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Review of the Effectiveness of Gender Impact Assessment and Development of its Cooperation System (IV): Focus on National Research Development Programmes

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I . Introduction

1. Background and Goal of the Study

While the scale of R&D investment in South Korea has been steadily increasing, gender inequalities remain persistent in the National Research and Development Programmes (NRDP), and Gender Impact Assessment (GIA) has rarely been applied to these programmes. With thirty five central administrative bodies involved in its operation, the size of budget for NRDP is as significant as its impact on citizen's lives. Moreover, the direction of research and development (R&D), and the application of its outcomes are critical in improving the living conditions of women and

men. Therefore, the application of GIA is essential to the field of R&D.

The call for the incorporation of a gender perspective into science and technology has been made in international society for a long time. Efforts to ameliorate gender inequalities and expand gender-sensitive research have continued through the development and implementation of national guidelines. In South Korea, policies to increase women's participation in science and technology have been implemented, and yet women's participation has plateaued at a still unsatisfactory level. Gender innovation means gender mainstreaming, which it is claimed can enhance the participation of women scientists and technicians in R&D and improve the gender-sensitivity of research.

GIA is an institution to evaluate public policy from a gender perspective, and to steer it towards gender equality; and the NRDPs, whose annual budgets account for 20 trillion won, are an important part of public policy. This research starts from the proposition that GIA should be actively promoted in the field of science and technology in order to achieve the goal of gender equality. It aims to develop a methodology for GIA with consideration of the features of the NRDPs, and seek the ways to vitalize GIA in this field.

2. Research contents and methods

A. Research contents

For this research both international and domestic case studies on gender mainstreaming in science and technology have been collected, and the gender features as well as gender regulations related to NRDPs have been analysed. Also, this research has made use of the outcomes from pilot GIA studies in the Bio- and Medical Technology Development

Programme and the Material and Component Technology Development Programme, which have been undertaken by the Ministry of Science and ICT (MIST) and the Ministry of Trade, Industry and Energy (MOTIE), respectively, to aid in the development of a GIA index for NRDPs. Subsequently, the selection criteria for GIA-targeted NRDPs have been considered, and suggestions have been made for the improvement of indices for analysis and evaluation.

B. Research Methods

- Literature review and analysis of materials on gender in the development of science and technology
- Content analyses on GIA reports of NRDPs
- Delphi survey with GIA experts as well as scientists and technicians
- Focus Group Interviews (FGI) and In-Depth Interviews (IDI) with stakeholders of NRDPs
- Hosting of a GIA forum
- Production of the booklet “101 GIA Case Studies”

3. Expected Outcomes

This study will make a contribution to enhancing the of quality of GIA reports through the development of a GIA index and check points for NRDPs. Further, it will help to increase gender equity in the research pool for science and technology, make the R&D process more gender-sensitive, and promote creation of a research environment reflecting gender differences.

II . Literature Reviews on Gender in Research and Development for Science and Technology

1. Overseas case studies on incorporating gender into Research and Development for Science and Technology

This study starts by analysing the policies that overseas research institutes have implemented in order to support the pool of women researchers and diffuse research that incorporates a gender perspective and gendered analysis, regarding these as the key gender issues in R&D programmes. Firstly, we examine the measures introduced by research institutes in the EU, the US, Germany, Switzerland, and Japan in order to encourage women to participate in R&D programmes, to develop their careers and to support their work-life balance. The National Health Research Institute in Canada has made a research plan for Sex and Gender-Based Analysis (SGBA) in order to perform and expand research incorporating a gender perspective and gender analysis. The plan aims to systematically identify the ways in which diverse members in Canada are affected in the R&D process of science and technology. The National Institutes of Health in the US runs courses on “The Science of Sex and Gender in Human Health” as part of an educational programme for research with a gender perspective. This institute particularly foresees that sex, as a biological variable, is a necessary factor to differentiate in the process of design, analysis and reporting of research on humans and other vertebrates. As part of this, any proposal to perform research on a single sex only is required to submit a literature review, data, and relevant evidence to explain the rationale for this choice.

2. Domestic discussion on gender in Research and Development for Science and Technology

Earlier research about R&D for science and technology from a gender perspective has addressed the issues of the low participation rate of women researchers, the absence of women in the decision-making process, the lack of gender research reflecting gender differences, and suggested ways to tackle the gender imbalance in R&D. Firstly, considering the expansion of women researchers in the NRDPs, Chung et al (2007) found from the GIA conducted on the BK21 project, which is a training programme for R&D, that women researchers are concentrated in humanities and social sciences, and that the proportion of women gets lower as education level increases. Furthermore, they examined gender imbalance in the processes of decision-making, budget allocation, advertisement of the programme, and recipients of the programme. Shin et al (2014) analysed whether decision-making about the government-led R&D projects and the opportunities to undertake them have been impartially distributed to men and women researchers, and put forward ways to improve institutions for enhancing gender balance. Its suggestions include focusing gender analysis and assessment of R&D on the principle that the benefits of the development of science and technology should be equally distributed to both women and men. Kang et al (2016) performed keyword searches related to gender in science and technology research published in SCI journals for the twenty years between 1995 and 2014 and in so doing identified the current situation of research that has employed SGBA in different countries. In the US, research using SGBA accounted for 30.09% of the total sample; in China the proportion was 7.04%; in the UK, 6.78%; and in Japan, 6.08%. In South Korea, the equivalent figure was as low as 3.47%.

