51.6% men (UNDP, 2012). The enrolment of women increased as the education is free for women up to secondary level. However from high school to the highest academic positions, the representation of women in science declines substantially as shown in Table 1. Very few women enter the University for Higher Studies and a significant number drops out after HSC.

The enrolment of female students in both SSC and HSC has been increasing since 2006. But more girls seem to opt for business studies than science because of demand in job market. However, there is a small increase in the number of female students in science as well since 2006. This may be attributed to Science Education awareness program/workshop initiated by scientific professional bodies along with the media and other International Bodies.

Table 1. Women in science - academic ladder (Choudhury, 2010)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Students (%)</th>
<th>Teachers (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSC</td>
<td>45</td>
<td>25</td>
</tr>
<tr>
<td>HSC</td>
<td>40</td>
<td>22</td>
</tr>
<tr>
<td>University</td>
<td>23</td>
<td>15</td>
</tr>
</tbody>
</table>
**Women at University level**

In Bangladesh, there are 37 public and 80 private universities. 95% of the private universities offer mostly BBA, English, Economics and social sciences and major in basic science subjects are few and far between. In public Universities, seats are limited and for enrolment, the competition is open to both sexes. The gender distribution in teaching staff and the student's enrolment shows an alarming disparity in male versus female ratio (Choudhury, 2009 C). Number of female students in both the public and private universities is less than 30% of the male counterpart. Many girls drop out after HSC and are not allowed to go to the University as there is no sex-segregated University. India and Pakistan has few women universities. Enrolment of students in the public universities is purely on merit and the seats are limited.

Teachers and students of different universities are presented in Table 2 which shows that Govt. universities had total 6921 teachers with 15.1 % women teachers and 116397 students with 25.3 % girls in 2005 which gradually increased to 18.1% and 31.2% respectively in 2009 [University Grants Commission (UGC) 2010].

In general, percentage of student enrolment for women has not increased significantly though has a positive trend over 2005-2009 in the universities on the average.

Status of women in Science at the topmost universities of Bangladesh in different disciplines was studied. The percentage of women enrolled as students in science faculty and bio-science faculty in the University of Dhaka (DU) are presented in Figuer 1 and Figuer 2 which shows increase from 30%(2005) to 36 % (2009) in science faculty and more than 50(%) in bio-science faculty. Seats are limited and admission is purely on merit. Fewer girls are attracted to Math and Physics than in biology.

Number of students in Bangladesh University of Engineering and Technology, the topmost engineering university in the country is presented in Figure 3. There has been an increase of female students from 15% to 20% from 2002 to 2010 in BUET.

The Bangladesh Agricultural University (BAU) is the first university of the agricultural sciences established in 1961. There are four other agricultural universities. The number of female students in BAU are presented in Figure 4.

The female student enrolment in agricultural sciences increases from 20%(2002) to 35% (2010).

**Women Faculty in some Universities**

The percentage of women teachers - Professors, Associate Professors, Assistant Professors and Lecturers in different faculties of Science, Engineering, Earth science, Pharmacy and Bio-science faculties of

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**Table 2. Number of Teachers and students by type of universities (UGC data, 2010)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Types of Universities</th>
<th>Total teacher</th>
<th>Women (%)</th>
<th>Men</th>
<th>Total Students</th>
<th>Girls (%)</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Govt.</td>
<td>6,921</td>
<td>1,085(15.1)</td>
<td>5,836</td>
<td>116,397</td>
<td>29,475(25.3)</td>
<td>86,922</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>5,38</td>
<td>798(14.2)</td>
<td>4,840</td>
<td>88,922</td>
<td>20,621(23.2)</td>
<td>68,048</td>
</tr>
<tr>
<td>2006</td>
<td>Govt.</td>
<td>7,905</td>
<td>1,435(18.2)</td>
<td>6,470</td>
<td>124,129</td>
<td>45,408(36.6)</td>
<td>78,721</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>17,040</td>
<td>30,280 (2.4)</td>
<td>93,957</td>
</tr>
<tr>
<td>2007</td>
<td>Govt.</td>
<td>8,068</td>
<td>1,455(18.1)</td>
<td>6,613</td>
<td>139,983</td>
<td>52,917(37.8)</td>
<td>87,066</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>23,026</td>
<td>40,067(23.5)</td>
<td>23,026</td>
</tr>
<tr>
<td>2009</td>
<td>Govt.</td>
<td>9,163</td>
<td>1,656(18.1)</td>
<td>6,507</td>
<td>262,941</td>
<td>81,988(31.2)</td>
<td>180,953</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>5,710</td>
<td>1,701(29.8)</td>
<td>4,009</td>
<td>200,939</td>
<td>49,125(24.5)</td>
<td>151,814</td>
</tr>
</tbody>
</table>
Dhaka University are presented in Table 3 (DU Annual report, 2013-14).

The percentage of women teachers - as Professors in Bio-science is highest (26.9%) and lowest in engineering faculty (8.8%) while in case of Lecturer women represent 52.55% in bio-science and 21.9% in engineering science (Table 3) of Dhaka University, the topmost university of the country.

Similar data were obtained for Bangladesh University of Engineering and Technology (BUET) which is the best university for engineering sciences. The percentage of female faculty has been gradually increasing since 2002 (13%) to 19% (2010) in engineering science as well (BBS, 2010 and UGC Annual report 2010). However, it is obvious from all the data presented in these figures that the percentage of female teachers is significantly less
than that of male teachers (Choudhury, 2010).

The Bangladesh Agricultural University (BAU) is the first university of agricultural sciences of Bangladesh established in 1961. There are four other agricultural universities. The number of women teachers in BAU is presented in Figure 5. The ratio of women to men teacher increases from 6.8% (2002) to 12.7% (2010) [statistical yearbook, 2010, Bangladesh Bureau of Statistics (BBS)].

Women in some research organizations
Bangladesh made tremendous progress in food production. From a country with chronic food production deficiency, it has reached a stage where it has become self-sufficient in food production, with nearly 40 million tons of food production in 2014. Various steps taken by the government resulted in record production of major crops. There are 10 crop research organizations in the national agricultural research system and a large number of other organizations dedicated to agricultural research. Bangladesh was at one time was the largest jute producing country and jute is known as the Golden Fiber of the country. Recently,
genomic sequencing of jute has been discovered by a group of scientists led by a women scientist in collaboration with an expatriate scientist. This invention is treated as the prime success of agricultural sector of Bangladesh.

**Agricultural research organizations**

The contribution of women scientists in in the agriculture research is very significant. However their numbers in the research system is far below the male counterparts. Table 4 shows the total number of scientists and women scientists 9.7% to 24.8% in four research organizations.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Total</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BJRI</td>
<td>144</td>
<td>14 (9.7)</td>
</tr>
<tr>
<td>BARI</td>
<td>598</td>
<td>127 (21.2)</td>
</tr>
<tr>
<td>BRRI</td>
<td>161</td>
<td>40 (24.8)</td>
</tr>
<tr>
<td>BINA</td>
<td>105</td>
<td>11 (10.4)</td>
</tr>
</tbody>
</table>

BJRI: Bangladesh Jute Research Institute; BARI: Bangladesh Agricultural Research Institute
BRRI: Bangladesh Rice Research Institute; Bangladesh Institute of Nuclear Agriculture

Table 5 shows percentage of women scientists in BAEC. Total number of scientists in BAEC is 360 of which 124 are women scientists. The percentage of women scientists at the top of the ladder in BAEC i.e. Chief scientists is 24.5% and in the lower category beginner scientist is 66.6% [BAEC information, 2014].

**4. Women in leadership positions:**

It is essential to have women in leadership and decision making positions. In the present Government, status of women representation in policy making bodies is better than before. There are about 13% Women Ministers in the cabinet (2009). The Prime Minister and Leader of the Opposition in the Parliament are both women for last 2 decades (Choudhury, 2010). In addition Speaker of the parliament, deputy leader of the house, parliament whip are all chaired by women. We have few Parliamentary Standing Committees Chair, few judges of High court and Supreme Court, few Secretaries are also women. At present 20% seats in the Parliament are occupied by women.

Women representation in civil administration and other professional sectors in Bangladesh are better than that in scientific profession (Table 6). Women in civil service administration were 15% in 2006 and 20% in 2010. In the higher rank (secretary) women representation is only 5% whereas women in lower rank (assistant secretary) is 33% (BBS, 2010).
5. Women in Professional Societies

Women participate in professional societies and Table 7 represents status of women physicists in Bangladesh Physical Society (BPS). Only 7.6% are Fellows and average participation in other categories is about 15%. Woman physicist will get an executive post like vice-president or secretary occasionally but never the post of president even though qualified.

Table 6. Women in Civil Administration (BBS, 2010)

<table>
<thead>
<tr>
<th>Rank/Status</th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>Women (%)</td>
<td>Men</td>
<td>Women (%)</td>
</tr>
<tr>
<td>Total</td>
<td>3,416</td>
<td>676(15.0)</td>
<td>3,746</td>
</tr>
<tr>
<td>Secretary</td>
<td>63</td>
<td>1(1.6)</td>
<td>53</td>
</tr>
<tr>
<td>Addl Secre</td>
<td>83</td>
<td>0</td>
<td>88</td>
</tr>
<tr>
<td>Joint Secre</td>
<td>339</td>
<td>25(6.9)</td>
<td>314</td>
</tr>
<tr>
<td>Deputy Secre</td>
<td>1,299</td>
<td>172(11.7)</td>
<td>1,288</td>
</tr>
<tr>
<td>Sr Asstt Secr</td>
<td>1,108</td>
<td>206(15.7)</td>
<td>1,099</td>
</tr>
<tr>
<td>Asstt Secre</td>
<td>924</td>
<td>2,729(22.7)</td>
<td>904</td>
</tr>
</tbody>
</table>

Table 7. Women in BPS (BPS book of abstracts, 2015)

<table>
<thead>
<tr>
<th>Category</th>
<th>Total physicist in BPS</th>
<th>Women physicist in BPS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fellow</td>
<td>66</td>
<td>5(7.6)</td>
</tr>
<tr>
<td>Honorary Fellow</td>
<td>7</td>
<td>1(14.3)</td>
</tr>
<tr>
<td>Foreign Member</td>
<td>14</td>
<td>0(0)</td>
</tr>
<tr>
<td>Life member</td>
<td>847</td>
<td>131(15.5)</td>
</tr>
<tr>
<td>Member</td>
<td>457</td>
<td>70(15.3)</td>
</tr>
</tbody>
</table>

6. Bangladesh Constitution and Status of Women

According to Article 28 of the Constitution of the People’s Republic of Bangladesh

“i) The state shall not discriminate any citizen on grounds only of religion, race, caste, sex or place of birth ii) Women shall have equal rights with men in all spheres of state and of public life. iii) No citizen shall, on grounds only of religion, race, caste, or place of birth be subjected to any disability, liability, restriction or condition with regards to access to any place of public entertainment or resort or admission to any educational institutions. iv) Nothing of this article shall prevent the state from making special provision in favour of women or children or for the advancement of any background section of citizen.’’

The Constitution of the country also ensured equal opportunity for women in empowerment under Article 29. This article envisaged as follows: Equality of opportunity in public employment

But the practical scenario is different in science and technology sector. There is a strong underrepresentation of women in higher positions of academic and scientific leadership positions in Bangladesh. At the top research or academic institutions, less than 1% women are in the top executive position. In the academic front there are only two Vice-chancellors and one Pro vice-chancellor who are females (out of 37 public universities and 80 private universities) though there are many qualified, experienced and efficient women to occupy those positions. Although women scientists and researchers of our country are hardworking, creative and having high intellectual capabilities but they are still underrepresented in the policy making positions of scientific profession and education (Choudhury, 2009B, C)

Women in Bangladesh very often face discrimination in career in every field of science and engineering. A study undertaken to see the barriers limiting the appointment, retention, and advancement
of women faculty in some of the universities, administration and other academic institutions conclusively proved this situation (Choudhury, 2009, 2010).

7. Government Policies
A number of initiatives have been taken in general to uplift women status and integrate their role in the development of the country. These initiatives are in terms of legislation as well as non-legislations. But no conscious effort has been made for the enhancement of women participation in science and engineering.

National Science and Technology Policy, 2011
The government adopted a new science and technology policy in 2011. The policy has taken into account the present situation of women in science and scientific professions. An action in this regard plan has been formulated for the implementation of the NCST Policy 2011. Pro-women activities of the action plan are mentioned below:

• Providing special incentives to women’s professions in research and development (R&D)
• Ensuring participation and empowerment of women in all areas of science and technological education and research.
• Providing opportunities to women in higher studies, research and fellowship under NST (National Science and Technology) fellowship programs.
• Encouraging female students of school/college and members of science club to get involved in innovative activities organized by: National Museum of Science and Technology on science/seminars every year on World Science Day.

Promoting Women in Higher Education
Bangabandhu Fellowship has been re-introduced by the government with a view to creating a variety of qualified scientists, researchers and academicians in the field of science and technology through MS, PhD and postdoctoral research both at home and abroad. There is provision for scholarships for 54 PhD in foreign countries, 94 PhD in home country, 40 MS and 8 postdoctoral researches in foreign countries; in total 190 scholarships. Up to now 20 students have completed PhD abroad under this scheme of which 21% were women.

Under NST Fellowship programme, In the financial year 2012-13, 700 students were awarded for NST fellowship in Masters, MPhil and PhD programs in different universities, institutions in the country and this number has been increased in 2013-14 to 1001. Among them 336 recipients were women in the year 2012-13 and 529 in 2013-14.

Support for women scientists are increasing to some extent but yet too far from getting proper recognition. Government has introduced quota system to reserve employment for women. As regards the academic and research organizations are concerned the employment and promotion are based purely on merit cum seniority and no provision exists for separate consideration for women.

National Women’s Development Policy, 2011
To establish equal rights for men and women in areas of state and public life in the light of the Constitution of Bangladesh, the government has formulated the National Women Development Policy. The policy aims to ensure full and equal participation of women in the mainstream socioeconomic development; to bring up women as educated and skilled human resources; to recognize appropriately women’s contribution in socio-economic spheres; to innovate and import technology favoring the interest of women and discourage those act against the interest of the women and to provide support services essential for the development of women.

The ministry of Women and Children Affairs, headed by a women Secretary has identified the following gender gaps in the activities of the Ministry: Although quota system has been
introduced in government jobs to empower women, women’s participation in government policy making positions has not been commensurate. An analysis of the statistics of male and female officials working in different organizations under the Ministry of Agriculture in 2014-15 fiscal year shows that only 5 percent of officers and 4.5 percent of staffs are women; Women’s participation in agriculture management is low and they also lag behind in the areas of management of agricultural inputs and its access.

**Digital Bangladesh 2021: Women in ICT Education and Training Initiatives**

The present Government has set the vision of building a “Digital Bangladesh” by 2021. Digital Bangladesh aims at an e-state combining with e-governance, e-banking and e-commerce, e-learning, e-agriculture, e-health, and so on. The vision encompasses much more and takes into account a strong correlation between economic and social development of a country and its proficiency in science and technology. Women’s participation in this sector has been given importance.

A knowledge based society, efficient management and skilled human resources for both male and female as well calls for extending ICT facility to every nook and corner of the country. Therefore, high level of internet penetration has been planned for the development of ICT. Bangladesh Telecommunication Company Ltd. (BTCL), a government owned company is planning to extend its optical fibre connectivity up to 4,400 Union Parishad (UP) Centers in Phases. The connectivity will be used to install community e-Centers at the UP Complex so that the rural people can avail the online services from a single point. Therefore, government-owned BTCL has greatly helped to increase IT-related activities and awareness in the country. In the rural context, ICTs provide update information that enhance opportunities to generate income and combat poverty, hunger, ill health and illiteracy.

In Bangladesh women’s involvement in ICT industries and ICT based government and non-government organizations has increased and has changed the behavioral aspect of Girl’s & Women’s lifestyle resulting in confidence building in the female community.

**8. Mentor-Mentee initiatives for Young Women Scientists(YWS)**

Mentoring and guiding aspiring researchers is a way to inspire women to stay in science. Women may at times be tempted to abandon their field because of self-doubt or to avoid competing with male co-workers who don’t face the same obstacles. Role models and mentors can provide objective counsel, and help a young woman scientist with her career choices.

An international workshop on “Mentor- Mentee” program was organized by the Bangladesh Academy of Sciences in 2012 with the author as Coordinator. The theme of the workshop was *Challenges of Young Women Scientists (YWS) in New and Emerging Sciences*. The workshop comprising with 60 young women scientists as ‘mentees’ (age less than 40 years) and 8 ‘mentors’ from home and abroad focused the technical and scientific challenges along with the social barriers that women face in pursuing a career in Science & Engineering. The main aim of this workshop was to develop a sustained relationship between experienced women scientists who give advice as mentors to less-experienced young women scientists i.e. mentees. There were panel discussions in themes such as Successes and barriers for women scientists in pursuing scientific dreams and Public communication for women in science. The panelists stressed the role of media in promoting science to the public as the number of science graduates are alarmingly dropping in last couple years as compared to business studies. An eminent scientist spoke about how to *Balance your life* in pursuing career and looking after family. How to become an entrepreneur in *Managing Research and Development- potential for commercialization* was discussed by eminent and established business persons. The workshop ended with group discussions in different groups with
topics such as, Issues related to career development, Issues relating to the setting up of mentor-mentee and Issues relating to what women scientist can do for other grassroots in achieving MDG goals. The mentors helped the mentees in presenting answers to what challenges do you feel in the given issue and how to address the issue.

Few recommendations were submitted to the Academy, such as: YWS should be inspired to achieve success in their research in their organizations and to create positive impact in their communities; YWS who reach higher education and launch their careers, institutional policies such as mentoring, childcare and funding can influence their advancement along with the male colleagues and Women scientists should be sensitized themselves for self-actualization and self-realization of potentials. The interaction between mentor and mentees can help to promote young women scientists.

9. Challenges of Women in Science

Deeply-rooted gender biases and stereotypes reinforce the idea that women should not pursue careers in science and that has a very real effect on the number of women in science.

i. From a young age, girls are told that science and math are difficult, and it’s unwise to pursue such a competitive field. Females at all levels—from elementary school to professionals—often lack the confidence that their male counterpart possess.

ii. Many times, a woman’s decision to pursue a degree in the science depends on whether anyone encourages her to do so—and especially if that person is a woman. It makes a big difference for women to see other successful female scientists and talk to them about their career paths.

iii. If girls are not actively recruited or given scholarships, many will be discouraged from attending graduate school altogether.

iv. How to balance a career with motherhood. Many women feel as though they can’t have kids before they achieve tenure, and if they already have families, there isn’t enough time or money to do both without some form of support (like childcare or research grants). Women and girls are not encouraged to choose scientific professional career in fear of losing them in family affairs.

v. Women in scientific professions face discrimination in terms of employment, promotion and retention within S&T careers.

vi. Whether in classroom at any level of study or professional career at any level, lack of support and encouragement from family and colleagues and friends and surrounding environment are important without which women may fall down from science and scientific fields at any stage of the ladder.

vii. As a society, we must make a concerted effort to break down biases about women scientists, ensure young girls have the freedom and confidence to pursue careers in science, support students through every academic stage.

viii. To encourage universities to increase the number of female professors and the Academies to include women scientists as Fellows.

10. Future Strategy for Women’s Participation in Science

In scientific research, women must be encouraged to work as both as researchers and within the evaluation, consultation and implementation processes. In S&T professions women must be encouraged to strengthen their role in the wider context of innovation and knowledge transfer. Research must address women’s needs as much as men’s needs. Research must be carried out to contribute to an enhanced understanding of gender issues.

Government should take specific steps to provide special incentives to women in the profession of research and development (R&D) activities
that has been spoken in the National Science and Technology policy 2011 and ensuring women’s participation as well as empowering them in every sphere of science and technology related education and research.

International research collaboration, networking and the ability to communicate science among fellow women scientists and others will help enhance women scientists’ visibility in science and technology. Collaboration can be initiated with International scientific communities for giving a chance to mingle and exchange of opinions among young female scientists and engineers in Bangladesh in order to develop their leadership through AAASA special committee for WISE; OWSD; WIP and other organizations. Government and Science Academies should come forward to initiate this kind of collaboration.

11. Conclusion
Greater participation of women is a must for the development of the country and utilization of new technologies. Strategies for the participation and leadership of women in national innovation systems must be emphasized. Gender dimensions effecting scientific development should be properly addressed. Science Academies should consider and make way to include more women scientists to work with men with equal opportunities. Science education at all levels, involvement of women in education, policy making, administration and development programs are highly essential for achieving any program of development. Science’s role in improving quality of life is now more prominent than ever. And according to the UN Education, Scientific and Cultural Organization (UNESCO), active inclusion and participation of women in science is crucial in countries’ efforts to alleviate poverty. Encouraging women to take part in science would allow any country to maximize its valuable human assets, empower its women, and improve its economic prospects. Women succeed in science as a result of their own merit, initiative and drive. Family support, institutional support and most importantly government support are very important for women to succeed in their professional career.

12. References


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Website of Bangladesh Bureau of Educational Information and Statistics (BANBEIS) http://www.banbeis.gov.bd/

Women Scientists in India

Rohini M. Godbole, Indian Institute of Science
Ramakrishna Ramaswamy, Jawaharlal Nehru University

1. Executive Summary

The importance of mainstreaming gender in all walks of life cannot be over-emphasized. This is not just to make sure that women get a chance to give expression to their creativity and abilities but also because it is essential for the balanced development of any society. In fact when considering women in science, it is even truer: research is a highly creative and individualistic activity and each person makes his/her unique contribution. The process of scientific development, innovation and discovery can only benefit from diversity, gender being just one component. Also given the fact that women are 50% of humanity, their intellectual potential is something that we can ill afford to ignore.

In India the situation of women in science is similar to other Asian countries, with some notable differences. India is a land of contradictions: it has had a powerful woman prime minister, a woman president, it has a large number of very highly accomplished women and at the same time it rates extremely low in the treatment of the average woman. There is considerable variation in different regions of India in their level of development, cultural outlook, as well large variations even within a given region, and in different economic and social strata. The variations tend to be lower for women in scientific careers, and thus it is possible to make some general statements that capture the overall situation.

Indian 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). However, prior to Indian independence in 1947, the numbers had been very low, even as a fraction of those who studied science. Since then however, Indian women have come a long way in terms of science education. Today they form almost 40% of the undergraduates in science, with engineering close second. Even among the Ph.D.’s in science, about 25-30% are women. There is a fair distribution among different subjects, with life sciences and chemistry dominating. In fact women participate in large numbers not just in learning...
science but they also form a significant fraction of science teachers in schools/colleges.

In India, the real attrition begins after the Ph.D. The fraction of women with successful careers in science and those who achieve top positions in research and/or administration is very small, independent of discipline. Of the 25-30% Ph. D.’s, the proportion in faculty is between 15 and 20%, and at higher levels the number further drops. The numbers are even lower with an increase in the reputation (as publicly perceived) of the Institution. Women heads of laboratories, science departments of the government, or as members of governing or advisory bodies are rare.

The perceived reason for the steady decrease in numbers is the inability of women to balance a family and career, the inherent assumption being that the family is solely the responsibility of the woman. For more than a decade, the Government of India has announced “gender equity in Science and Technology (S&T)” to be the goal of its S&T policy. A number of programs to provide ways for women to come back to science after a break have been introduced by different arms of the government as well as the private sector. In the 12 years of operation, 15% of the fellowship awardees have returned to science careers. Three different schemes are working satisfactorily but improvements are necessary and are possible. The Department of Science and Technology (DST) of the Government of India and the Science Academies conduct a series of mentoring workshops and surveys. The latter have led to several recommendations [3,4,5,12,14] that have been taken seriously and have been implemented where possible by the Government. Others need to be discussed, accepted and implemented, and to that end a Standing Committee of the Government of India was formed in 2006. This has not been functional so far. The three Academies of science in the country (NASI, INSA and IASc) have formed a Joint Panel for Women in Science and it is hoped that this will galvanize governmental action.

2. Introduction

In India as elsewhere, from about 1975 when the first United Nations World Conference on the occasion of International Women’s year was held in Mexico, till 1995 when the Fourth World Conference was held in Beijing, discussions on women mainly focused on empowerment of women through science and technology (S&T). In the early years Science for Women was more a part of our national S&T policies and not so much about Women in Science.

The Beijing declaration explicitly included improvement in Women’s access to Science and Technology as one of the targets, and the first IUPAP conference on Women in Physics [2] made recommendations for Governments, Academies, and Scientists to follow in order to achieve this.

Triggered by these recommendations in part, a serious study and discussion of science as a career choice for women in India was taken up by the Indian National Science Academy (INSA), and this led to the important INSA report on “Science Career for Indian Women: an examination of Indian women’s access to and retention in Scientific Careers” [3]. Around the same time, the Task Force for Women in Science and Technology (DST Task Force) was formed, and they also prepared a report [4] on the situation in India. Independently, a number of Indian Government Agencies put various measures in place to increase participation of Women in Science in India.

Here we will present statistics available from these earlier reports and give a summary of the situation including effects of the various schemes that have been put in place since 2000.

Although Indian women are not perceived as being incapable of doing science and engineering, their representation in these fields is small: the generic scientist is still perceived to be male. There are efforts to change this perception, but the change is slow, and there are few women scientists.

1 http://www.un.org/womenwatch/daw/beijing/platform/educa.htm
in positions of administrative power, namely as Institute Directors or University Vice Chancellors (some numbers are given below).

Immediately after Indian independence the fraction of women in universities was about 10% and those in the science were fewer than 5%. In 1950, university enrolment in the sciences accounted for about 20% of the total irrespective of gender. By 2000, women’s share in university enrolment increased to about 40% and appears to have plateaued at this level, as has the share within the sciences. This is true for average enrolments, although there are regional variations within the country.

Among graduating engineers, the number of women had increased by the end of the last century to about 10% from a negligible beginning in 1950. Globalization has caused a further increase in the percentage of women students in engineering since 2000. Many private engineering schools will boast of about 50% (or more) women enrolment in certain branches of engineering, although the numbers in the more prestigious engineering Institutes (like the Indian Institutes of Technology) still hover around single digits.

The numbers that are available in [3-9], as we will also see later, indicate that the fraction of women as recipients of an advanced degree decreases along the line of undergraduate degree in science (40%, 20% in engineering) to Masters (35%, with only 15% in engineering) and similarly for the Ph. D. Thus the fraction of women Ph.D. holders is not insignificant, but this is not reflected in the number of women faculty in institutions of higher education or research in science. The most significant drop in the leaky pipeline seems to be after the doctoral degree and not before.

The Indian National Science Academy took the first steps in conducting an early survey on the participation in science by women and brought out the report “Science Careers for Indian Women: an examination of Indian women’s access to and retention in Scientific Careers” [3]. This report and its follow up from the DST Task Force [4] reveal the following. While in Government establishments such as the Department of Biotechnology (DBT) and the institutions it supports and the Indian Council of Medical Research (ICMR) the percentage of women is as high as 25% to 30%, in the faculty of all the major research Institutions of the country and the universities, the percentage of women faculty in science is still 10% or lower [3-5,9] distributed among different disciplines in no specific pattern.

Women’s share of prestigious national awards or membership in the national academies is also low [3,4,9,10] although the biological and medical sciences have slightly higher numbers. However, the latter is still not commensurate with the much higher (greater than 50% at times) fraction in the student population in the subject. One should also add here that, in schools and colleges a majority of the science and mathematics teachers in India are women. The conclusions one can draw from these numbers, many of which will be presented in detail in the report below, are the following:

1. There is significant participation of women in studying science as well as in teaching science in schools and undergraduate colleges.

2. However this is not true of women doing science, namely involved in pursuing scientific research as a career.

3. The percentage of women faculty and students in science and engineering decreases with the perceived high status of the Institution as well as with increasing position of authority within the hierarchy.

The serious attrition as far as participation of women in science in India is concerned is during the transition from the pursuit of degrees in science to that of scientific careers.

The issue of participation of women in science has many dimensions and measures to achieve gender equity in science vary across cultures and societies. The remedies required to address this imbalance in India have to therefore be specific to the problems. As is clear from the discussion above, in the Indian context the issue is neither
about attracting young girls to science and engineering education nor about convincing them that studying these subjects is well within their abilities. The issue is more about how to attract women to a career in science and to retain the trained scientific womanpower in science.

In the context of women scientists and women science professionals in India the need of the hour is the creation of structures that can facilitate negotiation of a career in science in a professional manner while maintaining a career-family balance. These measures range from simple matters such as ensuring child-care facilities, to the difficult and somewhat ill defined task of creating awareness in society as a whole and not just among the women/girls, but their parents, their families, colleagues at work etc.

Below we present available facts and figures regarding access of women to higher education, careers in S&T, gender equity in employment and at work place. We then summarize data on women in leadership positions in science, science administration and within professional scientific societies. The different action-plans that have been put in place by the Government and special funding programs for women in science are then discussed, as are the actions of various groups that have been put in place by the government and the academies to address these issues. We conclude by noting best practices and recommendations that have emerged through these deliberations in the last decade and a half, and discuss strategies to achieve them.

3. Status of Women in Science and Engineering

Higher education

The drop in female enrolment between primary and secondary education, and between secondary and tertiary education is steep for mainly societal reasons. Our focus will be on tertiary education at the undergraduate and graduate levels. Access to these for the Indian population as a whole has increased in since 1947. We show in Figure 1, taken from R&D statistics of the DST for 2007-2008, the year-wise university enrolment of women in different disciplines. Enrolment in engineering has been lower compared to the Sciences.

Women’s share in the total enrolment has also increased. Tables 1 and 2, taken from [3] show that both the number of colleges and universities and also the fraction of women in science education have increased in the decades from 1950 to 2000.

The enrolment has not been uniform across disciplines as already seen in Figure 1. The growth in the fraction of women in S&T through the decades is shown in Figure 2 below (taken from [3]). As one can see sciences account for nearly all the enrolment while engineering accounts for a much smaller fraction, even till recently (the last data is from 1990-91).

The situation in engineering has changed somewhat in the last 15 years as a result of globalization. It is also interesting to compare the total fraction of

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of universities/university level institutions</th>
<th>Colleges</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-51</td>
<td>32</td>
<td>695</td>
</tr>
<tr>
<td>1960-61</td>
<td>56</td>
<td>1,542</td>
</tr>
<tr>
<td>1970-71</td>
<td>102</td>
<td>3,604</td>
</tr>
<tr>
<td>1980-81</td>
<td>133</td>
<td>4,722</td>
</tr>
<tr>
<td>1990-91</td>
<td>190</td>
<td>7,346</td>
</tr>
<tr>
<td>2000-01</td>
<td>256</td>
<td>12,806</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Total enrolment</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-51</td>
<td>396,745</td>
<td>10.9</td>
</tr>
<tr>
<td>1960-61</td>
<td>1,049,864</td>
<td>16.2</td>
</tr>
<tr>
<td>1970-71</td>
<td>1,953,700</td>
<td>22.0</td>
</tr>
<tr>
<td>1980-81</td>
<td>2,752,437</td>
<td>27.2</td>
</tr>
<tr>
<td>1990-91</td>
<td>4,924,868</td>
<td>29.2</td>
</tr>
<tr>
<td>2000-01</td>
<td>8,399,443</td>
<td>39.4</td>
</tr>
</tbody>
</table>
women enrolment in different disciplines in more recent times. Figure 3 below shows numbers for the year 2000-2001 taken from [4,7].

