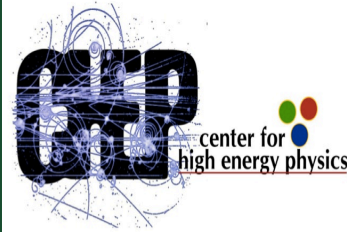


Gender Equity in STI ecosystem and its importance for Indian Science and Development



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January 5, 2023

108th Indian Science Congress

PLENARY SESSION

“Harnessing Women Scientist Talent Pools For India’s Science and Technology Growth Towards Achieving SDGs ”



ISCA 108 theme

**Science and Technology for Sustainable
Development with Women's Empowerment**

Plan of my talk

- 1) Role of Gender **equality** as an indicator and facilitator of development.
- 2) Specialise to the case of gender mainstreaming in Science : status of **gender (in)equity** in India and desirability of **equity**.
- 3) Causes: **Obvious** and **hidden**. Focus on the hidden ones: **Invisible and Unconscious Bias**
- 4) **Action plan** : Need of the hour is to go beyond the obvious steps that have been taken so far!

.

The 17 sustainable development goals (SDGs) to transform our world (2015) :

Goal 1 : No Poverty

Goal 2 : Zero Hunger

Goal 3 : Good Health and Well Being

Goal 4 : Quality Education

Goal 5 : Gender Equality

...

Goal 13 : Climate Action

Gender parity and development

Many examples of Gender parity affecting development. A recent report from Mc Kinsey Global Institute report on Covid and Gender parity in work force : An improvement in parity from current 0.61 to 0.67 will lead to increase in GDP by 9 trillion dollars in 2030 whereas an increase to 0.71 will lead to increase by 14 trillion dollars.

Mainstreaming Gender in all walks of life essential : not alone for the sake of social justice and bettering the lot of the women, but also for the sake of development. Said much better by none other than Prof. Amartya Sen!

Gender Equality (Equity) feeds in positively in achieving a number of other Sustainable Development Goals . So in that sense 'Gender Equality' is much more than just the goal # 5 among the SDG!

A plot from the McKinsey –Global-Institute-Report (2022).

Exhibit 3

Taking action now could increase 2030 GDP by \$13 trillion relative to the ‘do nothing’ scenario.

**GDP impact to 2030,
\$ trillion (2019)**

“Do nothing”
Gender-parity regres-
sion due to COVID-19¹

–1

“Wait to take action”
Delayed gender-parity
improvement²

8

“Take action now”
Gender-parity best-
in-region improvement³

13

**Female to male
employment
in 2030, ratio**

Parity

0.61

Parity

0.67

Parity

0.71

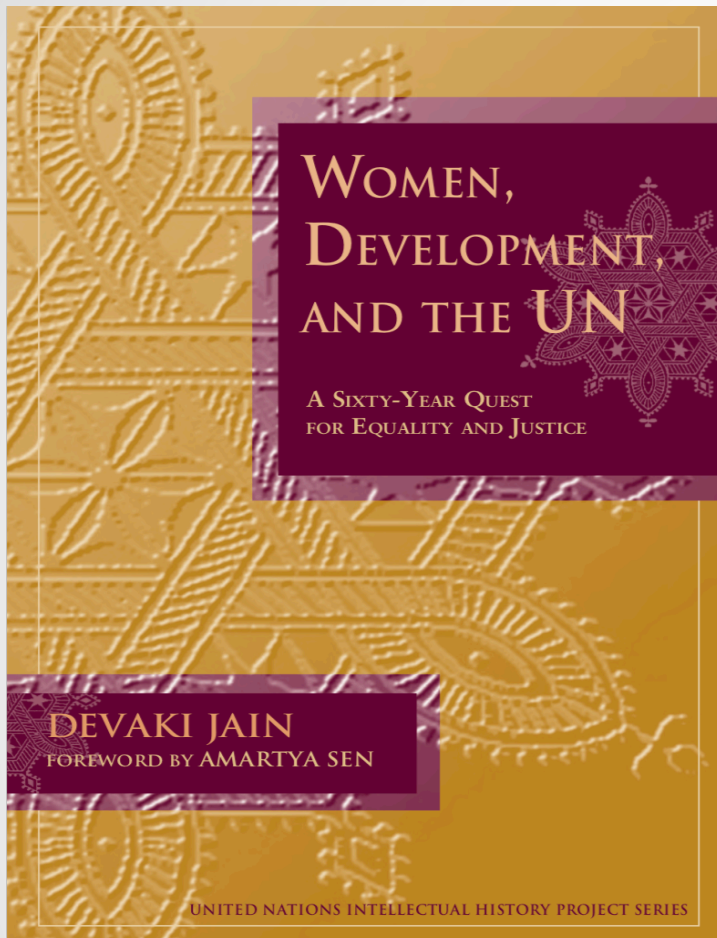
¹Based on factoring in impacts from differing industry mix for men and women, as well as other factors that could affect female employment. Compared with a baseline in which women see no disproportionate impact compared with men in each sector.

²Improved using best-in-region improvements, which means every country achieved the fastest rate of progress in its region on 3 key gender gaps: workforce participation (~60% of impact), part- and full-time mix (~20%), and sector mix and productivity (~20%), starting in 2025.

³Same as 2, starting in 2021.

Source: ILO; McKinsey in partnership with Oxford Economics; McKinsey Global Institute analysis

Gender Diversity and Development : *Words of the Master*



Amartya Sen (in the foreward to this book, 2005)

“The focus of women’s movement initially was mainly on women’s *well-being,.....*”

However, over the years, the aims and objectives of women’s movements have gradually evolved and broadened from this “welfarist” focus

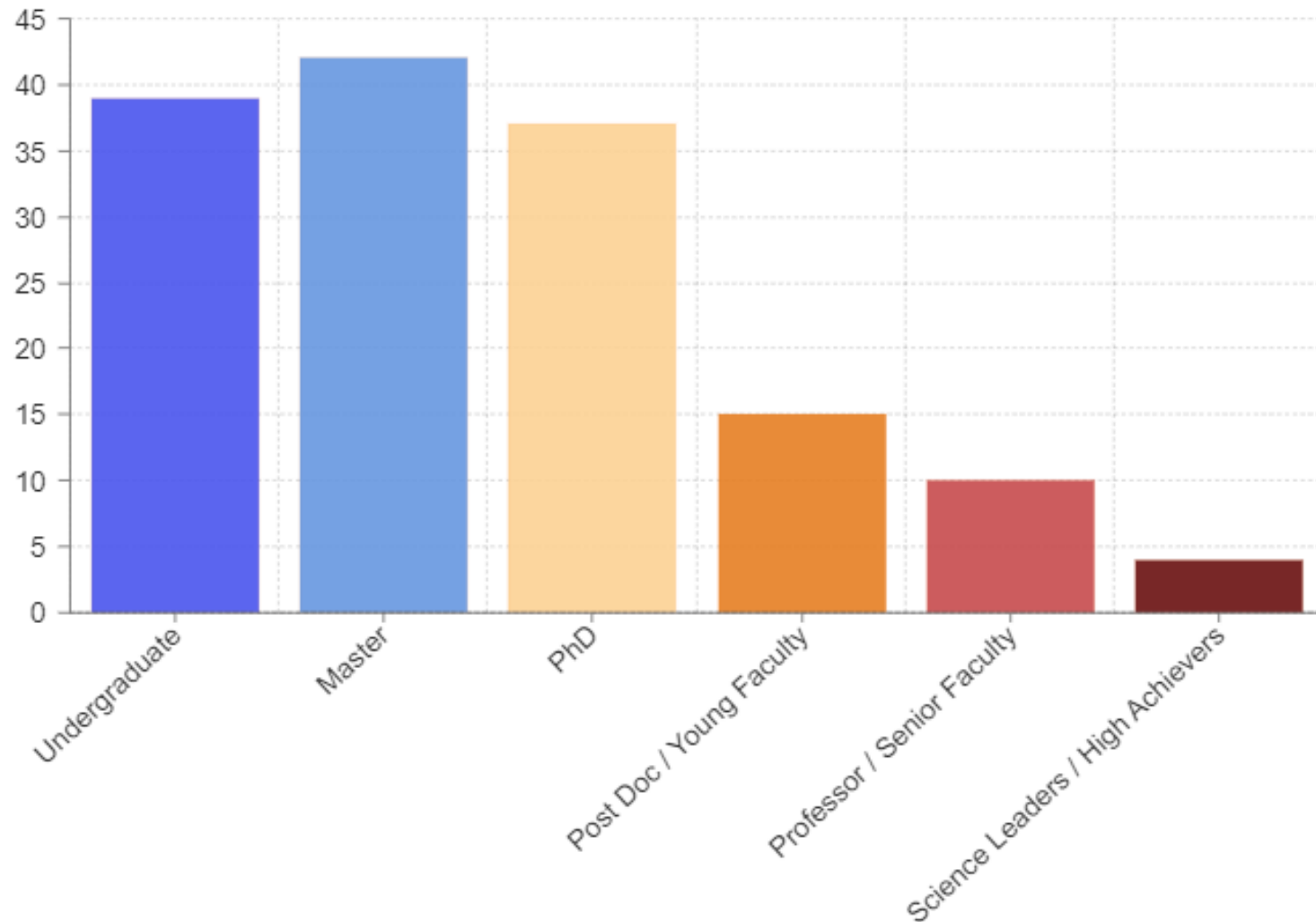
No longer treated as the passive recipient of welfare-enhancing assistance, women are increasingly seen as active agents of change and as dynamic promoters of social transformation that can alter the lives of *both* women and men. “

