SCIENCE CAREER FOR INDIAN WOMEN:

An examination of Indian women's access to and retention in scientific careers.

REPORT

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Valuable information on women studying science (university enrolments) was sourced from a recent report of the University Grants Commission (UGC), obtained through the courtesy of Professor Arun Nigvekar (Chairman, UGC). Several heads of organisations, their colleagues, some committee members, and other scientists, whose names are mentioned in the report, have helped to obtain useful information regarding women practicing science. Our thanks to all these scientists, and their colleagues, for the help given.

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PREFACE

Gender disparity at all levels and its adverse impact on women has become a fact of life. This is partly due to the biological role and responsibilities of women as mothers, but mostly due to the traditional mindsets, which visualise women as being child bearers and home-makers, and men as breadwinners. Yet in many invisible, un-rewarded ways women contribute significantly to the economic well-being of the family, and take on the double or triple burden of home making, work outside home and fighting male chauvinism. Among the various professional spheres, women seem to miss out more in science and technology, particularly physical sciences, agriculture and engineering fields. Those who do study science, often end up in what are considered as less challenging teaching jobs.

There is a growing realisation that by not allowing the creative talent of women from being expressed through their involvement in research and development, society is missing out, and something needs to be done to make scientific research more gender friendly.

The Indian National Science Academy constituted a committee to investigate the issue of Science Career for Women and suggest measures to increase women's participation in study and practice of science. The present report has attempted to do that. Secondary sources of data were used to get a picture of the status of Indian women in science. To make an objective analysis of the factors, which influence science career for women, a study was contracted to the Research Centre for Women's Studies, SNDT women's University, Mumbai. This is a unique study, which has relied on feedbacks from women scientists and post-graduate students, from many parts of India. Effort was also made to examine the science policy in context of women. This report summarises only salient observations. A detailed discussion of this aspect can be read in the RCWS original report.

Implementation of the recommendations made in the final chapter is possible only with collective determination and effort of several agencies like UGC, NCERT, Science funding agencies, and Academies. INSA can facilitate the process by initiating a dialogue between these agencies and organisations.

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CHAPTER I

STUDY AND PRACTICE OF SCIENCE BY INDIAN WOMEN

Genesis of the Study

Last century has seen an explosion of knowledge in Science and Technology. Science and technology has permeated every sphere of life and has become a part of day-to-day living. Though female sex represents half of humankind (unfortunately less than half in India due to deliberate elimination of females), the status of women in society at all levels is inferior to that of men. Large-scale gender discrimination and inequity have denied females opportunities for education and employment on par with males. Though women contribute significantly to national development and well-being their contribution to the family (child rearing and home keeping) lacks a monitory tag, and is taken for granted and worst still, viewed with cynicism. Even some of the labour intensive economic activities done by women are poorly rewarded, being unskilled or low-skilled jobs.

In the developed world, school education is universal and educational opportunities at college level are more or less similar for both the sexes. However, traditional mindsets internalised over generations prevent women from opting for courses like science (particularly physical sciences and mathematics) and technology, which are perceived as being more in the male domain. Study of science and technology does not ensure further opportunities and smooth career path for women, thanks to the notorious 'glass ceiling'. Numerous studies show that even in these advanced countries there is tremendous sexual nepotism- conscious or unconscious. Women who seek science career have to face the triple burden of professional work, domestic work (including child rearing) and fighting male chauvinism.

The situation in the impoverished communities of developing countries like India is worse because education and health, particularly of females are issues of low priority, the primary concern being livelihood. Apart from child labour to augment family income, girls are often taken away from school to do house work and take care of younger siblings when both the parents go to work. There is also the fear of safety of girls. Denial of school education blocks the stream that would feed into higher education including science education. Those who overcome the hurdles against school education, come up with other obstacles of the kind described earlier for the women from developed countries. Thanks to the curse of dowry system, the first worry of parents is getting the daughters married. Often education is seen as a stepping-stone to marriage. Unfortunately, most girls feel obliged to yield to parental pressure.

In recent years the issue of marginalizing women from scientific career is being seen with concern all over the world. In India the problem is two fold: 1) getting more women to study science and technology and 2) ensuring that those who study are able to pursue a career in science and technology. Attrition after higher education, apart from other things, is a national waste and impoverishment of Indian science.

Against this back-ground, the president of the Indian National Science Academy (INSA), Professor M.V.S. Valiathan identified 'Science Career for Women' as a

thrust area for investigation by INSA. A committee was constituted to bring out a report on the subject, which should include specific suggestions.

The committee included the following members, representing different disciplines of science.

Bal Vineeta	Medicine/ Immunology
Balasubramanium D	Biophysics/ Molecular cellular biology
Bamji Mahtab S. --- Chair person	Biochemistry/ Nutrition
Buti Bimla	Plasma Physics
Datta Kasturi	Biochemistry/ Molecular cellular biology
Godbole Rohini	Theoretical high energy physics
Khanna Chopra-Renu	Plant physiology/biochemistry
Raman Parimala	Mathematics-algebra
Sahni Ashok	Geology

In its first meeting held on March 8, 2003 it was decided that the report should cover three aspects. 1) The present status with regard to study and practice of science by Indian women, 2) Factors influencing science career for women- a behavioural study and 3) Recommendations for facilitating women's entry and continuation in science career.

The second aspect, which involved study of behavioural and sociological dimensions, was contracted out to the Research Centre for Women's Studies (RCWS), S.N.D.T. University, Mumbai, headed by Prof. Veena Poonacha. They also offered to examine using secondary sources, the first aspect, which involves obtaining quantitative data on women studying and practicing science. However, much of this effort on the first aspect was left to the committee and its chairperson.

SNDT has also attempted to examine educational policies and government policies to find out if these policies are gender sensitive. However for brevity, this aspect has not been included in depth in this consolidated report. Information can be sourced from the SNDT report (Poonacha and Gopal, 2004).

The present report deals primarily with science since Parikh and Sukhatme have recently published a comprehensive report on Women in Engineering Profession in India (Parikh and Sukhatme, 2002).

The term 'study of science' means women who enrol in university to get a degree in science and pursue further studies to obtain post graduation and doctorate in science. The term 'practice of science' means those who after post graduation pursue a career in science.

Methodology

Information on women's enrolment at different levels of university education was obtained through a recent report of the University Grants Commission (Courtesy Dr. A. Nigvekar, Chairman, UGC) (University Grants Commission, 2002). Information on women scientists working in different government organisations and some universities was obtained directly from the heads of concerned organisations such as Department of Biotechnology (DBT) (Dr. Manju Sharma, courtesy Dr. Renu Swarup), Indian Council of Medical Research (ICMR) (Prof. N. K. Ganguly), Department of Ocean Development (DOD) (Prof. Harsh Gupta), or through some scientists working in those organisations (Dr. J.C. Katyal, DDG education, ICAR and Dr. Parimala Raman, DAE). Prof. Indira Nath helped to source some of the information from DST. Only three universities- University of Hyderabad (courtesy Professor K. Subbarao), Indian Institute of Science, Bangalore (courtesy Prof. Goverdhan Mehta, V.C) and Jawaharlal Nehru University (courtesy, Prof. Kasturi Datta) could be covered. Though the data are incomplete, trends are apparent. No private institution could be covered.

Salient Observations

Indian Women Studying Science

Growth in women's enrolment in different faculties

Since 1951 there has been a steady growth in universities/university level institutions and colleges in India (Table 1). The growth of student enrolment and percentage of women is shown in table 2. While over the years there is a steady rise in the proportion of women entering university, the wide gap between women and men entering university persists (Table 2).

Table 1. Decadal growth in Universities and Colleges

Year	University/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. Decadal growth in women's enrolment

Year	Total	% Women
1950-51	3,96,745	10.9
1960-61	10,49,864	16.2
1970-71	19,53,700	22.0
1980-81	27,52,437	27.2
1990-91	49,24,868	29.2
2000-01	83,99,443	39.4

Table 3 shows comparison of numbers and percentages in the year 1995-96 and 2000-01 in various disciplines. The highest representation of women is in education. During 2000-01 more than 50% students in the field of education were women. This is followed by disciplines like arts and medicine. In 2000-01, 44% of medical admissions were women. Contrary to these fields, very few women seem to opt for fields like engineering, agriculture and veterinary science. Over the five-year period, (1995-96 to 2000-01) overall preference of students for different subjects has not shown much change (Table 3, values in parenthesis). Slight reduction in preference for arts and increase in preference for science and engineering followed by commerce seems to be there.

Table 3. University Enrolment in different faculties

Faculty/Year	1995-96		2000-01	
	Total enrolment	% Women	Total enrolment	% Women
Arts	31,62,582 (48.1)	40.6	38,75,102 (46.1)	44.2
Science	12,27,359 (18.6)	37.0	16,70,263 (19.8)	39.4
Medicine	1,88,117 (2.9)	39.8	2,62,753 (2.9)	44.0
Agriculture	40,505 (0.6)	14.3	50,308 (0.6)	17.4
Veterinary Science	12,340 (0.2)	18.0	13,588 (0.2)	20.9
Engineering & Technology	3,86,879 (5.9)	16.0	57,664 (6.9)	21.5
Commerce/management	11,23,633 (17.1)	32.5	15,00,609 (17.8)	36.5
Law	2,61,130 (4.0)	16.8	2,67,043 (4.0)	20.0
Education	1,00,602 (1.5)	46.5	1,09,196 (1.3)	51.2
Others	70,788 (1.1)	35.0	73,932 (0.9)	37.7
Total	65,74,005 (100)	36.0	83,99,443 (100.5)	39.4

However, data for girls over a longer period (1970-1971 to 1995-96) (Table 4, sourced from SNDT report), show a marked increase in preference for commerce from 1.9% to 14.1%. On the other hand, percentage of females in arts came down by over 10 percentage points and that in science over 5 percentage points. Marginal increase in law was also seen. These long-term data do support the general feeling that a shift in preference from science to subjects like commerce (which may include computer science), and law, which perhaps have better job potential did occur. But this trend seems to have been arrested and between 1995-96 and 2000-01 there was no further attrition in science.

Table 4. Women students enrolled in different faculties- change over time

Courses	Women Students Enrolled in 1970-71		Women Students Enrolled in 1995-96	
	Total Number	Percentage	Total Number	Percentage
Arts	4,21,850	64.3	11,91,774	54.4
Commerce	12,675	1.9	3,09,830	14.1
Science	1,68,540	25.7	4,40,354	20.1
Education	20,799	3.2	85,699	3.9
Law	2,626	0.4	39,551	1.8
Engineering and Technology	910	0.1	26,368	1.2
Others including medicine, agriculture, veterinary science, music, fine arts/ social work, physical education etc.	28,422	4.3	97,562	4.5
Total	6,55,822 (21.9% of all enrolment, men and women students)	99.9	21,91,138 (34.1% of all enrolment, men and women students)	100

Source: University Grants Commission, *Towards Equality-The Unfinished Agenda-* Status of Women in India 2001, National Commission For Women 2002.

Graduation to post graduation

Table 5 gives information on proportion of women persisting with education as one moves from graduation to post graduation and Ph D. During index year 2000-01 there was increase in the proportion of women studying science at PG level compared to graduation level but some decline occurred at the level of Ph.D. It would therefore appear that relatively more women tend to persist with studies after graduation though some attrition occurs at the level of Ph.D.

Table 5. Percentage enrolment of women at various levels in different faculties in the year 2000-01.

Year	Percentage of women		
	Graduation	Post-graduation	Ph.D.
Arts	44.2	44.7	38.6
Science	39.0	42.5	37.2
Engineering /Technology	21.8	15.8	16.5
Medicine	45.5	34.4	29.3
Agriculture	17.2	18.8	14.6
Veterinary Science	21.6	18.6	14.5

Differences between Indian states

Among the different states of India, some states like Goa, Kerala, Punjab, and Pondicherry had more than 50% women enrolling in college during 2000-2001 (Table 6). On the other hand, states like Arunachal Pradesh, Bihar, Jharkhand, Orissa and Rajasthan had less than 35% women entering college (Table 7). The enrolments in the other states were between these two extremes.

Table 6. States with more than 50% women enrolment

State	Total	Science	Engineering & technology	Medicine	Agriculture	Veterinary science
Goa	58.6	59.8	26.2	61.4	-	-
Kerala	60.0	63.9	30.6	56.5	53.8	47.6
Punjab	53.2	53.8	19.4	56.0	26.4	22.9
Pondicherry	54.5	57.3	29.2	47.3	-	41.3

Table 7. States with less than 35% women enrolment

State	Total	Science	Engineering & technology	Medicine	Agriculture	Veterinary Science
Arunachal	33.1	37.8	28.8	46.3	-	
Bihar	23.9	21.0	11.9	20.7	32.2	12.8
Orissa	34.6	28.3	18.6	25.0	34.0	-
Rajasthan	32.6	37.7	11.3	24.4	10.6	-

Differences among different universities

Out of 233 universities and institutions giving degrees, only 24 had 50% or more women. This includes the three women's universities- Padmavati Mahila Vishvavidyalaya (AP), SNDT university (Maharashtra), and Mother Teresa university (TN). On the other hand 50 universities had less than 20% women. This includes some large universities like BB Ambedkar (Bihar), Jai Prakash (Bihar), Veer Kunwar Singh (Bihar), and Allahabad University (UP) (Table 8). Most technical universities had low representation of women. On the other hand some medical universities in AP like Nizam's Institute and Sri Venakateshwara Institute of Medical sciences had more than 60% women. The prestigious All India Institute of Medical Sciences (AIIMS) had only 38.6% women. Agriculture universities including IARI had less than 20%. Most IITs had less than 10% women.