As mentioned above, women comprise about 40% of the undergraduate student body. In engineering, about 30% of the students overall are women but the fraction at the more prestigious technical institutes such as the IITs (Indian Institutes of Technology) is low. The fraction of women students appearing for the entrance examination itself is small and their success rate is even smaller. Thus the increase in the number of women

---

Figure 1. Growth in the absolute numbers of women with access to University education in STEM subjects from 1974-1975 to 2005-2006 [13].

Figure 2. Relative growth in women enrolment in Science and Engineering taken from [8].

Figure 3. Subject-wise distribution of the University enrolment in the year 2000-2001.
engineering students is not because more women are going to the IITs. In fact, usually the fiercely competitive nature of the admission process requires one to spend money and time to prepare for these examinations. Parents, on average, tend not to spend this for a daughter. Similarly, while the fraction of women medical students is about 45% in total, at the more prestigious institutes such as AIIMS (All Indian Institute of Medical Sciences) this percentage tends to be somewhat lower, and for much the same reasons.

The data in [3] (graphics in Figure 4 are due to S. Narasimhan) indicates that the numbers do not fall off steeply as the level of education increases. As many as 35% of the total Ph.D. awardees in science are women. Fluctuations are, of course, large. These numbers are for the year 2000-2001. One also sees that the fractions are not very different between Arts (Humanities and Social Sciences), Science and Medicine and that it does not go down drastically with increasing level of the degree as well. Figure 4 makes it clear that women in India have fair access to University education and higher studies.

Some caveats are necessary, though. All the quoted numbers are averages over the entire country. However, the cultural diversity of India implies that there are large fluctuations. In states such as Rajasthan, Arunachal Pradesh, Bihar or Orissa, the proportion of women in higher education is well below 35% while in others such as West Bengal, Kerala, Tamil Nadu or Maharashtra, the numbers are much higher, and with the national average being 40%. This speaks for the social and developmental norms in these states, and also provide some data where programs to encourage women are more essential.

**Gender inequality in employment**

The number of women on the faculty of institutions of learning and research as well as teaching is not commensurate with the fractions at the Ph.D stage, and furthermore, there is a decrease as one goes up the hierarchy at all these institutions.

In India there has been a near complete separation of research from undergraduate science teaching. Women participate in a major way in teaching science and mathematics in schools as well as in colleges but the percentage of women on the faculty of the high profile institutes like TIFR (Tata Institute of Fundamental Research), the IITs, or IISc is about 10-12%. Tables 3 and Tables 4 taken from [4] display these numbers for a variety of government laboratories as well as the high profile teaching and research institutes. (The full forms of the names of the research organizations that do not appear in the report itself are given at the end of this report.)

As one can see from Tables 3 and 4, apart from the Department of Biotechnology (DBT) and the Indian Council of Medical Research (ICMR) the percentage of women faculty is woefully low, particularly when one considers positions of Associate Professors and above! The picture is better at the entry level (Assistant Professors or Lecturers). The situation is starker when one considers leadership positions such as Directors/Deans of these Institutes and/or membership of Advisory bodies of these Institutes.

The premier teaching Technology Institutes of the country, the Indian Institute of Technologies also have a rather low fraction of women in faculty. In the two graphics below in Figs. 5 and 6 we show for example, the gender distribution of faculty
Table 3. Women scientists in various organizations.

<table>
<thead>
<tr>
<th>Organization</th>
<th>2004</th>
<th></th>
<th>2008</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total scientists</td>
<td>Women (%)</td>
<td>Total scientists</td>
<td>Women (%)</td>
</tr>
<tr>
<td>CSIR</td>
<td>5,030</td>
<td>13.0</td>
<td>4,556</td>
<td>16.05</td>
</tr>
<tr>
<td>DST</td>
<td>-</td>
<td>-</td>
<td>659</td>
<td>20.8</td>
</tr>
<tr>
<td>DAE</td>
<td>436 (TIFR)</td>
<td>16.5</td>
<td>4,173 (BARC)</td>
<td>15.0</td>
</tr>
<tr>
<td>DBT</td>
<td>179</td>
<td>31.8</td>
<td>208</td>
<td>27.4</td>
</tr>
<tr>
<td>ICMR</td>
<td>615</td>
<td>27.3</td>
<td>561</td>
<td>29.0</td>
</tr>
<tr>
<td>DRDO</td>
<td>-</td>
<td>-</td>
<td>6,890</td>
<td>14.0</td>
</tr>
<tr>
<td>DOD</td>
<td>127</td>
<td>8.7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ICAR</td>
<td>2,000</td>
<td>8.5</td>
<td>2,378</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Table 4. Women faculty in select universities

<table>
<thead>
<tr>
<th>University</th>
<th>2004</th>
<th></th>
<th>2008</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total scientists</td>
<td>Women (%)</td>
<td>Total scientists</td>
<td>Women (%)</td>
</tr>
<tr>
<td>IISc Bangalore</td>
<td>Academic: 316</td>
<td>6.6</td>
<td>Total: 330</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>Scientific: 113</td>
<td>9.7</td>
<td>Asst. Prof.: 91</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assoc. Prof.: 92</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Professor: 147</td>
<td>8.3</td>
</tr>
<tr>
<td>University of Hyderabad</td>
<td>Total: 101</td>
<td>15.8</td>
<td>Total: 135</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Asst. Prof.: 41</td>
<td>31.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assoc. Prof.: 32</td>
<td>40.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Professor: 62</td>
<td>8</td>
</tr>
<tr>
<td>Jawaharlal Nehru University</td>
<td>82</td>
<td>16</td>
<td>120</td>
<td>20</td>
</tr>
<tr>
<td>Delhi University</td>
<td>-</td>
<td>-</td>
<td>Sciences</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Asst. Prof.: 184</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assoc. Prof.: 22</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Professor: 85</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maths: 38</td>
<td>34.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Asst. Prof.: 8</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assoc. Prof.: 9</td>
<td>47.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Professor: 11</td>
<td>18.2</td>
</tr>
</tbody>
</table>

(as of year 2008) in various physics departments of different research organizations, IITs and Universities, as well as the gender distribution of faculty at IIT Madras (IIT-M). This shows clearly the low fraction of women faculty when one considers only engineering departments. (Both figures are due to S. Narasimhan, based partly on data from [10].) The conclusion that emerges is that the percentage of women faculty in pure engineering departments or in institutions with a focused mandate is small; in the Universities the fractions are better primarily because of diversity in disciplines that tend to improve the gender balance.

The situation may be different in some newer institutions like the IISERs though there has not been enough time to make firm statements. Cursory examination of the gender distribution of the faculty of these new Institutes shows that it is
marginally higher (17%) than the Universities and IIT’s.

Effects of marital status on work participation

The large drop in the number of women between the doctoral and professional stages appears to be, in part due to social pressure on women to have a family which is seen as incompatible with a professional career. There are also patriarchal attitudes in hiring practices, so many women are discriminated against at this stage as well, with administrators deciding that women “should” be opting for family over a career.

The proportion of women scientists who never married (14%) is higher than that of similar male scientists (2.5%), and further, the number of women scientists married to scientists (40%) is more than double the reverse case (19%). When speaking of work post-marriage, many scientists recounted that family support was not only essential, but that it enabled them to do better work or more work.

For women holding positions in governmental institutions, there is presently a policy that entitles them to two years of support for “child-care leave”, which they can take at any point until their children are 18 years of age. This is intended to help balance the pressures of maintaining a family and a career. The scheme has not been in force for long enough for any conclusions to be definitively drawn as of now.

Interestingly enough, the Indian Academy of Science (IASc) and National Institute of Advanced Studies (NIAS) undertook a survey which included women who could not continue in Science after a Ph.D., along with scientists of both
genders who had continued in science or related professions. In the survey all but the women who had had to leave, said that in their perception those who left had left due to family reasons whereas those who had actually left answered that it was because they did not find appropriate job or support. This survey, in spite of the small sample size, indicates that the normal perception that marriage and family is responsible for leaky pipe line needs further analysis: the leak may arise from other biases as well.

**Leadership role**

Given the fact that the fraction of women among practicing scientists is rather small it is clear that women will be scarce in top positions in institutional and governance structures. There have been outstanding women scientists who have made important contributions to science, but by and large, they have not been seen as leaders in scientific research. This situation is only slowly changing.

**Principal investigators**

The small fraction of women in faculty at institutions of higher education and research is reflected in grant applications to various funding agencies such as the Department of Science and Technology (DST), Department of BioTechnology (DBT) as well as to international funding programs. A large fraction of women scientists work in Institutes that come under Department of Space (DOS), Department of Atomic Energy (DAE), Defense Research and Development Organization (DRDO) or the Indian Space Research Organization (ISRO) where they do not need to make grant applications. The fraction of women as division and project heads in the above (DRDO, ISRO and DOS) is substantial, about 30%, and in fact the current head of the Integrated Guided Missile Development Program (Agni-IV) is a woman.

Outside the system of these special institutions the DST and DBT have made special efforts and introduced schemes to increase the number of Principal Investigators. In Figure 7 the relative number of Principal Investigators of different genders is shown. The data are from the DST annual report 2011-2012, as presented in [14].

The fraction of women principal investigators in the early years is about 11% reflecting their population in the faculties at research institutions and universities. There has been a steady increase in the absolute numbers of women PIs, and by 2010 the number was close to 23%. This steady increase in the ten-year period also coincides with the inception of the special funding schemes for women, which we will describe below in Section 4.

**Team leaders and administrators in academia and research institutes**

There are four major government agencies, which fund basic research in various areas: the DST, DBT, Department of Earth Sciences and Council for Scientific and Industrial (CSIR). In addition to these the Departments of Space and Atomic Energy (DOS and DAE) invest heavily in basic as well as mission oriented research. None of the secretaries of these departments so far (with one exception) have been women. Even the Program Advisory Committees of these departments have few women members,

There have similarly been few women directors of major research establishments. The All Indian Institute of Medical Sciences (AIIMS) has had only one woman director in its 60-year history given the large number of women in medicine, and this is also true for the Indian Council for Medical Research (ICMR). A woman has not headed the institutes listed in Table 4 so far. The prestigious Indian Statistical Institute, founded in the year 1931, now has its first woman director only now. The first woman director of the Indian Institute of Geomagnetism was appointed in 2005, after its establishment as an autonomous institute in 1971. Other institutions that have been headed by women at some time include the National Institute of Immunology, the National Brain Research Centre, and the Institute of Advanced Study in Science and Technology.
Of the 44 Central Universities in the country, no more than 4 are headed by women, and many of the universities have never had a woman vice chancellor or pro VCs. The situation is marginally different at State universities. The IIT Council (the Council which oversees the running of the Indian Institutes of Technology) has had its first women member this year.

The data shows that women directors of science institutes, whether in areas of Biological/Medical Sciences or in Physical Sciences are rare, and as heads of departments in universities and research institutes, they are not uncommon, but the fraction rarely exceeds 15% overall. In all, therefore, women’s participation in governance structures is fairly limited. With such low numbers, changes are difficult to bring about.

**The Indian Academies of Sciences and the World Academy of Sciences**

There are three Academies of Science in India: The Indian National Science Academy (INSA), Indian Academy of Sciences (IASC) and the National Academy of Sciences, India (NASI). There is also as the Indian National Academy of Engineering (INAE). Information about women’s presence in the three science academies as well as The World Academy of Sciences is available online.

The percentage of women in the fellowship for the IASC is 7%, for INSA it is 5%, the numbers being fairly similar in other academies. In TWAS as well, the percentage of women Fellows is around 7%. Table 5 shows the distribution among subjects for INSA, and this distribution of women fellows across the disciplines is very similar for all the academies (data not shown). Paradoxically, there were two women among the Foundation Fellows of the Indian Academy of Sciences, Bangalore in 1934, but only once has a woman been President of any of the Academies: Manju Sharma was President NASI for a two year period, 1995-6. The Councils have had women members and vice presidents, but the numbers have been limited in absolute and relative terms.

The three areas where we see larger representation

**Figure 7.** Gender participation in R&D projects supported by central S & T agencies, taken from the DST Annual Report 2011-2012 [14]
of women are medical sciences, biological sciences and mathematics. Thus merely increasing the fraction of women among eligible scientists may not be enough; additional biases and prejudices may be at work.

All Academies have a junior category of membership (up to the age of 35) and in this category the numbers for women have now started reaching 25%. This is the stage and age where the leaking of the pot is at its worst in India; so early intervention may lead to better recognition subsequently. Information about gender distribution for all the academies is available on the web page of women in science panel of the Indian Academy of Sciences: http://www.ias.ac.in/womeninscience/

Gender disparity in recognition is at its starkest in the topmost scientific award given to scientists below the age of 45 in India, the Shanti Swarup Bhatnagar Award. Out of the 461 awards given so far only 15 have gone to women: 4 in medical sciences, 2 in mathematics, none in physics, 3 in chemistry, 2 in engineering, 3 in biology and 1 in earth sciences. In other awards as well, the numbers are similar. Of the approximately 40 Infosys awards, 6 have gone to women so far, only 1 in the area of natural sciences. Among the medals of the INSA again about 7% of the medals have gone to women.

Indian women are thus hugely underrepresented at the highest levels of academic recognition and honours. They are also absent in leadership positions. The fraction of women making important contributions to research and technology development is much larger than these small numbers at the top would indicate: there are, of course, islands of excellence inhabited by women scientists, but these clearly need to grow.

### Academic associations

Academic associations for different subjects in India are at different level of maturity and no conclusions can be drawn from the available data. Hence we do not discuss this.

### 4. Government policy

#### Act on fostering and supporting women in S&T

The Science and Technology Policy of the Govt. of India of the year 2003, enunciates a commitment to promote the empowerment of women in S&T and ensure their full and equal participation. One of the actions taken was the INSA report and one result of the same was also the formation of a Task Force for Women in Science of the Department of Science and Technology (DST Task Force for Women in Science) which came up with a set of recommendations which were presented by the task Force members and a group of scientists to the Minister of Science and Technology in 2006. A recommendation made there was to form a Standing Committee of the Government of India for Women in Science; with an aim that one could structure government policies towards encouraging women in S&T. Such a committee was formed in 2009, but unfortunately it has not met yet. The community of women scientists needs to ensure that this committee is activated. The Government of India needs to take concrete steps to implement the recommendations of the 2013 National Science, Technology and Innovation Policy (STIP) that has gender parity as a stipulated goal.

#### Government funded programs

As stated earlier the first official enunciation of empowerment of women in Science and Technology as well as their full, equal participation

<table>
<thead>
<tr>
<th>Subject</th>
<th>Women</th>
<th>Men</th>
<th>Percentage for Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>17</td>
<td>52</td>
<td>25</td>
</tr>
<tr>
<td>Mathematics</td>
<td>6</td>
<td>64</td>
<td>8.5</td>
</tr>
<tr>
<td>Physics</td>
<td>4</td>
<td>116</td>
<td>3.3</td>
</tr>
<tr>
<td>Chemistry</td>
<td>1</td>
<td>117</td>
<td>0.08</td>
</tr>
<tr>
<td>Plant &amp; Animal Science</td>
<td>20</td>
<td>200</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>816</td>
<td>5.6</td>
</tr>
</tbody>
</table>
came in 2003 and it was further reiterated in the policy in 2013. However, some special programs to increase the participation of women in Science were already put in place by the DST beginning in 2003 and later, also by the DBT. The majority of governmental programs as well as by the private sector have been to provide a reentry for those who have had to take a mid career break to resume life as working scientists and/or special rewards/awards to women scientists to encourage participation in science/technology.

The DST presently has a division called ‘Science for Equity, Empowerment and Development Division’ (SEED). Various programs for women scientists by the DST (under the DISHA program) have been introduced with a view to provide an enabling and supportive framework for gender mainstreaming of women in science, technology and innovation. There are in practice three different types of programs:

a) Scholarship for Research in Basic/Applied Science (WOS-A): These are to encourage women to participate in research at the cutting edge in basic and applied sciences.

b) Scholarship for Research in S & T - based societal programs (WOS-B): Women scientists who apply for this scheme are required to develop their own project/proposals for disseminating science and technological solutions addressing issues at the grass roots for societal benefit through search, design, adaptation and demonstration of S&T skills and techniques for enhanced opportunities for income generation, drudgery reduction and capacity building in different occupations at the grassroots level.

c) Internship for self-employment (WOS-C): This was essentially put in place to target women entrepreneurs, while WOS-B aims to increase women’s participation in establishing development programs using women’s involvement in science. Since its inception about 930 special fellowships (including 1 year internships for women scientists to retrain themselves in a new area, which is included under WOS(C)), the total number of projects which have been granted under the schemes WOS (B) and WOS(C) are 525 and 405, whereas the number of women scientists who applied under these two categories are 3500 and 8861 respectively. Now the visibility of these programs have increased and this year in the first quarter some 650 applications have already been received for the WOS (B) scheme.

Consider WOS-A, which focuses on getting more women in research and teaching positions in Institutes and Universities. In the first three years of the program, a total of 3160 proposals were received for WOS (A) out of which 425 were sanctioned. The distribution across different disciplines is given below in Table 6.

In the first three years the response was very strong and most of the applicants were Ph. D. holders who had been spending time out of science. The larger number of women getting training in Life Sciences is reflected in almost an order of magnitude higher number of applications (and also successful grants). Since 2006, an additional 1671 projects have been granted under the scheme.

An interesting part of the scheme that was recently introduced is “DISHA-Mobility”. Through this scheme, women can continue involvement in science even if keeping the family together requires them to relocate within the country. Although not the most optimal

### Table 6. Number of applications received and granted in the first three years of WOS (A) program from 2003-2006.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Applications Received</th>
<th>Applications Granted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics/Mathematics</td>
<td>283</td>
<td>25</td>
</tr>
<tr>
<td>Chemistry</td>
<td>434</td>
<td>69</td>
</tr>
<tr>
<td>Life Sciences</td>
<td>1976</td>
<td>233</td>
</tr>
<tr>
<td>Earth/Atmospheric</td>
<td>199</td>
<td>27</td>
</tr>
<tr>
<td>Engineering Sciences</td>
<td>268</td>
<td>45</td>
</tr>
</tbody>
</table>
from a woman scientist’s perspective, this offers the possibility of continuing involvement in science in spite of family responsibilities. Indian administrative and banking services as well as mission oriented services like the Indian Space Research Organization (ISRO) and Defence Research and Development Organization (DRDO) follow the rule of transferring spouses together when both are employed in the same service. This certainly has helped women working in organizations. In fact India has had recently its first woman foreign secretary and the Indian banking industry its first woman president. For most of the women in science this cannot work so optimally but it suggests that a helping hand from the institutions can go a long way in helping women integrate family and career.

NASI and the DST jointly administer a newer version of WOS-B called KIRAN. They also held a series of workshops around the country in the Year of Science 2012-2013 and have recently formulated a report after interaction with about 5000 women scientists and students [14]. The recommendations arrived at in the various studies mentioned so far [3,4,12,14] will be summarized in the final parts of this report.

Through the years the DST program has been running vigorously and has led to an increase in the number of proposals from women PIs. This has in turn led to some women getting high-level faculty positions after a career break. About 15% of the women recipients of the fellowships have been able to return to a meaningful career in Science.

After ten years of implementation of this program the DST has now decided to include new elements such as special training programs for women who have had to leave science to gain other capabilities where they can utilize their knowledge in science as well as various mentorship and awareness workshops at various levels, addressing the student community, executives in industry or administrators in high level institutions etc. These are all government-funded programs to increase the awareness about the issues of women in science.

d) Biotechnology Career Advancement and Re-orientation Programme for Women Scientists (BiO-CARe).

The DBT has a useful and successful program to provide ways and means to encourage and empower women on the career path. They have instituted a number of awards and grants only for women working in biological sciences, specifically with a focus on biotechnology. These early career women-only grants started in 2011. About 200 grants have been given so far and about 50% of these went to women returning to a career after a break. Of these, 10% found gainful employment in scientific research. Furthermore, since 1999 the DBT has given special awards to junior women scientists, with substantial funding for research. The DBT also offers lifetime awards to senior women bio-scientists; in all they have offered 51 such awards since in 1999.

e) Golden Jubilee Biotech Park for Women:

The Women’s Biotech Park in Chennai was set up by the Department of Biotechnology in the year 2000 in order to provide opportunities for professionally qualified women to take to a career of remunerative self-employment through the organization of environment friendly biotechnological enterprises. This was registered as a society under the Registrar of Societies Act, on 8 July 1999, and to promote viable commercial projects based on the bio sources available within the state they have classified technologies into four broad segments: Agriculture, Food, Medical and Environmental biotechnology. Eleven entrepreneurs have been supported so far.

f) Efforts by the University Grants Commission (UGC)

The University Grants Commission (UGC) has also instituted five-year fellowships for women
to provide a pathway to reentry to programs in basic research. The UGC holds workshops (up to 10 each year) for women, not just for women in science, but also more generally for empowerment of women in academics.

5. Programmes in universities, research institutes, and academic societies

Apart from the programs set in motion by the DST there have been a series of measures taken by the Academies of science separately and jointly. The INSA report [3] as well as the series of workshops held by the NASI and the resultant report [14] were funded by the DST. INSA also held a joint workshop with AASSA in September 2013 on the subject of Women in Science. The Indian Academy of Science (IASc), Bangalore, has a Panel on Women in Science (WiS) with a number of activities. Workshops are held all over the country in women’s colleges to encourage young women and to educate them and their families about the various options that are available today. In fact in the next section we will give description of some of the initiatives of the WiS panel of IASc.

In fact, this interaction with International groups is a new and welcome feature. Recently, the DST organized a three-day meet to discuss the issues of women in science in South East Asia, and a half-day meeting specific to India with the British Council. In addition there have been specific Indo-US initiatives supported by the DST through the Indo-US S&T Forum. Three mentorship workshops were held in three different locations in India jointly by a team from US led by Prof. Geri Richmond and groups of Indian women scientists. Further the WiS Panel of IASc, the Indo French Centre for Promotion of Cooperative Research (IFCPAR), New Delhi and the French Embassy held a highly successful ‘Women in Science’ workshop, which has led to greater interaction and cooperation between women scientists of both countries.

There are a large number of very active Women's Studies departments in a number of universities in India. However, only a few of them focus on issues of women in science, notably those at Jawaharlal Nehru University (JNU), New Delhi, the University of Hyderabad, and S.N.D.T. Women’s University (Srimati Nathibai Damodar Thakersey Women’s University). In addition organizations like the National Institute of Advanced Studies (NIAS), also engage on research on women in science. It is interesting that two very useful projects came out of joint initiatives between the Academies of Science and these groups. For example, the INSA report [3] was a result of the cooperation between the INSA and S.N.D.T Women’s University (incidentally one of the oldest universities exclusively for women in India which has celebrated its centenary), whereas the survey: “What fraction of Trained Scientific Women Power are we losing and why?”[12] involved cooperation between IASc and NIAS.

Almost all research organizations and universities celebrate on 8 March, International Women’s Day, and in research institutes, there are discussions on Women in Science. Other than these celebrations, all institutions have a special cell to address grievances of women (students and faculty) on sexual harassment. By and large the general feeling is that this is the only subject that needs concern women in science. In fact it can be fairly said that all the research institutions and Universities in India require greater awareness on gender parity and specific actions needed to achieve it. Such groups have been effective in a few Institutes with an active gender sensitivity cell.

6. Organizations for Women in Science

There are a few organizations that specifically deal with issues of women in science. These are:

Indian Association of Women Scientists (IWSA)

The activities of this organization that is based in Mumbai and has been in existence since 1973, are a...
mixture of socially oriented schemes and science-based projects. They run hostels for girl students so that girls from rural areas can study, they run crèches and also train crèche workers. They hold programs to nurture young talent as well as refresher course for young school and college students. Discussing problems of women scientists and providing a forum for them is also one of their aims. Although they have a few branches across India, most of their activities happen in Mumbai and surrounding areas. One can find relevant information at http://www.iwsa.net

The DST Task Force
Since 2005 this body has served as a focal point for activities pertinent to women in science. The major achievement being research, as well as interviews with a large number of women all across India that led to [4]. They have created a directory and a list of available women speakers. The Task Force was disbanded in 2010, but information about its activities can be found at http://indianwomenscientists as well as at http://www.ias.ac.in/womeninscience.

The WiS Panel of IASc
The IASc Council formed a committee in 2001 to discuss issues of women in the sciences, and their deliberations led to the formation of the Women in Science (WiS) Panel in 2003. The webpage http://www.ias.ac.in/womeninscience summarizes information of interest to women scientists and acts as a source for related material and research. It also maintains a database of over 2500 Indian women scientists that has been used by different surveys to identify possible interviewees. One survey led to report [12]. An Indo-Dutch team also undertook another survey using the same database and the result of their research have led to two research publications on careers of women scientists.

The WiS panel focuses on activities that academicians can undertake, and on mentorship. These programs have to have three aspects.

a) Approach young students and make them aware of possibilities of a career in scientific research, education and entrepreneurship.

b) Encourage those who already in the profession to realize their full potential, point them to available help and also conduct the careers in a professional manner. Help create awareness among them as to what structures, societal and institutional can help them to successfully negotiate family and career.

c) Sensitize different sections of society and Institutions to the issues involved in making possible successful participation in science by women in Science.

To achieve these aims the WiS panel brought out two books [15,16]. In [15], about 100 Indian women scientists have told their stories as to what helped and hindered them in conducting a successful scientific career. In [16] there were only 25 stories, but there was also a description of science they had done. The DST has also brought out a book containing detailed life and career stories of a few Indian women scientists [16]; these also serve as inspirational material designed to attract young women to a career in science.

A second exercise that the WiS panel undertook was to conduct a survey along with social scientists in NIAS to ask, “why does the pipeline leak?” The importance of this survey was that the panel reached out to women who had left science after doing a Ph.D. degree. In the report [12] it was distinctly shown that family responsibilities are only partially responsible for the hindrances faced by women scientist. Most women scientists are aware of this, but it is important that such conclusions are validated by a properly conducted survey.

The WiS panel also conducts workshops on ‘Life in Science: Career in Science’ in schools and colleges, and to audiences of both men and women. These comprise of talks by five or six successful women scientists about their science, and serve as both career guidance and gender sensitization sessions.
A joint panel of all the science Academies for Women in Science has recently been formed; many of the above activities may be performed jointly by all the Academies.

Groups of Women Scientists in various disciplines

In addition to this the biologists, mathematicians as well as the physicists are part of the International Associations of women in each of these sciences. For example, when the International Congress of Mathematicians’ there was a special session on “Women in Mathematics” and this was mainly conducted by Indian women mathematicians. They also hold 2 or 3 workshops in India per year. Women physicists have participated annually in the International Conference on Women in Physics (ICWIP) over the years and have presented country papers. In IUPAP supported conferences held in India there are sessions on ‘Women in Physics’.

7. Best practices

A Wish list

In the foreseeable future both social and economic reasons suggest that the participation of women in science in India will increase considerably. There is thus a need to facilitate ways in which the pursuit of science by women can be effective. This has to be seen as a Human Resources problem, and some measures are not difficult to implement.

• Measures necessary are not just to attract girls to science and engineering, but also to keep them there. One must thus create the means to facilitate negotiation of a science career.
• Awareness that it is not impossible to maintain a career/ family balance needs to spread to parents, the family and colleagues so that this is an acceptable option.
• It is necessary to address gender imbalance from an early age: include young girls in programs like Science Olympiads.
• Academies of Science have a role to play by mentoring, showcasing work done by women scientists, to an audience of both genders, to create awareness on various career options available to young women scientists.

• Gender Audits: Institutions should give information on fraction/distribution of women in faculty, students etc. they should also set up graduated goals for inclusivity, after determining their feasibility.
• Childcare: A good creche is needed on every campus. Proactive hiring policies for helping couples manage dual careers can help women more.
• Encourage and reward excellence shown by women.
• Improved work climate: Gender sensitivity and effective addressing of harassment issues.

Some important policy decisions therefore need to be taken by the government. It is necessary that different sections of society that have a stake in these issues should be involved in formulating and implementing policies that can improve the workplace for women. Indeed, some issues - like periodic and mandatory gender audits - should be a legal requirement for publicly funded institutions.

Existing Efforts

As described in the other parts of this report, some steps towards implementing some of the recommendations in the above list have been taken by different organizations and institutions in India and are being implemented at some level. We list these here:

• DST and DBT Schemes for women to come back to science after a break.
• DBT, INSA and NASI special awards for women.
• Establishment of the Task Force for Women in Science by the DST.
• Support of women entrepreneurs by DST, DBT and other organizations.
• Mentorship and awareness programs run by
different agencies and groups: DST-NASI, IASc, NIAS and DST.

8. Challenges and Prospects

There are several issues that women scientists face that stem from innate prejudice and bias, as well as patriarchal attitudes in the workplace. In addition there is widespread gender insensitivity as well as explicit sexual harassment.

One of the biggest challenges to women in the workplace is that allegations of harassment or gender discrimination are often ignored or not taken as seriously as they should be. In fact, in several cases, perpetrators of harassment remain in positions of authority and the system does not adequately punish them for such misdemeanors. In such situations, many women prefer to tolerate behaviour that should otherwise be reported.

In the Indian context even the sensitized mainly look for providing pathways for women to return to science after a break, more or less presupposing that a break for family reasons is essential. What most women scientists want are measures which will help them negotiate this period without losing contact with cutting edge research. Indeed, women would prefer a workplace that offers enough facilities that make it unnecessary to take a career break in the first place. The need is for measures and schemes to smooth over bumps in the road without too much disruption. The challenge today is to bring about a change in the mindset of administrators as well other colleagues.

When dealing with issues such as the representation and rights of various disadvantaged groups, intervention through governmental policies has proven to be a very effective means of bringing about the changes that are essential. In the matter of gender as well, it is therefore very important that the government introduce legislation where needed in order to facilitate and ensure a more equitable and a more equal workplace.

9. References


10. Glossary of the short forms used in the text

AIIMS: All Indian Institute of Medical Sciences
BARC: Bhabha Atomic Research Centre, Mumbai
CSIR: Council for Scientific and Industrial Research
DBT: Department of Bio Technology
DST: Department of Science and Technology
DAE: Department of Atomic Energy
DRDO: Defence Research and Development Organization
DOD: Department of Defence
ISRO: Indian Space Research Organization
IAsc: Indian Academy of Sciences
ICMR: Indian Council for Medical Research
ICAR: Indian Council of Agricultural Research
IISc: Indian Institute of Science, Bangalore
IISER: Indian Institute of Science Education and Research
IIT: Indian Institute of Technology
INSA: Indian National Science Academy
JNU: Jawaharlal Nehru University, New Delhi
NASI: National Academy of Sciences, India
R&D: Research and Development
S&T: Science and Technology
TIFR: Tata Institute of Fundamental Research, Mumbai
TWAS: The World Academy of Sciences, Trieste
UGC: University Grants Commission
Women in Science and Technology in Korea

Doe Sun Na, Korean Academy of Science and Technology & University of Ulsan
Eunhee Cho, Chosun University

1. Executive Summary

Korea has achieved miraculous economic development over the last half century, increasing the gross national income 350-fold from 1960 to 2014. Korean companies such as Samsung, LG, and Hyundai are world famous for their high quality products. Education is believed to have played a pivotal role in Korea’s rapid transformation from one of the world’s poorest countries to a world leader. Men and women have equal access to education: in 2013 74.5% of female high school students entered college compared to 67.6% of males. Although gender discrimination in salary and promotion was prevalent until recently, the situation is rapidly improving in most major institutions including academia, government, and large corporations.

