Science and Technology Trends
Gender Issues in Science and Technology in Asia

Gender Policy and Future Challenges in the Field of Science and Technology in South Korea

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1. Introduction

Since the early 2000s, Korea has actively promoted gender policies in the field of science and technology for more than the past 10 years. Gender policies in science and technology are affected by the development of the policies for women. Korea enacted the「Framework Act on Women's Development」[1] in 1995, and founded the Ministry of Gender Equality in 2001.[2] On the other hand, students were increasingly reluctant to enter schools of natural sciences or engineering, and the avoidance became an international policy issue. At the time, Korea actively studied the causes and set policies to handle the situation. Not many women were involved in science and technology, and the number of women among scientists and engineers was small. Thus, the social consensus on the policy of supporting the minority group could be easily formed. Under these conditions, policies to assist them were promoted more aggressively than before.

One of the most defining moments was the enactment of an act to support female scientists and engineers. This act was enacted in late 2002 and was called 「Act on Fostering and Supporting Women Scientists and Technicians」. According to the Act, the Minister of Science, Information and Communications Technology (ICT) and Future Planning should develop a master plan every five years by integrating plans and policies on fostering and supporting women in science, engineering, and technology, which are established by the heads of relevant central administrative agencies and local governments. The First Master Plan was promoted from 2004 to 2008, and the Second Master Plan was in effect from 2009 to 2013. Currently, the Third Master Plan (2014–2018) is being pushed forward.

The Korean government's aims in gender policy in science and technology are very motivated considering recent situations. Setting such ambitious policy goals, indicates that the government is willing

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1 Framework Act on Women's Development was altered to Framework Act on Gender Equality in 2014.
2 Ministry of Gender Equality was renamed as Ministry of Gender Equality and Family in 2005.

to exert more effort to achieve them, and can be seen positively. However, as there are not enough decent jobs in the labor market, an increasing number of men file complaints against the affirmative action for women. Also, some female scientists are also opposed to the policy. That is, the government is motivated to support female scientists and engineers, but it is getting harder to obtain social consensus on the policy.

This paper deals with the following three issues. First, what is the status of gender equality in science and technology in South Korea? Second, which policies are promoted to improve gender equality in science and technology by the Korean government, and what are their goals? Third, what efforts should be made to enhance gender equality in science and technology?

2. Status of Gender Equality in Science and Technology

2.1 Gender Gap in Higher Education in Science and Technology

In Korea, 71% of all high school graduates enroll in college immediately following graduation as of 2014.[3] Female students show higher enrollment in college education than male students. In 2014, 68% of male high school graduates and 75% of female graduates enrolled in college immediately following graduation.

Is the opportunity to receive education in natural sciences and engineering in universities and graduate schools evenly provided to male and female students? In the field of natural sciences, opportunity is relatively equal to both genders. However, in the field of engineering, this does not always seem to be the

Table 1. Ratio of female students by qualification and major field of study

Year	Natural Sciences			Engineering		
	Bachelor's degree	Master's degree	Doctorate degree	Bachelor's degree	Master's degree	Doctorate degree
2000	52.5	40.6	32.7	29.6	10.6	6.6
2001	53.4	42.7	33.2	30.0	12.3	7.5
2002	52.8	43.5	33.9	29.8	13.0	8.8
2003	52.5	43.8	36.1	29.4	13.2	10.2
2004	52.9	44.3	37.8	29.2	13.2	11.5
2005	53.2	44.6	37.0	29.4	12.8	10.7
2006	53.4	45.1	37.1	29.4	13.6	10.6
2007	53.5	46.5	38.2	29.7	13.7	10.3
2008	52.8	47.6	39.6	29.6	14.0	10.3
2009	52.4	47.7	40.3	29.7	14.7	10.7
2010	52.6	48.7	40.0	30.1	16.0	11.9
2011	52.6	49.1	37.8	30.3	17.4	12.3
2012	52.0	50.7	37.7	30.3	17.6	12.3
2013	51.6	50.8	36.5	30.4	17.2	13.1

Source: Korean Educational Statistics Service, (http://kess.kedi.re.kr/index).

