Women in STEM

with WISE (Women in Science and Engineering) Committee of AASSA

Date: August 4-6, 2025

Place: Kavli IPMU, The University of Tokyo (Kashiwa, Japan)

Speakers

from Australia, Bangladesh, India, Nepal, Philippines, Russia, South Korea, Sri Lanka, Thailand, Turkey and Japan.

Movie "Marguerite's Theorem"

Organizers

Yukari Ito, Elisa Ferreira, Anamaria Hell
(Kavli IPMU)

UTokyo

KAVLI IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

aassa THE ASSOCIATION OF ACADEMIES AND SOCIETIES OF SCIENCES IN Asia

日本学術会議 SCIENCE COUNCIL OF JAPAN

Preface

January 2026

This is summary of all talks at Conference "Women in STEM"- The 3rd AASSA-WISE-SCJ Symposium which was held at Kavli Institute for the Physics and Mathematics of the Universe (IPMU) at the University of Tokyo by hybrid from August 4 to 6 in 2025.

The symposium will provide a forum to discuss initiatives supporting women researchers in the STEM (Science, Technology, Engineering and Mathematics) fields, and to exchange views on the status of women researchers in STEM across the Asia-Pacific region. In addition, the event will aim to build a lasting network among women researchers and to share mentoring practices and support measures to further promote their active engagement.

I thank all speakers for their contributed talks and the summary of their talks in this book. I hope this will help many people to understand the situation of several countries in Asia and give hints and solutions for women in STEM all over the world.

Sincerely yours,

Yukari Ito
Kavli Institute for the Physics and Mathematics of the Universe,
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Supporting and increasing the visibility of women in science

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Abstract
Attracting women and girls to science, technology, engineering and mathematics (STEM) and providing an environment for them to thrive and progress is a shared responsibility of government, academia, the education system, industry, and the community. I will discuss the Women in STEM Decadal Plan[1], developed by the Australian Academy of Science (AAS) in collaboration with the Australian Academy of Technology & Engineering. This ten-year plan offers a vision and opportunities to guide stakeholders as they identify and implement specific actions needed to build the strongest STEM workforce to support Australia. The AAS also hosts the STEM Women website[2a], an online directory which aims to promote gender equity in STEM by showcasing the breadth of scientific talent to enable a diverse range of women to be offered opportunities to progress their careers and personal capabilities. In partnership with the Association of Academies & Societies of Sciences in Asia (AASSA) and the InterAcademy Partnership (IAP) in September 2021 this was extended to STEM Women Asia[2b] to help discover the diversity of women with STEM skills across Asia and Oceania. Then in November 2022, STEM Women Global[2c] was launched to increase the visibility of women working in STEM worldwide. Further, the AAS convenes the International Science Council (ISC) Regional Focal Point for Asia & the Pacific (RFP-AP)[3], which acts as a hub for ISC members and activities in the region. The ISC RFP-AP aims to ensure that the unique needs and priorities of the Asia and Pacific regions are integrated into the global scientific dialogue. A mentoring programme[4] commenced in September 2024 to connect early career researchers (ECRs) with senior science mentors to guide young scientists from low-income nations within the region to become future leaders in academia. A case study of an ECR in chemistry who participated in the program will be presented.

Keywords: diversity and inclusion, gender equity, SDG5, STEM women, women in science

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INTRODUCTION

I am very pleased to have the opportunity to discuss something I am very passionate about: gender equality in chemistry and, more broadly, science & engineering. This year marks the13th anniversary of AASSA or the Association of Academies and Societies of Sciences in Asia. Progress has been achieved, but there is still much more to do.

We are all dedicated to advancing Science and Engineering and to the pursuit of knowledge. But we cannot do it without input from a diverse range of perspectives. The importance of diversity in science is an unshakeable reality that the scientific community must uphold. It is not just men, and not just women – we must listen to all voices.
Recent studies have shown that women encounter more discrimination in their employment and evaluations of their achievement; that their careers have been more impacted by decisions about children and marriage; and that they subsequently submit fewer journal articles than men. A recent report by Elsevier indicates the percentage of active women authors in chemistry at 40%.

When I was growing up, science was not seen as an option for women. The scientific system was built around a narrow conception of what a scientist was and, unless you fit the mould, unless you were a wealthy male, you were not expected nor encouraged to advance.

Things have changed: much has improved and there is still more to be done. Ongoing scientific work with people across the globe and from all different backgrounds has shown that diversity is a profitable asset to the generation of scientific knowledge. The importance of diversity in science is an unshakeable reality by which the scientific community must stand.

For much of my life I have felt on the outer and I would like to give you a sense of why I think inclusion and diversity are so important. It is not just about social justice or feeling warm and fuzzy inside. It's practical – diversity allows us to tap into potential we might not otherwise see.

As a Croatian immigrant raised in remote Australia, the pursuit of knowledge came second to making a living. Education was a luxury. In fact, I am actually the first person in my family to finish primary school. It was not until my schoolteacher, Mrs Ashman, saw something in me, that I considered higher education. She told me that at university, I would meet people like me; people with a passion for understanding the world.

I first attended university in 1972, and I dropped out after the first semester. I did not find those people like me, and I did not enjoy the experience. But, deep down, I have always wanted to know how things work. Once you know how something works, then you can fix it or make it better. So instead of university, I joined a government research laboratory as a junior technician.

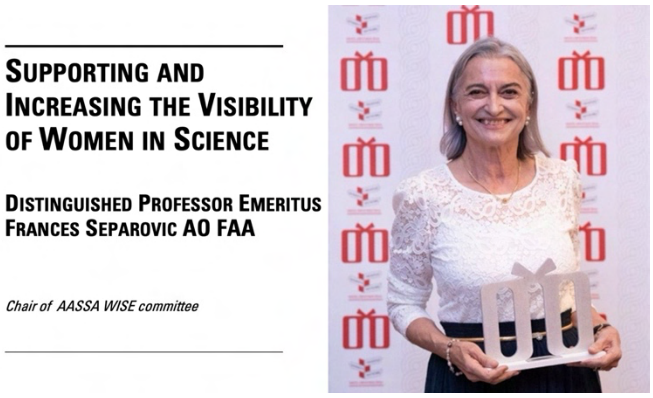
It was not until my son was born that I realised I wanted more for him, and more for myself. I went back to school, balancing part-time study with full-time work and caregiving. Like many women before and after me, I refused to be deterred by the financial and social constraints that come with pursuing education as a single mother. By the time I graduated, I realised that I truly enjoyed research and learning. So, I decided to continue my education and eventually a PhD.

By then, my son was grown, and I was able to fully engage in an academic career. So, I took a leave of absence from the CSIRO and received a Fellowship to the National Institutes of Health USA. In 1996, I returned and became Associate Professor of Chemistry at the University of Melbourne and in 2005, I am proud to say, the first female Chemistry Professor in the state of Victoria and only the third in Australia.

There are lessons to be learned from my story. I could focus on the negative: the way in which the scientific system does not accommodate women's biologies or our life experiences; the difficulty of imagining academia as a single mother from a remote town in Australia. But, instead of what does not work, I want to discuss what does. I would like to mention some of the steps, the people, and the industry that have brought me to where I am today.

1. RECOGNITION:

When we see ourselves reflected in leadership, we can envision our own futures. One of the most important ways we can help women excel in science is by recognising them. In 2012, I was the first woman chemist elected a Fellow of the Australian Academy of Science. In the 13 years since, 12 more have come on board – in comparison to the 81 men.



This is even though women working in chemistry (in Australia) accounted for approximately 49% of final year high-school enrolments over a ten-year period and represent between 42-56% of professional chemists and chemistry technicians. Clearly, there is still some work to be done.

It is a fallacy that women need to be invited or encouraged into the field: women have *always* been a part of science. The first recorded chemist was a Babylonian woman perfumier named Tapputi. We turned flowers into scents, grain into bread and minerals into metal. But we haven't always been recognized.

Even after the development of modern chemistry in the 19^{th} century, women like Marie-Anne Lavoisier were hard at work, not as chemists but as "lab assistants." So, the problem of gender equality in chemistry (and other branches of science) is not about finding women; it is about recognising them.

Awards like IUPAC's Distinguished Women in Chemistry or Chemical Engineering or AASSA's Professor Yoo Hang Kim Young Women Scientists are one way to recognise the achievements of women. But do not wait for a gendered award to come along: if you know a worthy woman scientist, recognise her in broader awards.

When considering awards, recognitions, and invitations, ensure you are always thinking of the whole spectrum of scientists. As Margaret Sheil wrote in her 2011 article on Women in Chemistry in Australia: *It is [our] collective responsibility to showcase these role models to the future generation of chemists… if we want to ensure that we capture all possible talent in our important and enabling discipline.*

2. OPPORTUNITY:

In my career, I have often been the only woman in the room, and it has been wonderful to see an increase in the proportion of women in science, especially at the senior levels. But this change in the number of women has been painfully slow and has at times led to situations where I have experienced or observed harassment. It is difficult to imagine the amount of potential scientific knowledge we have missed because of these attitudes but we can still see their legacy: as of 2023 there is still a 12% pay disparity between male and female workers in scientific research services in Australia, which also reflects the fewer number of women at senior levels.

I was able to continue my studies and attain a PhD without paying fees, during a brief period in time when Australian universities were fee-free. As a single mother, if it had cost me money, I would not have been able to pursue it. I did a PhD because I enjoyed it. It is challenging, it is hard, and everyone faces a different struggle.

But I did it and I did it well enough to be considered for an academic distinction. My supervisor told me that the all-male committee thought it was a ‘waste of time’ giving me first class honours because I was a single mother – I was “never going to amount to anything.” I’ll be honest, this personally *motivated me* to do more and work harder. But not everyone will respond that way, and nor they should. We cannot recognise women’s achievements if we don’t allow them the opportunity to achieve.

3. MENTORSHIP:

In high school I was awarded the title of ‘dux’ or ‘leader’ due to my academic prowess. But it was not a passion for science that drove me. Actually, I just wanted to fit into Australian society. And I chose to study maths and physics because I thought it was a great place to meet boys! Fortunately, I had teachers who saw my potential and encouraged me to continue my studies.

Diversity is not about trying to fit in, it is about accepting differences and bringing each person’s unique perspective to the table. For those women who are told to “be more confident,” or “be more assertive,” or really “be more like a man,” it does get easier. It helps to have a Mrs Ashman: a support base, mentors, and colleagues with whom we can talk and share our experiences.

There is a power in having someone see your potential and guide you, especially when you are early in your career. Sometimes mentorship comes about naturally: you connect with a younger colleague and advise them throughout their career. But you may not be a part of a network that exposes you to potential mentees or you might not have experienced the benefits of mentorship yourself and simply don not know where to start.

The good news is there is a solution. Programs like the International Science Council’s (ISC) Asia-Pacific Academic Mentoring Program are designed to make this process easier. I recently had the pleasure of learning about a woman scientist from Papua New Guinea, a lecturer from the Innovative University of Enga in PNG, who is a part of ISC Regional Focal Point for Asia-Pacific’s Academic Mentoring program. Through this program she is mentored by a distinguished plant scientist and Fellow of the Australian Academy of Science, who will be able to share her wealth of knowledge and experience in the field. Without programs like this, the two may never have crossed paths. This young woman in science hopes to be able to advise her government and region in scientific matters. I hope to see her one day giving her own speech on mentoring women in science, if it’s still needed.

It does not matter from which country you come, many women in science face similar issues in building their careers. By sharing our experiences and our ideas, we can build on our strengths and continue to advance our field by leveraging the genius and tenacity of all people.

I have been privileged to be surrounded by amazing women chemists in Australia, who are dedicated to advancing diversity within the discipline. I work with Margaret Sheil at the Australian Academy of Science, the first woman chemistry professor in Australia. And I work with Mary Garson, IUPAC President-elect, who is particularly dedicated to the fight for gender equality in chemistry. You may know of the Global Women's Breakfast, which gather thousands of women chemists and their supporters around the world in a grand networking event.

These women demonstrate leadership and exemplify mentorship - empowering people to do things. Encouraging people to believe in themselves, making them take ownership of things, being responsible and being enthused. Thanks to women like Margaret and Mary, and organisations like the InterAcademy Partnership, to which AASSA belongs, science is making leaps and bounds toward gender equality, but we are not there yet. There is more to be done both on an organisation and on an individual level.

I encourage everyone – men and women - to take a moment to reflect on your own careers and how the people and opportunities afforded to you have culminated into your positions, your standing, and your participation in the Women in STEM symposium.

Think about the people who have come before you and have guided you – because no one of us have achieved what we have alone. Then I challenge you: think about what you can each do to support diversity and gender equality in your institutions, organisations, and personal lives. You may be the encouragement that one person needs to achieve their full potential – for the benefit of science.

Women in STEM and Small-Scale Chemistry: Empowering Change through Innovation and Inclusion

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Abstract

Women's participation in STEM across the Asia–Pacific region continues to be limited by structural, cultural, and educational barriers, including gender norms, unequal access to quality science instruction, and the lack of meaningful laboratory experiences. This paper examines how small-scale chemistry—an innovative, safe, low-cost, and sustainable approach to laboratory teaching—can help address these challenges and expand girls' engagement in science. By minimizing chemical use, reducing hazards, and enabling hands-on experimentation in diverse classroom settings, small-scale chemistry creates inclusive learning environments that build confidence, interest, and scientific competence among girls. The paper further explores the model's significant implementation across ASEAN and South Asia, highlighting its role in strengthening teacher capacity and widening access to practical science learning. Finally, it analyzes how small-scale chemistry advances key Sustainable Development Goals (SDGs), particularly those related to health, education, gender equality, reduced inequalities, sustainability, climate action, and global partnerships. Together, the integration of small-scale chemistry and gender-responsive STEM strategies represents a powerful pathway for improving science education systems and promoting women's empowerment in STEM.

Introduction: Women, Science, and Systemic Challenges

Across the Asia-Pacific region, women's participation in STEM remains a pressing issue. While women's enrollment in higher education continues to improve, their representation in physical sciences and engineering remains limited. The *UNDP Women in STEM Asia-Pacific Study (2024)* reported that women comprise only about 35% of the STEM workforce, with the gender gap most visible in leadership and technical positions.

In the Philippines—despite progressive gender policy—educational disparities remain deeply structural. The *Second Congressional Commission on Education (EDCOM2, 2025)* revealed that **62% of high school teachers teach outside their college major**, including **98% in the physical sciences** and **80% in the biological sciences**. This mismatch undermines both teacher confidence and student outcomes in STEM.

These figures mirror regional challenges across Southeast Asia, where resource limitations and gendered expectations constrain women's full participation in science education. Addressing these barriers requires pedagogical innovation grounded in sustainability and inclusiveness.

What Small-Scale Chemistry Is and Why It Matters

Small-scale chemistry originated from the idea that meaningful scientific learning does not require large volumes of chemicals or traditional laboratory infrastructure. By using microquantities—drops, grains, or small-well reactions—it transforms chemistry instruction into a safer, cleaner, and more manageable experience. This approach replaces bulky and costly laboratory glassware with compact, low-cost kits and tools that fit easily into any classroom setting.

The benefits extend beyond simplified equipment. Small-scale chemistry reduces chemical hazards, minimizes waste, and lowers operational costs, making practical science feasible even in schools with limited resources. Students gain access to hands-on learning regardless of their school's financial capacity, and teachers are able to integrate more laboratory activities into everyday instruction without extensive preparation or safety concerns.

Most importantly, the approach broadens participation. By removing logistical and psychological barriers, small-scale chemistry provides all students—not only those already confident in science—with opportunities to experiment, ask questions, and engage actively. It reinstates the central purpose of science education: enabling learners to explore ideas, test concepts, and experience discovery in an environment that is equitable, safe, and inviting.

Small-Scale Chemistry Projects in ASEAN and South Asia

Since 2003, the Department of Chemistry at Chulalongkorn University has led a pioneering effort to introduce small-scale chemistry as a transformative model for science education. Grounded in the principles of green chemistry, the approach emphasizes minimal chemical use and simple, low-cost apparatus, enabling teachers to deliver safe, hands-on experiments directly in the classroom. By lowering costs and reducing hazards, the program broadens access to practical science learning, particularly for resource-limited schools, and enhances student engagement across diverse learning contexts.

The initiative expanded nationally in 2014 through a partnership with the Chemical Society of Thailand, supported by sustained sponsorship from Dow Thailand Group. Its regional growth began in 2017 with the backing of Bangkok Bank, extending the program's reach across ASEAN. In 2022, the project further expanded into South Asia under the endorsement of the International Union of Pure and Applied Chemistry (IUPAC). Today, the network includes more than 5,000 secondary schools in ten countries—Thailand, Myanmar, Cambodia, Indonesia, Vietnam, the Philippines, Nepal, Sri Lanka, and India.

The program now operates on an annual cycle from April to March, integrating teacher workshops, training-of-trainers initiatives, video competitions, and regional networking activities. Together, these components build teacher capacity, strengthen professional confidence, and foster sustainable collaborations across participating countries. Through its extensive reach and lasting partnerships, the small-scale chemistry project has become a significant driver of innovation and inclusivity in science education throughout ASEAN and South Asia.

Small-Scale Chemistry and the Sustainable Development Goals

SDG 3 – Good Health and Well-Being - Small-scale chemistry minimizes exposure to hazardous chemicals and reduces laboratory accidents, promoting safer learning environments for teachers and students.

SDG 4 – Quality Education - The approach expands access to meaningful laboratory experiences across diverse educational settings, advancing inclusive, equitable, and high-quality STEM education.

SDG 5 – Gender Equality - By creating safe and encouraging learning environments, small-scale chemistry supports girls' active engagement and strengthens pathways for women in STEM.

SDG 10 – Reduced Inequalities - Low-cost and scalable, the method helps level the playing field between schools in urban and rural areas and between high- and low-income communities.

SDG 12 – Responsible Consumption and Production - Micro-scale experiments reduce chemical waste, improve resource efficiency, and promote sustainable laboratory practices.

SDG 13 – Climate Action - By reducing environmental impact and offering hands-on opportunities to explore climate-related concepts, small-scale chemistry contributes to climate education.

SDG 17 – Partnerships for the Goals - Its implementation depends on collaboration among universities, ministries, NGOs, and international scientific networks, supporting the SDG call for global partnerships.

Conclusion

Women's meaningful participation in STEM is vital to building resilient, equitable, and innovative societies. Yet across the Asia–Pacific region, girls continue to face systemic barriers that limit their exposure to high-quality science education and diminish their confidence in pursuing scientific pathways. Small-scale chemistry provides a practical, scalable, and transformative solution to these challenges. By reducing cost, complexity, and safety concerns, it brings hands-on laboratory science into classrooms that previously lacked such opportunities—benefiting all learners and particularly empowering girls, who often have fewer chances to engage actively in laboratory work.

The method's widespread adoption across ASEAN and South Asia demonstrates its effectiveness in expanding access, strengthening teacher capability, and fostering sustainable educational networks. Its alignment with multiple Sustainable Development Goals further underscores its importance as a tool for advancing equity, sustainability, and global cooperation in STEM education.

When paired with gender-responsive teaching and supportive institutional policies, small-scale chemistry becomes more than an instructional strategy—it becomes an agent for systemic change. By opening doors to inquiry, confidence-building, and scientific discovery, it enables girls to envision themselves as future scientists, leaders, and innovators. As educational systems work toward more inclusive and sustainable futures, small-scale chemistry stands out as a powerful catalyst for empowering women in STEM.

Author Note

Supawan Tantayanon is a Professor of Chemistry at Chulalongkorn University, Thailand, and a former President of both the Science Society of Thailand and the Chemical Society of Thailand. She is internationally recognized for her leadership and pioneering work in Small-Scale Chemistry, teacher training, and sustainable laboratory innovation. She currently serves as organizer and trainer for regional Small-Scale Chemistry (SSC) workshops across ASEAN and South Asia, focusing on empowering women in STEM and advancing the UN Sustainable Development Goals through green chemistry education. In addition, she serves as the Chair of the Advisory Board on Education and Outreach (ABEO) of the Organization for the Prohibition of Chemical Weapons (OPCW) and as a member of the Executive Board of the International Union of Pure and Applied Chemistry (IUPAC).

Advancing Human Resource Development of Women in Science and Engineering in the Philippines

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Abstract

Advancing human resource development of women in science and engineering is a crucial driver of inclusive growth in the Philippines. Despite strong educational participation, women remain underrepresented in technical professions, particularly in engineering and ICT, where cultural stereotypes, work-life balance constraints, and limited mentorship opportunities hinder career progression. Current statistics show that while women account for nearly half of science graduates, only 30% of engineering graduates and 15% of licensed engineers are female. Nonetheless, Filipina scientists and engineers have made notable contributions in research, infrastructure, and innovation, supported by government, academe, and industry initiatives such as scholarships, mentorship programs, and diversity policies. This paper highlights key trends, persistent challenges, and success stories, underscoring the importance of visibility, leadership, and institutional support. It argues that achieving gender equity in STEM requires strategic investments in training, mentorship, and inclusive policies. By empowering women in science and engineering, the Philippines can not only close gender gaps but also strengthen its national development and global competitiveness.

Introduction

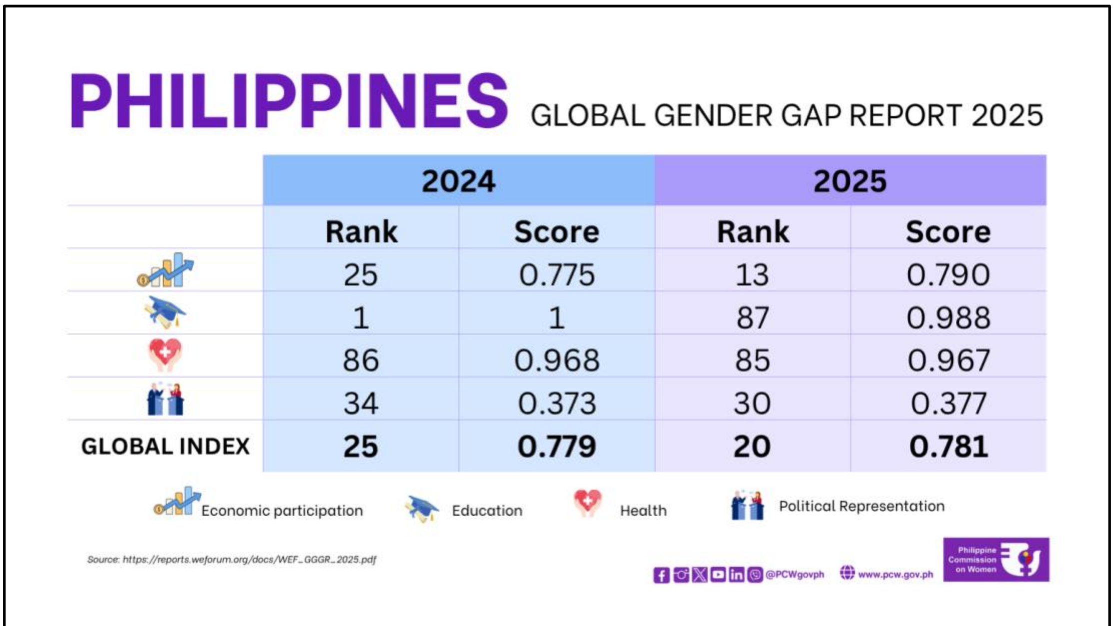
Empowering women in science and engineering is more than a gender issue — it's a development imperative. Globally and particularly in the Philippines, women remain underrepresented in STEM fields. By focusing on human resource development, we open the door for gender equity and economic progress.

Over the previous two decades, women have significantly increased their participation in careers related to science, engineering, and technology (SET). This growth in involvement has been hailed in the academic literature as an indication of greater gender parity within these professions and is a result of educational equity laws. Though statistical data indicates that women's participation in these professions has risen, studies have also shown that women remain notably underrepresented in higher levels of management in the SET industry and had poorer retention rates than their male counterparts. (Etzkowitz, et al., 2000, Servon & Visser, 2011). It has long been believed that increasing gender diversity in the workplace requires the presence of women in SET careers. Ethnic and gender diversity has been promoted by academics as beneficial to science, performance, and enterprises (Servon & Visser, 2011). Even though studies have shown how important it is for women to be in the field, there is also evidence that women face barriers to job growth and retention. Although women's engagement in SET careers has increased because of gender equity legislation over the past 20 years, this gain has not been smoothly translated into women's participation in SET workforces. Rather, studies show that many women are impacted by what seems to be a leaky pipeline in the SET sector, and that most women who earn graduate degrees in these fields go on to pursue positions in higher education. More precisely, problems with the professionalization and masculine social conceptions of the sector seem to be the cause of this leaky pipeline (Servon & Visser, 2011).

We argue that gender disparities that hinder women's involvement and contribution in STEM are ultimately detrimental to economic, national, and social growth in addition to scientific and technological advancement. (Leggon, et al, 2015).

Key Statistics on Women in STEM in the Philippines

The World Economic Forum's (WEF) 2025 Global Gender Gap Report, released in June 2025, shows that the Philippines has returned to the top 20 worldwide, moving up five spots to 20th out of 148 countries. Although the Philippines does quite well in terms of educational attainment and skill sets, there are still gaps in technical professions and leadership positions, particularly in STEM. However, there was a slight decrease in educational equality in the Philippines for the first time in a long time. In primary school, boys' net enrollment slightly exceeded girls', causing a 1.2 percentage point decline from full parity the year before.



PHILIPPINES GLOBAL GENDER GAP REPORT 2025

	2024		2025	
	Rank	Score	Rank	Score
Economic participation	25	0.775	13	0.790
Education	1	1	87	0.988
Health	86	0.968	85	0.967
Political Representation	34	0.373	30	0.377
GLOBAL INDEX	**25**	**0.779**	**20**	**0.781**

Figure 1. Philippines' Global Gender Gap Report (GGGR) *(Source: Philippine Commission on Women, 2025)*

The Global Gender Gap Report also showed that the country produces a large number of STEM graduates in comparison to other disciplines, although STEM fields are still dominated by men, as is the case with engineering and ICT. The nation's female graduates continue to excel in business, administration, and education as shown in Figure 2.

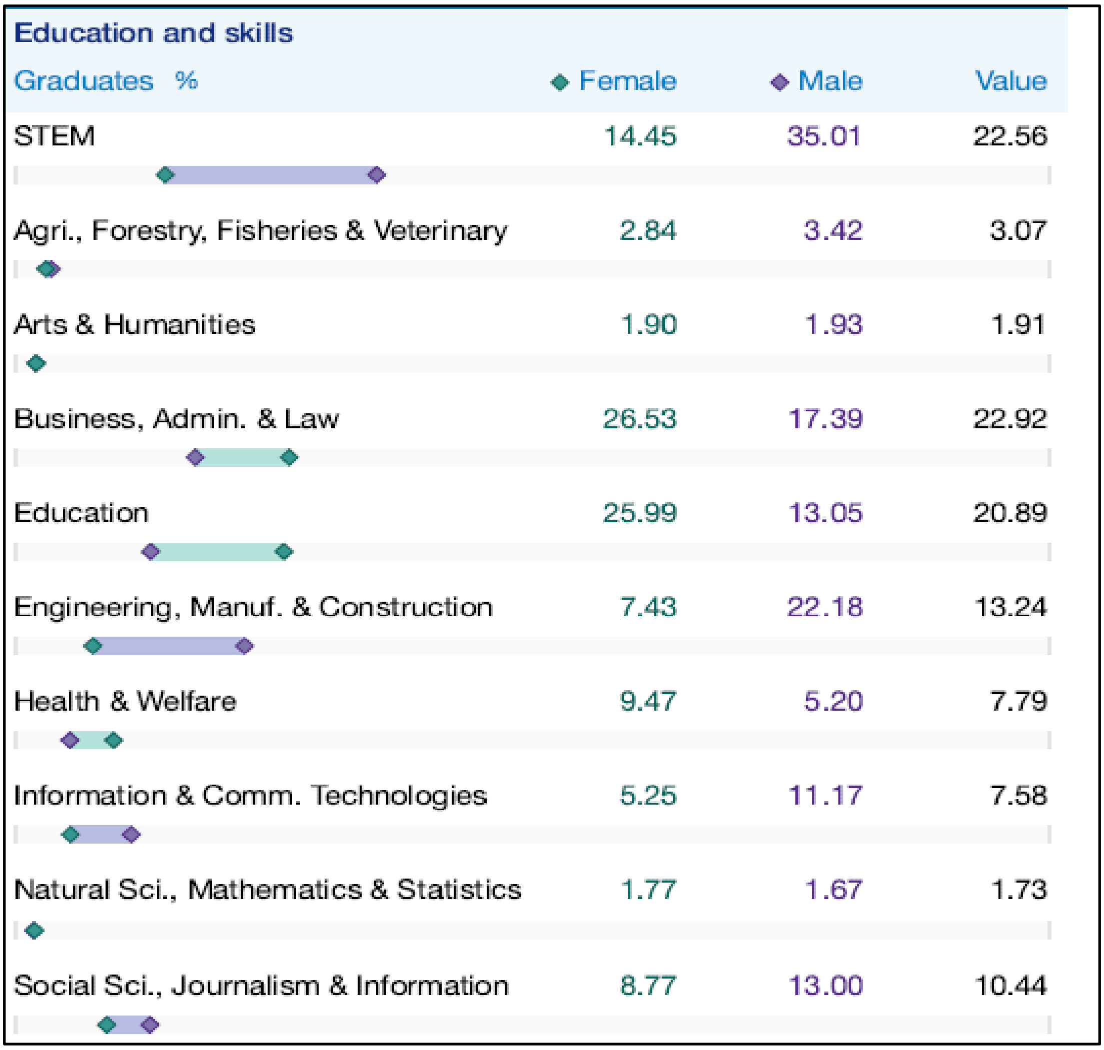


Figure 2. Complementary Targets and Contextual Indicators of the GGGR under Education and Skills *(Source: World Economic Forum's GGGR, 2025)*

Figure 2 shows the distribution of graduates by field of study and sex, revealing persistent gendered patterns in education. Men dominate in STEM (35.01% vs. 14.45%), Engineering, Manufacturing, and Construction (22.18% vs. 7.43%), and Information and Communication Technologies (11.17% vs. 5.25%), reflecting the enduring underrepresentation of women in technical fields linked to higher economic returns. Conversely, women outnumber men in Education (25.99% vs. 13.05%), Business, Administration, and Law (26.53% vs. 17.39%), and Health and Welfare (9.47% vs. 5.20%), aligning with traditional associations of women with caregiving and administrative professions. More balanced distributions are observed in Arts and Humanities, Natural Sciences and Mathematics, and Agriculture, though the overall shares remain small (World Economic Forum, 2025). These patterns highlight how cultural norms and systemic barriers continue to shape women's and men's educational pathways, with lasting implications for wage equality, career mobility, and leadership opportunities.

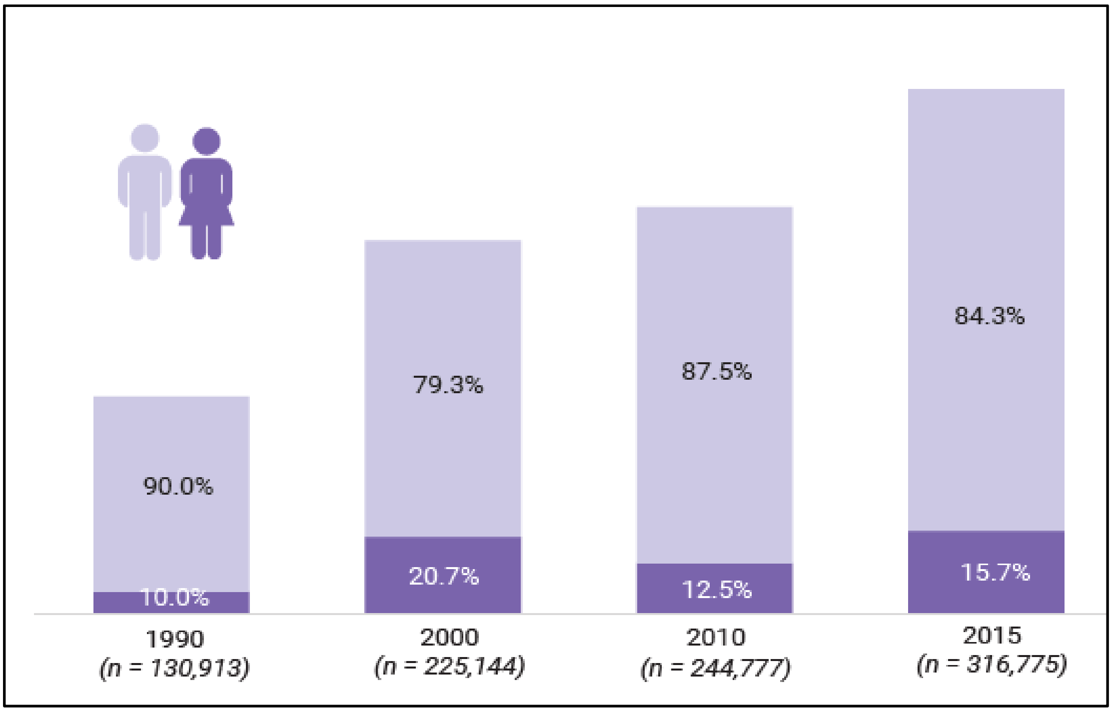


Figure 3. Number of Engineers, Architects in the Philippines and related occupations by sex, 1990 to 2015. *(Source: DOST-SEI)*

Figure 3 shows the gender distribution of engineers, architects, and related professionals in the Philippines from 1990 to 2015, showing a persistent male dominance despite gradual increases in female representation. In 1990, only 10% of workers in these fields were women compared to 90% men, but by 2000 women's participation rose to 20.7%. However, the share of women declined to 12.5% in 2010 before slightly increasing again to 15.7% in 2015. Overall, while female participation in engineering and architecture-related professions has improved since 1990, men continue to comprise the overwhelming majority, with 84.3% in 2015, reflecting the enduring gender gap in technical professions despite some signs of progress (Department of Science and Technology Science Education Institute, 2021).

Women in S&T occupations are also most prevalent in the nursing and midwifery (74.4%) and health (66.2%) sectors, according to the 2015 census, as shown in Figure 4. It is important to keep in mind that the vocations listed are based on the household member's usual employment or activities over the past 12 months.

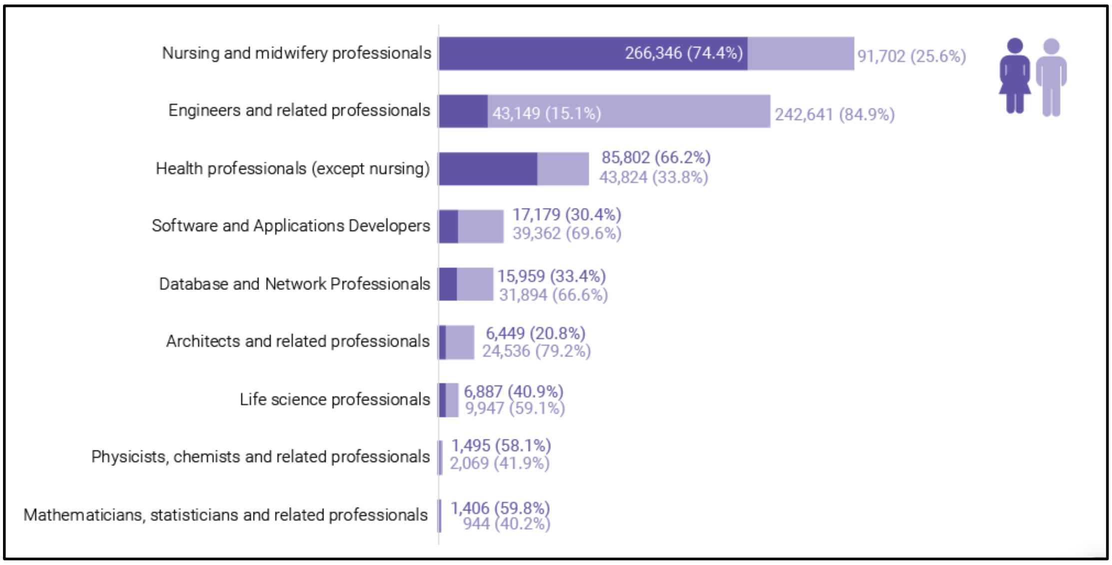


Figure 4. Number of workforce by S&T occupation and sex, 2015. *(Source: DOST-SEI)*

Overall, the data demonstrates that while women play a critical role in health sciences and are gradually increasing their presence in select STEM fields, systemic gender imbalances endure in engineering, ICT, and architecture, signaling the need for policies and programs that encourage women's greater participation in these high-value professions.