WiS and theme of today's symposium

Given : In general, basic science progress impacts development in many different tangible and intangible ways.

To the extent gender (in)equity impacts progress of science a discussion of 'Gender (in)equity in Science' then belongs very much in the theme of the symposium today.

Just like Amartya Sen has said, do not think of all actions in the context of Women in Science (WiS) as 'help' to women for realizing their potential and their 'empowerment' but more of its impact on the processes of promotion of science and resulting 'empowerment' of Science and Technology.



WiS : Indian Story, the big fall!

Real data available.

Women in science : India

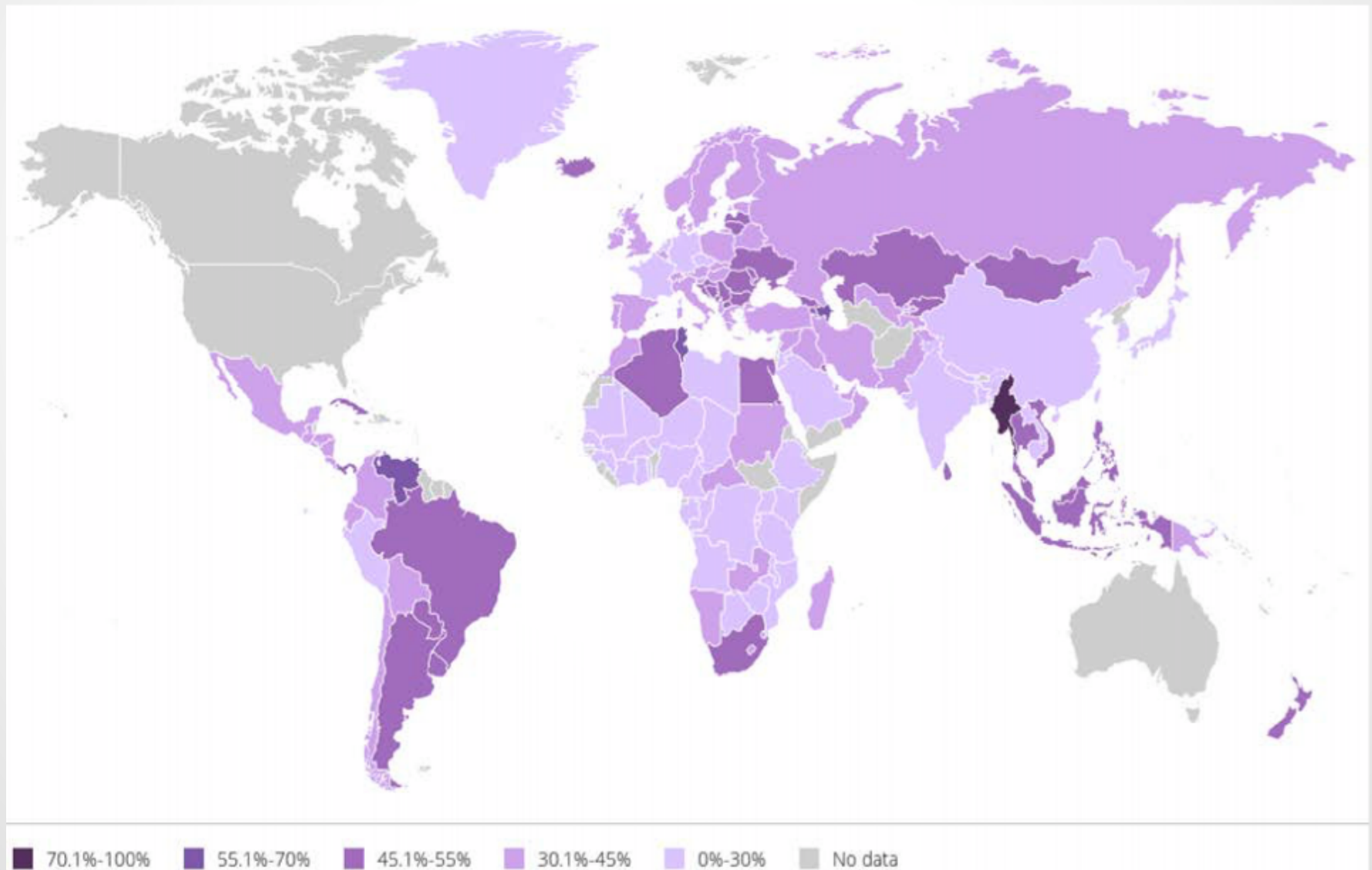
In India the participation of women in ***studying science*** or for that matter in ***teaching science***, at all levels, is NOT LOW AT ALL.

However, number of women ***doing science*** is certainly NOT commensurate with their participation in the other two aspects of scientific activity.

Further it is even less when one considers decision making positions in this context.

Number of women in science in India is not small but surely the number of women in Indian Science is small

Unesco Institute of Statistics :
Women in Research: World average at 30%
India at 15% in the upper half of the lowest group.



Devil is also in the detail

Share of female students is lowest in Institutions of National Importance followed by Deemed University-Government and then State Private University (24.7% to 43%)

Similarly, the Gender ratio in Faculty is also more skewed as the Institutions' perceived level increases as well as the position in the hierarchy. (24 % to 15 % in professor's position for example).

Fraction of Women Professors, Directors, Deans, V.C.s etc. far from equitable! Not even commensurate with the small fraction present in research

Women's presence in the fellowship/awards etc. is also strikingly low.

Is this necessarily bad ?

Presence of women among practitioners of science is small across all sciences. Is that necessarily bad?

Yes. Matter of judicious utilisation of available resources! *It is certainly not the optimal use of humanity's intellectual potential.*

Any diversity can only be good for science, like any creative activity. Adds additional dimensions

(Social Science research available in the backup slides and also in M.