This equality, however, has not yet permeated all aspects of society in Korea. Disparity lies mostly in the process of hiring. Women are much less likely to be hired as regular employees, and many end up in non-regular positions (which pay less), or work part time. Women in executive positions are still rare: this is partially due to the fact that gender equality policies have only been in effect for 15 years, and also a culture that requires single-minded dedication to one’s career in order to advance to those levels.

Achieving gender equality and women’s empowerment are still major challenges in S&T. Although 43,662 (18.9%) of the 231,589 scientists in academia, private research institutes, and public research institutes were women in 2013, they occupied a disproportionately higher number of non-regular positions (33.3%) than regular positions (13.7%). From 2006 to 2013 the percentage of women scientists increased from 15.4% to 18.9%, with both regular and non-regular positions increasing from 9.8% to 13.7%, and from 28.2% to 33.0%, respectively.

Marriage is a crucial issue influencing the work participation of women scientists. The work participation of unmarried women in science and engineering were 84.5% and 84.1%, respectively: however, the percentage in the married women decreased drastically to 51.9 and 54.1%, respectively. Unless this situation is improved soon, Korea will have great difficulty continuing to develop its scientific and technological expertise and consequently its economy.
The status of women scientists’ leadership in Korea may be one of the world’s poorest. This can be seen from the statistics of principal investigators, management positions, and the executives of academic associations. Although 18.9% of all scientists are women, they make up only 8.6% of principal investigators and 7.1% of the executive positions. Furthermore, only 5.5% of KAST (Korean Academy of Science and Technology) members are women. Among the 85 major academic associations in science and engineering of Korean Federation of Science and Technology Associations (KOFST), less than 5% of executive committee members are women.

The Korean government implemented the ‘Act on Fostering and Supporting Women Scientists and Engineers’ in 2002. The goal of this legislation is to help women in science and engineering fully develop their skills and capabilities in research and technical positions. Based on this act, 5-year master plans have been implemented. The first (2004-2008) and second Plans (2009-2013) have been successfully completed and the third Plan (2014-2018) started in 2014. The Korean government established a ‘Center for Women in Science, Engineering and Technology (WISET)’ to implement these plans, with a budget of over $5 million in 2014. WISET is the focal point for providing a support system toward fostering and utilizing women in science, engineering and technology.

The Korea Federation of Women’s Science and Technology Associations (KOFWST) was founded in 2003 by a group of women scientists with the aim of increasing the competitiveness of women and enhancing Korea’s scientific and technological competence. Since its foundation, KOFWST has continued to increase its member organizations. The current membership includes 48 associations spanning the full spectrum of science and engineering fields, from basic science to industry, of which the total membership is approximately 60,000 women. KOFWST has been proactive in promoting the welfare, rights, and interests of women in science and engineering. Recently, KOFWST expanded its role by initiating conflict resolution programs and activities to advise on policies on pending social issues.

Many universities have set a goal for women to make up 30% of the faculty in science and engineering, and many academic societies including the Korean Chemical Society and the Korean Physical Society have women scientist committees to foster and support women scientists. The Korean Academy of Science and Technology launched a women scientist committee in 2014. The continuous efforts of the Korean government and women scientist organizations have made meaningful progress. However, Korea still has a long way to go before gender equality and female empowerment become a reality. With the concerted and sustained efforts of government, academia, research institutes, and women scientists themselves, Korea will cultivate many women leaders in science and engineering in the next decades.

2. Introduction

Through the so-called ‘Hangang river miracle’, Korea has achieved dramatic economic development. The GDI (growth national income) per capita increased from 79 dollars in 1960 to 27,970 dollars (World Bank) in 2014. Koreans these days are much better off physically and economically than 50 years ago. This dramatic economic development was made possible through prioritized investment in technology oriented industries and the education and training of scientists and engineers. Government policy played a pivotal role in the nascency of now world-class Korean companies such as Samsung, Hyundai, and LG. From the 1960s to the 1990s, young people were highly motivated to become scientists and engineers, and the best students majored in science and engineering. These college graduates were the prime workforce driving the growth of companies, leading to the development of the Korean economy.

However, after the Korean economic crisis of
1997, the best students have not gone into science and engineering. Instead they have rushed into professional fields such as medicine, law, education, and public service, believing that these would provide greater and/or more stable lifetime income. Korean leaders are very concerned about this phenomenon, because without the best people working toward new discoveries and inventions, Korea’s future is threatened.

At the turn of the new millennium, Korea adopted various aspects of the UN millennium development goals (MDG), including gender equality and empowerment of women. Women are underutilized and can contribute to the development of Korean science and engineering. Women scientists can help address the deficit of the scientific workforce, and also provide diversity, enhancing the total creativity and capacity of the workforce. In 2002, Korean government established the ‘Act on Fostering and Supporting Women Scientists and Engineers’. As a result, the government also implemented policies requiring women to make up at least 30% of every government committee: the current recommended goal is 40%. This policy is not limited to fields in science but actually applies to all disciplines. In 2005, women scientists also started to be appointed to the leadership positions of public sector organizations in science and engineering, which was quite a change for Korea. However there have been only a few such cases.

Due to the remnants of traditions that women are responsible for the majority of household work, it is very difficult for women to succeed as scientists. Men and women have equal access to education: in 2013 74.5% of female high school students entered college compared to 67.4% of males. Despite the equality in education, female college graduates are more likely to be employed as non-regular rather than regular workers. This is true for women with graduate degrees in science as well.

Although the presence of women government officials leaders in science can encourage and inspire young women to enter and pursue their career in science, the number of women scientists in leadership positions in Korea is among the lowest in the world. Among the 85 member organizations of Korea Federation of Science and Technology Associations (KOFST) less than 5% of the executive committee members were women in 2012. Currently 26 (5.5%) of the 473 Korean Academy of Science and Technology (KAST) members are women.

While the status of women has been bleak, the Korean government is leading the way for their empowerment. The percentage of women among government employees has dramatically increased from 35.5% in 2008 to 49.0% in 2014, and is expected to become a majority in 2016 (Statistics Korea).

Although the percentage of women government officials at senior levels is still low, was dramatically increased in 2014 from the previous year: in 2014 women made up 11.0% of 4th level (out of 9 levels) and 4.9% 3rd level directors compared to 4.5% and 3.2% in the 4th and 3rd levels, respectively in 2013 (Ministry of Personnel Management). Other areas of society are following this lead, and with concerted and sustained efforts by government, academic societies, and women scientists themselves, we will be able to improve this situation and to achieve gender equality. In this report we will review 1) the status of women scientists in Korea, 2) actions taken by the government, women scientist organizations and academic societies to improve the situation, and 3) challenges to achieving gender equality.

### 3. Status of Women in Science and Engineering

#### Higher education

Women traditionally study natural sciences but not engineering. Women made up 27.2% of freshman enrollment in S&T total, and 50% and 17.5% of that in science and engineering, respectively. This is not due to discrimination during the university application and examination process, but rather a attitude of girls and their parents preferring other fields of study (Table 1).
In 2013, women received 53.7% of the bachelor’s degrees in natural science majors but only 18.9% of those in engineering (Table 2). Women accounted for 28.1% of all university education. Fewer women progress to graduate level education. Women receive 51.2% of master’s degrees but only 36.7% of the doctoral degrees for natural sciences. This tendency is also true for engineering majors.

Table 1. First year enrollment of women in S&T degree programs (2013).

<table>
<thead>
<tr>
<th>Degree</th>
<th>Fields</th>
<th>Natural science</th>
<th>Engineering</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Women (%)</td>
<td>Total</td>
<td>Women (%)</td>
</tr>
<tr>
<td>Associate</td>
<td>16,883</td>
<td>8,751 (51.8)</td>
<td>63,417</td>
<td>7,938 (12.5)</td>
</tr>
<tr>
<td>BS</td>
<td>46,605</td>
<td>23,501 (50.4)</td>
<td>92,259</td>
<td>19,515 (21.2)</td>
</tr>
<tr>
<td>MS</td>
<td>7,948</td>
<td>3,951 (49.7)</td>
<td>15,578</td>
<td>2,712 (17.4)</td>
</tr>
<tr>
<td>PhD</td>
<td>4,046</td>
<td>1,528 (37.8)</td>
<td>6,085</td>
<td>881 (14.5)</td>
</tr>
<tr>
<td>Total</td>
<td>7,5482</td>
<td>37,731 (50.0)</td>
<td>177,339</td>
<td>31,046 (17.5)</td>
</tr>
</tbody>
</table>

Note: Numbers are headcount of the 1st year students in 272 universities who started studies in each level.

Table 2. Women received university degrees in S&T by gender (2013).

<table>
<thead>
<tr>
<th>Degree</th>
<th>Fields</th>
<th>Natural science</th>
<th>Engineering</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Women (%)</td>
<td>Total</td>
<td>Women (%)</td>
</tr>
<tr>
<td>Associate</td>
<td>13,387</td>
<td>7,614 (56.9)</td>
<td>45,873</td>
<td>6,820 (14.9)</td>
</tr>
<tr>
<td>BS</td>
<td>37,098</td>
<td>19,905 (53.7)</td>
<td>77,232</td>
<td>14,580 (18.9)</td>
</tr>
<tr>
<td>MS</td>
<td>6,613</td>
<td>3,383 (51.2)</td>
<td>13,856</td>
<td>2,573 (18.6)</td>
</tr>
<tr>
<td>PhD</td>
<td>2,251</td>
<td>827 (36.7)</td>
<td>3,163</td>
<td>328 (10.4)</td>
</tr>
<tr>
<td>Total</td>
<td>59,349</td>
<td>31,729 (53.5)</td>
<td>140,124</td>
<td>24,301 (17.3)</td>
</tr>
</tbody>
</table>

Note: The numbers are headcount of graduates from 272 universities who have received degrees in each level.


<table>
<thead>
<tr>
<th>Year</th>
<th>Degree</th>
<th>Women in Natural Sciences (%)</th>
<th>Women in Engineering (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Associate</td>
<td>Bachelor</td>
<td>Master</td>
</tr>
<tr>
<td>2006</td>
<td>54.8</td>
<td>54.6</td>
<td>43.7</td>
</tr>
<tr>
<td>2007</td>
<td>54.8</td>
<td>53.7</td>
<td>46.8</td>
</tr>
<tr>
<td>2008</td>
<td>55.3</td>
<td>53.8</td>
<td>46.5</td>
</tr>
<tr>
<td>2009</td>
<td>56.5</td>
<td>53.7</td>
<td>48.7</td>
</tr>
<tr>
<td>2010</td>
<td>56.1</td>
<td>54.6</td>
<td>49.1</td>
</tr>
<tr>
<td>2011</td>
<td>54.7</td>
<td>54.7</td>
<td>49.5</td>
</tr>
<tr>
<td>2012</td>
<td>57.0</td>
<td>54.5</td>
<td>50.1</td>
</tr>
<tr>
<td>2013</td>
<td>56.9</td>
<td>53.7</td>
<td>51.2</td>
</tr>
</tbody>
</table>

However it is notable that during 2006-2013, the percentage of women receiving master’s and doctor’s degrees increased in both science and engineering majors (Table 3).

### Gender inequality in employment

Employment equality is essential to utilizing women to their full potential in science and engineering. Table 4 shows that in 2014, 43,662 (18.9%) of the 231,589 scientists in academia, private research institutes, and public research institutes were women. There is striking gender inequality in employment status. While women occupy 18.9% of all scientists they have a disproportionately higher number of non-regular positions (33.0%) than regular positions (13.7%).

In the years from 2006 to 2013 the percentage of women scientists increased from 16.1% to 18.9%. The data also reveal that the disparity has improved during the 8 year period: the increase for regular positions (9.4% to 13.7%) was larger than the increase for non-regular positions (31.8% to 33.0%) (Table 5).

Table 6 shows the percentage of women in various positions in natural science and engineering in 272 universities. Women make up 24.4% of the 78,761 total positions, accounting for 40.1% and 13.7% of the positions in natural science and engineering, respectively. Women in the regular positions were strikingly low: only 12.5% of the 28,265 regular faculty positions, accounting for 25.6% and 5% of the positions in natural science and engineering, respectively.

### Effects of marital status on work participation

Marriage dramatically influences work participation for female but not male scientists. Before marriage work participation is similar between men and women. The work participation of unmarried women in science and engineering were 84.5% and 84.1%, respectively; however, the percentage in the married women decreased drastically to 51.9% and 54.1%, respectively (Table 7).

One of the biggest challenges for married women scientists is taking care of household chores and family members in addition to their workload. The competitive nature of the Korean education...
system puts a heavy burden on parents. The ever-demanding nature of science research, especially during the early career period, discourages many young women.

Leadership roles

Women leaders are important to the development of institutions because they can provide directions in developing policies for fostering and supporting young women scientists. In addition, the presence of women leaders encourages younger generations to pursue careers in science and engineering.

Principal investigators

Although 18.9% of all scientists are women in 2013 (Table 5), they make up a much smaller percentage of principal investigators (PI): 9,324 (8.6%) of 108,673 research projects were led by women (Table 8). Despite the percentage of women PIs being low, there is a clear increasing trend during the 8 years from 2006 to 2013 (Table 9), especially in the public research institutes. The gradual increase of principal investigators in public research institutes may reflect the government’s policy of affirmative action.

Team leaders and administrators in academia and research institutes

In 2013 women occupied 2,313 (7.1%) of all leadership positions (32,468) in S&T organizations (Table 10). In universities, the percentages are approximately the same for the last 8 years. The percentage of women administrators in public research institutes, although still small, increased from 4.9% to 8.6% during 2006~2013 (Table 10). The small number of women leaders is partly due to the fact that there are fewer women scientists in older age groups than in younger groups (Figure 1).

Korean Academy of Science and Technology

Korean Academy of Science and Technology (KAST) was established in 1994. In 2015, 26 of 473 KAST members (5.5%) are women. The number of women in KAST held steady for several years. In 2015 6 (18%) of the 33 newly elected KAST members are women, resulting in the increase

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**Table 6.** Employment type of women researchers in universities in 2013.

<table>
<thead>
<tr>
<th>Employment type</th>
<th>Number</th>
<th>Natural science</th>
<th>Engineering</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Women (%)</td>
<td>Total</td>
</tr>
<tr>
<td>Regular faculty</td>
<td>10,219</td>
<td>2,616 (25.6)</td>
<td>18,046</td>
<td>906 (5.0)</td>
</tr>
<tr>
<td>Non-regular faculty</td>
<td>4,727</td>
<td>1,705 (36.1)</td>
<td>8,127</td>
<td>852 (10.5)</td>
</tr>
<tr>
<td>Part time lecture</td>
<td>10,391</td>
<td>5,746 (55.3)</td>
<td>12,110</td>
<td>2,861 (23.6)</td>
</tr>
<tr>
<td>Other researcher</td>
<td>6,710</td>
<td>2,788 (41.5)</td>
<td>8,431</td>
<td>1,767 (21.0)</td>
</tr>
<tr>
<td>Total</td>
<td>32,047</td>
<td>12,855 (40.1)</td>
<td>46,714</td>
<td>6,836 (13.7)</td>
</tr>
</tbody>
</table>

Note: Regular faculties include assistant, associate, and full professors in tenure track positions.

**Table 7.** Marriage effects on work participation in 2013.

<table>
<thead>
<tr>
<th>Marital status</th>
<th>Natural Science</th>
<th>Engineering</th>
<th>Med sci&amp; pharm</th>
<th>Non-S&amp;E field</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women (%)</td>
<td>Men (%)</td>
<td>Women (%)</td>
<td>Men (%)</td>
</tr>
<tr>
<td>Unmarried</td>
<td>84.5</td>
<td>84.1</td>
<td>85.9</td>
<td>87.4</td>
</tr>
<tr>
<td>Married</td>
<td>51.9</td>
<td>90.8</td>
<td>54.1</td>
<td>95.3</td>
</tr>
</tbody>
</table>

Note: Numbers are percentage of women working with above BS degrees in the field.
of percentage of women from 4.4% in 2014 to 5.5% in 2015. A women scientist committee was established in KAST in 2014, and it plans efforts to increase the number of women members in KAST and mentor young women scientists.

### Academic associations

Scientific associations provide opportunities to develop academic ability as well as avenues to cultivate leadership. We examined 85 associations in science, engineering, medical sciences, agriculture, fisheries, food, and environment. There were 1,646 presidents in the histories of the 85 associations, of which only 8 were women representing 0.5%. The situation for board members is slightly better. In 2012 4.47% and 3.13% of the board members in the science and engineering associations were women (Table 11). This is much smaller than the number of women scientists in these associations (data not shown).

It is crucial to establish appropriate policy to encourage including more women and cultivating their leadership in these associations.

### 4. Government policy

#### Guideline for employment, promotion, and committees

In 2001 Korean government implemented a policy to increase representation of women to 30%: all government committees should include at least 30% women. This policy opened the door for women scientists to contribute to policy decisions...
and network with other opinion leaders. This has provided many opportunities to women and stimulated public and private organizations to also institute such guidelines. In 2014, 31% of the government committee members were women (Ministry of Personnel Management). The committees in public organizations including universities and public organization also mostly adhere to the guideline.

The 30% guideline also applies to the hiring and promotion of employees. Many universities and research institutions have adopted policies to hire and to promote more women scientists. Many universities have set a goal of 30% of faculty being women. To increase the number of full-time female professors in science and engineering, more efforts are needed. Some universities have implemented “stop-clock” tenure programs in order to support female faculty during their childbearing years. The program allows women professors to set clocks for childcare after birth, and subtract the stop-clock period from the time frame for promotion evaluation.

**Family support policies/Child care centers**

The labor policies of the Korean government are very supportive of women and families with children. Women have one day of menstrual leave day each month (in reality very few scientists take advantage of this) and 90 days paid maternity leave. Also employees can take a leave of absence to care for young children less than 8 years old (up to one year per child), and family members: during the leave of absence they receive 40% of their salary (up to 1 million Won, ~$800) per month.

Korea has very strong policies on child care centers supported by legislation. Organizations with more than 300 female employees must operate a child care center within or near the workplace, and the employer is required to cover 50% of the expenses. In 2014, 344 (10.7%) of 3211 organizations in S&T operated child care centers (Table 12): 95 (34.9%) of 272 universities, 83 (45.1%)
of 184 public research institutes, and 166 (6.0%) of the private research institutes.

Legislation of ‘Act on Fostering and Supporting Women in Science and Technology’

In 2002, the Korean government implemented the ‘Act on Fostering and Supporting Women Scientists and Engineers’. The goal of this legislation is to help women in science and engineering fully develop and apply their skills and capabilities in research and technical positions. Based on the act, 5-year master plans have been implemented. The first Plan (2004-2008) and second Plan (2009-2013) have been successfully completed. The third plan (2014-2018) was started in 2014.

The Ministry of Science, ICT & Future Planning, established a ‘Center for Women in Science, Engineering and Technology (WISET)’ to implement these plans. WISET works very closely with the government and is the central hub for collecting data on education and employment status, and providing a total support system for fostering and utilizing women in science, engineering and technology. WISET also collects data on women friendly policies in institutions such as availability of child care, maternal leave, affirmative action, etc. This data enables WISET to plan and implement detailed mentoring, networking, and scholarship programs which are effective in educating and training female students and scientists. Examples of fostering programs are WISE (women in science and engineering), scholarships for outstanding female students, mentor/mentee programs, education programs, and so on. WISET has programs for all stages of careers, from high school to top leaders.

5. Professional societies and organizations

In 2014 the Korean Federation of Science and Technology Associations, which is a federation of over 500 associations, introduced a policy for encouraging its member associations to increase women scientists in their executive committees.

Thirteen academic associations such as the Korean Chemical Society, the Korean Physical Society, and The Korean Society of Industrial Engineering Chemistry have women scientists committees, which are members of the The Korea Federation of Women’s Science and Technology Associations (KOFWST). Some associations such as Korean Society for Biochemistry and Molecular Biology do not have a women scientist committee; instead they collaborate with women scientist associations in the field, for example the Women’s Bioscience Forum.

6. Women Scientist organizations

KOFWST was founded in 2003 with the aim of raising the competitiveness of women and to contribute to scientific and technological development of Korea and the world. Since its foundation, KOFWST has continued to incorporate more member organizations. From 4 member organizations, it has grown to 48 associations spanning the full spectrum of science and engineering fields from basic science to industry, whose members include about 60,000 women scientists and technologists. KOFWST has been proactive in promoting the welfare, rights, and interests of women in science and engineering fields.

KOFWST’s major activities can be categorized into conferences, forums, workshops, award programs,

<table>
<thead>
<tr>
<th>Organization type</th>
<th>Number of organizations</th>
<th>Organizations with child care centers (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>272</td>
<td>95 (34.9)</td>
</tr>
<tr>
<td>Public research</td>
<td>184</td>
<td>83 (45.1)</td>
</tr>
<tr>
<td>institutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private research</td>
<td>2,755</td>
<td>166 (6.0)</td>
</tr>
<tr>
<td>institutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3,211</td>
<td>344 (10.7)</td>
</tr>
</tbody>
</table>

and publications. Annual conferences facilitate networking and strengthen the leadership skills of the next generation of female scientists and engineers. KOFWST/Press/National Assembly/NGO joint Forum series have served as a channel between women scientists and policy makers. The Women Leaders’ Forum has provided members with opportunities for expanding their knowledge and establishing networks with experts in diverse fields. Starting with the first on Oct. 16th, 2007, a hundred forums had been held by the end of 2013. KOFWST’s fellowship award programs, the Amore-Pacific Woman Scientist Award and the Young Woman Scientist Award, have recognized talented women scientists and engineers (61 in total by 2013), and helped its awardees become more visible among their peers. KOFWST publications also help guide the next generation in their career development. Major publications include: Women Meet Science (2005); Meet Women Leaders in Science - Awaiting Marie Curie of Tomorrow I & II (2008, 2010); Celebrating Women of Outstanding Achievement I & II (2008, 2010); Who’s the Next? (Vol. 1-4, 2011). A web site, online monthly newsletter ‘e-News’, and annual newsletter ‘Women in Science and Technology’ serve as a communication infrastructure to promote communication among women scientists and engineers as well as to publicize KOFWST’s activities.

In addition, KOFWST has facilitated activities by providing grants to its member organizations and supported the establishment and development of new women’s S&T associations. KOFWST has been also proactive in promoting cooperation and exchanges with international organizations to foster global leadership. International meetings that KOFWST has played a leading role in organizing include: Asia-Pacific Women Science Leader’s Forum (2007~2008); Korea-China-Japan Women Leader’s Forum for Science & Technology (2008~); EU-Korea Joint Conferences (2008~); Canada-Korea Joint Conference (2010); USA-Korea Joint Conference (2010~); Asia Women Eco-science Forum (2011~).

Recently, KOFWST expanded its mission to serve the public by helping to develop policies on pending social issues. Many societal concerns today, such as nuclear energy or genetically modified organisms, are intertwined with various scientific and sociocultural issues. Resolution will require the commitment of many people with diverse backgrounds, as well as proper social support through conflict mediation and consensus building. An interdisciplinary approach is necessary to address sensitive social issues and reduce costs incurred by social conflicts.

7. Best practices

Legislation for empowering women and its implementation

The government-driven legislation “Act for fostering and supporting women scientists” has not only had tremendous influence on planning and implementing government policies for women scientists, but also on the male leaders of the scientific communities. Universities and research institutes have adopted policies recommended by the government in hiring and promoting women scientists. The first women leaders of public sector organizations in science and technology were appointed in 2005, and since then several more have been appointed. Women scientists in the middle and senior management levels continue to increase.

WISET (Center for Women in Science, Engineering and Technology) was established in 2004 as the center for planning and implementing government policies. WISET collects all data on women scientists from college students to the leader levels, and uses it to inform government policy. WISET can serve as a model organization to other countries.

Establishment of KOFWST

KOFWST was established in 2003 by Doe Sun Na and a group of women leaders in science and engineering. The inaugural members were 4 associations; Women’s Bioscience Forum, Women
in Nuclear Korea, Korea Women Inventors Association and Women Information Technology and Science Association of Korea which comprised 2,000 women scientists. Now KOFWST has 48 women scientist associations encompassing 60,000 women scientists. As far as we know, KOFWST is the only women scientist association whose members are associations but not individuals. The 48 women scientist organizations provide women scientists with opportunities to practice leadership, and these opportunities are the driving force for the growth of KOFWST. KOFWST has been the home ground of many women leaders in Korea. Many women scientists trained in KOFWST have become the leaders in their own fields and in the scientific community, and several have become influential figures in Korea. The work that KOFWST does for the benefit of women scientists also benefits Korea.

8. Challenges
To achieve gender equity in science and engineering, it is important to realize that the problem is very difficult to tackle. Despite the fact that Korea is a highly industrialized country, it is still heavily influenced by patriarchal traditions. Women in science and technology are equally well educated as men. However there are tremendous inequalities in employment and promotion, which will lead to underutilization of women’s talents. The government, women scientist organizations, and academic societies have strived since 2002 to foster and support women scientists, and so far have had limited success. Women leaders in science and engineering are still rare. Cultivating women scientists as leaders requires long and sustained effort. Since there are many more outstanding women scientists in the younger generation, with consistent and continued measures we hope to see more women leaders in science and engineering within 10~20 years.

9. References
2) KOFWS. 2013. The 10th Anniversary of the KOFWST
Women in Science and Technology in Malaysia: A Case Study

Khairul Anuar bin Abdullah and Asma binti Ismail
Academy of Sciences Malaysia

1. Introduction

The role of women in developing countries has evolved. The involvement of women has shifted from merely that of low economic prospective to that of high end capacities. This change also indicates the growing empowerment of women due to development.

To illustrate, in Malaysia, women constitute nearly half of the population. Of an estimated total population of 30 million persons recorded in February 2014, about 14 million were women. In fact, with the size of the female population increasing from 11.5 million in 2000 to 14 million in 2014, women continue to be an influencing factor that shapes the development of the future generation, and contribute to the economy.

Hence, in developing the countries which are going through rapid socio-economic change, women’s contribution is further needed. It is not anymore sufficient to depend solely on one gender, namely the male, to boost the economy what more to fill in the financial needs of the household. In the Malaysia’s 30 year plan, Vision 2020, its citizens are expected to participate fully in the nation’s development. One of the challenges addressed in this vision is the creation of a more scientific and industrial society’. Women’s active involvement is expected to help provide the labor force in this area. Figure 1 illustrates social norms as one of the contributing forces to gender gaps in the economy sector.

To promote women’s active involvement, the...
Government’s goal is not only to encourage more women to participate in the labour force, but to also enhance the quality of their participation by increasing the number of women in decision making. Therefore, it is essential that women are given the right opening, setting and mindset to enable them to participate and contribute in the various fields of national development. Figure 2 shows Malaysia’s challenges in gender streaming across fields, is also commonly experienced by other countries.

To achieve this, key programmes will focus on:

1. Increasing women participation in the labour force;
2. Increasing the number of women in key decision making position;
3. Providing more educational and training opportunities for women to improve their upward mobility;
4. Eliminating all forms of discrimination against women; and
5. Operationalising the national policy for women through the implementation of an action plan.

2. Policies, Closing Gaps And Success

Malaysia is a combination of the modern world and a developing nation, its cities and natural landmarks make this country a traveler’s playground. Accordingly, it has the perfect balance of modernity and natural beauty. The mixture of cultures living in incredible harmony on such astonishing scenery make Malaysia a photographers top travel destination. Malaysia has moved on from the ‘hunter-gathering agricultural age’ to the ‘Industrial age’ and now we are in the ‘Knowledge-based Economy age’. However, we are still our first baby steps towards the Bio-Green Economy age, and thus, have yet to explore into the Ubiquitous-Humanisation Economy Age.

The assets that drive economic success of a K-based economy are as follows:

• patents
• advanced research
• venture capital
• University graduates and Ph.D.
• air, rail and sea hubs

Advances in science and technology have marked
the onset of the Third Millennium.

S&T carries with it a wide prospect of opportunities. Hence, if S&T is used rationally and effectively, it could help eradicate hunger, poverty, destitution and indignity. Consequently, lessenng the number of under-developed countries, and in turn, boosting their economic openings to put them on par in the race for socio-economic stability.

In the Malaysian socio-economic scenario, Malaysian Vision 2020 has clearly placed Science & Technology (S&T) and Information and Communication Technology (ICT) as a critical pathway to achieve the status of a developed nation and to help enhance Malaysia’s survival in the K-based economy. Notably, emphasis on human resource development in S&T continues into the 10th Malaysia Plan (2011-2015), during which premier universities and Research institutes are expected to create centres of excellence for research.

Furthermore, the Ministry of Science, Technology and Innovation (MOSTI) and the Ministry of Higher Education are the lead ministries that formulate policies in the area of science, technology and innovation for fundamental research (MOHE) and applied and commercialization of research (MOSTI). While Innovation aspects of Research are looked into by AIM (Agency Innovation Malaysia). To add, Government-based Venture Capitalists (MTDC, BiotechCorp, MAVCAP) are also looking into pre-commercialisation and commercialisation of research. In line with this effort, MOSTI and Academy Sciences Malaysia (ASM) have also implemented numerous programmes related to the promotion of S&T and national R&D activities.

Indeed, if Malaysia aspires to be a developed nation by the year 2020, it will require a ratio of 50:10,000 populations of RSEs. However, the reality is that we are currently just at a ratio of 21:10,000 RSEs. Hence, we need both men and women to pull their weights to fulfil the statistics within 6 years. Therefore, we cannot afford to spare either gender in achieving the objective of vision 2020.

The World Congress of Science 1999 concluded that, there will be no sustainable human development unless there is a will to provide for the future in partnership with women. indeed, Science and Technology have been termed as "engines of social and economic change", and as women make up around 50% of the population, their contribution to development is of paramount importance. Thus, the following should be implemented to ensure that there is a wider scope of involvement of women, especially in under-developed and developing countries:

- **Include** women representatives from Science, Technology and Innovation in bodies formulating policies to ensure gender sensitive consideration and bodies
- **Establish** a monitoring mechanism through the gender focal point to track and measure the progress of 30% leadership in respective of public and private agencies
- **Develop and implement gender disaggregated data** as part of gender ‘mainstreaming’ in both public and private sector organisations to:
  - assess training and development needs of women in STI;
  - identify demographic profile of women and their fields of expertise,
  - list number of patents produced by women; and
  - Indicate funds allocated for women scientists for capacity building.
- **Establish dedicated incubators** to nurture young women with STI talent prior to placement in job markets or involvement in entrepreneurship.

Apart from that, the Parliament of Malaysia in 2002 introduced a new policy through legislation that parents must send all their children that are eligible to school, and if the parents fail to register school going children, they will be fined RM 5000 in default or imprisonment of not more than 6 months or both.

Malaysia is forging its steps in becoming a developed
nation by the year 2020. Duly, in 2002, Malaysia had made an amendment to the Education Act 1966 (Act 550) which makes it compulsory to have 6 years of primary education for all children of Malaysian citizens, who are of ages 6-12 years.