Women only make up a small portion of the science and technology sector globally, which highlights the critical need for policies that support capacity building and contribute knowledge and skills development, leadership and vision, and perspectives and aspirations to the agenda for science and technology as well as to the general well-being of society. Women have been excluded from better jobs and are viewed more as a backup human resource, even in cases where there seems to be an overall gender balance among researchers. Across all nations, women continue to be the least integrated into the STEM workforce. Beyond issues of rights and social justice, women's underrepresentation in STEM results in a substantial loss of scientific human capital for advancement (Leggon, et al., 2015).

Challenges Facing Women in STEM

Why does this gap persist? First, gender stereotypes and cultural expectations discourage women from pursuing or staying in STEM careers. Second, work-life balance constraints—especially around caregiving and societal roles—impact career progression. Third, the lack of mentorship and leadership representation. Seeing is believing, and when women don't see themselves in top roles, it affects aspirations. Finally, the limited institutional support for women-led research, innovation, and entrepreneurship.

Gender Stereotypes and Cultural Expectations

Research has shown that prejudice in the workplace and organizational policies hinder women's ability to advance in their careers. Such institutional failure is a significant deterrent and obstacle to female STEM involvement, with a cascade effect (The Hindu, 2013). Like in other developed and developing nations, women still experience gender disparities in terms of job satisfaction, income level, and recognition from colleagues and society at large, regardless of their professional acumen, "even when obligations at home are solved and the conflict between professional and traditional roles is defeated." (Zubieta 2006:192). Moreover, the issue in many nations is not just getting women interested in STEM fields; more importantly, it is changing the attitudes of both men and women and removing other social barriers that prevent them from pursuing STEM (Leggon, et al, 2015).

Work-Life Balance Constraints

Women manage the demands of their homes, jobs, and involvement in the community. The status of women in the workforce generally and in the STEM workforce specifically is impacted by these factors (Leggon et. al, 2015). For working women, maintaining a healthy work-life balance is crucial, especially in the current environment when women face several obstacles and issues in both the home and the workplace. According to a review of the research, working women find it more difficult than men to balance job and family, and they encounter conflict because work-related issues affect their homes more often than work-related issues. A study by Sundaresan (2014) on the implications of work-life balance to working women found that due to longer work hours, the majority of working women feel work-related stress at home. High levels of stress and worry, marital discord, job burnout, and an inability to reach one's full potential are all major effects of a poor work-life balance. Their inability to strike a balance between job and family life frequently causes them to feel angry and resentful. Additionally, once women begin establishing their families; they start dropping out of their professions, they become mothers/homemakers and abandon their professional goals.

Lack of Mentorship and Leadership Representation

Women's engagement and presence in managerial roles in the science, engineering, and technology sectors have increased during the past 20 years. Although participation rates have gone up, there are still few women in SET professions being retained and promoted to senior positions, particularly in the private sector. Because of this, a lot of SET companies in the private for-profit sector have started to voice their concerns about the underrepresentation of women in leadership and officer roles in various disciplines (Leggon et al, 2015).

Industry Engagement and Inclusion

Industry engagement is key. More women are entering traditionally male-dominated sectors like tech, construction, and energy. Companies are also adopting diversity and inclusion programs, while engineering organizations are building mentorship and support systems. Role models and career mentoring play a vital role in this cultural shift.

Policies and HR Interventions

The social, political, and economic potential of the next generation of women may change if "co-ed institutions should also work toward gender equity, including promoting leadership opportunities for female students," according to a study on women's higher education in Asia (Servon & Visser, 2011). Moreover, effective HR policies can make a difference. Examples include: Flexible work hours and telecommuting, safe spaces and anti-harassment measures, intentional promotion of women to leadership, and support for work-life integration and parental leave. These are not perks but enablers of gender-inclusive success.

Recommended Strategic Actions

To accelerate progress in closing gender gaps in science, technology, engineering, and mathematics (STEM), a multifaceted strategy is essential. First, increased investment in STEM training for women is needed to provide equitable access to quality education, scholarships, and capacity-building programs that prepare women for high-demand careers in technology and innovation. Complementing this, national mentorship and networking initiatives should be established to connect aspiring female students and professionals with role models, industry leaders, and academic experts who can guide their career development and help dismantle stereotypes.

Equally important are institutional gender audits and stronger data collection mechanisms, which ensure accountability by regularly assessing gender equality within schools, universities, and workplaces, while also identifying gaps that require policy or programmatic intervention. Finally, recognizing and rewarding inclusive practices in schools, companies, and government institutions will not only highlight best practices but also encourage replication of models that have proven effective in promoting gender equity. These actions demand sustained commitment, coordination, and courage across government, academia, and the private sector to transform systems, foster inclusivity, and ensure that women are empowered to fully contribute to STEM and national development.

Conclusion and Call to Action

In closing, the pursuit of gender equity in STEM is not solely a matter of empowering women; it is a transformative endeavor that enriches society as a whole by fostering innovation, competitiveness, and sustainable development. To achieve this, we must educate boldly by ensuring equal access to quality STEM education and dismantling barriers that deter women from pursuing technical fields. We must mentor consistently, building networks of guidance and support that cultivate confidence, leadership, and resilience among women and girls in STEM.

We must lead inclusively, embedding gender-responsive policies and practices within institutions, industries, and communities so that diversity becomes a cornerstone of progress. This shared responsibility calls for unwavering commitment across sectors to make science and engineering a space where all individuals can thrive and contribute meaningfully. I invite your thoughts, questions, and ideas on how we can collaborate to shape a more inclusive, equitable, and innovative future for STEM in the Philippines.

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Breaking Waves: Empowering Women in Marine Science in Thailand

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Abstract

Women across the Asia-Pacific region play a critical role in advancing scientific knowledge, environmental conservation, and community engagement. Yet, gender inequality persists across many STEM fields, including marine science. This paper examines the evolving landscape for Thai women in marine science, highlighting structural and cultural challenges they face, and proposing evidence-based pathways to promote gender equality and inclusive leadership. Drawing on global research and Thailand's unique context, this work demonstrates that empowering women in marine science is essential for achieving sustainable and effective ocean conservation.

Keywords: Gender equality, women in STEM, marine science, Thailand, ocean conservation, leadership, career advancement

Introduction

Women across the Asia-Pacific region play a critical role in advancing scientific knowledge, environmental conservation, and community engagement. Yet, gender inequality persists across many STEM fields, including marine science. This paper summarizes my presentation for the *Women in STEM Conference*, highlighting the evolving landscape for Thai women in marine science, the structural and cultural challenges they face, and the pathways needed to promote gender equality and inclusive leadership.

Gender equality and women's empowerment represent one of 17 Global Goals in the United Nations 2030 Agenda for Sustainable Development [1]. Despite this global commitment, women continue to face biases and barriers throughout their scientific careers, from publishing and funding to hiring and promotion to senior positions [1, 3, 4]. These challenges are particularly pronounced in marine science and conservation, where women remain significantly underrepresented in leadership roles and decision-making positions [1, 8].

Historical Context: Gender Bias in Marine Science

Although Thailand has made significant progress in women's education and workforce participation, marine science has historically been a male-dominated field. Old job advertisements from two decades ago illustrate explicit preferences for men even for scientific roles where gender has no relevance to performance. This structural bias reflected deeper societal norms that shaped career opportunities for women.

Research by Giakoumi et al. (2021) confirms persistent gender disparities in marine conservation globally [1]. Their comprehensive study of European marine science institutions revealed that women remain underrepresented in leadership positions, research cruises, field-intensive studies, and policy-level decision making. Specifically, women occupied only 13% to 24% of senior positions across major research institutes, despite representing nearly half of early-career researchers [1]. These patterns resonate strongly with the Thai experience and reflect a global phenomenon known as the leaky pipeline [3, 5, 6].

Similar patterns have been documented in oceanography [3], fisheries science [4], and coastal research [12], demonstrating that gender bias in marine science is both deeply ingrained and self-perpetuating across different sub-disciplines and geographic regions [5, 6].

Thailand's Gender Equality Landscape

Based on the World Economic Forum's Gender Gap Index Thailand performs strongly in several areas [2, 19]:

- Educational Attainment: High levels of women's participation in science and higher education
- Health: Comparable metrics between men and women
- Economy: Improvements in women's involvement in scientific careers, entrepreneurship, and conservation roles

However, significant gaps remain in:

- Economic opportunity at senior levels
- STEM career progression
- Political empowerment and representation in science governance

This gap between early-career participation and leadership advancement highlights the leaky pipeline that disproportionately affects women [1, 3, 5]. While Thailand ranks favorably in the Global Gender Gap Index overall, the persistence of gender disparities in senior scientific positions mirrors global trends observed in both developed and developing nations [1, 20].

Challenges Faced by Women in Marine Science

Women entering marine science continue to encounter several barriers, as documented extensively in recent literature:

1. Cultural Expectations and Gender Norms

Fieldwork requiring extended time at sea is often perceived as unsuitable for women due to safety concerns, caregiving roles, or lingering stereotypes [7, 12]. Research on women in coastal sciences reveals that these perceptions create significant obstacles to full participation in field-intensive research [12].

2. Male-Dominated Research Environments

Many leadership structures, committees, and expedition teams remain male-heavy, limiting networking access and mentorship opportunities for women [1, 5, 6]. Studies of international marine science conferences show that women, particularly early-career researchers, participate at lower rates and face greater barriers to visibility and recognition [5].

3. Implicit Bias and Stereotyping

Women often face assumptions about physical ability, emotional resilience, or scientific authority barriers rarely imposed on male colleagues [1, 4, 12]. These biases manifest in hiring decisions, grant evaluations, publication citations, and leadership selections [1, 3].

4. Work-Life Balance Pressures

Career advancement often coincides with major family responsibilities, creating additional stress and career constraints for women [1, 11, 15]. The lack of institutional support for work-life balance represents one of the most significant barriers to women's retention and advancement in marine science [11, 12].

These challenges reduce visibility, slow career progression, and discourage young women from entering or remaining in ocean science fields [1, 4, 8, 14]. Moreover, the intersection of gender with other dimensions of diversity including race, ethnicity, and socioeconomic status can compound these barriers [17].

Progress and Strengths in the Thai Context

Despite these obstacles, Thailand has several strengths that position it well for accelerating gender equality in marine science:

- High educational attainment among women, particularly in biology, environmental science, and marine-related disciplines [2, 19]
- Strong presence of women leaders in universities, conservation NGOs, and government science programs

- Growing national awareness of gender equality, fostered by international commitments and regional collaborations [2, 19, 20]
- Active youth engagement in conservation, where girls are increasingly becoming visible ambassadors of ocean stewardship [8, 9]

These strengths form a foundation for systemic advancement and align with successful initiatives documented in other regions [3, 9, 11].

Conclusion

Women in Thailand and across the Asia-Pacific are making remarkable contributions to marine science advancing research, driving community engagement, and shaping the future of ocean sustainability. Yet, persistent gender barriers continue to limit the diversity and strength of the field.

By promoting inclusive systems, supporting women scientists through all career stages, and increasing visibility of diverse female role models, we can create a more equitable and resilient scientific community. The evidence is clear: gender diversity in marine science leads to more innovative research, better conservation outcomes, and more effective policy solutions [1, 8].

Empowering women in STEM is not only a matter of fairness; it is essential for achieving sustainable and effective ocean conservation in a rapidly changing world [1, 9, 18]. Thailand's strengths in education, regional collaboration, and growing awareness of gender equality provide a solid foundation for leadership in this critical area.

The time for action is now. By implementing evidence-based strategies and learning from successful programs worldwide, Thailand can become a regional leader in promoting gender equality in marine science creating pathways for the next generation of women ocean scientists and conservation leaders.

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Utilization Strategies for Korean Senior Female Scientists and Engineers in the Era of Population Decline

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Summary

As population decline intensifies, growing attention is being paid to potential workforce groups such as women, older adults, and foreigners who could help fill labor shortages. This study explores strategies to utilize senior female scientists and engineers, a subset of the female workforce..

Using data from the Regional Employment Survey (first half of 2022) and the Survey on Research and Development Activities (2002–2021), the study estimated the population size of Korean senior female scientists and engineers by occupation. Special focus was placed on female researchers aged 50 and older, whose positions generally require long-term skill accumulation. The total number of senior female scientists and engineers is approximately 79,000, of which only 8.1% (6,458 individuals) are employed in science and technology occupations. The remaining 91.9% (72,797 individuals) work in science and technology–related occupations. Among researchers, a group that requires particularly long-term expertise, the share of senior workers has been increasing since the early 2010s. As of 2021, there were 90,860 male researchers aged 50 and older and 10,890 female researchers in the same age bracket. Among those aged 60 and above, 20,939 were men and 1,739 were women (2021 figures).

Next, using the Pilot Survey on Career Status of Male and Female Scientists and Engineers (2021) conducted by the Korea Foundation for Women in Science, Engineering and Technology (WISET), the study analyzed the post-retirement aspirations of mid- to late-career female scientists and engineers (366 respondents) and identified policy needs for their effective utilization. The most desired activities after (mandatory) retirement were hobbies and leisure (42.9%) and social service, talent donation, and public contribution (21.4%). Meanwhile, 33.6% expressed interest in employment or entrepreneurship. When asked about programs they would most like to participate in to prepare for retirement, respondents pointed to social contribution programs (26.5%) and post-retirement life planning and psychological counseling programs (26.5%). In contrast, relatively few women hoped to receive re-employment training (10.2%) or entrepreneurship preparation training (9.2%).

Based on these findings, the study proposes the following strategies for utilizing senior female scientists and engineers:
1) Establish systems to allow university professors to continue research after mandatory retirement; 2) Reinstate the retirement age of 65 at government-funded research institutes; 3) Operate career planning and development coaching programs for senior female scientists and engineers; 4) Expand social contribution opportunities that align with their aspirations and develop new initiatives to support these; 5) Identify and promote best practices; 6) Conduct follow-up studies on career development; 7) Create staff scientist positions; and 8) Establish and operate policy networks dedicated to their utilization.

1. Introduction

South Korea ranks among the leading countries worldwide in terms of R&D expenditure and the size of its research workforce. In 2021, national R&D expenditure amounted to 102.1352 trillion KRW, placing Korea 5th globally. As a share of GDP, R&D investment stood at 4.93%, second only to Israel (5.44%) (Ministry of Science and ICT et al., 2023:4). The number of researchers, measured in FTE (Full-Time Equivalent), reached 470,728 in 2021, the 4th highest in the world, and the number of researchers per 1,000 economically active persons was 16.7, the highest among major countries (Ministry of Science and ICT, 2023:25).

Globally, the advancement of digital transformation and convergence technologies is intensifying competition for technological leadership among major economies. Securing the scientific and technological workforce necessary to develop advanced technologies has therefore become critical. However, South Korea is projected to experience a rapid population decline compared to other advanced economies, raising concerns about future difficulties in supplying sufficient S&T personnel. According to Statistics Korea, the national population peaked at 52 million in 2022, but is projected to decline to 50 million by 2040 and 38 million by 2070. Meanwhile, the proportion of the elderly population (65+) is expected to rise from 17.5% in 2022 to 34.4% in 2040 and 46.4% in 2070 (Statistics Korea, 2022:2–6).

The decline in the youth population began in the early 2000s. The population of young people aged 15–29 peaked at 11.24 million in 2000 and fell to 8.57 million in 2022, a decline of 23.8% (-2.67 million) (calculated using Statistics Korea's KOSIS Economic Activity Population DB). Similarly, analysis of the Ministry of Education's Higher Education Statistics Survey shows that both total university entrants and entrants into science and engineering degree programs began to decline in the early 2000s. Entrants into higher education institutions (junior college and above) peaked at 839,516 in 2001 but fell to 694,601 in 2022 (-144,915). Entrants into science and engineering degree programs declined from 343,280 in 2001 to 241,095 in 2022 (-102,185) (Korean Educational Development Institute, datasets for 1999–2022).

According to the Mid- to Long-Term Forecast of Supply and Demand for S&T Human Resources, 2019–2028 by the Korea Institute of S&T Evaluation and Planning (KISTEP), there will be a shortage of around 10,000 S&T workers with associate degrees or higher over the 2019–2028 period. Specifically, shortages are expected at the bachelor's level (≈47,000) and doctoral level (≈3,000), while an oversupply is projected at the associate (≈37,000) and master's levels (≈2,000) (Lee Jeong-jae et al., 2019:106). The 4th Basic Plan for the Development and Support of S&T Talent (2021–2025) similarly projected shortages of new entrants into S&T fields due to declining eligible student populations: 800 fewer entrants in 2019–2023 and 47,000 fewer in 2024–2028 (Ministry of Science and ICT, 2021:8).

Because highly skilled S&T personnel cannot be trained in the short term, the government has adopted policies not only to nurture the next generation but also to strengthen the capabilities of incumbent personnel, expand opportunities for women and senior scientists and engineers, and attract foreign talent.

This study aims to explore strategies for utilizing senior female scientists and engineers in order to maintain and enhance the size and quality of the S&T workforce amid population decline. Although prior research has examined the utilization of senior S&T personnel (Lee Byung-min et al., 2002; Kim Hyun-su et al., 2013; Joo Hye-jung et al., 2019; Kim In-ja et al., 2023; Ahn Dong-man et al., 2023), gender-specific analyses remain scarce, given the minority status of women within this group.

The research questions guiding this study are as follows:
1) What is the population size and demographic profile of senior female scientists and engineers?
2) What kinds of lives do they envision after retirement?
3) What policies are needed to better utilize their expertise?

Senior female scientists and engineers have likely faced significant challenges as minorities in male-dominated organizations from their student years through to their senior careers. After mandatory retirement, they may again face difficulties as pioneers striving to maintain professional careers. Given their rarity and the potential contributions they can make not only as scientists and engineers but also as leaders in social contribution, there is a strong need for policy support tailored to their characteristics to expand their utilization.

2. Prior Research Results

a. Definition of Senior Female Scientists and Engineers

Although policies to utilize senior scientists and engineers have been in place since 2002, prior empirical research on their status and career trajectories remains limited, with relatively few recent studies. To understand the status of senior female scientists and engineers, a definition of “senior” is first required, yet what constitutes “senior” varies widely by researcher. Kim Hyun-su et al. (2013), Choi Jae-young et al. (2014), Heo A-rang & Kim Geun-se (2013), and Kim In-ja et al. (2023) define seniors as those nearing retirement or already retired, implicitly assuming that most seniors are retirees in their 50s–60s or older.

Considering career interruptions and difficulties with promotion/appointments, Kim So-young & Choi Hye-won (2018) argue that the scope of senior female scientists and engineers should include, in addition to those nearing or past retirement, women with career breaks and women who have changed jobs. Oh Myung-sook et al. (2022:8) define senior female S&T personnel in industry as women in the maturity or late career stage aged 45 or older who are currently employed in industry or who left their primary job for involuntary reasons other than pregnancy, childbirth, or childcare, and who have changed or are preparing to change jobs. Their age threshold of 45+ is based on prior findings that career exit in industry often occurs between the 40s and 50s (Hong, 2015) (Oh et al., 2022:1).

For reference, the ReSEAT (Retired Scientists and Engineers as Advisors to Technology) program defines eligible seniors as individuals aged 50+ who have retired from domestic S&T institutions—including research institutes, S&T-related organizations, universities, and corporate R&D centers—who are not employed full-time or as regular staff elsewhere and who meet specific criteria (e.g., senior-level positions in government-funded or local research institutes; associate professor or above at universities; senior technical managers or ≥20 years of research experience in industry; or ≥20 years of experience in S&T policy at central/local governments) (Korea Science and Technology Support Center, “Eligibility Criteria for Senior Scientists and Engineers,” last accessed Apr. 23, 2023).

An operational definition of “female scientists and engineers” is also required. Under the Enforcement Decree of the Act on Fostering and Supporting Women in Science and Technology, a “woman scientist/engineer” includes women with degrees in science or engineering from higher education institutions; women with industrial engineer or higher qualifications under the National Technical Qualifications Act; and women recognized by the Minister of Science and ICT as having equivalent degrees or qualifications (last accessed Apr. 23, 2023). This definition requires a STEM degree/qualification but does not restrict employment status, occupation, or industry. Thus, women who graduated in STEM but have never been employed—or whose jobs are unrelated to their major—are included.

However, for senior female S&T personnel, career experience is essential to accumulate high-level skills, and the occupational scope should be limited to S&T occupations or related occupations. For defining S&T occupations and related occupations, we follow Lee Jeong-jae et al. (2019), who classify S&T-related jobs into S&T occupations ('science professionals and related workers'; 'ICT professionals and technicians'; 'engineering professionals and technicians'; plus 'university professors and lecturers (science/engineering/medicine)' and 'technical sales') and S&T-related occupations ('managers in research, healthcare, and ICT'; 'health professionals and associate health professionals'; and 'secondary school teachers in math/science') (see Table 1).

Table 1 Science and Technology-Related Occupations by the 7th Korean Standard Classification of Occupations (KSCO)

Classification of Science and Technology Occupations			7th Korean Standard Classification of Occupations (KSCO)	
Primary Category	Secondary Category	Tertiary Category	Classification Code	Note
Science and Technology Occupations	Science Professionals and Related Occupations	Life and Natural Science Professionals	211	
		Humanities and Social Science Professionals	212	
		Life and Natural Science Testers	213	
	ICT Professionals and Technicians	Computer Hardware and Communications Engineering Professionals	221	
		Computer Systems and Software Professionals	222	
		Data and Network Professionals	223	
		formation Systems and Web Operators	224	
		Telecommunications and Broadcasting Transmission Equipment Technicians	225	
	Engineering Professionals and Technicians	Architectural and Civil Engineering Technologists and Testers	231	
		Chemical Engineering Technologists and Testers	232	
		Metallurgical and Materials Engineering Technologists and Testers	233	
		Electrical and Electronic Engineering Technologists and Testers	234	
		Mechanical and Robotics Engineering Technologists and Testers	235	
		Fire and Disaster Prevention Technologists and Safety Officers	236	
		Environmental Engineering, Gas, and Energy Technologists and Testers	237	
		Aircraft and Ship Engineers and Air Traffic Controllers	238	
		Other Engineering Professionals and Related Occupations	239	
	University Professors and Lecturers (Natural Sciences, Engineering, and Medical Sciences Fields)		251	Science, Engineering, and Medical Fields Only
	Technical Salespersons		2743	Subcategories
Science and Technology-Related Occupations	Managers in Research, Health Care, and ICT		1311, 1331, 135	Some Subcategories
	Health Professionals and Associate Health Professionals	Health Professionals	241	
		Pharmacists and Oriental Pharmacists	242	
		Nursing Professionals	243	
		Dietitians and Nutritionists	244	
		Therapists, Rehabilitation Professionals and Medical Technologists	245	
		Health Care Workers	246	
	Secondary School Teachers(Mathematics and Science Fields)		252	Mathematics and Science Fields Only

Source: Lee, J.-J., et al. (2019:67). Mid- to Long-term Supply and Demand Forecast of Science and Technology Personnel, 2019–2028. Ministry of Science and ICT & National Research Foundation of Korea.

b. Population Size of Senior Scientists and Engineers

Only a handful of prior studies have estimated the population size of senior S&T personnel, and results vary depending on how "senior" is defined and on the underlying data. Excluding Kim In-ja et al. (2023), most are dated studies that proxied seniors by the number of researchers in typical retirement-age brackets due to lack of data on actual retirees. Specifically: Kim In-ja et al. (2023) used the Survey of Research and Development in Korea to analyze the number of researchers aged 50+ by age group and sector and, using internal data from the National Research Council of Science & Technology, examined retiree numbers at government-funded research institutes (GFRIs): 297 (2019), 364 (2020), 366 (2021). The number of researchers aged 50+ was 93,234 in 2020 (Kim et al., 2023:32–34). Choi Jae-young et al. (2014) used the Science and Technology Statistical Yearbook to examine 60+ researchers, finding an increase from 4,563 (2008) to 6,715 (2012), with their share rising from 1.3% (2003) to 1.7% (2012). Kim Hyun-su et al. (2013) analyzed the Economically Active Population Survey and estimated 490,000 employed S&T workers in their 50s and about 71,000 aged 60+ (2012). Lee Byung-min, Lee Ki-ho & Yoo Young-bok (2002) reported 414 researchers aged 50+ across 15 GFRIs (data source not specified), indicating scholarly interest in senior S&T utilization even two decades ago.

These studies did not break out women due to their very low share. Regarding senior female S&T personnel, Oh Myung-sook et al. (2022) treated it as a key research question and, using the 2019 Industrial Technology Workforce Supply and Demand Survey, estimated 10,000–30,000 senior female S&T personnel in industry. In addition, WISET (2023) provides counts of women aged 50+ working in STEM at universities, public research institutes, and private corporate labs: 9,020 women aged 50+, of whom 7,023 (77.9%) at universities, 1,453 (16.1%) at public research institutes, and 544 (6.0%) at private corporate labs (2021).
Among women in STEM at universities (total 21,795), those aged 50+ numbered 7,023 (5,347 in their 50s; 1,676 aged 60+). Employment types among women 50+ show the largest shares for tenured professors (50s: 40.3%; 60+: 46.2%), with non-tenure-track professors at 26.6% and 34.4%, and lecturers at 29.9% and 18.3%, respectively (WISET, 2023:31). In public research institutes, women in STEM total 11,303, with 1,453 aged 50+ (1,335 in their 50s; 118 aged 60+). By tenure, women with 10–20 years' service number 1,698 (15.0%), and those with ≥20 years number 1,198 (10.6%). Among women aged 50+ in public institutes, 16.4% are non-regular employees (WISET, 2023:35). In private corporate labs, women in STEM total 22,776, with 544 aged 50+ (495 in their 50s; 49 aged 60+). By tenure, 2,186 women (9.6%) have 10–20 years' service and 215 (0.9%) have ≥20 years (WISET, 2023:42). Non-regular employment is rare in private labs.

Aggregating across universities (excluding lecturers and other researchers), public institutes, and private labs, women in STEM totaled 45,183 in 2021; among them, 5,408 (12.0%) were 50–59, and 1,517 (3.4%) were 60+. By tenure, 5,584 (12.4%) had 10–20 years' service and 2,683 (5.9%) had ≥20 years. (See Table 2.)

Table 2 Status of Female Science and Technology Personnel in Science and Engineering Fields by Age and Years of Service (2021) at Universities, Public Research Institutes, and Private Sector Research Organizations

Status of Female Science and Technology Personnel by Age Group			Status of Female Science and Technology Personnel by Years of Service		
Age Group	Population (Persons)	Percentage (%)	Years of Service	Population (Persons)	Percentage (%)
≤29 years old	10,491	23.2	<3 years	17,948	39.7
30~39 years old	16,863	37.3	<5 years	9,890	21.9
40~49 years old	10,904	24.1	<10 years	9,078	20.1
50~59 years old	5,408	12.0	<20 years	5,584	12.4
≥60 years old	1,517	3.4	≥20 years	2,683	5.9
Total	45,183	100.0	Total	45,183	100.0

Note: For universities in science and engineering fields, years of service were surveyed only for full-time and part-time faculty. Therefore, instructors and other researchers (estimated 9,691 individuals) were excluded from the age group Percentage.
Source: Korea Foundation for Women in Science, Engineering and Technology (WISET) (2023). 2021 Survey on the Utilization of Female Science and Technology Personnel.

3. Status of Senior Female Scientists and Engineers

This study analyzes the size and characteristics of senior S&T personnel using Statistics Korea's Regional Employment Survey (first half of 2022) and the Survey of Research and Development in Korea (2002–2021) by the Ministry of Science and ICT and KISTEP. The Regional Employment Survey is used for population size, gender/age/occupation/education distributions, and the R&D Activities Survey is used to focus on researchers who require long-term skill accumulation.

a. Findings from the Regional Employment Survey (H1 2022)

The survey covers all household members aged 15+ nationwide; the H1 2022 sample comprises 425,439 persons. Here, a senior S&T worker is defined as someone who (1) works in an S&T occupation or related occupation; (2) holds an associate degree or higher; (3) majored in a STEM field for the highest degree; and (4) falls within age thresholds corresponding to expected retirement windows by industry—55+ for professional S&T (industry code 70) and public administration/defense (84); 60+ for education (85); and 50+ for all other industries (1–68, 74, 86–99). We adopt Lee et al. (2019) for the scope of occupations (Table 1). Because the survey's occupation codes are three digits, some four-digit categories (e.g., technical sales, managers in research/healthcare/ICT) are excluded. STEM majors are grouped into: (1) natural sciences, mathematics/statistics; (2) ICT; (3) engineering, manufacturing, construction; and (4) agriculture/forestry/fisheries/veterinary science. Note that using age as a proxy for seniority may over/under-estimate true seniority where tenure data are unavailable.

Under these criteria, the number of senior S&T workers is about 352,000, of whom women account for about 79,000 (22.5%). By occupation, engineering professionals/technicians constitute ~158,900 (45.22%); health professionals and associate health professionals 124,900 (35.5%); ICT professionals/technicians 49,500 (14.1%); university professors/lecturers (STEM/medical) 9,620 (2.7%); science professionals/related 5,584 (1.6%); ICT-related managers 1,791 (0.5%); and secondary school teachers (math/science) 1,506 (0.4%). Among men, 79.7% work in S&T occupations and 20.3% in related occupations; among women, 91.8% work in related occupations and only 8.1% in S&T occupations. For women, health professionals and associate health professionals account for 91.4%. Tables 3 and 4 present counts and shares by gender, occupation, and age group; women are concentrated in ages 50–54 and underrepresented at 60+ compared to men.

Table 3. Size of Senior S&T Workers by Gender, Occupation, and Age Group (H1 2022) — (Unit: persons)

Gender	Occupation		50~54 years old (persons)	55~59 years old (persons)	≥60 years old (persons)	Total (persons)
Male	Science and Technology Occupations	Science Professionals and Related Occupations	847	2,143	1,804	4,794
		ICT Professionals and Technicians	31,971	11,062	4,798	47,831
		Engineering Professionals and Technicians	46,020	51,600	58,270	155,890
		University Professors and Lecturers (Sciences, Engineering, and Medical Sciences Fields)	-	-	8,626	8,626
	Science and Technology-Related Occupations	Managers in Research, Health Care, and ICT	967	492	0	1,459
		Health Professionals and Associate Health Professionals	19,658	14,397	18,407	52,462
		Secondary School Teachers (Science and Engineering Majors)	-	-	1,506	1,506
	Subtotal		99,463	79,694	93,411	272,568

Gender	Occupation		50~54 years old (persons)	55~59 years old (persons)	≥60 years old (persons)	Total (persons)
Female	Science and Technology Occupations	Science Professionals and Related Occupations	232	331	227	790
		ICT Professionals and Technicians	1,345	324	0	1,669
		Engineering Professionals and Technicians	1,773	1,098	134	3,005
		University Professors and Lecturers (Sciences, Engineering, and Medical Sciences Fields)	-	-	994	994
	Science and Technology-Related Occupations	Managers in Research, Health Care, and ICT	332	0	0	332
		Health Professionals and Associate Health Professionals	35,013	25,327	12,125	72,465
		Secondary School Teachers (Science and Engineering Majors)	-	-	0	0
	Subtotal		38,695	27,080	13,480	79,255
Total	Science and Technology Occupations	Science Professionals and Related Occupations	1,079	2,474	2,031	5,584
		ICT Professionals and Technicians	33,316	11,386	4,798	49,500
		Engineering Professionals and Technicians	47,793	52,698	58,404	158,895
		University Professors and Lecturers (Sciences, Engineering, and Medical Sciences Fields)	-	-	9,620	9,620
	Science and Technology-Related Occupations	Managers in Research, Health Care, and ICT	1,299	492	0	1,791
		Health Professionals and Associate Health Professionals	54,671	39,724	30,532	124,927
		Secondary School Teachers (Science and Engineering Majors)	-	-	1,506	1,506
	Subtotal		138,158	106,774	106,891	351,823

Source: Statistics Korea (KOSTAT), Regional Employment Survey (First Half of 2022).

Table 4. Distribution (%) of Senior S&T Workers by Gender, Occupation, and Age Group (H1 2022) — (Unit: %)

Gender	Occupation		50~54 years old (%)	55~59 years old (%)	≥60 years old (%)	Total (%)
Male	Science and Technology Occupations	Science Professionals and Related Occupations	0.3	0.8	0.7	1.8
		ICT Professionals and Technicians	11.7	4.1	1.8	17.5
		Engineering Professionals and Technicians	16.9	18.9	21.4	57.2
		University Professors and Lecturers (Sciences, Engineering, and Medical Sciences Fields)	-	-	3.2	3.2
	Science and Technology-Related Occupations	Managers in Research, Health Care, and ICT	0.4	0.2	0	0.5
		Health Professionals and Associate Health Professionals	7.2	5.3	6.8	19.2
		Secondary School Teachers (Science and Engineering Majors)	-	-	0.6	0.6
	Subtotal		36.5	29.2	34.3	100.0

Gender	Occupation		50~54 years old (%)	55~59 years old (%)	≥60 years old (%)	Total (%)
Female	Science and Technology Occupations	Science Professionals and Related Occupations	0.3	0.4	0.3	1.0
		ICT Professionals and Technicians	1.7	0.4	0	2.1
		Engineering Professionals and Technicians	2.2	1.4	0.2	3.8
		University Professors and Lecturers (Sciences, Engineering, and Medical Sciences Fields)	-	-	1.3	1.3
	Science and Technology-Related Occupations	Managers in Research, Health Care, and ICT	0.4	0	0	0.4
		Health Professionals and Associate Health Professionals	44.2	32.0	15.3	91.4
		Secondary School Teachers (Science and Engineering Majors)	-	-	0	0
	Subtotal		48.8	34.2	17.0	100.0
Total	Science and Technology Occupations	Science Professionals and Related Occupations	0.3	0.7	0.6	1.6
		ICT Professionals and Technicians	9.5	3.2	1.4	14.1
		Engineering Professionals and Technicians	13.6	15.0	16.6	45.2
		University Professors and Lecturers (Sciences, Engineering, and Medical Sciences Fields)	-	-	2.7	2.7
	Science and Technology-Related Occupations	Managers in Research, Health Care, and ICT	0.4	0.1	0	0.5
		Health Professionals and Associate Health Professionals	15.5	11.3	8.7	35.5
		Secondary School Teachers (Science and Engineering Majors)	-	-	0.4	0.4
	Subtotal		39.3	30.3	30.4	100.0

Source: Statistics Korea (KOSTAT), Regional Employment Survey (First Half of 2022).

Table 5 presents counts and shares by gender, occupation, and academic degree. Overall women exhibit a higher share at the associate level and lower shares at bachelor/graduate levels relative to men. By occupation, women have lower education levels than men in ICT professionals/technicians and health professionals and associate health professionals, but slightly higher in engineering professionals/technicians and university professors/lecturers.