Nielsen et al 1740–1742 , PNAS, February 21, 2017 ,vol. 114 , no. 8)

Obvious Reasons

1) The ticking clocks:

The time period where one has to establish oneself in a research career and develop a niche is **ALSO** the time when biological clock is ticking.

Specific to careers of Women in Science.

2) Negotiating career and family balance :

Controlled by social conventions and expectations.

Expectations from the society, family as well as expectations from women themselves which are reinforced due to training.

Faced by women trying to mark their place in ANY field.

Is this all?

Perception:

**Sort these problems and all will be well.
In India,**

- **Policies exist to come back to a career after a break.**
- **Policies for flexi times.**
- **Encourage young girls to choose S&T**
- **Hold training programs for Women Scientists.....**

Reality:

These are necessary but not sufficient.

Invisible and Unconscious Bias

Biases about what women can do and can not do,
Biases about what women should do and should not do.

Impacts the mentoring we give to young women!
Impacts decisions young men and women take!

This can directly impact both the number of women that stay in S&T and what they can achieve

Almost all arise from (lack of) importance attached to women's participation in Science in the eyes of Society and scientists

Unconscious and/or Invisible Biases

Research over the last decades:

- 1) **Unconscious gender bias in hiring** (Corrinne Moss-Racusen) (Nature)
- 2) **Unconscious Biases in evaluation** (Wold and Wenneras) (Nature)

We need science to be meritocracy, in fact things should be decided by merit alone. Studies seem to indicate they are not! We as a community need to become aware of these biases.

- 3) **Unconscious bias in appreciation**

Bias in recognition:

Quoting from a book “Women of Science: Righting the Record”

Asimov’s ‘Biographical Encyclopedia of Science and Technology’ (1976) had 1195 men and 10 women. Out of the 10 women 5 were Nobel prize winners. Of course, half of 1195 men were not Nobel prize winners .

Obvious conclusion to many of us:
The bar for women to be included was **incredibly high!**

Of course, can not rule out the conclusion that women scientists though small in number are just incredibly more brilliant than men !!!! 😊

Bias in recognition:

Article in nature by Ben Barres (Prof. at M.I.T):

Does gender matter?

Nature, Commentary, Vol. 442, July 2006.

Wrote an article in Nature, in the aftermath of the famous statement by Larry Summers. I quote:

“Shortly after I changed sex, a faculty member was heard to say “Ben Barres gave a great seminar today, but then his work is much better than his sister’s.”

He/they further claimed “after the change of sex I could actually finish my sentence without interruption!”

Invisible and Unconscious bias

In fact ,even Royal Society acknowledges this on their webpage and describes its action plan against it!

A film 'Picture A scientist' brings this out through interviews and conversations. **(Available on Netflix).**

Suggestion: 'Introspect and autocorrect' for invisible bias! But this needs to be done by the science community at large.

Of course, that is not enough. We need to keep these things in mind while designing policies as well.

Invisible and Unconscious Bias

I can keep on giving examples, but that is not the point. Each one of us has to introspect ones biases which are set by experiences !

Even some of the abovementioned 'cures' to bring 'gender equity' still are affected by a bias that a career break is **inevitable** and achieving **family and career balance** is a woman's responsibility.

Women scientists who care about science as much as their family (a norm for male scientists) might **prefer** support structures which allow them to get over this speed breaker by slowing down and not by coming to a stop! Important to appreciate this while making policies.

STIP-2020?

Science, Technology and Innovation Policy (**STIP**) of India released in January 2021 has taken a big step by having a separate discussion of **E&I**

The discussion cuts across all issues ..previously one had a separate discussion for **gender equity** another for including **those on margins of society in the** march on path of science etc..

A holistic approach can take towards our aim perhaps faster and better.

Do not know when these draft policies will become policies!

Equally importantly we need in India more research on the science of 'Gender bias / Gender equity'.

All the studies I quoted were from outside. The issue of WiS has cultural, societal dimensions which will vary from country to country or society to society

(example: girls can not do / do not want to do math/computer science in the US. This is not true in India.)

Last word

The path to go to a situation when we will just speak of scientists/engineers and not their gender, surprisingly, goes through the path of being very aware of the same for a while! (R.G. Current Science Editorial)

All of us, individuals, society, and the governments need to work towards this.

We need 'women for science' and 'science for women'
The choice of the theme of this ISC certainly shows that steps in the right direction are being taken! Here is hoping that these add to the progress of both the science and development in India.

Last word

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Backup slides

What are the reasons?

There are some obvious ones and some not so obvious!

In India discussions have happened mainly on 'handling' the obvious ones. Need of the time is to now look at not so obvious ones!

Any way first let us see what the reasons are!

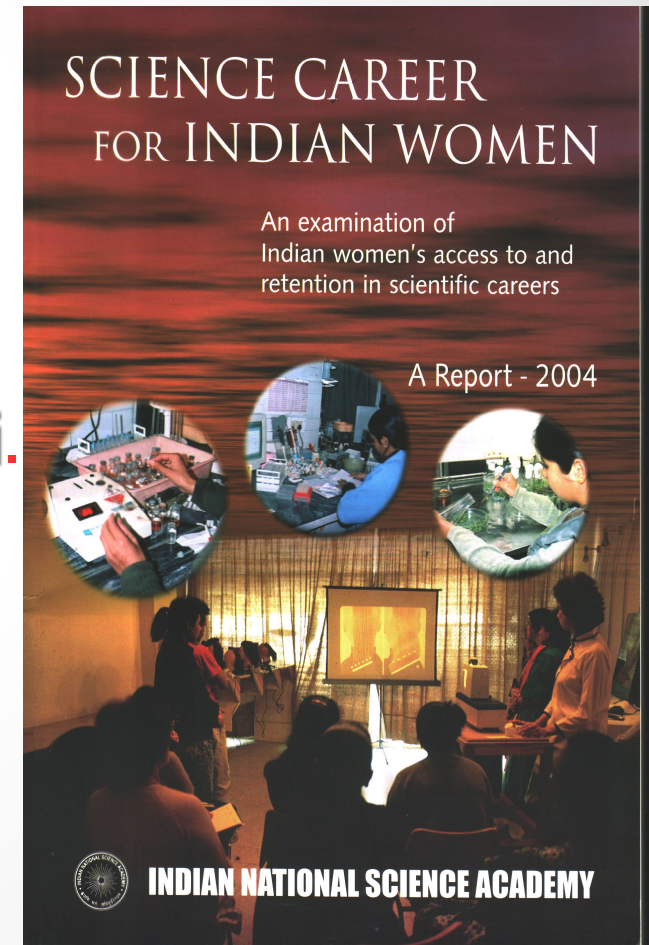
Sources for Numbers

1) A report brought out by the Indian National Science Academy (INSA) (**Mehtab Bamji, Rohini Godbole, Vinita Bal**)

The report (2004) led to formation of a DST task force for women in Science.