Table 8 Large universities with less than 40% or more than 40% women students

University	Total enrolment	% women
BB Ambedkar (Bihar)	47,810	19.6
Veer Kumar Singh (Bihar)	50,000	19.8
Allahabad University (UP	22,515	18.0
MS University (Gujarat)	33,500	45.5
Mumbai	3,83,891	50.5

Indian Women Practicing Science

Venues of employment for people with science degrees include universities (teaching and research), research institutions under government departments and councils, and private R&D institutions- industries. Due to constraint of time and resources, in the present study it was not possible to cover all the organisations. Attempt was made to obtain information about women employed in faculty and technical positions in various government institutions (DST, DBT, CSIR, ICAR, ICMR, DAE, and DOD) and 3 universities – Indian Institute of Science (IISC), Bangalore, Hyderabad

University, Hyderabad and Jawaharlal Nehru University (JNU). IISc is one of the oldest and most reputed postgraduate teaching and research Institutes. University of Hyderabad is a relatively young central university, but has acquired good reputation for both teaching and research at postgraduate level. Couple of other universities were approached but no response was obtained. Table 9 shows that DBT followed by ICMR are the best employers of women. Representation of women in the other organisations is less than 15% both at scientific and at technical levels. Data could not be obtained from DST, despite efforts.

Table 9. Relative presence of women as scientific and technical staff in Government R&D institutions, and some universities.

Organisation	Grade of the scientist	Scientists-total	% women	Technical-total	% women
CSIR	---	5030	13.0	3250	14.0
DBT	---	179	31.8	277	23.1
ICMR	---	615	27.3	1939	20.1
DAE	---	436	16.5	-	-
DOD	---	127	8.7	-	--
ICAR	Assistant Professor	12750	10.4		-
ICAR	Associate Professor	4750	6.2	-	-
ICAR	Professor	2500	3.5	-	-
IISc	Academic	316	6.6	34	14.7
IISc	Scientific	113	9.7		
Hyderabad University (Science departments)		101	15.8 (Only one professor)		
Jawaharlal Nehru University (Science schools)		82	16	20	0

Perusal of the annual reports from a few institutions showed that in most cases the presence of women in advisory committees was less than 15%. One very prestigious biological sciences institute where 30% of faculty members were women, did not have a single woman in the advisory committee (Bal, 2004).

Achievements and Recognition of Indian Women Scientists

Recognition in science can be judged on the basis of variety of factors such as ability to secure permanent faculty position, attract research grants, and research scholars, publications and patents, invitations to speak in conferences, travel fellowships, invitations to be on various policy making, and review committees, awards, academy fellowships etc. Some of the criteria such as publications are objective but others depend on the scientists' visibility and recognition by peers. In a recent study, Vineeta Bal (2004) has tried to assess the performance of Indian women biological scientists on the basis of publications in 38 high impact journals (Impact factor 5 and above). According to that limited analysis, 85.7% of the papers from India had men as the corresponding/senior authors and only 14.3% had women. This observation will be discussed later.

Very few women are elected as fellows of science academies (Table 10). Women seldom receive awards open to both the sexes. For instance, National Biosciences award, instituted by the DBT in 1999, has given 24 awards between 1999 and 2003. Only 2 awards (8%) have gone to women. Bhatnagar prize for young scientists was instituted in 1958, by CSIR. It is one of the most prestigious awards in natural sciences. Out of 333 awards given between 1958 to 1998, women received only 8 awards (2.4%). Maximum recognition for women was in medicine (7.5% awards), whereas in physics, earth science and engineering not a single woman got the Bhatnagar award. Even more shocking is the fact that, in the last 5 years (1999-2003), not a single woman has received the Bhatnagar award (Bal, 2004).

Table 10. Science Academy fellowships for women

Academy	Total fellowship	% Women
Indian National Science Academy	744	3.2
Indian Academy of Sciences- Bangalore	841	4.6
National Academy of Agricultural Sciences	395	4.0

Not a single woman has become fellow of INSA in the sectional committee IV- engineering and technology, and in sectional committees VI- plant sciences, IX- Molecular biology and genetic engineering, and X- Agriculture sciences only one woman each is a fellow. Thus in biological sciences also women fail to get recognised though they are present in reasonably large numbers.

Out of the 502 awards and medals given by INSA over the years, only 14 (2.8%) have gone to women.

No woman has become INSA president, and out of 41 recent past office bearers, only one was a woman (Prof. Indira Nath).

Discussion

Study of Science

When secondary school level enrolments are compared with college enrolments, it is interesting to note that the proportion of women enrolling in college (39.4%, in 2001-02) is comparable to the percentage of girls enrolling in secondary school as quoted in Table 11 (Bal, 2002).

Table 11. Indicators of Education- School enrolment

Country	Primary enrolment (% Females)	Secondary enrolment (% Females)
USA	49.7	50
India	45.2	39.8
Sri Lanka	49.5	52

Source: Derived from UNFPA (2001), quoted by Bal, 2002.

While in the USA the gender distribution is similar at primary and secondary school levels, in our neighbouring country, Sri Lanka the proportion of girls at secondary level increases, suggesting that more boys drop out of high school. In India on the other hand the situation is reverse and more girls drop out after primary school. The reasons for not going to school at all or discontinuing after primary school are complex, and mostly related to societal prejudices and economic compulsions. The value of education for girls is not perceived in poor communities like India.

Though India has never had any official restrictions on women entering universities, societal pressures, economic factors and access to colleges, which are away from home, restrict the entry of Indian women into university. At a recent conference in Delhi, it was interesting to learn from a Saudi delegate that though Saudi Arabia opened the portals of university education for women only in 1973, currently 43.1% of the Saudi undergraduates in Science colleges are women. This figure is higher than the figure of 35% for Egypt – an Arab country, which liberalised university education for women in 1920s (Islam 2004). Higher literacy rate and economic affordability may contribute.

The greater visibility of women at the university level in the more progressive states of India is expected (Tables 6-8). It needs to be noted that though Punjab has shown progress in terms of women's education, the female-male sex ratio is one of the lowest in the country in Punjab. This suggests that greater presence of women in the university does not necessarily imply better status of women, and detailed sociological studies are needed to understand Punjab type of situation. Dowry problem is even more acute among some educated and rich societies.

An interesting observation that differentiates India from other developed countries relates to the absence of attrition in women's percentage (if anything there is some improvement) as we move from graduation to post graduation in science (Table 5). Thus, the percentage of girls studying science increased from 39% at graduation to

42.5% at post graduation. Some reduction occurred at Ph.D. level. On the other hand a survey done at MIT in 1999 (quoted by Bal, 2002), shows continuous attrition in female representation as one moves from under-graduate level, to graduate, post doc and faculty levels (Table 12). This phenomenon is seen even in biology where women's presence is more than in other fields. It would therefore appear that in India the phenomenon of 'leaky pipeline' in education, including science education, disfavouring women occurs mostly at school level and if school drop out can be plugged, the presence of women in higher education including science may increase. It is possible that more men than women, find job opportunities after graduation or branch out into other areas like management, civil service etc. for greener pastures whereas women persist with post graduation because of lack of any other alternative till they settle down in marriage.

Table 12. Gender disparity at MIT in the year 1994 : % women at each level.

Level	Biology	Chemistry	Mathematics
Undergraduate	50.8	52.7	30.1
Graduate	46.1	29.3	15.2
Post docs	30.5	22.0	28.6
Faculty	14.0	6.2	2.1

Derived from Bal (2002)

Far fewer females seem to opt for engineering, agriculture and veterinary science. However, in agriculture and veterinary science, some southern universities show higher percentage of women (Table 6). On the other hand, medicine does seem to attract women. In medicine, women tend to cluster in disciplines such as obstetrics/ gynaecology, paediatrics, and pathology. Few women enter into more lucrative male-dominated disciplines like surgery, or orthopaedics (Sagar, 2004).

Unfortunately the UGC report clubs all disciplines of science. It does not provide split into different branches of natural science. However, the general perception is: more Indian women, like women in other countries, tend to cluster in biological sciences than physical sciences. According to a recent report, however, 32% of enrolment in physics in India is of women (Godbole *et al.*, 2002). This is considered quite high in global context where the representation of women in physics ranges from 6% in Netherlands to 36% in Poland. New research from UNESCO's Institute of Statistics (based in Montreal, Canada) shows that while many developed countries have low percentages of women doing post graduation, in some developing countries of South America like El Salvador and Argentina women make up almost 60% of S&T post graduates.

There is a feeling all over the world that interest in science among students is declining, and more students opt for courses like commerce, management and computer science. Data in tables 3 and 4 suggest that while some shift away from science did occur between 1970-71 and 1995-96, the trend has probably been arrested. These data do not permit any comment on the quality of students opting for different subjects. It is possible that the brighter ones still opt for commerce, management,

computer science, engineering, medicine etc. where there is better employment potential.

Women Practicing Science – Is there a glass ceiling in India?

Women who qualify in science either take up teaching jobs or faculty positions in Universities or Institutions, which are engaged in research with or without teaching. While the present analysis does not provide estimate of women opting for teaching in schools or undergraduate colleges with no research opportunities, numbers in table 9 show that proportion of women in national laboratories and prestigious universities is less than 15%, except in DBT and ICMR where the percentage exceeds 25%. These figures when compared with the figures in table 5 (42.5% women at post-graduate level and 37.2% at doctorate level), clearly show attrition from studying science to practicing science- the infamous 'glass ceiling'. The figures in table 5 apply to all natural sciences. The percentage in biology must be much higher. The higher presence of women in DBT and ICMR is obviously due to the fact that these organisations are primarily engaged in research in biological sciences

Women Fail to Get Recognition

Recognition of women scientists as judged by awards and fellowships is meagre compared to men even assuming their smaller numbers in academics (Table 10). The fact that not a single woman in last 5 years has got the Bhatnagar award might imply that situation is getting worse, rather than improving. It is possible that fewer women get nominated, because of their lower visibility. They are not part of the networks, which give visibility to men.

Within an organisation, the career path for women tends to be slower as seen from the number of professors vs. assistant professors/ lecturers. Is the performance of women who are in the academic stream inferior to that of men? There are no robust studies to assess that. The fewer papers in prestigious biology journals published by women compared to men (Bal 2004), can be due to fewer women in higher ranking positions in academics. Scientific productivity as judged by publication output tends to be proportional to the academic position, because ability to attract research grants, students etc. improves with position. Several reports from other countries show that once differences in structural positions and resources are adjusted for, sex differences in research productivity disappears (Feist and Gorman, 1988, Xei and Shauman, 1998, quoted by Kumar, 2001). A recent study by Neelam Kumar from NISTADS, shows that gender inequity in the academic hierarchy is an important aspect of the social organisation of Indian science (Kumar 2001). The study included physical scientists of both the sexes in four different Indian cities, working in universities and national laboratories. Out of 490 scientists, only 56 (18%) were women. The percentage distribution of male and female scientists by position – Professor, Associate professor, and Assistant professor was as follows. Male- 18.0, 37.7, and 44.3. Females- 3.6, 35.7, and 60.7. Clustering of women in the lower grades is obvious. Objective scores of productivity were obtained through a scoring system for types of publications. The results showed statistically significant differences in academic rank, social class, background, and rural/urban origin. Though the mean for research performance for men was higher than that for women, it was statistically not significant. The lower means for productivity may be related to the ranks. The study supports the thesis of 'glass ceiling' in Indian context. According to the authors the study refutes the traditional argument that women because of their family responsibilities and family-

work conflict, have lesser time, energy and commitment to invest in their professional careers and are therefore less productive than men.

Conscious or unconscious marginalisation of women from science job market is a worldwide phenomenon. According to the Greenfield report, 2002 (commissioned by UK government) fewer than 10% of senior scientific positions in any country are held by women. In UK even in a faculty like biology, where women's presence is substantial, the graph dipped from 50% women obtaining Ph.D. to less than 10% professors. Relatively more women tend to settle down in less challenging teaching jobs (Greenfield report, Peters et. al 2002).

The European Commission's ETAN Expert Working Group on Women and Science reported in 2002 that women make up less than seven percent of science professors, five percent of academy members and have a very small proportion of senior scientific positions in six member states. Another European Commission report this year points out that although women obtain nearly 40% of all PhDs (even more in life sciences), in the European Union, only 15% of industrial researchers in Europe are women (http://unesdoc.unesco.Org/images/001/001181/18131/e.pdf.). According to a report from Korea, women constituted only 3.8%, of full time faculty in natural sciences and engineering (Jeong-Ro, 2002).

A study from Sweden points out the shocking level of nepotism and sexism in this advanced country where women are believed to enjoy a high status in society. During selection of post-doctoral candidates by Medical Research Council, 62 men and 52 women applied. While the success rate for men was 26%, that for women was only 7%. When the scores given by the review committee based on publications quality etc. were analysed there was mismatch between this objective parameter of scoring and the rank given to judge competence. According to the authors, the females had to be 2.5 times more productive to get the same competence score (Wenneras and Wold 1997).

While remedial suggestions can be made for problems related to support systems and encouragement, changing mindset is not going to be easy.

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CHAPTER II

FACTORS INFLUENCING SCIENCE CAREER FOR INDIAN WOMEN

Throughout history, social life has been gendered and constructed on the basis of perceived differences between the sexes. This gendering of social life is created by the following three sets of processes in society: 1) perceived assumptions of gender differences, at the ideological level, are exaggerated and justified through arguments that draw from science or religion; 2) these differences, within the socio-economic and political processes of society, are assigned different, though seemingly natural roles and entitlements, to the resources of the family and community; and 3) individual identities are imperfectly correlated with the stereotypical images of gender group identities (Poonacha and Gopal, 2004).

To examine the socio-economic and institutional factors that limit women's participation in science, the INSA contracted a study to the RCWS, SNDT Women's University, Mumbai. The study was premised on the assumption that gender (like other social markers of class and race) is a category of social discrimination. Women have differential access to community resources and have fewer options in life to pursue creative and satisfying careers. The question therefore is: what are the socio-economic constraints of women's lives that restrict their access to and retention in science careers? Are there any limitations in educational/science policies as well as institutional practices that perpetuate women's exclusion? The study cohort was scientists and post graduate students working/studying natural science in representative sample of science research and educational institutions across the country. Due to constraints of resource and time, faculties of engineering and other applied sciences were not included.

