

State of Art on the Women Engineers and Scientist: Science, Policy and Society

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Abstract

India is a fast developing country. The science and technology are playing important role in the rapid growth of nation. There is a significant role of women in the area of science, engineering, technology, medical and life sciences, business, education, leadership, entrepreneurship and management. Despite significant contribution of women, they are still not reaching the highest level in the science and technology era in government, academic, public and private sectors. This happens due to lack of information, gender inequality, harassment at workplace, lack of the support from family and society etc. There are numerous challenges in the women progress since the past history, though women developed and contributed nicely in different field. In this study, the contribution of women in the field of academic, social, science and technology with different important research is introduced. The different government policies and opportunities is avail to women through Department of Science and Technology (DST), The Council of Scientific and Industrial Research (CSIR), INSA (Indian National Science Academy) etc. The role of women in the different era of science and technology through their innovative research and noble services towards nation is discussed in the paper to find the research gap as well give the idea of present scenario. The aim of the rigorous literature survey is to approach and encourage the young women researchers who have good potential to shine and contribute in this field of science and technology for sustainable career growth. The research survey is giving clear idea about the opportunity and possibility through the proper awareness for the different government policies, research structures, societal and institutional help to grow successfully in the fields of science and technology to take a pride in nation development.

Keywords: *issues, policy, present need, science, society, sustainable career, technology, women participation*

INTRODUCTION

The India is the country having lots of contradictions in the matter of women, therefore our country India is in the same situation like Asian countries in the matter of women in science. If we take a glance in the past, there are powerful women leaders, scientist, social workers, business lady, and academicians, though there is a very less growth in present. There is different culture and difference of development in various regions is responsible for the low growth of women in the scientific career. Now a days women are actively participating in the educational-sphere, disaster risk management, natural resources management, medical sciences, political area and many more and simultaneously fulfilling the social responsibilities too. But the gender equality, harassment at workplace, lack of awareness regarding the career opportunities, lack of the support from society and family, are hardens in the way of women. There are several places where, due to support of family and society as well the awareness of education and opportunities, women played the significant role with the tremendous research contribution in the field of science, technology, environment, mathematics, law, waste management etc. Therefore, it is mandatory to find the gap and reasons behind it to give equal opportunity to women growth in science career. The role of Indian government is also significant to address unmet need of this global issue. The role of women in different area to develop sustainable

career can be understand through the Fig. 1. Nowadays women are actively playing their duties as a scientist, doctor, lawyer, politician, entrepreneur, and social worker, academicians for the nation and society development.