2) The DST Task Force report, **Ed: M. Bamji.**

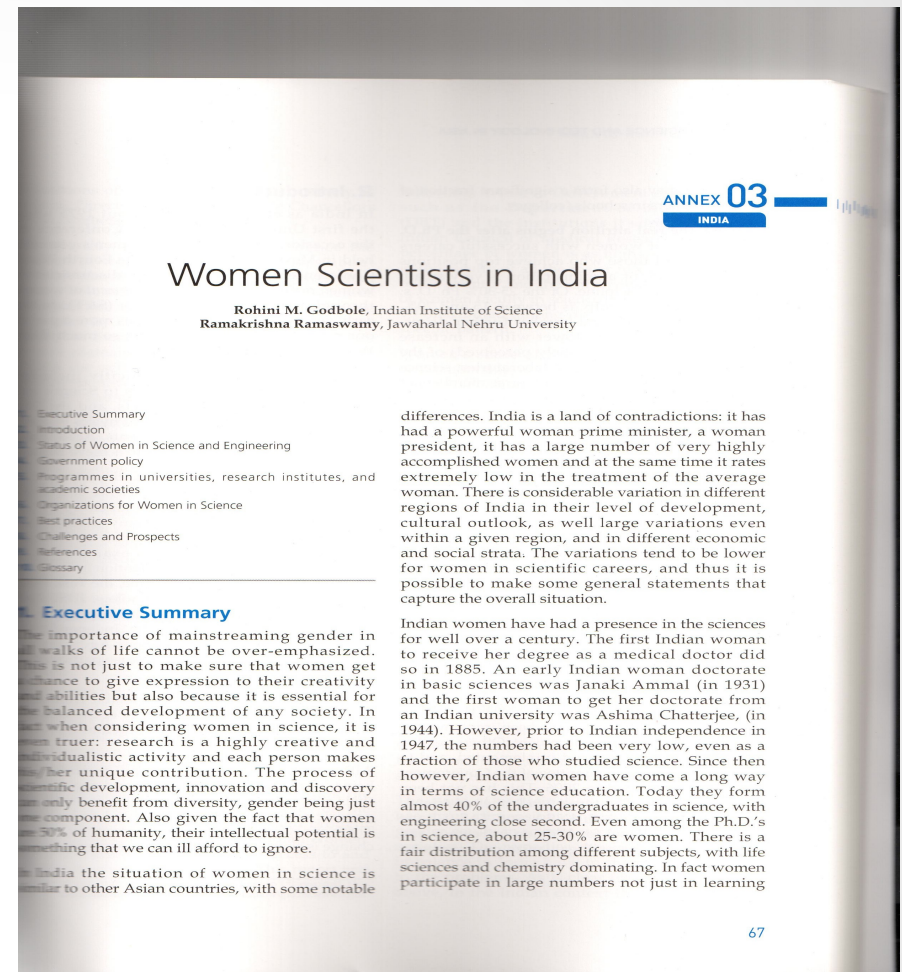
This led to the formation of Standing committee on WiS of the Govt. of India.



3) Some more recent reports :



*Association of Academies and
Societies of Sciences in Asia:
AASSA report (2015-2016)*

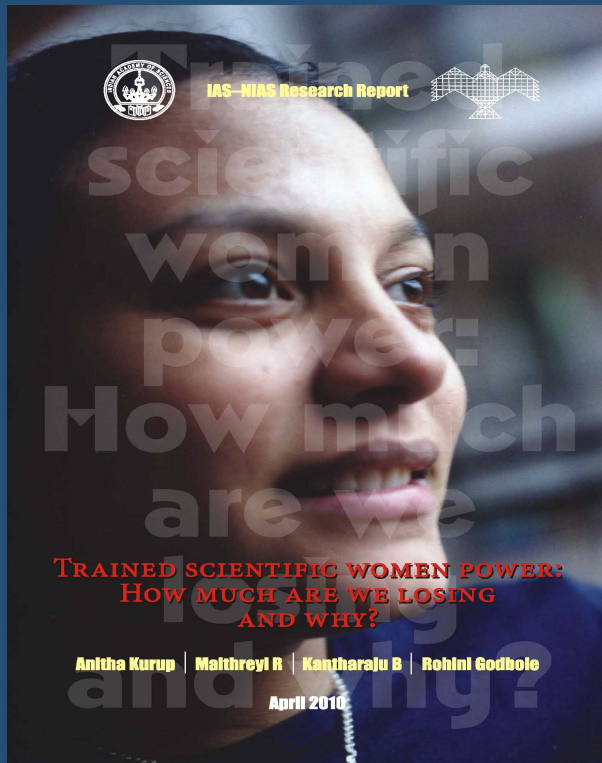


*India Report prepared by
Rohini Godbole and R.
Ramaswamy*

Why do we lose trained women? (Survey)

Survey report is available from the web page of the WiS Panel:

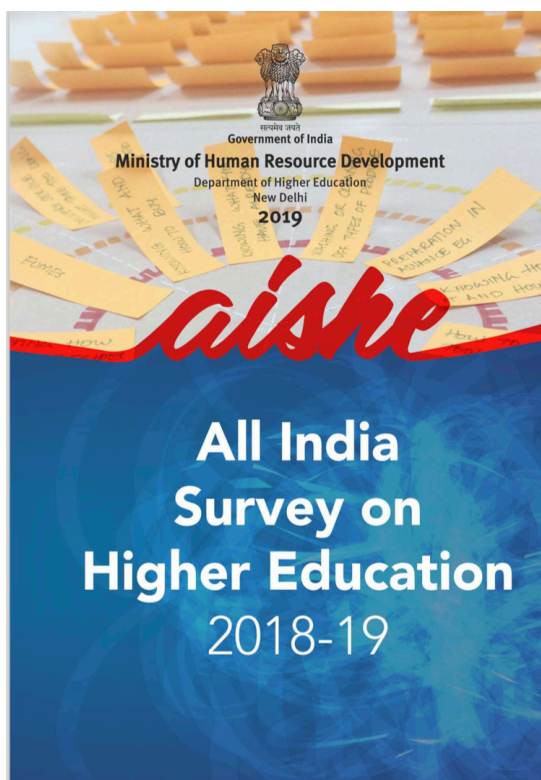
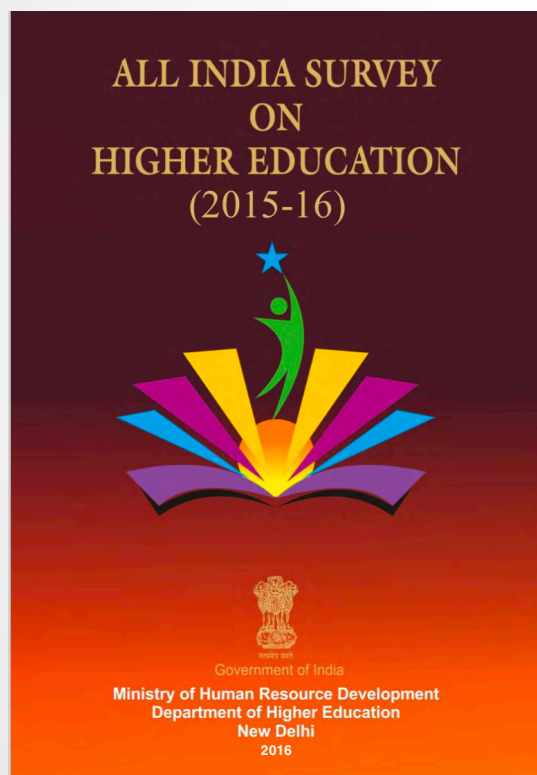
http://www.ias.ac.in/womeninscience/surveyreport_web.pdf (2010)



*Trained Scientific Woman Power:
How much are we losing and
Why? (Anitha Kurup, Maithreyi
B., R. Godbole et al)*

*A joint project between natural
scientists and social scientists.*

Sources: Current situation in Higher Education



Not only to be fair!

This tells that diversity is intrinsically good for science.

Makes pragmatic and economic sense!

Achieving equity and inclusion is not to be done ONLY with a sense of correcting a historical wrong.

Not to be looked as a charity to the poor women so that their creative abilities get expression.

This is something all of us need to appreciate when we think of the subject because our point of view affects our own response to the issue!

Plug the leak

Indian problem: Not just *development* of human resource
BUT ALSO human resource *deployment (for women)*

Apart from losing the **advantages** that **diverse** work force brings, this is **pragmatically also a** problem of **low return on investment**.

A country committed on path of innovation based progress can not afford this **‘brain drain’! Loss of trained scientific human resource needs to be plugged!**

How to measure and cure (in)equity?