Aims and Objectives

The study aimed at understanding the experiences of women pursuing scientific careers, their motivation and constraints. The data were contextualized within the broad framework of higher education and science policies and programmes in the country, to address questions about the impact of neo-liberalization policies of globalisation and privatisation on research and development institutions, and scientists, particularly women. In doing so the study raises questions about the purpose of scientific research and for whose benefit? These questions prompt an investigation into the composition of the organization of scientific establishments, the factors leading to a gendered distribution, and the overall culture of science that retains or rejects people within it.

It is hoped that this study will have policy implications and facilitate the development of a gender friendly environment within scientific institutions.

Research Questions

1. What is the socio-economic background of women scientists across the broad spectrum of scientific research institutions?
2. What makes women opt for scientific careers?
3. What kinds of career paths do women scientists and students take?

4. What are the constraints faced by women in pursuing science education?
5. Do their career goals alter once they enter research institutions?
6. If so, what are the reasons for changing their career paths?
7. What is the prevailing organizational culture of scientific research and development institutions seen through the experiences of women scientists?
8. How far have the existing government policies of higher/science education promoted science education in the country?
9. Are the policies sensitive to gender issues?
10. How far has the changing education policies affected science education with special reference to gender issues?

(For detailed discussion of questions 7-9 the original report of Poonacha and Gopal 2004, may be referred.)

Methodology

Data were gathered through:

1. Focused group discussions and in depth interviews with women scientists as well as science students to understand their experiences and constraints within science education and research institutions.
2. Administration of pre-tested structured questionnaires to the selected cohort of women scientists and students in universities and research institutes.
3. Focused group discussions with girls in pre-university to understand their career options.
4. An examination of secondary sources of data on university enrolment figures and government policies on education (See the original report of Poonacha and Gopal, 2004).

The quantitative data gathered through the administration of a detailed semi-structured questionnaire provided information on the socio-economic profile, educational background, job and research-related organizational practices, career prospects, gender dimensions of the scientific field, and family details.

The qualitative data gathered through in-depth interviews and focussed group discussions with scientists and students at their institutions while introducing the study helped to elicit further information on institutional practices that hindered or advanced their careers. Focussed group discussions were also conducted with girl students in a science college in Mumbai of the junior college and undergraduate science classes, to understand their motivation for career options. Attempt was made to get information on a random sample of 25 women who had opted out of science career, by administration of a semi-structured questionnaire and interviews, but this effort was not very successful since the women were reluctant to speak.

While the present study did not include students at pre-university level to find out gender differences in selection of subjects at the university level, this aspect has been covered in a recent study (Mukhopadhyay, 2001) from India and salient findings from the latter study will also be discussed.

Sampling design

Although the selection of the sample was purposive, the study is fairly representative of women's experiences in science. This is because the respondents were drawn from a wide range of scientific research institutions/university departments in Mumbai, Pune, Nagpur, Akola, Shillong, Gauhati, Aligarh, and Bangalore. The institutions selected covered a geographical and regional spread (Table 1). A majority of the institutions were from Maharashtra, such as Pune, Nagpur and Akola, apart from Mumbai, but an all-India representation was attempted with institutions selected from Aligarh, Shillong, Gauhati and Bangalore. Few responses to the structured questionnaire were also obtained from Delhi and Pune, through the efforts of some committee members.

Profile of institutions

As indicated in Table 1, scientists and students from 19 universities and colleges and 17 science institutions were selected.

Table 1. Typology of the institutions

S. No.	Typology of Institution	Number
1	Central University, Departments of Science	5
2	State University, Departments of Science	7
3	Deemed University with special status/ DST funded	2
4	CSIR Laboratories	4
5	ICMR Institutes	3
6	DBT Institutes	2
7	DAE Institutes	3
8	DST Institutes	1
9	Indian Institute of Technology	1
10	Colleges of Science	6
11	Agricultural University	1
12	State funded research institute	1

Further details about the universities and institutions listed in Table 1 are as given below:

1. Four central universities, namely Jawaharlal Nehru University (JNU), University of Delhi (DU), Aligarh Muslim University (AMU) and the North Eastern Hill University (NEHU);
2. Six universities run by state governments, namely the universities of Mumbai, Pune, Nagpur, Agra, Gauhati, and the SNDT Women's University;

3. Six colleges affiliated to the universities mentioned above;
4. One state-run agricultural university, namely the Krishi Vidyapeeth at Akola;
5. Two deemed universities, namely the Indian Institute of Science (IISc) and the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) in Bangalore, the latter is funded by the DST;
6. Three institutions run by the Indian Council of Medical Research (ICMR) along with a centrally funded institute of medical research namely the All India Institute of Medical Sciences (AIIMS) and another funded by the state government, namely the BC Roy Medical Institute at Collate;
7. The Indian Institute of Technology (IIT) funded by the central government; and
8. Twelve scientific research institutions run by the central government and one run by the state government. These included two under the Department of Bio-technology, three under Department of Atomic Energy, one institute under the Department of Science and Technology, six labs of the Council of Scientific and Industrial Research and one under government of Maharashtra.

Process of data collection

The respondents were first contacted through the telephone or emails through numbers and addresses listed in the institutional websites. Heads of institutions also helped to contact the subjects. The initial contacts helped to organise focused group discussions with groups of women scientists and students during the visit of the investigating team to the institutions. During these meetings, the purpose of the study and the possible areas of discrimination were explained. Pamphlets on the Supreme Court guidelines regarding sexual harassment and the recent scheme of the DST to encourage women scientists who had dropped out of science to return to research were also distributed. Following this the questionnaires were handed over to the scientists and students. The respondents were asked to either mail or email the questionnaires back to us. Wherever possible these questionnaires were collected by the investigators then or through subsequent visits. At these institutions, references were also obtained for other institutions.

Some of the scientists were also contacted through the members of INSA committee and they responded through email. Thus a snowballing sampling method with a purposive design was adopted.

Time line and sample size

A pilot study was conducted, to pre-test and finalize the semi-structured questionnaire, between mid-August and mid-September 2003. The process of data collection, from contacting scientists through email to receipt of questionnaires, took place from mid-September 2003 to mid-February 2004. The entire sample for the study was 296, including 149 scientists and 147 students.

Non responses

While majority of those who participated in the study, conscientiously answered all the questions, there were a few who returned the questionnaire partially completed. Many respondents also did not return the questionnaires despite repeated reminders. This has proved to be a limitation.

Observations

Socio-economic Profile of Scientists

About 70 per cent of the scientists were between the ages of 30 and 50 years, of which nearly 44 per cent were in the age group 40 to 50 years. Among students nearly 87 per cent were below 30 years (Table 2).

Majority of the respondents were upper cast Hindus (Tables 3, 4). Some respondents did not want to be identified with any religion or cast.

Table 2. **Age group of scientists and students** (Age[#])

Age group	Scientists	Per cent	Students	Per cent
20-29	6	4.0	128	87.1
30-39	39	26.2	11	7.5
40-49	65	43.7	2	1.4
50-59	35	23.5	3	2.0
60-69	2	1.3	-	-
No response	2	1.3	3	2.0
Total	149	100.0	147	100.0

([#]Each table in this chapter presents data derived from the answers in questionnaires for women scientists or students. The question, inbrief, is mentioned in the bracket.)

Table 3. **Religious Composition of Respondents** (Religion)

Religion	Scientists	Per cent	Students	Per cent
Hindu	117	78.6	118	80.2
Muslim	14	9.4	17	11.5
Jain	-	-	2	1.4
Christian	6	4.0	4	2.7
Buddhist	3	2.0	2	1.4
Sikh	1	0.7	1	0.7
Any other	3	2.0	-	-
Not Applicable	3	2.0	2	1.4
No Response	2	1.3	1	0.7
Total	149	100.0	147	100.0

Table 4. Caste Composition of Respondents (Caste/Ethnicity)

Caste	Scientists	Per cent	Students	Per cent
Forward Caste	103	69.1	93	63.2
Backward Caste	-	-	2	1.4
Other Backward Caste	5	3.4	11	7.5
Scheduled Caste	4	2.7	5	3.4
Scheduled Tribe	3	2.0	1	0.7
Any Other	5	3.4	5	3.4
Not Applicable	22	14.7	20	13.6
No response	7	4.7	10	6.8
Total	149	100.0	147	100.1

This was an interesting contrast to what one of the women scientists from Bangalore had to say, on the day a new set of computers were inaugurated in their lab. She was shocked by the response of some of her male colleagues, who commented that it was not andauspicious' day for the inauguration. She also said that caste and religious backgrounds of scientists matter very much. It does affect the growth of science and the upholding of rationality, which is one of the basic foundations of science. It is reflected not only in the work that scientists do, but also in their training of students, by the examples they set for themselves. In another university, the upper caste lab attendants referred to a Dalit woman professor as Bai, wheras the senior male professors were called 'Sir'. While *Bai* when literally translated refers to a lady, in common usage it means a woman domestic help. It was obviously a way of getting back at the caste of the woman professor by the upper caste employees. A majority of the respondents said that women, or for that matter anyone, who enters science should rid society of superstitions.

Over 78 per cent of the scientists and 18 percent of the students were married (Table 5). In a later section, there will be a discussion on the role that family and its support structures play in women being able to pursue science careers.

Table 5. Marital status of scientists and students (Marital Status)

Marital Status	Scientists	Per cent	Students	Per cent
Unmarried	27	18.1	119	80.9
Widowed	4	2.7	1	0.7
Separated	1	0.7	-	-
Married	117	78.5	26	17.7
No response	-	-	1	0.7
Total	149	100.0	147	100.0

Disciplines Pursued by the Scientists

Table 6 shows that there were more students in biological sciences than in other streams. Both scientists and students were aware that life sciences and biological sciences had always had more women. In some of the group discussions with students on the question of why there were fewer girls in Physics compared to Biology, the students responded saying that, 'Society moulds us in a way, telling us that girls can't be pilots or do things with machines.' University departments tended to offer traditional disciplines such as Zoology and Botany, while the premier science intuitions offered broader areas like Biological sciences, Chemical sciences and Physical scences, and supported research in these areas.

Table 6. Disciplines pursued by scientists and students (What is the discipline in which you have obtained your higher education?)

Disciplines	Scientists	Per cent	Students	Per cent
Agriculture	4	2.7	11	7.5
Biochemistry	14	9.4	24	16.3
Biological Sciences	19	12.8	42	28.5
Space/ Atmospheric Science	-	-	2	1.4
Biometry/ Computer Science	1	0.7	2	1.4
Botany	15	10.0	5	3.4
Ecology	1	0.7	3	2.0
Chemical Sciences	34	22.8	17	11.6
Home Science	4	2.7	-	-
Environmental Sciences	-	-	2	1.4
Mathematics	12	8.0	4	2.7
Medicine/ Life Sciences	4	2.7	9	6.1
Space Science	1	0.7	1	0.7
Pharmacy	7	4.7	3	2.0
Physics	17	11.4	17	11.6
Zoology	14	9.4	5	3.4
Missing	2	1.3	-	-
Total	149	100.0	147	100.0

Nearly 75 per cent of the women scientists had completed their doctoral degrees, while amongst students a similar proportion had completed their master's degree (Table 7). Eleven per cent of those who responded to the students' questionnaire had also obtained their Ph.D.

Type of institution also determined, the way science had developed. Some women

scientists mentioned that certain institutions encourage holistic science (e.g. genetics, biological sciences), which are underrepresented in India. Outside of these progressive institutions, where science is practiced differently, these women scientists saw little professional prospects.

Table 7. Last degree obtained (Qualification –only last 2 degrees)

Last degree	Scientist	Per cent	Student	Per cent
AISSE	-	-	1	0.7
B.A.	-	-	1	0.7
B. Ed.	-	-	1	0.7
B.Sc.	2	1.4	10	6.8
M. Pharm.	-	-	2	1.4
M. Phil.	-	-	3	2.0
M.D.	3	2.0	-	-
M.Sc.	27	18.1	111	75.5
Ph.D.	113	75.8	16	10.9
No response	4	2.7	2	1.3
Total	149	100.0	147	100.1

Motivation and Constraints in Access and Entry into Science

This section summarises the responses obtained in, group discussions as well as those obtained through structured questionnaires.

The study tried to trace the motivational factors and constraints faced by women and girls in entering science careers at all levels. Focussed group discussion (FGD) with students who were on the threshold of pursuing a career in science in the junior and senior college, indicated the factors that motivated young girls to enter science, the career they envisaged, and their perceptions about the reasons students chose to go into or stay away from science (see Appendix I- Poonacha and Gopal, 2004)

Students in the higher secondary and graduate level felt that science offered them more options in terms of future careers. Parental pressure, added to the fact that they had secured high marks at the higher secondary level, prompted them to pursue science. Students also felt that it was still a bit premature for them to decide what careers they would follow, but some of them felt that biotechnology, microbiology, life sciences were some of the preferred options.

Most post graduate students mentioned pursuing science for the love of the subject and making a conscious choice in opting for science as a career (Table 8). Table 9 indicates that most scientists (nearly 60 per cent) had chosen to pursue science while in their secondary school, whereas the students made their decisions only during their graduation and post-graduation (66 per cent). Table 10 suggests that more than 80 per cent of the scientists and students did not face any serious discouragement when they

decided to pursue their science interests. In fact parents and teachers together encouraged a majority. Personal motivation also played a major role in selecting scientific career (Table 11).

Table 8. Conscious choice in opting for science career (Was your entry into science a conscious choice?)

Conscious Choice	Scientists	Per cent	Students	Per cent
Yes	141	94.6	135	91.8
No	5	3.4	7	4.8
Not Sure	3	2.0	1	0.7
Any Other	-	-	1	0.7
No Response	-	-	3	2.0
Total	149	100.0	147	100

Table 9. When was the decision to pursue a science career taken? (When did you plan to pursue a career in science?)