**The Malaysian government expanded educational opportunity for female students.**

When girls and boys are together, they tend to exaggerate the gender differences - this is a very robust phenomenon referred to as either “gender intensification”

**Therefore, Custom-tailored learning and instruction were introduced;**

The Underwoods found a dramatic difference in story recall, depending on the gender composition of the pair. Boys in ‘boy-boy’ pairs performed least well, while girls assigned to ‘girl-girl’ pairs obtained the highest scores. The most striking find, however, was that girls in girl-boy pairs performed almost as badly as the boys did. Just putting a girl with a boy degraded her performance by roughly 50% on this computer-based task.

**Best practice for the subject areas**

In the coed classroom, the process of ‘gender intensification’ (see above) kicks in so strongly, that the girls can easily get the idea that “any girl who likes computers is a weirdo or a geek.” In the all-girls classroom, the girl who likes computers will find much greater freedom to express herself and pursue her interests.

In single-gendered schools, teachers are (or should be) free to choose materials that fit the interests of their students. In coed schools, the girls are often held back or held down to the abilities and interests of the boys.

**Greater autonomy, especially in heterosexual relationships**

Let’s start with one of the most basic facts about single-gendered education at the middle school and high school level: girls in single-gendered schools are much less likely to experience unwanted pregnancies than are girls at coed schools. What’s the explanation for that fact? The most common explanation put forward is that girls at single-gendered schools are less likely to be involved in heterosexual relationships than are girls at coed schools.

**Women enrolment in higher institutions**

Though women have the drive and capability to succeed in S&T, there seems to be a phenomenon whereby the percentages of female began to wane at the working level (and at higher postgraduate level) – “leaky pipeline”

The leaky pipeline is a concept that has been used to refer to the steady attrition of girls and women throughout the formal S&T system, from primary education to tertiary and postgraduate levels to S&T decision making, to all aspects of careers in S&T.

3. **Present Scenario And Major Barriers**

The current growth of economy presents a stellar opportunity for women to assume leadership roles in research and development of information technologies and applications. However, there are major barriers that need to be overcome in strategising women’s contribution in socioeconomic sector, and more pertinently in the field of STI, which are as follows:

- Family formation
- Socio-cultural attitudes
- Education due to poverty or lack of finance
- Biased Academic appointments
- In some countries – the leak happens as early at secondary school level and at university level
- Biasness in employment in Science
- Biasness in employment in Science and Technology professions
- Biasness in employment in S&T Development and Transfer of technology level
• Self-restriction or lack of self-confidence

Moreover, the performance and involvement of women participation in the fields of STI are also influenced by five theoretical perspectives: individual motivations and goals; social learning; network affiliation; human capital (level of education, work-related skills); and environmental influences (Miri et. al, 1997). Each of these perspectives is associated with empirical work showing relationships between these individual level factors and performance.

To add, in many Science, Technology, Engineering, and Mathematics disciplines, women are still outperformed by men in test scores, jeopardising their success in science-oriented courses and careers. A study was conducted on psychological intervention, values affirmation, in reducing gender achievement gap in a college-level introductory physics class. In this randomised double-blind study, 399 students either wrote about their most important values or not, twice at the beginning of the 15-week course. The intervention approach had reduced the male-female performance and learning difference substantially and elevated women’s modal grades from the C to B range. It was interesting to note that the benefits were strongest gained from women who tended to endorse the stereotype that men do better than women in physics (Akira Miyake et. al, 2010).

The top 5 favorite field of study among female students are as follows:

Women do have different preferences for men in choosing their academic field, and the pattern is similar in developing and most industrialised countries. This is possibly due to; academic qualification, passion, family pressure, perks, non-stringent entry, nature of work, attitude/ peer influence.

Malaysia established the Ministry For women, Family and Community development in the year 2001. The vision was to act as a focal point in achieving gender equality, family development and caring society as the basis for the formation of a developed nation of distinction. In June 2011, with the help of Ministry of Women, Family and Community Development the Malaysian cabinet approved the policy of ensuring that 30% of

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**Figure 3.** Student Enrolment in Public Higher Education Institutions by Level of Study and Gender.
(Source: Ministry of Education Malaysia, 2012)
women are at the decision making level in the private sector and that they are given a 5 year transition period to raise the number of women members in the board of directors of companies and hold top positions in their respective companies.

The highest percentages of women were seen in the human health and social work, education industry. From the total women employed, only 3.3% are in scientific and technological careers. However, the number of women in STI is still lower than men (which is also a widespread global phenomenon). The trend is even more distinct in professional, managerial and leadership positions.

S&T related registered professions highly involved by professional women are as follows:

- Dentist (64.3%)
- Medical Doctor (47.8%)
- Veterinary Surgeons (41.5%)
- O & G (34.9%)
- Psychiatrist (28.7%)
- Lawyer (50.5%)

The percentage of women involvement in the aforementioned professions have experienced

<table>
<thead>
<tr>
<th>Profession</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Male</td>
</tr>
<tr>
<td>Accountants</td>
<td>28,461</td>
<td>14,331</td>
</tr>
<tr>
<td>Professional Architects</td>
<td>1,841</td>
<td>1,528</td>
</tr>
<tr>
<td>Architects</td>
<td>1,626</td>
<td>1,073</td>
</tr>
<tr>
<td>Professional Engineers</td>
<td>15,182</td>
<td>14,560</td>
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<td>49,729</td>
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<tr>
<td>Dentists</td>
<td>4,289</td>
<td>1,578</td>
</tr>
<tr>
<td>Medical Doctors</td>
<td>25,698</td>
<td>13,814</td>
</tr>
<tr>
<td>Veterinarians</td>
<td>1,794</td>
<td>1,066</td>
</tr>
<tr>
<td>Land Surveyors</td>
<td>473</td>
<td>468</td>
</tr>
<tr>
<td>Quantity Surveyors</td>
<td>2,182</td>
<td>1,261</td>
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<tr>
<td>Lawyers</td>
<td>14,188</td>
<td>7,204</td>
</tr>
<tr>
<td>O &amp; G</td>
<td>N/A</td>
<td>461</td>
</tr>
<tr>
<td>Psychiatrist</td>
<td>N/A</td>
<td>94</td>
</tr>
</tbody>
</table>

Figure 4. Registered Professionals by Profession and Gender, 2012-2013. (Source: Statistics On Women, Family And Community 2013, Malaysia)
a slight increase from 2012 to 2013, while the number of women involved in the field of S&T of Universities and institution of higher learning was still low, especially at higher positions (Professor, Associate Professor, Chancellor, and Vice Chancellor).

From the data obtained, there was a 2% increment of women involvement in the Government sector-decision making level positions.

Without undergoing gender tracking to find out the issues that take place as they go through the entire stage of their decision making process and without giving serious consideration as to the realities of life that women are facing in trying to balance between family and career, the existing policy will ensure women to remain ‘status quo’ in their contribution to S&T.

The Academy of Sciences which has a great influence on the Science policy and strategies in the implementation of S &T where the Fellows of the Academy shall be elected from such Malaysian citizens who by virtue of their respective achievements in the field of science, engineering and technology are regarded as being of exceptional merit and distinction. It is found that female fellows are still noticeably lower in numbers compared to the male fellows. This is in effect with the lesser number of women participation in S&T and lower enrolment in the tertiary level education (PhD).

4. Conclusion and Recommendation

Providing open opportunities in Education appears to be a key instrument in increasing women’s Participation in the Science and Technology. Hence, a new legislation must be introduced to protect and ensure women are given equal rights to job opportunities in Science related fields. It is crucial that the Government of Malaysia recognise the importance of the participation of women in achieving the vision 2020. As a result of which, with Government’s realisation and support for women through policies, a outlet path is created through participation of women in science and technology.

5. References


<table>
<thead>
<tr>
<th>Position</th>
<th>2012*</th>
<th></th>
<th></th>
<th>2013**</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Male</td>
<td>Female</td>
<td>Female (%)</td>
<td>Total</td>
<td>Male</td>
</tr>
<tr>
<td>Chief Secretary to the Government</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Secretary General</td>
<td>24</td>
<td>18</td>
<td>6</td>
<td>25.0</td>
<td>24</td>
<td>17</td>
</tr>
<tr>
<td>Deputy Secretary General</td>
<td>54</td>
<td>38</td>
<td>16</td>
<td>29.6</td>
<td>56</td>
<td>41</td>
</tr>
<tr>
<td>Director General, Director and General Manager of Statutory Bodies</td>
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<td>38</td>
<td>6</td>
<td>13.6</td>
<td>44</td>
<td>38</td>
</tr>
<tr>
<td>Persekutuan Director General of Federal Departments</td>
<td>109</td>
<td>95</td>
<td>14</td>
<td>12.8</td>
<td>110</td>
<td>91</td>
</tr>
<tr>
<td>Total</td>
<td>233</td>
<td>191</td>
<td>42</td>
<td>18.0</td>
<td>235</td>
<td>188</td>
</tr>
</tbody>
</table>

Figure 5. Women as Secretary General, Assistant Secretary General and Director General, 2012-2013.
(Source: Statistics On Women, Family And Community 2013, Malaysia)
2. Unlocking Women’s Potential, World Bank, November 2012


Women in science and technology education in Nepal

Anjana Singh
Tribhuvan University, Kirtipur, Kathmandu, Nepal

1. Executive Summary

Education is accepted as the entryway to economic security and opportunity-particularly for women, whose wages persistently lag behind those of their male counterparts. Concerning the history of Nepal, the status of female in education is not available however the female of the royal families had taken leading role in the political scenario of the country at that time. Female personalities related to the royal family had played vital role to raise the nation and nationalities by the means of political, social, cultural and religious sectors. There are no examples in the history of Nepal where female personalities had directly ruled over the country as the head of the state. However, some females in different periods had strongly involved in the Nepalese politics as a second person. The first elected government in Nepal was established in 2015 BS (1959 AD). That government had nominated the female minister in the cabinet for the first time in Nepal. The number of females in bureaucracy and education had gradually increased even in the party-less Panchayat system which lasted for 30 years in Nepal. After the restoration of democracy in 2046 BS (2008 AD), the number of female in politics has increased, though their role in decision making remains poor in the male dominant leaderships of the political parties. Women in development have been accepted in government level since the 6th plan as a national policy. After the restoration of multi-party system in 2046 BS (2008 AD), policy makers are giving due importance to uplift the status of women. A separate ministry to look after the welfare of women has been established-especially after the World Women Conference held in Beijing in 1995, the question of women empowerment has been brought into limelight. However according to UGC report 2012/13 within these 31 years male education is declining from 81% to 52.2% while female education is increasing drastically from 19% to 47.5%. Gender parity index (GPI) in 2012/13 according to UGC report is 0.91 in higher education which shows gender disparity is decreasing. GPI has raised from 0.50 to 0.91 from 2005 to 2012 A.D.
2. Introduction
Prior to 1950 AD, as ruled by authoritarian Ranas, education was restricted, considered as a threat of inciting insurgency. So there was limited number of schools for educating Kathmandu based elite. Only in 1951, after more than hundreds years of Rana dynasty, education was recognized as a right of people. According to USAID report, about 98% of the population was illiterate with just 300 graduates in the entire country. In 1960 AD, the literacy rate was 8.9%. During the period of Panchayat system, the literacy rate has not increased significantly according to the country’s need. The policy makers of the system had not invested in the education sectors for which they had been approved funds from the donor agencies. There are general and technical programmes about 88.76% and 11.24% respectively. Out of this medicine and science and technology is 2.7%.

3. Status of Women in Science and Technology
Education, though important to all, is more beneficial to the women. This is so because educating a girl is more rewarding. Therefore, Mahatma Gandhi once said that educating a man is educating an individual but educating a woman is educating a family. Like Mahatma Gandhi, the World Bank Vice-President Lawrence Summers made groundbreaking speech in 1992 about the importance of girl education in the Third World countries. He said that educating girls not only help to reduce the cycle of female deprivation but it also yields a higher rate of returns than any other investment in this part of the globe. Economic values of education are enormous. A recent study in India shows that the benefits of schooling to the girls far outweigh the costs in reducing fertility, infant mortality and maternal deaths. Following are some of the logics for the question:

• Studying science and technology will lead to better paid employment outcomes increase women’s financial independence and security.
• Knowledge of science and technology is essential to understanding the modern world and without it, it is impossible for women to participate in informed decision making in many social and political issues.
• Women with natural talents for an interest in science and technology have a right to an education that enables full developments of those natural talents and interest.
• National productivity requires a workforce trained in science and technology and is a waste of human capital if such training is not given to more than 50% of the population.
• Science and technology help to empower women by improving their ability to access information, education and services such as market prices for crops, professional development opportunities and tools to promote their health and that of their families.

Higher Education
The enrolment of male students are declining while females are increasing since 1980 to 2012 A.D. Male are decreasing from 81% to 52.2% while females are increasing from 19% to 47.5%. The ecological belt shows 48.51% in hill, 45.9% in mountain and 46.75% in Terai. The female enrolment across the development region is 56.33% in western, 48.57% in eastern, 46.3% in central, 43.4% mid-western and 43.46% far-western. Enrolment for female at Tribhuvan University (TU) 49%, Kathmandu University 45.42%, Lumbini Buddhist University (LBU) 21.85%, Pokhara University (PokU) 35% and Poorvanchal University (PU) 40.82%. Medical institutes like B.P. Koirala Health Sciences (BPKH) 36.6%, Patan Academy of Health Sciences (PAHS) 40% and National Academy of Medical Sciences (NAMS) 17.39%. Female enrolment in Community campuses 53.3%, private campuses 49.4% and Constituent campuses 41.7% respectively.

In totality the highest rate of girls in medical faculty is 56.8%, education again 56.8%, humanities 46.2%, management 43.4%, and engineering 11.2%. At various levels in total girls’ enrolment in is bachelors’ 48.9% and masters’ 40%.
Table 1 shows the higher rate in natural sciences (43%) in comparison to engineering (20%) of the total number. Female traditionally study natural sciences but not engineering. Thus there are less females in engineering in Nepal.

**Gender Inequality in Employment**

Female employment equality is essential to utilizing women to their full potential in science and engineering. Gender parity index (GPI) in 2012/13 is 0.91 in higher education which shows gender disparity is slowly decreasing. Comparatively, GPI in various sectors are as follows: Hill 0.96, Mountain 0.85, Terai 0.90, Eastern region 0.95, Western region 1.3, Central region 0.88, Mid-western region 0.83 and Far-western 0.83. GPI in bachelor's level is 0.98 and masters level is 0.69. GPI in facultywise is as follows: medicine 1.32, education 1.3, management 7.8 and humanities and social sciences 0.88.

**Effects of Marital Status on Work Participation**

Female scientists are affected at work participation. Work participation before marriage is almost same between male and female. However, after marriage, the participation of women decreases. But there is no data available. Females have many more family responsibilities than compared to males in Nepali society which is may be also true to other countries as well. Even if women scientists are highly educated with great potential, they cannot escape from the old tradition that they take care all of the household work. Thus women give up work and their talents stay back to look after their house and family. There should be a check and balance in this.

**Leadership Roles**

Female leaders are vital for the development of institutions as they can provide identify directions in developing policies for the development and in support of upcoming young female scientists. The presence of women role model leaders encourages younger generations to follow careers in science and engineering. However in Nepal the data is yet to build up in the area.

**Women Leaders**

There are negligible examples coming up recently in the leadership roles in Nepal. For example in Tribhuvan University which is considered a state university consists of 20% female dean, 25% head of the departments and there is a female professor as a leader at the public service commission (2014). This data suggests that slowly females are coming up besides their social difficulties.

**Nepal Academy of Science and Technology**

Nepal Academy of Science and Technology (NAST) consist of 44% of female staffs (2014). Male and female academicians in NAST are 88.6% and 11.3% respectively.

**4. Government Policy**

The interim constitution of Nepal-2064 BS (2008 AD) has made the provision of including 33% female participants in political parties and the parliament but however it is still lacking in the country. However there are few scholarship programs for the female candidates though it is very low.

While it was once rare to see women in higher education, now more women than men are attending college. Though a lot of progress has been made, inequalities still exist between men
and women. Women still typically earn less than men and occupy a smaller percentage of high-paying jobs than men. So while women may be the majority of college students today, there are still many reasons for organizations to offer scholarships for women to try to close these gaps. Such scholarships can be great news for female students, as they can help them to pursue their career.

5. Programs in Universities, Research Institutes, and Academic Societies

The population census of Nepal-2011 has revealed that 51.5% are female. The overall literacy rate has increased from 54.1% in 2001 to 65.9% in 2011. The male literacy rate is 75.1% in comparison to female which is 57.4%. Kathmandu has the highest literacy rate 86.3% and Rautahat has the lowest which is 41.7%. Literacy rate is one of the most critical indicators of the development of the nation. In this rapidly changing techno-driven world, the economic development is easily impeded if the nation lacks literate people. Greater disparity among literacy is that sons are still considered as the future care taker of their parents. Daughters have to get involved in household duties from their early age. If the schools are nearby, they may probably have chances to attend after finishing their chores in time. When the schools are too far, there is no chance for the opportunity. The statistics in literacy rate based on geographic location in Nepal confirms this fact. According to NAST, 2010, the human resources in the field of science and technology is higher in engineering (20%) followed by natural sciences (44%), medical sciences (8%), agriculture (26%), forestry (2%) and food technology (0.3%) (NAST 2010). In all fields such as government, higher education, business, private and non-profit organizations, the number of females as managers, researchers, technicians, teaching staffs is significantly lower (16%) than that of males counterpart (84%). The human resources by gender wise and duties is presented in Table 2 (NAST 2010). Similarly female involvement by sector wise is given in percentage in Table 3. The numbers of different levels of teachers in constituent and private campuses of different universities are yet to be determined. But there is no concrete data in this regard in Nepal and has to be developed. However the number of skilled manpower has been dramatically increased in the country in the last 2 decades. Almost 85% of the skilled manpower generated by the Council for Technical Education and Vocational Training (CTEVT) are working in the health sectors of Nepal (Table 4). The female qualification figure is very less in compare to males is presented in

<table>
<thead>
<tr>
<th>SN</th>
<th>Sectors</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
<th>Total</th>
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<tbody>
<tr>
<td>1</td>
<td>Government</td>
<td>733</td>
<td>72</td>
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<td>203</td>
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<td>100</td>
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<td>892</td>
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<td>10</td>
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<td>34</td>
<td>193</td>
<td>39</td>
<td>4,538</td>
<td>838</td>
<td>5,689</td>
</tr>
<tr>
<td>4</td>
<td>Private and non profit</td>
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<td>103</td>
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<td>57</td>
<td>294</td>
<td>495</td>
<td>165</td>
<td>130</td>
<td>962</td>
<td>519</td>
<td>1,767</td>
</tr>
<tr>
<td>5</td>
<td>Others</td>
<td>17</td>
<td>6</td>
<td>31</td>
<td>10</td>
<td>90</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>188</td>
<td>40</td>
<td>326</td>
</tr>
<tr>
<td>6</td>
<td>Total</td>
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<td>229</td>
<td>4,724</td>
<td>399</td>
<td>10,214</td>
<td>1,839</td>
<td>2,927</td>
<td>641</td>
<td>15,995</td>
<td>3,695</td>
<td>35,108</td>
</tr>
</tbody>
</table>

Source: NAST 2010
M-Male; F-Female
Still women in Nepal receive less degree in engineering, mathematics, physical science, computer and information sciences. In contrast, women continue to earn the largest degree at all levels in the fields they have traditionally dominated such as health professions such as nursing, physical therapy, health administrations and education. In the past 10 years the number of female in microbiology discipline has increased dramatically in the country that have potential role in the infection control system in the hospitals, monitoring of the diagnostic system of the infectious diseases, environment management and public health, agricultural development, in industries for quality maintenance and in the water and food safety (Table 6). Still females in Nepal have preference in medicine, microbiology, information technology and engineering.

In totality the human resources in science and technology is increasing which is also true to women population as well.

### Table 3. Female involvement in S&T by sector wise

<table>
<thead>
<tr>
<th>SN</th>
<th>Sectors</th>
<th>Male</th>
<th>Female</th>
<th>Percentage (%)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Government</td>
<td>22,219</td>
<td>2,727</td>
<td>10.9</td>
</tr>
<tr>
<td>2</td>
<td>Higher education</td>
<td>5,107</td>
<td>1,745</td>
<td>25.4</td>
</tr>
<tr>
<td>3</td>
<td>Business</td>
<td>5,689</td>
<td>950</td>
<td>14.3</td>
</tr>
<tr>
<td>4</td>
<td>Private and non profit</td>
<td>1,767</td>
<td>1,304</td>
<td>42.4</td>
</tr>
<tr>
<td>5</td>
<td>Others</td>
<td>326</td>
<td>77</td>
<td>19.1</td>
</tr>
</tbody>
</table>

Source: NAST 2010

### Table 4. Middle level human resources produced by CTEVT, 2010

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</tr>
<tr>
<td>2</td>
<td>Engineering</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Health</td>
<td>85</td>
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</tbody>
</table>

Source: NAST 2010

### Table 5. Qualification of human resources in S&T by gender

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<td>1</td>
<td>Doctorate</td>
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<td>54</td>
<td>437</td>
</tr>
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<td>2</td>
<td>Master</td>
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<td>Bachelor</td>
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<td>2,338</td>
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</table>

Source: NAST 2010

### Table 6. Researches in microbiology by genderwise

<table>
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<tr>
<th>SN</th>
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</thead>
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<tr>
<td>1</td>
<td>Medical</td>
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<td>139</td>
<td>280</td>
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<tr>
<td>2</td>
<td>Agriculture</td>
<td>11</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>Environment</td>
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<td>28</td>
<td>72</td>
</tr>
<tr>
<td>4</td>
<td>Food</td>
<td>23</td>
<td>19</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>219</td>
<td>194</td>
<td>413</td>
</tr>
</tbody>
</table>

Source: Central Department of Microbiology, Tribhuvan University, Nepal, 2014

Research Centre for Applied Science and Technology (RECAST)

In Research Centre for Applied Science and Technology (RECAST) consist of male: female ratio of professionals is 75% and 25% respectively (RECAST 2013).

Women in Science and Technology (WIST)

Women in Science and Technology (WIST) is a non profit, non governmental, professional organization established in 1992. Approximately 445 women members working in the field of science and technology and graduates in science can be members of this organization. Its motto is to empower women scietists and technologists and to use their skill and knowledge to empower women and improve the livelihood of women in rural and urban areas in Nepal.
6. Best practices

Mobilization of skilled women in the development of the country

- About 2/3rds of women in Nepal are engaged in agriculture. More than half of the country’s food is produced by women. Research based scientific knowledge in agriculture and food production among the women will increase the gross domestic product of the country.

- Skills development improves output, quality, diversity and occupational safety and improves health, thereby increasing incomes and livelihoods of the poor.

- It also helps to develop social capital and strengthens knowledge about informal sector associations, rural organizations and governance. According to human capital theory, the better education enhances the agricultural individual’s and also increases the higher productivity.

- Skilled women in Nepal can be mobilized in the environmental sector for minimizing environmental pollution, utilization of Nepal’s vast biodiversity, innovation of environmental friendly techniques and tools.

- Mobilization in health sector especially for the reduction of maternal and infant morbidity and mortality.

- Mobilization in the innovation of information technology.

- Mobilization of skilled women in the social security which is worst in Nepal.

Suggestions

The suggested roles that should be played by educated stakeholders of Nepal for the uplifting of females in the science and technology is as follows:

- Encouraging female in practical based science and technology education from the school level.

- Creating awareness about their role as a potential leader in the society.

- Creating awareness and incline them towards the economic development of the country through science and technology.

- Creating awareness for the independent life i.e. alleviation of male dependency in the society.

- Change the radical thinking of male.

- Policy implementation of the reservation system for marginalized group of females.

- Political commitment for the participation of females in the national development.

- Allocation of sufficient funds for the uplifting of science and technology in the country.

7. Limitations

- Cultural and social attitudes are often unfavourable to women’s participation in the fields of science and technology, which limits their opportunities in these areas to some extent.

- Due to ancient notion, they believe science subject are very difficult to girl students, can only be managed by boy students.

- The girls in this field lack role models, career guidance from fellow women because this has been a male dominated domain for a number of years.

- Science and technology courses are more costly than other courses as they do not have practical components.

- To get higher education in S&T girls have to leave home since the educational institutions are not available nearby their residence. Leaving home is constrained by economic and social obstacles.

- Women are often financially dependent on men or do not have control over economic resources, which makes accessing science and technology services more difficult.

8. Challenges

Gender equality in science and technology is necessary to realize the problem but is difficult to solve. Access to information is another important point. Retention of females in leaky pipeline, check and balance especially at the tertiary and mid-career level is very important. However there is remarkable disparity in leading to underutilization
of women’s talents. The government sector, women scientist organizations, and academic societies need to encourage and support women scientists. However, till date no such efforts are made till date. Women leaders in science and technology are negligible. Cultivating women scientists as leaders requires long way to go and need a sustainable attempt. We hope to see women leaders in science and technology in near future. Gender gap involvement in science and technology should be made closer by encouraging the female human resources. Political intervention in the sector of science and technology should be discouraged. In the context of the development of science and technology, Nepal requires all possible regional and international cooperation from the developing and developed countries.

9. References


1. Executive Summary

Pakistan’s estimated population in 2014 is over 186 million, making it the world’s sixth-most-populous country, behind Brazil and ahead of Nigeria. According to the World Bank, the female % of total in Pakistan was last measured at 49.19 in 2011. Though women constitute almost half of the population but women are underutilized talent in Pakistan like many other countries. The status of women in Pakistan varies considerably across classes, regions, and rural urban divide due to uneven socio-economic development and the significant impact of tribal, feudal and capitalist social formation of women life. The gender equality was specifically guaranteed in the constitution of Pakistan which was adopted in 1973. The constitution stipulates that “there shall be no discrimination on the basis of sex alone.” The constitution additionally affords the protection of marriage, family, the mother and the child as well as ensuring “full participation of women in all spheres of national life”. But ground situation is not very favorable. Although successive Governments have taken various steps toward institutional building for women’s development, such as the establishment of the Women’s Division in the Cabinet Secretariat, and the appointment of commission on the Status of Women. Ministry of Women’s Development (MWD) established Women’s Studies Centers at various Universities of country. More recently the landmark development in women rights and protection against harassment legislation and empowerment was made. These may help in improving the status of women in future if implemented with true spirit.

Education has a central significance and pivotal role in the development of human society. It is further, one of the most important means of empowering women with the knowledge, skills and self confidence. On education development index which combines all educational access measures, Pakistan lies at the bottom with Bangladesh. The overall literacy rate is 57.7 percent with 69.5 percent for male and 45.2 percent for female. The survey’s data shows that literacy remains higher in urban areas (73.2 percent) than in rural areas (49.2 percent), and is more prevalent for men (80.3 percent) compared to women (65.5 percent) in rural areas. While youth (15-24 years)
literacy rate is 79.1% for males and 61.5% for females. Although status of women has improved in recent years in Pakistan but gender inequality remains persistent to directly and significantly affect economic growth. Government is trying to make friendly policy for women education in general but no particular initiative has been taken yet to enhance the participation of women in science and technology which is believed to be one of the key elements in the uplift of socio-economic growth of the country. Therefore, women constitute quite less percentage with compare to their male counterpart in science and engineering. Besides having low representation in science and engineering, some women scientists and engineers have shown positive and encouraging impact especially in the fields of solar energy, natural products and immunology etc.

2. Introduction

The education system in Pakistan is generally divided into five levels: Primary (grades one through five); Middle (grades six through eight); High (grades nine and ten, leading to the Secondary School Certificate or SSC); Intermediate (grades eleven and twelve, leading to a Higher Secondary School Certificate or HSC); and University programs leading to undergraduate and graduate degrees. Education system is composed of both public 72% and private 28% institutions with student’s distribution 66% students are in public and 34% are in private institutions. Similarly, teaching staff in public is 57.88% while in private 42.12%. However, taking in consideration the composition of the education system by gender female students make 42.62% and male students 57.38% while female teachers make 55% and male teachers 45%. The distribution of educational institutions by level is given in Figure 1 which shows 58% is shared by Primary Schools while Universities have the least share i.e. only 0.5% with ~135 Universities in country.

The school drop-out rate among girls is very high i.e. almost 50%, while the educational achievements of female students are higher as compared to male students at different levels of education. Similarly the public Universities of Pakistan have female enrollment more than males but it does not translate in work force which is only 14%. There are a number of specific barriers which play over all devastating role in this scenario. For example

i. Poverty, Marriage and Motherhood emerge as common obstacles in Pakistan like many other developing countries:

- Poverty is one of the main issues
- For less fortunate girls/women, scholarships and grants are the only options which are not easily available
- Girls cannot benefit from education at all because they are expected to stay at home and help with household chores while the boys in the family go to school
- It is very normal in significant number of families to give priority to the educational
development of boys

- Girls and young women cannot continue their education beyond school because they are married off early and are expected to devote their lives to their children, husbands and family

ii. Culture, Societal and Economical:

- Negative attitudes arising from cultural and societal values and more recently extreme mind set
- Girls are less likely to study science as there is a lack of investment in girl’s education
- Parents also invest less in their daughter’s higher education because they usually expect them to remain at home once they are married
- Shortage of science school teachers who are responsible for training of next generation of scientists
- Persistent use of outdated methods of teaching science i.e. memorizing facts fail to sustain the curiosity of students and seems to affect girls more strongly
- Lack of government support for promoting state-of-the-art methods in science education
- Most science subjects are regarded as inappropriate for girls. Therefore, the exclusion of girls starts at primary school level, when school children are shown images that perpetuate gender stereotypes and convey the message that science and technology are not for girls
- When girls do become interested in science, they do not often receive encouragement to study science because traditional beliefs dictate that these areas of study are appropriate only for boys
- Teachers and academic advisors often actively discourage girls from studying these subjects at school as these are difficult subjects and that arts and humanities may be better choices
- In co-education schools teachers encourage boys to engage with science by allowing them to ask more questions, while ignoring girls, giving them inadequate replies or criticizing them for minor errors
- While girls are encouraged in girls schools and perform far better in the sciences

iii. Personal Choice and Competence:

- If women have more opportunities to study science and sometimes up to a medical, engineering or Ph. D degrees. Even then some of these women willingly or unwillingly (husband/in laws) choose to end their career in science to get married and raise a family
- Others simply cannot compete with their male colleagues because, in the traditional role, they are expected to get home early to prepare the family meals etc. In simple, women need to spend more time to look after the family then to advance their study or career

3. Status of Women in Science and Engineering

Higher Education

Higher Education Commission (HEC) was established in 2002 with specific aim to facilitate Institutes of higher learning to serve as an engine of socio-economic development of Pakistan. The commission has played a vital role in enhancing the development of human resource in all field of higher education especially in science and engineering. As a result an increase in the enrollment of both genders is witnessed in the Universities over the years (Figure 2). HEC initiated a number of programs like overseas, indigenous and split scholarships for MS, MS leading to Ph. D and Ph. D for all qualifying students and University faculty. Because of funding and sustainability in Government policies there was gradual and significant increase in Ph. Ds (Figure 3). Under these initiatives by 2011 a total of 1258 Ph. Ds in various fields are produced with 83% male while only 17% females with the fact that traditionally women are more inclined in studying Natural Sciences and particularly Biological Sciences and Medicine in Pakistan rather than Engineering and Information
Although with passage of time there is significant increase of female participation in Engineering and Information Technology. The research of indigenous Ph. D program is supervised by scientists and engineers working in R and D Organizations and Higher Education Institutes of Pakistan. The HEC data of supervisors also showed gender disparity i.e. that 85.56% are male and only 13.06% are females.