3 Korea Educational Statistics Service DB (http://kess.kedi.re.kr/index)

case. Only a very small number of female students study subjects in engineering. Table 1 shows that since 2000, the ratio of female students in natural sciences has exceeded 50% at the bachelor's level. However, the ratio in engineering has remained around 30%. Generally, graduates who study engineering are more successful in finding jobs than those who study natural sciences. It is the same for female students. However, more female students study natural sciences than engineering. Even though engineering graduates are able to find jobs more easily than those from natural sciences, female students generally are disinclined to study engineering subjects. The reason is because college and workplace culture in engineering is male-dominated.

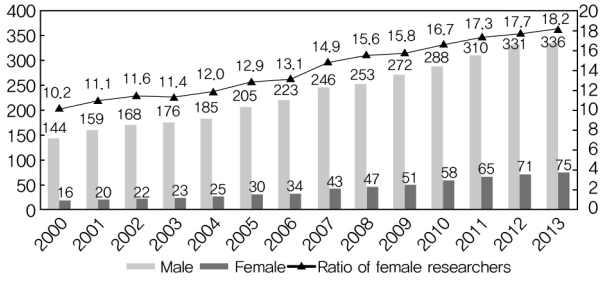
For the past 10 years, the Korean government has made efforts to encourage female students to be involved in natural sciences and engineering, but the ratio of female students in bachelor's programs has remained largely unchanged. However, the ratio of female students in master's and doctorate programs have significantly increased, particularly in engineering. Like college students studying other subjects, more college students in natural sciences and engineering are enrolling in graduate school due to difficulties in finding jobs. In particular, the number of female college students enrolling in graduate school is increasing, as they generally have a harder time than male students in finding jobs.

2.2 Gender Gap in Finding Employment in R&D

As of 2013, the number of the researchers involved in R&D activities in colleges, hospitals, and companies was 410,333 (Figure 1). Among them, the number of female researchers is 74,617 (18.2%). The percentage is considerably lower than the average of EU members (27 countries), 33%, and other European nations like England (38%), Spain (38%), Belgium (33%), Denmark (32%), Austria (28%), France (27%), and Germany (25%).[4]

Currently, the ratio of female researchers is significantly higher than that in early 2000. The ratio between 2000 and 2013 increased from 10.2% to 18.2%, and the number increased 4.6 times from 16,385 to 74,617. Over the same period, the number of male researchers rose 2.3 times. The increase in female researchers results from the increase in the number of female students who have earned degrees in higher education. In addition, the effort made by the Korean government to increase female researchers may be a key contributing factor. The government plans to increase the ratio of women who are newly employed by national and public research institutes to 26.8% by 2016 and 30% by 2018.[5] The ratio of newly employed women in 2013 was 20.3%.[6] The policy tasks to achieve these goals will be discussed in the next chapter.

Figure 1. Number of researchers (thousands) by gender and the ratio of female researchers (2000–2013)



Source: National Science and Technology Information Service (NTIS), http://sts.ntis.go.kr/index.jsp.

4 European Commission (2013). *She Figures 2012: Gender in Research and Innovation, Statistics and Indicators*. http://ec.europa.eu/research/science-society/document_library/pdf_06/she-figures-2012_en.pdf.

5 Press release of Ministry of Science, ICT and Future Planning (July 24, 2014) "Increase in new employment of female scientists and engineers in government funded research institutes (GRIs) to 26.3% in 2016."

6 Ibid.

Figure 2. Distribution of researchers by degree and major field of study (2013)

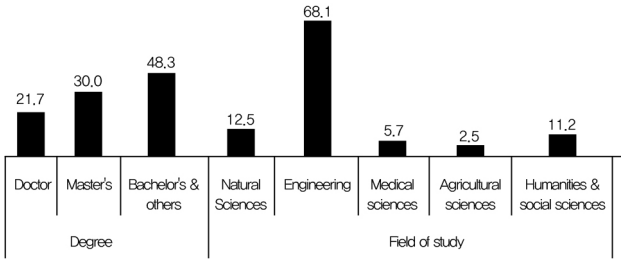
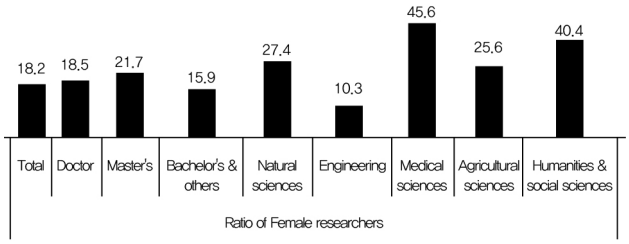


Figure 3. Percentage of women by degree and major field of study (2013)



Source: National Science and Technology Information Service (NTIS), http://sts.ntis.go.kr/index.jsp.