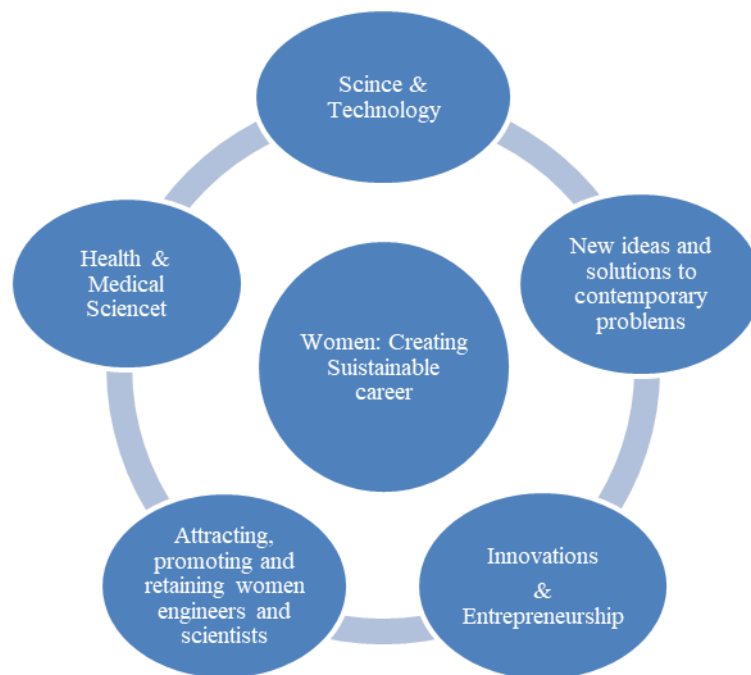


Fig. 1: Women - Creating Sustainable career in different field

WOMEN IN SCIENCE AND TECHNOLOGY

Women contributed in the area of academic, science and technology though women are lacking behind to achieve equality with men [1]. The women of India have actively participated in all era such as medical doctor degree was achieved by the Indian lady in the year of 1885 first time and in the year of 1931, Janaki Ammal got first doctorate in basic sciences. In the year of 1944, Ashima Chatterjee got her doctorate from Indian University. The contribution made from Kalpana Chawla and Sunita Williams are also remarkable in the field of engineering, science and technology. There are important researches are going in various field though there are only 25 to 30% women. From the table 1[2], the women participation in the Science and Engineering education can be understand as well the women in Science, Technology, Medical and Engineering is increased [3] in the past few decades. The data of Table 2 [8] reveals the present scenario of women enrollment in education compare to men. This data comparison shows the improved numbers of women enrollment year by year in education.

Table 1: Percentages of Women Enrollment in the University for Education till from 1950 to 2001[2].

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

Table 2: Gross Enrolment Ratio of Men-Women in Education from Year 2001 to 2015[4,5,6]

| Level / Year | Secondary (IX-X) 14-15 Years | | | Senior Secondary (XI-XII) 16-17 Years | | | (IX-XII) 14-17 Years | | | Higher Education 18-23 Years | | |
|--------------|---------------------------------|------|------|--|------|------|-------------------------|------|------|---------------------------------|------|------|
| | M | F | T | M | F | T | M | F | T | M | F | T |
| 2001-02 | NA | NA | NA | NA | NA | NA | 38.2 | 27.7 | 33.3 | 9.3 | 6.7 | 8.1 |
| 2002-03 | NA | NA | NA | NA | NA | NA | 41.3 | 33.2 | 37.5 | 10.3 | 7.5 | 9.0 |
| 2003-04 | NA | NA | NA | NA | NA | NA | 42.9 | 34.3 | 38.9 | 10.6 | 7.7 | 9.2 |
| 2004-05 | 57.4 | 45.3 | 51.7 | 30.8 | 24.5 | 27.8 | 44.3 | 35.1 | 39.9 | 11.6 | 8.2 | 10.0 |
| 2005-06 | 57.6 | 46.2 | 52.2 | 31.4 | 25.2 | 28.5 | 44.6 | 35.8 | 40.4 | 13.5 | 9.4 | 11.6 |
| 2006-07 | 58.6 | 47.4 | 53.5 | 31.5 | 26.1 | 28.9 | 45.0 | 36.8 | 41.1 | 14.5 | 10.0 | 12.4 |
| 2007-08 | 62.6 | 53.2 | 58.2 | 36.3 | 30.4 | 33.5 | 49.4 | 41.9 | 45.8 | 15.2 | 10.7 | 13.1 |
| 2008-09 | 64.8 | 55.5 | 60.4 | 37.5 | 31.6 | 34.5 | 51.0 | 43.5 | 47.4 | 15.8 | 11.4 | 13.7 |
| 2009-10 | 66.7 | 58.7 | 62.9 | 38.5 | 33.5 | 36.1 | 52.5 | 46.1 | 49.4 | 17.1 | 12.7 | 15.0 |
| 2010-11 | 69.2 | 60.9 | 65.2 | 42.3 | 36.2 | 39.4 | 55.7 | 48.5 | 52.2 | 20.8 | 17.9 | 19.4 |
| 2011-12 | 69.0 | 63.9 | 66.6 | 47.6 | 43.9 | 45.9 | 58.8 | 54.5 | 56.8 | 22.1 | 19.4 | 20.8 |
| 2012-13 | 69.6 | 67.0 | 68.1 | 41.9 | 39.5 | 40.8 | 57.0 | 56.5 | 56.8 | 22.7 | 20.1 | 21.5 |
| 2013-14 | 76.8 | 76.5 | 76.6 | 52.8 | 51.6 | 52.2 | 62.5 | 62.6 | 62.5 | 23.9 | 22.0 | 23.0 |
| 2014-15 | 78.1 | 78.9 | 78.5 | 54.6 | 53.8 | 54.2 | 64.9 | 65.8 | 65.3 | 25.3 | 23.2 | 24.3 |

