

# WOMEN'S CONTRIBUTIONS TO THE 'STEM' AND 'STI': THE STEM OF SUSTAINABLE DEVELOPMENT

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**ABSTRACT:** The process of sustainable development, technology and innovation (STI) can only benefit from diversity, gender being Just one component. Also given the fact that women are 50% of humanity, their intellectual potential is something that we can ill afford to ignore. For the balanced development of any society, women must get a chance to give expression to their creative and unique contribution. The under-representation of women in science is visible in the overall career trajectory from being appointed and promoted to being rewarded and selected as members/fellows of science academies to holding leadership positions in scientific institutions. The significance of the representation of women in science academics reflects their overall position in the scientific community. In the present research paper, we will throw light on the participation of women in the field of science and technology, their staff, explanations for their low participation, advantages of putting women's leadership in STI, etc.

**KEYWORDS:** STEM, STI, sustainable development, science technology, women's leadership

## INTRODUCTION:

Women constitute 50% of the human resource, thus, contributing a major strength to the socio-economic development of the country. Gender inequality, parity, inclusiveness of women in major development

Around the same time, the task force for women in science and technology (DST) was formed, and they also prepared a report <sup>4</sup> on the situation in India.

Although Indian women are not perceived as being inadequate of doing science and engineering, their representation The first and fourth United Nations World Conferences were held in Mexico and Beijing respectively, mainly focused on the empowerment of women through science and technology (S&T). In the early years, science for women was more a part of our national S&T policies and not so much about women in science.

The Beijing declaration <sup>1</sup>, explicitly included improvement in women's access to science and technology as one of the targets and the first IUPAP conference on women in physics <sup>2</sup> made recommendations for government, Academies, and scientists to follow to achieve this. A serious study and discussion of science as a career choice for women in India was taken up by the Indiana National Science Academy (INSA) <sup>3</sup>. on in these fields is small. There are efforts to change this perception, but the change is slow, and there are few women scientists in positions of administrative power.

Immediately

Activities and getting more women in science and technology (S&T) are the issues discussed all over the world under the auspicious of several National & international events. Government departments, academies and NGOs have played a major role in the sensitization of the population, especially authorities regarding the involvement of women in S&T.

Although Indian women are not perceived as being inadequate of doing science and engineering, their representation in these fields is small. There are efforts to change this perception, but the change is slow, and there are few women scientists in positions of administrative power.

Immediately after Indian independence the fraction of women in universities was about 10% and those in the science was fewer than 5%, by 2000, wPhD's share in University enrollment increased to about 40%.

The available number indicates that the fraction of women as recipients of an advanced degree decreases along the line of an undergraduate degree in science (40%, 20% in engineering) to masters (35% is 5% in engineering) and similarly for Ph.D. <sup>3-9</sup> Women's share of prestigious National awards or membership in the National academies is also low <sup>10</sup> Although the biological and medical sciences have slightly higher numbers.

The issue of participation of women in science have many dimensions and measures to achieve gender equality in sciences that vary across cultures and societies. The main issue related to their imbalance in India is how to attract women to a career in science and retain the trained scientific women in science.

In the context of women scientists and women science professionals in India of the time are for the creation of structures that facilitate negotiation of maintaining a career-family balance.

Below we present available facts and figures regarding access of women to higher education careers in STI, gender equality in employment and the workplace. We will discuss and summarize data on women in leadership positions in science, science administration and within professional scientific societies.

Before going forward to discuss more participation of women in STEM it is necessary to know 'What is STEM and STI'.

**STEM** is the common abbreviation for four closely connected areas of study: science, technology, engineering and Mathematics. Similarly, **STI** is used as an abbreviation for science, teaching and Innovation. The fields are often associated due to the similarities they share both in theory and practice. Till now, the representation of women in these fields has been much less compared to

men.<sup>12</sup>The number of Indian women who have opted for STEM as a field of study has increased in the last three years, but challenges remain.

### REPRESENTATION OF WOMEN IN SCIENCE AND TECHNOLOGY :

In the first half of the 20<sup>th</sup> century, several European academies accepted women scientists as members .

Gender in STEM and STI is an initiative jointly organised by the Inter- academy partnership ( IAP) and the International science council (ISC). A recent study shows that there has been a marginal increase in the elected membership of women in senior academics from 13% in 2015 to 16% in 2020.

Among the senior academies, the academy of sciences of CCuba leads the way with 33% female representation in .<sup>12</sup>

### GLOBAL TRENDS :

In 1925, Sabin, an anatomist had become the first woman elected to the U.S.National Academy of sciences.