In addition, diverse research has been performed on the institutional improvement of gender equality in R&D in the field of science and technology. Kim et al (2015) gives a case study of the Bill and Melinda Gates Foundation, which established a strategy to assess gender impact when funding agriculture research, and reflects on ways to promote and strengthen gender-sensitive research in the agriculture R&D programme. Moon et al (2014), Baek et al (2017), and Lee et al (2017) suggest proposals for gender innovation, which is widely recognized by the international society as a way to facilitate the process of R&D and enhance its outcomes through the introduction of SGBA.

3. The Current Situation of GIA in the NRDPs

GIA conducted on the NRDPs by the central administration for the last three years has been minimal; GIA was performed on three programmes in 2015, six in 2016, and five in 2017. The Ministry of Women and Family has been making efforts to increase the effectiveness of the institutional operation of GIA by reflecting its outcomes in gender budgeting, and yet it appears that the NRDPs continue to lack a link between GIA and gender budget.

III. Gender regulations and gendered features of the NRDPs

1. The concept and implementation system of the NRDPs

A National Research and Development Programme (NRDP) means a R&D programme in the field of science and technology in which the

central administration selects the R&D projects on the basis of law, and provides all or partial funding for R&D costs or supports the research in other ways through public funds. By directly supporting R&D activities, these programmes aim to raise national competitiveness by technological innovation, development of a knowledge-based economy, the training of human resources, the building of infrastructure, and the reorganization of systems to make use of this developing technology; as a result, these programmes differ from private R&D programmes conducted by corporate firms in terms of objectives, goals and features.

The NRDPs are implemented mainly by the Ministry of Science and ICT (MSIT) and the Presidential Advisory Council for Science and Technology. The MSIT is responsible for the design and budget allocation and adjustment of the NRDPs, and for overseeing the performance evaluation of departmental R&D programmes. The Presidential Advisory Council for Science and Technology is composed of advisory and deliberative councils. The advisory council gives advice on the strategies to develop science and technology, overall policy direction, and institutional and policy improvements in related areas. The deliberative council discuss the major policies in the field of science and technology, the adjustment of human resources, local technological innovation policies in relation to technological development and to industrialization, R&D plans and programme adjustments, the operation of R&D budgets, and so on.

The NRDPs follow a process of planning, budgeting, ex-ante evaluation and ex-post evaluation. First of all, the MSIT proposes the direction of policy-making in each department through the <Basic Plans for Science and Technology>, published once every five years. On this basis, the allocation and organization of budgets for the NRDPs is made. For major

R&D programmes of national development, the direction of government investment on R&D is decided through the Presidential Advisory Council for Science and Technology. Performance evaluation of each programme takes place three times: in the interim, at completion, and follow-up. The department responsible for the R&D programme forms a R&D Self-Evaluation Committee, whose evaluation is inspected by the MSIT as part of its oversight role.

2. Gender regulations and gender features in related committees

The 2018 Guidelines for the Self-Evaluation of the National Research and Development Programmes stipulates that women should be adequately represented on the R&D self-evaluation committees set up to evaluate the outcomes of the research programme. Also, in the regulations for management of the R&D projects in each department, a rule to consider gender balance in the formation of the relevant committees has been stipulated. The Ministry of Land, Infrastructure and Transport (MOLIT) has included an enforcement ordinance that gender should be considered when forming the Committee for Science and Technology of National Land and Transport, which deliberates and adjusts the comprehensive and implementation plans of the science and technology R&D projects of the MOLIT. The Rural Development Administration has also stipulated in the regulations of R&D projects for agricultural science and technology that gender balance should be considered in the appointment of committee members for the project design committee, the project selection committee, and the project outcomes evaluation committee.

In contrast, while the MSIT is authorized to select and evaluate the

NRDPs, statistical data on how many women participate in the committees related to project design and selection is not open to the public.

3. Gender regulations and gendered features of the research pool

As of 2016, the number of women researchers in Korea is recorded as 90,615, making up 19.7% out of the total, which represents a small increase over recent years. However, the proportion is very low compared to countries such as Iceland (45.6%), the UK (37.4%), Germany (28.0%), and France (26.7%). Looking at the features of researchers involved in R&D by age and gender from 2014 to 2016, gender differences become more apparent. The proportion of women researchers by age group shows that women make up 20.4% of researchers in their 30s, dropping to 12.7% of researchers in their 40s, 9.9% in their 50s, and 8.8% in their 60s. There are many factors through which this tendency can be explained: for instance, in past the rate of women majoring in science and engineering was much lower than at present; many women researchers tend to quit due to marriage or birth; and that the lack of institutional support for work-life balance discourages women in continuing their career.