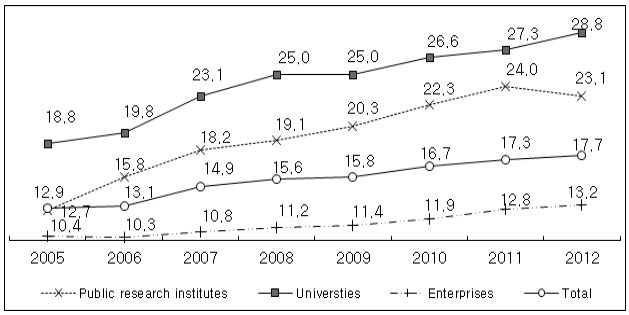
The distribution of qualification among all researchers is 21.7% for doctorate degree, 30.0% for master's degree, and 48.3% for bachelor's degree and others. The distribution by field of specialization is 12.5% for natural sciences, 68.1% for engineering, 5.7% for medicine, pharmacy and public health, 2.5% for agricultural science, and 11.2% for humanities and social sciences. According to the results, the ratio of the researchers studying engineering is high, but the ratio of female students who major in engineering in college and graduate school is less than 30% as shown in Table 1. Thus, the ratio of female researchers also remains low. The ratio of female researchers by qualification is 18.5% for doctorate degree, 21.7% for master's degree, and 15.9% for bachelor's degree and others. The ratio of female researchers by field of specialization is 27.4% for natural sciences, 10.3% for engineering, 45.6% for medicine, pharmacy and public health, 25.6% for agricultural science, and 40.4% for humanities and social sciences and others.

It is more achievable for the Korean government to increase the ratio of female researchers in universities and public research institutes than in private research centers. This is because public institutes are more dependent on funds granted by the government than private centers. Figure 4 shows that the ratio of female researchers in universities between 2005 and 2012 significantly increased from 18.8% to 28.8%, and the ratio in public research institutes almost doubled from 12.7% to 23.1%. However, the ratio in private companies only increased slightly from 10.4% to 13.2%.

2.3. Gender Gap in Participation in National R&D Programs

National R&D programs refer to R&D programs that are funded in accordance with the 「Framework Act on Science and Technology」. Corporate research institutes, as well as universities and public research institutes participate in national R&D programs. The Korean government believes that the opportunity to take part in national R&D programs should be evenly provided to men and women in order to improve gender equality in science and technology not only in universities and public research institutes, but also in corporate research centers.

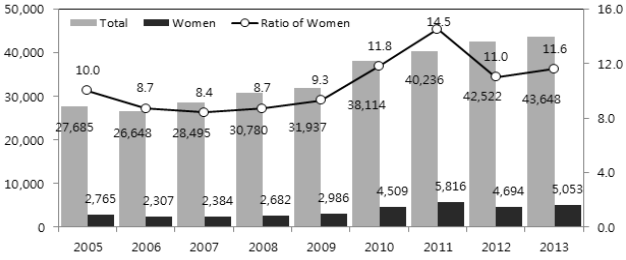
Figure 4. Ratio of female researchers by type of institution (2005–2012)



Source: National Science and Technology Information Service (NTIS), http://sts.ntis.go.kr/index.jsp.

In 2013, the total number of projects under national R&D programs was 43,648, and the budget for these projects was KRW 16,877.7 billion. In addition, 5,053 projects (11.6%) from the said total were led by female principal investigators. Figure 1 shows that the ratio of female researchers was 18.2% in 2013, but Figure 5 shows that the ratio of female principal investigators was less than the ratio in Figure 1, at 11.6%. That means women have fewer opportunities than men to take part in R&D activities that are directly managed by the government.