Only 17 women have won a Nobel prize in physics, chemistry or medicine since Marie Curie in 1903, compared to 572 men till 2017 while only 28% of all of the world's researchers are women. This presents a harsh reality of very few women in the field of science, technology, engineering and mathematics STEM, introduced in 2001 by scientific administrators at the US National Science Foundation.

Globally, 18% of girls in tertiary education are pursuing STEM studies compared to 35% of boys. Even within the STEM fields, women prefer to study life sciences and are less represented in majors like computer science and mechanical and electrical engineering. Worldwide, only 33% of researchers are women. Women account for just 22% of professionals working in artificial intelligence and 28% of engineering graduates.

### 13 AMAZINGLY COOL WOMEN IN STEM WHO CHANGED THE WORLD<sup>13</sup>

1. Katherine Johnson, a NASA space scientist born in 1918 . was awarded the presidential medal of freedom in 2015 for a lifetime of work as a pioneering physicist, mathematician and space scientist.
2. Augusta Ada king, countless Lovelace and mathematicians.
3. Radia Perlman, an Internet pioneer is known as the mother of the internet.
4. Rebecca Cole, MD graduated from medical school in 1867and became a public health advocate, physician and hygiene reformer in the US.
5. Joan Clarke, Code Breaker and cryptanalyst was the only woman to works in the nerve centre of the question crack German Enigma ciphers.
6. Susan Kare , Iconographer: Science 1983 , kare has designed thousands of icons for the world's leading software companies.
7. Rear Admiral grace hopper , Inventor and computer scientist: she invented the first widely used programming language COBAL .
8. Florence Nightingale , social reformer and statistian : she is known as the inventor of modern nursing.
9. Adrian Ocampo, planetary geologist : she is a planetary geologist and the science program manager at NASA headquarters.
10. Irene Au , human computer interaction designer : she created her own program of study in human computer interaction. She built exceptional design teams for Google and Yahoo.
11. Roberto Bondas, astronaut Neurologist: she is first Canada's female astronaut and the world's first astronaut Neurologist and has received many orders.
12. Ginni Rometty, CEO of IBM: she is a computer science graduate in the 70s. She has been IBM's CEO.
13. Barbara McClintock, geneticist: she is the only woman to have received, by herself, a Nobel prize for medicine in 1983 for her work.

Besides these women, some other STEM aligned women in history made a name for themselves in the physical sciences, fields typically dominated by white men. American physicist Sally Ride became an astronaut for NASA, and famed polish chemist Marie Curie changed the world with her studies on radioactivity.

### INDIAN SPECIFIC STATISTICS:

The contribution of women in the science and technology field has been as worthy as men but somehow their contributions are not much-talked about.<sup>14</sup>

Here is the list of some Indian women who have contributed to science and technology-

1. **Kadambari Ganguly:** she was the first female graduate and female physician of the British Empire.
2. **Anandi Gopal Joshi:** she became the first Indian to study medicine from women's medical college in Philadelphia, USA.
3. **Anna Mani :** she was an Indian physicist and meteorologist; she was also a forum deputy director general of the Indian meteorological department.
4. **Rajeswari Chatterjee :**60 years ago she was the only woman faculty in the Indian Institute of science . She is the first woman scientist to initiate director-general wave engineering and antenna engineering in India.

Some other outshines are Dr Indira hinduja, Kiran Mazumder Shaw, Dr Aditi pant, Madhuri Mathur, Dr Suman Sahai, and kalpana Chawla, they made valuable contributions to the science field in India.

A survey conducted in the year 2020 has revealed that out of 1044 members of the Indian National Science Academy (INSA), only 89 are women, which is 9% of the total.

Similarly, the governing body of INSA consisted of only 7 women out of a total of 31 members in the year 2020 whereas in the year 2015 it did not include any women members.

India's figures for women graduates in STEM are impressive at 43% as opposed to the US (34%) and Canada (31%) and several other countries. But only 14% of Indian women in STEM are employed in research and development institutions.

## STATUS OF WOMEN IN STEM

The number of women in STEM occupations increase each year.

In the field of science, technology and innovation (STI), underpinning most of the SDG women remain under-represented.<sup>15</sup>

In technology and innovation, the gender gap in patenting remains.

Women make up only 28% of the workforce in science, technology, engineering and mathematics (STEM) and men vastly outnumber women majoring in most STEM field colleges. The gender gaps are particularly high in some of the fastest-growing and highest paid jobs of the future, like computer science and engineering.<sup>16</sup>

The presentation of women varies widely across STEM occupations women make up a large majority of all workers in health-related jobs, but remain underrepresented in other job clusters, such as the physical sciences, computing and engineering.