Table 5. Senior S&T Workers by Occupation, Gender, and Education Level (H1 2022) — (Unit: %, persons)

Occupation	Gender	Population (Persons)	Percentage (%)				Chi-square Analysis Results
			Associate Degree	Bachelor's Degree	Graduate Degree	Total	
Science Professionals and Related Occupations	Male	4,794	-	40.5	59.5	100.0	-
	Female	789	19.1	51.0	29.9	100.0	
	Total	5,583	2.7	41.9	55.3	100.0	
ICT Professionals and Technicians	Male	47,831	10.5	70.1	19.4	100.0	χ2=92.450 df=2 p <.001
	Female	1,669	17.9	65.6	16.5	100.0	
	Total	49,500	10.8	70.0	19.3	100.0	
Engineering Professionals and Technicians	Male	155,890	19.5	63.3	17.2	100.0	χ2=88.106 df=2 p <.001
	Female	3,005	12.7	68.7	18.6	100.0	
	Total	158,895	19.4	63.4	17.2	100.0	

Occupation	Gender	Population (Persons)	Percentage (%)				Chi-square Analysis Results
			Associate Degree	Bachelor's Degree	Graduate Degree	Total	
University Professors and Lecturers (Science, Engineering, and Medical Science Majors)	Male	8,626	-	13.5	86.5	100.0	χ2=7.593 df=2 p <.01
	Female	994	-	10.4	89.6	100.0	
	Total	9,620	-	13.2	86.8	100.0	
ICT-related Managers	Male	1,460	22.7	39.0	38.2	100.0	-
	Female	332	-	100.0	-	100.0	
	Total	1,792	18.5	50.3	31.1	100.0	
Health Professionals and Associate Health Professionals	Male	52,462	15.2	41.4	43.3	100.0	χ2=18700.307 df=2 p <.001
	Female	72,464	39.8	48.5	11.7	100.0	
	Total	124,926	29.5	45.5	25.0	100.0	
Secondary School Teachers (Science and Engineering Majors)	Male	1,506	-	59.3	40.7	100.0	-
	Female	-	-	-	-	-	
	Total	1,506	-	59.3	40.7	100.0	
Total	Male	272,569	16.1	58.2	25.8	100.0	χ2=18471.380 df=2 p <.001
	Female	79,253	37.4	49.4	13.2	100.0	
	Total	351,822	20.9	56.2	22.9	100.0	

Note: Cells marked with "(-)" indicate no employed individuals.
Source: Statistics Korea (KOSTAT), Regional Employment Survey (First Half of 2022).

Table 6. Tenure at Current Workplace among Senior S&T Workers (H1 2022) — (Unit: persons, %)

Years of Service at Current Workplace	Number of Highly Experienced Science and Technology Professionals (persons)			Percentage (%)		
	Male	Female	Total	Male	Female	Total
<5 years	92,220	29,602	121,822	33.8	37.3	34.6
5–<10 years	31,235	13,020	44,255	11.5	16.4	12.6
10–<15 years	25,421	9,196	34,617	9.3	11.6	9.8
15–<20 years	21,405	6,906	28,311	7.9	8.7	8.0
≥20 years	102,289	20,533	122,822	37.5	25.9	34.9
Total	272,570	79,257	351,827	100.0	100.0	100.0

Source: Statistics Korea(KOSTAT), Regional Employment Survey (First Half of 2022).

b. Findings from the Survey of Research and Development in Korea (2002–2021)

Focusing on R&D personnel, who require long-term skill accumulation, we use the Survey of Research and Development in Korea (institutions surveyed include public research institutes, universities and affiliated hospitals, medical institutions, and enterprises; 73,326 institutions in 2021). Counts below are headcounts (not FTE). In 2021, total researchers numbered 586,666; researchers aged 50+ numbered 101,750 (17.3%), and those aged 60+ numbered 22,678 (3.9%). Among women, 50+ numbered 10,890 and 60+ numbered 1,739. By affiliation among 50+: enterprises 59.2%, universities 30.7%, research institutes 10.1%; for women 50+: universities 60.5%, enterprises 28.0%, research institutes 11.5%. Among 60+, 46.8% in enterprises, 44.6% in universities, 8.5% in research institutes; among women 60+, 76.1% in universities. (see Table 7)

From 2002 to 2021, the number of 50+ researchers rose from 12,525 to 101,750 (×8.1), and their share from 6.6% to 17.3%. The aging trend is more pronounced among men: men 50+ rose from 6.9% to 19.9%, women 50+ from 4.1% to 8.4%. Similarly, 60+ researchers increased from 2,162 (1.1%) to 22,678 (3.9%), especially rapidly since the early 2010s. In 2021, women 60+ numbered 1,739 (1.3% of all women researchers) (see Tables 8 & 9).

Table 7. Distribution of Researchers Aged 50+ and 60+ by Gender and Affiliation Type (2021) — (Unit: %, persons)

Affiliation Type	Researchers Aged 50 and Above (%)			Researchers Aged 60 and Above (%)		
	Male	Female	Total	Male	Female	Total
Companies and Enterprises	62.9	28.0	59.2	49.2	19.0	46.8
University	27.1	60.5	30.7	42.0	76.1	44.6
Research Institution	9.9	11.5	10.1	8.8	4.9	8.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of Researchers (persons)	90,860	10,890	101,750	20,939	1,739	22,678

Notes:
1. Researchers aged 50 and above include those aged 60 and over.
2. Companies and Enterprises include private companies as well as government-invested and government-reinvested institutions. Universities include university-affiliated hospitals. Research institutes include national and public research institutes, national and public hospitals, private hospitals, government-funded research institutes, local government-funded research institutes, and other non-profit organizations.

Source: National Science & Technology Information Service (NTIS). Detailed Analysis of Science and Technology Statistics Database (Last accessed April 23, 2023).

Table 8. Trend in Number and Share of Researchers Aged 50+ (2002–2021) — (Unit: persons, %)

Reference Year	Researchers Aged 50 and Above (persons)			Researchers Aged 50 and Above (%)		
	Male	Female	Total	Male	Female	Total
2002	11,624	901	12,525	6.9	4.1	6.6
2005	15,914	1,212	17,126	7.8	4.0	7.3
2010	34,893	3,905	38,798	12.1	6.8	11.2
2015	54,266	5,457	59,723	14.8	6.4	13.2
2020	83,233	10,001	93,234	19.0	8.4	16.7
2021	90,860	10,890	101,750	19.9	8.4	17.3

Source: National Science & Technology Information Service (NTIS). Detailed Analysis of Science and Technology Statistics Database (Last accessed April 23, 2023).

Table 9. Trend in Number and Share of Researchers Aged 60+ (2002–2021) — (Unit: persons, %)

Reference Year	Researchers Aged 60 and Above (persons)			Researchers Aged 60 and Above (%)		
	Male	Female	Total	Male	Female	Total
2002	2,010	152	2,162	1.2	0.7	1.1
2005	2,431	158	2,589	1.2	0.5	1.1
2010	4,866	622	5,488	1.7	1.1	1.6
2015	10,046	842	10,888	2.7	1.0	2.4
2020	19,098	1,602	20,700	4.4	1.3	3.7
2021	20,939	1,739	22,678	4.6	1.3	3.9

Source: National Science & Technology Information Service (NTIS). Detailed Analysis of Science and Technology Statistics Database (Last accessed April 23, 2023).

4. Career Development Status of Senior Female Scientists and Engineers

a. Overview of the Analysis

To identify post-retirement aspirations, we analyzed WISET's Pilot Survey on the Career Status of Male and Female Scientists and Engineers (2021). The survey targeted employees at institutions similar to those covered by the 2021 WISET utilization survey (universities, public research institutes, and private firms with R&D centers; medical institutions excluded). Eligibility: (1) bachelor's degree or higher; (2) major in engineering or natural sciences; and (3) ≥1 year of full-time work at the current employer. A total of 1,510 individuals responded (907 men, 603 women). We focus on the 366 who self-identified as being in the career completion period (268 men, 98 women), defined as "the period from the peak of occupational activity to gradual decline," with a guideline of ≥15 years of full-time experience in the field and <10 years to retirement.

Among these 366 respondents (see Table 10), age distribution: ≤49 (31.7%), 50–59 (51.1%), ≥60 (17.2%). Women skew younger: ≤49 (41.8%), 50–59 (49.0%), ≥60 (9.2%). Tenure: ≥15 years—men 98.5%, women 94.9%. Highest degree: bachelor 27.9%, master 21.6%, PhD 50.5%; women have higher shares at bachelor/master and lower at PhD. Majors: engineering 63.9%, natural sciences 36.1%; women have lower engineering and higher natural sciences shares. Affiliation: universities 35.2%, public institutes 26.8%, private corporate labs 38.0%; women are less concentrated in universities and more in private labs. Residence: Seoul 23.5% (women 30.6%), Gyeonggi/Incheon 24.0%, other metropolitan/sejong 22.7%, other provinces 29.8%.

Table 10. Characteristics of scientists and engineers in career completion-stage (N=366) — (Unit: persons, %)

Personal Characteristics		Number of Respondents (persons)			Respondent Percentage (%)		
		Male	Female	Total	Male	Female	Total
Age Group	≤49 years old	75	41	116	28.0	41.8	31.7
	50–59 years old	139	48	187	51.9	49.0	51.1
	≥60 years old	54	9	63	20.1	9.2	17.2
Years of Full-Time Employment (Including Non-Regular Employees)	5–<10 years	2	0	2	0.7	0	0.5
	10–<15 years	2	5	7	0.7	5.1	1.9
	≥15 years	264	93	357	98.5	94.9	97.5
Final Academic Degree	Bachelor's Degree	64	38	102	23.9	38.8	27.9
	Master's Degree	53	26	79	19.8	26.5	21.6
	Doctoral Degree / PhD	151	34	185	56.3	34.7	50.5
Major of Final Academic Degree	Engineering	188	46	234	70.1	46.9	63.9
	Natural Sciences	80	52	132	29.9	53.1	36.1
Affiliation Type	Science and Engineering Universities	101	28	129	37.7	28.6	35.2
	Public Research Institutes	72	26	98	26.9	26.5	26.8
	Private Sector Research Institutes	95	44	139	35.4	44.9	38.0
Place of Residence	Seoul	56	30	86	20.9	30.6	23.5
	Gyeonggi and Incheon	65	23	88	24.3	23.5	24.0
	Metropolitan Cities (excluding Incheon) and Sejong Special Self-Governing City	63	20	83	23.5	20.4	22.7
	Provinces (excluding Gyeonggi)	84	25	109	31.3	25.5	29.8

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

b. Desired Life After Retirement and Preparation

When asked about the activity they most wish to pursue after (mandatory) retirement, more respondents preferred social contribution or hobbies/leisure over economic activities such as employment or entrepreneurship. Employment/entrepreneurship (subsistence employment 14.5%; non-subsistence 12.6%; start-up 8.7%) totaled 35.8%. Social contribution was 22.4%; hobbies/travel/leisure 40.7%. Differences by gender were not statistically significant.

Among those desiring employment, preferred types were full-time 35.4%, part-time 37.4%, and freelance 27.3%. Women were far less likely to prefer full-time (19.2% vs. men 41.1%) and more likely to prefer freelance (53.8% vs. men 17.8%). Among those preferring entrepreneurship, 81.3% sought technology-based start-ups.

Most believe preparation for post-retirement life should begin in one's 50s (46.7%) or 60s (34.2%). Currently, negative responses (not at all/hardly: 39.6%) slightly exceeded positive (somewhat/very: 30.4%), with women reporting more negatives (48.0%) than men (36.6%). The most desired programs for preparation were social contribution programs (29.0%) and post-retirement life planning/psychological counseling (24.3%), with relatively lower demand for re-employment training (14.8%) and start-up preparation (11.5%). Major obstacles cited were lack of financial leeway (29.8%) and lack of time (25.1%); lack of vision or motivation for a second life accounted for 12.6%; 18.3% reported no obstacles.
Tables 11–15 summarize preferences, employment/entrepreneurship types, preparation timing and degree, desired programs, and perceived obstacles.

Tables 11 Preferred Activities After (Mandatory) Retirement

Type of Activity	Number of Respondents (persons)			Respondent Percentage (%)		
	Male	Female	Total	Male	Female	Total
Income-Generating Employment	42	11	53	15.7	11.2	14.5
Non-Economic Employment	31	15	46	11.6	15.3	12.6
Business Start-Up	25	7	32	9.3	7.1	8.7
Volunteering and Social Contribution	61	21	82	22.8	21.4	22.4
Hobbies, Travel, and Leisure Activities	107	42	149	39.9	42.9	40.7
Other Activities	2	2	4	0.7	2.0	1.1
Total	268	98	366	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

Tables 12 Preferred Types of Employment and Business Start-Up After Retirement

Types of Employment and Business Start-Up		Number of Respondents (persons)			Respondent Percentage (%)		
		Male	Female	Total	Male	Female	Total
Types of Employment	Full-time	30	5	35	41.1	19.2	35.4
	Part-Time	30	7	37	41.1	26.9	37.4
	Freelancer	13	14	27	17.8	53.8	27.3
	Total	73	26	99	100.0	100.0	100.0
Types of Business Start-Up	Skill-/Knowledge-Based Start-Up	21	5	26	84.0	71.4	81.3
	Non-Skill/Knowledge-Based Start-Up	4	2	6	16.0	28.6	18.8
	Total	25	7	32	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

Tables 13 Preparation for Life After Retirement

Preparation Status		Number of Respondents (persons)			Respondent Percentage (%)		
		Male	Female	Total	Male	Female	Total
Age Group for Starting Preparation	<40 years old	10	8	18	3.7	8.2	4.9
	40–49 years old	31	14	45	11.6	14.3	12.3
	50–59 years old	127	44	171	47.4	44.9	46.7
	60–69 years old	94	31	125	35.1	31.6	34.2
	≥70 years old	6	1	7	2.2	1.0	1.9
	Total	268	98	366	100.0	100.0	100.0
Level of Preparedness	Strongly Disagree	27	20	47	10.1	20.4	12.8
	Disagree	71	27	98	26.5	27.6	26.8
	Neutral	86	24	110	32.1	24.5	30.1
	Agree	60	24	84	22.4	24.5	23.0
	Strongly Agree	24	3	27	9.0	3.1	7.4
	Total	268	98	366	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

Tables 14 Preferred Program for Preparing for Life After Retirement

Preferred Program	Number of Respondents (persons)			Respondent Percentage (%)		
	Male	Female	Total	Male	Female	Total
Reemployment Training Programs	44	10	54	16.4	10.2	14.8
Business Start-Up Training Program	33	9	42	12.3	9.2	11.5
Post-Retirement Life Planning and Psychological Counseling Programs	63	26	89	23.5	26.5	24.3
Policy Guidance Program	24	11	35	9.0	11.2	9.6
Social Contribution Programs	80	26	106	29.9	26.5	29.0
Certification and Degree Acquisition Programs	10	7	17	3.7	7.1	4.6
Others	14	9	23	5.2	9.2	6.3
Total	268	98	366	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

Tables 15 Main Obstacle to Preparing for Post-Retirement Life

Main Obstacle	Number of Respondents (persons)			Respondent Percentage (%)		
	Male	Female	Total	Male	Female	Total
Low Motivation or Vision for Post-Retirement Life	32	14	46	11.9	14.3	12.6
Time Constraints	65	27	92	24.3	27.6	25.1
Financial Constraints	79	30	109	29.5	30.6	29.8
Insufficient Social Connections	18	5	23	6.7	5.1	6.3
Age Discrimination	17	4	21	6.3	4.1	5.7
Gender Discrimination	2	0	2	0.7	-	0.5
Others	4	2	6	1.5	2.0	1.6
No Obstacles	51	16	67	19.0	16.3	18.3
Total	268	98	366	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

c. Need for (Re)employment and Career Transition

Only 14.2% stated they definitely want (re)employment after leaving their current job; 34.2% would prefer it if possible; 30.3% were uncertain; and 21.3% did not want (re)employment. The top reasons for wanting (re)employment/career transition were economic (29.9%), maintaining/developing current career (27.7%), and enjoyment/fulfillment (20.3%). Women placed relatively greater emphasis on health and maintaining activity. Regarding the relation to existing expertise, 66.1% wanted to use their career/expertise in the same field; 19.8% wanted to apply it in a new field; 5.1% wanted something entirely different. As for desired retirement age, 40.1% chose “work as long as possible,” with women higher at 47.5%; 70s or later was selected more often by men.

Tables 16–19 summarize intentions, reasons, relation to expertise, and desired complete-retirement age.

Table 16 Willingness for (Re)Employment or Career Change

Willingness	Number of Respondents (persons)			Respondent Percentage (%)		
	Male	Female	Total	Male	Female	Total
Definitly yes	41	11	52	15.3	11.2	14.2
Yes, if possible	96	29	125	35.8	29.6	34.2
Not sure	75	36	111	28.0	36.7	30.3
No	56	22	78	20.9	22.4	21.3
Total	268	98	366	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

Table 17 Main Reason for Wanting (Re)Employment or Career Change

Main Reason	Number of Respondents (persons)			Respondent Percentage (%)		
	Male	Female	Total	Male	Female	Total
Career Growth	40	9	49	29.2	22.5	27.7
Financial reasons	44	9	53	32.1	22.5	29.9
Job Satisfaction	29	7	36	21.2	17.5	20.3
Health and Activity	23	12	35	16.8	30.0	19.8
Others	1	3	4	0.7	7.5	2.3
Total	137	40	177	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

Table 18 Relationship Between Career, Professional Expertise, and Desired (Re)Employment or Career Change

Relationship	Number of Respondents (persons)			Respondent Percentage (%)		
	Male	Female	Total	Male	Female	Total
Utilize Career Experience and Expertise in the Same Field	95	22	117	69.3	55.0	66.1
Apply Career Experience and Expertise to a New Field	25	10	35	18.2	25.0	19.8
Completely Different Field from Previous Work	3	6	9	2.2	15.0	5.1
Difficult to Predict at Present	14	2	16	10.2	5.0	9.0
Total	137	40	177	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

Table 19 Preferred Age for Complete Retirement from Career

Age Group Classification	Number of Respondents (persons)			Respondent Percentage (%)		
	Male	Female	Total	Male	Female	Total
<60 years old	0	2	2	0.0	5.0	1.1
60–64 years old	8	7	15	5.8	17.5	8.5
65–69 years old	29	6	35	21.2	15.0	19.8
70–79 years old	44	3	47	32.1	7.5	26.6
80–89 years old	2	1	3	1.5	2.5	1.7
Until No Longer Able	52	19	71	38.0	47.5	40.1
Not sure yet	2	2	4	1.5	5.0	2.3
Total	137	40	177	100.0	100.0	100.0

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

d. Retirement-Related Systems at Current Institutions

Among completion-stage respondents, 90.7% reported a mandatory retirement system at their workplace (women 86.7%). Retirement ages were mostly 60 or higher (60: 42.2%; 61+: 51.5%). A total of 64.5% reported the presence of an early retirement system; 35.8% reported continued employment systems for high-performing retirees (men higher than women in both). Support provided by institutions includes individual training leave for career transition (29.8%) and training programs (25.1%); the absence of support was reported by 18.3%.

Tables 20–21 summarize retirement systems and support for preparing retirement (multiple responses).

Table 20 Retirement-Related Policies for Current Employment

Retirement-Related Policies		Number of Respondents (persons)			Respondent Percentage (%)		
		Male	Female	Total	Male	Female	Total
Retirement System	Available	247	85	332	92.2	86.7	90.7
	Not Available	21	13	34	7.8	13.3	9.3
Retirement Age	<60 years old	13	8	21	5.3	9.4	6.3
	60 years old	99	41	140	40.1	48.2	42.2
	≥61 years old	135	36	171	54.7	42.4	51.5
Voluntary Retirement	Available	177	59	236	66.0	60.2	64.5
	Not Available	91	39	130	34.0	39.8	35.5
Post-Retirement Reemployment of Skilled Personnel	Available	102	29	131	38.1	29.6	35.8
	Not Available	166	69	235	61.9	70.4	64.2

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

Table 21 Retirement Preparation Support at Current Workplace (Multiple Responses)

Support Provided	Number of Respondents (persons)			Respondent Percentage (%)		
	Male	Female	Total	Male	Female	Total
Job Recommendations for Reemployment	32	14	46	11.9	14.3	12.6
Training and Education Program for Career Transition	65	27	92	24.3	27.6	25.1
Individual Training Leave for Career Transition	79	30	109	29.5	30.6	29.8
Wage Payment for a Certain Period After Retirement	18	5	23	6.7	5.1	6.3
Office Space for Retirees	17	4	21	6.3	4.1	5.7
Networking Support for Retirees	2	0	2	0.7	-	0.5
Others	4	2	6	1.5	2.0	1.6
Not Available	51	16	67	19.0	16.3	18.3

Source: Korea Foundation for Women in Science, Engineering and Technology (WISET). Pilot Survey on the Career Status of Male and Female Science and Technology Professionals (2021) – Data Analysis Results.

5. Conclusion and Policy Proposals

a. Conclusion

Using an operational definition that requires being female, working in S&T occupations or related occupations, holding an associate degree or higher, majoring in STEM, and meeting age thresholds aligned with expected retirement by industry (50/55/60+), this study more precisely estimates the policy target group than prior work based solely on age. Key findings: (1) Senior S&T workers number ~352,000 (H1 2022), including ~79,000 women (22.5%). About 91.8% of senior women are in related occupations, with healthcare dominating (≈ 72,000). Excluding healthcare, the largest detailed occupations for senior women 50+ are computer systems & software professionals and university professors/lecturers (STEM/medical), each around 1,000. (2) Among researchers, women 50+ number 10,890 and women 60+ number 1,739 (2021), concentrated in universities (60.5% and 76.1%, respectively). (3) Many women scientists and engineers in career completion period prefer hobbies/leisure and social contribution over employment/entrepreneurship post-retirement; when seeking work, they prefer part-time or freelance, and those favoring start-ups tend toward technology-based ventures. (4) Desired programs: social contribution and post-retirement life planning/counseling; main obstacles: financial and time constraints.

b. Policy Trends

Policies supporting senior R&D personnel are implemented by NRCS&T, Korea Industrial Technology Association, Korea Institute of Advancement of Technology (TIPA), National Research Foundation of Korea, and the Korea Institute of Human Resources Development in Science and Technology (KIRD), among others, primarily tailored to public research institutes. Given that only 11.5% of women 50+ researchers are in public institutes while 60.5% (50+) and 76.1% (60+) are in universities, targeted policies for university faculty/lecturers are lacking and needed. WISET mentors 40–50 women-led firms via programs leveraging senior female scientists and engineers; unlike general technical mentoring, these emphasize network linkage and policy participation by senior women.

c. Policy Proposals

1) Create systems enabling university professors with strong research capacity to continue research after mandatory retirement, proportionate to secured R&D funding. 2) Restore the statutory retirement age to 65 at government-funded research institutes to improve utilization of senior women; current extensions/re-employment schemes are unevenly applied. 3) Build a database and operate coaching programs that classify career path archetypes for senior women and provide career design and development support from 5–10 years pre-retirement through post-retirement. 4) Expand social contribution opportunities and develop new programs—e.g., senior-to-senior support, media channels to transmit experience to next-generation (prospective) women in STEM, and a unified, accessible platform. 5) Identify and publicize best-practice cases of senior female S&T utilization, especially post-retirement career continuation stories, and make them widely accessible to motivate others. 6) Conduct follow-up research with larger samples and qualitative methods to identify barriers within workplaces (universities, public institutes, corporate labs), gender differences in impacts of retirement policies, and effects of extending/abolishing mandatory retirement. 7) Create staff scientist positions to employ former high-skilled women with career breaks or those preferring lower-intensity roles post-retirement—helping alleviate researcher shortages amid demographic decline. 8) Establish and operate a policy network for utilizing senior female scientists and engineers, led by WISET in cooperation with relevant ministries, local governments, associations, sectoral organizations, firms, and universities.

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Elevating Knowledge on Gender Disparities in Sri Lanka's Research and Development Sector: Trends, Challenges and Approaches towards Equity

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Abstract
Research and Development (R&D) sector plays a key role in Sri Lanka by improving the nation's science and technology competencies, but the gender gap in the field remains a concern. This study provides a comprehensive analysis of gender distribution and its temporal trends across disciplines, age, educational level, employment sectors, including academia. The analysis is based on published national data from Science & Technology and R&D surveys, including head counts and Full-Time Equivalent (FTE) values. Gender proportions were calculated across each category.

Findings indicate a gradual narrowing of the gender gap in Sri Lanka's R&D workforce from 1984 to 2022, with female representation rising from 23.9% in 1984 to 45.4% in 2022, despite the existence of sector-specific variations. Natural, agricultural, medical and social sciences show a more balanced gender participation, while engineering remaining male-dominated. Both men and women are most represented in the 31-40 and 41-50 age groups in R&D however, with a consistent gender gap in all categories with hierarchical pattern in some.

Overall data demonstrates that Sri Lanka's R&D sector has made significant strides toward reducing the gender gap over past several decades, though deficiencies exist. This study underscores the need for targeted policies to bridge gender gaps focusing more on selected fields highlighted and at higher professional ranks to achieve gender equality, which will promote inclusive innovation in Sri Lanka's R&D sector by maximizing talent, driving sustainable national development.

Introduction

Research and Development (R and D) plays a key role in the world today, driving innovation, economic growth, agricultural productivity, improvement of healthcare and social advancement. Science, technology and innovation (STI) are progressively identified as the backbone of national development and global competitiveness. Countries with strong systems of STI have consistently shown fast economic growth and good resilience to global challenges such as pandemics and climate change [UNESCO, 2021]. STEM (Science, Technology, Engineering and Mathematics) workforce is at the center of this progress, providing the knowledge and crucial skills needed for innovation.

R and D participation shows a persistent gender disparity across the world. According to UNESCO Institute for Statistics (UIS), women constitute only 33% of researchers globally, with significant regional variations [UNESCO, 2018; 2021]. Women are more likely to be concentrated in life sciences and health-related fields, while underrepresented in engineering, technology, and leadership positions [UNESCO, 2021]. Although progress has been made in several regions, women representation in STEM remains uneven [UNESCO, 2021]. This inequality reflects the disparity in education access, employment and hinder the national development by restricting the talent pool [European Commission, 2021].

Sri Lanka mirrors many of these global patterns. Women in Sri Lanka slightly outnumber the men in general population; female-to-male ratio is 100:92.75 [Dep of Census and Statistics, 2021]. However, this ratio is not mirrored in the R&D workforce. Over the past years, Sri Lankan women have had reasonably balanced opportunities for education, with high literacy rates and remarkable representation in universities [UGC, 2023]. Female students have outnumbered male students in number of undergraduate streams, such as biological and social sciences [UGC, 2023]. But this educational success has not translated into lasting R and D careers. Evidence suggests that there are perceived barriers in Sri Lanka in entering certain scientific fields (notably engineering and physical sciences), in attaining doctoral-level qualifications, and in advancing into senior academic or leadership roles [NSF, 2022; Ranathunge & Wickremasinghe, 2010].

The gender disparity in R and D is not simply a matter of equity. It has direct practical consequences for national development. A gender-balanced research workforce significantly enhances innovation outcomes by integrating a broader range of perspectives, diverse problem-solving methodologies, and inclusive research agendas [Hunt et al., 2013; Nielsen et al., 2017]. This diversity fosters creativity, drives more comprehensive inquiry, and leads to solutions that are both socially relevant and scientifically robust. For Sri Lanka, which is classified as a low-middle-income country, seeking to strengthen its knowledge economy, ensuring that women are fully integrated into STI is a developmental imperative [NSF, 2022]. Recognizing this, Sri Lanka's policymakers and academic leaders have increasingly emphasized the need for gender inclusivity in science. Reports from the NSF, the UGC, and the National Academy of Sciences of Sri Lanka (NASSL) highlight both progress and challenges [NSF, 2022; UGC, 2023; NASSL, 2023]. Over the past two decades, female participation has increased in many R&D fields, particularly in natural and agricultural sciences. At the same time, disparities persist in engineering, private-sector research, doctoral-level qualifications, and leadership positions [NSF, 2022]. These patterns reflect both the "horizontal segregation" (discipline-specific clustering of men and women) and "vertical segregation" (unequal representation at senior levels) commonly observed worldwide [European Commission, 2021].

The present study examined the gender gap in research and development in Sri Lanka using nationally representative data spanning multiple dimensions: gender distribution across scientific disciplines, age structure of R and D participation, highest academic qualifications of researchers, employment patterns in state and private sectors, representation in national science leadership roles, gender composition of academic staff in higher education, and trends in postgraduate research student enrollment. By mapping these patterns and highlighting temporal changes, this paper seeks to provide an evidence base for policy interventions aimed at reducing disparities and strengthening the inclusivity of Sri Lanka's STI system.

Method

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This study draws on secondary data from national sources, including the Sri Lanka Science, Technology & Innovation Statistical Handbook (2004–2022) published by the National Science Foundation (NSF), the Sri Lanka University Statistics (2010–2023) compiled by the University Grants Commission (UGC), the National Survey of R&D in Sri Lanka (1996), and fellowship records of the National Academy of Sciences of Sri Lanka (NASSL). Data was extracted on researcher distribution by discipline, age, educational qualification, employment sector, and gender, as well as academic staff categories and postgraduate research student enrollment. NASSL records were reviewed to assess women's representation in leadership. To ensure comparability across years, data were harmonized into consistent categories and analyzed descriptively, focusing on temporal trends and gender disparities. As only aggregate, publicly available data were used, no ethical approval was required (Figure 1).

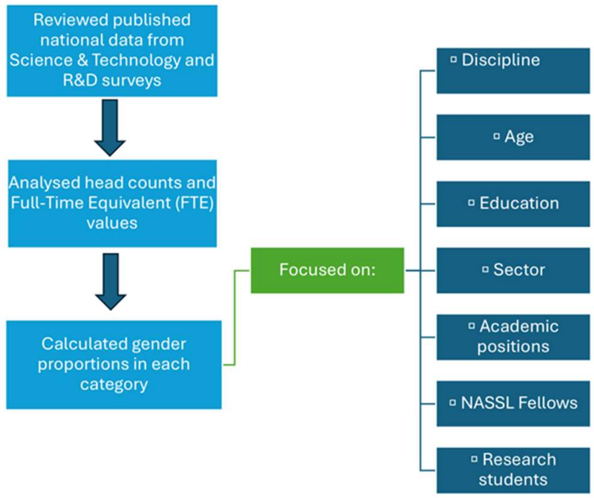

Figure 1: Method; data collection and analysis

Results

1. Gender distribution across scientific disciplines and temporal trends

The gender gap is narrowing in Sri Lanka's R&D workforce from 1984 to 2022. Female participation has increased steadily from 23.9% in 1984 to nearly equal representation with males at 49.5% in 2020, before slightly declining to 45.4% in 2022. Overall, the trend reflects significant progress toward gender parity, though men still hold a marginal majority (Figure 2).

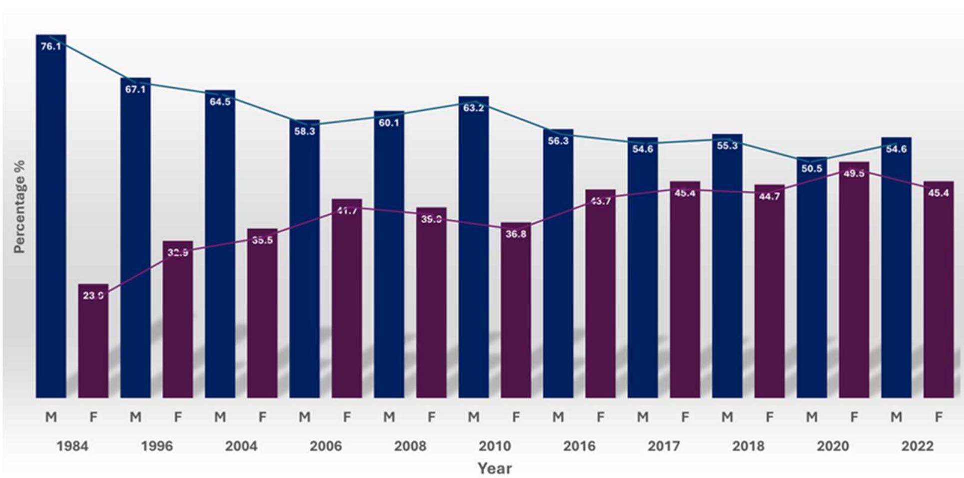

Figure 2: Gender gap in R&D by Year

The R and D workforce in Sri Lanka shows gender disparities across scientific disciplines. Data from the NSF statistical handbooks (2004–2022) demonstrate that Natural Sciences and Agricultural Sciences consistently reflect a relatively balanced gender distribution, with women making up a significant proportion of researchers. In contrast, Engineering and Physical Sciences remain heavily male-dominated. Temporal trends suggest gradual improvement in female participation across all fields, though the rate of increase differs. For example, in Agricultural Sciences, female participation has steadily risen to nearly match that of males, while in Engineering, the female share remains comparatively low despite some progress. These findings reflect global patterns, where women are more represented in biological and social sciences but face barriers in engineering and physical sciences (Figure 3).

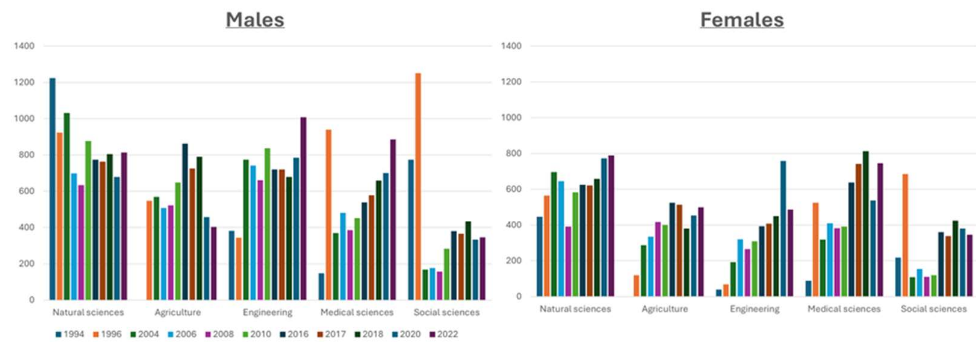

Figure 3: Distribution of female and male R&D scientists (Head count) by Discipline and Year

2. Age distribution of researchers

Analysis of researcher age groups from 2016–2022 reveals a declining trend in R&D participation with advancing age across both genders. The age group below 35 years show comparatively higher female representation, suggesting improved entry of women into research careers in recent years. However, in older cohorts (45 years and above), male representation dominates, reflecting limited career progression for women as they advance. This age funnel pattern indicates that while more women are entering research, many are lost to the system before reaching senior positions, likely due to systemic challenges such as limited promotion opportunities, family responsibilities, and lack of mentorship (Figure 4).

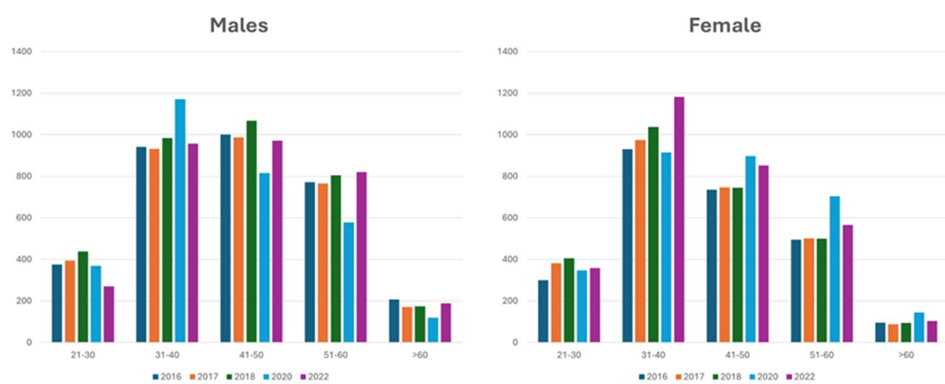

Figure 4: Researchers by age group (2016-2022)

3. Educational qualifications of R&D scientists

Gender analysis of educational qualifications shows that both male and female researchers pursue postgraduate education, but differences exist at higher academic levels. Women are well-represented among those with master's degrees, frequently matching or even surpassing men in enrollment and attainment. Doctoral qualifications (PhD and equivalent) however, remain more common among men, highlighting a continuing gap in advanced research training. This pattern suggests that women frequently enter postgraduate education but face barriers in transitioning from Masters to doctoral and postdoctoral research levels. Such barriers could be attributed to structural challenges, including limited funding, workplace support, and family commitments (Figure 5).

