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

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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 1. Growth in Universities

<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 2. Growth in % of women in university enrolment

<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

![Graph showing growth in absolute numbers of women with access to University education in STEM subjects from 1974-1975 to 2005-2006.](image1)

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

![Graph showing subject-wise distribution of University enrolment in the year 2000-2001.](image2)

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

![Graph showing subject-wise distribution of University enrolment in the year 2000-2001.](image3)

**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
(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

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### Table 3. Women scientists in various organizations.

<table>
<thead>
<tr>
<th>Organization</th>
<th>2004</th>
<th>2008</th>
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<tbody>
<tr>
<td></td>
<td>Total scientists</td>
<td>Women (%)</td>
</tr>
<tr>
<td>CSIR</td>
<td>5,030</td>
<td>13.0</td>
</tr>
<tr>
<td>DST</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DAE</td>
<td>436 (TIFR)</td>
<td>16.5</td>
</tr>
<tr>
<td>DBT</td>
<td>179</td>
<td>31.8</td>
</tr>
<tr>
<td>ICMR</td>
<td>615</td>
<td>27.3</td>
</tr>
<tr>
<td>DRDO</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DOD</td>
<td>127</td>
<td>8.7</td>
</tr>
<tr>
<td>ICAR</td>
<td>2,000</td>
<td>8.5</td>
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</tbody>
</table>

### Table 4. Women faculty in select universities

<table>
<thead>
<tr>
<th>University</th>
<th>2004</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total scientists</td>
<td>Women (%)</td>
</tr>
<tr>
<td>IISc Bangalore</td>
<td>Academic: 316</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Scientific: 113</td>
<td>9.7</td>
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<td></td>
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<tr>
<td>University of Hyderabad</td>
<td>Total: 101</td>
<td>15.8</td>
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<tr>
<td>Jawaharlal Nehru University</td>
<td>82</td>
<td>16</td>
</tr>
<tr>
<td>Delhi University</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>
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

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2 [http://www.ias.ac.in/womeninscience/](http://www.ias.ac.in/womeninscience/)
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 5. Gender distribution of the fellowship for INSA (2012)

<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><strong>Total</strong></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) **Scholarships 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>
<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>
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<td>Earth/Atmospheric Scienes</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 INSAs report [3] as well as the series of workshops held by the NASI and the resultant report [14] were funded by the DST. INSAs 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 INSAs 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 crèche 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