Stage of Planning	Scientist	Percent	Student	Percent
Secondary School	88	59.0	42	28.6
Graduation	35	23.5	45	30.6
Post-Graduation	19	12.8	52	35.4
Ph.D.	2	1.3	4	2.7
No response	5	3.4	4	2.7
Total	149	100.0	147	100.0

Table 10. Discouragement faced by respondents (Did anybody discourage you in science?)

Faced any discouragement	Scientists	Per cent	Students	Per cent
Yes	13	8.7	12	8.2
No	132	88.6	119	81.0
No Response	4	2.7	16	10.8
Total	149	100.0	147	100

Table 11. **Persons who gave encouragement** (Who encouraged you for science education?)

Encouragement from*	Scientists	Per cent	Students	Per cent
Father	60	40.3	53	36.0
Teacher	12	8.1	11	7.48
Mother	26	17.4	26	17.6
Friends	-	-	3	2.0
Brother (s)	7	4.7	8	5.4
Sister (s)	3	2.1	2	1.3
Self	47	31.5	41	27.8
Any Other	3	2.1	4	2.7
No Response	4	2.7	8	5.4

*Multiple responses

Lack of finance was an important factor for fewer girls coming into research. Families were unwilling to invest in girls' scientific pursuits, which included both education and the competitive exams that followed. This was evident in bigger institutions as well as at the college level. Compared to scientists (40.3 %), fewer students (26.5 per cent) had fellowships from the CSIR. However, a greater proportion (51.7 per cent) were utilising other fellowships in the absence of CSIR fellowships. Does this mean that getting CSIR fellowships is becoming increasingly difficult for women? If so why? In the IITs, there is tremendous gender skewedness, among students and even more among faculty. One of the faculty mentioned, that preparation for the Joint Entrance Examination of the IIT requires tremendous investment both in terms of money and time; parents are unwilling to invest in girls. The situation was becoming worse for girls with each passing year. In some institutions students are not admitted for research if they do not pass the NET qualifier exam. This is a kind of barrier which can perhaps be dismantled to make research more student /gender friendly.

Those who were educated in cities and towns and had their education in the English language rather than the regional language definitely had an advantage. A majority of the scientists (73.8%) and students (68%) were educated in cities and towns (Table 12). The higher percentage of students than scientists from smaller towns indicates that more students from smaller towns are coming into science, which is an encouraging sign. In terms of medium of instruction, however, the movement of students from regional language into higher education in English language was less compared to that of scientists (Tables 13 and 14).

Table 12. Where the respondents did their schooling (Where did you do most of your schooling?)

Place	Scientist	Percent	Student	Percent
Village	7	4.7	8	5.4
Town	29	19.5	38	25.9
City	110	73.8	100	68.0
Town/City	2	1.3	-	-
No response	1	0.7	1	0.7
Total	149	100.0	147	100.0

Table 13. Scientists' medium of instruction at school, under-graduation, post-graduation (Medium of instruction)

Medium of Instruction	School	Per cent	Under-graduation	Per cent	Post-graduation	Per cent
English	71	47.7	144	96.6	144	96.7
Regional language	74	49.7	4	2.7	3	2.0
Any other	4	2.7	1	0.7	2	1.3
Total	149	100	149	100	149	100

Table 14. Students' medium of instruction at school, under-graduation, post-graduation (Medium of instruction)

Medium of Instruction	School	Per cent	Under-graduation	Per cent	Post-graduation	Per cent
English	103	70.1	145	98.6	146	99.3
Regional language	37	25.1	2	1.4	1	0.7
Any other	7	4.8	-	-	-	-
Total	147	100	147	100	147	100

In colleges in North India, the motivation for girls and women to pursue science at the higher secondary level and subsequently at the graduate level (or the English language as a second choice) was because it enhanced their value in the marriage market. Girls were encouraged to take up science as it added value, and was useful for them to teach children at home. Thus both family and institutions played a role in the entry and access into science careers. In premier institutions of science, there is covert if not overt gender discrimination. There is hesitation to take girls as students. Supervisors

hesitate to take girls as their discontinuation after marriage is a disincentive. Conditions are put on the girls, 'will you complete or not?'

In colleges (especially in North-east), the load of teaching extends to even the junior college, which leaves no scope for teachers to think of research. Managements of the colleges do not encourage teachers to pursue research, and colleges do not have facilities for research. Therefore college teachers depend on their own motivation to do research. Within institutions, personal contacts also play a role in access to a jobs or positions.

Women continue to have social obligations to family and other commitments after securing jobs. These affect women in the prime period of their career. Family responsibilities leave little time to publish as prolifically as her male colleagues. In fact some women who were older were of the opinion that the scientific field is extremely competitive and since women are biologically different, they have to end up sacrificing their ambitions. One woman scientist said "Once you want equality, you can't be going home. In that case you step out of science." On the query, if she didn't think science had lost out on women's talent, she said "you can't have both."

Some institutions do not allow both the spouses to work in the same unit or institution. This comes in way of women finding employment. While crèches in institutions was an important need for workingwomen, a demand for that facility from women may result in women not getting jobs.

Even if women are serious about pursuing research, at the level of recruitment a less serious man is taken because women would not have enough publications. Hence there is need to recognise that women have special and separate social obligations, which come in the way of their uninterrupted pursuit of research. Support systems to help women with such special needs are essential.

Entry Level Constraints

While 9 per cent students said it was difficult to obtain a post-graduate admission or research position, majority said they did not experience any difficulty (Table 15). In the FGD, many girl students said they were denied Research Associate-ship on the pretext that they will marry and leave. When permanent positions come up, men are preferred. One scientist observed that it was not that men did not leave their doctoral or post-doctoral research incomplete and leave the institution, but women's examples are specifically chosen to build a negative image and use it against them.

Table 15. Difficulty in obtaining post-graduate/ research position for students (Was it difficulty for you to obtain this post-graduate/ research position?)

Difficulty experienced by students	Student	Per cent
Yes	13	8.8
No	128	87.1
No Response	6	4.1
Total	147	100.0

Group discussions in many institutions revealed that women scientists were discriminated against, during selections through interviews and if they are selected motives are attributed. For instance, the selection of the only woman head of a unit in a premier lab was attributed to the fact that she cried and obtained the post due to sympathy, and not because she was meritorious. Table 16 indicates that about 13 percent of the scientists experienced difficulty in getting their first job. Even though recruitments were made through advertisement and interviews (Table 17), it was felt that some amount of personal contacts, played a role in getting a job. This observation may however apply to both the sexes.

Even as a majority accepted their present job because it suited their qualification, many also accepted the job because it was at a convenient location or fitted with household responsibilities (Table 18). One of the scientists noted that she did not move out of her job into a better position in another city, as her husband had a job in a science institution in the same city. If she opted to move out it would have upset the family arrangements, and so she denied herself the opportunity. This is a compromise that women often tend to make, and sometimes sacrifice a brilliant career.

Table 16. Scientists' experiencing difficulty in getting first job (Did you have any difficulty in getting your first job?)

Experience of difficulty	Scientists	Per cent
Yes	17	11.4
No	120	80.5
No response	12	8.1
Total	149	100.0

Table 17. Process of obtaining present job for scientists (How did you get your first previous /present job?)

Process of obtaining scientists' present job*	Scientist	Per cent
Personal Contact	7	4.7
Interview	58	38.92
Advertisement	29	19.46
Through transfer from another dept in same organisation	2	1.3
Promotion	8	5.6
Moving from another organization	2	1.3
Any other	4	2.7
Not Applicable	1	0.7
No Response	30	20.13

*Multiple responses

Table 18. Reasons for accepting present post (Mark three important reasons for accepting your present post.)

Reasons*	Scientists (N= 149) who gave one reason	Per cent	Scientists (N= 149) who gave second reason	Per cent
Suitable to Qualification	129	86.5	6	4.0
Convenient Location	2	1.3	44	29.5
Attractive Salary	2	1.3	14	9.4
Fits with Household Responsibilities	4	2.6	20	13.4
Carries prestige	2	1.3	23	15.4
Congenial Atmosphere	2	1.3	4	2.7
Any other	6	4.0	2	1.3
No Response	4	2.6	36	24.2

*Multiple responses

Personal interest and motivation played a role in majority of scientists taking science careers and their current jobs (Table 19, 20). However, many women scientists noted that retention in their career was as big if not a bigger problem than access and entry.

Table 19. Motivation for scientists to specialize in their particular branch of science (What motivated you to specialise in this branch of science?)

Motivation*	Scientist N=149	Per cent
Interest in Science	137	91.9
Job Potential of the Course	18	12.1
Inclination for Practical Work	7	4.7
Influence of the peer group	2	1.4
Encouragement and Support from Family	19	12.8
Any Other	1	0.7
No Response	3	2.0

*Multiple responses

Table 20. Factors that motivated scientists to work to their present level (What motivated your work for your present level?)

Motivation*	Scientist N=149	Per cent
Interest in Subject	112	75.1
To Improve Career	42	28.2
Availability of Financial Help	7	4.7
Sponsored by Organisation	1	0.7
Any Other	4	2.7
No response	6	4.0

*Multiple responses

Table 21 mentions some of the reasons for women leaving their previous job. While many of them left for better professional prospects, there were those who also left because it was convenient for the family, managing husband's transfer and children's education. Scientists in University departments seemed to move out more compared to those placed in scientific institutions for better professional prospects (16 per cent vis-à-vis 10 per cent, data not shown) as well as to be with spouses and families.

Table 21. Scientists' reasons for leaving previous job (Reasons for leaving))

Reasons for leaving previous job	Scientists	Per cent
Better Professional Prospects	39	26.2
Transfer Not Acceptable	1	0.7
Husband's/ Father's Transfer	5	3.4
Children's Care/Education	2	1.3
Not Satisfied with Type of Job	6	4.0
Any Other	8	5.4
Not applicable	88	59.1
Total	149	100.0

Organisational practices and Workplace discrimination

A majority (over 75%) of the women scientists were in research and teaching (Table 22) since they belonged to both university departments and scientific research institutions. However only 29.5 % were involved in project planning.

Few institutions faced location-specific problems with special implications for women. For instance, in some areas of North East, the threat of militancy prevents movement after dark, particularly for women. This restricts research requiring longer hours of work. In smaller towns, with politico-cultural difficulties, when girls have to stay late, teachers ensure that some boys of the same department stay behind to accompany them to their hostels due to curfew or lack of safety for women in general.

Table 22. Nature of work handled by scientists (Nature of work handled in your present post)

Nature of Work*	Scientists N=149	Per cent
Teaching	112	75.2
Research and Documentation	119	79.8
Scientific Documentation	38	25.5
Technical, Computer	29	19.5
Consultancy	25	16.8
Project Planning	44	29.5
Laboratory testing etc	35	23.5
Laboratory supervision	45	30.2

*Multiple responses

In most institutions both scientists and students were satisfied with working hours in general (Table 23). Many women noted that research is a pursuit which does not have pre-set working hours, and hence most scientists and students have to stay behind after the administrative and official hours of the institute or department (Table 24 and 25).

Table 23. Satisfaction of scientists about working hours (Satisfaction with working hours)

Satisfied	Scientists	Per cent	Student	Per cent
Yes	131	87.9	113	76.9
No	11	7.4	19	12.9
No response	7	4.7	15	10.2
Total	149	100.0	147	100.0

Facilities for work were another area of discontent. While nearly 48-50 per cent of scientists and students were satisfied, considerable proportion (32 and 33 per cent) was satisfied only to some extent (Table 26). Satisfaction of both scientists and students tended to be more in science institutions than in University departments since these organizations have better funding and nurturing environment compared to Universities.

Table 24. Students' requirement to stay beyond office hours to do work (Do you have to work beyond the institute hours?)

Students' requirement	Students	Per cent
Often	45	30.6
Sometime	67	45.6
Never	20	13.6
Any Other	10	6.8
No Response	5	3.4
Total	147	100.0

Table 25. Requirement for scientists to stay beyond office hours to do work (Do you have to stay beyond office hours on your own to complete work on hand?)

Scientists' requirement	Scientist	Percent
Often	39	26.1
Sometimes	90	60.4
Never	10	6.7
Any Other	1	0.7
Not Applicable	1	0.7
No Response	8	5.4
	149	100.0

Table 26. Satisfaction with Infrastructure provided by Organization (Are you satisfied with the basic infrastructure facilities provided by your organization?)

Satisfaction with Infrastructure	Scientist	Per cent	Student	Per cent
Yes	72	48.3	74	50.3
No	26	17.5	16	10.9
To some extent	46	30.8	47	32.0
Any other	-	-	2	1.4
No response	5	3.4	8	5.4
Total	149	100.0	147	100.0

Gender Related Constraints and Sexual Harassment

Discussions with scientists and students revealed quite a bit of gender related discrimination and harassment. Some of the comments follow. “If you dress well they don’t take you seriously. Older men are condescending. But if you challenge them then they become hostile.” These were the words of a promising scientist in a major national institute. If a woman is good in her work, her growth is suppressed. Women scientists were unanimous in their feeling that men just cannot tolerate a woman in a higher position. Equality is not part of their attitude. Others from specific locations noted: In the 50 years of the CSIR and 42 labs across the country, there is not one woman who is the Director. During interviews, if a woman went in to appear before the panel and returned after a long time, there are taunts that because she is a woman they kept her in for a longer time. But if she returned quickly, there would be comments that it was because she was a woman they did not ask her anything.

Students tend to be more vulnerable and harassed. One woman’s supervisor had not signed her Ph.D. thesis after her submission of drafts 6 years ago. While another woman trainee was offered a soft option: work in the computer lab, and not in the control room in the plant, even though she was more than qualified to be in the plant. Some of these complaints may be individual experiences and not necessarily related to gender.