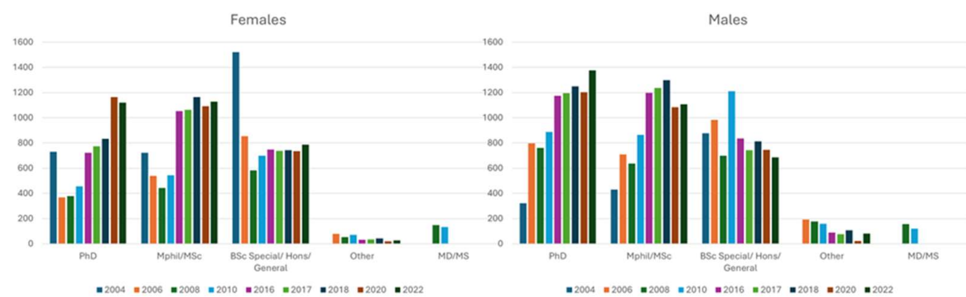

Figure 5: Educational qualifications of R&D Scientists by year

4. Employment sector: State vs private R&D

The distribution of R&D scientists by employment sector shows notable differences in gender representation. Within the state sector, including universities and government research institutes, the gender distribution among scientists is comparatively balanced. Female researchers maintain a substantial presence across numerous disciplines, reflecting ongoing progress toward gender equity in public research institutions. Private sector however, (industrial and corporate R and D labs): Male dominance is pronounced, with women comprising a much smaller share. This reflects sectoral variations in inclusivity: the state sector offers relatively stable career pathways and institutional support, while private-sector R&D, particularly in engineering and technology-driven industries, seem to remain less women-friendly (Figure 6).

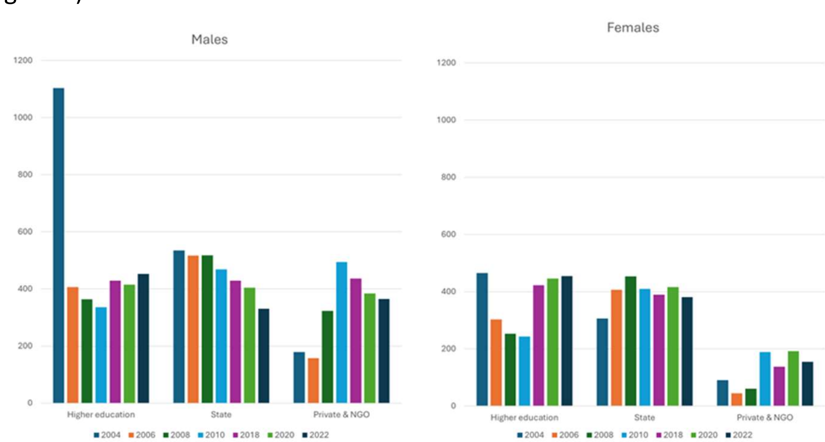

Figure 6: Distribution of male and female in R&D by sector ad year (FTE)

5. Postgraduate research student enrollment

Enrollment of research students shows encouraging signs of progress. University data highlight that both male and female enrollment has increased over time. Natural and

Agricultural Sciences: Female students are well represented, in some years approaching parity or exceeding male numbers. Engineering and Technology disciplines: Male students continue to dominate, reflecting inadequate undergraduate participation, thus continuation of similar trend in the pipeline (Figure 7). Overall, the upward trend in research student enrollment across genders signals a promising pipeline for future R&D diversity. However, the discipline-specific disparities suggest the need for targeted policies to encourage women into underrepresented fields such as engineering.

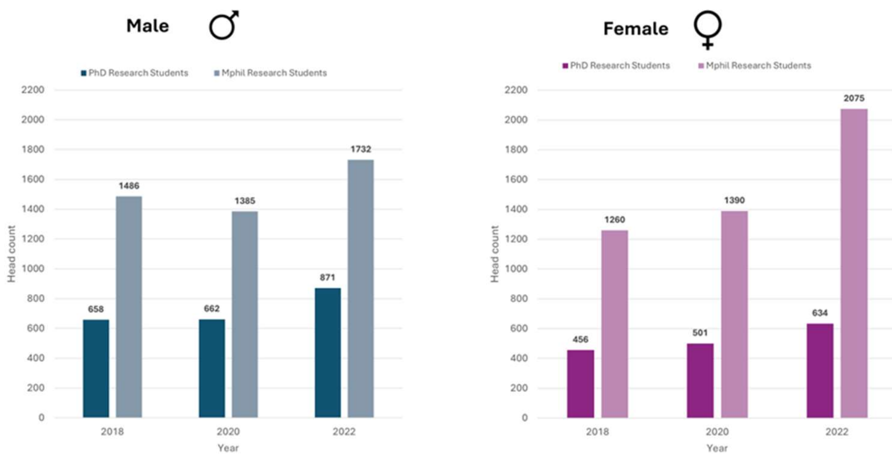

Figure 7: Number of Research students in Universities (2018-2022)

6. Teaching staff in higher education institutions (2010–2023)

University Grants Commission data provide detailed insights into academic staffing by gender and staff category. Lecturers and Assistant Lecturers: Female representation is strong and, in some faculties, outnumbers males. Senior Lecturers: A near-parity trend is observed, though men remain slightly more numerous. Professors and Chair Professors: Women are a clear minority, often less than one-third of the total. The longitudinal trend (2010–2023) shows gradual increases in female staff across all categories, but the gap widens at senior academic levels. This indicates vertical segregation within academia, where women are concentrated at junior levels but face barriers in progressing to professorships and leadership roles (Figure 8).

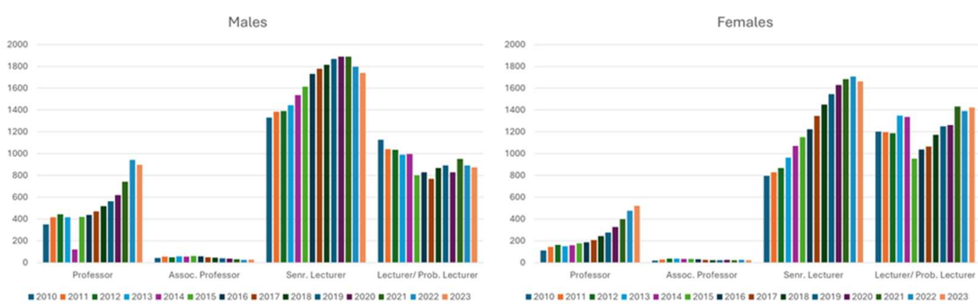

Figure 8: Distribution of male and female in teaching staff in higher education institutions according to staff category (2010-2023)

7. Representation in national-level scientific leadership (NASSL Fellows)

Data from the National Academy of Sciences of Sri Lanka (NASSL) indicate a persistent gender gap among its Fellows since the Academy's inception, which is more prominent in leadership roles (https://nassl.org/). Historically, the election of Fellows has been predominantly male.

However, the NASSL employs a transparent and impartial selection process—comprising nomination, screening, and secret ballot voting—to ensure fairness in elections. Encouragingly, recent years have shown a positive shift with an increase in the percentage of female Fellows (see Figure 9), suggesting progress, albeit at a measured pace, toward greater gender equity within the Academy.

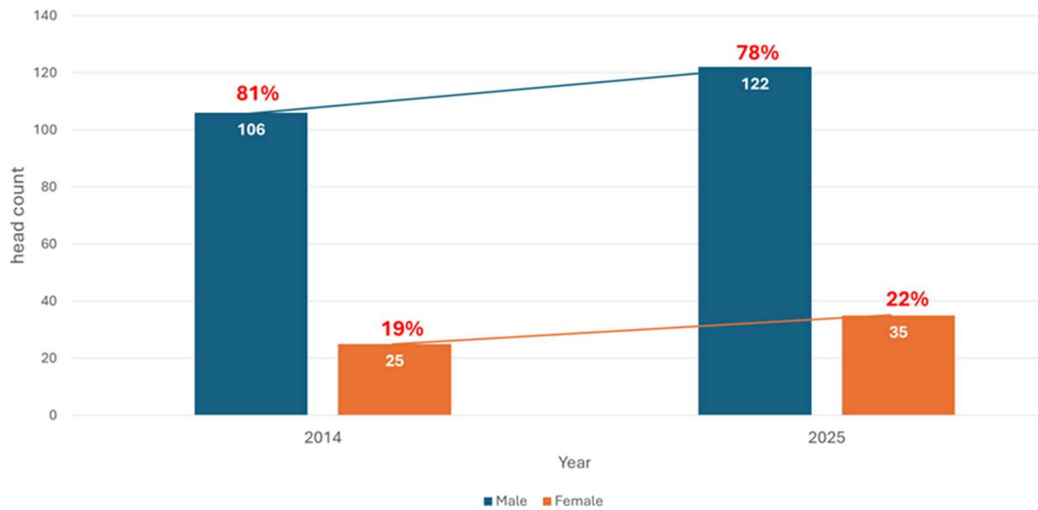

Figure 9: Gender distribution of fellows of national academy of sciences of Sri Lanka

Discussion

The narrowing gender gap in Sri Lanka's R&D workforce from 1984 to 2022 demonstrates significant progress toward gender parity, with female participation rising from 23.9% to nearly equal representation by 2020. Findings highlight a narrowing gender gap overall, yet persistent inequalities in specific disciplines. Although women's participation in early-career research roles is relatively strong, significant challenges persist in their progression to senior positions and attainment of doctoral qualifications. These disparities highlight enduring structural and cultural barriers within academic and research institutions. The strong presence of women in state institutions contrasts with their underrepresentation in private R&D, suggesting institutional differences in recruitment, retention, and work-life policies.

The increase in research student enrollment for both genders shows encouraging progress toward a more diverse future research workforce, with female representation nearing or exceeding parity in Natural and Agricultural Sciences. However, the continued male dominance in Engineering and Technology reflects low female undergraduate participation, creating a pipeline challenge. This highlights the need for targeted policies and interventions to promote women's involvement in underrepresented fields like engineering, ensuring equal opportunities and fostering greater diversity and innovation in research.

The underrepresentation of women in NASSL and senior academic and leadership positions reflects the leaky pipeline, where fewer women progress from early career to leadership. These findings align with global patterns, yet Sri Lanka shows unique strengths, such as near gender parity in several scientific disciplines and growing postgraduate enrollment, which could be due to multiple factors including wider availability of opportunities, increase access to information, changes in socio-cultural and economic factors, changing attitudes and increasing presence of role models.

To close the gender gap in R&D, it is essential to strengthen mid-career support for women through targeted fellowships, mentoring, and leadership training, while also encouraging greater participation in engineering and private-sector research via scholarships, internships, and industry partnerships. Family-friendly workplace policies across state and private institutions can help reduce attrition, and reforms in nomination processes are needed to enhance the visibility and recognition of women scientists. Finally, consistent monitoring and reporting of gender disaggregated data across all R&D sectors will ensure accountability and guide evidence-based policies.

Acknowledgments

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Turkish Women in Science and Technology: Current Status and Empowering Strategies

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The participation of Turkish women in science and technology reflects a century-long transformation grounded in the country's modernization process, educational reforms, and evolving social attitudes. While their representation in academic and research environments has grown steadily, gender disparities persist in leadership positions and innovation-driven sectors. This paper outlines the historical background, current situation, and strategic priorities shaping the advancement of women in science, technology, engineering, and mathematics (STEM) in Türkiye, drawing on recent data and institutional developments.

Historical Background

The engagement of women in science in Türkiye has deep historical roots. The first Teachers' Training College for Women (Darülmuallimat), established in the 19th century, symbolized an early commitment to women's education during the late Ottoman period. Following the constitutional reforms of 1908, secondary schools for girls were opened, and women began to pursue higher education abroad. Among the first was Remziye Hisar, who studied chemistry at the Sorbonne under Marie Curie and became Türkiye's first female chemist.

A major transformation occurred after the foundation of the Republic in 1923. Mustafa Kemal Atatürk's reforms introduced equal educational opportunities for women and promoted their participation in public life. As universities opened their doors to female students and faculty, women became active contributors to scientific and cultural life. The vision of Mustafa Kemal Atatürk that "women have not lagged behind men in science, scholarship, and culture—perhaps they have even gone further ahead" established a philosophical basis for gender equality in modern Türkiye.

The Current Landscape of Women in Science

Today, women in Türkiye occupy a significant share of the national academic and scientific workforce. In higher education, the Turkish Council of Higher Education (CoHE) reported that out of 7.3 million university students, 52.8% are women (CoHE, 2025). Female students have outnumbered men consistently in recent years, and the gender gap among academic staff is gradually narrowing.

Nevertheless, leadership positions remain unevenly distributed. As of 2024, women hold about 28% of senior academic posts—such as rectors, deans, and department heads—while the proportion of female rectors remains between 7% and 11% (Saraç, 2024). These figures illustrate that while women's academic participation is strong, their representation in top decision-making roles still lags behind.

Institutional Efforts and TÜBA's Role

The Turkish Academy of Sciences (TÜBA) plays a pivotal role in promoting scientific excellence and equality of opportunity. Established as an autonomous institution, TÜBA currently has 235 members—120 full, 30 associate, and 85 honorary or emeritus members. Among them, 24 are women, representing roughly 11% of the total membership (TÜBA, 2025a).

TÜBA's flagship initiative, the **Outstanding Young Scientists Awards Program (GEBİP),** launched in 2001, has been instrumental in supporting early-career researchers under the age of 40 across all disciplines. The program provides a three-year research grant and mentorship by senior academy members, fostering professional development and collaboration. Between 2020 and 2024, a total of 187 scientists were honored under TÜBA's various award schemes, of whom 53 were women—accounting for 28.3% of recipients. This proportion exceeds the female share of academy membership, suggesting a more balanced gender distribution among emerging scientists (TÜBA, 2025b).

Beyond research funding, GEBİP cultivates a sense of academic community and long-term engagement. Annual meetings between fellows and academy members strengthen mentorship networks and promote interdisciplinary collaboration. The program has also served as a foundation for the **Turkish Young Academy**, established in 2021, which encourages scientific dialogue, policy advice, and international cooperation among young researchers.

From 2005 to 2015, TÜBA supported the **L'Oréal–UNESCO "For Women in Science" Program in Türkiye**, recognizing and promoting the achievements of outstanding women scientists nationwide. These initiatives have collectively increased the visibility of women researchers and contributed to more inclusive scientific practices.

Challenges and Structural Barriers

Despite substantial progress, women in science and technology in Türkiye still encounter structural obstacles that limit their advancement. Persistent gender bias in recruitment and promotion, limited access to mentorship and research networks, and enduring social expectations about family responsibilities continue to affect women's career trajectories. Underrepresentation in engineering and physical sciences remains particularly notable.

The process of European Union alignment has encouraged more inclusive policy-making and stronger dialogue between state institutions and civil society on gender equality. National efforts have also been reinforced by Türkiye's commitment to UNESCO's Millennium Development Goals and the United Nations Sustainable Development Goals, both emphasizing gender equality as a cornerstone of sustainable development.

Strategies for Empowerment and Inclusion

To further close the gender gap in science and technology, several strategic actions have been identified:

- Strengthening STEM education for girls at early stages to nurture scientific curiosity and confidence.
- Expanding mentorship and leadership training to support women's advancement into senior academic and policy positions.
- Showcasing female role models to inspire younger generations and challenge prevailing stereotypes.

- Implementing institutional reforms to ensure transparent recruitment, equal pay, and family-friendly work environments.
- Encouraging international collaboration through networks such as AASSA-WISE, TWAS, and L'Oréal-UNESCO initiatives.
- Promoting societal change by engaging academia, industry, and policymakers in efforts to normalize women's leadership in STEM.

Outlook and Future Vision

Türkiye's experience demonstrates that sustained policy commitment, institutional reform, and cultural change can together foster greater gender balance in science and technology. The combination of historical progress and modern initiatives has created an encouraging foundation for further advancement.

TÜBA plans to expand recognition programs and events celebrating women in science and technology, aiming to strengthen mentorship, visibility, and role modeling for future generations. These efforts align with the enduring belief of Mustafa Kemal Atatürk that "everything we see in the world is the creative work of women."

By building on this legacy and promoting an inclusive scientific culture, Türkiye continues to take meaningful steps toward ensuring that women not only participate in, but also lead, the nation's scientific and technological progress.

Acknowledgements:

As Full Member of TÜBA and AASSA-WISE committee member, K. Arzum Erdem Gürsan would like to express her gratitude respectively to the Turkish Academy of Sciences (TÜBA) and The Association of Academies and Societies of Sciences in Asia (AASSA) for their partial support, and acknowledge valuable contribution of Dr. Zeynep Aysan Şahintaş from TÜBA International Relations Office for the documentation.

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Barriers to Breakthroughs:
Women in Nepal's Information and Communication Technology Landscape

(A prospective based on WIIT Report)

(Author: Gunakeshari Pradhan Manandhar, Chairperson, Women In Information Technology (WIIT); Associate Academician NAST Nepal; Former Deputy Managing Director Nepal Telecom, Nepal)

Abstract

The article presents an in-depth look at the current realities, challenges, and prospects for women in Information and Communication Technology (ICT) in Nepal, based on findings and analysis from the WIIT report "Barriers to Breakthroughs: Women in Nepal's ICT Landscape" (2025), which draws on quantitative and qualitative data collected from across Nepal. The article explores gender disparities, workplace experiences, challenges and breakthroughs of women in ICT in Nepal and also presents a comparative outlook within South Asia ICT sector. The article is concluded with recent initiatives in Nepal and recommendations for various stakeholders to address gender gap towards attaining equity in ICT sector.

Abbreviations: Information and Communication Technology (ICT), Women In Information Technology (WIIT), Women in Science, Technology, Engineering and Mathematics (STEM), Information Technology (IT), University Grant Commission (UGC), Nepal Engineering Council (NEC), Focus Group Discussions (FGD), Key Information Informants (KII), Nepal Telecommunication Authority (NTA), International Telecommunications Union (ITU), International Women's Day (IWD).

Background

There is a huge gap between the genders in ICT jobs globally as indicated in UN-Women Gender Snapshot 2022 (*UN-Women gender snapshot, 2022*). According to a UNESCO report 2024, women represent only 28 percent of engineering graduates and 40 percent of computer science and informatics graduates globally. These and other national, regional and global studies indicate that a lot has to be done towards gender equity in science and technology sectors. Even more harsher situation is indicated for Nepal in the recent research conducted by Women In Information Technology (WIIT).

The impact of ICT is transforming the way we live, work and even think. This has therefore a far-reaching implication for the society in general, and for women in science, technology, engineering and mathematics (STEM), in particular (*UNESCO, 2024*). However, as representation of women in ICT is very low, women risk missing out on the jobs of the future.

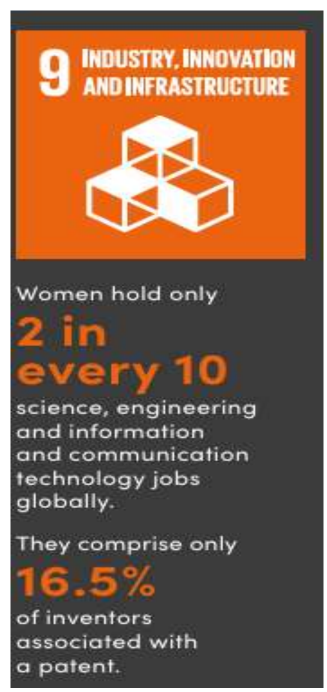

Figure 1. UN-Women Snapshot -2022

1. Introduction

1.1 ICT sector in Nepal and labor market

The Information and Communication Technology (ICT) sector is recognized as a key driver of economic growth and innovation, both globally and within Nepal. Nepal being a landlocked country, digital era brings a new frontier for development. Over the past six years, ICT service exports have made up an average of 10 percent of Nepal's total service exports, amounting to 0.3 percent of GDP. This positions Nepal competitively within South Asia *(World Bank, 2025)*. The ICT sector in Nepal also reflects diversity with considerable investments from private as well as public sector covering various industries from Telecommunications, Internet service providers, Software Development to IT services. Nepal's ICT services employment rate has been higher than in most other South Asian countries (*World Bank, 2024)*.

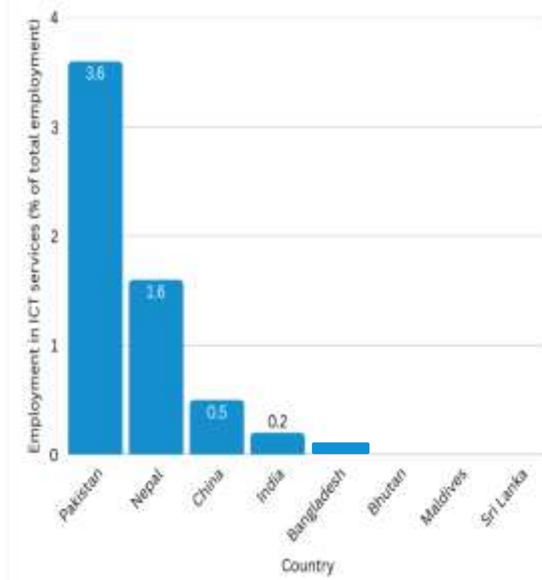

Figure 2. *Employment in ICT services South Asia (Source: World Bank 2024a)*

Although the ICT labor force remains small, it has grown faster than overall employment in Nepal. However, gender disparities continue to persist within the sector.

National Population and Housing Census 2021 established that 51.02 percent of Nepal's population is women. Nepal Labour Force Survey 2017/18 (*Central Bureau of Statistics, 2019*) reveals that almost half of men of working age (15+ years) are employed (48.3 percent) while only 22.9 percent of working-age women are in some form of employment. Of the active work force of women, only 0.5 percent are working in ICT and technology fields.

Nepal also has very low women representation in decision making positions in ICT and more specific details on women data are still lacking without which there will be constraints in informed policy decisions and appropriate interventions (*Government of Nepal, 2024*).

With women accounting for only a small percentage of the ICT workforce, the under-representation of women in this sector is a significant concern.

1.2 Declaration of Information Technology Decade in Nepal

Nepal has reached 149.23 percent of population penetration of broadband service (*NTA, 2024, June 15*), in a total population of 29,164,578 (*National Statistics Office, 2023*). Considering this and the upward trend in ICT services contribution to GDP, Nepal has officially declared 2024-2034 as the Information Technology Decade (*Goverenment of Nepal, 2024, May 15*).

One huge obstacle to gender parity in the ICT sector is that women have less access to technology as users, which decreases their digital literacy. The GSMA Mobile Connectivity Index 2024 (*GSM Mobile Index, 2024*) revealed gender-equality disparities with Nepal's score 67.2 for women mobile internet access compared to global average of 76.5 emphasizing need for targeted interventions to bridge the digital gender divides.

Therefore, in order to bring reality to the vision of Information Technology Decade with the purpose of creating regional IT hub in Nepal, Nepal needs substantial efforts in ICT education, research and development with considerate focus in creating and nurturing female ICT workforce.

1.3 Gender gap in University enrollments

The university enrollment data for 2080/81 (*UGC, 2024*) published by University Grant Commission (UGC) in Nepal, reflects Nepal's progress in expanding higher education access, particularly for women. Women in Nepal have achieved higher university enrollment rates than men in recent years. Total enrollment in 2023/2024 stands at 2,74,914 of male students while female students are 3,58,140.

However, when comparing the distribution of female and male students within different faculties, the biggest gender differences are found in technical faculties such as science, technology and engineering (*UGC, 2024*).

Considering ICT faculties enrollment, at both Bachelor's and Master's levels, male students significantly outnumber females. Female participation is slightly better at the Bachelor's level, with percentages generally around 25–30%. The Master's level shows a sharper gender gap, with female percentages mostly under 20%, indicating limited advancement opportunities for women in higher technical education.

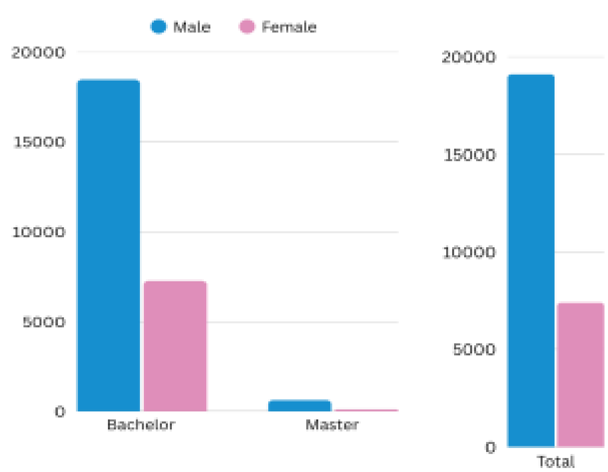

Figure 3 *Enrollment in ICT faculties (Source: UGC-Nepal)*

1.4 Gender Gap at Engineering graduates and research level

Considering registered engineers' data from Nepal Engineering Council (NEC) till June, 2025 (2082, Asar 31), only 13.77% of ICT graduates are women. Data also shows only 4.9% of total engineering graduates are women in ICT.

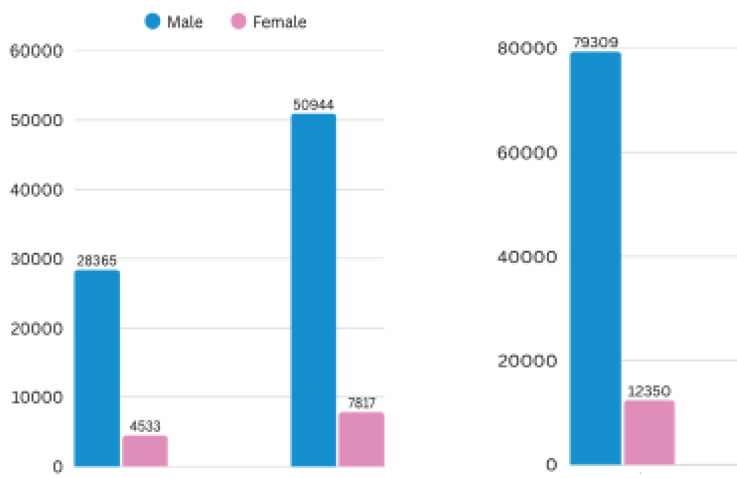

Figure 4. Registered Engineering graduates (Source: NEC 2025)

After discussions with some of the faculty heads of universities, there appeared to be around five women (head count) only who have completed their PhD in ICT related topics in Nepal.

2. WIIT and Research Initiative Rationale

Despite Nepal's progress in digital development through some of the government initiatives as well as initiatives by non-profit and private sector, the benefit of ICT sector remains unequally distributed with very low participation of women in this sector. However, on the other hand, there has hardly been efforts to gather evidence based data to understand the gender imbalance situation and to obtain both ICT organizations and ICT women's perspectives for further improvements in this sector in Nepal. We cannot assess our progress if we fail to collect and share information. Gathering sex and gender-disaggregated data on a regular basis at country level is essential to devise evidence-based policies and monitor progress in closing the gender gap (*UNESCO, 2024).*

Women in Information Technology (WIIT), a non-profit organization based in Nepal, has worked for more than 5 years to address this gap. With its many activities and specifically, the publication of '101 success stories of Women in ICT' (self-written by each of the 101 women) in 2023 brought focus on women role models in ICT, inspiring many girls and young women to consider ICT as career.

In 2024, WIIT initiated a national-level research study with support from The Asia Foundation in Nepal to systematically document the status, challenges, and opportunities for women in Nepal's ICT sector. This research report 'Barriers to Breakthroughs: Women in Nepal's Information and Communication Technology Landscape' (*WIIT, February 2025*) is a first of its kind in Nepal offering evidence-based insights and recommendations for the growth of women's participation, leadership and meaningful engagement in Nepal's ICT sector.

WIIT Publications 2021-2025 *WIIT Event on IWD & Research Dissemination 2025*

3. Research Overview: Women in ICT in Nepal

WIIT study (*WIIT, February 2025*) aimed to gather realistic data on the status of women in Nepal's ICT workforce.

3.1 Comprehensive Approach to Understanding the Landscape

The study covered over 35 districts of Nepal and 1,232 respondents, including ICT companies, ICT-enabled companies and ICT women professionals. A mixed-method approach was employed for the purpose of survey and research, combining surveys, key informant interviews, and focus group discussions.

The ICT companies participating in the survey were mostly involved in software development, web design, mobile app development, digital marketing, Internet service providers, Telecommunications, IT services & consulting. The banking sector, healthcare, education, manufacturing, airlines, hotels participated as ICT-enabled companies. The professional ICT women respondents were from ICT and ICT-enabled companies as well as government and public sectors. Half of the professional women respondents were found to be single.

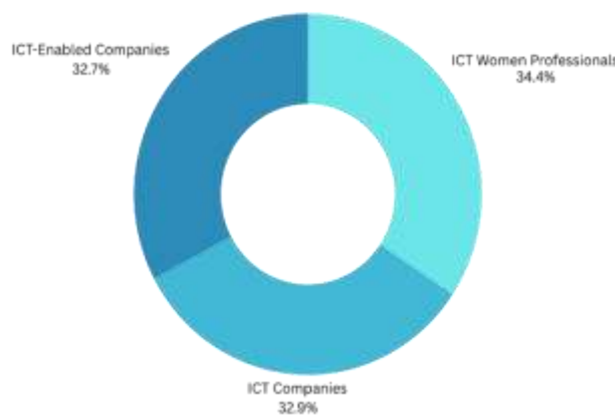

Figure 5. Distribution of Respondents

For qualitative data, Focus Group Discussions (FGD) among various groups were conducted involving ICT professional men & women, government representatives, industry representatives, ICT colleges & universities representatives and finance sector representatives. Key Information Informants (KII) interviews involved prominent women leaders in ICT sector. The approaches enabled us to do an in depth exploration of both numerical trends and experiences of women in ICT sector in Nepal.

3.2 Key findings: Unveiling the Disparities and Strength

3.2.1 Stark Reality: A Gap in Women's Representation in ICT

a) Workforce constituents

The study revealed that women constitute only **7.88 percent of the workforce in Nepal's ICT companies** working in core technical roles and responsibilities and just **0.51 percent in ICT-enabled companies**. Both types of bigger companies with more than 100 employees demonstrated even lower percentage of women professionals.

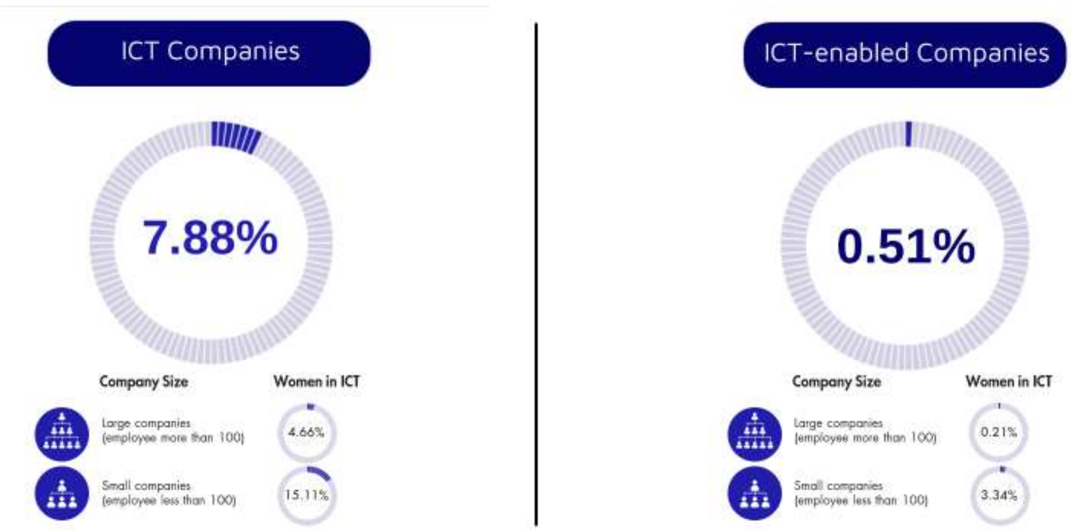

Figure 6. ICT Workforce Constituents (Source (WIIT, February 2025))

Considering some of the countries in South Asia and beyond, India has around 30 to 34 percent of IT employees as women (NASSCOM, 2023). It is interesting to note that 43 percent of STEM graduates are women in India, which is considered as highest globally. Bangladesh has 20 percent of IT employees as women (World Bank, 2021). Women engineering graduates in Sri Lanka rose to 30% in 2021 (World Bank, 2023). Indonesia also has 22 percent of women's participation in technology roles (BCG, 2020).

These figures indicate Nepal clearly lags behind some of its regional counterparts in integrating women into the ICT work force.

b) Age group, level of positions and education

The study found that Nepal has a very young ICT work force of women. Majority of women ICT professionals falls within the 18-35 demographic accounting for 89.22 percent. There is a significant decline of women aged over 35 years in the ICT sector.

According to World Bank data, in Nepal women represented 13.9% of those employed in senior and middle management in 2017 which ranks in the lowest quintile of all economies (World Bank, 2017). WIIT study also found that only 19.55 percent of ICT professional women hold top or managerial positions, whereas data from individual ICT women professionals indicate that even a lower range of 13.5 percent hold executive, director, or senior managerial roles in this sector.

Education qualification of women in ICT in Nepal exhibits 67.11 percent hold a bachelor's degree while 20.95 percent have master's degree as per the study. This indicates women are well educated in ICT sector but still lag behind in leadership positions.

In conclusion, the stark reality of women's participation in ICT sector calls for a better understanding of barriers, deriving supportive systems and implementing them effectively. Fostering a more inclusive and diverse workforce will require considerable efforts in targeted interventions focusing on younger generations & their retention, promoting visible representation of women in leadership positions and implementing supportive policies and provisions.

3.2.2 Workplace Policies & Support Systems in Organizations

a) A significant gap has been found in Nepal's workplace policies and support systems in the ICT sector. Nearly half (45.64%) of the surveyed companies lacked formal policies or initiatives, larger companies were more likely to have some structured programs.

b) The study also found that out of the companies having formal policies, 65.7 percent of companies do not provide targeted support for women in ICT industry. The survey included provisions such as flexible work from home, ICT training programs and opportunities to attend seminars/workshops, mentorship, soft skill programs and scholarships & funding for higher education & courses. Flexibility to work from home and ICT training programs were the main targeted programs provided by some of the companies who have targeted support provisions.

c) Only 55 percent of companies offer gender specific leave provisions. Although regarding paid maternity leave, 98- day time off and 15 days' paternity leave is mandated by law (*Nepal Labour ACT 2017*), many companies practice less or no paid leave.

   Comparatively, Sri Lanka and Bhutan seem to have standardized and better-enforced maternity leave policies *(ILO, 2019).*

d) Pay Equity: Regarding Pay Equity, this study indicates that only 12.1 percent of women in ICT sector in Nepal have experienced unequal pay while 87.9 percent reported that their pay is equitable.

   In comparison, neighboring countries India and Bangladesh report more pronounced gender pay gaps in ICT sector earning 15-20 percent less than male counterparts (*World Bank, 2021*).

   Nepal seems to be lagging in common supportive systems globally and in region. However, **pay equity in Nepal's ICT sector is a stimulus for the women in this sector**.

3.2.3 Identified Barriers to Breakthroughs: A Reality Checks for Women

A girl's journey begins with early signs of intelligence and quick learning from a young age. However, as girls grow, barriers start building up with societal expectations that hinders their path to knowledge and confidence. However, to embrace the demanding world of science and technology, women need breakthroughs to gain knowledge and confidence. The breakthroughs can come with right support and supportive environments provisioned at various stages of a women's journey.

a) Significant Barriers noted in this study are:

Significant Work-Life Balance Issues: A major challenge reported by women professionals (cited by 49.7% of surveyed women in Nepal) is also a common barrier for women in STEM across the Asia Pacific.

Lack of Role Models or mentors: Lack of guidance and visible female leadership is a consistent barrier in Asia

Lack of awareness about ICT career opportunities: Lack of early exposure to STEM education and targeted initiatives at school and colleges often creating miss concepts about ICT career.

Subconscious Bias: Prevalent in hiring and promotion processes is a widely recognized issue in STEM globally, including in Asia where social biases often persist.