Easy to see lack of diversity and equity in science.

I also argued why this needs to be cured!

How to cure things and How to judge what level of diversity and equity is correct? Is there such a thing as 'correct' level?

Lack of numerical representation is a symptom. Setting and achieving numerical targets is necessary but not sufficient.

One has to address the root causes.

One has to analyse the reasons!

Bias in hiring

Recent research:

In a randomized double-blind study ($n = 127$), science faculty from research-intensive universities rated the application materials of a student—who was randomly assigned either a male or female name—for a laboratory manager position. Faculty participants rated the male applicant as significantly more competent and hireable than the (identical) female applicant.

Corinne A. Moss-Racusin, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman.

Faculty from various depts of Yale university, article published in PNAS

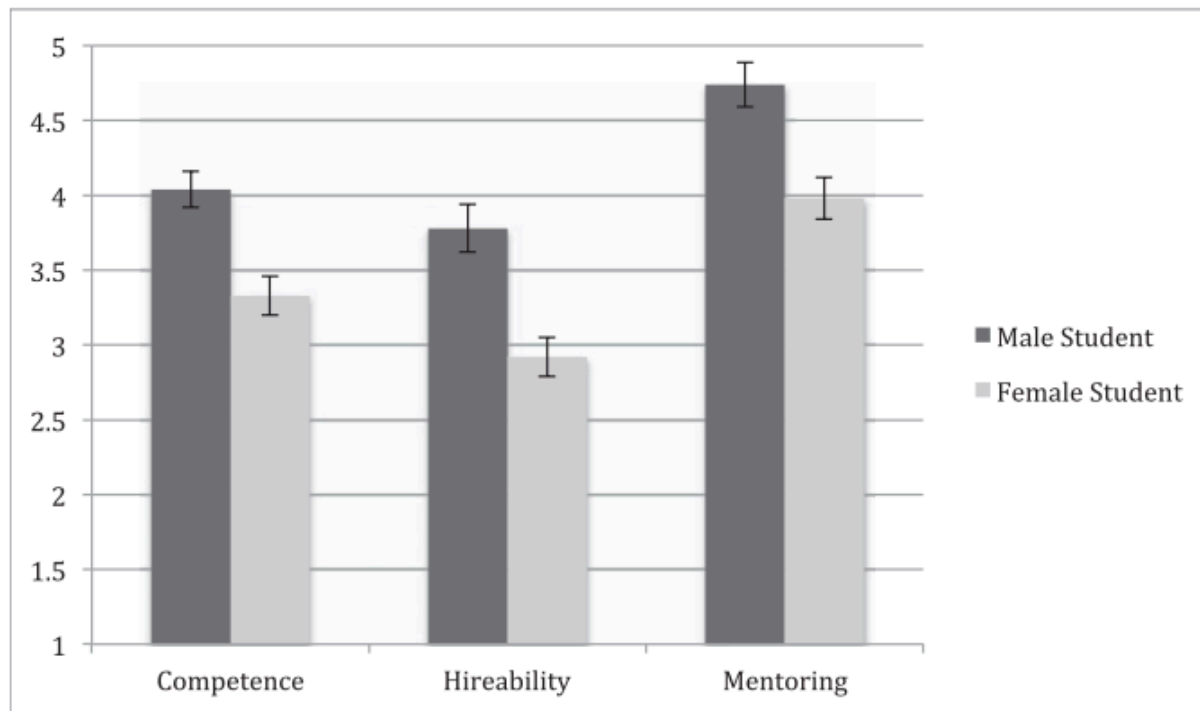


Fig. 1. Competence, hireability, and mentoring by student gender condition (collapsed across faculty gender). All student gender differences are significant ($P < 0.001$). Scales range from 1 to 7, with higher numbers reflecting a greater extent of each variable. Error bars represent SEs. $n_{\text{male student condition}} = 63$, $n_{\text{female student condition}} = 64$.

The higher scores for male student were independent of the gender of the evaluator. So, it is not a story of us vs them! (2012).

(PNAS , October 9, 2012 , vol. 109 , no. 41 , 16475)

Biases in evaluation, (Wenneras and Wold)

NATURE, VOL387, 22MAY, 1997,

Analysis of competence scores assigned to post doctoral applicants for a position in Medical biophysics in Sweden. The x axis was impact points computed from # of publications and impact factor of the journals.

Multiple regression analysis shows that the competence score is related not only to impact points but also to the gender.

Female applicant had to be 2.5 times more productive than the average male applicant to receive the same competence scores as the average male applicant.

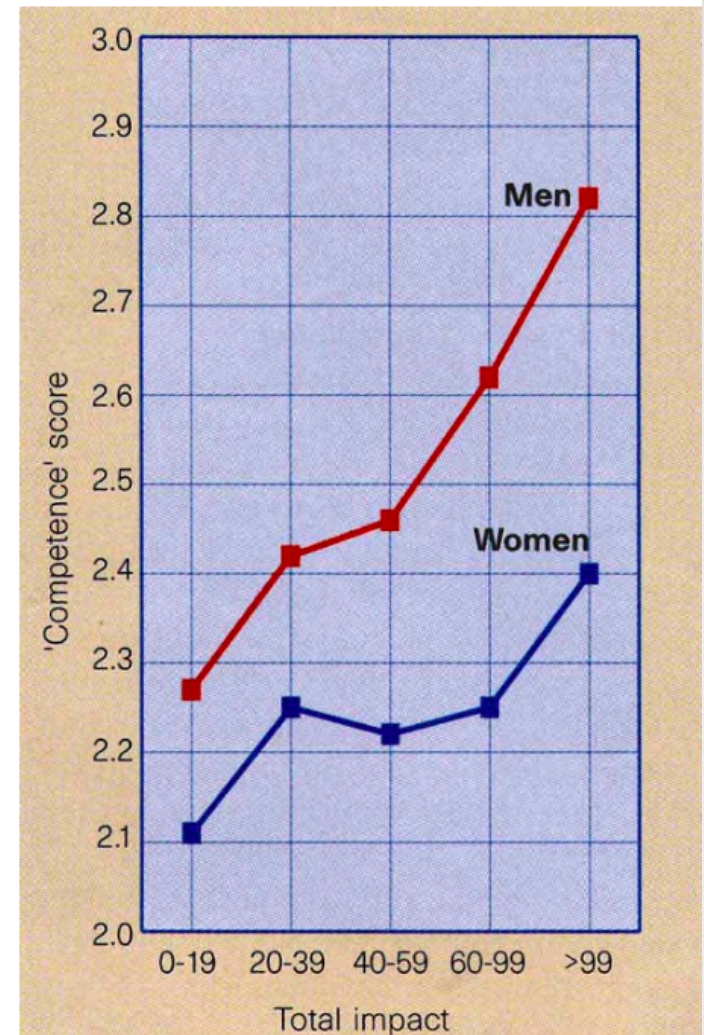


Figure 1 The mean competence score given to male (red squares) and female (blue squares) applicants by the MRC reviewers as a function of their scientific productivity, measured as total impact. One impact point equals one paper published in a journal with an impact factor of 1. (See text for further explanation.)