The proportion of male members in the lab varied (Table 27) but there was almost always their presence. Many women students also noted that they often had to bear with uninvited sexual attention while at work in the labs.

Higher percentage of male than female students undertook duties, which are not necessarily part of their work (Tables 28, 29), Women students felt that they were being discriminated against during fieldwork too. Many students expressed the problem of personal safety as a major problem regardless of where they were- library, or the lab, or during fieldwork; half their energies were expended in ensuring personal safety. This indeed is a matter of great concern needing institutional safeguards.

While over 50% scientists said they were allotted tasks that are not part of their job specification often or some times (Table 30), only few women attributed extra duties to their gender.

Students expressed difficulty in obtaining a research position as supervisors would impose conditions or just plainly refuse women students.

While most students did not have a gender preference for the supervisor, where gender preference was indicated, slightly higher percentage preferred a woman as a supervisor (12 per cent) compared to a male supervisor (9 per cent) (Table 31). Women teachers did not perceive much difficulty in students approaching them (Table 32).

Table 27. Percentage of males in the department/ or lab (What is the percentage of male members in your faculty/ department/ section?)

Proportion of men	Scientist	Per cent	Student	Per cent
0	13	8.7	-	-
1-10	15	10.0	17	11.6
11-20	6	4.0	16	10.7
21-30	2	1.3	4	2.7
31-40	10	6.7	9	6.2
41-50	21	14.2	18	12.3
51-60	9	6.1	5	3.5
61-70	11	7.4	7	4.7
71-80	26	17.5	6	4.1
81-90	16	10.6	-	-
91-100	3	2.1	1	0.7
Not applicable	6	4.0	-	-
No response	11	7.4	64	43.5
Total	149	100.0	147	100.0

Table 28. Do women students undertake duties which are not part of their research (Do you have to undertake duties which are not part of the normal duties relating to your research as such or for professors?)

Undertake duties	Student	Per cent
Often	12	8.1
Sometimes	65	44.2
Never	61	41.5
Any other	2	1.4
No response	7	4.8
Total	147	100.0

Table 29. Male students undertaking duties, not part of their research (Do you think male students undertake duties which are not part of their study/research?)

Male students undertake duties	Student	Per cent
Often	36	24.5
Sometimes	73	49.7
Never	19	12.9
Any other	5	3.4
Not applicable	4	2.7
No response	10	6.8
Total	147	100.0

Table 30. Allotment of tasks for scientists other than job specifications (Are you allotted tasks which are not part of your job specifications by your superior?)

Allotting of tasks	Scientist	Per cent
Often	14	9.3
Sometimes	64	43.0
Never	59	39.6
Any other	5	3.4
Not applicable	5	3.4
No response	2	1.3
Total	149	100.0

Table 31. Students' preference as supervisor or guide (In your study/ research work who would you prefer as a supervisor/ guide)

Preference	Students	Per cent
Prefer a man	13	8.9
Prefer a woman	18	12.2
No preference	113	76.9
No response	3	2.0
Total	147	100.0

Table 32. Scientists' perception of students approaching them easily (Do students approach you easily for research guidance?)

Scientists approach	Scientist	Per cent
Yes	97	65.1
No	8	5.4
Not applicable	29	19.5
No response	15	10.0
Total	149	100.0

Though in response to the structured questionnaire 76.5% women scientists and 80% students said they did not face any specific difficulties as women (Table 33), focus group discussions did reveal this problem. Difficulties faced included non-cooperative colleagues, gender discrimination in rules and practices and lack of facilities (Table 34, 35).

Table 33. Facing special difficulties as a woman (Q. 7.5. (Scientist). Are there any special difficulties you face as a woman in your organization or department? 3.13. (Student). Are there any special difficulties you face as a woman student in your institute/ university/ department?)

Difficulties faced	Scientists	%	Students	%
Yes	21	14.1	25	17.0
No	114	76.5	117	79.6
Not applicable	3	2.0	-	-
No response	11	7.4	5	3.4
Total	149	100.0	147	100.0

Women scientists felt that to counter the gender related stress, women required support systems such as flexitime, mid-career break, transfer with spouse, day-care for older people, and crèche, desirable location of work (housing), and a women's cell in their institution (Table 36). About 37 per cent women suggested gender sensitisation of their male scientist colleagues.

Table 34. Nature of difficulties faced by scientists as women (Difficulties faced in terms of:)

Type of difficulty	None		Little		Some		Substantial		Most		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Gender discrimination in rules and practices	67	45.0	17	11.4	9	6.0	1	0.7	2	1.3	53	35.6	149	100
Non cooperative colleagues	49	32.9	21	14.1	17	11.4	5	3.4	6	4.0	51	34.2	149	100
Lack of freedom in professional practice	59	39.6	12	8.1	10	6.7	5	3.4	2	1.3	61	40.9	149	100
Lack of facilities and technical practice	45	30.2	18	12.1	12	8.1	8	5.4	6	4.0	60	40.2	149	100

Table 35. Nature of difficulties faced by students (Difficulties faced are in terms of:)

Type of difficulty	None		Little		Some		Substantial		Most		Not applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Gender discrimination in rules and practices	79	53.7	10	6.9	8	5.4	3	2.0	2	1.4	45	30.6	147	100
Non cooperative colleagues	57	38.8	34	23.1	9	6.1	2	1.4	1	.7	44	29.9	147	100
Lack of freedom in professional practice	72	49.0	13	8.7	12	8.2	2	1.4	2	1.4	46	31.3	147	100
Lack of facilities and technical practice	60	40.8	12	8.2	14	9.5	7	4.8	7	4.8	47	31.9	147	100

Table 36. What scientists think are special benefits required (What special benefits for women (other than maternity benefit) do you think are necessary in your organisation?)

Benefits required	Yes		No		Not applicable		No response		Total	
	N	%	N	%	N	%	N	%	N	%
Flexitime	82	55.0	15	10.1	10	6.7	42	28.2	149	100
Transfer with spouse	49	32.9	12	8.1	37	24.8	51	34.2	149	100
Mid-career breaks	73	49.0	26	17.4	10	6.7	40	26.9	149	100
Women's cell	81	54.4	12	8.0	11	7.4	45	30.2	149	100
Day-care for older people	63	42.3	19	12.7	17	11.4	50	33.6	149	100
Desirable location of work	55	36.9	20	13.4	22	14.8	52	34.9	149	100
Gender sensitisation of men	51	34.2	17	11.4	22	14.8	59	39.6	149	100

Sexual harassment was a widely prevalent phenomena, reported across institutions by many scientists and students. The guidelines of the Supreme Court and the mandatory order enjoining institutions to undertake steps to prevent sexual harassment seems to have had some impact on institutions. Only 44 per cent scientists and 29% students said they knew that their institution had a policy to prevent sexual harassment (Table 37).

Table 37. The institute has a policy on sexual harassment (Does your organization have a policy for the prevention of sexual harassment)

Institute has policy on sexual harassment	Scientists	Per cent	Students	Per cent
Yes	66	44.3	43	29.3
No	27	18.1	24	16.3
Don't know	50	33.6	68	46.3
Any Other	-	-	3	2.0
No response	6	4.0	9	6.1
Total	149	100.0	147	100.0

In qualitative discussions students were more forthcoming about sexual harassment they faced from other students and teachers, while scientists linked sexual harassment to organizational practices and professional advancement. Girls in a premier lab said sexual harassment from teachers and colleagues was a "top priority problem!!" But nobody talks about it. Initially, their women teachers told them to cope by ignoring and sidestepping the issue. Others reported that there is always some uninvited sexual attention within the work situation. Only few scientists (15 per cent) and students (10 per cent) knew about someone else facing sexual harassment (Table 38).

Table 38. Knowledge of any one who has faced sexual harassment (Have you or any of your colleagues/ Students faced sexual harassment?)

Know of anyone who has faced sexual harassment	Scientists	Per cent	Students	Per cent
Yes	23	15.4	15	10.2
No	96	64.4	74	50.3
Don't know	24	16.1	48	32.7
Not applicable	1	0.7	5	3.4
No response	5	3.4	5	3.4
Total	149	100.0	147	100.0

Scientists in one national lab reported that they faced abusive language during meetings. Sexually coloured remarks are often made in front of women. These are indirect methods of keeping women out. Pregnant women are singled out for harassment, laughed at, and kept out of fieldwork despite their willingness to participate. A teacher at a state university who had recently delivered and returned to work was asked to produce the circular that women could take feeding breaks. At another institution, husbands of women scientists were not allowed to drop their wives at work on their vehicles.

Women would constantly have to face taunts at work such as: "If you have so many problems, why don't you stay at home?" "A woman who gets a job is actually taking a man's job away", "Why are you applying for a higher post, why do you need so much money?" etc.

Professional Growth

Retention within the career was a bigger problem compared to access. Once women were in, there are numerous ways to keep them out. Rules are thrown at them, they are not taken seriously in committees, opportunities are denied to lecture abroad or in India by which people come to know them and their work, etc.

Decisions on committees are made by groups of men. Only those women who "need props, attention from men" are taken in. ndependent women, who can take decisions on

their own are kept out saying they are "moody, rash, temperamental, etc". Even if women struggle to be in these committees, their opinion is not seriously taken. They remain as tokens, as men make the decisions. Often men on the committees take women members' ideas and pass them on as their own. Appropriation of women's work was a matter of course due to women's vulnerability and lesser bargaining power.

Gender- specific problems that arise be redressed only if more women are involved in decision-making e.g. men do not feel the need for crèches, or day care ford ependents, etc.

Male networking was an important aspect of men in professions. Women remain sincere to their work timings while men don't stay in their seats or labs, but are out at tea, or networking with others. "Men are not interested in their work. They just need recognition only from their peers. They don't care to listen to me or my work." "Men rarely discuss science with women colleagues. Women's talent and competitiveness actually threaten men". After submitting proposals, or applications, follow-up has to be done at every level of the university or institution's bureaucracy, for which men rely on their networking and women are handicapped.

While 52% per cent scientists said they were satisfied with their achievement in career, nearly 33.6 per cent said they were not (Table 39). Women scientists felt they enjoyed their science, while men did it for accolades, often mechanically. While most women seemed to be satisfied with their achievements, (slightly higher proportion in scientific institutions than in universities), some felt that they could have done more. Women expressed their inability to achieve their fullest potential since they often had to fight battles at the workplace, within the family, etc. Among students too, while 54 per cent were satisfied, about 26.5 per cent were not satisfied with their career achievements.

(Table 39). Satisfaction with achievement in career/ research (Are you satisfied with your achievement in your career/ your research?)

Satisfaction	Scientist	Per cent	Student	Per cent
Yes	78	52.3	79	53.8
No	50	33.6	39	26.5
Unsure	16	10.7	23	15.6
No response	5	3.4	6	4.1
Total	149	100.0	147	100.0

In qualitative discussions women mentioned several problems that they faced in terms of infrastructure, funds, awards, and incentives, which play a major role in satisfaction with one's career. The women perceived a kind of gender blindness. In University departments in certain towns, women said that pressures to play double roles frustrate their career prospects. Men laugh when such issues are raised. There is a glass ceiling after marriage. Even if women try to come back into careers after a break, institutions do not take them easily. In colleges (especially in North-east), the load of teaching even the junior colleges leaves no time or scope to even think of research. Managements also do not encourage. Colleges too, do not have facilities for research.

Sixteen per cent scientists said that there was a mismatch between their job and their qualification. They were overqualified for their job (Table 40). Nearly 70 per cent scientists preferred a job that was more interesting and responsible in contrast to more paying (Table 41). Among reasons for inability to fulfil career goals, nearly a quarter of the scientists cited household responsibilities. Apart from that, lack of time, and lack of organisational encouragement were among the reasons given by scientists. Students cited lack of finance as an important reason for inability to fulfil research goals in addition to lack of time (Table 42).

Table 40. Perception of mismatch of job and qualification by scientists (How does your job compare with your qualification)

Perception of job	Scientists	Per cent
It is Equal to your qualification	114	76.5
It is Less than your qualification	24	16.1
It is More than your qualification	3	2.0
Any other	1	0.7
No response	7	4.7
Total	149	100.0

Table 41. Type of career advancement preferred by scientists (What kind of career advancement would you prefer most?)

Preference*	Scientists	Per cent
A More Interesting Job	61	40.9
A More Paying Job	12	8.0
A More Responsible Job	30	20.1
Something that will give you more leisure	5	3.3
Any Other	10	6.7
Not Applicable	4	2.6
No Response	25	16.8

*Multiple responses

Thirty two per cent scientists and 19 per cent students mentioned obstacles faced in the progress of their professional and career. A greater proportion of women scientists located in universities, compared to those in scientific institutions faced obstacles in their career growth. Higher percentage of scientists reported being members of

professional societies earlier (54.4%) than at present (45.6%)–probably due to pressure on time.

Table 42. Reasons for inability to fulfil career goals (Why were you unable to fulfil your goal?)

Reasons*	Scientist	Per cent	Student	Per cent
Lack of time	27	18.1	22	15.0
Household responsibilities	38	25.5	12	8.1
Lack of finance	5	3.4	22	15.0
Objection from family	1	0.7	2	1.4
Ill-health	4	2.7	7	4.8
Organisation did not encourage	16	10.8	4	2.7
Any other	3	2.0	26	17.7
Not applicable	57	38.3	14	9.5
No response	17	11.4	43	29.3

*Multiple responses

As many as 35.6% of women scientists had denied themselves career options (Table 43). Greater proportion of these scientists (21.5 per cent) was located in universities than in science institutions (13.4%).

Table 43. Denied oneself any career options (Have you denied yourself any career options such as opportunity to go abroad for conferences, special training programmes, opportunity in improving/ furthering your study, research etc.?)