M- Male

F- Female

T- Total

NA- Not Available

The latest data reveals that since the year of 1958, only 16 women scientists have won the Shanti Swarup Bhatnagar. This award categorized for the outstanding research carried out in India by the person having the age below [7]. In the year of 2016 and 2017, the International Association of advanced materials, Sweden honored with the IAAM Young Scientist Award to the researchers from different countries for their remarkable research, where Indian women researchers also achieved that honor [8]. The INSA elected about 230 fellows during 2010-2016, where only 30 were women. The worldwide survey of 69 science academies showed the 12 percent women members are in the association [7]. There is a creamy group of women who can contribute in the area of science, technology, engineering, mathematics, academics etc., but the harassment at workplace, gender equality and lack of awareness in relevant fields are main negative factors for women growth.

Table 3: Percentages of Women Enrollment in the University for Education [2].

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

In the universities, there were different types of problems and reasons having less numbers of female in workplace which can understand from the data of Table 3. From this data, it is also clearly investigated that since 2005 women played important role in the field of science and achieved high standards as well addressed the large number of women all over the nation [9].



Fig. 2: Contribution of Women in STEM

There are different field of science and engineering, in which women contributed for research and innovation, which is shown in Fig. 2.

GOVERNMENT POLICIES AND ORGANISATIONS FOR WOMEN IN SCIENCE AND TECHNOLOGY

The women empowerment [10] in science and technology was introduced in the year of 2003 and then various government policies were implemented. The department of science and technology is giving opportunity to women for research who is having the essential education but career break or unemployment. The DST is actively contributing for the women growth through the Science for Equity, Empowerment and Development Division. Under the different government scheme for women, the scholarship facility is provided to do research in the area of science, engineering and technology. For the women scientist different 930 fellowships are introduced by government. For the healthy environment at workplace, law and regulations are modified for strict follow up. The different secured applications and program is introduced by government for women, to work safely with confidence. The ISRO and DRDO also provided the platform to women scientist under different scheme with multiple benefits including women growth in career of scientist. The UGC commission also implemented various scheme for women in academic and science. There are few universities working on the women related issues. The Jawaharlal Nehru University, New Delhi and Srimati Nathibai Damodar Thakersey Women's university are doing the research on the women on science and issues related to them. The group of various academic and government organizations are, as well the different government policies are attracting the women in science and technology for sustainable growth.

PRESENT NEED OF BENEFICIAL PRACTICES FOR WOMEN

There are many hardens in the path of women to build and maintain a career in the field of science and technology. To overcome problems faced by the women in different aspects, there is an urgent requirement to facilitate them for survival and effective contribution in research. There is a science career with future opportunities need to be introducing to maintain interest in this field. The social and family support can be avail by different awareness program to take women participation in the field of science, engineering and technology. One should focus on the gender equality matter to do needful for the women. The institutions and academia should motivate the women by introducing the women scientist and their innovative work and contribution in this field. The facilities should be given to

women having the family and child by availing leave and childcare facility which help women to manage the social life and workplace responsibilities. For the excellence and achievements, women should be rewarded to encourage her for future growth. The working environment need to safe and healthy without any issues of harassments. These all need should be fulfilled for women growth and career in science which is shown in Fig. 3. From the Figure 3, it is clearly summarized that the modification in rules and regulations with the positive efforts can be motivating women for the career in science and technology. The different addressed issues affected the numbers of women participation at workplace in the different field. The reputed scientific organizations are giving opportunity to women for research and career in science but the different problems affected the women enrolment in this field can be overcome by social and family support. The awareness regarding the opportunities is in different field need to spread in society. The government, organizations, NGO can bring interest of women in higher education, science career and research through different scholarships and benefits. The issue of Gender quality is also affecting the women existence in different area, so one should form a committee to remove this difference from society. At workplace as well in education system, the female participation should be equally like male involvement. For this matter, employment and recruitment cell have to work hard to maintain the equal level of male and female in different places. The discussed matter regarding women reveals the present need of women for the active involvement in the field of science. This gap can be filled by best practice in practical life.