Gender differences in the reception of results of research on gender bias:

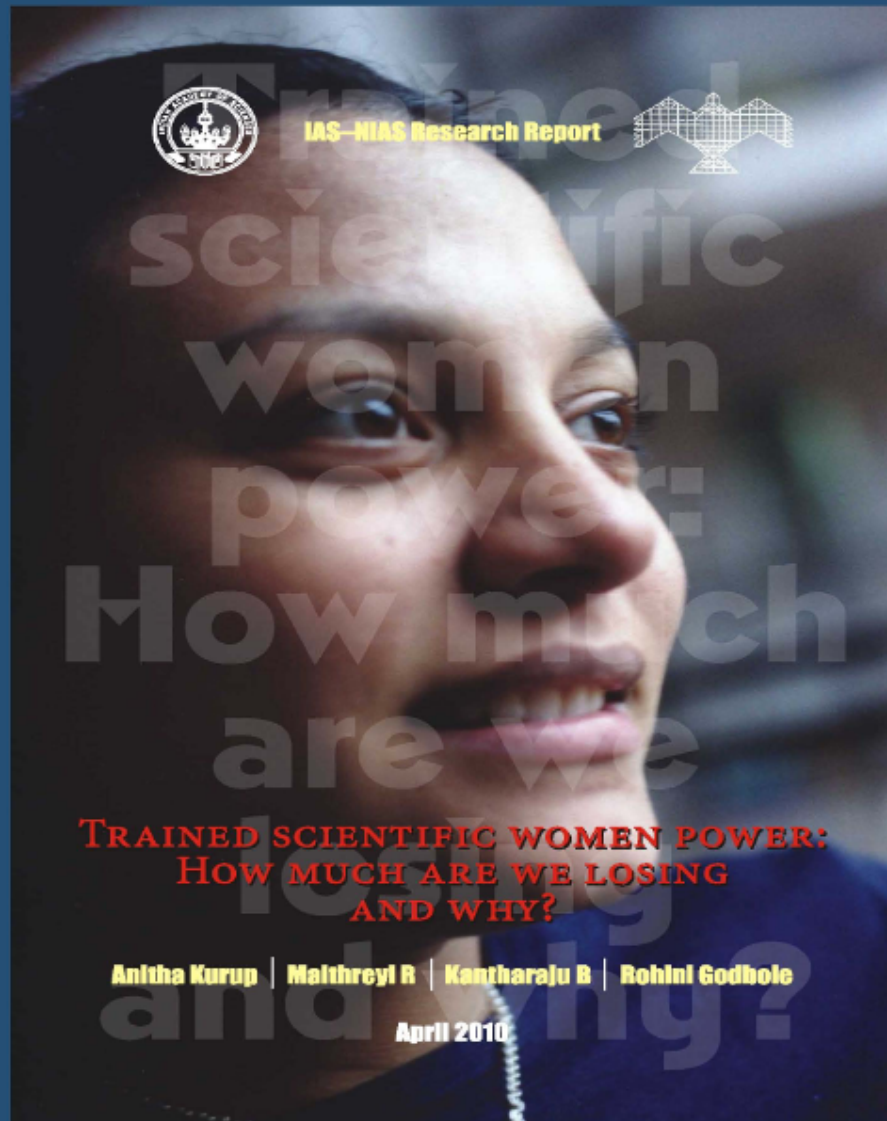
Ian M. Handley et al, PNAS, October 27, 2015 , vol. 112 , no. 43 , 13201–13206

“Results from our three experiments, using general-public and university faculty samples, demonstrated that men evaluate the quality of research unveiling gender bias as less meritorious than do women. ” (*Flip the result in the abstract and gender response also flipped*)

The authors correctly only claim that there is a gender difference as to how the research on ‘gender bias’ is perceived and received.

Non-STEM faculty did not show any such gender difference in their reactions.

Unconscious bias translates into visible obstacles



From:

Loss of trained scientific woman power: How much are we losing and why?

Interesting lessons learnt :

Biases are also a reason for the loss, not only the family responsibility!

More Invisible (not necessarily) unconscious Bias

Avoiding bias in hiring and evaluation for promotion is of course essential. Since the Bias is invisible Institutions need to take special steps. Eg. Consider academic age rather than biological. Avoid asking in interviews whether one is married and what are the plans of the spouse! (This should not be relevant for making a selection)

Managing dual careers:

Hiring practices make this management difficult

“we don’t hire couples together” Even future nobel laureates Rosalyn Yallow and Maria Goepert Meyer faced this.

Having avoided bias in hiring/promotion

Necessary to avoid (in) sensitivity to gender dependency of certain needs!

After hiring Institutions need to understand that some needs might have a gender dependency

Example:

Accommodation on campus: this was my own experience and even now continues for post doctoral positions quite often!

Also: Realising that child care can be an issue for students/PDF's too!