**Gender Inequality in Employment and Productivity**

Although there is no conscious discrimination against women in terms of employment including salary, facilities, study leave and promotions etc., the distribution of formal employment in Pakistan is heavily biased in favor of men. However, the fact that equal participation of both genders is a key for valuable and sustainable economic growth.
progress of any country. It is observed that even though 55% of the students enrolled in disciplines of sciences and engineering at various academic institutions are female, women make up hardly 14% of the work force in these fields. The data collected and analyzed by Pakistan Council of Science and Technology (PCST) shows inequality in education as well as in employment (Figure 6). Besides, one thing is quite important to note in Table 2 that women scientists and engineers are more at higher salary grades per Government salary scales as compared to lower salary grades. Further, woman participation is in all important sectors are visible through Figure 7 with highest proportion in textile followed by education and health.

In order to enhance the scientific culture and activities, Government of Pakistan started Research Productivity Award (RPA) in 2004 through PCST on the basis of specific criteria including impact factor and citation etc. Figure 8 shows the number of females and males awarded RPA in different years. One can observe the small number of women scientist and engineers succeeded in getting the award with the point to be noted that the proportion of RPA increased significantly since 2008.
In terms of impact factor and citation the situation is little encouraging as obvious in Figure 9 and proportion has been increased since 2005-2006. Further it has been revealed from the data collected and analyzed by PCST that females, though in small number in science and engineering, are more productive during age 46-55 followed by 26-35 (Figure 10). When data is taken in account discipline wise then it supports the fact that women are more inclined towards natural sciences as compared to mathematics and engineering (Table 3).

**Effects of Marital Status on Work Participation**

Authentic data is not available in this category though but it is a general observation that marriage is one of the key factors in badly
influencing work participation for female. The reasons have been pointed in introduction.

Leadership Roles
It is believe to be true that “women have the power to change the world so a woman is a change-agent. She can feed her family. Build her business. Raise her kids. Employ her neighbors. She can inspire sustainable transformation and create a new story for herself, her children and her entire community. A woman is powerful and full of often-untapped potential. A woman can change the world. But first, she needs to be given an opportunity. This is also true in development of science and engineering. In Pakistan, though women scientist and engineers are in low % tage but they had played significant roles as Vice Chancellor of Universities, Dean of Science/Engineering Faculties, Chairperson of various Science Departments, Head/Director of different Division/Institutes etc.

Principal Investigators (PIs)
Because of unavailability of exact data it is hard to give exact figure, however the prevailing situation related to participation of women in science and engineering does point out that there must also be less number of women PIs.

Team Leaders and Administrators in Academia and Research Institutes
The same situation exists in this area too.

Pakistan Academy of Sciences (PAS)
PAS was established in 1953 and in 2013 only 7 out of 82 PAS fellows are women. This make them only 8.5%. Although efforts are being made to increase the number of women fellows.

Academic Associations
Scientific associations are an instrumental tool to provide vast opportunities to develop academic abilities and avenues to nurture leadership. There are more than thirty associations in science, engineering, medical sciences, agriculture sciences, fisheries, food, environmental, energy etc. but hardly one or two women are at the top position. There are only two women forums in engineering i.e. Women in Engineering (WIE) forum, which is a part of Institute of Electrical and Electronics Engineers. IEEE, Pakistan. IEEE is the world’s largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. The second one is International Organization of Pakistani Women Engineers (IOPWE). The purpose of this forum is to enable women achieve their full educational and career potential.

4. Government Policy
As mentioned in introduction, a number of initiatives have been taken in general to uplift women status and integrate their role in the development of country. These initiatives are in
terms of legislation as well as non-legislations. But no conscious effort has been made for the enhancement of women participation in sciences and engineering. One significant development by a government body i.e. Pakistan Council of Science and Technology (PCST) took place in 2013 in the form of launching website for women scientists and engineers. The main goal of this initiative was to facilitate women in scientific communities, to improve visibility of women scientists in socio-economic development of country. However, Pakistan like Korea needs to have an act on fostering and supporting women in science and engineering.

5. Programs in Universities, Research Institutes and Academic Societies
Since Government does not have any legislation and women scientists and engineers do not have vocal associations to adopt policies to hire and to promote more women scientists and engineers. Therefore no University or Institution has set any goal in this direction.

6. Women Science and Technology Association
Although we do not have any such association which may help in raising the competitiveness of women and to contribute to scientific and technological development of Pakistan but women scientists and engineers either in individual capacity or under the umbrella of some scientific associations try to hold conferences, workshops/seminars and awareness programs etc. to bridge the gap.

7. Best Practices
Legislation
We do not have any act or any legislation and need to pay attention to get it.

Establishment of Women Science and Technology Association
Women scientist and engineers need to develop a national women science and technology association to promote women scientists and engineers and to take care of their problems and help them to get these solved/resolved.

8. Challenges
Getting gender equality in science and engineering is an uphill task. There are so many challenges out there to take care of and identifying the root causes of poor participation of women in science and engineering is not very straightforward. There are a number of barriers and are linked to an invisible web with intertwined strands representing culture, societal, personal, institutional, political and economic obstacles. In brief:

- Pakistani women scientists/engineers/medical doctors, in general, do not face conscious discrimination in terms of salary, facilities, study leave and promotions etc.
- However, at entry plus Primary level and onward, a number of barriers are out there for girls to face like culture, societal, economical which are then vary in rural and urban area affecting rural the most. Therefore, there is need to have political will and progressive policies not only for female education but also for political and economic reforms that empower women in all sphere of their life. For example:
  - Concerted efforts are needed to change mind set towards female education and then science education
  - Enhancement of good, well trained school science teachers with effective and innovative methods of science teaching because they are the ones who would train the next generation of scientists
  - Everyday experiences should intertwine into curricula for science subjects in primary schools to increase the fascination with science in girls students
• Make sure that girls stay involved by encouraging them to participate in activities like science fairs and competition while at Secondary level
• At College and University level, incentives should be offered for research trainings and scholarships for female students considering career in science
• To have mentoring programs
• To have family support/child care centers plus more flexible working time to increase retention of women scientists and engineers as work force

9. References
1. Pakistan Education Statistics 2010-11
4. Pakistan Council of Sciences and Technology (PCST) Survey 2010-2013
Gender Parity and Filipino Women in Science and Technology

Lourdes J Cruz
National Academy of Science and Technology

1. Executive Summary
The Philippines has consistently been among the top ten countries when assessed in terms of the Gender Gap Index but apparently there are still problems with gender parity in science and technology particularly as one goes up the career ladder. For the period examined, 2011 to 2014, there were more female than male graduates at the Bachelor’s level in the Colleges of Science whereas the reverse is true for graduates of BS Engineering courses. The F/M ratio was above 1.0 among BS graduates of the College of Sciences in three main state universities and one private university studied. In the University of the Philippines Diliman, the percent female among BS graduates was 54.3% and 52.5% among MS graduates. The level of gender parity in S&T education depends on the specific fields of study with life sciences, chemical sciences, geological sciences and mathematical sciences attracting more females than males whereas Physics is a male dominated field of study. In Engineering, only 42.8% of BS graduates and 39.5% of MS graduates were women. Most engineering courses attracted more males than females except for Industrial Engineering and Materials Science & Engineering.

The Science Career Path in the Philippines involves the progressive recognition of scientists by the National Academy of Science and Technology (NAST) from a young science graduate (Stage 1) to becoming an Outstanding Young Scientist awardee (Stage 2), who can then progress further to become a member of the Academy (Stage 3) and finally to the highest recognition as a National Scientist (Stage 4). Although 51-56% of BS graduates are females, women make up only 33.5% of Outstanding Young Scientists awardees, 23.8% of NAST Academicians and 26.8% of National Scientists. A similar decreasing trend has been observed in other countries and referred to as the “Leaky Pipe”. It is clear that the biggest decrease in percent females is from Stage 1 to Stage 2. The succeeding decrease from Stage 2 to 23.8% in Stage 3 is not as big but still quite substantial but the change from Stage 3 to Stage 4 is not significant. For a developing country like the Philippines where the number of researchers per million people is very low, the loss of women
from the S&T pool as in the above ‘Leaky Pipe’ is a big waste of human resources. Strategies and incentives must therefore be set up to prevent both the diversion from science at early career stages and to encourage the re-entry of women back into the scientific system at the latter stages.

2. Introduction

Since the World Economic Forum first published the Global Gender Gap Report [GGGR] in 2006, the Philippines has consistently been among the top ten countries when assessed in terms of the Gender Gap Index as a framework for measuring the extent of gender disparities in different economies (1). GGI uses four sub-indexes, namely Economic Participation, Educational Attainment, Health and Survival, and Political Empowerment. Among the lower middle income countries, the Philippines is second only to Nicaragua in terms of GGI and it has the highest GGI in the Asia and the Pacific region.

According to the GGGR 2014, so far eight countries including the Philippines have closed the gender gap on education and health but no country has yet closed the gap on political empowerment and economic participation. The Philippines’ rank in Political Empowerment is 17, where the political variables considered and their [F/M] ratios are as follows: Women in ministerial positions, rank 72 [0.19]; Women in parliament, 41 [0.38]; and Years with female head of state in last 50 years, 6 [0.46]. The Philippines has had two women presidents, Corazon C. Aquino and Gloria Macapagal-Arroyo, who served for six and nine years respectively. Among the 33 current Cabinet members or ministers of President Benigno Aquino, only six are females. So far, only one woman science minister has served in the Philippines government, Dr. Estrella F. Alabastro, who was Secretary of the Department of Science and Technology from March 2001 to June 2010.

The Philippines ranks 24th in overall Economic Participation with the following ranks of economic variables and female-to-male ratios [F/M]: Labour force participation, 102 [0.65]; Estimated earned income, rank 44 [0.68]; Wage equality for similar work, 9 [0.79]; Legislators, senior officials and managers, 5 [0.91]; and Professional and technical workers, rank 1 [1.55]. For the science and technology community, the most relevant variables are the last two particularly the F/M ratio among professional and technical workers.

3. Gender Parity in Science and Technology Education

The variables of the sub-index on Educational Attainment include literacy rate, enrolment in primary education, enrolment in secondary education, and enrolment in tertiary education, where assessment of gender parity for each variable is based on the ratio of females to males (1). Although, the F/M ratio for overall enrolment in tertiary education in the Philippines is 1.24, it will be important to verify the F/M ratio among graduates of S&T courses. [F/M ratios of 1 and above are given a score of 1.0.] To illustrate the actual situation, the data for BS graduates in science and engineering in several schools, three public/ state universities and two private universities are hereby presented.

Table 1 shows that there are more female than male graduates in Bachelor of Science courses whereas the reverse is true for graduates of BS Engineering courses. The F/M ratio in BS courses is above 1.0 for the period 2011 to 2014 in three state universities: the University of the Philippines (UP Diliman and UP Los Baños) and Mindanao State University-Iligan Institute of Technology (MSU-IIT), and in the University of Santo Tomas [UST], a private university. The FM ratio is also above 1.0 for the combined College of Arts and Sciences in UP Los Baños. The only exception is De La Salle University [DLSU], a former all-male college, where the F/M ratios for Science and Engineering graduates are both 0.36, a value way below the ratios of other schools. This lack of gender parity in DLSU has little effect on the overall value for the country because the S&T enrolment in DLSU
is relatively small compared to other Philippine universities. Nevertheless, DLSU as a university should strive to attain gender parity in S&T.

Among the various BS courses in UP Diliman shown in Table 2A, the highest F/M ratios are in Chemistry, Biology, and Molecular Biology and Biotechnology, followed by Mathematics and the Geological Sciences. On the other hand, there are more males than females in Physics as indicated by a 0.84 F/M ratio in the period 2008-2011. Subsequently, the National Institute of Physics offered a BS Applied Physics course in addition to the regular BS Physics course. For the period 2011-2014, BS Applied Physics showed a higher F/M ratio of 0.64 than BS Physics with a 0.38 F/M value. The F/M ratios of the overall science graduates for 2011-2014 are all above 1.0 for the BS, MA and PhD levels.

For the BS Engineering graduates shown in Table 2B, there are generally more males than females except in Industrial Engineering and Materials Engineering, where the F/M ratios are above 1.0. On the other hand, Electrical Engineering’s showed an extremely low F/M ratio of 0.12 (11.1%). Although the F/M ratios at the BS and MS level are below 1.0, the F/M ratio for overall graduates at the PhD level is above 1.0 [58% F]. It is interesting to note that in the last four years, the highest percentage of females among PhD Engineering graduates are in Remote Sensing (91.1%), Chemical Engineering (87.5%) and Environmental Engineering (56.2%) whereas there have been no female PhD graduates in Electrical and Electronics Engineering, Energy Engineering and Material Science Engineering.

Consideration of the above data on gender distribution indicates that the level of gender parity in S&T education depends on the specific fields of study. Since the universities do not impose any gender-based quota, the data show that in general life sciences, chemical sciences, geological sciences, and mathematical sciences attract more females than males whereas Physics is a male dominated field of study. Most engineering courses attracted more males than females except for Industrial Engineering and Materials Science & Engineering.

Table 1. Comparison of Gender Distribution in Science and Engineering Graduates in Selected Universities (2011-2014).

<table>
<thead>
<tr>
<th>University Offering BS Science Courses*</th>
<th>Type of University</th>
<th>F/M</th>
<th>F (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP Diliman</td>
<td>State</td>
<td>1.19</td>
<td>54.3</td>
</tr>
<tr>
<td>MSU-IIT</td>
<td>State</td>
<td>1.85</td>
<td>64.9</td>
</tr>
<tr>
<td>UST</td>
<td>Private</td>
<td>1.45</td>
<td>59.3</td>
</tr>
<tr>
<td>UP Los Baños, (Arts &amp; Sciences)</td>
<td>State</td>
<td>1.69</td>
<td>62.9</td>
</tr>
<tr>
<td>DLSU**</td>
<td>Private</td>
<td>0.36</td>
<td>26.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>University Offering BS Engineering Courses*</th>
<th>Type of University</th>
<th>F/M</th>
<th>F (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP Diliman</td>
<td>State</td>
<td>0.75</td>
<td>42.8</td>
</tr>
<tr>
<td>UP Los Baños</td>
<td>State</td>
<td>0.69</td>
<td>40.8</td>
</tr>
<tr>
<td>MSU-IIT</td>
<td>State</td>
<td>0.73</td>
<td>42.3</td>
</tr>
<tr>
<td>UST</td>
<td>Private</td>
<td>0.67</td>
<td>40.1</td>
</tr>
<tr>
<td>DLSU*</td>
<td>Private</td>
<td>0.36</td>
<td>26.5</td>
</tr>
</tbody>
</table>

* The two main campuses of the University of the Philippines System are UP Diliman in Metro Manila and UP Los Baños in Laguna, a province south of the National Capital Region. MSU-IIT is the top university in Mindanao, the Philippines’ second biggest island while UST in Manila is the oldest university in the country.
WOMEN IN SCIENCE AND TECHNOLOGY IN ASIA

Table 2. Gender distribution in different science and engineering courses in UP Diliman in the Philippines.

A. Gender distribution among graduates of the College of Science

<table>
<thead>
<tr>
<th>BS Courses</th>
<th>2008-2011</th>
<th></th>
<th>2011-2014</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F/M</td>
<td>F (%)</td>
<td>F/M</td>
<td>F (%)</td>
</tr>
<tr>
<td>Chemistry</td>
<td>1.81</td>
<td>64.4</td>
<td>1.37</td>
<td>57.8</td>
</tr>
<tr>
<td>Molecular Biology &amp; Biotechnology</td>
<td>1.53</td>
<td>60.5</td>
<td>1.29</td>
<td>56.2</td>
</tr>
<tr>
<td>Biology</td>
<td>1.40</td>
<td>58.3</td>
<td>1.48</td>
<td>59.7</td>
</tr>
<tr>
<td>Geological Sciences</td>
<td>1.25</td>
<td>55.6</td>
<td>1.09</td>
<td>52.2</td>
</tr>
<tr>
<td>Mathematics</td>
<td>1.11</td>
<td>52.6</td>
<td>1.27</td>
<td>55.9</td>
</tr>
<tr>
<td>Physics</td>
<td>0.84</td>
<td>45.7</td>
<td>0.38</td>
<td>27.3</td>
</tr>
<tr>
<td>Applied Physics</td>
<td>-</td>
<td></td>
<td>0.64</td>
<td>39.3</td>
</tr>
</tbody>
</table>

Overall Distribution

<table>
<thead>
<tr>
<th>BS Courses</th>
<th>2008-2011</th>
<th></th>
<th>2011-2014</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F/M</td>
<td>F (%)</td>
<td>F/M</td>
<td>F (%)</td>
</tr>
<tr>
<td>1,435 BS graduates</td>
<td>1.30</td>
<td>56.6</td>
<td>1.19</td>
<td>54.3</td>
</tr>
<tr>
<td>402 MS graduates</td>
<td>1.10</td>
<td>52.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65 PhD graduates</td>
<td>1.16</td>
<td>53.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Gender distribution among graduates of the College of Engineering

<table>
<thead>
<tr>
<th>BS Courses</th>
<th>2011-2014</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F/M</td>
<td>F (%)</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>0.94</td>
<td>48.3</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>0.77</td>
<td>43.6</td>
</tr>
<tr>
<td>Computer Engineering</td>
<td>0.58</td>
<td>36.8</td>
</tr>
<tr>
<td>Computer Science</td>
<td>0.76</td>
<td>43.2</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>0.12</td>
<td>11.1</td>
</tr>
<tr>
<td>Electronics &amp; Communications Engineering</td>
<td>0.53</td>
<td>34.6</td>
</tr>
<tr>
<td>Geodetic Engineering</td>
<td>0.73</td>
<td>42.3</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>1.35</td>
<td>57.5</td>
</tr>
<tr>
<td>Materials Science &amp; Engineering</td>
<td>1.52</td>
<td>60.3</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>0.18</td>
<td>15.4</td>
</tr>
<tr>
<td>Metallurgical Engineering</td>
<td>0.96</td>
<td>49.0</td>
</tr>
<tr>
<td>Mining Engineering</td>
<td>0.41</td>
<td>29.2</td>
</tr>
</tbody>
</table>

Overall Distribution

<table>
<thead>
<tr>
<th>BS Courses</th>
<th>2011-2014</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F/M</td>
<td>F (%)</td>
</tr>
<tr>
<td>3,213 BS Graduates</td>
<td>0.75</td>
<td>42.8</td>
</tr>
<tr>
<td>352 MS graduates</td>
<td>0.65</td>
<td>39.5</td>
</tr>
<tr>
<td>50 PhD graduates</td>
<td>1.38</td>
<td>58.0</td>
</tr>
</tbody>
</table>

4. Gender Parity in the S&T Career System

After a BS degree, the graduates have a number of options to pursue. Some continue on to work toward a graduate degree in the same field of science or an allied field; others opt to pursue research management courses or science education...
courses. Some want to gain work experience in research and development before enrolling in higher degree programs whereas a few decide to use their basic knowledge in science to follow their interest in advocacy work with non-profit organizations. Nevertheless, the training and discipline one gains in science serves as a good preparation for other endeavors if one decides not to pursue science as a career.

The pertinent data on Philippine human resources in R&D were obtained from the 2012 Compendium of S&T Statistics (2) report of DOST and summarized as shown in Table 3. It is clear that more females than males are involved in research and development whether they are in higher educational institutes, government R&D institutes or in private non-profit organizations. On the other hand, more males than females are involved in R&D in private industry as reflected by the data for 2003, the only year for which the DOST compendium provides data on gender distribution in industry (2).

With respect to faculty positions, the F/M ratios shown in Table 4 indicate a big variation among the schools represented. The two state universities UP Diliman and MSU-IIT show opposite trends with F/M ratio slightly less than 1.0 for UP Diliman and 1.85 for MSU-IIT. Likewise, the two private universities showed disparate F/M ratios with a value of 1.33 for UST and 0.79 for DLSU.

Among faculty members in UP Diliman, the F/M ratio is 0.84 (45.7%) in the College of Science and 0.31 (23.7%) in the College of Engineering. The faculty has a lower F/M ratio than among graduates of the S&T colleges. One explanation for this observation is perhaps the preference of females to go to other career options as in full time research employment shown in Table 3 versus a more competitive and demanding teaching job that involves lecture preparation and grading papers in the evening. In general, married young women prefer jobs wherein they can dedicate time after office hours to family activities and concerns.

As one goes up the career ladder, a young scientist aspires to make significant contributions to the advancement of science and present research findings in international conferences and meetings. In addition, if hired as a faculty member, the young scientist can form a research group and mentor students and upcoming scientists, a challenging and rewarding experience. In recognition of their accomplishments and as an incentive to pursuing a lifetime career in science, the National Academy of Science and Technology of the Philippines (NAST PHL) provides the Outstanding Young Scientists award to those who are 40 years old and below. Based on accomplishments, senior scientists and technologists may be nominated by NAST members (referred to as Academicians) for election as Academicians of NAST. The most prestigious recognition by NAST is the nomination and election of the best scientists from among the NAST members and their conferment as National Scientists by the President of the Republic of the Philippines.

Table 3. Philippine Human Resources in Research and Development*

<table>
<thead>
<tr>
<th>Year</th>
<th>Government R&amp;D Institutes</th>
<th>Public Higher Educational Institutes</th>
<th>Private Higher Educational Institutes</th>
<th>Private Non-Profit Organizations</th>
<th>Private Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>56.5</td>
<td>56.4</td>
<td>55.7</td>
<td>52.7</td>
<td>45.0</td>
</tr>
<tr>
<td>2003</td>
<td>54.5</td>
<td>55.1</td>
<td>61.6</td>
<td>51.4</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>55.3</td>
<td>57.1</td>
<td>53.0</td>
<td>53.0</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>55.6</td>
<td>56.1</td>
<td>55.6</td>
<td>55.0</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>56.9</td>
<td>58.3</td>
<td>54.8</td>
<td>55.1</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>55.8</td>
<td>56.6</td>
<td>56.1</td>
<td>53.4</td>
<td></td>
</tr>
</tbody>
</table>
The gender distribution among Outstanding Young Scientist (OYS) Awardees of NAST is given in Table 5 and that for NAST Academicians and National Scientists in Table 6. The F/M ratio of total OYS awardees is 0.50 but the data for the fields of expertise show a big range from 0.93 in Chemical Sciences to zero for Engineering Sciences & Technology. Next to Chemical Sciences are Biological Sciences and Social Sciences with F/M ratios of 0.67 and 0.60, followed by Medical, Physical and Mathematical Sciences.

Table 6A presents the gender distribution among scientists elected as members of NAST since the Academy was established in 1972. The overall F/M ratio and the ratio for living Academicians are practically the same. However, there is a wide span of values ranging from an F/M ratio of 0.69 (40.9% F) in Biological Sciences down to a ratio of 0.08 (7.1% F) in Agricultural Sciences. Social Sciences and Medical Sciences have very similar gender distributions of 29.4 and 28.6% F, respectively. This was followed by Chemical, Mathematical and Physical Sciences at 16% F; then by Engineering Sciences & Technology and Agricultural Sciences at 9.1% before the lowest value for the Agricultural Sciences.

The total number of Academicians elected as National Scientists (NS) since 1972 is 41 with a F/M ratio of 0.37 or 26.8% F. It is curious to note that the % F among living National Scientists are higher than for all NS ever elected. The data set for National Scientists grouped according to the decade of election showed 1998—2007 to be the best decade for female National Scientists at 44.4% F. There seemed to be an increasing trend in percent female national scientists from 1978 to 2007 but the period from 2008 to the present gave a disappointing 20.0% F. Certainly something must be done to increase again the number of female national scientists.

Figure 1 illustrates an example of a Science Career Path that involves progressive recognition of scientists in the NAST system from a young science graduate [Stage 1] to become an Outstanding Young Scientist awardee [2], progressing further to become a member of the Academy [Stage 3] and finally to the highest recognition as National Scientist [Stage 4]. It is clear from the values indicated that the biggest decrease in percent females is from 51-56% in Stage 1 to 33.5% in Stage 1. The succeeding decrease from Stage 2 to 23.8% in Stage 3 is not as big but still quite substantial. At the final step, the change in %F is minimal.

This decrease in %F along the illustrated career
Gender Parity and Filipino Women in Science and Technology

Path is what is often referred to as the ‘Leaky Pipe’ of women involvement in science. The factors believed to contribute to the big decrease between Stage 1 and 2, are often associated with a young woman’s decision to focus on starting a family and not devoting as much time in developing a scientific career. In trying to address the dropping out of women from a scientific career, perhaps the biggest effort is to address the big decrease at the early stages of a woman’s career (between Stages 1 and 2) but the factors that can contribute to women’s persistence in science (between Stages 2 and 3) should be addressed as well.

5. Women Empowerment and Attempts to Attain Gender Equality in the Philippines

Despite the increasing gender disparity along the Philippine S&T career path, the country is still rated relatively high using the Gender Gap Index. Perhaps it comes as a surprise for a country with low GDP to have a high GGI. To understand the status of women in Philippine society, it would be worthwhile to look at the Filipino women’s traditional role and the country’s long history of laws, policies, pronouncements, and measures toward attaining gender parity.

Filipino women have traditionally occupied a relatively high status in the family and society compared to women in other Asian countries. In the pre-Spanish era, women could own property,

<table>
<thead>
<tr>
<th>Academician’s Division</th>
<th>Females</th>
<th>Males</th>
<th>F/M</th>
<th>F (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sciences</td>
<td>9</td>
<td>13</td>
<td>0.69</td>
<td>40.9</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>5</td>
<td>12</td>
<td>0.42</td>
<td>29.4</td>
</tr>
<tr>
<td>Medical Sciences</td>
<td>6</td>
<td>15</td>
<td>0.40</td>
<td>28.6</td>
</tr>
<tr>
<td>Chemical, Mathematics &amp; Physical Sciences</td>
<td>4</td>
<td>21</td>
<td>0.19</td>
<td>16.0</td>
</tr>
<tr>
<td>Engineering Sciences &amp; Technology</td>
<td>1</td>
<td>10</td>
<td>0.10</td>
<td>9.1</td>
</tr>
<tr>
<td>Agricultural Sciences Division</td>
<td>1</td>
<td>13</td>
<td>0.08</td>
<td>7.1</td>
</tr>
<tr>
<td>Total (1972-2014)</td>
<td>26</td>
<td>84</td>
<td>0.309</td>
<td>23.6</td>
</tr>
<tr>
<td>Living Academicians (2014)</td>
<td>15</td>
<td>48</td>
<td>0.312</td>
<td>23.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Academician’s Division</th>
<th>Females</th>
<th>Males</th>
<th>F/M</th>
<th>F (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year elected: 1978–1987</td>
<td>4</td>
<td>14</td>
<td>0.28</td>
<td>22.2</td>
</tr>
<tr>
<td>1988–1997</td>
<td>1</td>
<td>3</td>
<td>0.33</td>
<td>25.0</td>
</tr>
<tr>
<td>1998–2007</td>
<td>4</td>
<td>5</td>
<td>0.80</td>
<td>44.4</td>
</tr>
<tr>
<td>2008–present</td>
<td>2</td>
<td>8</td>
<td>0.25</td>
<td>20.0</td>
</tr>
<tr>
<td>Total NS (1972-2014)</td>
<td>11</td>
<td>30</td>
<td>0.37</td>
<td>26.8</td>
</tr>
<tr>
<td>Living NS (2014)</td>
<td>5</td>
<td>11</td>
<td>0.45</td>
<td>31.2</td>
</tr>
</tbody>
</table>
serve as community leaders and officiate rites and ceremonies of the society. Spanish colonization of the Philippines from 1521 to 1898 curtailed the freedom of Filipino women and their role in the society. On the other hand, the Americans [1898-1946] introduced public education that provided equal opportunities for education of men and women. It is believed that during Spanish period, the authority of women in the home remained although it may not have been openly recognized. The late JM Flavier, former Senator and Secretary of the Department of Health, in his 1970 book Doctor to the Barrios stated that “whether some men are willing to admit it or not”... “rural women in the Philippines wield considerable authority”. “In the Philippine barrio, the one responsible for the home is the wife”; “she holds the key to household development”.

The empowerment of women was first institutionalized in the Philippines on 7 January 1975 with the establishment of the National Commission on the Role of Filipino Women [NCRFW] that was renamed as the Philippine Commission for Women [PCW] in 2009. Presidential Decree No. 633 of Ferdinand E. Marcos mandated NCRFW to “review, evaluate, and recommend measures, including priorities to ensure the full integration of women for economic, social and cultural development at national, regional and international levels, and to ensure further equality between women and men.” Among its responsibilities was the monitoring of the implementation of the UN Convention on the Elimination of All Forms of Discrimination Against Women.

In 1986 the “People Power Revolution” propelled the election of Corazon Aquino as the first woman President of the Philippines. Together with the reemergence of democracy, a new Philippine Constitution was ratified through a plebiscite held in February 2, 1987. Relevant to women’s rights is Section 14, Article II of this Constitution, which stipulates that “The State recognizes the role of women in nation-building, and shall ensure the fundamental equality before the law of women and men.” With Executive Order 348 of February 17, 1989, Pres. Aquino approved the Philippine Development Plan for Women and in July 22, 1991 Republic Act 7192 was enacted to promote “the integration of women as full and equal partners of men in development and nation building”.

RA 7192 served as the foundation for the drafting of the Philippine Plan for Gender-Responsive Development [PPGD] 1995-2025 and its approval by President Fidel Ramos. PPGD outlined the policies, strategies, programs and projects that must be adopted to enable women to participate in and benefit from national development. RA7192 also served as the basis for the Gender and Development [GAD] Budget Policy initiated in the 1995, which mandates all government departments, bureaus, and agencies to set aside at least 5% of their total budget appropriations on gender and development. In accordance with the PPGD, President Gloria Macapagal-Arroyo approved the Philippine Framework Plan for Women, 2001-2004 to serve as a “guide for national government agencies and local government units in the formulation of their respective gender development plans and budgets”.

The highlight for Filipino women’s rights is embodied in the Magna Carta for Women, also known as Republic Act 7910 of August 14, 2009, wherein “the State affirms the role of women in nation building and ensures the substantive equality of women and men”. RA 7910 mandates the State to “promote empowerment of women” and to “pursue equal opportunities for women and men and ensure equal access to resources and to development results and outcome.” Pertinent to the focus of this paper are the provisions of “equal access and elimination of discrimination in education, scholarships, and training”; and women’s “participation in the formulation, implementation, and evaluation of policies, plans, and programs for national, regional and local development”. The affirmative action mechanisms provided by RA 7910 include: 1) the incremental increase in the number of women in managerial and executive positions to achieve a 50-50
gender balance; and 2) the inclusion of at least 40% membership of women in all development councils from the regional, provincial, city, municipal and barangay level.

The Philippine Commission on Women continues to perform its oversight function on women’s empowerment and gender equality, trying to make sure that government agencies and offices comply with the Magna Carta for Women. Its effort has contributed to the improvement of the Philippine GGI from 0.7516 in 2006 to 0.7814 in 2014, an increase of 4% in GGI over 8 years. The country has attained gender equality in the Educational Attainment and the Health and Survival sub-indicators but it is still far from gender parity in terms of two sub-indexes: Political Empowerment and Economic Participation and Opportunity. Government agencies and offices have complied poorly with RA 7192, an act requiring the allotment of 5% of an agency’s total budget on gender and development has been quite poor (12). To improve the situation, the Department of Budget Management is now strictly enforcing the GAD Budget Policy and the Commission on Audit is closely monitoring the degree of enforcement.