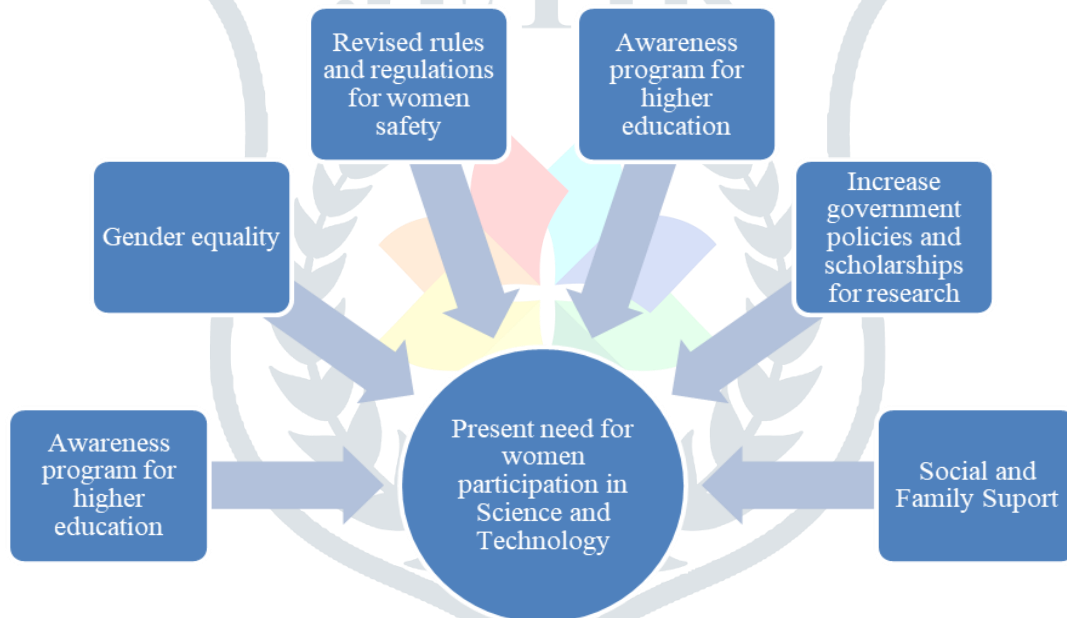


Fig. 3: Present need for women participation in Science and Technology

CONCLUSIONS WITH SUGGESTIONS

There is a universal truth that the women play an important role in the society to grow and enhanced different important sector of nation growth. Women are a foundation of family who give equal opportunity to family members to grow with all necessary requirement and comfort. So it's a prime duty of society, nation and family members to give opportunity to women for her better growth in different field. There are different problems in the way of women which can be resolve effectively with different rules and regulations. The proper awareness program and opportunities through different government policies are the solution to increase women participation in the different field of science, engineering and technology. The gender inequality issues can be solving by the modifications in different rules and regulations. There are basic requirements such as higher education, good health, awareness and motivation through various awareness program, safety, security and dignity are important for women empowerment. The Indian history reveals the problems faced by women during the ancient and British rule time. In such difficult time, legendary women set best examples of

contribution for the freedom of India. In past, there is less awareness and opportunities for women due to different belief but today picture of women is changed. Today, women is performing well in sports, academics, science, technology and many other fields successfully, as well handling the social responsibilities too. On other side, the women involvement found very less in knowledge society decision making, at such places the male participation found strong and in more number since last few years. This scenario reveals the lack of higher education in the women group compare to man. In IT sector, the role of women is remarkable in India but in entrepreneurship it counts very less. There are several issues, though the introduced issues of women can be solved with proper rules, regulations and monitoring, than women participation can be increase in the different field of science as well in entrepreneurship. The combined positive efforts of government, society and organizations can prove helpful to women for sustainable career growth in different sectors for nation development.

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ABBREVIATIVES

DST: Department of Science and Technology
CSIR: Council for Scientific and Industrial Research
INSA: Indian National Science Academy
DBT: Department of Bio Technology
DAE: Department of Atomic Energy
DRDO: Defense Research and Development Organization
ISRO: Indian Space Research Organization
ICMR: Indian Council for Medical Research
DOD: Department of Defense
ICAR: Indian Council of Agricultural Research
UGC: University Grants Commission