Financial Constraint: Barriers to accessing higher education and specialized training

b) Breakthroughs through Supportive systems

Based on survey among professional women and focus group discussions, the study has also come up with a number of essential supportive systems to overcome barriers and build career in ICT.

b. Family support for sustained Leadership – key source of encouragement
a. Work-Life Balance – flexible work arrangement improves work-life balance
c. Organizational support for women's growth –need for change in workplace culture
d. Promoting women in leadership roles – training programs & quotas for managerial roles
e. Trends in Inclusive work culture – non-profit organizations initiatives, career workshops
f. Education and awareness – early exposure to tech education, contests, ICT clubs
g. Mentoring & Networking – essential element of professional growth
h. Financial and Institutional Support – pathways for greater inclusion in ICT sector
i. Advocacy for Gender-focused Policies – Collaborations for inclusive workplace policies

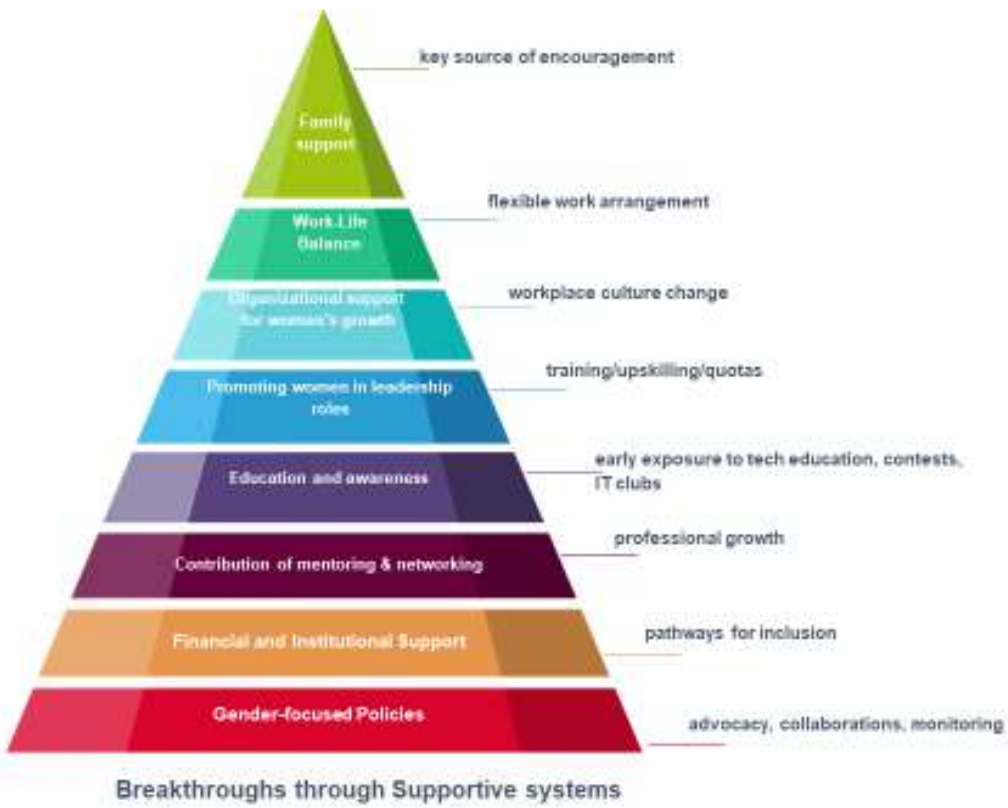

Figure 7. Breakthroughs through supportive systems

c) Competitive Edge: Women's Invaluable Contributions

The participation of women in the ICT sector not only fosters diversity but also brings significant qualitative advantages to workplaces and innovation ecosystems. WIIT study revealed some remarkable key competencies that women in ICT are perceived to demonstrate at a higher level, giving them a distinct competitive edge in professional environments. (WIIT, February 2025)

A overwhelming 98.3% of respondents identified women in ICT as possessing strong work ethics which includes being disciplined, focused, matured, punctual, tolerant, professional, and detail-oriented. These traits contribute significantly to workplace reliability and operational efficiency, especially in ICT domains where precision and accountability are crucial.

95.7% of participants appreciated the empathetic nature of ICT women, especially in fostering strong customer relations and effective communication. These qualities are essential in user-centered design, customer support, and team collaboration—areas necessary for ICT service delivery.

A considerate number of respondents (87.1%) highlighted the value women bring to team dynamics. Including women in team, enhances diverse perspectives and collaborative decision-making, promoting more balanced and innovative outcomes in technical projects.

Figure 8. Competitive edge of ICT Women

Flexibility and multitasking—being quick learners, creative thinkers, and adaptive professionals, were identified in 83% of responses. These qualities supplement evolving ICT roles where upskilling and handling projects demands are essential.

Despite being underrepresented in leadership roles, only 26.8% of the respondents associated women with strong leadership presence. However, above data underscores that women in ICT already exhibit considerate strengths in ethics, emotional intelligence, and teamwork—key drivers of performance in both technical and managerial roles.

Recognizing and nurturing these advantages can bridge gender gaps while also elevating the overall quality and inclusiveness of the ICT sector in Nepal.

d) Attributes of professionally successful women in ICT: Stories told

Despite all challenges, more and more women have demonstrated their professional and leadership qualities and are leading successful careers in ICT sector in Nepal. Some inspiring stories are also part of the WIIT compilation and the stories highlight various common aspects of challenges faced by women in professional sector. Those stories indicate a few vital aspects of success in this sector as listed below.

i) Resilience and determination
ii) Courage to seize opportunities, take credit and show sincerity
iii) Encouraging men's engagement for nurturing a confident woman, women-friendly environment and promoting women leadership
iv) Support of women for women in facing challenges, harassments, breaking barriers and developing a capacity of persistence.

4. WIIT Research Value Contributions

This research report, being a first of its kind in Nepal holds significant value and offers multiple contribution:

a) As foundational resource
  - Provides objective and concrete input for policymakers and industry leaders to design and implement targeted interventions

- Provides actual field-based reference data and live experiences that can serve as a stepping stone for future researches of more focused and objective nature.
- Serves as a benchmark for measuring future progress over time

b) At regional level, it contributes
   - As a localized case study that resonates deeply with shared challenges in women's STEM participation across Asia-Pacific contexts

5. Paving the Way Forward

5.1 **Collaborative Ecosystem for Gender Equity in ICT**

Over the past decade, women in the ICT sector in Nepal have been steadily engaging in advancing gender equality and empowering women in Information and Communication Technology. Through a range of targeted initiatives—digital literacy programs, skills development workshops, mentoring, awareness campaigns, and advocacy, consistent efforts have been put in place to inspire and support girls and women to pursue education and careers in ICT. These sustained efforts have now started to contribute to building a more inclusive digital ecosystem and fostering the meaningful participation of women in Nepal’s evolving technology landscape.

a) Computer Association of Nepal, Federation formed an IT Women Committee as early as year 2010 and started working on ICT awareness programs all over Nepal. The team has now evolved and expanded to implement more skill based programs and advocacy.

ICT awareness program in Dhading 2010

ICT women team of 2010

b) Nepal Telecommunication Authority (NTA), a government organization regulating ICT sector, launched International Girls in ICT Day (an initiate of ITU) in year 2013 in Nepal giving rise to many non-profit women ICT organizations in subsequent years. In 2025, NTA has been bringing together these organizations, young women and girls to celebrate the event by conducting nationwide events such as hackathons on Apps Developments & Robotics, training/workshop programs, events for ICT women with disabilities, regional conferences with role model promotions and dialogues with stakeholders. Supported by Ministry and ITU, NTA also provides recognition to facilitate prominent Women ICT professionals.

International Girls in ICT Day 2013 launch *International Girls in ICT Day 2025*

c) Established in 2019, Women In Information Technology (WIIT) Nepal is dedicated to empowering and promoting the meaningful representation of girls and women in ICT. The organization is persistently working in fostering a more inclusive and equitable ICT sector through continuous advocacy, conferences, capacity building, contests, publications, research work and engagements with local communities throughout Nepal. With the WIIT research findings, WIIT is also approaching related government bodies to derive more effective policies and strategies and for aggressive implementations.

AI Training for tech women 2025 *Robotics Workshop/Contest Dolakha 2024*

d) ICT Foundation Nepal initiated Women ICT ICON Award in year 2020 to bring forward ICT role models and encourage more women in this sector. This is the biggest annual award for ICT women in Nepal and till date five women have received this award.

Women ICT ICON Award 2021

e) The ICT clubs in many universities in coordination with industry, are also active in mentoring and capacity building to prepare girls for ICT careers.

f) Some organizations such as Women Leaders in Technology and Women in Computing also initiate fellowship programs and extensive training programs for girls while Robotics Association of Nepal and Squeal Foundation conduct hackathons/contests and conferences for girls and young women frequently.

g) Some International Non-Profit Organizations such as The Asia Foundation in Nepal, UN Women Nepal as well as Telecom organizations in Nepal, frequently support interventions initiated for ICT women and girls. The Asia Foundation created Women in Data Steering Committee inspiring and motivating girls & young women to work in ICT sector and also supported research initiation of WIIT.

   The telecom organizations have also been encouraging women to take-up leadership roles and as a result, many decision making positions in these companies have been held by women. The incumbent telecom operator, one of the largest public organization in Nepal, has had a number of women leaders and is currently being led by a woman.

Despite these efforts and interventions, progress toward achieving equity in Nepal's ICT sector remains gradual and uneven. The government agencies have largely remained reluctant participants, with limited efforts in driving targeted programs or enforcing existing gender-responsive policies. To foster a more inclusive digital ecosystem, ICT firms and startups should also be encouraged—through incentives and recognition—to adopt equitable workplace practices and increase the recruitment of women. Furthermore, building the ICT capacity of schoolteachers is crucial to empower and motivate girls to pursue technology education. Moving forward, coordinated action (not just intension) from all sectors—government, public, private, academic and regional allies—is essential to ensure sustained progress in gender equity in Nepal's ICT landscape.

5.2 Recommendations for actions

In view of the research study findings, current initiatives and market trends, the following forward looking strategic actions are recommended:

1) Institutionalize Gender-Disaggregated Data Collection
   Regularly collect and publish data on gender in ICT to inform policy and track progress

2) Build Retention Pathways Beyond Early Career
   Build pathways to women's growth into leadership through mentorship, flexible work policies, upskilling and visibility

3) Leverage the Competitive Edge of Women
   Recognize and amplify women's strengths such as professional ethics, collaboration, innovation, and resilience—in shaping inclusive digital solutions

4) Enforce Gender-Responsive Workplace Policies
   Mandate inclusive HR frameworks and ensure compliance through independent monitoring

5) Foster Regional and Cross-Sector Collaboration
   Build partnerships across Asia-Pacific and among academia, government, and industry to scale inclusive practices, enable ICT women ecosystem, promote regional platforms for women tech leaders, researchers, and policymakers.

6) Promote Women Leaders and Role Models
   Highlight and invest in ICT women leaders to inspire the next generation and influence organizational change

By taking these steps, Nepal and the region will be better positioned to support women in the technology sector and advance toward a more inclusive and balanced digital future for all.

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Breaking Barriers: Women in STEM in India — Realities, Challenges, and the Road Ahead.

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Abstract

This article offers a comprehensive exploration of the current realities, challenges, and future prospects for women in STEM in India, examining gender disparities, workplace experiences, and the national efforts driving greater inclusivity in the scientific community. Drawing on data from UNESCO (2024), NITI Aayog, the Department of Science and Technology (DST), and institutional programs such as the GATI Self-Assessment Team at IIT Kanpur, the She Research Network, and the ISRO Mars Mission, it highlights both systemic barriers and inspiring breakthroughs. The discussion concludes with a forward-looking perspective on building an equitable STEM ecosystem in India.

Illustration 1: Source- Vigyan Dhara, Feb 2024

1. Background: The Gender Equation in Science

Science, Technology, Engineering, and Mathematics—collectively known as STEM are foundational to economic growth and global standing of the nation. Ensuring gender diversity within these fields is not just a matter of equality; it is essential for driving innovation, developing sustainable solutions to climate issues, and expanding global economic participation.

Yet, women remain significantly underrepresented in STEM worldwide. The Global Gender Gap Report 2023 reveals that women comprise only 29.2% of the STEM workforce across 146 countries. India mirrors this disparity, a research by Muralidhar and Ananthanarayanan (2024) shows that women account for only 17% of STEM faculty across 100 universities.

This underrepresentation stems from deep-rooted cultural perceptions that frame STEM as a male-dominated domain. The concept of the "leaky pipeline" illustrates how gender disparities widen over time, starting with relatively equal participation in early education but eventually narrowing sharply as women progress through academia and into professional roles. From a young age, boys and girls are socialized into traditional gender roles at home and in school, often discouraging girls from pursuing advanced studies in STEM.

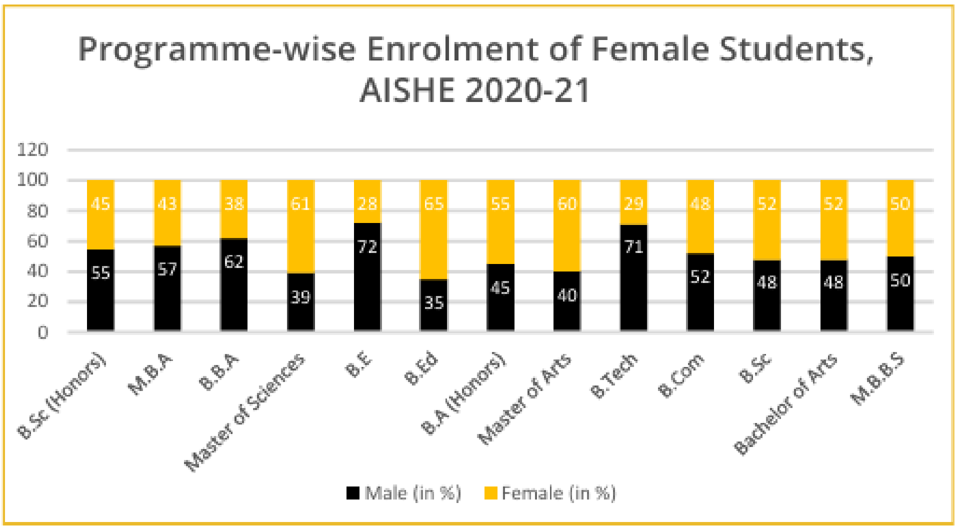

Figure 1: Programme-wise enrolment of female students, Source: AISHE 2020-21

As women enter the workforce, male dominance in STEM fields can lead to professional isolation and limited access to opportunities, prompting many to leave the sector. This attrition is clearly reflected in educational and employment data. The choice of higher education degree for women is shaped by socio cultural factors which leads to relatively low enrolment in science, technology and engineering as depicted in Figure 1.

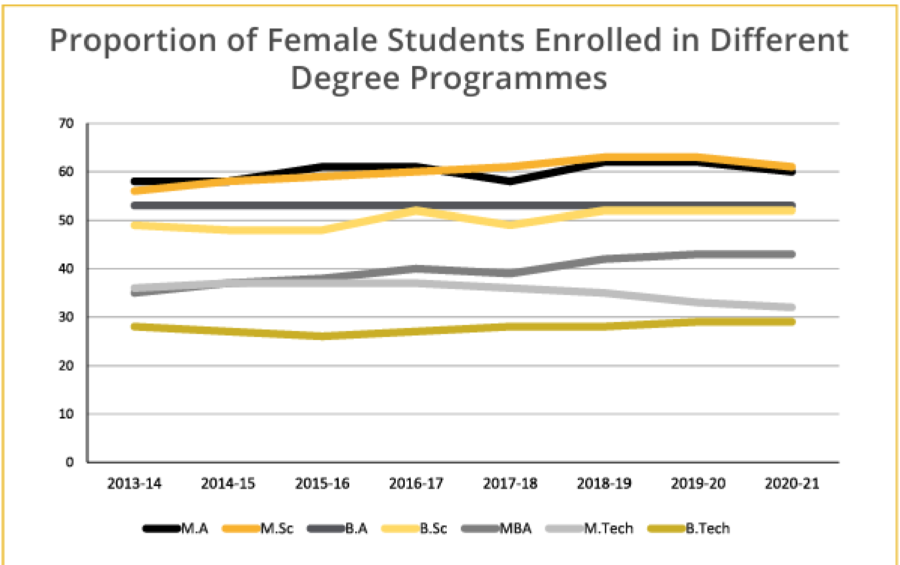

Figure 2: Proportion of female students enrolled in different degree programmes, Source AISHE 2020-21

Even with STEM as Figure 2 shows, Female enrolment in Bachelor of Technology was at 28.7% and Bachelor of Engineering was at 28.5%. The female enrolment has been low in Civil, Mechanical and Electrical with less than 10% students across all levels. It has also been observed that only 18.6% of women are engaged in R&D activities compared to 81.4% of men (Figure 3) (Sinha, S., & Oberai, D. (2024, February).

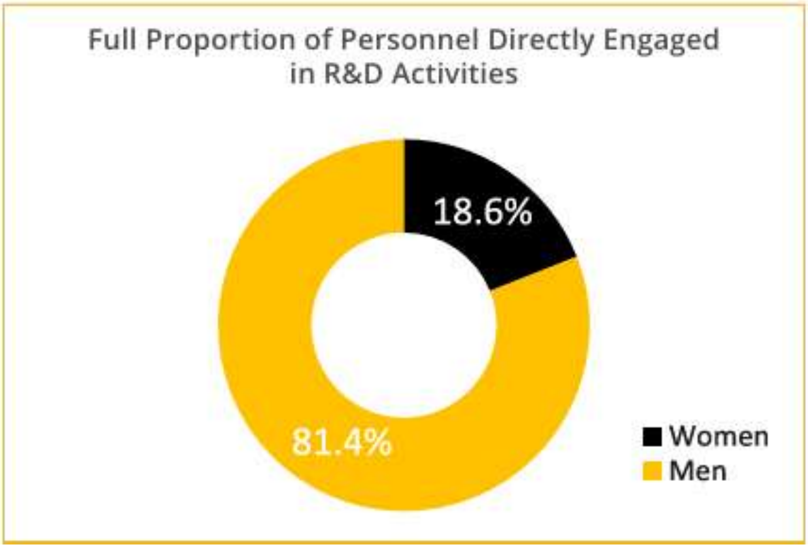

Figure 3: Proportion of personnel directly engaged in Research and Development activities, Source: Research and Development Statistics at a glance, 2022-23, DST.

Even with STEM as Figure 2 shows, Female enrolment in Bachelor of Technology was at 28.7% and Bachelor of Engineering was at 28.5%. The female enrolment has been low in Civil, Mechanical and Electrical with less than 10% students across all levels. It has also been observed that only 18.6% of women are engaged in R&D activities as compared to 81.4% of men (Figure 3) (Sinha, S., & Oberai, D. (2024, February)).

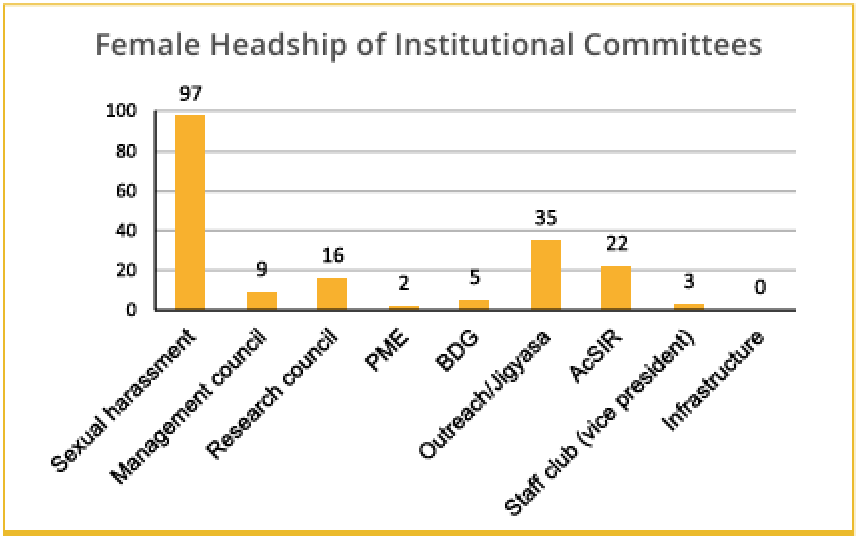

Figure 4: Female headship of institutional committees, Source: Women in STEM: A CSIR Survey towards Gender Parity, 2022.

Moreover, women also struggled to break the glass ceiling in reaching positions of eminence such as heads of institutional committees. The dominance of men in STEM have prevented women from growing into leaders which is reflected in the appointments of committee heads. Women headship is mainly concentrated in POSH commitees and in those pertaining to outreach activities which highlights the segregation of women in areas of work that are traditionally considered suitable for women (Figure 4). To retain women in STEM workforce professional opportunities should be equally available to all genders. Opportunities for re-entry of women after childbirth and flexible workplace hours are required for women to allow them to maintain a work-life balance while achieving their professional goals.

2. Historical Perspective: India's Pioneering Women in Science

India's scientific journey is marked by extraordinary women whose achievements transcended social and structural barriers.

For over 100 years, women scientists in India have proven their strength and made great contributions to the scientific growth of the country.

Their pioneering work laid the foundation for a new era of women scientists in India, which is now carried forward by leaders like Dr. Tessy Thomas and Dr. Ritu Karidhal, embodying the future of Indian innovation.

Table 1. Pioneering Indian Women in Science

	Scientist	Field	Notable Contribution
	Kadambini Basu Ganguly (1861–1923)	Medicine	First Indian woman physician to graduate and practice western medicine in India
	Dr. Janaki Ammal (1897- 1984)	Botany & Cytogenetics	Created sugarcane hybrids with higher sucrose content at the Sugar Breeding Centre (Coimbatore). Fellow of the Indian Academy of Sciences, INSA. - Awarded an honorary LL.D. by the University of Michigan - **Awards**: Padma Shri - **Honors**: EK Janaki Ammal National Award for Plant Taxonomy and Animal Taxonomy.

	Rajeshwari Chatterjee (1922 –2010)	Microwave Engineering and Antennae Engineering	Contributed to Elements of Microwave Engineering, Antenna Theory and Practice **Awards:** **-Mountbatten Prize** for the best paper by the Institute of Electrical and Radio Engineering in the United Kingdom **-J C Bose Memorial Prize** for the best research paper by The Institution of Engineers.
	Dr. Asima Chatterjee (1917-2006)	Organic Chemistry	Developed anti-epileptic and anti-malarial drugs. -First Women President of the Indian Science Congress and a member of Rajya Sabha. **Awards**: -Padma Bhushan -Shanti Swaroop Bhatnagar Award -C V Raman Award of the UGC -P C Ray Award.
	Anna Mani (1918-2001)	Meteorology and Physics	She contributed to the study of radiation, ozone, and atmospheric electricity, both on the surface and in the upper air, using special sounding techniques. **Books:** -Handbook for Solar Radiation Data for India in 1980 -Solar radiation over India in 1981 **Awards:** K.R. Ramanathan Medal.
	Dr. Tessy Thomas (1963)	Missile Technology	Project Director, Agni IV & V missiles -Regarded as the 'Missile Woman' of India, she is the first woman scientist in the history of the country to head a missile project. **Awards**: Agni Self-reliance award in 2001.

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Source: Women in Science/ Indian Academy of Sciences, Picture sources: Kadambini Ganguly - Wikipedia, , Anna Mani: The Inspiring Indian Physicist and Her Enduring Legacy - RedGIF, Rajeshwari Chatterjee - Alchetron, The Free Social Encyclopedia, Dr Janaki Ammal: India's First Woman Botanist, https://madrascourier.com/biography/asima-chatterjee-indias-first-female-scientist/, Tessy Thomas - first missile woman of India.

3. **The Present Landscape: Women in STEM in India (2025)**

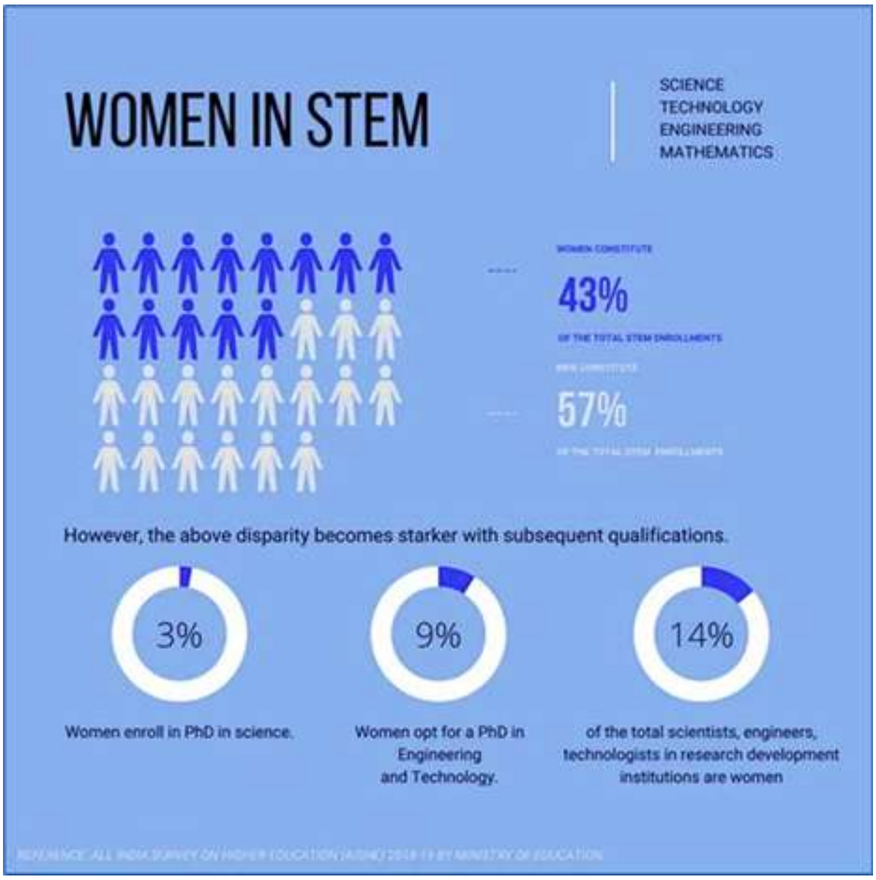

Figure 5: Women in STEM. Source: AISHE 2018-19.

Globally, women's underrepresentation in science and technology remains one of the most persistent challenges to inclusive innovation. UNESCO's *Science Report* notes that women make up only 33% of researchers worldwide (Lewis, J., Schneegans, S., & Straza, T. (2021), UNESCO Publishing). Yet, India stands as an outlier in higher education, with 43% of STEM graduates being women, among the highest proportions globally. However, participation at the workforce level tells a different story. According to *AISHE Report 2018-19*, 3% women enroll in PhD in the sciences while 9% opt for a Ph.D. in Engineering and Technology, and women account for only 14% of the total scientists, engineers, and technologists in research and development (R&D) organizations (AISHE 2018-19).

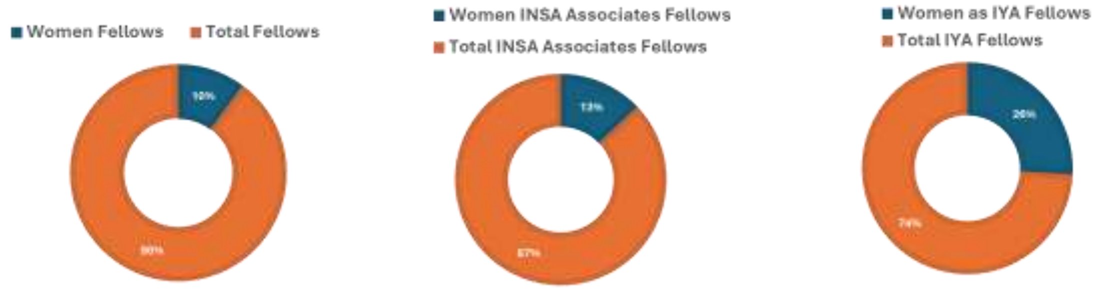

Figure 6: Representation of Women in Indian National Science Academy.

A study by Muralidhar and Ananthanarayan (2024) revealed the base rate of women faculty in Indian academia to be 16.6% across 98 Indian universities. Engineering, Chemistry, Computer Science, and Physics show base rates of women faculty that hover around 0.1, the lowest across all subfields (Figure 7).

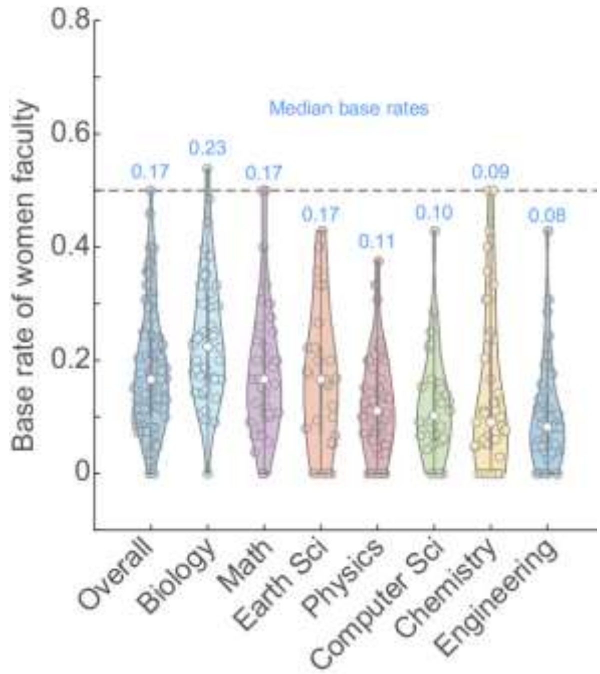

Figure 7: The overall base rate of women faculty in academia is 16.6% (Muralidhar and Ananthanarayan, 2024)

This highlights the persistent gender imbalance and occupational segregation in STEM academia. According to the National Institutional Research Framework (NIRF) rankings 2022, the top 8 institutions, which were part of the base rate dataset, were included for analysis. All 8 of these institutes had women's base rates less than the median overall base rate of 16.7% (Figure 8).

The median base rate of these top institutes or universities was only 10%. (Figure 8).

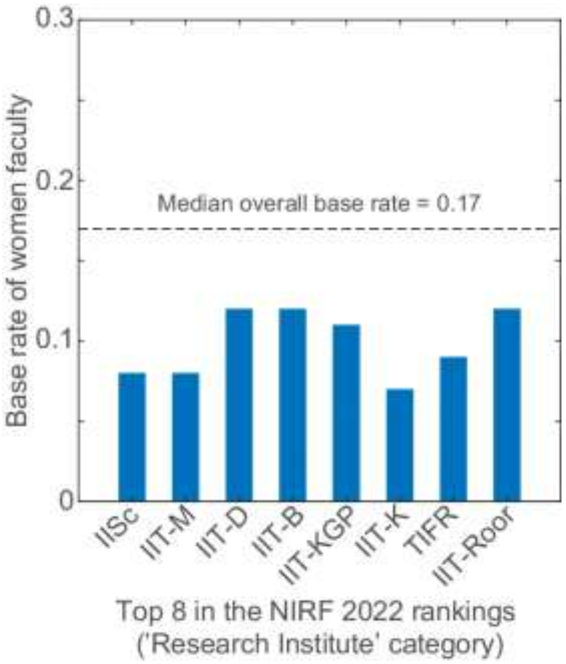

Figure 8: Top 8 in the NIRF 2022 rankings (Muralidhar and Ananthanarayan, (2024))

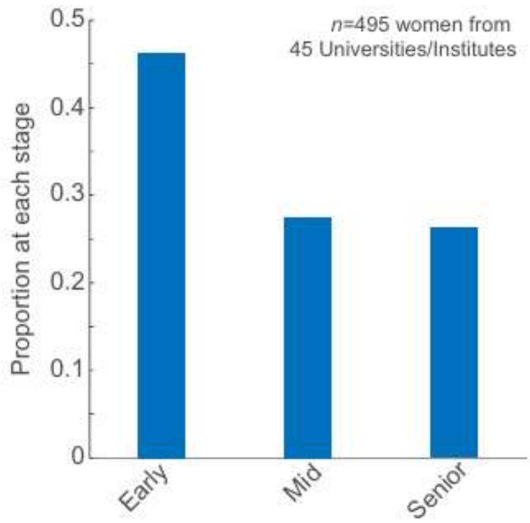

Figure 9: Proportion on Women scientists by career stage (Muralidhar and Ananthanarayan, 2024)

The Leaky Pipeline of Women in STEM:

The "leaky pipeline" remains a defining feature, representing the attrition of women from science at successive career stages due to social expectations, workplace bias, and institutional rigidity. India has witnessed a steady increase in women's participation in STEM education and research. The imbalance intensifies within premier institutes such as IITs and IISc, where cultural, structural, and recruitment barriers persist.

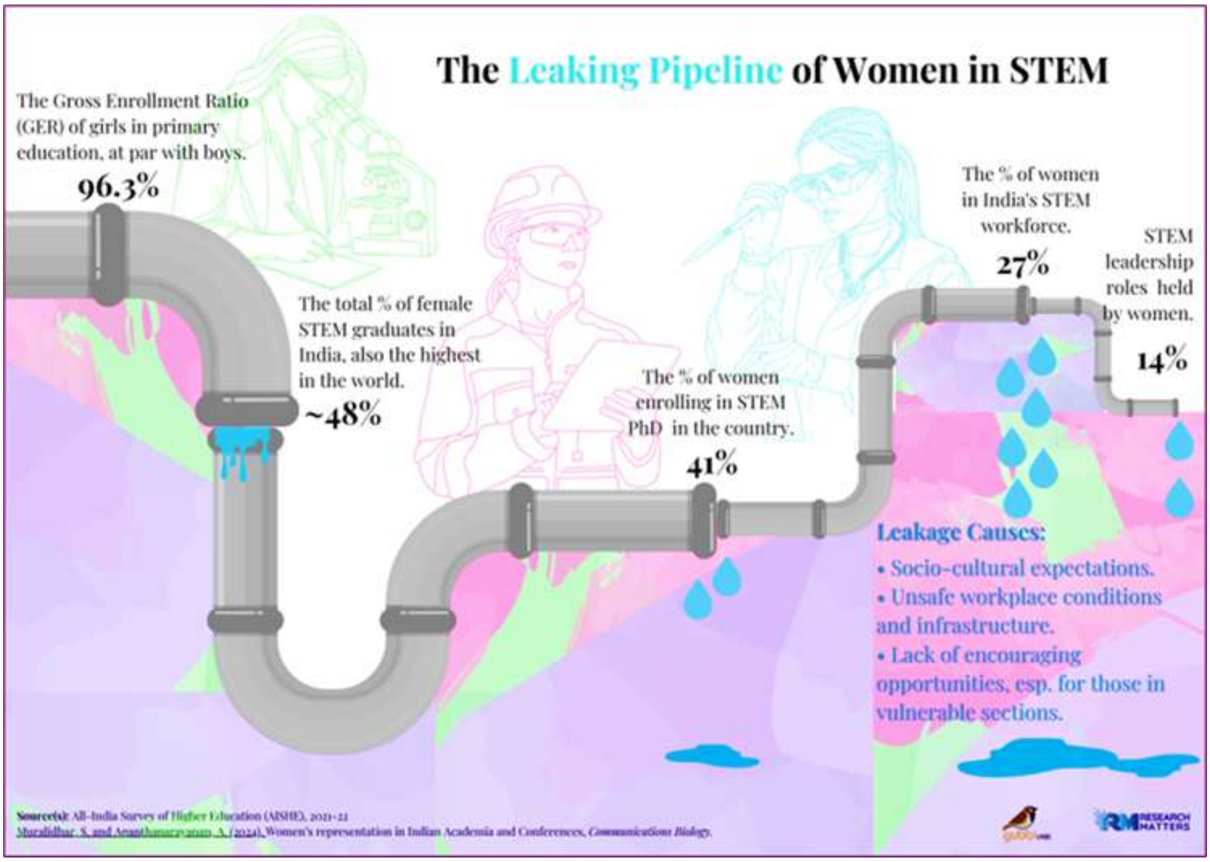

Illustration 3: The cause of leaky pipeline for Women in Science
(Source:https://researchmatters.in/sciqs/leaking-pipeline-women-stem)

Invisible Biases About What Women Can and Cannot Do

The invisible biases against women are deeply ingrained societal assumptions that subtly influence perceptions and decisions. For instance, women may be seen as less competent in technical or mathematical domains, leading to fewer opportunities, lower expectations, and exclusion from leadership roles or high-stakes projects. Such biases often manifest in hiring practices, peer evaluations, and classroom dynamics, where women's contributions are undervalued or overlooked.

Negotiating the Balance Between Family and Career

Women in STEM frequently face the dual burden of professional ambition and societal expectations around caregiving. The lack of flexible work arrangements, inadequate parental leave policies, and limited access to childcare can make it challenging to maintain career momentum. This tension often leads to career interruptions or part-time work, which can hinder advancement and contribute to the leaky pipeline phenomenon in STEM careers.