Denied career options	Scientist	Per cent	Student	Per cent
Yes	53	35.6	25	17.0
No	89	59.7	108	73.5
Not applicable	5	3.4	8	5.4
No response	2	1.3	6	4.1
Total	149	100.0	147	100.0

At least 21.5 per cent women scientists felt that this self denial has affected their career growth (Table 44). Seventeen per cent women scientists also said they were denied career options such as promotions (Table 45). Among those who gave reasons for this

denial of promotion, lack of experience, lack of functional capabilities, and lack of confidence and drive, were mentioned as reasons for the denial (Table 46).

Table 44. Denial of options/ opportunities has affected career (Has this denial affected your career in any way?)

Denial affected career	Scientist	Per cent	Student	Per cent
Yes	32	21.5	15	10.2
No	39	26.2	17	11.6
Not applicable	59	39.6	55	37.4
No response	19	12.7	60	40.8
Total	149	100.0	147	100.0

Table 45. Scientist ever been denied promotion (Have you ever been denied promotion?)

Been denied promotion	Scientist	Per cent
Yes	26	17.4
No	92	61.8
Not applicable	20	13.4
No response	11	7.4
Total	149	100.0

In terms of recognition for work in the organisation, nearly half the scientists (49 per cent) and students (51 per cent) said they received recognition, while about 39 per cent scientists and 32 per cent students said recognition came only at times. Scientists also said that praise and inclusion in decision making (20-21 per cent) was a manner of recognition (Table 47). Students felt that some praise and grades for the work done was the manner of recognition they received (Table 48).

Over 15% scientists mentioned being superseded. Among those who had applied for a better post, 66% had got it. In the absence of comparable data on men, no comment on this success rate can be made.

Table 46. **Scientists' perception of reasons for denial of promotion** (Your perception of why you did not get the promotion?)

Perception of denial of promotion	Yes		No		Not applicable		No response		Total	
	N	%	N	%	N	%	N	%	N	%
Lack of experience	4	2.7	19	12.8	12	8.1	114	76.5	149	100
Lack of qualification	4	2.7	21	14.1	12	8.1	112	75.2	149	100
Lack of functional capabilities	2	1.3	19	12.8	13	8.7	115	77.2	149	100
Lack of managerial experience	3	2.0	14	9.4	17	11.4	115	77.2	149	100
Discrimination on being a woman	11	7.4	13	8.7	12	8.1	113	75.8	149	100
Lack in personality	-	-	16	10.7	17	11.4	116	77.9	149	100
Lack self-confidence and drive	1	0.7	17	11.4	15	10.1	116	77.9	149	100
Lack of personal connections	13	8.7	7	4.7	13	8.7	116	77.9	149	100
Not fitting into organizational culture	5	3.4	15	10.1	14	9.4	115	77.2	149	100

Table 47. Perception of scientists in terms of recognition (Recognition is in terms of)

Recognition	None		Little		Some		Substantial		Most		Not applicable		No Response		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Praise	17	11.4	18	12.1	31	20.8	30	20.1	12	8.1	-	-	41	27.5	149	100
Promotion	30	20.1	10	6.7	32	21.5	24	16.1	4	2.7	1	0.7	48	32.2	149	100
Inclusion in decision making	22	14.8	10	6.7	32	21.5	29	19.5	7	4.7	-	-	49	32.9	149	100
Recommendation for award	43	28.9	12	8.1	14	9.4	12	8.1	4	2.7	1	0.7	63	42.3	149	100

Table 48. Recognition for students is in terms of (Recognition is in terms of)

Recognition	None		Little		Some		Substantial		Most		Not applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Praise	3	2.0	19	12.9	40	27.2	16	10.9	19	12.9	50	34.0	147	100
Grades	14	9.5	11	7.5	33	22.4	11	7.5	6	4.1	72	49.0	147	100
Recommendation for award	26	17.7	8	5.4	17	11.6	11	7.5	3	2.0	82	55.8	147	100

Coping with Family and Career: Support of immediate family

Women scientists, and a large number of students did speak of subtle discrimination meted out to them by their family members. Though in an earlier question, almost 70% scientists and students had said that their parents had encouraged them to take up science career, in the qualitative discussion women mentioned that their brothers received more encouragement in terms of attention and incentives if they wished to pursue science. Families hesitated to invest in girls' education, particularly science education. In many families it was the mothers who discouraged the girls.

Quite often girl students would have to disrupt their career as a student or researcher for marriage. At a premier lab, girls mentioned that if a marriage proposal had come their way, they would have to agree to it, out of loyalty to their parents. "After all, it is because of them that we are here." Only a small percentage of students felt that commitment to career increases or decreases chances of marriage. Few were unsure (Tables 49, 50).

Table 49 – Commitments to career lessens chances of marriage (Does commitment to your career/ higher studies/ research lessen your chances of marriage?)

Lessens chances of marriage	Scientist	Per cent	Student	Per cent
Yes	10	6.7	21	14.3
No	21	14.1	82	55.8
Unsure	7	4.7	16	10.9
No response	111	74.5	28	19.0
Total	149	100.0	147	100.0

Table 50 – Commitments to career increases chances of marriage (Does commitment to your career/ higher studies/ research lessen your chances of marriage?)

Increases chances of marriage	Scientist	Per cent	Student	Per cent
Yes	3	2.0	19	12.9
No	18	12.1	61	41.5
Unsure	14	9.4	31	21.1
Not applicable	103	69.1	27	18.4
No response	11	7.4	9	6.1
Total	149	100.0	147	100.0

Constraints in attending to social & household responsibilities

Qualitative discussions revealed that women found the responsibilities of marriage and family to be an impediment in their science careers. Combining career and research was difficult, and only the more privileged women who received support from their families were able to cope with the dual burden of home and work. Combining family and work did result in neglect of household responsibilities to greater or lesser extent (Table 51).

Table 51. Due to career/ research commitment, cannot attend to household responsibilities (Do you feel whether married or unmarried that because of your commitment to a job/ research, you cannot/ may not be able to attend properly to household responsibilities?)

Inability to attend to household responsibilities	Scientist	Per cent	Student	Per cent
Yes	18	12.1	16	10.9
No	44	29.5	57	38.8
Sometimes	71	47.7	67	45.6
Not applicable	12	8	4	2.7
No response	4	2.7	3	2.0
Total	149	100.0	147	100.0

Attitude of family members

With regard to the attitude of family members to the careers, of scientists, many mentioned encouragement from parents and husband and to a lesser extent from in-laws (Table 52). But there were instances when women said that though they received tremendous support from their husbands, at times they had to curtail their ambitions in order to please their husbands. Students received lot of encouragement from parents (Table 53). Thus once the girl decided to take up science studies, parents did support them, even in this male dominated society.

Do women practice science differently and address different issues

There was a mixed response to this question. Many said "it hardly matters whether the practice of science is by a man or a woman. Science is science for all, and that gender has very little to do with it. By entering science, women like men attain intellectual growth; it provides tremendous confidence, mental maturity, happiness and so on." "It definitely helps other women stand up and gain confidence, and encourages other women to join the field." Students particularly felt that there is lack of role models. "A role model is required; we need an Indian woman scientist, whom every woman can follow as a guiding light. Unfortunately, we have none in India."

Table 52. Attitude of family members to scientists' career (How do your parents/ in-laws view your working? What is your husband's attitude to your working?)

Attitude	Oppose		Dislikes, but not hinder		Indifferent		Barely accept		Encourage		Not applicable		No response		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Parents	3	2.0	3	2.0	10	6.7	2	1.3	119	79.9	1	0.7	11	7.4	149	100
In-laws	3	2.0	7	4.7	24	16.1	8	5.4	79	53.0	6	4.0	22	14.8	149	100
Husband	0	0	4	2.7	5	3.4	8	5.4	98	65.8	3	2.0	31	20.8	149	100

Table 53. Attitude of family members to student's research career (How do your parents/ in-laws view your involvement in higher studies/ research? What is your husband's attitude to your involvement in higher studies/ research?)

Attitude	Oppose		Dislikes, but not hinder		Indifferent		Barely accept		Encourage		Not applicable		No response		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Parents	1	0.7	2	1.4	3	2.0	3	2.0	130	88.4	0	0	8	5.4	147	100
In-laws	2	1.4	3	2.0	4	2.7	1	0.7	27	18.4	0	0	110	74.8	147	100
Husband	0	0	0	0	2	1.4	0	0	24	16.3	0	0	121	82.3	147	100

Women also get the sense of fulfilment of achieving something on their own, to be able to shape the careers of others in a positive manner; however, "women scientists are in a minority and they tend to ape their 'successful' male colleagues." Some women believed that research was teamwork, and therefore there is "less need for personal glory" They were prepared to play second fiddle in collaborative projects so that the work moves along. Some students remarked, "a woman scientist in a group may understand any difficulty faced by women, and will (hopefully) be active enough to sort out any problem."

Table 54 shows that nearly 50 per cent scientists and 33 per cent students said women bring a different consciousness to the practice of science. Many (46.3 per cent scientists and 41.5 per cent students) felt that women's practice of science would have an impact on the way science is currently practiced (Table 55). In some of the discussions at institutes, where certain applied technologies were being researched, women felt that their experience as women did influence the topics chosen or the manner in which they conducted their research. Women would be more sensitive to understanding the pollution in kitchen, or the nature of agriculture cropping that is followed in the country. Agricultural scientists said that men believe in intensification, whereas women have understood the value of integrated farming and conservation. In another institution where research in ecological and holistic sciences was encouraged, students noted that women generally seem to have empathy for living subjects, but "those who are aware of ecology are not necessarily in positions of power."

Table 54. Women bring a different consciousness and temperament into scientific practice (Do you think women scientists bring a different consciousness/ temperament into their scientific practice?)

Perception of women bringing a different consciousness on practice of science	Scientists	Per cent	Students	Per cent
Yes	74	49.7	49	33.3
No	22	14.7	20	13.6
Don't know	17	11.4	44	29.9
Unsure	24	16.0	26	17.7
No response	12	8.1	8	5.4
Total	149	100.0	147	100.0

Many said that "currently science is seen as a predominantly male enterprise… from nomenclature to choice of research topics to paradigms of research, every thing is male dominated… hence the work culture is essentially extremely hostile to women researchers." This led to the feeling that more representation of women scientists was required in academic bodies, decision- making forums, and at policy level.

Table 55. Women's practice of science has an impact on the manner it is practiced (Do you think women scientists practice of science has and can have an impact on the way science is currently practiced?)

Impact on practice	Scientist	Per cent	Student	Per cent
Yes	69	46.3	61	41.5
No	22	14.8	24	16.3
Don't know	20	13.4	31	21.1
Unsure	21	14.1	21	14.3
No response	17	11.4	10	6.8
Total	149	100.0	147	100.0

Bringing more women into science to achieve a critical mass

Women scientists and students felt the need to encourage more women into science careers. Some of the mechanisms suggested were: provision of more scholarships, and information on vacancies, grants etc., flexible policies to enable combining family responsibilities and profession, representation of women scientists at the policy level, and sensitisation to gender equity in science, at all levels of science professionals (Table 56).

Table 56. Factors to address to encourage more women into science (How can more women be encouraged into science careers?)

Factors to encourage women*	Scientists N=149	Per cent	Students N=147	Per cent
Preferential treatment for women during recruitment and promotion	13	8.8	2	1.4
More scholarships, information on vacancies, grants, etc. for women students	58	38.8	53	36.1
Representation of women scientists at policy level	33	22.1	14	9.5
Flexible policies in combining family and professional roles	40	26.8	48	32.7
Sensitisation to gender equity in science, for all levels of science professionals	28	18.8	20	13.6
Any other	1	0.7	6	4.1
No response	19	12.8	13	8.8

*Multiple response

It is noteworthy that only 8.8% scientists and 1.4% students sought preferential

treatment during recruitment and promotion. Thus what the women want are policies that would give them a level playing field and not preferential treatment. Almost one third scientists and students felt that women scientists' work could alter the theoretical contents of science (Table57).

Table 57. Women scientists' work could alter the theoretical contents of science (Do you think women scientists' work could alter current theoretical contents of science?)

Alter theoretical contents	Scientist	Percent	Student	Per cent
Yes	50	33.6	34	23.1
No	42	28.2	23	15.6
Don't know	16	10.7	46	31.3
Unsure	20	13.4	30	20.4
No response	21	14.1	14	9.5
Total	149	100.0	147	100.0

Recommendations Based on Responses

Since the (SNDT) study, is an enquiry into issues of access and retention in science careers, and has addressed numerous issues covering both students and scientists at various levels, such as colleges, university departments, scientific institutions, the recommendations have been broadly categorised into the following three areas:

1. **Science Education**: The essence of science education is to inculcate an attitude of enquiry and a scientific temper, hence attention has to be given to aspects within the education system such as:

1.1 Provision of quality school facilities, required number of teachers, facilities such laboratories, equipment, libraries, etc. along with ensuring access and entry,

1.2 Emphasis on learning by doing, with stress on internalisation of knowledge rather than methods of learning by rote and reproduction in exams. There should be the practice of learning science through simple experiments such as by doing and observation,

1.3 Frequent training courses for teachers so that their capabilities are upgraded and they become role models for students

2. **Higher education**: At the higher level of education and scientific practice, which is the focus of this study, the following measures should be implemented to ensure women's entry and retention at the tertiary level:

2.1 Educational support such as special scholarships for girls, information dissemination at school and college level, mentoring by women scientists, etc. to bring

more women into science. It is important to mention here a relevant clause from the Government of Maharashtra's (Dept of WCD) *Women's Policy, 2001.**

2.2 Opportunities for women to network with other women in the institution. Need more women to be mentors and role models for younger scientists and students to build a strong interest in their work and self-confidence that will take them beyond the marriage trap into a long-term relationship with science.

2.3 All faculty and staff to be oriented to gender issues and to be informed and sensitised to women's social position, which reflects on their location in science. This gender sensitisation should also extend to increase the impact of women's studies and science on family and society.'