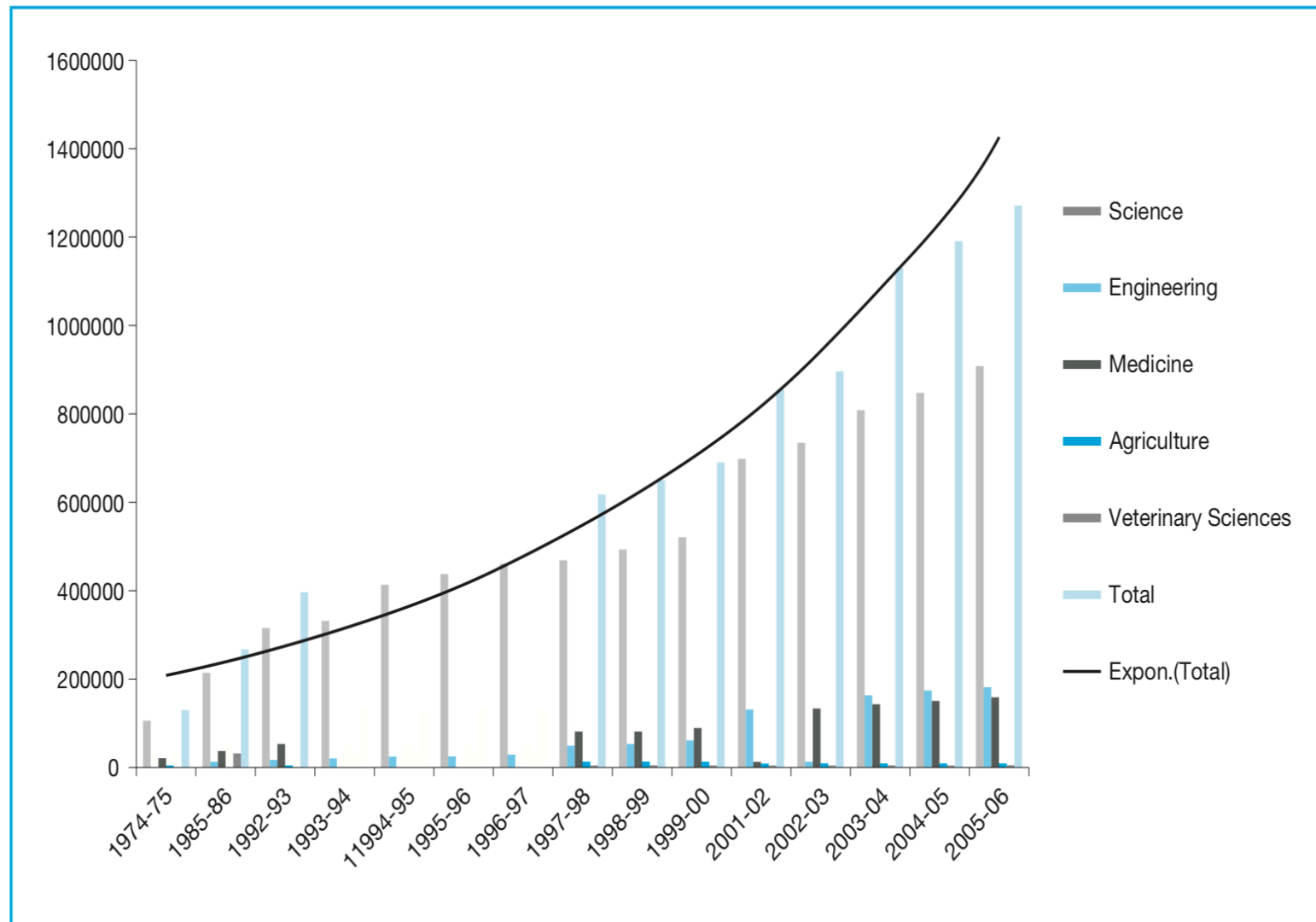
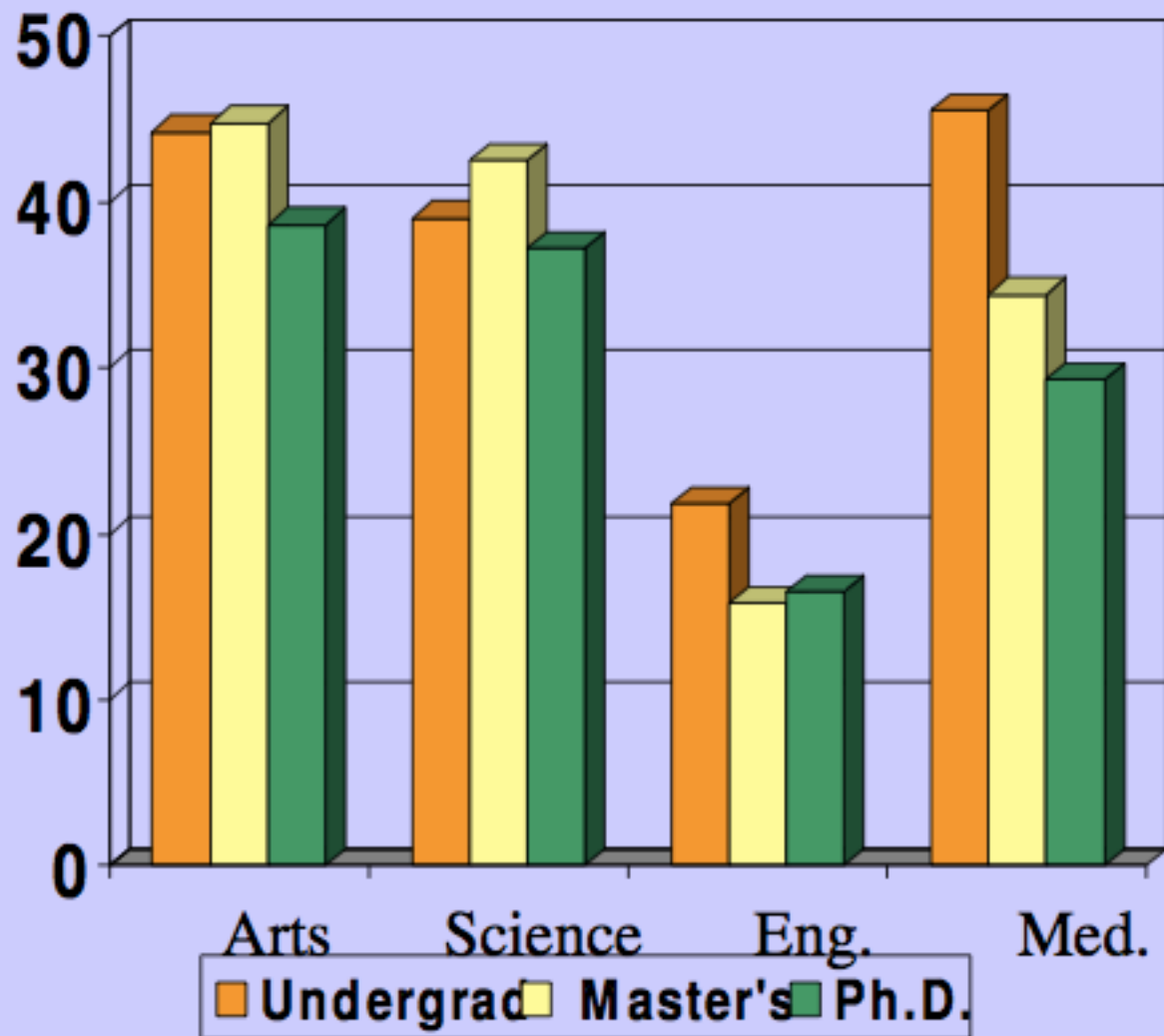


Figure 1. Growth in the absolute numbers of women with access to University education in STEM subjects from 1974-1975 to 2005-2006 [13].

Higher Education in India: 2000-2001



1/3 students in science
women! Increasing!

Drop off not after M.Sc.
The leaking pot is not
here!

Even at Ph.D. level #
in science not too small
wrt arts and medicine.