Social Bias Against Women in Certain STEM Fields

Fields like physics, engineering, and computer science are often stereotyped as male domains, discouraging women from entering or persisting in them. These biases are reinforced through media portrayals, educational materials, and peer culture, which can create hostile or isolating environments for women. As a result, even highly qualified women may self-select out of these fields due to lack of belonging or support.

Lack of Support During Postdoc to Faculty Transition

The transition from postdoctoral researcher to faculty is a critical juncture where many women exit academia. This phase often lacks structured mentorship, transparent hiring practices, and institutional support. Women may face challenges in securing grants, building networks, and navigating tenure-track expectations, all while contending with implicit bias and limited representation in decision-making bodies.

Lack of Resources and Leadership Commitment

Without sustained investment and leadership buy-in, diversity initiatives often fail to produce meaningful change. Many institutions lack dedicated funding for gender equity programs, mentorship networks, or inclusive hiring practices. Leadership commitment is essential to drive policy reforms, track progress, and foster a culture where women and in STEM can thrive not just survive.

Key Solutions to Address the Leaky Pipeline for Women in STEM

Having outlined the systemic barriers, the following section focuses on solutions, practical, stage-specific interventions that institutions can adopt to retain and empower women in STEM. These recommendations aim to dismantle discriminatory structures, foster inclusive environments, and ensure equitable opportunities across all career stages.

Support for Postgraduates and Advanced Degree Holders

For women pursuing postgraduate and advanced degrees, early career progression is often hindered by rigid eligibility rules and insufficient mentorship. To fil these gaps, it is important to remove age-based restrictions on grants and positions, which unfairly penalize nontraditional career paths and disproportionately affect women. Also, institutionalization of mentorship and sponsorship networks, ensuring that early-career women receive both guidance and active advocacy from senior academics would be imperative.

Support for Early- and Mid-Career Scientists

- Women in early and mid-career stages face the dual challenge of advancing professionally while managing family responsibilities. Institutions must provide equitable support system, such as:

- Create an Office for Equity and Inclusion in every institution to serve as a hub for mentorship, advocacy, and community-building.
- Strengthen family support systems by offering adequate parental leave for both men and women, accounting for childbirth in grant decisions, and providing extensions when necessary.

- Implement tenure clock extensions for women affected by childbirth, ensuring fair access to career milestones such as tenure and promotion.
- Guarantee at least 30% representation of women scientists on panels related to recruitment, promotions, and budget decisions, so women's perspectives shape institutional policies.
- Provide on-campus childcare facilities, recognizing that caregiving is not solely a mother's responsibility and alleviating stress for new parents.
- Respect the schedules of young parents by avoiding meetings outside standard working hours, ensuring faculty with family responsibilities are not excluded.

Support for Senior Scientists

- At senior levels, women scientists often encounter entrenched biases and limited leadership opportunities. Institutions must actively counter these barriers.
- Encourage long-term mentor–mentee relationships, providing continuity of support for early-career women and counteracting systemic biases.
- Amplify the voices of experienced women scientists in decision-making at academy, departmental, and government levels, fostering diversity of thoughts and innovative solutions.
- Promote career-enhancing opportunities such as sabbaticals, normalizing their use among women academics who may hesitate due to societal pressures.
- Conduct regular gender sensitization workshops for all staff and faculty, making inclusivity and respectful behaviour a sustained institutional priority.

The leaky pipeline of women in STEM is not an inevitable outcome but the result of systemic barriers that can be dismantled. By implementing these solutions, such as abolishing discriminatory practices, strengthening mentorship, supporting family responsibilities, amplifying women's voices, and embedding inclusivity into institutional culture, academia can retain women at every stage of the pipeline. This not only ensures equity but also enriches the scientific enterprise with diverse perspectives and talents. (Shruti Muralidhar & Vaishnavi Ananthanarayanan, 2024).

GATI: Gender Advancement for Transforming Institutions

Gender Advancement for Transforming Institutions (GATI) was launched in 2020 by India's Department of Science and Technology, represents a milestone in building equitable academic ecosystems. Inspired by the UK's *Athena SWAN Charter*, GATI encourages self-assessment, accountability, and strategic reforms in STEMM institutions.

Thirty Indian institutions partnered with six institutions from the UK to pilot this initiative. Among them, **IIT Kanpur's GATI Self-Assessment Team (GSAT)** has championed inclusive policies addressing structural, psychological, and cultural barriers — ensuring all genders contribute equally to scientific excellence.

Impact under GATI: IIT Kanpur

- Adopted the GATI framework to *support the promotion of inclusive working practices* that increase the retention of valued women academics and support staff.
- *Embraced the institutional policies, practices, action plan and organizational set-up.*
- *Efforts in removing the structural barrier* – social, cultural, and economic.
- All *genders are equally capable of making valuable contributions* and promoting excellence in all areas of human enterprise.
- *Efforts in removing Barriers*: psychological barriers; sociological barrier; enhance Innate skills; stereotype threats.

Illustration 4: GATI self assessment (GSAT) team at IIT Kanpur

Global Partnerships for Equity:

International collaborations under GATI India–UK and Women in Science Brazil–UK have amplified the global dialogue on gender equity. As featured in *The Academia Women* magazine (July–Sept 2022), these partnerships fostered exchange and empowerment across borders.

Connecting over gender equity initiatives

As an extension of an International Women's Day event organised by the University of Manchester with the theme #BreakTheBias, nine academics or professional services staff from higher education institutions in Brazil, India and the UK explained how they are involved in promoting gender equity.

The nine women taking part were Dr Diane Harris, Dr Rachel Cowen, Prof Bushra Ateeq, Dr Flávia Noronha Dutra Ribeiro, Prof Dawn Edge, Prof Shyama Rath, Prof Samara Carbone, Adèle MacKinlay and Dr Laura A. Richards.

Authors:

Dr Diane Harris, Dr Rachel Cowen, Prof Bushra Ateeq,

Dr Flávia Noronha Ribeiro, Prof Dawn Edge,

Prof Shyama Rath, Prof Samara Carbone, Dr Adèle MacKinlay & Dr Laura A. Richards.

Source: theacademicwoman.co.uk

Dr. Bushra Ateeq of IIT Kanpur notes,

"Maintaining diversity and gender balance within my research group is crucial for innovation — such teams bring unique capabilities and outlooks."

Initiatives for women empowerment at IIT Kanpur

- **Empowering Women in Tech: IIT Kanpur's Breakthrough Workshop**

On **June 28, 2025**, IIT Kanpur hosted its **Women in Tech workshop in collaboration with Techgyan**, delivering over six hours of intensive hands-on training in AI, machine learning, web development, and data science. The event drew strong participation, with **35% of attendees being female engineering students**, and women-led teams securing top positions in hackathons. Participants gained industry-ready skills and confidence, exemplified by students building predictive ML models within days. Joint certifications from IIT Kanpur and Techgyan enhanced career prospects, while affordable accommodation, meals, and free extended online courses ensured accessibility and continuity of learning. By combining practical skill-building with inclusive support, **the workshop became a catalyst for greater female representation and leadership in STEM, setting a benchmark for women's empowerment in technology.**

- **Engineering Equality: IIT Kanpur reserves 246 Seats for Women**

A bold initiative empowering female students to break barriers in STEM, boosting representation and shaping future leaders in technology.

IIT Kanpur has taken a landmark step toward women's empowerment in science and technology by reserving 246 engineering seats (20%) exclusively for female students. This initiative directly addresses the gender gap in STEM by expanding access across disciplines, encouraging more women to pursue engineering, and strengthening their representation in higher education. By creating new opportunities and fostering inclusivity, IIT Kanpur is shaping a future where women can lead and innovate in technology at scale.

Collaborative Ecosystems: The She Research Network and International Partnerships

The She Research Network (SRN-India), launched in 2023, connects over 500 women researchers across IITs, IISc, CSIR, and DRDO institutions, fostering mentorship and collaboration (Illustration 5).

Illustration 5: She Research Network in India (SheRNI). Source: SheRNI

India's 'Rocket Women'— redefining leadership in the cosmos.

Behind India's historic space milestones are extraordinary women.

Ritu Karidhal (in red) **and Nandini Harinath** (in green) — **Deputy Operations Directors of the Mars Orbiter Mission (Mangalyaan)** — alongside **Anuradha TK, Geosat Programme Director** (in white), have shattered stereotypes.

Illustration 6: Ritu Karidhal (in red) and Nandini Harinath (in green) — Deputy Operations Directors of the Mars Orbiter Mission (Mangalyaan) — alongside Anuradha TK, Geosat Programme Director (in white). (Source: [The women scientists who took India into space - BBC News]).

Their mission placed India in Mars orbit on its first attempt on September, 2014 — a world first. In 2023, India's Chandrayaan-3 lunar mission, led by another generation of women scientists, reached the Moon's south pole, propelling India into the elite space club of four nations following the United States, China, and the former Soviet Union. The remarkable achievement was spearheaded by a team of outstanding space researchers shown in the illustration below.

Illustration 7: Women Space research Team behind the success of Chandrayaan-3. (Source: [List of Female Scientists Behind the Successful Chandrayaan 3 Moon Mission])

Tessy Thomas: India's "Missile Woman" and a Beacon for Aspiring Scientists

Among India's most inspiring figures in modern science stands Dr. Tessy Thomas, often celebrated as the "Missile Woman of India." As the first woman scientist to head a missile project in the Defence Research and Development Organisation (DRDO), Dr. Thomas shattered barriers in one of the most male-dominated fields in Indian science — defence technology.

Born in Alappuzha, Kerala, Dr. Thomas's journey from a small-town student to the leader of the Agni-IV and Agni-V missile projects is emblematic of India's scientific rise and the resilience of women in STEM. Her career not only advanced India's strategic capabilities but also demonstrated that gender is no obstacle to excellence. Today, her success story continues to inspire a generation of young women engineers, proving that scientific leadership has no gender.

Illustration 8: Tessy Thomas: First Missile Woman of India (Source: https://www.adda247.com/defence-jobs/tessy-thomas-first-missile-woman-of-india/)

Government Initiatives for Promoting Science Among Women:

The Indian government has launched a range of targeted initiatives to empower women in science, aiming to bridge gender gaps and foster inclusive participation in STEM fields. India recognizes that women's representation in science and technology is crucial for national progress. To this end, several flagship programs have been introduced:

School Level (Encouraging early interest)

Initiative	Focus	Implementing Agency/Ministry	Link: Reference
Vigyan Jyoti	Nurturing girl students for STEM careers, especially where women are underrepresented.	DST (KIRAN Division)	https://vigyanjyoti.dst.gov.in/
Samagra Shiksha (Girls' specific)	Quality education, free textbooks, stipends,	Ministry of Education	https://samagra.education.gov.in/

	encouraging girls in science stream.		

College/University & PhD Level (Building research capacity)

Initiative	Focus	Implementing Agency/Ministry	Link: Reference
Women Scientist Scheme (WOS-A)	Fellowship for PhD holders to re-enter research.	DST	https://www.indiascienceandtechnology.gov.in/programme-schemes/women-schemes/women-scientist-scheme-wos
Women Scientist Scheme (WOS-B)	Support for R&D projects addressing societal issues.	DST	https://www.indiascienceandtechnology.gov.in/programme-schemes/women-schemes/women-scientist-scheme-b-wos-b
Women Scientist Scheme (WOS-C)	Training in intellectual property rights	DST	https://www.indiascienceandtechnology.gov.in/programme-schemes/women-schemes/women-scientist-scheme-c-wos-c
UGC-PDF for Women	Post-Doctoral Fellowship for unemployed women PhD holders.	UGC	UGC-Post Doctoral Fellowship for Women Candidates | India Science, Technology & Innovation - ISTI Portal
SERB-POWER	Equal opportunities & grants for women	SERB (DST)	Home: Anusandhan National Research Foundation, Department of Science &

	researchers in R&D.		Technology, Government of India
WISE-SCOPE	Funding S&T projects for societal challenges (health, livelihood).	DST	https://dst.gov.in/callforproposals/call-proposals-under-wise-scope-fellowship
Technology Development and Utilization Programme for Women (TDUPW)	Provides assistance for those projects which are relevant to technology development and utilization by women with special emphasis to technologies developed by scientific establishments.	ISTI	https://www.indiascienceandtechnology.gov.in/programme-schemes/women-schemes/technology-development-and-utilization-programme-women-tdupw
Indo-U.S. Fellowship for Women in STEMM (WISTEMM)	Provide opportunity to bright Indian women students and scientists to gain exposure and access to world-class research facilities in U.S. academia and labs	IUSSTF	https://iusstf.org/indo-u-s-fellowship-for-women-in-stemm-wistemm-

Faculty & Senior Researcher Level (Sustaining careers)

Initiative	Focus	Implementing Agency/Ministry	Link: Reference
WISE-PDF	Post-Doctoral Fellowships for women continuing research.	DST	WISE Post-Doctoral Fellowship (WISE-PDF) | Department Of Science & Technology
WIDUSHI	Support for near-retirement/retired women scientists.	DST	WIDUSHI (Womens Instinct for Developing and Ushering in Scientific Heights & Innovation) | India Science, Technology & Innovation - ISTI Portal
WISER	Integrating women into ongoing R&D+I projects.	DST	IGSTC
WISE-IPR	Training women in Intellectual Property Rights.	DST	Applications invited from women scientists for selection under 'WISE Internship in IPR (WISE-IPR)' | Department Of Science & Technology
BioCARe (Biotechnology Career Advancement & Re-orientation Programme)	Increases women's participation in biotechnology research.	ISTI Portal	Biotechnology Career Advancement and Re-orientation (BioCARe) Programmes | Department of Biotechnology

CURIE (Consolidation of University Research for Innovation & Excellence in Women Universities)	Establishes/upgrades research infra in women's universities.	ISTI Portal	CURIE initiative of DST enhancing research facilities in women universities | Department Of Science & Technology

- **Women in Science and Engineering-KIRAN (WISE-KIRAN):** It ensures the participation of women in the field of Science and Technology (S&T) through various gender-enabling programs.
- **Women Scientists Scheme'** under WISE-KIRAN provides various opportunities to women scientists and technologists, especially those who have had a break in their careers, to pursue research.
- **Indo-US Fellowship for Women in STEMM** (Science, Technology, Engineering, Mathematics & Medicine): It encourages women scientists and technologists to conduct international collaborative research at prestigious US institutions.
- **Vigyan Jyoti**: Program launched by the DST for meritorious girl students of Class 9-12 to encourage them to pursue education and careers in science and technology, particularly in the areas where women are underrepresented.
- **Gender Advancement for Transforming Institutions (GATI):** It aims to transform institutions for a more gender-sensitive approach and inclusiveness with the ultimate goal of improving gender equity in S&T.
- **SERB-POWER (Promoting Opportunities for Women in Exploratory Research):** It aims to address the lower participation of women scientists in research activities and to mitigate gender disparity in science and engineering.
- **National Award for Woman Scientist:** The Ministry of Earth Sciences has initiated this award since 2018 which is being conferred to one woman scientist each year.
- **Women in Engineering, Science, and Technology (WEST):** A new I-STEM (Indian Science Technology and Engineering Facilities Map) initiative called WEST was launched by the Government of India in 2022.

Together, these initiatives reflect a multi-layered approach—from nurturing young talent at the school level to supporting established women scientists in leadership roles. They not only provide financial assistance but also create networks, mentorship opportunities, and institutional support systems that help women thrive in science and technology.

In essence, the Indian government's efforts are reshaping the scientific landscape by ensuring that women are not just participants but leaders and innovators in advancing national and global research.

Women's Leadership in Higher Education: The Need of the Hour

Despite remarkable gains in female enrolment, India's higher education ecosystem remains male-dominated at the leadership level. As of 2025, women account for only 14% of vice-chancellors, deans, and directors in Indian universities (UGC, 2025).

This imbalance constrains the policy vision and institutional culture needed for inclusive growth. Women leaders bring collaborative decision-making, empathy, and foresight — qualities essential for nurturing innovation and diversity. Expanding leadership pathways through initiatives such as GATI, DST-WISE, and robust mentorship frameworks is critical to correcting this disparity.

The defining challenge of the coming decade is to create an academic ecosystem where women lead as fully as they learn. Rising to this challenge is not only a question of equity — it is a strategic imperative to unlock India's full potential in science, technology, and education.

The Way Forward: Toward an Inclusive STEM Ecosystem

India's scientific success story can only be complete when gender inclusivity becomes integral to innovation. Policy reforms, inclusive leadership, and global partnerships are essential pillars for achieving parity in STEM.

Five key steps forward include:

1. Institutional accountability through gender audits and transparency.
2. Structured mentorship and networking via national platforms like SRN.
3. Career re-entry pathways and flexible research roles for women post-career breaks.
4. Visibility and recognition through awards and representation in policy bodies.
5. Global collaboration to promote knowledge sharing and inclusive research practices.

Conclusion

India stands at the cusp of a new era of global scientific leadership, but true leadership cannot thrive without inclusivity. The journeys of pioneers like Tessy Thomas and Ritu Karidhal, alongside countless women researchers, reveal a simple truth: opportunity transforms not only individual lives, but the trajectory of nations.

Bridging the gender gap in science is not merely a matter of fairness; it is a strategic imperative for India's future. Every barrier removed is an innovation unlocked, every pathway opened is a frontier advanced.

When the next generation of women scientists set their sights on Mars, quantum breakthroughs, or biotechnology revolutions, they must see not ceilings, but horizons illuminated by the brilliance of those who came before them, and widened by the resolve of a nation that chooses equity as its engine of progress.

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Women in Science in Russia.

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Abstract

It is commonly believed that women in Russia are underrepresented in science and industrial production. Their primary occupations are focused on household responsibilities, child-rearing, or careers in humanities and creative fields. However, recent research shows that this situation has changed: women now comprise approximately 30% to 40% of researchers in the engineering and natural sciences.

At the same time, women encounter significantly more obstacles and stereotypes on their scientific career paths. These challenges include the "double burden", the gender pay gap, segregation by fields of study and employment sectors.

Despite these difficulties, the contribution of Russian women to science, as well as their overall involvement, is very substantial. Data on publication activity and citation impact, measured using metrics such as the H-index, show that the average publication output of women is higher than that of men. Moreover, the proportion of women holding leadership positions is increasing. These roles include laboratory heads, department managers, and directors of research institutes. The report is dedicated to the work of Russian women in science.

1. Historical background

Women's participation in science in Russia has a rather long and interesting history. Today, Russia cannot be called a country where gender inequality is clearly expressed. Formally, women have the same rights as men, but if you look at the issue in more detail, it turns out that women often face various kinds of prejudices on their career path.

Just a few centuries ago, obtaining higher education for women in Russia was almost impossible. The first female scientists received their basic education at home, and later went through a rather difficult path.

1.2. Among the first Russian women scientists, I would like to say a few words about:

Nadezhda Prokofyevna Suslova (1843-1918) - physiologist, surgeon, gynecologist, the first Russian woman to become a doctor of medicine. She was born in the Nizhny Novgorod province to a family of a serf peasant who received his freedom and became the owner of a cotton-paper factory. Having a certain income, her father was able to give his daughter a sufficient education, initially at home from her mother, then at a boarding school in Moscow, where she thoroughly studied foreign languages. Nadezhda Prokofyevna had a great desire to continue her education, but she did not have the opportunity, since it was impossible for women at that time. However, in 1862, three women, including Nadezhda Suslova, were allowed to attend lectures of some professors at the St. Petersburg Medical-Surgical Academy. In 1864, Nadezhda Suslova entered the University of Zurich and in 1867, she was the first Russian woman to receive a diploma of Doctor of Medicine and Surgery and Obstetrics. After that, she returned to St. Petersburg and achieved recognition as a doctor: she had to take exams again and defend her dissertation for the second time. Nadezhda Suslova was one of the founders of paramedic courses for women in Russia.

Julia Vsevolodovna Lermontova (1947-1919) is the first Russian woman to earn a doctorate in chemistry. She was born in St. Petersburg into a hereditary military family. She received a good home education. In her youth, she developed a passion for medicine. However, at that time in Russia, higher medical education was excluded for women, for them there was only the possibility of becoming a midwife in midwifery schools at Moscow, St. Petersburg and Kazan universities. Julia Lermontova was able to obtain permission to attend classes as an auditor at the obstetrics school at the Clinical Institute of Moscow University, where classes were taught by Professor Alexander Ivanovich Babukhin, Head of the Department of Histology, Embryology and Comparative Anatomy. At that time, she was also attracted to laboratory work, where analyses were carried out using chemical preparations, and gradually an interest in a deeper study of chemistry arose.

In 1874, Julia Lermontova received her doctorate after defending her dissertation in organic chemistry at the University of Gottingen in Germany. Through her research, she determined the best conditions for the decomposition of oil and oil products to obtain the maximum yield of aromatic hydrocarbons. The logical final result of Lermontova's research in the field of oil refining was the invention of an original apparatus for the continuous distillation of oil under superheated steam.

Sofya Vasilyevna Kovalevskaya the first woman to earn a doctorate (in the modern sense) in mathematics, the first woman appointed to a full professorship in northern Europe and one of the first women to work for a scientific journal as an editor. According to historian of science Ann Hibner Koblitz, Kovalevskaya was "the greatest known woman scientist before the twentieth century". She was born in Moscow. Sofia's education was handled by Iosif Ignatievich Malevich, the son of a small landed gentry, who worked as a home tutor and mentor all his life, teaching according to an extensive program and giving children a fairly solid knowledge. In 1869, Kovalevskaya studied at the University of Heidelberg with Leo Königsberger, and from 1870 to 1874, she studied privately with Karl Weierstrass. According to university rules, women could not attend lectures. But Weierstrass, interested in revealing Kovalevskaya's mathematical talents, supervised her classes.

In 1874, the University of Göttingen awarded Kovalevskaya a PhD for her dissertation "On the Theory of Partial Differential Equations". In 1881, she was elected to the Moscow Mathematical Society (privat-docent). Under the name Sonya Kovalevsky, from the fall of 1884 to the fall of 1889, she worked as a professor in the Department of Mathematics at the Stockholm Higher School, which later became Stockholm University, with the obligation to lecture in German the first year and in Swedish from the second. In 1888 she won the Prix Bordin of the French Academy of Science for the discovery of the third classical case of the solvability of the problem of the rotation of a rigid body around a fixed point. A second work on the same topic in 1889 was awarded a prize by the Swedish Academy of Sciences, and Kovalevskaya was elected a corresponding member of the Physics and Mathematics Department of the Russian Academy of Sciences.

3. Modern realities

Almost 2 centuries later, the situation has changed significantly. According to the 2020 All-Russian Population Census, 59% of those with higher education are women. According to the Russian Ministry of Education and Science, as of the 2021/22 academic year, women accounted for 52% of undergraduate, specialist, and master's students, but at the postgraduate level, their share drops sharply and they constitute a minority - 44%. However, among postgraduate graduates, the share of women is increasing again and is 47%. Among doctoral graduates, the share of women is significantly lower - 39% (Rosstat, 2020).

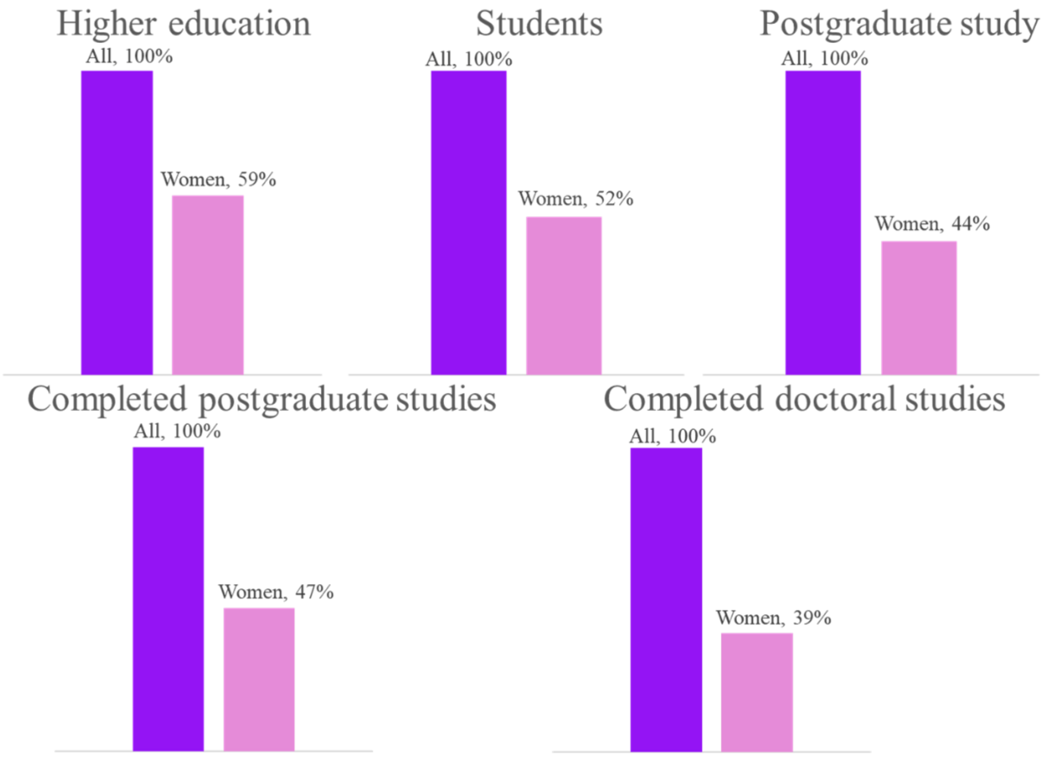

Figure 1. *Women in science in Russia today*

Today, the involvement of Russian women in science is assessed differently. One of the new approaches to measuring women's participation in science was proposed by Sofia Mikhailovna Rebrey (Rebrey S.M., 2025). In 2025, she published a study in which she compared traditional and new measurement methods. Traditionally, women's participation in science is assessed by calculating the proportion of female researchers, candidates and doctors of science.

According to Federal State Statistics Service (Rosstat, 2020), 40% of researchers with an academic degree in Russia are women. In addition, despite the gradual reduction in the number of scientists since 2015, the share of women, on the contrary, is growing. Another accessible indicator of women's participation in science is their employment in higher education, where they constitute the majority - 63%. A more detailed structure of higher education personnel shows that women are predominantly engaged in teaching (38%), administrative (16%), educational support (18%) and service (13%) work, rather than in research. Female researchers make up only 2% of female university staff, while for men the same indicator is 2.5 times higher. The only two areas where men dominate are scientific and engineering activities.

In terms of higher education leadership, general statistics indicate a predominance of women, but more detailed data on key leadership positions, including rectors, presidents, vice-rectors and branch directors, show that women are a minority in all positions except branch directors of non-state universities.

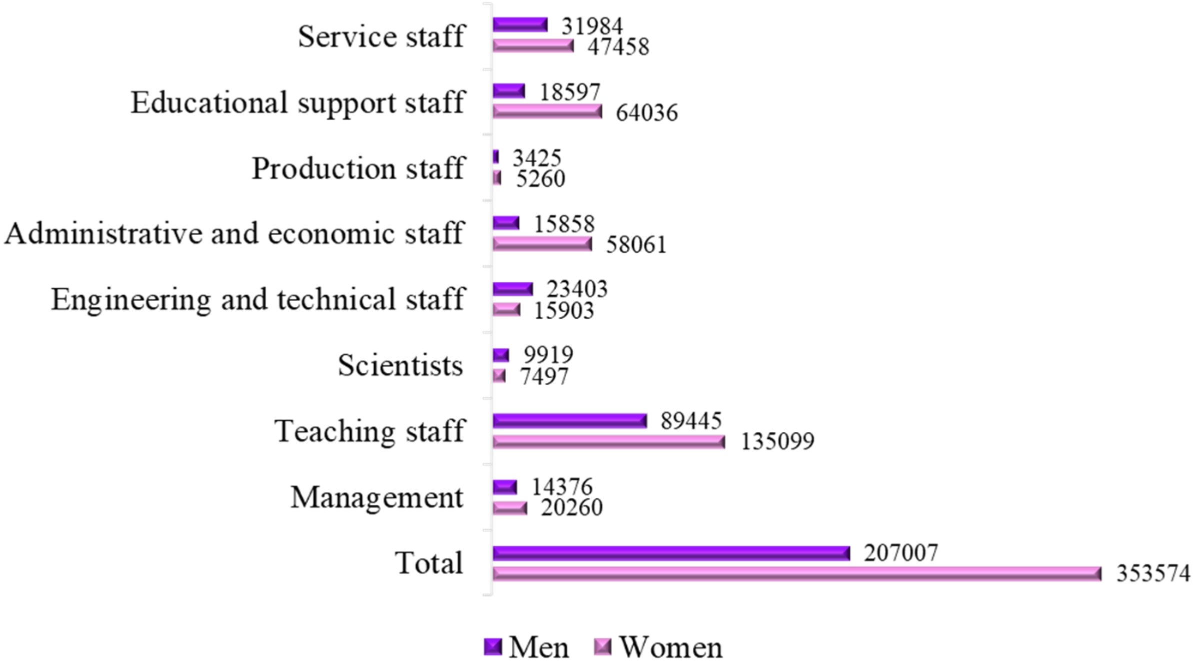

Figure 2. *Number of female and male staff of state, municipal and non-state universities in Russia, 2023*

Another evaluation indicator is the analysis of the results of elections to Corresponding Members and Academicians of the Russian Academy of Sciences. This status is received by scientists who have enriched science with outstanding scientific works and works of primary scientific importance (RAS, 2025).

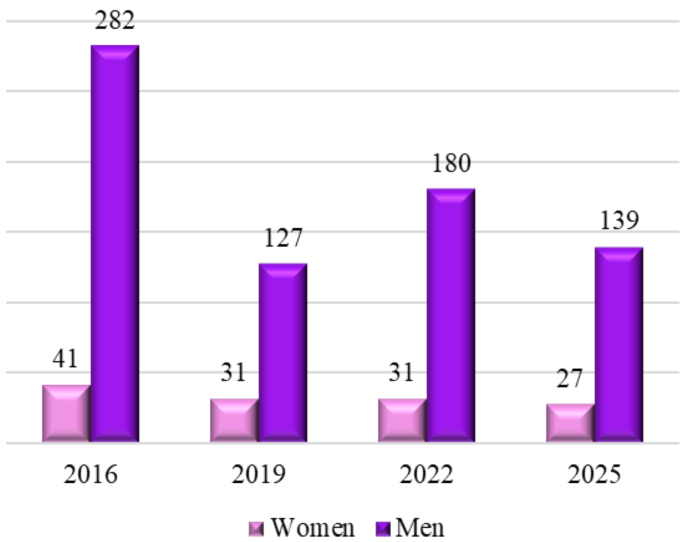

Figure 3. *Elections of Corresponding Members of the Russian Academy of Sciences 2016 – 2025*

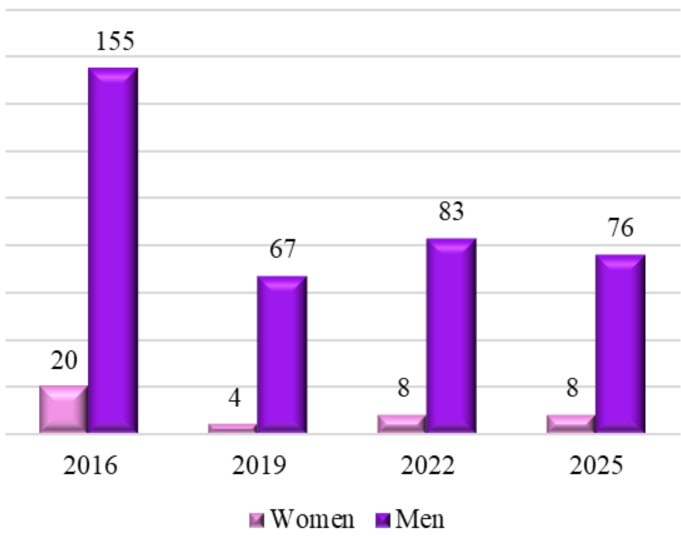

Figure 4. *Elections of academicians of the Russian Academy of Sciences*

In 2016, among 323 elected Corresponding Members of the Russian Academy of Sciences, there were 41 women. In 2019, 31 out of 158. In 2022, 31 out of 211. And in the last elections in 2025, 27 out of 166.

If we talk about the elections of Academicians of the Russian Academy of Sciences: in 2016, 20 women out of 175 elected academicians. In 2019, 4 out of 71. In 2022, 8 out of 91. In 2025, 8 out of 84.

In total, the RAS has 1,130 Corresponding Members, 145 women and 985 men, and 858 Academicians, 57 women and 801 men.

On the one hand, it may seem that among the age group of candidates, the overwhelming majority are men, however, according to the 2020 census, the share of women among candidates of sciences over 50 years old was 47%, and among doctors 39%.

The new approach to measuring women's participation and opportunities in science that Sofya Mikhailovna writes about involves analyzing unique bibliometric data collected by the Russian electronic scientific library called elibrary (Rebrey S.M., 2025). Here she assessed the number of registered authors, gender, academic degree and academic title, place of work, number of publications on elibrary, the Hirsch index and the Hirsch index according to the RINTS core. As a result, it turned out that women publish more actively than men. Moreover, female authors in economic sciences are characterized by a higher citation rate, measured using the Hirsch index. Despite this, women are cited less than men in top-ranking journals. It is the gender of the researcher, and not the academic title, university rating or number of publications, that plays a key role in citation in the most prestigious scientific periodicals.

Despite all the difficulties, in recent years, especially within the framework of the Decade of Science and Technology in Russia, a number of events have been held aimed at supporting and promoting women in the scientific field, as well as drawing attention to their contribution to science. For example:

All-Russian competition "Women of the Decade of Science and Technology", which is held by the Russian Union of Young Scientists and Tekhprosvet.

The project "Women in Science: Science Without Borders" within the framework of the Congress of Young Scientists, where women scientists tell their stories, share their experiences, and propose measures for the development of professional trajectories for women in science.

The event "Woman in Science" dedicated to the achievements and contribution of women in the scientific field, as part of the All-Russian festival NAUKA+ at the Grozny State Oil Technological University.

Lectures within the framework of All-Russian exhibitions, conferences, popular science events, the main theme of which is also “Women's contribution to Russian science”.

4. Conclusions

It should be noted that, despite all the difficulties, the contribution of Russian women to science, as well as their involvement, is very significant. In addition, the share of women occupying leadership positions, such as heads of laboratories, heads and directors of scientific institutes, is growing. Also, various public organizations and representatives of science themselves are actively involved in supporting and motivating young women scientists.

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Challenges of building research career in biomedical sciences and gender disparity in low- and middle-income countries

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Equal participation of both men and women in science and technology is essential for promoting a balanced socio-economic advancement in both of the developed and developing countries. Little attempt has been made to examine the gendering process in academia or research institutions in developing countries. Many evidences support that there is significant gender disparity among scientists in a research organization in a LMIC, which is attributed to a lack of opportunities of training and playing a leadership role in science. The bureaucratic impediment in the promotion, mentoring, leadership, and a less congenial work environment may have compromised the potential of women in a LMIC research organization to build career in health research. Understanding the gendering process in an academic organization and identifying gender specific barriers prohibiting women achieving their full potential in STEM disciplines would be imperative for promoting women in science, technology, mathematics and engineering (STEM) disciplines would be essential for fostering scientific development in LMICs.