For a developing country like the Philippines where the number of researchers per million people is very small, the loss of women from the S&T pool as in the above ‘Leaky Pipe’ is a big waste of human resources. Women can contribute a lot to inclusive development in the country. Strategies and incentives must therefore be set up to prevent both the diversion from science at early career stages and to encourage the re-entry of women back into the scientific system at the latter stages.

6. Acknowledgement

The author is grateful to NAST President William G. Padolina and to the NAST Secretariat for obtaining information from the universities and providing assistance in obtaining the compendium from the Department of Science and Technology (DOST).

7. References


Women in Education and Employment in Sri Lanka

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University of Colombo

1. Executive summary
Sri Lanka is a developing country in the South Asian region. Out of the total population the proportion of females in Sri Lanka is slightly higher than the males. Although the traditional cultural viewpoint considers the males as the sole or main breadwinners, the financial contribution by the females to their families is steadily increasing, in turn playing an important role in the country’s economy. Therefore the recognition and promotion of the role of women in education and employment are critically important aspects to focus on in order to facilitate the processes of development of the country.

Published data on education and employment with regard to gender was studied in order to gain a better understanding of the involvement of women in these fields.

Sri Lanka has a high literacy rate for both males and females. Although there is no apparent gender discrimination at enrolment in educational institutions, there appears to be gender bias towards selecting certain fields of study.

Sri Lanka has been actively involved in trying to achieve the ‘Millennium Development Goals’ adopted at the Millennium Summit of the United Nations in the year 2000. It is apparent that Sri Lanka has almost reached gender parity in primary education. The increase in participation of women in employment has undoubtedly helped in empowering women.

Females have satisfactorily reached all educational levels but there appears to be less involvement in technologically-demanding fields. More women were involved in postgraduate diploma level education rather than professional level degrees. External degree programs were more popular among women vis-a-vis fulltime courses. Successful completion also followed the same trends.

Labour force participation rate among females has increased during the past few decades. It is significant to note that out of the total paid-employed female population, the highest proportion is held by women professionals. Yet, still, more women are employed in the informal sector in Sri Lanka. The women have migrated for foreign employment almost in equal proportion to that of men. However, out of the total of such foreign employment, a significantly higher percentage of women have gone for unskilled
level jobs. Even though there is a fair number of employed women, both the unemployment rate and underemployment rate are higher in females than in males. The highest unemployment rate is seen in educated females.

There are many challenges which Sri Lanka has to conquer in the fields of education and employment such as, the existence of sub-national level pockets or areas which have not reached the universal primary level education, improving the quality of education, overcoming the cultural views to get more involvement of females in technical fields, development of skills and vocational training and overcoming limiting factors of employment particularly those that limit women to adopt and maintain leadership roles in society/workplace. These challenges should be identified and where possible rectified.

Improvement of primary education at sub-national level in certain deserving areas, promoting informal or part time tertiary education among women to encourage more involvement, development of skills and vocational training and overcoming limiting factors of employment particularly those that limit women to adopt and maintain leadership roles in society/workplace. These challenges should be identified and where possible rectified.

2. Introduction

Sri Lanka is a South Asian, developing country, with a population of about 21 million. In terms of the latest census data, the female population is about 51.6% thus edging slightly higher in number than the males (Census of Population and Housing, 2012). Traditionally in Sri Lanka the male was considered to be the sole or main breadwinner of the family and the role of the female was to look after and manage the household. These views/perceptions still hold true in parts of the society, more so in the rural sector and in families with poor socio-economic and educational backgrounds. Although there is no perceived gender discrimination in education and employment in Sri Lanka, there appears to be gender differences due to the aforesaid cultural view point.

Despite the cultural views it is undisputed that promoting female education and employment is productive in many ways. If females are educated they gain better access to information and become capable of making decisions rationally. They become knowledgeable to provide better care to their family members in terms of health and nutrition. Employment naturally enables women to be financially independent, self-confident and contribute to the economical development of their families and in turn the country. With an increased income, apart from the independence derived from economic empowerment, they will have access to improved health care facilities. This will bring about better maternity and child care thus supplementing the traditional view of the females as the one who looks after the family and manage the household. Therefore, the active engagement of females in education and employment is both important and indispensable in today’s world and would be critical for the country’s development.

This report is produced relying mainly on a study conducted in order to identify possible gender differences in undergraduate and postgraduate education and education-related employment in Sri Lanka and is supplemented by published data collected from several governmental and non-governmental institutions.

Data on undergraduates and postgraduates registered for degree programs in different fields as internal or external candidates were analyzed to identify gender differences in registration and performance. Similarly, information on employment in different sectors was also analyzed.

Data was accessed through online and published information (2006-2012) of the University Grants Commission, Department of Census and Statistics
3. Status of Women in Education

Background

A proper education system is an integral part of the development process of a country. As a developing country dubbed as the ‘Wonder of Asia’, Sri Lanka stands to gain immensely by investing and promoting the education in its people and thereby making use of their knowledge and skills to gain a competitive advantage over other countries in the region.

However, in the past the traditional view of males being considered as breadwinners dominated the education provided to the population and at times involuntarily preference was given to males to get a formal education and obtain employment. Females either never had a formal education or had to discontinue their education halfway due to family commitments. Yet providing and promoting equal education opportunities to women in Sri Lanka is just as important as they constitute more than half of the population. Sri Lanka has long recognized this need and has taken steps to promote education.

Current situation

Formal education in Sri Lanka is mainly funded by the government. Pursuant to the Education Ordinance No.31 of 1939 and establishment of a free education system, Sri Lankans who attend government funded institutions enjoy education ‘free of charge’ from primary school level to the basic degree level in the university. There is no gender discrimination in admission to educational institutions.

Sri Lanka has a high literacy rate of 92.7% (94.1% for males and 91.4% for females in 2012). Female literacy rate had made galloping advances and the female literacy rate in 2012 is much higher when compared with the rate of 67.3% in 1963.

Sri Lanka is in the process of trying to achieve Millennium Development Goals (established following the Millennium Summit of the United Nations in 2000) by 2015, aiming at improving the well-being of people. Two of the Millennium Development Goals, viz.; “To achieve universal primary education” and “To promote gender equality and empower women” are pertinent to the matters discussed herein.

As per the Country Report on Millennium Development Goals in 2008/09, the net enrolment rate for primary education was 97.5% in 2006 for both males and females, almost achieving the universal primary education target. The ‘ratio of girls to boys in primary education’ was 99% in 2006, on the verge of reaching gender parity in primary education. There are more females than males enrolled in secondary and tertiary education.

Mean percentage of females admitted for undergraduate studies from 2006 to 2012 in the 4 broad streams (arts, biological science, commerce, physical science) was 59% (range 26%-78%) with highest being in the field of arts and lowest in physical sciences, the category under which the field of engineering is placed (Table 1). Female admissions to specific undergraduate courses ranged from 18% to 82% (mean = 58%) with highest proportion of entry to the study of law and least to the study of engineering (Table 2). Courses such as law, arts and social sciences, indigenous medicine and agriculture seem to be popular among females, while computer science and

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**Table 1.** Mean percentage of females registered for undergraduate studies under the four categories in Sri Lanka: Arts, Biological Science, Commerce and Physical Science (2006/07 to 2011/12).

<table>
<thead>
<tr>
<th>Main Subject Categories</th>
<th>Arts</th>
<th>Biological Science</th>
<th>Commerce</th>
<th>Physical Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Percentage of Females</td>
<td>78</td>
<td>63</td>
<td>56</td>
<td>26</td>
</tr>
</tbody>
</table>
information technology and engineering courses were least popular and showed a lower number of admissions. Somewhat similar trends were also seen in external degree programs although the overall proportion of females among registered candidates was distinctly higher (70%) (Table 3).

At postgraduate level, the percentage of females involved ranged from 23% to 69% (mean = 45%), with highest in the field of education and lowest in the field of engineering (Table 4). Other preferred fields were law, indigenous medicine and arts while science and information technology, architecture, management and commerce were among the least preferred. Furthermore, female involvement was more in postgraduate diploma-level studies (59%) rather than in professional-level degrees like Doctor of Medicine (MD), Master of Surgery (MS) or Doctor of Philosophy (PhD), (40%) (Table 5). Successful completion rate of postgraduate diplomas and degrees also showed the same trend.
4. Women in Employment

Background

In the past Sri Lankan women were mainly confined to their homes and did not get themselves engaged in formal employment. This situation has changed over time and at present a lot of women are engaged in either formal or informal employment. In order to achieve the Millennium Development Goals, emphasis has been placed on empowering women. With employment, women receive an income, which makes them financially independent to a certain extent.

With the introduction of the open economy, women have contributed in no small measure to promote the Sri Lankan economy by working in export manufacturing sectors and agricultural fields as well as by seeking foreign employment, helping the country further, by bringing in foreign currency revenue to Sri Lanka.

Current Situation

Labour force participation rate has gradually increased from 1963 to 2012. In 1963 the labour force participation rate of females was at 20% while that of the males was at 69.2%. In 2012 the percentage of females has increased to 29.9%, with a slight drop shown for males at 66.8%. Furthermore it appears from an analysis of the data for the past decade that, the male labour force participation rate has continued to be about twice the rate for females. However, it can also be seen that labour force participation rate of females has gradually increased over the years.

Average percentage contribution of females to the total paid-employment in Sri Lanka from 2006 to 2012 is 34% with the highest proportion in the professional field 61%, and the lowest being among plant/machine operators and assemblers (10%) (Table 6). Substantial numbers of females are also employed as clerks, skilled agricultural and fishery workers, craft related workers and sales and service workers while a lesser proportion are employed as proprietors, managers, senior officials and in technical fields.

Furthermore the majority of females were engaged in the informal sector of employment (54.1% in 2012) rather than in the formal sector (45.9% in 2012).

When employment status and gender are taken into account, 71.6% of females were employed as contributing family workers while only 10.2% were employers.

In 2012, total number of people who departed for foreign employment was 279,482. Of this the percentage of females who left for employment abroad was 49.1%, which is almost the same as males. Yet in 2004 the percentage of females, who left for employment abroad was 62.4% which is about twice the number of males. An analysis of

<table>
<thead>
<tr>
<th>Type of Degree</th>
<th>Mean Percentage of Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG Diploma</td>
<td>59</td>
</tr>
<tr>
<td>Masters/MPhil</td>
<td>41</td>
</tr>
<tr>
<td>PhD/MD/MS</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 5. Mean Percentage of Female Postgraduate Enrolment by Type of Degree (2011&2012)

<table>
<thead>
<tr>
<th>Category of Employment</th>
<th>Percentage of Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professionals</td>
<td>61</td>
</tr>
<tr>
<td>Clerks</td>
<td>47</td>
</tr>
<tr>
<td>Skilled Agricultural and Fishery workers</td>
<td>37</td>
</tr>
<tr>
<td>Craft and Related workers</td>
<td>35</td>
</tr>
<tr>
<td>Sales and Service workers</td>
<td>35</td>
</tr>
<tr>
<td>Technical and Associate Professionals</td>
<td>33</td>
</tr>
<tr>
<td>Elementary occupations</td>
<td>33</td>
</tr>
<tr>
<td>Senior Officials and managers</td>
<td>24</td>
</tr>
<tr>
<td>Proprietors and Managers of Enterprises</td>
<td>24</td>
</tr>
<tr>
<td>Unidentified</td>
<td>23</td>
</tr>
<tr>
<td>Plant and Machine operators and Assemblers</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 6. Mean Percentage of Females in Different Categories of Paid-Employment (2006-2012)
the data for 2012 relating to foreign employment of women according to skill level, showed that the highest percentage of females (84.9%) had left the country to work as housemaids, 6.8% for unskilled jobs, 0.3% for semi-skilled jobs, 5.2% for skilled level jobs and 1.5% for professional, middle and clerical level jobs. In contrast, of the males (50.9% of total) who departed for foreign employment in 2012, 97% left for professional, middle and clerical level jobs and the proportion that left for unskilled level jobs was the least.

Unemployment rate in Sri Lanka has decreased from the year 2003 to 2012. The rate of unemployment of females have dropped from 12.3% to 5.8% and of males from 6.0% to 2.8%. While this may certainly be perceived as a good trend but it should be noted that throughout this period female unemployment rate has been almost twice as that of males illustrating the gender inequality in the labour market. Similar differences were seen in the unemployment rate of females with an education level of General Certificate of Education, Advanced Level (G.C.E A/L) or above, which in 2012 was as high as 10.2%, as opposed to 3.9% in males.

Total under-employment rate in 2012 was 2.9%, with the breakdown showing 2.4% for males and 3.9% for females. Female under-employment rate decreased with the increase in level of education. Thus Females with an education level of grade five or below had a rate of 6.2%, while females with G.C.E A/L or more had a rate of 1.7% under-employment.

5. Challenges

Sri Lanka has almost achieved universal primary level education and gender parity in primary education at national level. There could be sub-national level pockets or areas which have not reached the national standard.

Women may have difficulties in following formal education especially in rural and estate areas. Informal education at community or household level might be of some benefit to them.

As the country has succeeded in providing access to education to all, the next challenge is to uplift the ‘quality’ of education. Currently Sri Lanka is having an exam-oriented, theory-based education system. The education system needs to keep pace with the rapid changes in today’s world, particularly in the fields of science and technology. Curricula should therefore be revised to cater to these needs.

A challenge brought about by the culturally reinforced view that females are the “softer” gender has led to a situation where given a choice, females seem to select fields such as arts and avoid technically demanding fields such as engineering.

Even though in general there are a satisfactory number of females engaged in tertiary-level education, the fact that most of them are in fields such as arts, raises the question whether the knowledge and skills they acquire are relevant to the skills required in the labour market and thereby contribute to their employability.

Most females appear to be following subject streams which make them academically qualified without imparting practical knowledge. This lack of supplementing theory with practical knowledge has hindered the development of new research initiatives and innovations. In any event it is observed that, without the ability to think differently, adapt to changes and innovatively handle challenges it is difficult for women (or men) to survive in the today’s fast-changing society.

Female polarization towards part-time tertiary level education was apparent with lower numbers being able to acquire high-level postgraduate degrees compared with the opposite sex. This could be due to many reasons but the obvious one would be the greater commitments of females to the family, which hamper women in their attempts to engage in full-time or high-level degrees.

Sri Lanka’s primary and secondary education system is focused on passing examinations to qualify for tertiary level education. The
examination to enter the University system, the G.C.E Advanced Level is extremely competitive, Sri Lanka’s provision of free tertiary education has resulted in a dearth in facilities with only a fraction of students who qualify being admitted to universities. The situation is made worse since there are only a few approved vocational training institutes available in the country.

The increase in the female labour force participation rate over the years indicates that more women are prepared to come forward to engage in gainful employment though it might also indicate the inadequacy of incomes earned by their male counterparts to support a family. However the fact that female participation rate is approximately one half of the male labour force participation rate shows that there are still limiting factors preventing women from obtaining employment, despite such increase.

It appears that the majority of women are engaged in informal sector employment rather than in the formal sector employment. Yet it is important to note that work conditions and wages earned are far less satisfactory in the informal sector, than in the formal sector. Employment status data show a majority of women are contributing by working in the family, usually without payment. In the informal sector, due to their inherent inferior bargaining power stemming from cultural factors, women have more chances of getting exploited.

Female employment abroad while bringing in much foreign currency as revenue, results in a tremendous amounts of challenges to the country. A striking feature is that a very high percentage of females, the vast majority, leave the country to work as housemaids, which is an unskilled job. Usually, unskilled women seek employment abroad as a last resort to overcome poverty in their families. Thus it is unfortunate to note that due to the lack of skills development during their education, they are left with no alternative but to resort to unskilled employment as a housemaid, though well paid, than working within the country on a lower paying unskilled job. Language barriers, lack of knowledge of the culture and the laws in such foreign countries, being unaware of their rights as workers and unable to fight for those rights leave the housemaids vulnerable, on low wages making them open to exploitation and with little job security. Added to these are the social problems created back at home with the burden of childcare shifted to their husbands or a third party, with the possible neglect of children and increase incidence of child abuse. Currently the government has taken measures to restrict migration of women, by attaching several conditions prior to being granted clearance/approval for such migration (Circular 13/2013 issued by Sri Lanka Bureau of Foreign Employment). Although these restrictions have been criticised as being discriminatory against women, it is noted that the government has recognised the breakdown of the family structure and associated social consequences when the traditional guardian of the family leaves the homestead to seek greener pastures.

Unemployment is highest among educated females. This implies inter alia that there may be a deficiency in the education and societal systems due to which even educated females have less opportunity to obtain employment or are unable to continue due to lack of support for childcare and home maintenance. There does not appear to be a concerted effort to ensure the employability of such educated population and to maintain them in that status. Thus it begs the question whether existing educational/societal systems have become oblivious to the current demands of the rapidly evolving trends and needs of the modern world.

6. Recommendations

It is an urgent need to identify sub-national pockets where primary education has not reached the required standard, identify shortcomings and implement custom made programs to overcome such shortcomings.

Informal education should target females at community and household levels to secure an improved participation rate.
It is recommended that the level of quality in the education provided should be continually monitored and improved. The curriculum should encompass new fields of study such as computer science and information technology which should begin at primary level.

Since science and technology has become essential in the present world, females should be educated in technically demanding fields improving their employability. This may be achieved either by adding such subjects to the compulsory curriculum at lower level of education such as secondary level or at least provide incentives to females to enrol in these fields at tertiary level. Furthermore, problems associated with such fields that contribute to females keeping away should be identified and efforts made to rectify such issues e.g. creating female-friendly workplaces.

In order to provide a more relevant course content at the tertiary level, women should be given opportunities to develop skills such as language and basic technical skills as part of any undergraduate course.

Practical knowledge should be provided at all levels of education. Furthermore students should be encouraged to engage in research activities and the development of new inventions.

Opportunities should be provided for women to participate in part time tertiary level education to facilitate their education while meeting family commitments. More part time courses should be introduced to improve their skills so that even if they do not get formal employment they may still be able to use their skills to obtain additional income through self-employment. Amongst family commitments, taking care of children comes at the very top. Therefore, there is an indisputable need for setting up child care centres near higher educational institutions and workplaces in all townships proportionate to the local population.

Further vocational training institutes should be established throughout the country and they should also include courses, catering to the needs of the female population for them to be better trained to suit the labour market.

In moving forward it is of importance to identify the limiting factors preventing women from obtaining employment, maintaining the status of employment and reaching higher positions in employment, and devise a long term national plan to overcome them.

In order to minimize the exploitation of women in the informal sector, women should be educated about their rights. Imparting such knowledge is even more important in the informal sector which offers mostly unskilled labour employment. Furthermore education at the primary or secondary level should give women the opportunities to develop their skills and vocational training. This may in turn increase the employability of women and give them more chances of getting employed with a salary befitting their qualification. With family-friendly policies and practices, such as adequate and affordable child-care facilities in place, women would be able to maintain their status of desired employment devoid of family and social pressures that often compel them to give up their jobs. Efforts should also be made to change the attitude of women so that larger numbers would adopt leadership roles in the society.

Since a high percentage of females are leaving for employment abroad, there should be a national plan to register them, provide strong child support systems and have follow up plans not only for their children but also for themselves upon their return. Although a registering process is in place at the Sri Lanka Bureau of Foreign Employment, there are no formalized support systems for family members, particularly the children left behind. Practical methods should be developed through follow up actions, using local officials to establish a centralised monitoring mechanism with periodic inspections by higher officials.

It is of utmost importance that the education provided should focus on the employability of the recipient. Thus demands of the labour market
should be analysed to identify deficiencies in the current education system. It is necessary that all fields of education should include a job-oriented skill development programme. The inclusion of career guidance programmes at the secondary level education will help women to have a better knowledge and a clearer understanding of the opportunities available and the future prospects in different areas of education and contribute to their planning their careers more efficiently and effectively.

7. References
1. Introduction

“Everything we see in the world is the creative work of women. Humankind is made up of two gender, women and men. Is it possible for humankind to grow by the improvement of only one part while the other part is ignored? Is it possible that if half of a mass is tied to earth with chains that the other half can soar into skies?

Our women will be scientists and pass through all education steps as well as men. Then, walking together with men in social life, they will help and support each other.”

Mustafa Kemal ATATÜRK, 1923

Women’s contribution to science and education is essential since Science and Technology are considered as “Engines of social and economic development” for the nations and regions. The women’s equal participation and diversity will increase creativity and innovation in science, technology & industry where the full spectrum of the solution is explored.

Starting with early days of establishment of Turkish Republic in 1920s women have privileged and gained many rights decades earlier than their counterparts in other countries such as democratic rights, education etc. Positive discriminative legacies also played a crucial role in such a revolutionary change.

Since then women’s contribution to education, academy and science has been always been high in Turkey in comparison to women in other countries. The discrepancy between women’s contribution to general workforce and academy is astonishing. The participation rate of Turkish women in the work force is 28% (less than half the European Union average). Yet, the ratio is as high as 50% in the academic and higher education workforce in Turkey.

In general, both sexes are almost equally represented in the academic field. And through in these figures Turkey is at the top position in all over the World. According to Global Gender Index published in 2013 by Times higher Education, Women academicians were 47.5% in Turkey, other countries were as follows: 36.7% Sweden, 35.9% USA, 34.6% UK, 31.0% Denmark, 23.0% Taiwan, 12.7% Japan. Considering the fact that only the top
5 research intensive universities were included, this result make more sense.

Higher Education Council statistics reveal that women academicians’ ratio is still above 40% even in case of including all universities (private and state universities). There are several reasons underlying and in favor of gender equity in universities in Turkey such as a) The governmental policy for positive discrimination in education which has began in 1914s, b) Women have also gained the right to give lectures in universities since then (role models), c) General attitude in Turkish society that the academia is a good occupational option for women and d) Family support for women who are in academic carrier.

The milestones of women’s development in science, education and technology in Turkey are summarized in the following section:

1) The first university for female students was established in 1914 under the name of “İnas Darü’l Fünunu” (Women’s University/College) that did yield the opportunity to female students to study in (limited departments). After the proclamation of the Republic in 1923, they have right to study in all departments equally.

2) The first women’s association was founded on 07.02.1924, under the name of “Turkish Women’s Union (Türk Kadınlar Birliği)”, and the number of the women associations has been increasing day by day.

3) A right to be elected and elect as a member of parliament was given to Turkish women (5 December 1934).


5) “Women’s Library and Information Center Foundation (Kadın Eserleri Kütüphanesi ve Bilgi Merkezi Vakfı)” was founded in December, 1989, and its library was put into service on 14 April 1990.

6) General Directorate for the Status and Problems of Women was established on 25.10.1990 under Law no. 3670, and affiliated to the Prime Ministry on 24.06.1991. The ministry of family and social policies of Turkey was established in 2011.


8) The number of the university research centers, founded under the name of “Women’s Research and Education Centre (Kadın Sorunları Araştırma ve Uygulama Merkezi)” is about 20. The first one of these centers was established on 04.10.1989 in Istanbul University.

9) Local administration continues to establish Women and Men Equality Units.

10) There are a lot of promotions to support girls and women in the areas of education and employment and also to prevent the barriers.

Science and technology is the field that dominated by men and women hardly finds a place to do research even when they were accepted to engineering education. Although Turkish Women became equal to men in all areas of education with the proclamation of the Republic in 1923, they could not dare to study engineering. Under the guidance of Mustafa Kemal Atatürk, they applied for engineering education in the academic year of 1927-1928. However, there were no role models as the pioneers of the subject what they were studying on. Atatürk supported the women especially on education issues and always emphasized the universal importance of women for the society.

Despite those very positive and courage developments, the current situation is very inadequate for women’s contribution in science and technology. Women cannot be equally represented in top academic positions or cannot be in decision making boards or top management positions. Women’s participation to engineering is very low, with changing families and life styles, government supported women family child care is necessary and those steps have to be taken fast.
This report briefly presents the current situation of women scientists and academicians in Turkey.

2. Current Status of Women Scientist in Turkey

**Higher Education, Students**

According to the data shown in Table 2, students in Turkey prefer the professions such as teaching, architecture and pharmacy in order to be able to spend more time for family responsibilities.

Table 4 is presenting the proportion of female PhD (ISCED 6) graduates on engineering, manufacturing & construction by broad field of study is higher than those of European Countries.

**Higher Education, Academic Faculty**

According to the data presented in Table 5, the number of female teaching staff is getting closer to the one of men in the period of 1985-2013.

According to the data presented in Figure 1, gender equity is almost established in universities in 2013, however this is a very slow and demanding progress over the last 90 years of action.

Note that the glass ceiling effect is seen after instructor position and remarkable in senior faculty positions.

Table 8 show the glass ceiling index in Turkey comparison to the European countries. Since this index of Turkey has been found lower than the

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**Table 1. Number and Percentage of Female Students**

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Total</th>
<th>Women</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984-1985</td>
<td>287,087</td>
<td>94,878</td>
<td>33</td>
</tr>
<tr>
<td>2012-2013</td>
<td>4,676,566</td>
<td>2,141,107</td>
<td>46</td>
</tr>
</tbody>
</table>


**Table 2. Numbers of Female Students at Different Faculties for the 2012-2013 Academic Year**

<table>
<thead>
<tr>
<th>Faculty Students</th>
<th>Number of Female Students</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty of Education</td>
<td>142,324</td>
<td>63</td>
</tr>
<tr>
<td>Faculty of Architecture</td>
<td>9,028</td>
<td>61</td>
</tr>
<tr>
<td>Faculty of History&amp;Geography</td>
<td>150,350</td>
<td>60</td>
</tr>
<tr>
<td>Faculty of Theology</td>
<td>28,096</td>
<td>59</td>
</tr>
<tr>
<td>Faculty of Pharmacy</td>
<td>4,515</td>
<td>59</td>
</tr>
<tr>
<td>Faculty of Dentistry</td>
<td>6,280</td>
<td>56</td>
</tr>
<tr>
<td>Faculty of Fine Arts</td>
<td>12,977</td>
<td>55</td>
</tr>
<tr>
<td>Faculty of Law</td>
<td>22,969</td>
<td>48</td>
</tr>
<tr>
<td>Faculty of Medicine</td>
<td>23,579</td>
<td>46</td>
</tr>
<tr>
<td>Faculty of Communication</td>
<td>15,703</td>
<td>43</td>
</tr>
<tr>
<td>Faculty of Economics</td>
<td>220,482</td>
<td>41</td>
</tr>
<tr>
<td>Faculty of Business Administration</td>
<td>311,450</td>
<td>38</td>
</tr>
<tr>
<td>Faculty of Engineering</td>
<td>58,679</td>
<td>29</td>
</tr>
<tr>
<td>Faculty of Veterinary SCI</td>
<td>2,510</td>
<td>25</td>
</tr>
</tbody>
</table>


**Table 3. Women students’ ratio in universities, undergraduate, master degree and PhD students, 2013-2014 Academic Years**

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>1830987</td>
<td>54</td>
<td>1546807</td>
</tr>
<tr>
<td>Master Degree</td>
<td>154477</td>
<td>58</td>
<td>111376</td>
</tr>
<tr>
<td>PhD</td>
<td>38163</td>
<td>57</td>
<td>28826</td>
</tr>
</tbody>
</table>


**Table 4. Proportion of female PhD (ISCED 6) graduates by broad field of Study, 2010**

<table>
<thead>
<tr>
<th>Engineering, manufacturing &amp; construction</th>
<th>EU-27</th>
<th>EU-25</th>
<th>PT</th>
<th>TR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26</td>
<td>25</td>
<td>50</td>
<td>39</td>
</tr>
</tbody>
</table>

Source: She figures 2012, Gender in Research and Innovation, p. 54.
in those of European countries, it could be concluded that much better conditions are available in Turkey than those of European Countries.
Turkish Academy of Sciences, (TUBA) and GEBIP

The women scientist in Academy is very low compared to the almost equal gender representation in Turkish universities. The number of total members of TUBA are 197 and 8% are women. Policies are needed to increase women TUBA members.

TUBA has set up the supporting Highly Skilled Young Scientist Award Program (TÜBA-GEBIP) in 2001. GEBIP is one of the first of its kind in the world, aiming to foster young outstanding scientists who are at the stage of establishing their own research program in Turkey.

Women fellowships of young scientist GEBIP program are 25% in the last 12 years (total number of awardees is 289).

Table 9. Academic faculty distributions by area

<table>
<thead>
<tr>
<th>Area</th>
<th>Total</th>
<th>Female</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty of Pharmacy</td>
<td>877</td>
<td>652</td>
<td>74</td>
</tr>
<tr>
<td>Faculty of Architecture</td>
<td>1,338</td>
<td>870</td>
<td>65</td>
</tr>
<tr>
<td>Faculty of Communication SCI</td>
<td>1,210</td>
<td>647</td>
<td>53</td>
</tr>
<tr>
<td>Faculty of Dentistry</td>
<td>2,017</td>
<td>1,051</td>
<td>52</td>
</tr>
<tr>
<td>Faculty of Fine Arts</td>
<td>1,583</td>
<td>787</td>
<td>50</td>
</tr>
<tr>
<td>Faculty of Business Adm.</td>
<td>852</td>
<td>370</td>
<td>43</td>
</tr>
<tr>
<td>Faculty of Education</td>
<td>6,854</td>
<td>2,942</td>
<td>43</td>
</tr>
<tr>
<td>Faculty of Law</td>
<td>1,907</td>
<td>793</td>
<td>42</td>
</tr>
<tr>
<td>Faculty of Economics</td>
<td>329</td>
<td>142</td>
<td>41</td>
</tr>
<tr>
<td>Faculty of Medicine</td>
<td>24,400</td>
<td>10,035</td>
<td>41</td>
</tr>
<tr>
<td>Faculty of Language, History&amp;Geography,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. of Letters, F. of SCI&amp;Arts</td>
<td>11,406</td>
<td>4,793</td>
<td>42</td>
</tr>
<tr>
<td>Faculty of Veterinary SCI</td>
<td>1,443</td>
<td>424</td>
<td>29</td>
</tr>
<tr>
<td>Faculty of Engineering</td>
<td>9,210</td>
<td>2,594</td>
<td>28</td>
</tr>
<tr>
<td>Faculty of Theology</td>
<td>1,780</td>
<td>193</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: Turkish Republic Measuring, Selection and Placement Centre, Higher Education Statistics for the 2012-2013 Academic Year.

Women in Top Positions in Universities
Research Funds

Women Rectors: As of today (July 2014) Rectors of a total of 11 universities including 7 states and 4 private universities are women and three of them are engineers. Deans of a total of 12 faculties of engineering, including 9 states and 3 private universities are women.

Table 10 shows that 30% of researchers funded by government sources are Women.

However those efforts are not well acknowledged as women scientist ratio of TUBITAK and TUBA awardees over the last decade is only between 13% – 26%.

Salary Gap

There is no salary difference based on gender in Turkey. Both genders get the equal pay check for equal jobs and women earn equal salary with men. According to Turkish Constitution, there is no gender difference in salary. Payments are equal

Table 10. PI statistics in TUBITAK

<table>
<thead>
<tr>
<th>TUBITAK ARDEB Statistics (2014)</th>
<th>Men (%)</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal investigators (PI) of research projects (2008-2013)</td>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>Researchers in national ARBIS electronic data base</td>
<td>55</td>
<td>45</td>
</tr>
</tbody>
</table>
in all fields, not only in education and research.