2.4 In all educational institutions and campuses there has to be a women's cell to counter sexual harassment/ other problems specific to women

2.5 Women students and staff have to be provided facilities to support their double and triple burden in their day-to-day work – crèche, day care for dependents, etc.

3. Across institutions of science: To ensure greater linkages between institutions of higher education and institutions of science research, and for better access to funding for labs, encouragement for teachers, and collaboration between institutions, these are some of the critical issues to be addressed across institutions:

3.1 At the level of faculty recruitment and student intake there should be provisions to reduce discrimination when woman are being recruited. These include subtle discrimination by supervisors against women students, discrimination based on girls' vulnerability to succumb to social and familial pressures for marriage, etc.

3.2 There should be systemic mechanisms to ensure that women are able to be in the career path, even when they have to take breaks to have children, and when they end up publishing less, etc., which is an obstacle in career advancement.

3.3 In the evaluation (especially via informal methods) in career progress, women are frequently not considered, especially for fellowships, national awards, and international grants, because of highly male-dominated scientific hierarchy. This should be rectified.

3.4 There should be greater attempt to bring more women into policymaking and decision-making bodies, committees, and positions. This will increase the sensitivity and support that women will get in recruitment and career advancement.

3.5 Organisational practices – to build safe spaces/ atmosphere for women students and faculty/ scientists

3.6 Gender sensitisation sessions for all faculty and staff to make them informed and sensitive to women's social position, which reflects on their location in science. This gender sensitisation should also extend to increase the impact of women's studies and science on family and society.

3.7 Mandatory women's cell to counter sexual harassment/ other problems specific to women

3.8 Facilities specifically to help women in their day-to-day work – crèche, day care for dependents, etc.

3.9 Flexitime, mid-career breaks, relaxation in age limit for intake, and in submission of proposals needs to be incorporated. Need for systemic changes supportive of women to ensure that there is no discrimination when women have had a break in career to fulfil her family obligations, even if she is capable and willing to work, and competent, possessing the necessary requirements, such as publications, etc. The sensitivity that scientists also live in society should permeate all levels of science.

* Note: *Women's Policy, DWCD, Government of Maharashtra* – Clause (7) in the section on Education says "Considering importance of higher and technical education for economic development and empowerment of women, Government of Maharashtra has reserved 30 per cent of seats in all courses of higher and technical education vide G.R. dated 17.4.2000. This shall open avenues for girls in services in public and private sectors. 2000 institutions in the State for higher and technical education shall actively promote women's empowerment. Projects for the same shall be taken up under National Service Scheme. Vocational education being important for economic development of women, its promotion shall be a priority concern. Existing courses and curriculum shall be reviewed to ensure benefits to women from all strata of society (pp. 6-7)."

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CHAPTER III

GENERAL DISCUSSION AND RECOMMENDATIONS

All over the world the presence of women in science, particularly physical science and engineering is very low. India is no exception. The present study on 'Science career for Indian women' was taken up to identify the factors which prevent Indian women from studying science and worst still persisting with a science career after studying it. It is hoped that the study would lead to appropriate recommendations for overcoming the proverbial 'glass ceiling'. Engineering and applied sciences have been left out of the scope of the present study (except for passing reference in chapter 1), because as mentioned earlier, this subject has been examined in depth recently (Sukhatme and Parikh 2002).

The first chapter attempts to bring out the present status with regard to Indian women studying science at graduate and postgraduate level. Most of the data have been sourced from a recent UGC report. Unfortunately, UGC report clubs all natural science subjects (biological, chemical, physical, maths) and hence it is not possible to find out discrete trends. Attempt has also been made to get some idea of percentages of women working at faculty and technical levels in different government supported science institutions, as well as some universities and the kind of recognition they get in terms of awards and fellowships. These data are rather incomplete and do not give estimates of women engaged in teaching at undergraduate level.

The second chapter is based on a study conducted by the Research Centre for Women's Studies (RCWS), SNDT University, Mumbai, headed by Dr. Veena Poonacha to find out the factors which influence science career for women. Structured pre-tested questionnaires were administered to 149 women scientists from different institutions and university departments, as well as 146 postgraduate students, mostly doing research for Ph.D. degree. Focussed group discussions (FGD) and in-depth interviews were also conducted to supplement the information obtained through the questionnaires. Despite the limitation of sample size, the combination of these two methods does provide valuable insights in to the problems faced by women in science. These, besides other inputs have formed the basis of the recommendations made in the final section. SNDT has also done an analysis of science policies and detailed discussion on this aspect can be sourced from the SNDT report.

Study of Science by Indian Women

Data reported in chapter I suggest that the trend of science losing out to other disciplines like commerce (computer science, management) seen in 1970s and 80s might have been arrested and there seems to be no attrition in university enrolment- in fact a marginal increase in recent years (1995-96 and 2000-01) (Chapter I, Tables 3, and 4). No comment can be made regarding the quality of students who opt for science. While it is heartening to find some increase in the percentage of women studying science over time, the numbers are still small compared to men, particularly in engineering and agriculture/ veterinary sciences. In some universities like Goa, Kerala, Punjab and Pondicherry more than 50% of students studying science in university are women (Chapter I, Table 6). One wonders what happens to all these women? Is study of science just a passport for marriage? The increased proportion of women in science particularly

at the post-graduate level (Chapter 1, Table 5)- is a trend different from that seen in developed countries. It may well be due to more men than women opting for job-oriented disciplines like engineering, computer science, management etc. after graduation. Women may persist for lack of better option.

Though the sample in Chapter II is small the study does cover a wide geographical area. A special effort was made to include remote areas like northeast, and smaller towns like Aligarh. The effort of SNDT University is to be appreciated. The findings do show that in India the study of science by women is very much a privilege of the urban women from upper casts, who are probably better off financially and whose family back ground is more education oriented. Such elitist trend is also seen from smaller numbers of respondents coming from smaller towns, and vernacular language schools.

Special effort is needed to make science education accessible to this under-represented category of students.

While the status report given in the first chapter, does not give a break-up of different natural sciences, the data given in chapter II does show clustering of women in biological sciences. This, according to some respondents in the focus group discussion, is a matter of conditioning and mindset. The present study did not include pre-university students. However, an elaborate study reported by Mukhopadhyay (2001) on pre-university Indian girls and boys (discussed later) also reiterates this point.

It is heartening to find that both scientists and the postgraduate science students who were interviewed through the questionnaire said that their selection of science, as a career option was a conscious choice. While 59% scientists selected science as a career in high school, only 28.6% of students could decide at that stage. The reasons for this difference need to be examined. It is possible that 'practicing' scientists represent a more 'filtered', determined lot who decided on their career early, whereas students include many fence- sitters who would eventually drop out.

It is also encouraging to find that less than 10% scientists and students were discouraged from taking science. Here again it has to be remembered that these are the selective privileged individuals who have been able to opt for science. Many who did not may not have been encouraged. Besides self-motivation, parents and teachers provided the maximum encouragement. In the focus group discussion, the financial problems confronting women pursuing science were emphatically stated. Entering IIT is a very costly affair both in terms of appearing for the competitive exams, and subsequent fees, and only well-endowed families would care to give their daughters this option. With the present day policy of privatisation and globalisation, study of science is going to be more and more expensive, and the axe will fall on females.

Some support systems by way of fellowships, and opportunity for tutorials for girls would have to be considered.

An important question pertains to factors, which influence high school students' choice of subjects at university level. Do biological, differences between genders in terms of aptitude operate or are there only societal and cultural mindsets that act as filter? Are the female students who select science, different in terms of attitudes, aptitudes and scholastic performance, from those who prefer other subjects? What is the interplay between students' own choices and other factors like societal and family compulsions, stereotyped attitudes towards genders, and opportunities as determined by affordability for, and access to science courses? Are their cross-culture differences in science gender gap or is their commonality in the factors that operate across the cultures? These are

important but difficult questions requiring sophisticated well-designed studies, using culturally suitable instruments. Many social scientists and anthropologists from the west have attempted to do such studies in their cultures, but little information, if any, is available from countries like India. Recently Carol Mukhopadhyay of the Department of Anthropology, San Jose, California has examined the 'Cultural context of gendered science: with India as the case study' (Mukhopadhyay, 2001). An ethnographically-grounded, culturally contextualised, student academic decision process questionnaire (SAQ) was constructed and administered to linguistically, regionally and socio-economically diverse male and female pre-college students in four Indian cities—Bangalore, Hyderabad, Chennai and New Delhi. In addition, four 'survey' type Western methodology based math and science attitude questionnaires, suitable for cross –cultural comparison were adapted to Indian scene and administered to portions of the pre-college sample.

According to the authors there is an ongoing tension between the macro-structurally generated pressures that increase the desirability of education including science and technology education for women and micro-structural pressures that constrain women's education. Three major factors influence the overall gender disparity in education in India: 1) The emphasis on educational decisions as family decisions, guided by collective family concerns rather than individual decisions based on individual desires and goals; 2) gender-differentiated family obligations that produce gender differentiated educational expectations and goals for sons vs. daughters; and 3) family concerns with female chastity, marriageabililty and family honour that make the education of daughter socially problematic. These factors reflect and are derived from the 'patrifocal' family structure and ideology common in India. A 'patrifocal structure implies, subordination of individual goals to collective family welfare (patrilineality, patrilocal residence) which reinforce the centrality of sons and the peripheral status of daughters; gender-differentiated family responsibilities and activities, regulation of female sexuality through arranged marriages and restricted male female interactions.'

Since the daughters leave after marriage, their education has to be tailored to the opportunity of finding suitable husband rather than what they may want to do. These patrifocal pressures are more in families with limited economic resources, particularly since science education is more demanding in terms of time and resources, which are best saved for sons. Girls tend to select socially safer, less male-dominated and less occupationally lucrative fields, requiring less expenditure of family resources. Fields which will not threaten their future marriageability or their family's reputation. However, in families with no economic constraints, science education does carry a tag of prestige, and is considered desirable for both daughters and sons. Many families prefer an earning daughter in law.

A comparison of science-choosers and non-choosers by gender shows that science choosers regardless of gender come from distinct and socio-economically, educationally and culturally elite family backgrounds, - girls even more than boys. Science-choosing girls seem less patrifocally oriented than their female counterparts, especially on measures of future economic and natal family responsibilities. These girls show lesser interest in early marriage and want to work after marriage and help their natal family besides their own family. Girls with similar grades and equally positive math attitudes are more likely than boys to go into non-science fields, and attend lower ranked municipal schools. Among the students who were studying non-science subjects, like arts and commerce, females seemed to have better achievement scores.

Analysis of narrative vignettes from the SAQ suggest that science and gendered work have social context, social attributes, and social causality rather than biological, psychological or individualistic attributes. Students perceive scientists and engineers as beneficial to the society.

Results of three science attitudes questionnaires administered to grade VI students bring out interesting differences between Indian children and British children. There is less gender polarisation in the Indian than in the British data especially on science curiosity, and science activities. Both male and female Indian students are more engaged, curious about science and participate in more science learning – oriented activities than do British students. However, they tinker less and in less utilitarian ways, than British children. This perhaps is a reflection of Indian class and occupational structure.

Comparison of Indian and American 9^{th} and 11^{th} graders on the Fennema-Sherman Math Attitudes questionnaire also shows that Indians, particularly girls, perceive mathematics in a social context. Indian girls do not fear success nor do boys and girls think that girls are ill suited psychologically or cognitively for higher mathematics. In other words, Indian girls selection of subject is more socially influenced rather than any sense of inadequacy with regard to learning maths and perhaps other physical sciences.

In summary, in the Indian context, science especially the applied sciences and engineering is 'socially' rather than 'naturally' (biologically) or psychologically 'unsuitable' for many if not most females. The Western situation is different where there are ingrained feelings about girls being less suitable to study maths, physical sciences and engineering/technology.

An interesting case of the extent of such social conditioning pertains to the illustrations in the science textbooks recently published by NCERT (Mehrotra and Chunawalla, 2004). Very few illustrations show women, and the few that are there portray them in passive non-remunerative roles inside or outside their homes.

Right from school and college days, efforts have to be made to dispel gender-related differences in learning abilities.

Building Science Career

Data in chapter II suggest that getting the placement for research for students or the first job for the scientists seems to be less of a problem than what comes later in terms of gender discrimination. Only 8.8% of the students and 11% scientists mentioned experiencing difficulty in getting the first job. Since a parallel male cohort was not studied, it is difficult to say if men are more successful. Again it has to be remembered that these are the scientists and students who succeeded in getting job/placement and says nothing about the travails of those who did not get a job or placement.

Most (86 percent) of scientists, who were working, gave job satisfaction as the reason for taking up the job. Only 4 percent mentioned reasons like 'convenient location' and 'suitable for household responsibilities'. However, these were the lucky women whom circumstances allowed to combine home and profession; for large numbers they don't resulting in their opting out. In fact, effort to contact some of the women who had dropped out and make them talk proved to be a painful experience, because most did not even want to talk about their frustration (personal communication).

Majority (87 percent) of scientists said they specialised in the field they were in, out of interest. Other reasons being, job potential, family encouragement etc. Again 75% of scientists said they took the present job out of interest and 28% said 'to improve career'.

Only 4.7% quoted availability of financial help as the reason. Out of the 61 scientists who gave reasons for changing jobs, 39 said it was to improve career prospects. The rest mentioned family reasons and dissatisfaction with the job. The movement seemed to be more among those working in university colleges than those working in science institutions, suggesting perhaps better work environment in the latter. These responses would imply that women scientists, at least the privileged ones who have chosen and stayed in science career are able to derive satisfaction out of their jobs. Many women scientists who cannot combine the demands of home and research jobs might have settled for less demanding teaching jobs despite interest in research for family reasons, or worst still just discontinued.