Introduction

Both science and technology contribute greatly to positive socio-economic advancement in both developed and developing countries.(InterAcademy Council, 2004) Since 1980s, women participating in science had received increased attention, particularly in North America and Europe.(Gatta & Trigg, 2001) Since then women have made tremendous contributions to technological development globally.(UNESCO, 2007) Despite women's contributions to research and development, women's concerns are frequently disregarded or under-represented in the decision-making bodies at institutional, national and international levels, which leads to a lower input by women in science. (ETAN Expert Working Group on women and science, 2000)

Although there are no clear explanations to suggest any differences in scientific potential by gender,(Wittig, 1976) studies in academic institutions in Western countries have frequently documented gender disparity in every aspect of the scientific research, including selection of disciplines for career development, employment, salaries, job security, promotions, grant awards, publications, teaching responsibilities, mentoring programs and networking. In the UK, the majority of female scientists were biologists and chemists (41%) than engineers and technologists (7%), while in the US, more women than men were enrolled in one third of the medical schools between 1999 and 2000. (Burrel, 1984; Glover, 2001)Women were much more likely found in part-time or untenured positions and the median annual salary of women scientists was found to be lower than that of men in the same occupations.(Barzansky, Jonas, & Etzel, 2000; Blau & Lawrence, 2000; National Science Foundation, 2002) In addition, female researchers often received a significantly lower number of grants than their male counterparts.(Gordon MB, Osganian SK, Emans SJ, & Jr, 2009; Waisbren SE, Bowles H, Hasan T, Zou KH, Emans SJ, Goldberg C et al., 2008) Further, women with a PhD degree in science were found to be less likely than men to find satisfactory employment.(Holden, 2001)

How gendering occurs in an organization

Gender is a socially constructed distinction between masculinity and femininity.(Acker J, 1992) The distinction created by gender usually involves the subordination of women, and is portrayed as a 'symbol of power'. (Scott JW, 1986) There are a number of established theories about how gender disparity emerges in an organizational environment.(Acker J, 1992) The gendered process itself is inherent in the day-to-day activities of an organization. For an example, differences in job descriptions, pattern of work and wages at the entry level help to create gender disparity at the point of hiring. The fact that women give birth and need time away from the workplace is often considered a disruption of productivity of an organization unless women successfully negotiate their sexuality.(Pringle, 1989) On the other hand, men's sexuality dominates most workplaces and reinforces their organizational power. (Collinson DL & J., 1996) Further, it is difficult for women to separate work from the rest of their inherent social and familial responsibilities, which can label women as not a 'real worker', while men can avoid social and familial responsibilities in order to adhere to the rules of the organization.(Acker J, 1992)

Research conducted in academic settings has consistently documented that academic culture remains pervasively negative either consciously or unconsciously against women, and that the traditional gender roles of women play a vital role in accelerating the gendering process at an academic organization. (Ash AS, Carr PL, Goldstein R, & RH, 2004; ETAN Expert Working Group on women and science, 2000; European Communities, 2000; European Technology Assessment Network, 2000; Kaplan SH, Sullivan LM, Dukes KA, Phillips CF, Kelch RP, & JG, 1996; Wenneras C & Wold A, 1997)For many years researchers have researched gender equity in science to provide evidentiary support for raising awareness against gender discriminations and in turn to promote women in the sciences.(Gatta & Trigg, 2001) However, most evidence has been obtained from developed country settings and limited information has been available regarding gender disparity among scientists in the developing world. The goal of this paper is to review gender disparity among scientists in a research organization in Bangladesh, and construct relevant theories to explain the gendering phenomenon from a developing country perspective.

There has been remarkable gender disparity among the scientists in both scientific role and responsibility in most of the research institutions in LMICs, and a few factors are likely responsible for creating the gender disparity. First, gender awareness is a new concept in LMICs.[(Khatun, 2002)]It is possible that lack of gender awareness among the managers and staff had contributed the gender disparity among the researchers in LMICs. Second, lack of advanced training among female scientists, such as, a doctoral degree, might have attributed to receiving fewer competitive research grants. [(Chung SW, Clifton JS, Rowe AJ, Finley RJ, & Warnock GL, 2009)]Third, globally it has been found that professional networking is crucial for generating funds and the majority of the women so not avail themselves of the male dominated social networking systems. [(Ibarra H, 1992; Linehan M & Scullion H, 2001)] It is possible that male domination in the organization might have prevented woman researchers in LMIC institutions from expanding their research network and competing for grants.

There are a few other factors that have contributed to gender disparity among researchers in developed countries, and those may contribute to the gender disparity at LMIC institutions as well. Some of those factors include, lack of promotion of women, lack of women leadership, lack of mentoring opportunities for women, lack of congenial work environment and bureaucratic impediment in the organization for women to accelerate scientific productivity. We attempt to explain below how various factors may contribute to the gendering process in LMIC institutions in reference with examples of developed country settings.

Promotion

Promotion of faculty in an academic institution largely depends on the success in obtaining grants and publications.[(Cydulka RK, D'Onofrio G, Schneider S, Emerman CL, & Sullivan LM, 2000)] A higher academic rank and a PhD were associated with more publications in peer reviewed journals in various academic institutions. [(Kaufman RR, ; O'Meara KA, 2005; Perna L, 2005; Teodorescu D, 2000)] Generally, a smaller proportion of women in LMIC institutions are positioned at a rank higher than a middle rank and a fewer women than men had an opportunity to get a

PhD degree. This may indicate that a smaller proportion of women scientists were contributing to the scientific publications in LMIC institutions. Further, it has been documented in international settings that women researchers spend more time in routine work, such as, clinical and teaching activities , which has been associated with receiving fewer research grants and lower faculty ranks.(Nonnemaker L, 2000)Although LMIC institutions data are not robust enough to judge if there was a difference in job descriptions between male and female scientists, having a fewer female researchers with a PhD degree and lesser opportunity than men to be awarded research grants likely to limit the ability of female scientists to publish original articles in peer-reviewed journals, which has been documented in developed countries. (Jagsi R, Guancial EA, Worobey CC, Henault LE, Starr R, Tarbell NJ et al., 2006; Kaplan SH et al., 1996; Linehan M & Scullion H, 2001; Nonnemaker L, 2000; Sidhu R, Rajashekhar P, Lavin VL, Attwood J, Holdcroft A, & Sanders DS, 2009)

Leadership

Despite having an equal number of men and women at the entry level scientific position, there was a substantial gender disparity in senior-ranked positions in LMIC institutions and in the number women holding leadership positions, which might be due to a low recruitment and/or slow advancement of women at a higher scientific level. In most academic institutions, female scientists comprise a very low proportion of top management level positions and have been less likely to be promoted from assistant to associate and from associate to full professor positions, despite equal academic qualifications, levels of experience, training, and publications. (Blau & Lawrence, 2000; ETAN Expert Working Group on women and science, 2000) A few studies in the US have documented that female faculty members were less likely to be full professors than were men and often, such disparity was observed despite similar professional roles and achievement between competing men and women.(Ash AS et al., 2004; Kaplan SH et al., 1996; Wenneras C & Wold A, 1997)

It is not known if differences in scientific achievement between male and female researchers has hindered female scientists from being promoted to the top scientific leadership positions in LMIC institutions, but there is evidence that leadership of women can reduce a gender gap among faculty even in a highly competitive discipline, such as Emergency Medicine. (Cheng D, Promes S, Clem K, & Pietrobon R, 2006; Shah A, Braga L, Braga-Baiak A, Jacobs DO, & Pietrobon R, 2007; Shah DN, Volpe NJ, Abbuhl SB, & Pietrobon R, 2010)We have documented that the leadership roles are predominantly played by males in LMIC institutions, and a masculine leadership style may create a less than a conducive environment for female employees to get recognition and rewards despite demonstrating similar professional achievements as those of their male counterparts. (Miller K, 2007)

Mentoring

Mentoring is crucial for the development of early career researchers and increasing research productivity in academia.(Paul S, Stein F, Ottenbacher KJ, & Liu Y, 2002)A systematic review of mentoring in academic medicine found that having a mentor increased motivation and the number of publications and grants by the person being mentored. (Sambunjak D, Straus SE, & Marusić A, 2006) That analysis also found that influence of a mentor was also important for pursuing a leadership role and mentoring juniors in the future research career. It is important to mention here that mentoring is an important criterion for promotion from a junior rank to a senior rank of scientific position in LMIC institutions (information extrapolated from internal webpage of LMIC institutions) and in many institutions more males than female is assigned as mentors to junior researchers or PhD student. A formal mentoring program for junior scientists is often unavailable in LMIC research institutions, and data are scarce. Having a smaller proportion of female scientists holding a leadership positions and a greater proportion of juniors being mentored by male scientists indicate that opportunities for mentoring junior is limited among the women researchers in LMIC institutions. Lack of opportunity for mentoring junior may limit professional advancement for women researchers at this organization

Congenial work environment

Peer support and congenial work environment are essential for both men and women to sustain in a challenging professional environment. (Levine RB, Lin F, Kern DE, Wright SM, & Carrese J, 2011; Levitt DG, 2010; Sambunjak D et al., 2006)Studies have documented that difficulties with funding, good mentoring, work-life balance a noncollaborative environment and bias in favor of male faculty encouraged higher drop out of women scientists in USA compared to their male counterparts. (Levine RB et al., 2011) Male domination in a research organization may create barriers for women in developing country setting and encourage a non-supportive environment for potential women in advancing research career in many ways. For example, male researchers may favor a male coworker over a female in terms of job evaluation, mentoring or creating a professional network for career enhancement. This is further impacted in professions that demand working longer hours, frequent travel, extra institutional networking with various professional bodies outside office hours, writing manuscripts or grant proposals, etc. In addition, a male scientists may prefer to see a women colleague as a co worker or a research collaborator as opposed to a boss, which. may discourage women taking leadership positions in the organization.(Pololi LH & Jones SJ, 2010) Therefore, an academic organization needs to create a gender balance in both recruitment and leadership in order to create a congenial environment, so that both men and women can work in harmony while competing with each other on a transparent equal footing for promotion and career development.

Bureaucratic impediment

Career enhancement is structured around a bureaucratic process in academic settings and feminist scholars have argued bureaucracy to be a structural means of organizational control and male dominance. (Acker J, 1990; Lorber J, 1984)On the other hand, published reports suggest that more bureaucratic organizations enhance career rewards and advancement opportunities for women compared to less bureaucratic organizations (Baron, Hannan MT, Hsu G, & Koçak Ö, 2007; Bielby & Bielby DB, 1992; Cook C & Waters M, 1998; Elvira & Graham ME, 2002; Ferguson KE, 1984)Other studies have concluded that less formal organizational structures have been found to exclude women from powerful networks and thus limit career opportunities. (Collinson & Collinson, 1989; GM, 2002; Reskin BF & McBrier DB, 2000) The Annual Women in Academic Medicine and Science of the USA presented evidence that gender played a role in tenure or promotion in most academic institutions in USA via bureaucratic process. (Leadley J & Sloane RA, 2011) That survey found that in 2009, only 13% of all women who had a full-time faculty appointment held the rank of full professor and only 10% were tenured, whereas, among men who had a full-time faculty appointment 30% were full professors and 23% were tenured. The AMA report did not explain why women had less academic enhancement than men. This may be explained by traditional female roles in the family, such as, childbearing, child-rearing, caring for elderly parents, etc., which compel women to stay out of work and be evaluated on their return as 'unproductive' leading to a loss in professional advancement .(Lading A, Bornmann L, & Gannon F, 2007) Some women may even sacrifice their jobs due to their traditional roles in the society, unless they can negotiate with the organization to count that 'unproductive period' within the job tenure and thus lose the opportunity for a professional advancement around the same time as their male counterparts. (Lading A et al., 2007) Further research is required to examine in more depth the role of bureaucratic processes on the career advancement of women in LMIC institutions.

Conclusions

According to the national census of Bangladesh in 2001, the sex ratio in the population was 103.8 males per 100 females. (National Institute of Population Research and Training (NIPORT), 2009)but a significantly smaller proportion of women contribute to the large developmental sector.(Rushidan RI & N., 2005)The Government of Bangladesh is firmly committed to involving women in the mainstream of development by improving their economic status and empowerment in the society. Failure to fully utilize the available potential of qualified women scientists would be detrimental to the economy at both the institutional and societal level. The gender gap as observed in LMIC institutions are not be different than what are observed in Bangladesh and it would be more worrisome, because the research organizations in Bangladesh lose the opportunity to operate at its full potential and engage more empowered female scientists bringing in more research grants of greater dollar value. Therefore, creating a gender balance among researchers in LMIC institutions and promoting women in science will be essential for strengthening the scientific productivity and fiscal health of the organization.

Whatever the theory is regarding the gendering process in LMIC institutions it would be beneficial to carry out a more robust study to measure the magnitude of gender disparity among scientists and identify how the gendering process occurred in the organization. Results from such a study would provide a base from which modifications to gender policies could be made and professional barriers removed allowing the full potential of female scientists in LMIC institutions to be achieved.

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Women in STEM in Japan

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In this note, we would like to introduce a little about situation of women in STEM in Japan. More data were given in the talk by Elizabeth Oda and Motoko Kotani. Then we mainly report about our activities for women in Mathematics in Japan and introduce Asian-Oceanian Women in Japan (AOWM) which the author is working as the president now.

1. Gender Gap index of Japan

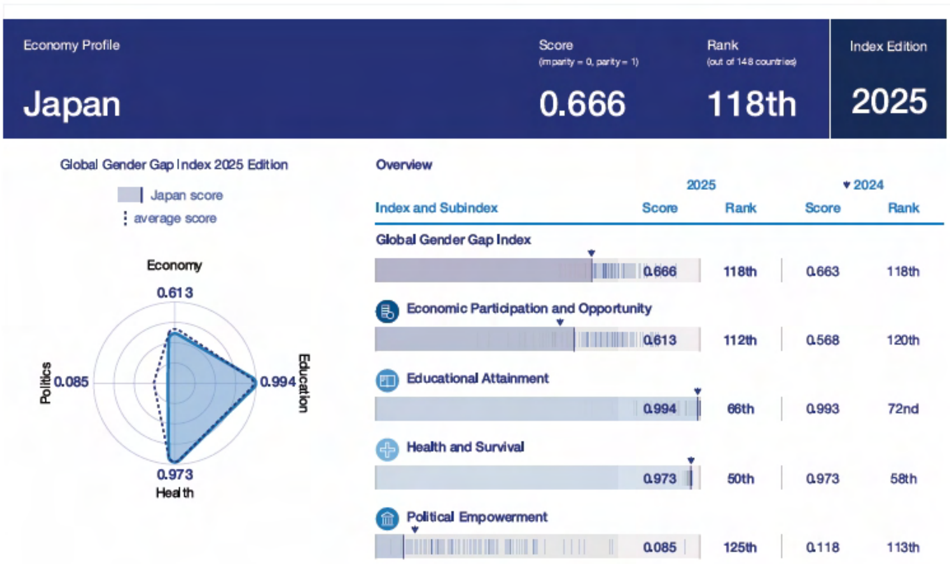
In the 2025 Global Gender Gap Index [1], Japan ranks 118th out of 148 countries. It is lowest country in G7 countries and one of the lowest in Asia. The other indexes are as follows:

Economic Participation and Opportunity 112th

Educational attainment 66th

Health and Survival 50th

Political Empowerment 125th



2. Women in Science in Japan

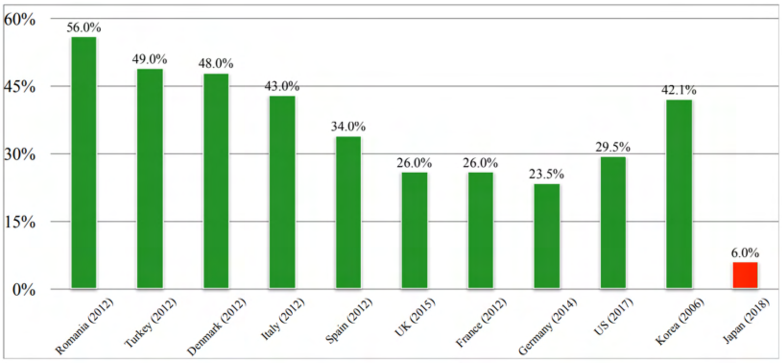
Gender gap in STEM: There are few women in STEM area in Japan, though the score of PISA (worldwide test of math, Science and reading for 15-year-olds) is very high!

It is said that because of the society, High school system, teachers, parents (gender bias).

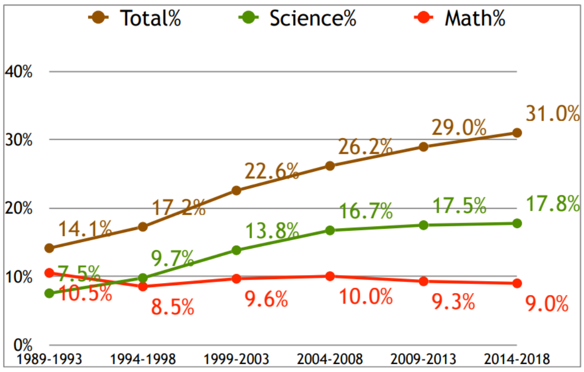
As an action against this, there are special events on STEM for female students, affirmative

action for entering University and hiring faculties, etc.
From the report by bannai and Sasada[2], we can see the real situation in Japan.

Female of Ph.D. recipients (Various Countries, Math)
*Korean data %female in the Ph.D. program



Ph.D. Recipients
(Japan, Comparison with Other Fields)



3. Women in Mathematics

There are 5 Continental Organizations for Women in Mathematics in the world.
Association of Women in Mathematics (AWM) started in 1971, European Women in Mathematics (EWM) is from 1986. Both of them have power to organize several activists.
There are also AWMA in Africa from 2013 and CGD UMALCA in South America from 2020.
Most new organization is Asian-Oceanian Women in Mathematics (AOWM) from 2020. There are many national organizations for Women in Mathematics, even in Asia and Oceania (Korea, India, Australia, etc.). The inaugural Meeting of AOWM was held on April 24-28, 2023, at ICTS in Bengaluru India and we share recent situation of women in mathematics in each country. And we will help each other to empower women in mathematics in several meaning. It is just a starting point but we can learn how to improve the power of women from other older organizations.

In Japan, there were also some conferences for women in mathematics recently. First of all, it will be important to make several networks to share information. Then we can consider our future together. Some examples of these kind of activities are flowing.

- Conference "Women in Mathematics" at RIMS, Kyoto University.
  2022.9.7～9、150 participants（Online）There were reports from AWM & EWM and the report of the conference can be seen in [3]
- Conference "The World of Mathematical Sciences" at Kavli IPMU
  2023.8.24～25、135 participants（Hybrid）
- Mathematical Magazine serious of "Introduction to Modern Mathematics"by female Mathematicians

4. Attractive events for young researchers

We would like to introduce two events one in the world, the other is in Tokyo.

1) Heidelberg Laureate Forum (HLF) is held every year in Heidelberg in Germany. It is for young researcher in Mathematics and Computer sciences with Laureates. From undergraduate students to postdoctoral fellows can apply in the winter from the website [4].
2) University of Tokyo provide a summer course "Global Unit Course" (GUC) and many international students have attended and enjoyed the stay in Tokyo. The students can apply from the website [5].

Young students in Asia can apply to get the chance to feel international atmosphere and know several different worlds. We believe these experience make the people more powerful and can be more powerful in their research activities.

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https://www.heidelberg-laureate-forum.org/
[5] UTokyo Global Unit Course:
https://www.u-tokyo.ac.jp/en/prospective-students/guc.html

Six Years of Women in Science Japan: Lessons on Community-Building, Mentorship, and Professional Development

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Abstract: Despite ongoing efforts to promote gender equity, women in STEM in Japan continue to face structural and cultural barriers to advancement. Founded in 2019, Women in Science Japan (WISJ) aims to address these challenges by providing a platform for peer support, mentorship, and professional development. This paper and associated presentation offer a retrospective analysis of WISJ's evolution over the past six years, examining the design, implementation, and impact of its core initiatives. Data and observations from community-led activities, including networking events, structured mentorship cohorts, and skills-based workshops, reveal which formats have proven most effective in fostering engagement and supporting career progression. Larger-scale initiatives, such as the recently launched Machine Learning Summer School, demonstrate the effectiveness of intentional program design. Insights are presented with attention to their relevance for comparable initiatives across Asia, offering practical ideas for community-building and professional support.

Keywords: gender equity; STEM; Japan; community programs; mentorship; professional development; women in science.

Introduction

Japan's gender gap in STEM remains persistent despite high achievement among school-age girls and substantial national investment in science and technology. Women constitute a small fraction of STEM university enrollees and an even smaller share of the STEM workforce and leadership[1]. More concretely, only one in seven scientists in Japan are women, and only one in five graduates of STEM programs in Japan are women[1]. This is not for a lack of ability: Japanese girls rank amongst the highest in math and science on secondary school exams across all OECD economies, but are the lowest share of women in STEM university programs[2]. This leads us at WISJ to ask: what's holding back girls in Japan from pursuing STEM careers?

The first hypothesis is a lack of role models and positive messaging. So-called "stereotype threats" and negative messaging from parents discourage girls from pursuing STEM, especially math-dominant fields. On the other hand, instilling positive messages, such as girls are good at math, increases girls' interest in STEM and their parents' encouragement of their daughters pursuing STEM careers[3]. Furthermore, connecting girls with successful women role models in STEM increases girls' interest and perceived ability to succeed in STEM[4].

The second hypothesis is that a profound lack of work-life balance for women in STEM dissuades girls from choosing such career paths in Japan. Commonly cited frictions include the burden of unpaid care work:

- Women in Japan spend about 220 minutes daily on unpaid care and housework, whereas men in Japan spend less than 50 minutes daily[2].
- In 2022, 80% of women took parental leave, while only 17% of men took parental leave[2].
- In academia, 50% of men's spouses/domestic partners are employed, whereas 97% of women's spouses/domestic partners are employed[5].

The consequences of an uneven work-life balance between women and men perpetuates the "L-Shaped Curve", a labor-force pattern in which women's full-time employment rate peaks in the 25–29 age group and then declines through the 30s and 40s, as many leave full-time roles around childbirth/child-rearing and later re-enter primarily as non-regular (part-time or contingent) employees. Unlike the "M-Shaped Curve," featuring a rebound in regular employment after child-rearing years, the L-shape features a steep early peak followed by a sustained low plateau, reflecting persistent non-regular employment in mid-career and onward. Women are far more likely to change jobs due to marriage or caring for children than men, as well as more likely to say that their promotion was delayed or that their job was reassigned after returning from parental leave[2].

The L-Shaped Curve is linked to the "Leaky Pipeline" observed in academia as well. As job positions become higher, the ratio of women to men in Japanese academia decreases:

- 50% of research associates are women
- 26% of associate professors are women
- 16.5% of professors are women
- 11.8% of deans and above are women[5]

Gender inequality in STEM manifests in many ways. Exclusion from professional and academic networks, persistent microaggressions and stereotypes, and biased hiring, promotion, and evaluation processes systematically restrict women's and gender minorities' access to opportunities, recognition, and advancement in STEM. These inequities are compounded by unequal pay and resources as well as exposure to sexual harassment, which together undermine safety, mental health, and long-term career progression.

Greater gender equality in STEM and the wider workforce would materially boost economic performance while strengthening innovation capacity. Persistently low representation of women leads to biased research and product design, narrower policy perspectives, and worsening talent shortages in tech and R&D, reinforcing a cycle that undermines Japan's long-term competitiveness.

In this context, Women in Science Japan (WISJ) was founded in 2019 to build community, provide role models, and offer practical skill-building for women and gender-minority scientists. Over six years, WISJ has experimented with program formats and organizational models to discover what reliably drives engagement and outcomes.

Women in Science Japan

WISJ is a discipline-diverse community of 180+ members (as of October 2025), with representation from AI, mathematics, physics, biology, environmental and material sciences, among others, and spanning from students through mid to late-career professionals. The membership is majority foreign-national, a feature that creates both strengths (heterogeneous networks and comparative perspectives) and design considerations (language, visas, and career mobility).

WISJ's mission is threefold: (a) build a supportive peer community; (b) provide structured professional development; and (c) catalyze informed discussion on gender equity in STEM in Japan. Core activity types have included a structured mentorship program, an annual Flagship Event, a Machine Learning Summer School for Scientists (MLS3), an online book club, and casual meetups.

Findings

This retrospective synthesizes program documentation and organizer observations from 2019–2025. It draws on participation metrics (e.g., attendance, repeat participation), engagement indicators (e.g., Slack activity), and qualitative feedback. It also reviews program design artifacts, including role descriptions, facilitation guides, and proposals. The analysis is descriptive and practice-oriented rather than causal, aiming to surface community-building principles linked to consistent engagement and value.

What Worked

Skills-based workshops outperform panels. Interactive formats produced stronger engagement and actionable takeaways than traditional panel discussions. One such example is a "Resume Roast" event: attendees submitted their resumes ahead of time for live, light-hearted feedback from professional recruiters. Participants valued concrete practice, feedback, and artifacts (drafts, templates) over generalized inspiration.

Structured mentorship beats open-ended matching. Despite an initial onboarding session between the mentor, mentee, and program facilitator, early mentorship program pilots under-delivered due to a lack of boundaries and milestones. Iterating to a structured, time-bounded cohort model with clear goals, roles, and milestones improved participation, completion, and satisfaction for both mentors and mentees.

Focus beats breadth. Attempting to serve disparate audiences – high-school students and working professionals simultaneously – diluted impact. Concentrating on members in their early to mid-career yielded stronger outcomes.

Community governance for sustainability. Initiatives thrived when roles were explicit, contribution paths were clear, and leadership cycles were planned with succession and scope control. The most reliable pattern was to sunset repeatedly low-participation programs and to anchor effort where demand and volunteer energy intersect.

What Under-performed

- Panels and broad "awareness" events without actionable practice.
- Unstructured mentorship with ambiguous expectations and timelines.
- Programs outside the core audience, even when mission-aligned, if they lacked sustained volunteer capacity.

These patterns underscore that intentional structure, not merely topic relevance, is pivotal.

Program Highlight: Machine Learning Summer School for Scientists (MLS3)

The MLS3 was held over six Saturdays in July and August of 2025, covering a range of topics from computer vision to large language models (LLMs). Participants also worked on individual machine learning (ML) projects with the support of a mentor, culminating in presentations on the final day of the program. The program aimed to equip participants with the technical knowledge and skills needed to continue their ML journey in their respective scientific domains.

The post-program survey received responses from 18 of the 24 participants (75%). Key outcomes include:

- Overall satisfaction rated 9.6/10, with strong likelihood to recommend (5.9/6).
- Participants reported increased confidence in applying ML to their work or research (5.3/6).
- Self-assessed knowledge growth across technical areas, on a 1–6 scale (1 = no growth, 6 = immense growth): ML/deep learning (DL) (5.0), Python (4.2), and mathematics (3.0).
- Support from mentors was rated highly (5.4/6).

Qualitative feedback emphasized the value of networking with like-minded scientists, gaining confidence through hands-on projects, and exposure to practical ML applications.

One testimonial captures the spirit of the program: "I recommend WISJ MLS3 to all women in STEM living in Tokyo. The experience is eye-opening, empowering, and unique — I now have a strong network of inspiring women in academia and industry in Japan, in addition to foundational and industry-applicable knowledge of ML. The lectures and tutorials were well-thought out and immediately applicable to my work. I enjoyed the program very much and am very grateful for the transformative experience."

The program materials, including lecture slides and coding exercises, were made publicly available[6].

Looking Ahead

The top-cited requirements for reaching gender equality, according to women in STEM in Japan, are:

1. Reforming men's awareness
2. Overcoming gender biases
3. Increasing men's participation in housework and childcare
4. Expanding support of child and nursing care[5].

Each of the above are deeply-seated issues requiring change at both the governmental and societal levels. It is important to note that, while Women in Science Japan's approach offers support for individuals, lasting gender equality must come by addressing systemic barriers.

With that in mind, our organization builds an inclusive community where women and gender minorities in STEM can connect, share experiences, and counter isolation in male-dominated environments. Complementary workshops and events develop leadership, mentorship, and career skills while engaging institutions on equity and inclusion. Lasting equity will require coordinated policy, institutional accountability, and cultural shifts that dismantle bias. Our role is to cultivate the networks, skills, and confidence that enable women and gender minorities to participate fully—and to help shape the systems that govern their work.

References

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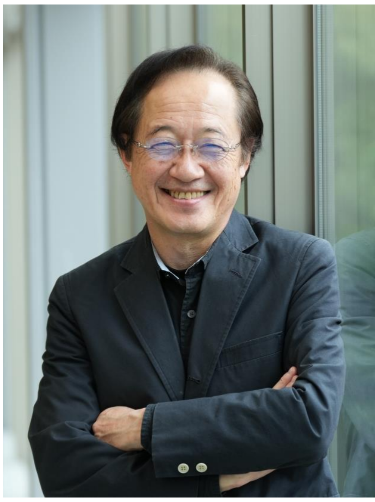
6. https://github.com/elizabeth-oda/wisj-machine-learning-program

Tokyo Tech | Institute of SCIENCE TOKYO | AIST Create the Future, Collaborate Together | G-QuAT

Opening Doors to Diversity:
Gender Reform at Tokyo Tech (now Science Tokyo)



Kazuya Masu [1,2]

1. Special Advisor, Professor Emeritus, Institute of Science Tokyo (former Tokyo Institute of Technology)
2. Director, G-QuAT, National Institute of Advanced Industrial Science and Technology

August 6, 2025, Kashiwa-Campus, UTOkyo
Conference "Women in STEM" - The 3rd AASSA-WISE-SCJ Symposium

Outline

1. はじめに	Introduction
2. 大学紹介	Overview of the University
3. 女性限定教員公募	Women-Only Faculty Recruitment
4. 学士入試における女子枠	Female Admission Quota in Undergraduate Entrance Exams
5. まとめ	Summary

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Kazuya Masu, Professional biography

March 1982	Ph.D, Tokyo Institute of Technology
1982-2000	Research Institute of Electrical Communication, Tohoku University
2000-2016	Professor, Precision and Intelligence Laboratory, Tokyo Institute of Technology
2016-2018	Director-General, Professor, Institute of Innovative Research, Tokyo Institute of Technology
2018-Sept. 2024	**President, Tokyo Institute of Technology**
Oct. 2024-	Director, Global Research and Development Center for Business by Quantum-AI Technology (G-QuAT), National Institute of Advanced Industrial Science and Technology (AIST)

Research Activities: **Si CMOS integrated circuit technologies** such as CMOS process and evaluation technology (metal CVD for multilevel interconnect, μ-RHEED microscope), and CMOS integrated circuit design and implementation (RF/high speed signaling, CMOS/MEMS integration)

4

Tokyo Tech journey during my presidency

- Mission: Establishing Tokyo Tech as a world-leading science and engineering university
- Values: Based on "Tokyo Tech Commitments 2018"
  - Appreciating diversity, Collaborative Challenges, and Decisive Action
- Key Initiatives
  - Strengthened research through enhanced industry-academia collaboration
  - Merger of Tokyo Institute of Technology and Tokyo Medical and Dental University to form "Institute of Science Tokyo"
  - Systems to promote female researchers and increase female student enrollment
- Fostering an ecosystem that embraces diversity in knowledge and talent

5

Tokyo Tech Commitments 2018

大学から未来が生まれる
Creating a better future

「多様性と寛容」 多様性（国籍，年齢，性別，研究スタイルなど）をもった構成員が集い，その多様性を互いに受け容れ，尊重する。	**Appreciating diversity** Attract a faculty, staff, and student population that represents diversity in the broadest sense of the word, and embrace this diversity
「協調と挑戦」 互いに協力し，時には切磋琢磨しながら新しいことへの挑戦を続け，社会へ貢献する。	**Collaborative challenges** Actively collaborate, and at times engage in friendly competition, in order to boldly take on new challenges and create heightened societal impact
「決断と実行」 改革により整備した教育，研究，ガバナンス体制を活かし，スピード感をもった決断と実行により常に世界から期待され，その期待に応える。	**Decisive action** Take advantage of new education, research, and governance structures in order to increase and respond to global expectations through agile decision making and action

What drove my determined initiatives

Background ①: Tokyo Tech's Legacy

1. Founded in 1881 as Tokyo Vocational School.
2. Vision of Arata Hamao: "Not to create factories and then schools, but to establish schools first and produce graduates who would then create factories.
3. "Personal reflections as a researcher:
   1. Passion for semiconductor and IC research (a personally fulfilling field)
   2. Deep concern over the decline of Japan's semiconductor industry

Background ②: Global Context

- Japan's 30 years of stagnation (Heisei era).
- Global GDP growth vs. Japan's stagnation.
- Decline in manufacturing GDP (including Western countries).
- Emergence of new industries (IT, biotech) in the West
- Re-examining Tokyo Tech's founding principles.

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What drove my determined initiatives

Background ③: Rapid Global Changes

- Global push toward carbon neutrality and ESG investment aligned with the SDGs (e.g., net zero CO_2 by 2050)
- Japan's commitment to carbon neutrality announced in 2020
- Growing ESG investment pressure from Europe
- Reflecting on Japan's last 30 years: stagnation, frustration, and the urgent need for transformation.

The Way Forward

- Moving beyond traditional science and engineering research.
- A stronger commitment to pioneering new research fields and nurturing emerging industries.

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Outline

Universities in Japan

	# of Univs (Japan)	Students Fresh man, undergraduate	Students Total undergraduate	Students Total Graduate (MS and Ph.D)
National Univ	86	110k	431k	155k
Public Univ	101	40k	146k	18k
Private Univ	607	400K	2,056k	93k
Total	794	550K	2,633k	266k

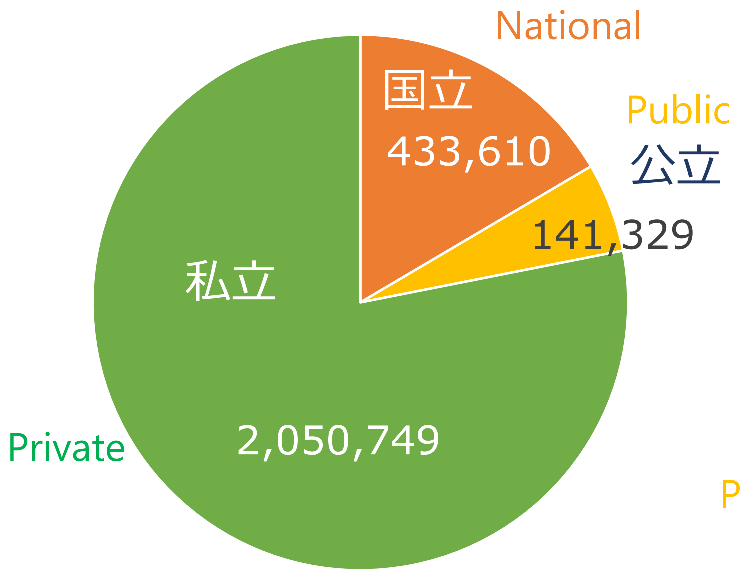
- # in parentheses indicate # of univs. with medical schools. In Japan, Each medical school has their own hospital.