Women scientists earn less than men scientists in US and other European countries. The salary gap is highest in astronomy with 51% and 23% in life sciences in the US.

Turkey also signed The Declaration on The Elimination of Discrimination against Women (Article 10 calls for equal rights in the workplace, including non-discrimination in employment, equal pay for equal work, and paid maternity leave.)

3. Conclusion and Recommendations

Facts and Challenges: General picture
- The greatest participation ratio of women into the faculties
- Women are less likely to be promoted to top academic positions (glass ceiling effect), low proportion of women in research decision-making boards and other important committees as leaders, mentors and role models
- Leaky pipelines due to inadequate government and workplace support
- The proportion of women in engineering and technology are increasing though girls are not reluctant to choose engineering as a carrier presents a big challenge to achieve a goal of 50% women in engineering.
- No gender based salary gap (for the same job)
- Great impact of gender bias, mental barriers (mindset of men leaders another barrier to cultivate women leaders), socio-cultural effects for both men & women.

Facts and Challenges: Neurobiology & Education
- No apparent neurobiological basis exists for math abilities and gender difference in science.
- Education methods, laboratory tools, hands-on practical approaches could improve girls’ learning and overcome the gender difference in science (except visuospatial transformation where the both gender profit equally and gender difference persists after training)
- There are deep, social, cultural and economical roots for the low representation of women in S&T: One end of the spectrum is the false belief that girls cannot be successful in science and maths, while the other end is the misperception that men and women are equal biologically.
- During creativity and innovation performances men and women seem to use different brain regions/networks and have different functional brain structure which is complementary to each other during innovative performance.
- Increasing awareness and the teaching gender stereotype is useful for eliminating mind set and increasing the success rate of women in science courses.

Recommendations-Education
- Aware public, parents and students that there is no apparent neurobiological limit for girls for math&science abilities as far as appropriate educational methods (laboratory tools, hands-on practical approaches) are used.
- Educate girls and enable full development of natural talents and interest
- Supply the equal opportunities in science education for girls and boys and encourage females in practical based S&T education from the school level.
- Educate parents and teachers about the “gender similarities” to break mind-set
- Provide opportunities to be a part of research projects during studentship and in the early stages of their career.
- Provide women faculty members to re-structure science and engineering courses
- Workshops, planning visits, meeting with mentors and role models
- Offer outreach to female students on career development, provide special grants only for girls to whom study S&T

Recommendations–Public & Society
- Establish a social media network for women in
science and technology

- Explain the concept of the modern world: Men and women are equal partners at home, parenting and in the workplace and females should participate in decision making on many S&T issues.
- Empower women scientists by balancing their lives at the personal, institutional/academic levels and revise the career description for women (double career), reimburse/ praise their family responsibilities
- Men and women are not the same in aspects of neurobiology though they have equal rights.
- Elucidate the importance of diversity in S&T development by women’s participation

Recommendations—Policy makers

- Introducing more women into S&T would increase the diversity since men and women employ different functional brain networks which are complementary to each other during creative thinking
- Legislation for women in science and engineering particularly during motherhood period
- Equality, objective criteria needs to be improved in new hiring & promotion
- Establish women scientist associations for ensuring leadership support, data collection life-long learning and skill set development, community building by mentoring & networking, and to implement the policy in the country
- Flextime for both gender to enable them to fit into the demands of women(s)’ careers and to work from home
- In order to eliminate structural barriers in front of women and organize physical environment some arrangements should be arranged officially.
- Family friendly policies for positive discrimination to increase the women representation in top positions including academies.
- Encourage women scientists in self-actualization.
- Establishing the national networking of Turkish women in science for exchange of ideas and experience.
- In order to enhance women’s contributions to the country’s development encouraging the training of women scientists is essential.
- Establish Standing committee on women in science in TÜBA
- Increase ratio of women scientists thoroughly by fellowships even at the permanent positions at the universities, TÜBA and TÜBİTAK.

4. References

Turkish Republic Measuring, Selection and Placement Centre, Higher Education Statistics (https://istatistik.yok.gov.tr/)


She Figures 2012, Gender in Research and Innovation, Statistics and Indicators, European Commission, Brussels.


**Contributors:** (alphabetically order in surname)
Namik Kemal Aras, Hayrunnisa Bolay, Arzum Erdem Gursan, Guinseli Naymunsay.
# The 2nd AASSA Regional Workshop on “Women in Science and Engineering”

2-5 May 2012, Baku, Azerbaijan

## PROGRAM

### 2 May 2012 Wednesday

Arrival of participants

### 3 May 2012, Thursday

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 – 9:30</td>
<td>Registration</td>
</tr>
<tr>
<td>9:00 – 10:00</td>
<td>Opening ceremony&lt;br&gt;Welcoming addresses by:&lt;br&gt;Academician Mahmud Kerimov, President of ANAS&lt;br&gt;Hijran Huseynova, Chairman of State Committee for Family, Women and Children Affairs, Azerbaijan&lt;br&gt;Prof. Howard Alper, Co Chair of IAP&lt;br&gt;Prof. Namik Aras, Representing AASSA</td>
</tr>
<tr>
<td>10:00 – 10:30</td>
<td>Prof Howard Alper, Co-Chair of IAP&lt;br&gt;Maximizing Opportunities: Increasing and retaining Women’s participation in science and engineering</td>
</tr>
<tr>
<td>10:30 – 11:00</td>
<td>Group Photo and Coffee break</td>
</tr>
<tr>
<td>11:00 – 11:30</td>
<td>Prof Velikhanly Naila Mammadali, Azerbaijan&lt;br&gt;Azeri woman’s in science</td>
</tr>
<tr>
<td>11:30 – 12:00</td>
<td>Professor Eun Hee Cho, Korea&lt;br&gt;Convergence, Communication and Science Diplomacy: The Vision of Korea Federation of Women’s Science &amp; Technology Associations in 2012</td>
</tr>
<tr>
<td>12:00 – 12:30</td>
<td>Dr Mustafayeva Ayten, Azerbaijan&lt;br&gt;Real opportunity for women to be involving in science and keeping of leadership</td>
</tr>
<tr>
<td>12:30 – 14:00</td>
<td>Lunch</td>
</tr>
<tr>
<td>14:00 – 17:00</td>
<td>Session 2. Overcoming challenges facing women scientists&lt;br&gt;Chairs: Prof Arzum Gürsan, Dr. Shabanov Zeynaddin Musannif</td>
</tr>
</tbody>
</table>
4 May 2012, Friday

09:00 – 14:30 Session 3. Best Practice in Promoting Women Scientists and Engineers
   Chairs: Prof Farida Shah, Dr Rzayeva Roida Ogtay

09:00 – 09:30 Prof Arzum Gürsan, Turkey
   Turkish Academy of Sciences in promoting development of women scientists

09:30 – 10:00 Dr Mirzazade Rena Riza, Azerbaijan
   Development of gender learning in modern Azerbaijan

10:00 – 10:30 Professor Heisook Lee, Korea
   Mentoring Strategies for effective Recruitment and Retention in STEM: Korean Case Study for Girls & Women in STEM

10:30 – 11:00 Coffee Break

11:00 – 11:30 Dr Shabanov Zeynaddin Musannif, Azerbaijan
   Role of women organizations in development of civil society in Azerbaijan

11:30 – 12:00 Dr Salimova Nazaket Ajdar, Azerbaijan
   Regional aspects of woman's education in Azerbaijan

12:00 – 12:30 Dr Shakhnoza Orifova, Tajikistan
   Tajikistan women in science and technology

12:30 – 14:00 Lunch

14:00 – 15:30 Mentoring session for girls

15:30 – 17:30 REPORTS ON SESSIONS I – III BY EACH SESSION CO-CHAIRS

18:00 – 21:00 Reception

5 May 2012, Saturday

Departure of participants

8:00 – 12:00 Walking tour “Old City”

WORKSHOP VENUE:
Irshad – hotel
11a Vagif Street, Baku AZ1007, Azerbaijan + (994)12 441 01 32
SUMMARY

The AASA Regional Workshop on “Women in Science” took place May 2-5 2012 at Azerbaijan State Museum of History and Irshad Hotel in Baku, Azerbaijan.

The workshop was jointly organized by the Association of Academies and Societies of Sciences in Asia (AASSA) and the Azerbaijan National Academy of Sciences (ANAS), and was supported by the Global Network of Science Academies (IAP).

The aims of the workshop were to recognize and discuss the status of women in science, and to search for methods, to promote women scientists and engineers appropriate to AASSA member countries. We hope that this workshop will be the start of a series of activities for the advancement of women in science in Asian countries.

The themes of the workshop were 1) to identify the problems of women scientists and engineers, 2) to explore government policies and the roles of the scientific community for advancement of women scientists and engineers, 3) to collate best practices in promoting the role of women, and 4) to find ways to encourage girls to become professionals in STEM.

Arif Hashimov, first vice president of ANAS, welcomed the workshop participants on behalf of Mahmud Kerimov, President of ANAS, in the opening ceremony. Honored Guests: Howard Alper, co-chair of IAP, Namik Aras, representing AASSA, Doe Sun Na, the international co-organizer of the workshop, Hijran Heseynova, Chairperson of State Committee for Family, Women and Children Affairs, Azerbaijan, Velikhanli Naiia, vice-presidents of ANAS, Vagif Farzaliyev, Academician-secretary of ANAS, and international guests and speakers. Velikhanli Naiia, vice-president of ANAS and Hijran Huseynova, Chairman of State Committee for Family, Women and Children Affairs, Azerbaijan, Howard Alper, co-chair of IAP, and Namik Aras, representing AASSA, also gave a welcome address.

The opening ceremony was followed by three sessions. More than 70 scientists from 5 countries, Azerbaijan, Canada, Korea, Malaysia and Turkey, as well as the government representatives from Azerbaijan, took part in the two-day discussion. During the sessions, 12 reports were presented.

Dr. Howard Alper from Canada introduced Canadian experience in motivating young girls to pursue potential careers in science, engineering and technology areas and proposed methods to retain women throughout their professional careers.

Dr. Farida Habib Shah from Malaysia, who is Vice President of Organization for women in science for the developing world (OWSD) and TWAS Fellow, pointed to the critical periods of “leakage” throughout the careers of women in S&T and suggested practical approaches to fix, reduce or prevent this leakage, which serves as the basis for the recommendations of the workshop.

Three presentations were made by scientists from Korea. Dr. Doe Sun Na summarized the progress of women scientists and engineers in Korea during the last ten years and she explained the affirmative action policies of the Governments and activities of women scientist organizations that contributed to this progress. Dr. Eun Hee Cho introduced the activities of Korea Federation of Women Science and Technology Associations (KOFWST) and Dr. Hei Sook Lee presented the mentoring system of Korea Advanced Institute of Women in Science, Engineering, and Technology (KAI WISET) as examples of good practices that promote development of women in S&T.

Dr. Arzum Erdem Gursan from Turkey presented the activities of the Turkish Academy of Sciences (TUBA) in promoting development of young scientists including women. In 2001, TUBA set...
up the supporting program “TUBA-GEBIP” to reward successful young scientists of Turkey without any gender or subject discrimination, and the number of women fellowships of TUBA-GEBIP increased to 24.5% in the last decade (total number of awardees is 264).

Six presentations were from Azerbaijan, the host country. Prof. Velikhanly Naila Mammadali, Dr. Mehdiiyeva Salima, Dr Mustafayeva Ayten, Dr. Rzayeva Roida, Dr. Mirzazade Rena Riza, and Dr. Shabanov Zeynaddin Musannif shared gender perspectives and status of women in Azerbaijan. Azeri women have held important positions throughout Azeri history and played important roles in developing this country. Azeri women have been very active in political movements and in science. In addition Azeri women, like other women around the world, have important responsibilities as mothers and wives. Azerbaijan culture is multifaceted, thus tolerance and respect are needed to understand gender issues in this multicultural country. Azerbaijan is witnessing a strong influx of women into science and engineering and many outstanding women occupy top ranked positions. All the lecturers from Azerbaijan delivered the message that Azerbaijan provides equal opportunities to women scientists, therefore they do not see any noticeable issue of women in science.

There was a brief mentoring session for young scientists in the afternoon on the second day of the workshop. A few young scientists at the postgraduate level participated in the mentoring session. They were enthusiastic about their work and career and eager to seek information on career development, such as ways getting fellowships for advanced training or studying abroad. The international participants provided information on global fellowship programs as well as exchange programs for young foreign scientists in Canada, Korea and Turkey. They also informed the trainees of fellowships for postgraduate and postdoctoral studies offered by OWSD. The young scientists were made aware of awards and prizes offered to young women by L’oreal Young Women Fellowship and OWSD young woman scientist awards.

The workshop was successful, thanks to the efforts of local organizers in Azerbaijan along with the international organizers. It helped participants recognize the problems for women in S&T Asia and provided opportunities to share the experiences of participating countries, and how they strive to overcome barriers and bias against women scientists and engineers in pursuing their careers. Upon wrapping up the active and constructive discussions over these two days, recommendations were made for the countries in this region to promote further development and participation of women in S&T with emphasis placed also on the retention of women in scientific careers. Recommendations were made on multiple levels, such as a general level and specific targeted levels.

It was decided to include the following measures to the workshop Communiqué:

I. General Recommendations

- Create awareness of all stakeholders on the significance of engaging women and getting women into the mainstream
- Establish a national chapter of OWDS or a national focal point to enable women in science to be part of an international network, as well as help in the organization and support for women in S&T at the national level
- Increase awareness on gender equality in science and technology at multiple levels such as in education, employment, advancement, recognition, and income.
- Collate and adopt good practices for supporting women scientists and engineers in other countries
- Build a life-long mentor-mentee systems among women scientists and engineers, and between successful senior scientists and younger women scientists
- Highlight successful women in science as role models and increase visibility of women
scientists and engineers in society by providing incentives such as awards and funds for young women scientists and mid-level career scientists

• Provide more training programs for capacity building of young scholars, especially in the newly emerging sciences

• Provide supporting facilities and women-friendly environment that will enable more girls and women at each step of their professional career move forward up to the top management or professorial levels

• Develop an international network and be a member of international organizations such as Global Network of Science Academies (IAP), Organization for Women in Science for the developing world (OWSD), and Global Young Academy

II. Specific Recommendations

2A. National Academy and Societies

• Increase number of women members in academy of sciences

• Include female scientists on selection boards for prizes and recognition.

• Make more efforts to ensure nominations go to women scientists

• Allocate more travel funds, PhD fellowships, and post-doctorate fellowships for young women scientists

2B. Government

• Implement policies that support women in science and technology

• Collect and analyze the necessary data on women scientists in various stages of career development to obtain gender-disaggregated data

• Push to have crèches and day care centers at the workplace or by local councils

2C. Faculty and academia

• Strengthen National Network Chapters for women scientists to network

• Allocate funds to women researchers and scientists as project leaders

• Bring up issue of women in science as a regular agenda in seminars and workshops

• Encourage international research collaboration, and networking of women scientists

• Ensure that more women are hired into full-time tenure track positions in science and engineering faculties

• Develop mentoring and networking opportunities for female faculty members and students

• Encourage women scientists in self actualization and self realization of their potential

2D. Postgraduates and Young scientists

• Develop more training programs for scientific communication and presentation skills to build confidence

• Allow more young women scientists up to 40 years age to receive academic scholarships

• Ensure that more young women scientists are invited to present in conferences and workshops.

• Conduct training programs to develop skills for grant applications, report writing, and other skills that will help them develop scientific leadership skills

2E. Tertiary education:

• Identify role models for women scientists

• Set up scholarship and funding to enable women to stay at universities

2F. Secondary education

• Create more awareness campaign through math and physics Olympiads, science fairs etc.

• Use new and emerging technologies for popularizing S&T among young children and young women

2G. Private and Public Sector

• Provide awareness program on gender equality training for senior staff

• Make special efforts to recruit qualified female professional staff
WOMEN IN SCIENCE AND TECHNOLOGY IN ASIA

- Ensure that boards of directors include balanced numbers of men and women
- Provide flexible working hours and recognize the need for work/life balance
- Provide women-friendly work environment for women scientists.

Report prepared by: Doe Sun Na (Korea / Co-chair of the Baku Workshop)
Eun Hee Cho (Korea)
Farida Habib Shah (OWSD)
Arzum Erdem Gursan (Turkey)

Date: 10 May 2012
# The 6th AASSA Regional Workshop on “Women in Science, Education and Research”

24 September 2013, New Delhi, India

## PROGRAM

### 23 SEPTEMBER 2013 (Monday)

<table>
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<tr>
<th>Time</th>
<th>Event</th>
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<tr>
<td>1900 hrs – 2100 hrs</td>
<td>Welcome Reception at IHC, New Delhi by Krishan Lal, President, INSA</td>
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### 24 SEPTEMBER 2013 (Tuesday)

<table>
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<tr>
<td>0900 hrs – 0945 hrs</td>
<td>Inauguration of INSA-AASSA Joint Workshop on Women in Science Education and Research</td>
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<tr>
<td>0900 hrs – 0910 hrs</td>
<td>Welcome Remarks by Krishan Lal, FNA, President, INSA</td>
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<tr>
<td>0910 hrs – 0920 hrs</td>
<td>Remarks by Doe Sun Na, Vice President, KAST, Korea</td>
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<td>0920 hrs – 0930 hrs</td>
<td>About the Workshop by Rohini Godbole, FNA, FTWAS, Chair of WiS panel of IASc</td>
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<td>0930 hrs – 0940 hrs</td>
<td>Remarks by Guest of Honour, Manju Sharma, Former Secretary, Department of Biotechnology, Government of India</td>
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<tr>
<td>0940 hrs – 0955 hrs</td>
<td>Inaugural Remarks by Mahtab S Bamji, FNA</td>
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| 0955 hrs – 1130 hrs | Session I: Thematic Talks  
(Chair: Indira Nath, FNA; Co-Chair: Ajit Iqbal Singh, FNA) |
<p>| 1000 hrs – 1020 hrs | Women in Science: Current Status &amp; Proposal by Doe Sun Na, Vice President, KAST, Korea |
| 1020 hrs – 1040 hrs | The Balancing Act: How Women Scientists Balance Different Roles and Responsibilities by Jennifer Graves, Australia Academy of Science |
| 1040 hrs – 1100 hrs | Women in Science in Leadership Roles: Ways to Plug the Leaky Pipeline by Farida Habib Shah, EC, TWAS, Vice President, OWSD |
| 1100 hrs – 1120 hrs | How to Achieve Gender Equity in Science by Rohini Godbole, FNA, FTWAS, Chair of WiS Panel of IASc |
| 1120 hrs – 1130 hrs | Open Discussion |
| 1130 hrs – 1200 hrs | Tea Break |</p>
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<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
<th>Speakers/Details</th>
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| 1200 hrs – 1315 hrs | **Session II: Facts and Figures** (Chair: Soraya Popal, ASA, Afghanistan; Co-Chair: Nadira D Karunaweera, NASSL, Sri Lanka) | Initiatives for Gender Parity in Science & Technology by Vinita Sharma, Department of Science & Technology, New Delhi  
Best Practices for Gender Equity in Science by Eun Hee Cho, KAST, Korea  
Challenges of Women in Science: Bangladesh Perspectives by Shamima K Choudhury, BAS, Bangladesh  
An Overview of Pakistani Women in Science, Education and Research by Azra Khanum, PAS, Pakistan  
Women in Science and Technology: Nepal’s Experience by Anjana Singh, NAST, Nepal |
| 1200 hrs – 1215 hrs | **Initiatives for Gender Parity in Science & Technology** by Vinita Sharma, Department of Science & Technology, New Delhi |                                                                                                       |
| 1215 hrs – 1230 hrs | **Best Practices for Gender Equity in Science** by Eun Hee Cho, KAST, Korea |                                                                                                       |
| 1230 hrs – 1245 hrs | **Challenges of Women in Science: Bangladesh Perspectives** by Shamima K Choudhury, BAS, Bangladesh |                                                                                                       |
| 1245 hrs – 1300 hrs | **An Overview of Pakistani Women in Science, Education and Research** by Azra Khanum, PAS, Pakistan |                                                                                                       |
| 1300 hrs – 1315 hrs | **Women in Science and Technology: Nepal’s Experience** by Anjana Singh, NAST, Nepal |                                                                                                       |
| 1315 hrs – 1330 hrs | **Open Discussion** |                                                                                                       |
| 1330 hrs – 1430 hrs | **Lunch Break** |                                                                                                       |
| 1430 hrs – 1545 hrs | **Session II: Facts and Figures (Contd.)** (Chair: Paramjit Khurana, FNA; Co-Chair: Jaya Iyer, FASc) | Women in Science in Australia – Facts and Figures by Jennifer Graves, Australian Academy of Science  
Women in Science and Education in Turkey by Hayrunnis Bolay Belen, Turkish Academy of Sciences (TUBA)  
Women in Mathematics, the French Situation by Indira Chatterji, University of Orleans, France/JNU, New Delhi  
Developments for Taiwanese Women in Physics (via Skype) by Mon Shu Ho, Taiwan |
| 1430 hrs – 1445 hrs | **Women in Science in Australia – Facts and Figures** by Jennifer Graves, Australian Academy of Science |                                                                                                       |
| 1445 hrs – 1500 hrs | **Women in Science and Education in Turkey** by Hayrunnis Bolay Belen, Turkish Academy of Sciences (TUBA) |                                                                                                       |
| 1500 hrs – 1515 hrs | **Women in Mathematics, the French Situation** by Indira Chatterji, University of Orleans, France/JNU, New Delhi |                                                                                                       |
| 1515 hrs – 1530 hrs | **Developments for Taiwanese Women in Physics** (via Skype) by Mon Shu Ho, Taiwan |                                                                                                       |
| 1530 hrs – 1545 hrs | **Open Discussion** |                                                                                                       |
| 1545 hrs – 1745 hrs | **Panel Discussion on Gender Equity in Science and Research: Status, Goals and How?** (Chair: Bimla Buti, FNA, Co-Chair: Vineeta Bal, NII, New Delhi) | Be Aware and Get Prepared by Eun Hee Cho, KAST, Korea  
A Fine Balance: Women in Science Navigating Academia by Ramakrishna Ramaswamy, FNA  
From Survival to Success: Strategies for Support for Women in Science by Shobhana Narasimhan, JNCASR, Bangalore  
One of Bangladesh’s Development Challenges: Overcoming Gender Barriers in Science by Haseena Khan, BAS  
Open Discussion |
| 1545 hrs – 1600 hrs | **Be Aware and Get Prepared** by Eun Hee Cho, KAST, Korea |                                                                                                       |
| 1600 hrs – 1615 hrs | **A Fine Balance: Women in Science Navigating Academia** by Ramakrishna Ramaswamy, FNA |                                                                                                       |
| 1615 hrs – 1630 hrs | **From Survival to Success: Strategies for Support for Women in Science** by Shobhana Narasimhan, JNCASR, Bangalore |                                                                                                       |
| 1630 hrs – 1700 hrs | **One of Bangladesh’s Development Challenges: Overcoming Gender Barriers in Science** by Haseena Khan, BAS |                                                                                                       |
| 1700 hrs – 1730 hrs | **Open Discussion** |                                                                                                       |
| 1730 hrs – 1800 hrs | **Tea Break** |                                                                                                       |
| 1800 hrs – 1830 hrs | **Special Evening Lecture**  
Scientific and Technological Empowerment of Women – Role, Relevance and Application by Manju Sharma, Former Secretary, Department of Biotechnology, Government of India |                                                                                                       |
| 1830 hrs – 1930 hrs | **Inauguration of Second Summit of the South Asian Science Academies** |                                                                                                       |
| 1930 hrs | Dinner hosted by Dr R Chidambaram, FNA (by invitation only) |                                                                                                       |
SUMMARY

The INSA-AASSA Joint Workshop on “Women in Science, Education and Research” took place on September 24, 2013 at the Indian National Science Academy in New Delhi, India. It was held as a satellite meeting of the Second Summit of the South Asian Science Academies held on September 24-27, 2013.

The workshop was jointly organized by the INSA (Indian National Science Academy) and AASSA (Association of Academies and Societies of Sciences in Asia). This was the second of a series of activities for the advancement of women in science that AASSA has organized. The precedent was the workshop on “Women in Science” which was held May 2-5 2012 in Baku, Azerbaijan.

The workshop was extremely successful in that the participants were able to identify the common recurring themes and to conclude with action plans to improve current situations of women in science: 1) the “Thematic Talks” identified the critical problems of women scientists, 2) presentations on “Facts and Figures” provided opportunities of the participants to share the current status of women in science in eight Asian countries, Australia, and France, 3) “Panel Discussion on Gender Equity in Science and Research: Status, Goals, and How” served as a time to deliberate on possible solutions, 4) the “Parallel Break-out Session” held the following day during the Second Summit of the South Asian Science Academies provided a chance for all participants working together to summate the work of the previous day, and finally 5) the draft report on the workshop was presented at the Summit, which included some suggestions that national academies and academicians can implement.

In the inaugural address, Krishan Lal, FNA, President of INSA, and the co-organizer of the workshop welcomed the participants and explained how INSA came to host the workshop. Doe Sun Na, the international co-organizer of the workshop and vice-president of Korean Academy of Science and Technology thanked Krishan Lal for his initiative in holding the workshop in India and addressed the importance of the workshop. Rohini Godbole, FNA, FTWAS, the convener of the workshop and Chair of WiS Panel of IASc, explained how the workshop is going to be run. Guest of Honour, Manju Sharma, former Indian Secretary of Biotechnology, also pointed out that development and proper utilization of women’s capacity would be essential for national competitiveness. Lastly, inaugural remarks by Mahtab S Bamji, FNA were followed by words of thanks from DM Salunke, FNA, Vice President, INSA.

The four “Thematic Talks” were presented. Doe Sun Na, Korea, identified common trends in women in science in many countries: more female students in school but less and less women in the upper levels. She attributed this to the accumulated underrating of women throughout their career paths due to implicit gender bias held by both men and women. She introduced the recommendations proposed at the precedent workshop in Baku as a starting point of this meeting. Jennifer Graves, Australia, showed how woman scientists were struggling in between so called ‘mommy track’ and ‘tenure track’ by taking herself as an example. Recognizing the gaps between male and female scientists stubbornly persist, despite paid maternity leave, equity officers, reentry schemes, and so on. She made proposals for balancing the lives of woman scientists at the personal, institutional, government, and Academy levels. Farida H. Shah, Malaysia, reported that they were also witnessing the same attrition of women in the upper level and identified specific points of attrition. Strategies were suggested to enhance women’s opportunities to proceed to the top. Rihini M Godbole, India, proposed setting up goals for gender equity and figuring out measures to reach them by the end of the workshop. India
showed some of the best practices to ease similar gender issues, including publishing books for young students to get to know the field of science and conducting surveys in women who dropped off the scientific career path. It was noted that contrary to common beliefs, the most prominent reason for career interruption, according to those who dropped out, was not due to family issues. They did not get a job they wanted! An interesting aspect of this survey was the cooperation between women scientists working on natural sciences and social scientists.

The second session on “Facts and Figures” covered current status of various aspects of women in science in nine different countries. Vinita Sharma, India, introduced a government initiative to provide integrated framework for gender mainstreaming in S&T. Eun Hee Cho, Korea, presented results of a recent survey on participation of women in scientific societies in Korea. Shamima K Choudhury, Bangladesh, recognized a similar situation of a leaky pipeline, shared her successful mentoring activities, and made recommendations for young women. Azra Khanum, Pakistan, and Anjana Singh, NAST, Nepal, reported a similar situation on literacy: despite increase in overall literacy rates, the gender gap gets wider. Also in both countries they noted that the number of female students increased but they were restricted in a few fields that were traditionally regarded as female friendly. Mon Shu Ho, Taiwan, presented via videoconference and described Taiwanese efforts for retention and promotion of women scientists. She mentioned a number of practices which can be emulated. Indira Chatterji, working in France, presented the French scientific career path pointing out that women seemed to opt out from making the best choices and faced glass ceiling and pipeline leakage after university level. Jennifer Graves, Australia, reported similar patterns of pipeline leakage in most natural sciences but for engineering female participations were low all the way through. Hayrunnisa Bolay, Turkey, delivered welcome news of Turkish women in the research area. The gender ratio is as high as 50% in academia and higher education thanks to government policies and support since the 1920s. However, there are still less women at upper levels.

The “Panel Discussion on Gender Equity in Science and Research: Status, Goals and How?” drew intense debate from the floor. The chairperson of the session, Bimla Buti, India, opened the discussion by mentioning that we should drive the policies for gender equity, make policy makers aware of the importance, and collect reliable data. The first panelist, Eun Hee Cho, Korea, introduced some best practices to facilitate women’s participation in science. Another panelist, Ramakrishna Ramaswamy, India, describing balancing a women’s life as juggling five knives at once, proposed points for deliberation such as ‘Do babies matter?, ‘Do women take away men’s jobs?, and ‘Do girls need advanced science courses?’ He also showed audiences that recent meta-analyses reveal no gender differences in math performance, but stereotypes influence the confidence and efficacy of women, with deleterious effects on actual performance. He also emphasized gender audits, rewards for excellence shown by women, improve work climate and data collection. The last panelist, Haseena Khan, Bangladesh, showed some cases demonstrating that women in Bangladesh, as in the other parts of world, were still facing obstacles at higher levels. When the participants on the floor were invited to make comments, many questions and comments were towards the only male panellist, Ram Ramsawamy, appreciating his balanced gender perspective and publications for young female students. Some delegates from the floor expressed concerns on the possible consequences of gender equity on family structure. However it was also noted that the glass ceiling is not just an obstacle for married women. Some expressed that the results of this workshop should provide some practical action plans that help stakeholders to implement actions for gender equity. And it was encouraging to hear from Krishan Lal, the president of INSA, asking what INSA could do.

Rohini Godbole gave a short talk on ‘Career
Development Workshop for Women in Physics’ for Shobhana Narasimhan, India, who could not make the workshop due to an unexpected accident. The Co-Chair of this panel discussion, Vineeta Bal, India, wrapped up the session by maintaining that men had to be willing to share women’s responsibility to ease these issues, and in the workshop we would have to prepare follow up actions.

A special evening lecture on scientific and technological empowerment of women was given by Manju Sharma, former Indian Secretary of Biotechnology. She explained the rationale behind gender equity and went over both international and Indian initiatives and policies. She emphasized that the critical issue was the inclusion of women in S&T leadership and commitment at the highest level.

On the following day, the “Parallel Break-out Session” was organized so that participants were divided into four groups, each dealing with one of the four themes which were brought up in the “Thematic Talks”: participation of women in science, the balancing act, leaky pipeline, and how to achieve gender equity. Contributors for each group were as follows: Doe Sun Na (Korea), Eun Hee Cho (Korea), Shamima K Choudhury (Bangladesh), Soraya Popal (Afganistan), Subhra Chakraborty (India), Jaya N Iyer (India), Ajit Iqbal Singh (India), Ram Chandra Bajgai (Bhutan), S. Bhoojedhur (Mauritius) in “Participation of Women in Science”; Jennnifer Graves (Australia), Kesang Dechen (Bhutan), Nadira Karuneweeera (Sri Lanka), Lateefa Quraishi (Afghanistan), Meslahuddin Ahmad (Bangalaeash), Surendra Raj Kafle (Nepal), Paula Atchia (Mauritius), Anjana Singh (Nepal), Michael Atchia (Mauritius) in “The Balancing Act”; Farida Habib Shah (Malaysia), Neera Bhalla Sarin, (India), Neelima Gupte, Anwar Nasim (Pakistan), R. Rajaraman (India), F. Naivyum Choudhary (Bangladesh), in “Leaky Pipeline”; Rohini Godbole (India), Neelima Gupte (India), J. Narda (India), Vinita Sharma (India), Hayrunnisa Bolay (Turkey), P.Khurana (India), T. O. Po Saw (Myanmar), Kingsley de Alwis (Sri Lanka), M Shamsher Ali (Bangladesh), Rashmi Sharma (India), Noopur Singh (US Embassy) in “How to Achieve Gender Equity”.

