

Women Scientists in India

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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 declaration¹ 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 [5]). 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

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

Table 2. Growth in % of women in university enrolment

Year	Total enrolment	Women (%)
1950-51	396,745	10.9
1960-61	1,049,864	16.2
1970-71	1,953,700	22.0
1980-81	2,752,437	27.2
1990-91	4,924,868	29.2
2000-01	8,399,443	39.4

Table 3. Women scientists in various organizations.

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

Table 4. Women faculty in select universities

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

(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

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. 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

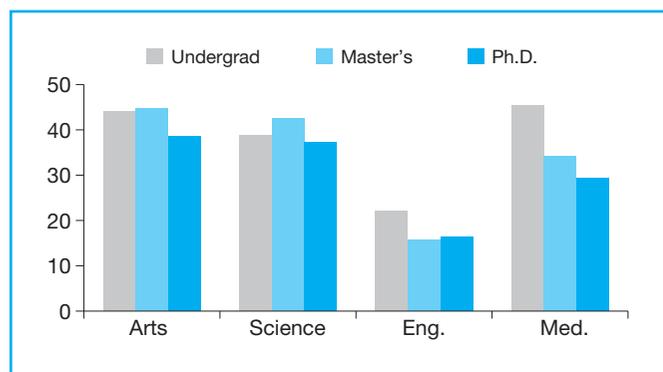


Figure 4. Change in the fraction of women with increasing level of education in different faculties. Here the data for medicine is shown separately

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

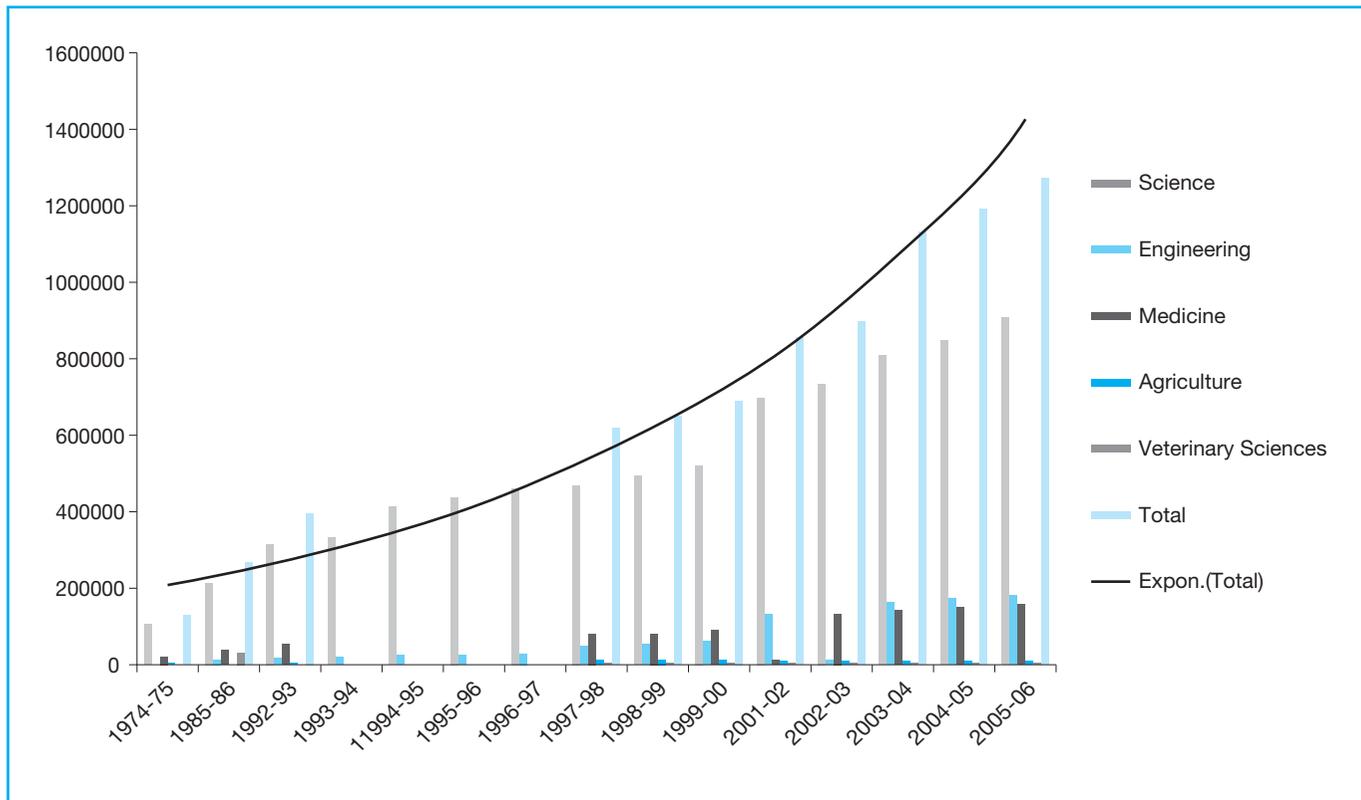


Figure 1. Growth in the absolute numbers of women with access to University education in STEM subjects from 1974-1975 to 2005-2006 [13].

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

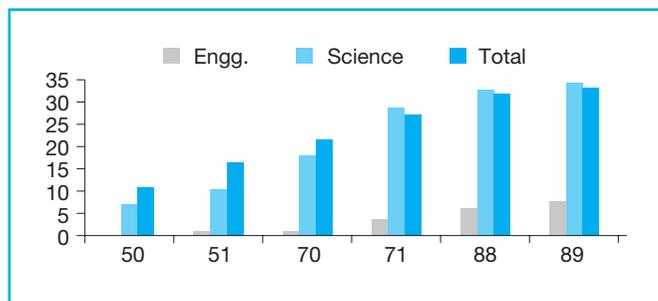


Figure 2. Relative growth in women enrolment in Science and Engineering taken from [5].

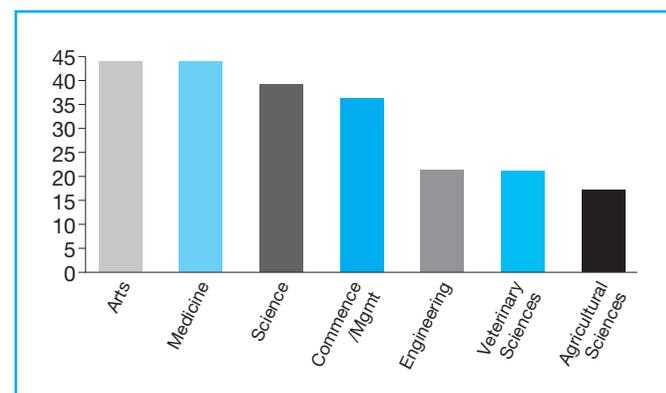


Figure 3. Subject-wise distribution of the University enrolment in the year 2000-2001.