Figure 5. Number and ratio of female principal investigators in national research and development projects



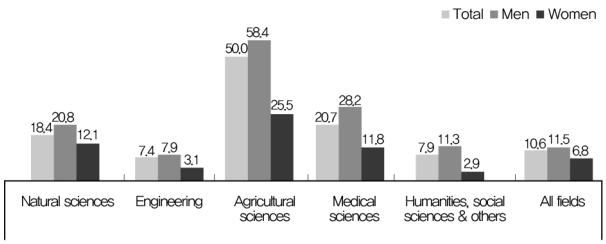
Source: Shin, S.M., Kim, Y.O., Oh, E.J., & Park, G.P. (2014). p. 48.

To clearly determine how many women versus men are principal investigators of national R&D projects, the ratio of principal investigators against the researcher pool of each gender and each field of specialization was calculated as shown in Figure 5. The reason for this analysis is because there are a big differences in the budget size or the number of participating researchers depending on fields of specialization. The total number of researchers is 410,333. Among them, 43,648 researchers (10.6%) are principal investigators of projects. The number of female researchers is 74,617, but only 5,053 (6.8%) researchers are principal investigators. In comparison, among the 335,716 male researchers, 38,959 (11.5%) researchers are principal investigators. Figure 6 shows that the ratio of women as principal investigators is lower than that of men in all fields. Among female principal investigators, 12.1% are specialists in natural sciences, 3.1% in engineering, 25.5% in agricultural and fisheries sciences, 11.8% in medicine, pharmaceutics, or public health, and 2.9% in humanities and social sciences and others.

3. Major Policies

Article 24 of the「Framework Act on Science and Technology」 prescribes that "the government shall devise schemes to train and utilize female scientists and engineers to elevate the national S&T capacity, and formulate and implement the necessary policies to enable female scientists and engineers to fully demonstrate their qualities and capabilities." The「Act on Fostering and Supporting Women Scientists and Technicians」is an actualization of Article 24 of the「Framework Act on Science and Technology」. Every five years, the Korean government formulates「Master Plan for Fostering and Supporting Women Scientists and Technicians」based on the「Act on Fostering and Supporting Women Scientists and Technicians」. The Ministry of Science, ICT and Future Planning organizes the master plan, but local governments and multiple government ministries including the Ministry of Education, the Ministry of Trade, Industry and Energy, the Ministry of Gender Equality & Family, and the Ministry of Employment and Labor are involved in the master plan.

Figure 6. Ratio of principal investigators among total researchers by field of specialization and gender



Source: National Science and Technology Information Service (NTIS), http://sts.ntis.go.kr/index.jsp & http://rndgate.ntis.go.kr/index.jsp.

Both the First (2004–2008) and the Second Master Plan (2009–2013) focused on the issue of female workforce. As such, the master plans promoted the policies that encourage talented female students to study and find employment in science and technology, support new female workforce specializing in science and technology to find employment in relevant field, and foster female scientists in science and engineering as leaders. The policies targeted projects that were beneficial to female students or scientists.

The Third Master Plan (2014–2018) adopts a new strategy, but without making drastic changes on the existing policy framework. That is, it expands the policies that concern both men and women, in addition to the policies that only target women. For example, the gender-awareness enhancement activity and the gendered innovation in R&D activities have been newly adopted. The Third Master Plan is composed of the following 11 policy tasks. Each task has several subtasks, which number 52 in total.

The policy goals and major policy tasks set by the Third Master Plan are as follows:

- The ratio of female students who enroll in bachelor's program in engineering: 25% (20.4% in 2012)
- The employment rate of female college students in science and technology: 60% (56.6% in 2012)
- The ratio of female researchers: 25% (ratio of female researchers among full-time R&D researchers, 13.0% in 2012)
- The ratio of female principal investigators in science and technology: 15% (ratio of female project principal investigators in national R&D programs: 11.6% in 2012)
- The ratio of newly employed female scientists and engineers: 30% (ratio of women among new employees in 109 organizations with women recruitment quotas: 19.2% in 2012)
- The ratio of part-time employment among all employment for women in science and technology: 10%
- The ratio of the participation of female workers in cooperative societies in science and technology: 30% (18% in April 2014)
- The ratio of female entrepreneurs among all start-up companies: 10% (5.4% in 2012)
- The ratio of the economically active female scientists and engineers in their forties: 60% (57.1% in 2012)
- Implementation of the legally mandated policies in the work-family reconciliation policies: 100% (88.6% in 2012)
- Implementation rate of the voluntary policies in the work-family reconciliation policies: average of 70%
- The ratio of female leadership in middle management or above in science and technology: 10% (7.0% in 2012)
- The ratio of the female principal investigators of large-scale research projects worth KRW 1 billion or more: 10% (4.6% in 2012)
- The ratio of the female commissioned members of major committees in science and technology: 40% (27.7% in 2013)
- Enhanced understanding of gender-awareness of researchers in science and technology public research institutes
- Development and application of the R&D gender analysis guidelines, and expansion of the statistical base for gender sensitivity in science and technology