Gender issues have figured in important ways in shaping the career of women scientists for centuries. Ideologies have developed over different eras and have resulted in the exclusion of women from science for a long time all over the world.<sup>17</sup> Women in science comprise only a small percentage of the total number of working women in India. Despite the overall quantitative improvement in numbers of women in science, the underrepresentation, particularly at senior level of teaching and research in India is still very significant. Women's contribution and efforts therefore, can't be ignored any longer. They must be represented in all delegations, committees and programmes, not because of gender parity, but because of their merit. Science and society are closely linked and there is a need for changes within the social structure and scientific institutions. Hence, there is a need to make women aware of careers in science as a possible option and then to retain them in the profession and give them the necessary recognition.

The three science academies, viz., IASC, INSA and NASI have played a pivotal role in bringing out specific issues pertaining to women scientists. To provide support and solution for women scientists and teachers, the national academy of sciences, India has launched a nationwide program on technological empowerment of women during the year 2012-13.

Women are universally underrepresented in science and technology. There are few role models to motivate young women scientists and students. IASC made a laudable effort of bringing out 'Lilavati's daughters', The women scientists of India an eye-opening collection of essays about nearly two India women scientists from the Victorian era to present-day India, giving an inspiring account of what brought them to science.

## MAIN REASONS FOR THE UNDER-REPRESENTATION OF WOMEN IN STEM

There are multiple reasons for the low participation of women in STEM. The STEM field is so perpetuated with gender stereotypes. It has a very strong male-dominated culture. There is a lack of role models for girls and women. Most of the women STEM graduates in India either pursue another career or do not work at all. That is a waste of talent. An important aspect of women quitting STEM careers or completely dropping out of the workforce is the loss of income to the Nation's Economy.

1. **STEREOTYPING:** the shortage of women in the STEM fields is not only due to skill inadequacies but also a result of specified stereotypical gender roles.
2. **PATRIARCHAL THINKING AND SOCIAL CAUSES:** patriarchal attitude manifests itself in providing appointments or fellowships and grants etc.
3. **LACK OF ROLE MODELS:** organizational factors have also played a big role in blocking gender equality. The paucity of women leaders and female role models has also probably blocked the entry of more women into these fields.
4. **LACK OF SUPPORTIVE INSTITUTIONAL STRUCTURES:** absence of supportive institutional structures during pregnancy and safety-related problems in fieldwork and the workforce women out of the workforce.

It is clear that to increase and retain women in STEM, institutional leadership in science needs to understand what might be going wrong and bring in diversity experts to correct gender imbalances. Hopefully, That day is not too far away.<sup>19,20,21</sup>

Women in STEM face a lot of challenges including a lack of role models, pressures to conform to societal norms and trapping of domesticity, stressors related to marriage, childbirth etc. and an inordinate amount of responsibility related to running households and elder care, physical safety during the commute to work sexual and other types of harassment in workplaces and a whole host of other issues.

## INITIATIVES LAUNCHED TO ENCOURAGE WOMEN IN THE FIELD OF SCIENCE :

The representation and disparity of women in STEM are results of deep-rooted social stigma, discrimination, biases, social norms and expectations that influence the quality of education they receive and the subjects they study. This divergence in professional choices not only highlights the imbalance in the society where one gender is suppressed with limitations and restrictions.

Women prefer to study life sciences and are less represented in majors like computer science and mechanical and electrical engineering. Worldwide, only 33% of researchers are women. Women account for just 22% of professionals working in artificial intelligence and 28% engineering graduates.

In the past few years, STEM has moved beyond being just a trendy hashtag, shaping into a movement encouraging more women to dip their feet in the field of science and technology.

In India, the scenario is comparatively better with nearly 43% of the total graduates in STEM being women. India is one of the countries to produce the highest number of scientists and engineers growth in the field of STEM has picked up considerably over the last few years.

In India, however, initiatives have been taken to promote women's participation in this field **18** Some schemes are as follows-

- The '**Vigyan Jyoti program**' was launched to address the problem of the under-representation of women in various fields of science, technology engineering and mathematics (STEM) in the country.

- ‘**Kiran scheme**’ was started in the year 2014-15 to provide opportunities to women scientists at the academic and administrative levels.
- Dst has also set up artificial intelligence laboratories in women’s universities to promote artificial intelligence (AI) innovations and prepare skilled manpower for AI-based jobs in the future.
- The objective of the university research for innovation and excellence in women’s Universities-CURIE program is to improve infrastructure and establish research facilities to create excellence in science and technology in women’s universities.
- The gender advancement for transforming institutions ( **GATI**) program was launched to develop a comprehensive charter and framework for assessing gender equality in the STEM sector.

Consequently, it would not only help women pursue their dreams but science itself would gain from their representation. Strong STEM education creates critical thinkers, problem solvers and next-generation innovators. The future is bright with the participation of women in STEM.

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