Problems Encountered

Organisational practices

In the structured questionnaire, majority of scientists (87.9%) and students (76.9%), expressed satisfaction with working hours. Dissatisfaction tended to be higher among students, particularly in the university departments. Both the scientists and the students had to stay beyond working hours, but they did not seem to mind it. However, in the focussed group discussions, problems regarding women's mobility after dark in some of the troubled regions of the country, like the Northeast did emerge. In some places the supervisors ensure that the boys in the department escort girls to their hostels. Such problems would affect work out put of women more than that of men.

Many women suggested flexible working hours to enable them to do justice to responsibilities of work and home.

Only about 50% respondents were satisfied with the infrastructure, the dissatisfaction being more with the university departments than science institutions. Though, this may be a gender non-specific problem, men do tend to manage getting better facilities because of their contacts, and ability to network.

Only some women felt that they were being given additional work because they were women. Most did not. Majority of the students (76.9%) had no specific gender preference for their supervisors. Among the rest, slightly higher percentage (12.2%), preferred women supervisor then a male supervisor (8.9%). Most women scientists felt that the students did approach them as supervisors. There were many non-respondents to this question. Gender unfriendly rules, were also mentioned.

Gender –specific problems

Though in the structured questionnaire over 70% of scientists and students said they did not face any gender-specific difficulties, in the focussed group discussions, this did come up as problem. Many women have become so used to gender-specific problems and discrimination, that while answering a questionnaire they may not even think of them. In a group discussion, when issues come up, they realise and respond. This is the strength of focussed group discussions in social science.

Some students did mention difficulty in getting placement because it was assumed that females discontinue studies to get married. No objective data on gender differences in discontinuation rates are available. Men may also discontinue for different reasons. Among the specific problems mentioned were: Non-cooperative colleagues, gender discrimination in rules and practices and lack of facilities. Students tended to be more vulnerable. Women are seldom appointed to decision –making bodies, and when they are, they are not listened to. The more pliable women have better chance of being

appointed on committees. Some of this may be impression, but not all of it. Many women felt that they are being denied opportunity to attend conferences, receive travel fellowships etc. that would give them visibility. Conscious or unconscious gender blindness is a problem, which is seldom realised.

Special effort is needed to ensure that competent women scientists are invited to conferences, given visibility and appointed on decision-making committees.

Sexual harassment

This emerged as a major problem during focussed group discussion. Some students expressed that half their energy is spent in ensuring personal safety in terms of sexual harassment. There is no time or place for such misconduct, which assumes several dimensions, some of which are mentioned in the earlier section. Sexual overtures, sexually tainted remarks etc. are commonly experienced. Pregnant women are the worst targets. While some institutions have a grievances redressal cell, many don't. Often even if such a cell is there, women don't get to know about it. While the chairperson of such a cell is generally a woman, she may be helpless to take action if the offender is a man senior to her in administrative hierarchy. A higher level of redressal for such contingencies would be required.

A grievance cell for sexual offences and discrimination should be there at the institutional level with a possibility of referring certain cases to a central cell for redressal.

Career growth and recognition

Women face real problems when it comes to career growth after entering an organisation. This aspect is amply brought out from the numbers quoted in Chapter I (Table 9), the study of Kumar (2001) and the responses of women scientists discussed in chapter II. Sexual nepotism is a worldwide phenomenon. Women tend to stagnate in lower positions such as lecturers/assistant professors. Productivity as judged by publications tends to improve with position because of better access to grants, students etc. Women who stagnate at lower positions don't have this advantage.

Data in Chapter I also show that women seldom get awards or fellowships. Not all of it can be due to their scientific achievements. In INSA, e.g., even in sectional committees for plant sciences, biochemistry, molecular biology etc. where women's presence is substantial, only 1 woman each is a fellow. In physics, 30% scientists are women (Godbole 2002), but only 2 women physicists have been elected as INSA fellows. Medical sciences and animal sciences have done much better. Not a single woman engineer has been elected.

Only conscious effort to overcome gender-based prejudices, can remedy these problems. Inclusion of more women in selection committees may help.

Coping with Career and Home

While many women do receive encouragement and support from their families, the familiar complaint of families treating girls differently from boys and giving them lesser opportunities came out strongly in FGD. Most women did feel that their work came in way of their ability to look after the home at least to some extent.

Some flexibility in rules and support systems like crèches, flexible timings, part time jobs were suggested.

DST has recently initiated a scheme, which attempts to re-employ women whose careers have been interrupted due to movement of their husbands, by offering a fellowship and research grant provided they can get a placement. Two thousand women responded to the first advertisement, out of which 1100 were from Life sciences. In each subject 9-10% got selected except life sciences where 6% got in (Indira Nath, personal communication). The numbers speak for themselves and bring out the magnitude of the problem.

Problems With Policy

Male-centric mindsets have failed to address the issue of purpose of women's education- particularly science and technology education. Several committees and commissions have been constituted to find out ways of reducing the gender gap in education, but these committees and commissions have ended up reiterating the importance of traditional gender roles for women. According to Poonacha and Gopal (SNDT report, 2004) these bodies 'reveal hesitancy in defining the aims of women's education, and seem to be caught up in contradictory value systems while defining the purpose of female education. The only dissenting voice had came from the Hansa Mehta Committee report of 1962 which stated that the so called psychological differences between the sexes arise not out of sex but social conditioning. However even this committee back tracked and added that as social transformation could not take place overnight, there was a need for some time to accept certain gender differentiations in the roles played (Mishra, 1966). The National Policy on Education (better known as Kothari Commission Report) also looked at women's education as a means of social transformation, but not as an intrinsic value or right. The report talks of scientific advancement and scientific temper, but fails to examine the need for including various marginalised groups in the process of development. The goals of education and realising excellence in science and technology, was not seen to be concomitant with the constitutional goals of equality.

Thus it appears that the societal brain washing is so deep rooted that a frontal attack is needed to change the mindsets of even the policy makers. This calls for improving dialogue with feminist social scientists with a discerning eye to identify problems and suggest solutions. Male-centric decision making bodies in science have often worked against women and science and technology has hurt rather than helped women. Classical example is the attitude towards reproductive health and family planning policies in this country, which over emphasise female contraception, without giving sufficient thought to how it would affect female health and psychology. Ultra sound technology has been used for prenatal sex determination and abortion of female foetuses. Technology has often worked against females. Greater inclusion of women in decision making bodies may bring a different perspective to the development goals of the country, and direction of scientific research since women may have a better

sensitivity to ecologically balanced development, rather than just blind pursuit of economic gain for a few.

Recommendations

To get more women in science, the problem of gender gap in education at school level has to be addressed. This however is beyond the scope of this report. The recommendations that follow pertain to attracting more to study science, and later practice science.

A. Special Programmes to Encourage Study and Practice of Science by Women		
	Recommendation	**Implementing agency**
1	Special merit scholarship for girls studying in government schools to take up science. Science education is becoming increasingly expensive due to privatisation, and axe will fall on girls.	NCERT
2	Travel support to girls from poor families and one escort when they come to city to write competitive exams.	NCERT
3	Opportunities for placement for girls especially from small towns and government schools to do summer projects in good laboratories.	DST, CSIR, ICMR, DBT etc. and Science academies.
4	Opportunities for science teachers from colleges to do short term research projects. Special leave with pay if they want to do Ph. D.	UGC, DST etc.
5	Role model programme. Fellowship to eminent women scientists to visit, give lectures, and interact with students and teachers in universities.	UGC, DST etc. and Science academies
6	A Web site and a directory of women scientists, giving professional profile. This can be used to identify speakers for conferences, appointment to committees etc	DST, Science academies.
7	Opportunity for women who have suffered a break in career to return to science career. More programmes like the one DST has stated.	Science agencies, academies.
8	Articles on achievements of women scientists	Journals like Current Science etc.
9	Gender sensitisation programmes in all institutions	

B. Steps to Reduce the Stress on Women Scientists and Students, and Facilitate Study and Practice of Science by Women.		
1	Flexible working hours, and part time jobs	UGC, Institutions
2	Facilities like crèche, day-care centre for the elderly, campus housing, transport, proper toilets, ladies rooms etc	As above
3.	Age relaxation in recruitment, and 2 mid-career breaks	As above
4	Paternity leave for the father only if there are small children to care for.	As above
5	Freedom for husband and wife to work in the same institution	As above
6	Transfer to enable the wife and husband to work in the same city.	Science agencies
7	'Grievance cell' for gender-related and sexual offences at the level of the institution as well as at a higher level.	UGC, Science agencies.
8	Inclusion of women in selection and other policy making committees	As above
9	Transparency in the process of selections. Reasons for rejection should be included. Performance assessment for a woman should be done on the basis of years spent in professional life, rather than biological age.	As above
10	More rigorous effort to identify meritorious women and objectivity in selection for fellowships and awards, as well as invitations to speak in conferences.	Academies, awarding agencies
11	Ensure gender neutrality in the illustrations in science textbooks. Stereotype roles of women inside the house doing domestic work and men engaged in scientific work should not be portrayed.	NCERT

Alas- INSA may not be able to help change the 'patrifocal' mind-set of society, which has become part of human psyche, however, responsibility to implement some of these recommendations can be undertaken by INSA as a part of its commitment to bring in gender-equity in Science.

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Executive Summary

All over the world, socio-economic and educational status of women is inferior to that of men. The situation is much worse in developing countries like India. Amongst the educational streams, women seem to be missing out on science, particularly physical sciences, engineering and technology. What is even more worrisome is the fact that many women after studying science, fail to persevere with a career in science (practice science), making a mockery of the educational inputs. The Indian National Science Academy (INSA) constituted a committee to examine this phenomenon and suggest corrective measures. The present report deals with the committee's findings and recommendations.

The first chapter examines the relatively current status of `Study and practice of science' by Indian women. Secondary data sourced from reports and records were used. The second, rather large chapter deals with `Factors influencing science career for Indian women'. It is based on a study conducted by the Research Centre for Women's Studies, (RCWS), SNDT Women's University, Mumbai on women scientists and post graduate science students spanning over several universities, and institutions across the country. The general discussion and recommendations reported in the third chapter are based on the above studies as well as other reports from India.

Study and Practice of Science by Indian Women.

Unlike in the west, in India, the educational pipeline leaks most heavily at the school level. There is higher drop out of girls as compared to boys from the primary to secondary stage. Though there is an overall drop in the number of students enrolling for higher education, the proportion of females at the high school level compares well with that at the university enrolment stage, suggesting that improvement in numbers of girls entering university may be achieved by preventing the secondary school drop out rate. Presence of women in subjects like agriculture and veterinary science, besides technology and engineering is very poor. However regional differences in college enrolment exist. There is evidence of the `glass ceiling' for women in terms of opportunities for academic advancement. Thus employment opportunities and career growth for women in national laboratories and good universities are limited. Few women receive recognition through awards and academy fellowships. Bias against women leading to the much talked about `glass ceiling' does operate and needs to be addressed in practical ways.

Factors Influencing Science Career for Women

This sociological/behavioural aspect was examined using structured questionnaire as well as focussed group discussions and in depth interviews with women scientists, and postgraduate science students from universities as well as government institutions. The regional spread was: Mumbai, Pune, Nagpur, Akola, Shillong, Gauhati, Delhi, Aligarh, Bangalore and Hyderabad. Though the sample size was only about 300 (maximum responses being from Mumbai and Pune), the combination of methods used makes the findings valid.

Majority of the respondents were from urban Hindu forward- cast families, from English medium schools. Over 90% respondents opted for science out of conscious choice. Besides self-initiative, maximum encouragement came from parents followed by teachers. In the cohort examined, only 13% scientists and 10% students said they faced

difficulty in finding the first job/placement. However, problems started after that. Many complained of gender- insensitive organisational practices and work place discrimination, which came in way of their career growth. There was a strong expression, particularly in the focussed group discussions of gender-related discrimination, nepotism and sexual harassment. Many scientists (35.7%) said they had denied themselves career options and 22.7% said that such denial had adversely affected their career. It may be pointed out that these are the relatively fortunate women who had managed to combine carer in science and home. Many others would have fallen by the way side being unable to cope with the triple burden of home, work and societal prejudices including gender-related nepotism. Indeed attempt was made to interview women scientists who had to give-up career for a variety of reasons, but these women did not want to talk, the experience being very painful. In some troubled areas like the northeast, women's mobility is curtailed for reasons of safety and that has adverse impact on their productivity.

While the women did not ask for any special personal privileges, they did want better supportive facilities like crèche, day care centre for elderly, flexible working hours, part time jobs, campus housing, etc. which would reduce stress on them and their families. Some organisations ban husband and wife working in the same institution and that has affected career of many women. Representation of women in policy- making, as well as selection committees was also suggested. Currently few women are considered suitable for being on committees.

In the present study, school students were not included. But in another very detailed study in India conducted by Mukhopadhayay, reasons for girls not opting for science, particularly physical sciences, mathematics and engineering were examined. Interestingly, no gender differences in aptitude, or natural inclination for these subjects was observed. Societal mindsets and pressures, particularly in patrifocal families, determined the ultimate preference and educational path of women.

Socio-economic pressures also play a major role in the college education for girls vs. boys. With increasing privatisation of education, this kind of pressure will increase with greater marginalisation of girls from science education. An interesting study, from Mumbai brings out sexual stereotyping in terms of gender roles depicted in the illustrations in science textbooks, published by NCERT.

Based on the data collected under the guidance of this committee and taking into account reports from other similar committees, a list of recommendations has been put together. If implemented sincerely, the Committee feels these recommendations would have significant impact on improving the status of women in science in India. These have been grouped as 1) facilitating programmes that would attract more girls/ women particularly from under-privileged classes into science, and help their retention in science career, and 2) support systems to reduce the stress on women scientists and students.

Women's presence in science is advantageous for the society at large. In addition to women bringing in a gentler, and more humane perspective to scientific research necessary for sustainable development, loss of womanpower from science is a major loss of trained resource, which can be difficult to compensate even in financial terms –a point that the society and the polity should remember.

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