Population (Japan)
- Total 120M @2023
- 18 year old 1.1M @2024
  <0.8M @2040

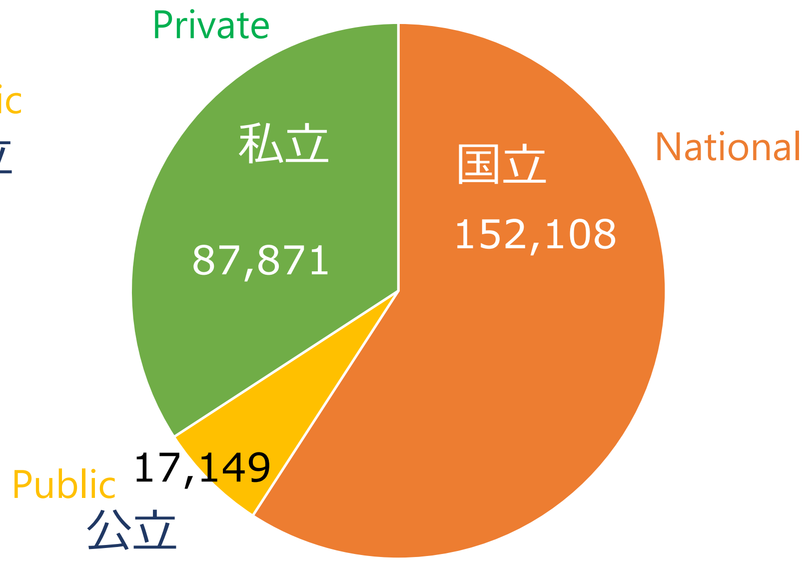
Rapid decline: Japan's Population Crisis

Total # of students（Bs + Grad＝2.88M)

国立大学は全体の2割
大学院生は全体の9%



学士課程（263万人）
Bachelor (2.63M)



大学院（26万人）
Graduate (0.26M)

「2021年国立大学法人基礎資料集」から作成　https://www.janu.jp/wp/wp-content/uploads/2022/08/20220331-pkisoshiryo-japanese.pdf

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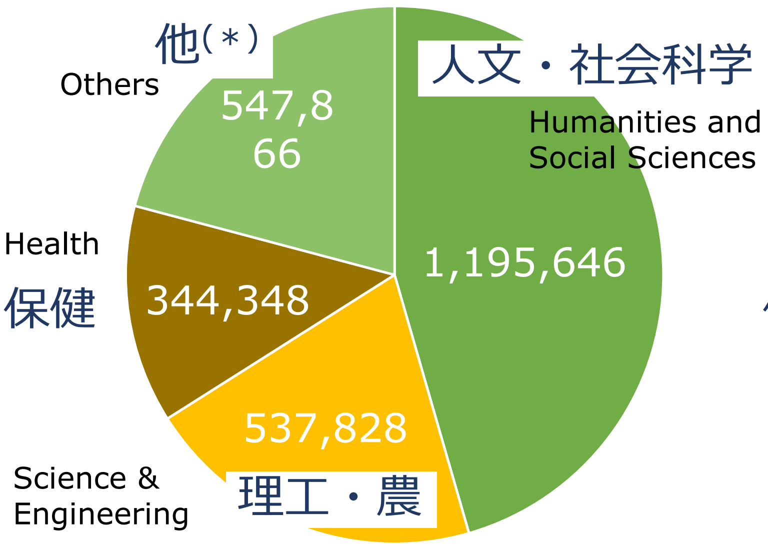
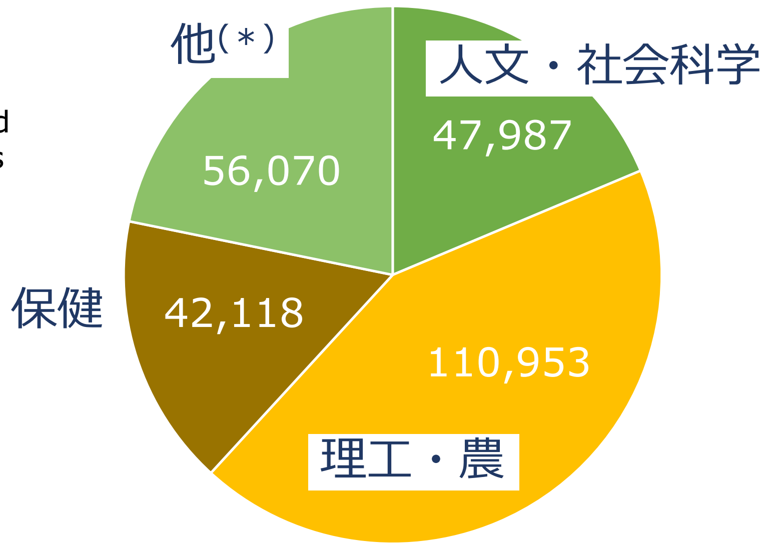
of students by field of study

大学院では理工系が多い



学士課程全体（263万人）



大学院全体（26万人）

他:家政、教育、藝術、商船

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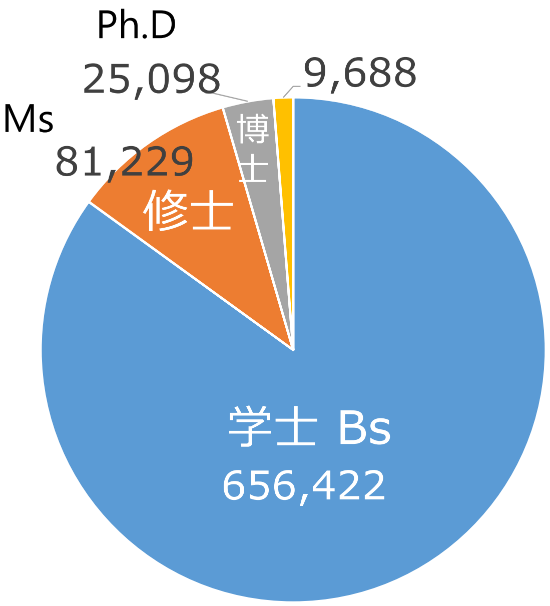
of students graduating from undergraduate or graduate programs



全体（77万人／年）
Total #　770K/year

- **Number of graduates**
  - Bs　580k/Year
  - Ms　55k/Year
    - Ms for Sci and Eng.　≈30k

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Institute of Science Tokyo (Science Tokyo)　東京科学大学

Tokyo Institute of Technology (Tokyo Tech) and
Tokyo Medical and Dental University (TMDU) were merge to establish
Institute of Science Tokyo (Science Tokyo) on October 1, 2024.

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Tokyo Institute of Technology（東京工業大学）

1. School of Science
2. School of Engineering
3. School of Materials and Chemical Technology
4. School of Computing
5. School of Life Sci. and Tech.
6. School of Environ. and Society

- Institute for Liberal Arts
- Institute of Innovative Research

Undergrad students:	up to 1,100 /year
Grad. Students (Ms):	up to 2,000 /year

- 90% of undergrad students go on to grad. school
- Half of M students join from other universities

- 4th-year undergrad. students are supervised in lab
- 60% of all students belong to lab and are supervised by faculty in each lab

(as of May 1, 2022)

Grad. students (Ms and PhDs)	5,726
International students (pursuing degrees)	1,499 (**25%**)
Undergrad. students	4,803
International students (pursuing degrees)	249 (5%)

Full-time faculty (full, assoc., and asst. profs.)	1,039
Specially appointed faculty	427
Administrative and technical staff	610
Part-time staff	1,438

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Tokyo Medical and Dental University （東京医科歯科大学 ）

- Faculty of Medicine
  - School of Medicine (6-year)
  - School of Healthcare Sciences
- Faculty of Dentistry
  - School of Dentistry (6-year)
  - School of Oral Healthcare Sciences
- College of Liberal Arts and Sci.
- Grad. Sch. of Medical and Dental Sciences
- Grad. Sch. of Health Care Sciences
- Attached organizations
  - Inst. of Biomaterials and Bioengineering
  - Medical Research Institute
- TMDU Hospital

(as of May 1, 2022)

Grad. students (Ms and PhDs)	1,468
International students (pursuing degrees)	306 (**21%**)
Undergrad. students	1,483
International students (pursuing degrees)	14

Faculty (full, assoc., and asst. profs.)		846
Admin staff		626
Medical staff		1,452
TMDU Hospital	# of beds	813
	# of dental treatment unit	327
	# of inpatients per day	583
	# of of outpatients per day	3,354

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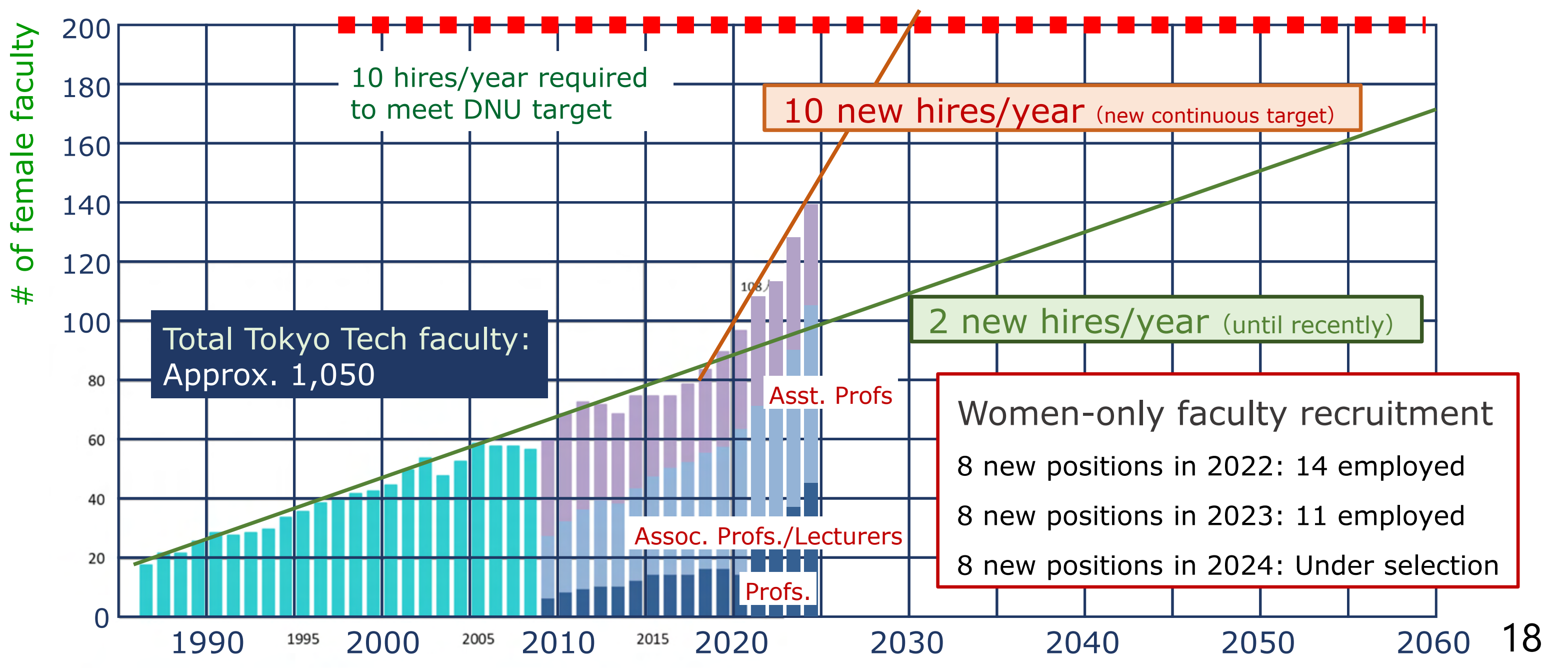
Outline

Female faculty at Tokyo Tech (full-time)

- Women-only faculty recruitment started since 2022

Designated National University（DNU）target by 2030: 20% of all faculty



Faculty Recruitment for Women Only

- Typical open calls (gender-neutral recruitment)]
  - When the field is narrowly defined, the number of female researchers is often very limited, resulting in few female applicants — and thus, low probability of hiring women.
- Open calls without narrowing the field
  - For example, broadly targeting fields related to engineering.
- Over 200 applications for 8 positions!
  - As a result, highly qualified faculty members were successfully recruited.
- Recruitment continues in FY2025.

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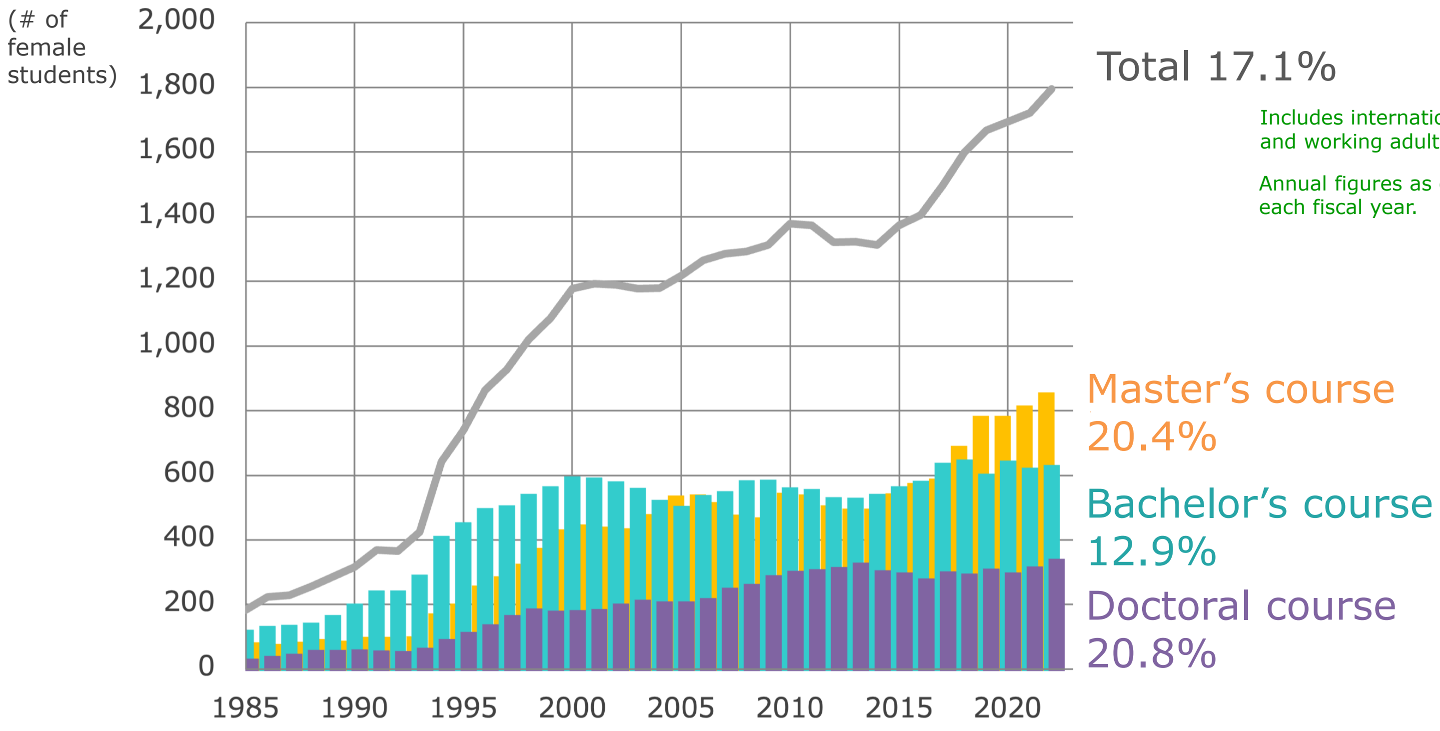
Current situation: Female students at Tokyo Tech



https://www.gec.jim.titech.ac.jp/about/doc/womennumberS.pdf

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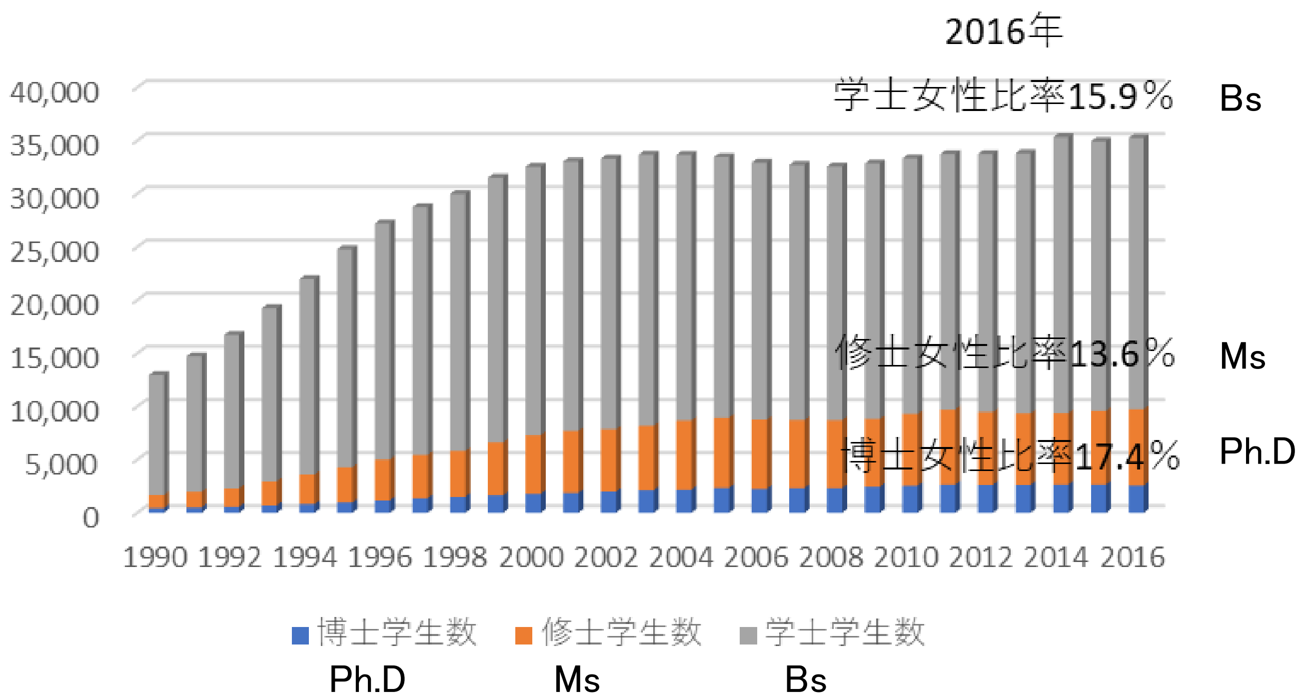
Female Students in Science and Engineering at National Universities



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Female Student Ratios: A Global Comparison among STEM Univs.

	MIT	Georgia Tech a)	Cal Tech	ETH Zurich	Imperial College London	Tokyo Tech	Jpn Univs (STEM)
学士課程 BS	48%	40%	45%	34%	40%	13%	22%
大学院課程 Grad	39%	26%	35%	33%	44%	21%	18%
学生全体 Total	40%c)	33%c)	37%c)	33%c)	40%c)	17%	---

2020-2022年数値
a) 新入生の比率，b) 令和3年学校基本調査より，　c)THE世界大学ランキング2023より

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学士課程入試　Undergraduate admission at National Univ.

- 1月中旬：大学入学共通テスト（志望者は全員受ける）
  Mid-January: National Common Test for University Admissions(All applicants are required to take this standardized test.)
- 2月初旬：総合選抜･推薦型入試
  Early February: Comprehensive and Recommendation-Based Admissions
  - 成績、調書、筆記試験、面接などで、総合的に能力を判定して合否を決める
    (Admission decisions are made based on a holistic evaluation, including academic records, essays, interviews, and standardized test scores.)
  - 総合型･推薦型入試に不合格の場合、「一般選抜（前期試験）」を受験可能
    (Admission decisions are made based on a holistic evaluation, including academic records, essays, interviews, and standardized test scores.
- 2月下旬：一般選抜（前期試験）
  Late February: General Entrance Exam (First Session)
  - 数学、物理、化学、英語の筆記試験の成績で、合否を決める
    Admission is determined based on written exam scores in subjects such as mathematics, physics, chemistry, and English.

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Female admission quota in the undergraduate program

1. 女子だけ特別扱いは不公平
   - 現状が“公平”ではないため、それを是正する“公正”が必要。これは優遇ではなく、機会の補正。
2. 同じ能力なら男子の方が損している
   - 能力評価の軸が異なる。そもそも筆記能力だけが能力ではない（探究心・チームワーク等）。

1. Giving special treatment to women is unfair.
   - The current situation is not “fair” to begin with. What is needed is “equity,” not just “equality.” This is not preferential treatment, but a correction of opportunity gaps.
2. If abilities are equal, boys are at a disadvantage
   - The evaluation criteria differ. Written exam scores are not the only measure of ability — curiosity, teamwork, and other qualities matter.

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Female admission quota in the undergraduate program

3. 将来辞めてしまう女性が多いから投資が無駄
   - それは環境のせいであり、制度改善こそ必要。個人の志望・ポテンシャルを先入観で否定すべきでない。
4. 世界でそんな制度をやっているのか
   - 英米のトップ大学ではアファーマティブ・アクションや多元選抜が常識。むしろ日本は遅れている。

3. It’s a waste to invest in women because many quit their careers.
   - That is due to environmental factors, not individual capacity. We must improve systems, not assume the worst based on prejudice.
4. Do other countries even have such a system?
   - Affirmative action and holistic admissions are standard at top universities in the US and UK. Japan is actually lagging behind.

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学士課程 女子枠入試の導入

一般選抜（前期日程）

- 共通テスト＋個別学力検査（全学共通の筆記試験）に重心をおいた選抜
- 数学、物理、化学、英語

総合型・学校推薦型

- 多様性を重視した選抜
- 個別学力検査、面接、調査書
- 受験者の意欲、創造性を重視

※ 2024年度入試より情報理工学院の収容定員の増加により募集人数が1028名から1068名となります
※ 女子枠が143名から149名に増加します

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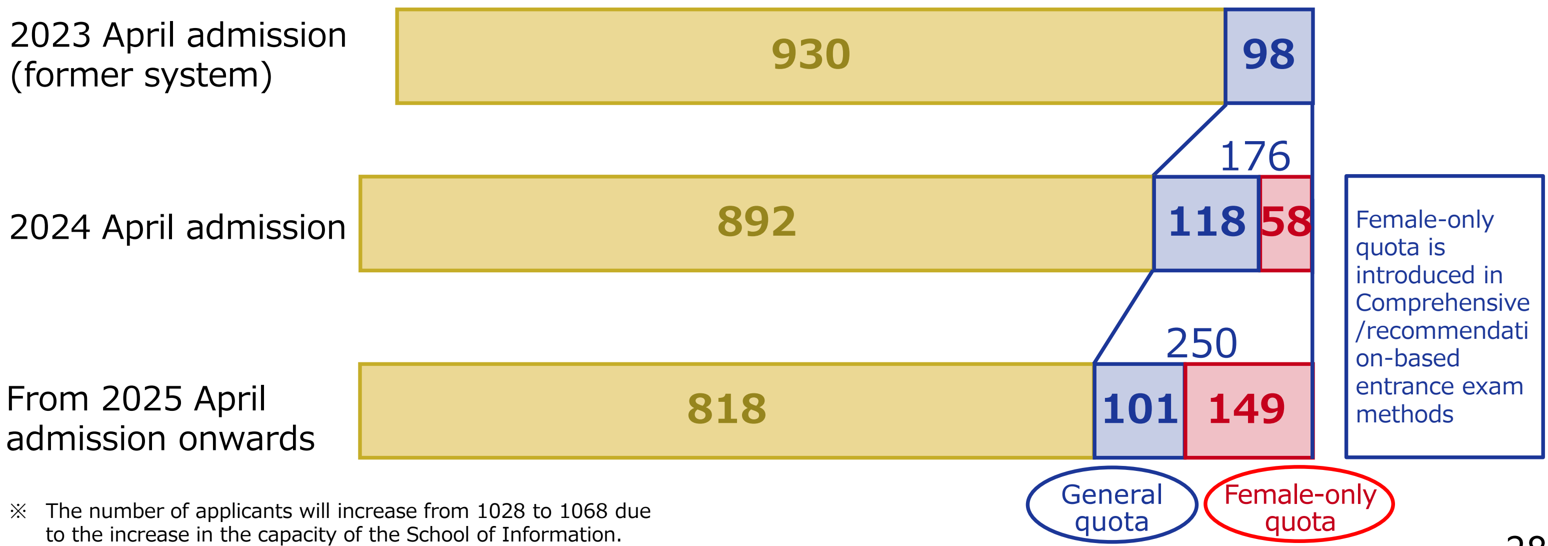
Drastic increase in students admitted to bachelor's degree programs through comprehensive/recommendation-based entrance exam methods

General Selection (first round)

- Selection based on on the Common Test and the Tokyo Tech's Achievement Test (written exam common to all schools)
- Mathematics, Physics, Chemistry, English

Comprehensive/recommendation-based entrance exam methods

- Selection emphasizing diversity.
- Individual Achievement Test, Interview, and Research Report.
- Emphasis on motivation and creativity



※ The number of applicants will increase from 1028 to 1068 due to the increase in the capacity of the School of Information.

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Drastic increase in students admitted to bachelor's degree programs through comprehensive/recommendation-based entrance exam methods

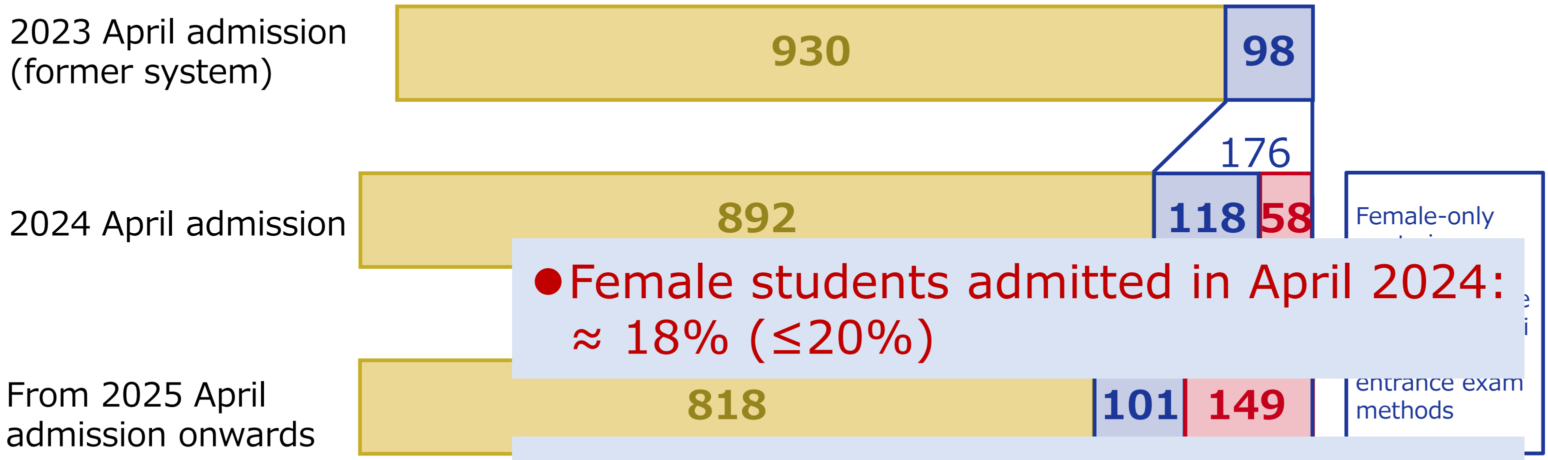
●Total number of applicants: ≈4,000

and the Tokyo Tech's Achievement Test (written exam common to all schools)

- Mathematics, Physics, Chemistry, English

Comprehensive/recommendation-based entrance exam methods

- Selection emphasizing diversity.
- Individual Achievement Test, Interview, and Research Report.
- Emphasis on motivation and creativity



●Female students admitted in April 2024: ≈ 18% (≤20%)

●Female students admitted in April 2025: over 250 (≥20%)

※ The number of applicants will increase from 102 to the increase in the capacity of the School of I

9

Response to criticisms regarding the female admission quota

1. 学内外に何度も説明会を開催し、丁寧に回答・説明した
2. 入学者の学力が下がる。偏差値が下がる。
   - 評価軸（目的意識、説明力等）が異なる
   - 基礎学力が基準に達している志願者が募集人員に満たなければ、合格者は募集人員より少なくする

1. Held multiple briefings on and off campus
   - Responded thoroughly and repeatedly to a wide range of questions
2. Concerns about lower academic standards → Decrease in deviation scores
   - Evaluation criteria (e.g., purpose of study, explanatory skills) differ.
   - If applicants who meet the academic baseline are fewer than the quota, the admission cutoff may fall below the number of available slots.

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Response to criticisms regarding the female admission quota

3. 男子学生への逆差別
   - 「いま」で捉えるのではなく、過去の歴史を振り返り、現時点を把握し、将来を考えてほしい
   - 女子学生が増えることで男子学生にもメリット
4. 女子学生へのスティグマ
   - Inclusion推進：アンコンシャスバイアス研修、D&I教育推進

3. Claims of reverse discrimination against male applicants
   - Encourage reflection on historical context, understanding of current realities, and consideration of the future.
   - Male students also benefit from having more female peers on campus.
4. Stereotyping of female students
   - Promote inclusion through initiatives such as unconscious bias training and D&I education programs.

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大隅良典記念奨学金に「女子学生枠」を創設

Establishment of "Female Student Quota" for the Osumi Yoshinori Memorial Scholarship

- 2016年にノーベル生理学・医学賞を受賞した大隅良典栄誉教授からの寄付を原資とした奨学金
- 既存枠である「地方出身者枠」や「ファーストジェネレーション枠」に加え、「女子学生枠」を新設
- A scholarship, endowed by a donation from Professor Yoshinori Ohsumi, who was awarded the Nobel Prize in Physiology or Medicine in 2016.
- In addition to existing categories like 'Local Natives' and 'First Generation,' a new 'Female Student Quota' has been introduced."

https://www.titech.ac.jp/student-support/students/tuition/ohsumi-scholarship

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女子学生支援：女子トイレの改革 Support for female students: Reform of women's restrooms

2023秋 (Autumn)

Case1 女性用トイレ・休憩室整備：本館モデルプロジェクト
Improvement of women's restrooms and lounge: Main building model project

2023夏(summer)

Case2 女性用トイレ整備：
すずかけ台大学会館モデルプロジェクト
Improvement of women's restrooms:
Suzukakedai University Hall Model

2023秋(Autumn)

Case3 女性用トイレ整備:西5号館2階（食堂フロア）
Women's restrooms maintenance: West Bldg. 5, 2nd floor (cafeteria floor)

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女子学生支援：生理用品の提供開始 Support for female students: Started providing sanitary products

2023年10月から、キャンパス内の学生の利用が多い課外活動施設の一部の女子トイレおよび多目的トイレの個室内で生理用品の無償提供を開始

From October 2023, we started providing sanitary products free of charge in the private rooms of women's restrooms and multipurpose restrooms in some of the extracurricular activity facilities that are heavily used by students on campus.

【大岡山】Oookayama: Taki Plaza2階・B2女子トイレ、1階多目的トイレ、西5号館2階（学生食堂） 女子トイレ・多目的トイレ
Taki Plaza: 2nd fl. and B2 women's restrooms, 1st fl. multipurpose restroom, West Bldg 5 (student cafeteria) 2nd fl.: Women's restrooms and multipurpose restrooms

【すずかけ台】Suzukakedai: 大学会館1階と2階女子トイレ、多目的トイレ
University Hall: 1st and 2nd fl. women's restrooms, multipurpose restroom

保育所の設置 Daycare facilities

- 大岡山 石川台に保育所 設置済み (目黒区の支援あり)
- すずかけ台 2024年12月に設置予定 （大学の独自予算）

- Oookayama: Daycare in Ishikawadai, partially supported by Meguro-ku
- Suzukakedai: Daycare will be opened in Dec. 2024, Tokyo Tech's budget.

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Summary

1. 女子比率の低さという理工系特有の課題に真正面から対応
2. 女子枠入試、女性限定教員公募、無意識バイアス研修など多面的に実施
3. 奨学金制度の整備や女子トイレ・更衣室等の環境整備にも注力

1. Addressed the low female representation, a structural challenge in STEM fields
2. Implemented diverse measures: female quotas, women-only faculty hiring, and bias training
3. Enhanced scholarships and improved campus facilities such as restrooms and changing rooms

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Summary

4. 制度設計では「公正さ」と「説明責任」を重視
5. 内外の批判・懸念にも丁寧に対話で対応
6. 女性の活躍は大学の課題であると同時に科学技術の未来への挑戦

4. Emphasized fairness and accountability in policy design
5. Responded to external and inter-nal concerns through careful dialogue
6. Promoting women in STEM is both a university mission and a societal imperative

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Women in Mathematics

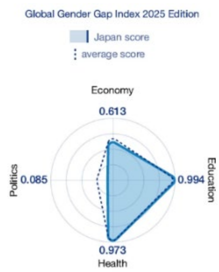
Motoko Kotani
Executive Director of Science, RIKEN
Executive Vice President,Tohoku University,
Vice President of International Science Council

1. Japan's Gender Gap

Japan ranks 118th out of 148 countries in the 2025 Global Gender Gap Index, published by the World Economic Forum. This places Japan lowest among G7 nations.

The index evaluates gender equality in four areas:

- **Economy**: Japan ranks 112th. Women are underrepresented in management roles (only about 16%) and earn significantly less than men.



- **Education**: Japan performs well, ranking 66th, with near-equal access to education for both genders.
- **Health**: Ranked 50th, Japan shows minimal gender disparity in health outcomes.
- **Politics**: Japan ranks very low at 125th. Only 10% of cabinet members and 15.7% of parliament members are women. In 2025, the first female head of the LDP was selected.

To tackle those gender issues,the *Cabinet Office* *"Gender Equality Bureau* " has formulated the *Basic Plan for Gender Equality* every five years since 2001. Regarding the promotion of women's participation in science and technology, this has been outlined in the *Basic Plan for Science and Technology Innovation* from the 4th (2011-2015) to the current one (6th 2021-2025). Japanese STI/GEI Policy is stated as follows.

1. Expanding women's participation in STI & Academia
   Strategically set and publish numerical targets for the female ratio of hiring and leadership positions in universities and research institutes
2. Gender analysis in research
   Promotion of research from the perspective of GEI
3. Creating environment adaptive for young female researchers
   Support for balancing research & childcare
4. Promotion of female students in science/engineering

According to "White Paper on Gender Equality 2022" (Cabinet Office Annual Report on Gender Equality in Japan), women make up only 18% of scientists and engineers in Japan in the year 2023, the lowest among OECD countries. As seen in the Gender Gap Index, the gender gap in school education is small in Japan. For example, despite no significant gender

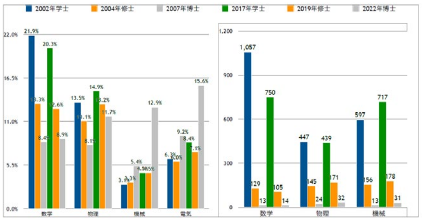
gap in mathematical literacy and scientific literacy in the OECD's PISA exam (Program for International Student Assessment of Literacy at Age 15), the female ratio in higher education is significant low. The percentages of women in science and engineering are 27% and 16%, respectively, the lowest among the 36 comparable OECD member countries. (Data compiled by HuffPost Japan based on OECD data)
https://twitter.com/HuffpostJ_SDGs/status/1500961994718994442/photo/2
There are challenges identified as

- Gender Bias and Stereotypes: Persistent societal norms discourage girls from pursuing STEM careers.
- Limited Career Advancement: Female researchers face barriers in promotion and leadership roles within academia and industry.
- Work-Life Balance: Long working hours and insufficient support for parenting make
- Academic Pipeline Issues: Fewer women enroll in STEM-related university programs, leading to a smaller pool of female professionals.

3.Gender Gap in Math

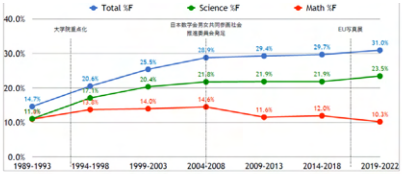
International Mathematical Union(IMU) sets Committee for Women in Mathematics (CWM). https://www.mathunion.org/cwm
It is concerned with issues related to women in mathematics worldwide, and encourages and facilitates actions including delivering *CWM News, CWM Newsletter, CWM annual call* for Networks Workshop and other Initiatives, appointing *CWM ambassadors*, promoting *CWM Gallery, World Meeting for Women in Mathematics,*(WM)[2] cooperation with the *Organization for Women in Science in the Developing World (OWSD)*, and *Standing Committee for Gender Equality in Science (SCGES), Gender Gap Project* cooperating with the International Science Council (ISC). There are regional/national organization, continental organizations such as *African Women in Mathematics Association(AWMA), Association for Women in Mathematics(AWM), and European Women in Mathematics(EWM). Asia-Oceania Women in Math (AOWM)* was established 2022. The current president of AOWM is Dr.Yukari Ito from Japan.

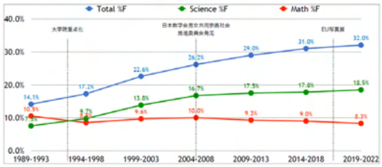
Dr.Sasada(U Tokyo) and Dr. Bannai(Keio U) have collected data of Japanese gender gap in Math 佐々田槙子、坂内健一「日本の数学界における男女共同参画の現状と提案」2019/10/16v4, https:// www.math.keio.ac.jp/~bannai/Report_MathGender.pdf



Notably, while the proportion of female students in science as a whole is gradually increasing, the trend in mathematics shows a decrease at both the master's and doctoral levels.

Female Under Grad. Master, Doctor in 15 yeas





Female in Master course Female in Docter course

4. Diversity Promotion at Tohoku University

Tohoku University is the first national university which accepted female student in 1913. Since then, it leads diversity promotion in Japanese universities. Since it was designated as the first *University for International Research Excellence* designated in 2024 by Japanese Government, the promotion has been accelerated by providing good practices.