Table 2. Total number of researchers and principal investigators in national R&D programs in South Korea

Gender	Fields of research	Total number of researchers (a)	Principal investigators in national R&D programs (b)	Ratio of principal investigators (b/a×100)
Total	Natural sciences	51,494	9,484	18.4
	Engineering	279,388	20,638	7.4
	Agricultural sciences	10,102	5,053	50.0
	Medical sciences	23,292	4,830	20.7
	Humanities, social sciences and others	46,057	3,643	7.9
	All fields	410,333	43,648	10.6
Male	Natural sciences	37,372	7,777	20.8
	Engineering	250,711	19,744	7.9
	Agricultural sciences	7,520	4,394	58.4
	Medical sciences	12,682	3,573	28.2
	Humanities, social sciences and others	27,431	3,107	11.3
	All fields	335,716	38,595	11.5
Female	Natural sciences	14,122	1,707	12.1
	Engineering	28,677	894	3.1
	Agricultural sciences	2,582	659	25.5
	Medical sciences	10,610	1,257	11.8
	Humanities, social sciences and others	18,626	536	2.9
	All fields	74,617	5,053	6.8

Source: National Science and Technology Information Service (NTIS), http://sts.ntis.go.kr/index.jsp & http://rndgate.ntis.go.kr/index.jsp.

Table 3. Description of the Third Master Plan for Fostering and Supporting Female Scientists and Technicians

Policy Projects	Examples of Sub-tasks
1. Support for female students to develop career visions in science and technology	- Provide training on careers in science and technology for middle and high school career counsellors - Support female students to major in science and technology, develop career plans, and provide guidance
2. Support for the research and employment of female college and graduate students in science and technology	- Female student-friendly job search support programs - Support labor cost if an unemployed woman with master's/doctorate degree in science and technology is employed - R&D internships for female students
3. Strengthening of the capacity of female scientists and engineers, as well as increase R&D participation	- Improve research capacity and support career development of new and part-time female researchers - Introduce active measures to increase participation of women in select national R&D projects - Increase incentives for model institutions that respect women recruitment quotas
4. Enhancement of global network of female scientists and engineers	- Host Gender Summit 2015 - Increase the participation of women in science and technology ODA - Create global research internship programs - Build a female researcher network and support exchange among researchers
5. Creation of female-friendly jobs in science and technology	- Introduce the transition to part-time employment of full-time researchers trying to reconcile work and family life - Develop new and flexible jobs, including part-time jobs
6. Support for start-ups by female scientists and engineers	- Start-up support programs customized for female scientists and engineers - Create a fund to support ICT-based start-ups with female entrepreneurs - Build a female entrepreneur network, and support exchange among entrepreneurs
7. Support for female scientists and engineers who have experienced career breaks and are returning to the job market	- Support female scientists and engineers returning to R&D jobs - Operate Career-interrupted Women Supporting Centers for female scientists and engineers - Support career transition of female scientists and engineers who have experienced career breaks
8. Creation of a workplace culture supportive of work-family reconciliation	- Develop various job types supportive of work-family reconciliation - Increase installation of day-care centers in science and technology institutes - Develop and disseminate women- and family-friendly management goals
9. Increase in female leadership in science and technology	- Establish Talent Academy for Women in science and technology (career development and consultation service) - Identify and promote role models for female scientists and engineers
10. Enhancement of gender-awareness in science and technology activities	- Develop and disseminate gender-awareness programs tailored to the characteristics of research institutes
11. Expansion of gender diversity and gender perspective R&D analysis and evaluation	- Introduce gender analysis in R&D - Expand gender classification in national statistics on R&D, including workforce in science and technology

Source: Ministry of Science, ICT and Future Planning, et al. (2014) 「*The Third Master Plan for Fostering and Supporting Women Scientists and Technicians (2014-2018)*」