Higher education: 2019

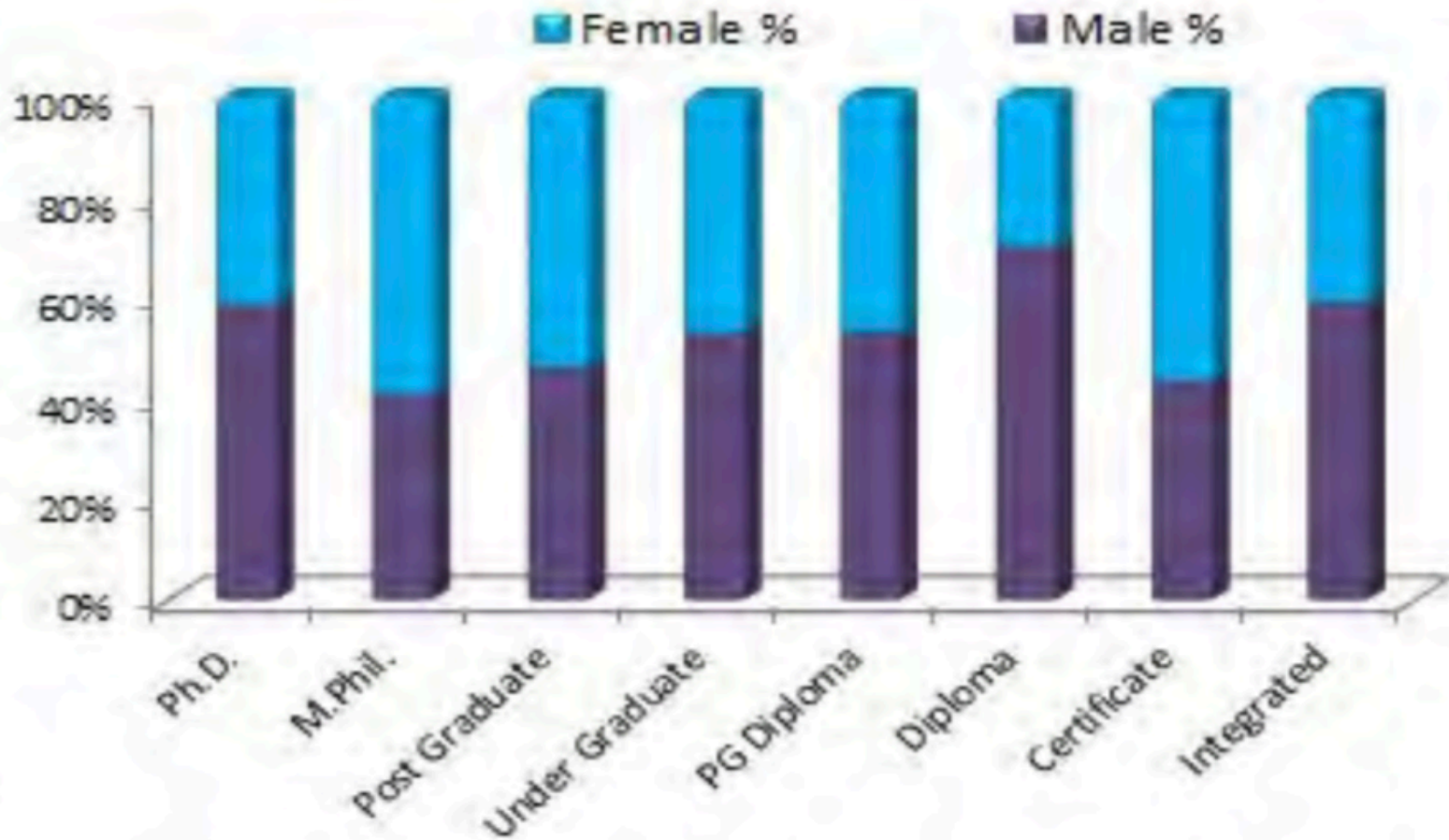
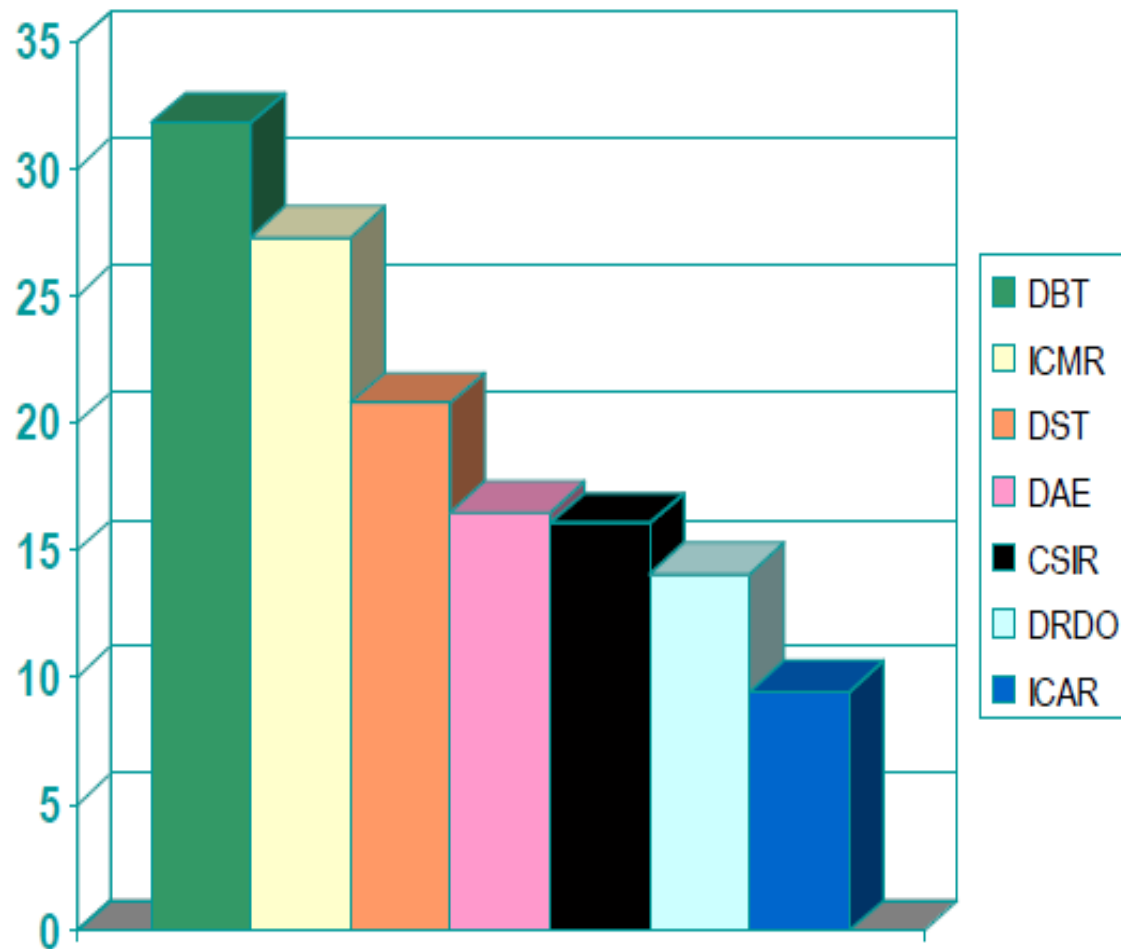


Figure 8: Gender Distribution at Different Levels

Percentage of Women Scientists



Source: Mantab Bamji, Task Force on Women in Science

The number of women in different organisations.

Devil is in the detail

I could present numbers of women's share in education and teaching. That will look quite good. In fact, the AISHE Webpage will show you that the Gender Equity Index in Numbers is 1.0

But interpreting numbers is always tricky!

Also, there is further breakup of these numbers in the reports themselves which are quite revealing.

Impact of Gender Diversity on actions

Willmien Kets and Sandroni : (October 2015)

Diverse groups are less conformist and more willing to go against the status quo if that leads to better outcomes. Whether a physics graduate goes on to work at a tech company, becomes a scientist, or ends up as a manager, it will be critical for her success as well as her employer's whether she is an original thinker.

The url is:

fortune.com/2015/12/16/affirmative-action-u-s-supreme-court-diversity

It is not cricket! (It is not fair!)

A small digression on diversity! A news item in DH a few days back.

Saqlain Mushtak, the Pakistani Bowler commented that the ICC needs to look at rules about what constitutes a legal delivery in spin bowling as that was formulated keeping the physiology of an anglo-saxon cricketer in mind. But Asian physiology is different and this needs to be included while formulating these rules!

ICC in the olden days dominated by White Caucacian Players at one point!

Gender diversity and knowledge gain (recent example)

Animal Behaviour 168 (2020) 19–24



Contents lists available at ScienceDirect

Animal Behaviour

journal homepage: www.elsevier.com/locate/anbehav



Getting back to Science

The role of diversity in science: a case study of women advancing female birdsong research

Casey D. Haines a, *, Evangeline M. Rose a, **, Karan J. Odom b, Kevin E. Omland a

Our case study suggests that women are making a greater contribution to the emerging field of female birdsong. This discrepancy demonstrates the importance of diversity in addressing previously understudied areas of science

Specific suggestions

GENDER-NEUTRAL CHILDCARE BENEFITS

➤ Creation of **equity-and-inclusion charter** to tackle discrimination

➤ At least **30% women in decision-making positions** across S&T ecosystem

➤ Retirement and spousal benefits for **LGBTQ+ community**

➤ Flexible timings and gender-neutral childcare benefits



➤ **Dual recruitment policy** so couples don't have to 'choose' spouse's career over theirs

➤ **Equal access to all** irrespective of caste, religion, race or geography

More discussion

**We can not be happy with special schemes for women and girls!
They are necessary but not sufficient!**

General measures that government/institutions want to harness to make our research more competitive should be designed so as to address possible disadvantages that women might face.

One example can be 'Inspire Faculty Fellowship' of the DST. Has an age limit which puts women at a disadvantage. Safe guard against discrimination due to age , caused by a break, can be introduced by considerations of 'academic' age rather than 'physical' age.

Adaptive promotion policies by Institutes!

Awareness

Example: 30% of the decision making positions mandated for women!

What is the underlying idea? Women would be aware of the invisible bias and can help the committee avoid it.

So for a **truly** effective implementation of the idea one needs to create the **awareness** among the remaining members of the selection committee as well. **Not necessarily** the job of the 30% women who are the mandated members!

Development of E&I charter suggested in STIP 2020 can put in place measures to create such awareness.

Awareness

Till that happens what can the Institutes and us scientists do?

We can set up own offices /groups which will do the awareness raising.

Very often we think it is enough to make schemes/efforts to help/enable women students and faculty. But raising the awareness is needed as much if not more!