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 socioeconomically 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, patrifocal 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.

Special Programmes to Encourage Study and Practice of Science by Women Recommendation Implementingagency

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.
2 Travel support to girls from poor families and one escort when they come to city to write competitive exams.
3 Opportunities for placement for girls especially from small towns and government schools to do summer projects in good laboratories.
4 Opportunities for women science teachers from colleges to do short term research projects. Special leave with pay if they want to do Ph. D.

5 Role model programme. Fellowship to eminent women scientists to visit, give lectures, and interact with students and teachers in universities.
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
7 Opportunity for women who have suffered a break in career to return to science career. More programmes like the one DST has started.
8 Articles on achievements of women scientists Life histories of successful past and present women scientist should be chronicled
9 Gender sensitisation programmes in all institutions, including schools.

NCERT DST, CSIR, ICMR, DBT etc. and Science academies. UGC, DST etc. UGC, DST etc. and Science academies DST, Science academies. Science agencies, academies. Journals like Current Science etc. Project for a suitable organisation

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
2 Facilities like crèche, day-care centre for the elderly, campus housing, transport, proper toilets, ladies rooms etc
3 Age relaxation in recruitment, and 2 mid-career breaks
4 Paternity leave for the father only if there are small children to care for.
5 Freedom for husband and wife to work in the same institution
6 Transfer to enable the wife and husband to work in the same city.
7 'Grievance cell' for gender-related and sexual offences at the level of the institution as well as at a higher level.
8 Inclusion of women in selection and other policy making committees
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.
10 More rigorous effort to identify meritorious women and objectivity in selection for fellowships and awards, as well as invitations to speak in conferences.
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.

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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.