Among the 11 policy projects of the Third Master Plan, numbers one to seven and number nine aim to benefit women, but they are policies necessary for both men and women. Many male students, scientists and engineers also hope to be supported by these policies. In reality, many male students also participate in the policies targeting female students[7]. However, the reason for maintaining these policies supporting women is because, as shown in the gender equality status, women face greater difficulties than men in finding opportunities to study, find employment, and develop careers in science and technology. That is, policy project numbers one to seven are affirmative actions for underprivileged groups. In comparison, the remaining three projects—numbers 8, 10, and 11—are not exclusively beneficial for women, nor specifically prioritize women. They help both men and women. In particular, number 10 was the first project to be selected in the master plan.

4. Future Projects

Considering the trend of the gender equality status in science and technology, it is expected that the Korean government will not achieve political goals in a short period. The gender policies in the field will be maintained for a long time. Then, what will be necessary to facilitate them? The gender policies in science and technology have been carried out for more than 10 years since their formulation. As such, the policies themselves need innovation. The important considerations are described as follows.

First, the policy goals regarding the entry of female students in science and technology need to be clarified. In the early 2000s, gender policies focused on attracting female students to science and technology regardless of specific majors. However, soon afterwards, the low ratio of female students in engineering emerged as an issue. Due to the policies, more female students are majoring in engineering, but the ratio still remains low compared with that of male students. About 68.1% of R&D researchers are people who study engineering. Thus, if the ratio of female students who major in engineering does not increase, it becomes difficult to increase the number of female R&D researchers. The Third Master Plan takes into consideration such points, and has set a goal of increasing the ratio of female college students in engineering to 25%. However, considering another aim—increasing the number of female scientists and engineers who participate in various decision-making bodies in leadership positions to 40%—the above goal of a 25% ratio is insufficient.

Second, the existing gender policies target universities and public research institutes rather than corporate research centers. The reason for this is that the R&D budget of universities and public research institutes is largely dependent on funds granted by the government, but that of corporate research centers is less dependent on governmental financial assistance. Thus, it is recommended to spread the gender policies to corporate research centers. In this context, the Ministry of Trade, Industry and Energy is promoting a policy to increase female R&D workforce in corporate research institutes, in cooperation with the Ministry of Science, ICT and Future Planning and the Ministry of Gender Equality & Family from late 2013[8]. If the effort is successful, gender balance in corporate researchers and their work-family reconciliation

7 In some projects the participation of male scientists and engineers is essential. For example, in case of a teamwork training program in R&D activities for female students, a woman may be a leader and be able to cooperate with male and female colleagues alike. Another example would be projects to reinvent university education in engineering to be more female-friendly. In Korea, more than 95% of all university professors in engineering are men. Thus, the innovation of engineering colleges depends on male professors.

8 Press release of Ministry of Trade, Industry and Energy (Nov. 28, 2013). “Fostering women studying science and engineering as a core R&D workforce in fields."

status will improve significantly.

Third, the existing gender policies were mainly designed to support women. However, it is advisable to increase the policies supporting both men and women, as with the work-family reconciliation support. Alternatively, gender policies that require participation from both male and female researchers such as gendered innovation may be reinforced. The existing gender policies generally focused on fostering and utilizing female workforce. However, "gendered innovation" underlines the finer details of R&D activities.

Considering the present economic circumstances, it would be difficult to appropriate new budget for gender policies in science and technology. However, the policy goals set by the government in the Third Master Plan are very ambitious. The goals have been set high whereas the budget that can secure policy measures is very limited. Under such conditions, the most proper strategy is to select a policy that can be achieved without large-scale investment. For example, there is the “Gender Impact Assessment” led by Ministry of Gender Equality & Family and the “Gender-responsive Budgeting” by the Ministry of Strategy and Finance. If the two systems are widely adopted in science and technology, it is expected to bear significant results with small budgets. Thus, relevant government ministries, such as the Ministry of Science, ICT and Future Planning, the Ministry of Trade, Industry and Energy, the Ministry of Strategy and Finance, and the Ministry of Gender Equality & Family should prepare for operation and divide roles to implement the system in cooperation. “Gender Impact Assessment” and “Gender-responsive Budgeting" are being applied on policies in science and technology, but this application is too limited to hold significance.

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