One of the resonating voices throughout the workshop was that equitable partnership in marriage should be a necessity to make gender equity and empowerment of women possible, which was set up as one of the ‘UN Millennium Development Goals’. Additional common running themes throughout the workshop were 1) Low participation in science by women, 2) Low presence in the science academies, and 3) Low presence in high-level and leadership positions. Turkey was a welcome exception, however even there item 3) above could be improved. H.B. Bolay, a Turkish delegate, told us that this was accomplished by a coordinated effort of 90 years. Two things to remember: It takes long but it works!

The following is the summation/distillation of the whole workshop.

I. General Statements

1. Essential to have women in leadership and decision making positions.

2. Skill development and mentoring at all levels: Students, entry-level scientists, scientists in mid-career, and senior level leadership positions.

3. Networking is essential.

4. Data collection and analysis is necessary for policy decisions.

5. Family-friendly policies: Good to have policies which allow for a break in work for family reasons but need to design policies which can obviate the need for a long break and/or minimize the length.

6. Flexibility of employment time and conditions: Flexible funding for up to a year of family leave in project positions. Possibility of up to 2 years of leave for family reasons during a career: schemes already exist in some countries like India.

7. Increase the public awareness of the “gender gap in science”.

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8. Educate society about “gender similarities” not “gender differences”.
9. Science communication and science outreach programs should be structured in order to utilize the abilities of women scientists who have opted not to take up science as a career but want to be home makers. In countries like India this happens already. One might have country specific issues to take care of in this case.

II. Actions
1. Set up database for women scientists, with a standardized format for sharing.
2. Collect and analyze the data necessary to design policy initiatives effective in meeting academic needs of women researchers
3. Need for setting up workshops for women
4. Training for leadership roles
5. Grant writing, networking for young researchers
6. Mentor/mentee workshop
7. Workshops for further training of college teachers
8. Networking
9. Create Zonal/National/International Women Leadership and Role Models
10. Empowering women throughout the career path
11. Help capacity building for Science
12. Travel grants and research grants for women at various levels
13. Provide short-term fellowships
14. Recommend nominations for Committees, Academies, and Awards/Honours

III. Recommendations for the Academies
1. Standing committee on women in science wherever needed
2. Increase ratio of women in offices and fellowships
3. Recommend Gender Audit, Modality/norms to be set up. The above standing committee can recommend these to the government.
4. Importance of school education in science in general, mathematics in particular cannot be underscored. Since large numbers of women are involved in school education, this issue has a huge overlap with educational activities of all academies and should take those into account.

IV. Recommendations for cooperation
1. Networking between different academies of Asian/Oceanic countries. All the academies should develop a database of women scientists which will be shared to all the academies of involved countries.
2. Establish funds for women scientist exchange programs, at different levels.
3. Have a special session on women in science whenever one of the big conferences (IUPAP etc) are held in the Australasian region. Establish travel funds for these sessions.
4. Structured Mentorship programs should be developed involving senior scientists, both men and women, who are willing to contribute towards this program.
5. All Asian/Oceanic countries should exchange information resources about their activities related to women in science. They should establish exchange programs in such a way that scientists in one country can participate in these activities in other countries and the necessary travel funds should be established.
6. AASSA special committee for women in science and engineering will be established soon. It could also include men.

V. Establishment of the AASSA Special committee
The inaugural members of the ‘AASSA Special committee on women in science and engineering’ are listed below.
1. Doe Sun Na (Korea) *Chair
2. Rohini Godbole (India)
3. Farida Habib Shaw (Malaysia)
4. Jennnifer Graves (Australia)
5. Eun Hee Cho (Korea)
6. Arzum Guisan (Turkey)
7. Azra Khanum (Pakistan)
8. Shamima K Choudhury (Bangladesh)
9. Anjana Singh (Nepal)
10. Nadira Karuneweera (Sri Lanka)
11. Ramakrishna Ramaswamy (India) (male member)

Report prepared by: Doe Sun Na (Korea / Co-chair of the Izmir Workshop)
Rohini Godbole (India)
Eun Hee Cho (Korea)

Date: 30 September 2013
The 8th AASSA Regional Workshop on “Women in Science & Technology”
29-30 May 2014, Izmir, Turkey

**PROGRAM**

**28 May 2014, Wednesday**
Arrival of participants to Izmir

**29 May 2014, Thursday**

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<tr>
<td>9.30 – 10.30</td>
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<tr>
<td>10.30 – 11.00</td>
<td>Opening Ceremony</td>
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<tr>
<td></td>
<td>Arzum Erdem Gürsan (TÜBA Associate Member)</td>
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<td></td>
<td>Namık Kemal Aras (Vice President of AASSA)</td>
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<td></td>
<td>Ahmet Cevat Acar (TÜBA President)</td>
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<tr>
<td></td>
<td>Candeger Yılmaz (Rector of Ege University)</td>
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<tr>
<td>11.00 – 11.25</td>
<td>Doe Sun Na</td>
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<tr>
<td></td>
<td>Women Scientists in Korea: Achievements and Challenges</td>
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<tr>
<td>11.25 – 11.50</td>
<td>Semahat Demir</td>
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<td>Importance of Diversity to Promote the Science and Technology Education and Workforce Internationally</td>
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<tr>
<td>11.50 – 12.00</td>
<td>Workshop group photo</td>
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<td>12.00 – 13.30</td>
<td>LUNCH</td>
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<tr>
<td>13.30 – 13.55</td>
<td>Khairul Anuar Bin Abdullah</td>
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<tr>
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<td>Women in Science and Technology in Malaysia: A case study</td>
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<tr>
<td>13.55 – 14.10</td>
<td>Aylin Guney</td>
</tr>
<tr>
<td></td>
<td>Women Scholars in the Field of International Relations: Challenges and Prospects Regarding the Turkish Case</td>
</tr>
<tr>
<td>14.10 – 14.25</td>
<td>Roida Rzayeva</td>
</tr>
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<td></td>
<td>Postmodern: A Thematization of Woman</td>
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### WOMEN IN SCIENCE AND TECHNOLOGY IN ASIA

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<tr>
<th>Time</th>
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<th>Topic/Details</th>
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<tbody>
<tr>
<td>14.25 – 14.40</td>
<td>Gunseli Naymansoy</td>
<td>Turkish Women in Engineering</td>
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<tr>
<td>14.40 – 15.00</td>
<td></td>
<td><strong>Coffee Break</strong></td>
</tr>
<tr>
<td>15.00 – 15.25</td>
<td>Farida Habib Shah</td>
<td>Women in S&amp;T in leadership roles – Current status</td>
</tr>
<tr>
<td>15.25 – 15.40</td>
<td>Safiye Özvurmaz</td>
<td>Are There Gender Differences in Students’ Perceptions of Status of women in Science?</td>
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<tr>
<td>15.40 – 15.55</td>
<td>Erdenebileg Tudev</td>
<td>The intervention study</td>
</tr>
<tr>
<td>16.00 – 18.00</td>
<td></td>
<td><strong>Visit the research centers in Ege University</strong></td>
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<tr>
<td></td>
<td></td>
<td>Pharmaceutical Sciences Research Centre (FABAL)</td>
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<tr>
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<td></td>
<td>Natural History Research and Application Centre</td>
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<td></td>
<td></td>
<td>Ege University Science and Technology Centre (EBILTEM)</td>
</tr>
<tr>
<td>18.00 –</td>
<td></td>
<td><strong>Bus transfer to the restaurant</strong></td>
</tr>
<tr>
<td>18.30 – 21.00</td>
<td></td>
<td><strong>WELCOME DINNER</strong></td>
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### 30 May 2014, Friday

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<tr>
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<tr>
<td>9.45 – 10.10</td>
<td>Naiyyum Choudhury</td>
<td>Women in Science and Technology For Development-Bangladesh Perspective</td>
</tr>
<tr>
<td>10.10 – 10.25</td>
<td>Eun Hee Cho</td>
<td>To Raise Female Leaders in Science and Engineering</td>
</tr>
<tr>
<td>10.25 – 10.40</td>
<td>Azra Khanum</td>
<td>Various Barriers Faced by Women Scientists with Reference to Pakistan</td>
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<td>10.40 – 11.00</td>
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<td><strong>Coffee Break</strong></td>
</tr>
<tr>
<td>11.00 – 11.25</td>
<td>Hayrunnisa Bolay Belen</td>
<td>Is There Any Neurobiological Basis for Gender Gap in Science</td>
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<tr>
<td>11.25 – 11.40</td>
<td>Vanny Narita</td>
<td>The Need to Develop Policies for Enhancement of Women’s Role in Science, Technology, and Innovation in Indonesia</td>
</tr>
<tr>
<td>11.40 – 11.55</td>
<td>Lourdes J Cruz</td>
<td>The Important Role of Filipino Women in Science, Technology and Inclusive Development</td>
</tr>
<tr>
<td>12.00 – 13.30</td>
<td></td>
<td><strong>LUNCH</strong></td>
</tr>
</tbody>
</table>

**Chairs:**
- Roida Rzayeva, Anjana Singh
- Khairul Anuar Bin Abdullah, Aylin Guney
- Nadira Karunaweera, Gunseli Naymansoy
- Eun Hee Cho, Erdenebileg Tudev

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*Note: The schedule is subject to change.*
ANNEX 13 The 8th AASSA Regional Workshop on “Women in Science & Technology”

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker/Panel</th>
<th>Topic/Activity</th>
</tr>
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<tbody>
<tr>
<td>13.55 – 14.10</td>
<td>Marine Nalbadyan</td>
<td>Mechanisms and ways to increase the efficiency of work of Armenian women in science</td>
</tr>
<tr>
<td>14.10 – 14.25</td>
<td>Isıl Aksan Kurnaz</td>
<td>Turkish Women in Life Sciences</td>
</tr>
<tr>
<td>14.25 – 14.45</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>14.45 – 15.10</td>
<td>Anjana Singh</td>
<td>Women in science and technology education in Nepal</td>
</tr>
<tr>
<td>15.10 – 15.25</td>
<td>Shamima K Choudhury</td>
<td>Gender in Science – a global problem</td>
</tr>
<tr>
<td>15.25 – 15.40</td>
<td>Aftab Ahmad Chattha</td>
<td>Research in Asia: Issues and Challenges</td>
</tr>
<tr>
<td>15.45 – 16.45</td>
<td>Chairs: Doe Sun Na, Hayrunnisa Bolay Belen</td>
<td>Final remarks on meeting report and discussion</td>
</tr>
<tr>
<td>16.45 – 17.00</td>
<td>Closing remarks</td>
<td></td>
</tr>
<tr>
<td>17.00</td>
<td>Bus transfer to the museums</td>
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<tr>
<td>17.00 – 18.15</td>
<td>Visit the museums in Ege University</td>
<td>Paper museum, Ethnography museum</td>
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<tr>
<td>18.30 – 21.00</td>
<td>DINNER</td>
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31 May 2014, Saturday

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>9.00 – 18.30</td>
<td>Field trip to Ephesus for foreign speakers</td>
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SUMMARY

The TÜBA-AASSA Workshop on “Women in Science and Technology” took place on May 29th to 30th, 2014, at Ege University in Izmir, Turkey. The workshop was organized by the Turkish Academy of Sciences (TÜBA) and the Association of Academies and Societies of Sciences in Asia (AASSA). This was the third of a series of activities for the advancement of women in science that AASSA has organized. The previous workshops of “Women in Science” and “Women in Science, Education and Research” were held in 2012 in Baku, Azerbaijan and 2013 in New Delhi, India respectively.

This workshop was aimed to sum up the last two workshops and to draw concrete recommendations and action plans. The essences of the last two years efforts “to recognize and to discuss the status of women in science, and to search for methods to promote women scientists and engineers
appropriate to AASSA member countries” were continued during this workshop.

The themes of the workshops were (1) to identify the problems of women scientists, (2) to explore government policies in promoting women scientists and the roles of the scientific community for advancement of women scientists, (3) to collate best practices in promoting the role of women, (4) to find out the proper ways to encourage girls to become professionals in Science and Technology and (5) to realize the summation/distillation of the New Delhi workshop.

In total 20 lectures were presented, of which 12 were from international speakers and 8 were from Turkey. The international speakers were from 9 countries, Armenia, Azerbaijan, Bangladesh, Korea, Malaysia, Nepal, Pakistan, the Philippines and Sri Lanka. The members of the ‘Special Committee on Women in Science and Engineering of AASSA’ actively participated in the meeting.

The workshop successfully identified the current situations and problems of women scientists, and addressed the methods to improve the situation. The recommendations and action plans of the New Delhi workshop were thoroughly reviewed and updated. We hope this will serve as the guidelines of future efforts for the advancement of women in science and engineering in AASSA countries and as well as in other countries in the world.

In the inaugural speech, Prof. Ahmet Cevat Acar, President of TÜBA, and the co-organizer of the workshop welcomed the participants and briefly presented the TÜBA and its activities, women in science figures in Turkey and emphasized women’s contribution to S&T for development. Prof. Namik Kemal Aras, Vice President of AASSA and Honorary member of TÜBA, welcomed the participants and gave a brief history of AASSA and explained how important is the proper utilization of women’s capacity for science, regional development and competitiveness. Prof. Atilla Silkü, the Vice Rector of Ege University and Prof. Arzum Erdem Gürsan, Associate member of TÜBA also gave their inaugural remarks.

Prof. Doe Sun Na, the international co-organizer of the workshop, Vice President of the Korean Academy of Science and Technology (KAST) and Chair of Special Committee on Women in Science and Engineering of AASSA addressed the importance of the workshop and briefly summarized the achievements women scientists and challenges for the last 15 years in Korea. In 2002 Korean government enacted the ‘Act for Fostering and supporting women in science and technology’ and then WISET was established to implement government policy. The status of women in Korea is very poor at the moment, few women are at the top scientific positions e.g. only 4.4% of Korean Academy of Science and Technology members are women, and is slowly getting better. Also there is leaky pipeline phenomenon due to marriage and family commitments.

Prof. Semahat Demir emphasized the importance of participation of women for promoting the science and technology education and international mobility, presented data and programs to promote science technology, engineering and mathematics (STEM).

Prof. Khairul Anuar Bin Abdullah, Malaysia reported that the global attrition of under-representation of women scientist is progressively changing and aggressively moving up in all fields. The change was accelerated in Malaysia after the Cabinet approved the policy that at least 30% of women must be involved in decision making positions. The governmental policy to enhance women’s opportunities to proceed to the top was extraordinary to improve women’s status.

Aylin Guney, Turkey explained the challenges and prospects of women scholars in international relations and mentioned that women use different methodology in international relations compared to men.

Roida Rzayeva, Azerbaijan gave a philosophical perspective to the dilemma of women in science. She stated that the middle-aged white man symbolizes the ideal person of modernism, an opposition not-suited to the scheme that is
different to the other. Each other was pushed out to the subconscious or consciously oppressed, ignored and tried to be eliminated, whereas postmodernism has been recognizing each other.

Gunseli Naymansoy, Turkey reported how women engineers were struggling in men dominated world taking them as an example and also presented the examples of first Turkish women engineers dating back from 1950s and showed successful women engineers as role models.

Farida Habib Shah, Malaysia was not able to attend the meeting. However her slides were presented by Shamima K Choudhury and she conveyed the information on current status of women in S&T in leadership roles, importance of role models and mentors for career development of women scientists.

Safiye Ozvurmaz, Turkey presented a prospective study investigating the gender effect on student’s perception of status of women in science.

The 2nd day meeting started with Naiyyum Choudhury, Bangladesh who gave a speech about the Bangladesh perspective for women in science and technology and achievements after the 2011 when national science and technology policy of Bangladesh was adopted and reported the areas of priority in science and technology for the Country’s future.

Eun Hee Cho, Korea identified several problems originating from both cultural and cognitive roots interfering to raise female leaders in science and technology. She offered educating people to remove the gender stereotype and implementing affirmative action for hiring and promoting more women in workforce. She outlined a research grant program for female college and graduate students introduced by WISET as a successful model for supporting future women leaders in S&T.

Azra Khanum, Pakistan stated the various barriers faced by women scientist with reference to Pakistan such as politics, bias, attitudes, family-child responsibilities, bias at the entry and achievement at all stages of academic carrier. She also noted that according to UNESCO institute for statistics only 27 per cent of the world’s total science researchers are women.

Hayrunnisa Bolay Belen, Turkey presented gender differences and similarities in cognitive performances, structural and functional brain activity regarding abilities in mathematics and science. She emphasized that both gender employ different strategies and brain networks during creative performances though the outcome is similar. Understanding the mechanisms of gender based differences during innovative thinking, would increase the efficiency of S&T education particularly for girls.

Lourdez J Cruz, the Philippines reported the women’s status in S&T in Philippines and noted that the country is in the 5th rank in global gender gap index. She showed female representation along the carrier path and noted that the highest women ratio was in the science academia of Philippines with 38 % women member in NAST PHL.

Nadira Karunaweera, Sri Lanka reported that there are a satisfactory number of females engaged in the tertiary-level education, except for more technically demanding fields and emphasized the contribution of professional courses enabling to by-pass traditional higher educational degree programs for the desired outcome.

Marine Nalbadyan, Armenia mentioned the ways to improve the work efficacy of Armenian women in science and noted that objective professional criteria should be applied for the hiring system depending only on researcher productivity, competence, capabilities and creativity regardless of gender.

İşıl Aksan Kurnaz, Turkey briefly summarized the women scientists in universities and science academy in Turkey, noted that the highest representation rate of female academicians and researchers in the globe is in Turkey (40 %). Low representation of women researchers at the top decision boards and their low representation in the national science academia (8%) have to be improved.
Anjana Singh, Nepal told that Nepali women receive less degree in engineering, mathematics and physical sciences, computer and information sciences compared to life sciences. Through figures from Nepal she confirmed global trend of the lower representation of women at the top positions of S&T.

Shamima K Choudhury, Bangladesh emphasized that women should become partners for introduction of modern scientific methods and particularly for sustainable agriculture in the rural areas of the developing countries. Low representation of women in science and engineering is the major hindrance to global capacity building in S&T. She also gave detailed recommendations to improve women’s status in S&T starting from primary to higher educational levels and at the professional level as well.

Aftap Ahmad Chatta, Pakistan presented statistics related to scientific outcomes in the region, a need for scientific networking and addressed the major hurdles for promoting science and technology in the region as conflicts, language barriers and lack of centralized institutes.

The meeting ended with a general discussion session chaired by Professor Na and Professor Bolay. Professor Na made the closing remarks based on presentations and discussions of the workshop and mentioned that the participants basically confirmed the recommendations of the New Delhi Workshop. Some modifications were made to improve the New Delhi statement as follows:

**Summary of Facts and Challenges**

I. General Observation
1. Marriage, motherhood, and poverty have great impact on women’s participation in science and engineering.
2. Leaky pipelines are mainly due to lack of family, government, and workplace support.
3. Women are less likely to be promoted to top leader positions (glass ceiling effect). Women in decision-making boards and other important committees as leaders, mentors and role models are much smaller than their counterpart males.
4. Much more women are on the temporary jobs compared to permanent ones.
5. Proportion of women in engineering is low and girls are reluctant to choose engineering as a career. This presents a big challenge to achieve a goal of 50% women in engineering.
6. Gender bias, mindset of male leaders, socio-cultural effects for both men & women have great impact on cultivating women leadership.
7. Women are more self-critical for evaluating own abilities and success, which contributes to leaky pipeline in the science and engineering career.

II. Education of Girls
1. No apparent neurobiological basis exists for math abilities and gender difference in science.
2. Education methods, laboratory tools, hands-on practical approaches could improve girls’ learning and overcome the gender difference in science. There are deep, social, cultural and economical roots for the low representation of women in S&E: One end of the spectrum is the false belief that girls can not be succesful in science and maths, while the other end is the misperception that men and women are equal biologically.
3. Creativity and innovation performances are similar in both gender however strategies employed for a solution are different as well as the functional brain connectivity maps. Men and women seem to use different brain regions/networks and have different functional brain structure which are complementary to each other during innovative performance.
4. Increasing awareness and the teaching gender stereotype is useful for eliminating mindset and increasing the success rate of women in science courses.
Recommendations and Actions

The participants confirmed the previous recommendations from the New Delhi Workshop in 2013. Some modifications were made to improve the statement. Several items were newly introduced.

I. General Statements

1. Women in leadership position: It is essential to have women in leadership and decision making positions.

2. Encourage women scientists in self-actualization and self-realization of their potential.

3. Skill development and mentoring: Mechanism need to be evolved for skill development and mentoring at all levels of career including the students, entry-level scientists, scientists in mid-career, and senior level leadership positions.

4. Networking: The Networking of women in science including relevant researchers and others should be established nationally and internationally that can provide support, guidance, and opportunity for female scientists through mutual exchange of ideas and experience.

5. Data collection and analysis: It is essential to collect and analyze data of women in science and engineering emphasizing horizontal segregation during career development like influence of family and role models, and vertical segregation in careers like issues of glass ceiling, sticky floor, mentoring/tutoring etc., which would be necessary for policy decisions.

6. Family-friendly policies: Day care centers are essential. Good to have policies which allow for a break in work for family reasons but need to design policies which can obviate the need for a long break and/or minimize the length.

7. Flexibility of employment time and conditions: Flexible time schedule for work is necessary. Flexible funding for up to a year of family leave in project positions should be available and possibility of up to 2 years of leave for family reasons during a career should be considered. Such schemes already exist in some countries like India and Korea.

8. Public awareness of gender gap in science: It is urgent to raise awareness of gender discrimination in science, engineering and technology at multiple levels such as education, employment, advancement, recognition and income, which need serious attention and action for clearing hurdles for women as they pursue careers in science and engineering for full utilization of the labor force.

9. Gender similarities and gender differences: The society needs to be sensitized for “gender similarities” not “gender differences”.

10. Empower women scientists by balancing their lives at the personal, institutional, and academic levels, and revise the career description for women (double career), reimburse/praise their family responsibilities.

11. Diversity is enhanced by women’s participation in S&E, which leads to effective development of S&E.

12. There should not be any salary gap for the same job based on the gender and the ratio of women in permanent positions should be increased.

13. The good practices for supporting women scientists should be collated and adopted to other countries also.

14. Science communication and science outreach programs: Scientists and engineers should put more effort for communicating with the public. The outreach programs can utilize the abilities of women scientists who have opted not to take up science as a career but want to be home makers. In countries like India and Korea this happens already. One might have country specific issues to take care of in this case.

II. Actions

1. Set up database for women scientists, with a standardized format for sharing.

2. Collect and analyze the data necessary to
design policy initiatives effective in meeting academic needs of women researchers
3. Organize workshops for women at different levels of career development. The workshops for training leadership roles and grant writing are needed especially for young female researchers.
4. Create a directory of women zonal/national/international women leadership, mentors and role models.
5. Develop proper networking mechanism for women scientists regionally and globally. Organize mentor/mentee workshops and planned visits on a regular basis.
6. Facilitate empowering women scientists throughout the career path
7. Create funds for travel grants, short term fellowships, and research grants for women at various levels.
8. Recommend nominations of women scientists for Committees, Academies, and Awards/Honors.
9. Provide more training programs for capacity building of young scholars, especially in the newly emerging sciences.
10. Provide supporting facilities and women-friendly environment that will enable more girls and women at each step of their professional career right up to the top management or professorial levels.

III. Recommendations for Education
1. Educate parents and teachers about the “gender similarities” to break mindset.
2. Help capacity building for science and engineering education with equal opportunities for boys and girls.
3. Provide opportunities for research projects during studentship and in the early stages of their career.
4. Develop country specific outreach program for female students, teachers, and science professionals.
5. Create more awareness campaign through math and physics Olympiads, Science fairs etc.
6. Use new and emerging technologies for popularizing S&T among young children and young women.

IV. Recommendations for the Academies
1. Establish Standing committee on women in science wherever needed.
2. Increase ratio of women in offices and fellowships
3. Recommend Gender Audit. Modality/norms should be set up. The above standing committee can recommend these to the government.
4. Emphasize the importance of school education in science in general, mathematics in particular. Since large numbers of women are involved in school education, this issue has a huge overlap with educational activities of all academies and should be taken into due consideration.
5. Organize international meetings of women academicians and scientists
6. Provide women faculty members opportunity to re-structure science and engineering courses.

V. Recommendations for Cooperation
1. Networking between different academies of Asian/Oceanic countries: All the academies should develop a database of women scientists which will be shared to all the academies of involved countries.
2. Establish funds for women scientist exchange programs, at different levels.
3. Have a special session on women in science whenever one of the big conferences (IUPAP, IAP, AASSA etc.) is held in the Australasian region. Establish travel funds for women scientists’ participation in these sessions.
4. Structured Mentorship programs should be developed involving senior scientists, both men and women, who are willing to contribute towards this program.
5. All Asian/Oceanic countries should exchange information resources about their activities related to women in science. They should establish exchange programs in such a way that scientists in one country can participate in these
activities in other countries and the necessary travel funds should be established.

Report prepared by: Doe Sun Na (Korea / Co-chair of the Izmir Workshop)
                      Hayrunnisa Bolay (Turkey)
                      Arzum Erdem Gursan (Turkey)
                      Eun Hee Cho (Korea)

Suggested Corrections by: Shamima K Choudhury (Bangladesh)
                          Naiyuum Choudhury (Bangladesh)
                          Azra Khanum (Pakistan)

Date: June 9th, 2014
The 11th AASSA Regional Workshop on “Gender Issues in Science Research and Education”
26-27 August 2015, Seoul, Republic of Korea

PROGRAM

Tuesday, 25 August 2015

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Wednesday, 26 August 2015

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<td>Opening Ceremony</td>
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<td>- Opening Remarks</td>
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<tr>
<td></td>
<td>Doe Sun Na (Co-chair, Organizing Committee / Vice President, KAST)</td>
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<tr>
<td></td>
<td>- Welcoming Remarks</td>
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<tr>
<td></td>
<td>Sung Hyun Park (President, KAST)</td>
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<td></td>
<td>Krishan Lal (President, AASSA)</td>
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<tr>
<td>09:20 – 09:30</td>
<td>Group Photo</td>
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<tr>
<td></td>
<td>Session 1: Keynote speech</td>
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<td>Chair: Yoo Hang Kim (Executive Director, AASSA)</td>
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<tr>
<td>09:30 – 10:00</td>
<td>How Can We Promote Gendered Innovations for R&amp;D, R&amp;Business Development and R&amp;S Social Development?</td>
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<td></td>
<td>- Myung Ja Kim (Fellow Emeritus, KAST / President, Green Korea 21 Forum, Korea)</td>
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<td></td>
<td>Session 2: Status of Women in Science, Technology, Engineering and Medicine</td>
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<td></td>
<td>Chairs: Khairul Anuar Bin Abdullah (Treasurer, AASSA) and Hong-Hee Kim (Fellow, KAST)</td>
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<tr>
<td>10:00 – 10:10</td>
<td>Women in Science and Technology in Asia</td>
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<td>- Doe Sun Na (KAST, Korea)</td>
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<tr>
<td>10:10 – 10:20</td>
<td>The Gender Gap in Science and Technology in Pakistan</td>
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<td>- Zabta Khan Shinwari (PAS, Pakistan)</td>
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<td>Time</td>
<td>Session</td>
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<tr>
<td>10:20 – 10:30</td>
<td>Women in Research and Development in Sri Lanka</td>
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<td>10:30 – 10:40</td>
<td>Status of Women in Science and Engineering in AASSA Countries</td>
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<tr>
<td>10:40 – 11:00</td>
<td>Discussion</td>
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<td>11:00 – 11:20</td>
<td>Coffee Break</td>
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<tr>
<td>11:20 – 11:30</td>
<td>Session 3: Empowering and Leadership</td>
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<td>12:00 – 12:10</td>
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<td>12:10 – 12:30</td>
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<td>12:30 – 13:30</td>
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<tr>
<td>13:30 – 13:40</td>
<td>Session 4: Inspiring and Mentoring</td>
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<tr>
<td>13:40 – 13:50</td>
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<tr>
<td>13:50 – 14:00</td>
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<td>14:30 – 14:50</td>
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<tr>
<td>14:50 – 15:00</td>
<td>Session 5: Policies and Best Practices</td>
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<td>15:00 – 15:10</td>
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<td>15:10 – 15:20</td>
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</table>
Thursday, 27 August 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:30 – 18:00</td>
<td>Wrap-up session for “11th AASSA Regional Workshop” &amp; Closing Remarks at Opal Room (*22nd floor of the main building of the Plaza Hotel)</td>
</tr>
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</table>

Friday, 28 August 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Contents</th>
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</thead>
<tbody>
<tr>
<td>07:30 – 08:30</td>
<td>Breakfast Meeting of the AASSA Special Committee on Women in Science and Engineering (WISE) at Gae-na-ri Room, Hotel President (Committee Members Only)</td>
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Saturday, 29 August 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Contents</th>
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<tbody>
<tr>
<td>09:00 – 20:00</td>
<td>Field Trip/Tour (Lunch and dinner will be provided during the tour)</td>
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<tr>
<td>Time</td>
<td>08/26 (Wed)</td>
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<tr>
<td>8:00</td>
<td>Registration Grand Ballroom</td>
</tr>
<tr>
<td>9:00</td>
<td>11th AASSA Regional Workshop on “Gender Issues in Science Research and Education” Grand Ballroom B</td>
</tr>
<tr>
<td>9:30</td>
<td>Conference Introducing the Gender Dimension to STEMM Higher Education</td>
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<tr>
<td>10:00</td>
<td>Coffee Break</td>
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<tr>
<td>10:15</td>
<td>Workshop (contd.)</td>
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<td>10:30</td>
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<tr>
<td>11:00</td>
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<td>11:15</td>
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<td>11:30</td>
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</tr>
<tr>
<td>12:00</td>
<td>Lunch &amp; Poster exhibition</td>
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<tr>
<td>12:30</td>
<td>Lunch</td>
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<tr>
<td>13:00</td>
<td>Conference Improving Diversity of STEMM Talents: K-12 Programmes</td>
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<td>14:00</td>
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</tr>
<tr>
<td>14:30</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>15:00</td>
<td>Coffee break</td>
</tr>
<tr>
<td>15:30</td>
<td>Workshop (contd.)</td>
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<td>16:00</td>
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<tr>
<td>16:30</td>
<td>Grand Ballroom A</td>
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<tr>
<td>17:00</td>
<td>Publication Ceremony of the AASSA Report on “Women in Science and Technology in Asia”</td>
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<tr>
<td>17:30</td>
<td>Break</td>
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<td>18:00</td>
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<td>19:00</td>
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<tr>
<td>19:30</td>
<td>Welcome Reception Grand Ballroom</td>
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<td>20:00</td>
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