Gender features of lead researchers from 2014 to 2016 show that the rate of women as lead researchers in the NRDPs has steadily increased; however, as of 2016 women account for only 14.6% of lead researchers, 5,147 out of 35,249. Furthermore, a gender gap in the research funding per person of the NRDPs remained persistently large from 2012 to 2016. As of 2016, the research funding per person of male-led research projects averaged 466 million won, more than double the 222 million won per person for female-led projects.

IV. Pilot analysis of GIA for the NRDPs

1. Outline of pilot analysis

In this section, pilot analyses of GIA of the Bio- and Medical Technology Development Programme and Material and the Component Technology Development Programme are described. The aim of the pilots was to reveal gender differences in recipients of the programmes and budget allocation, as well as to find ways to enhance women researchers' participation in the NRDPs and to invigorate gender-sensitive research. In order to do so, the current features of the targeted programmes and existing literature on gender-sensitive analysis were examined. Additionally, FGIs and IDIs were conducted with researchers involved in the NRDPs, managers of professional institutes, and gender experts.

2. Bio- and Medical Technology Development Programme in the MSIT

Bio-technology (BT) and cutting-edge medical innovations that are directly connected to citizens' lives and health, such as the development of new drugs or novel treatments such as stem cells, are central to the Bio- and Medical Technology Development Programme. Therefore, the physical differences between men and women must be considered in all stages of programme design, implementation, and operation. However, there have been negative criticisms regarding gender innovation or gendering of clinical research particularly in animal testing; difficulties in the use of female animals for experiments and in the interpretation of data have been raised.

As noted above, the total proportion of women lead researchers in the

NRDPS remains as low as 14.6%, though there is a relatively higher proportion of 24.0% in bio-technology programmes, and 16.6% in the Bio- and Medical Technology Development Programme. However, it has been argued that there should be more women lead researchers considering the total number of women researchers involved in the BT industry. Also, women researchers tend to have difficulties in getting access to important information on the programme because they rarely participate in the stage of research project design and are often marginalized from male-centred research networks. Moreover, it has been pointed out that opportunities to further their careers through participation in mid- and large sized projects are relatively fewer for women researchers than for men. This means that institutional support is required to enable women researchers to take active part in the process of design and selection of research projects, and to deepen their research careers.

3. Material and Component Technology Development Programme in the Ministry of Trade, Industry and Energy

Whilst the Material and Component Technology Development Programme is an essential R&D programme in the MOTIE, gender-sensitive research has been severely lacking. Women's participation in this field has been very limited, owing to the very small pool of human resources. However, the number of women entering traditionally male-dominant sectors, such as agriculture and the construction industry, has been increasing. In the case of the materials and components industry, the need to consider gender differences in R&D for metals, chemicals, fibers, and ceramic materials can easily be overlooked. For example, while the development of lightweight materials can be useful to both women and men, there are greater demands for such products from women. Hence, consideration

of gender is relevant in the stage of development and commercialization of lightweight products based upon new materials and components.

Until now, the number of women researchers involved in the Material and Component Technology Development Programme remains very low. Further, women researchers involved in the Material and Component Technology Development Programme tend to only undertake small-sized research projects with budgets of 100 million to 1000 million won. The majority of researchers responsible for research projects in this programme have degrees in engineering, and projects operated by private corporations rather than research institutes are usually implemented by high-level managers. Moreover, while the proportion of women in the committees to design and select the research projects is suspected to be minimal, gender statistics on the relevant committees are not open to the public.

In order for the committee responsible for design and evaluation of the research projects in the Material and Component Technology Development Programme to maintain gender balance, specific plans for improvement should be made on the basis of the results of GIA. Further, for those projects which have gender relevance and to which gender-sensitive research can be applied, gender should be considered from the beginning, and a gender-sensitive research proposal should be written accordingly.

V. Opinion survey on GIA for the NRDPs

1. Research outline

In this section, the results of a Delphi survey of experts concerning

the selection of GIA-targeted programmes and GIA methods for the NRDPs are reviewed. Participants in the survey include GIA experts and experts involved in running the NRDPs, totalling around sixty. The expert delphi survey was performed via email in two periods: the first from 16th to 24th August 2018, and the second from 14th September to 2nd October 2018. The survey is composed of five sections: firstly, the demographic features of respondents and experience and period of work in the related area; secondly, their opinions on the necessity of GIA in the NRDPs; thirdly, the adequacy of target-project selection and priority; fourthly, the adequacy of the index used for analysis and assessment; and lastly, the ways to strengthen GIA for the NRDPs. For the second survey period some items were added to the questionnaire, reflecting the results of the first survey. Differences between the results of the first and second surveys and between the opinions of GIA experts and NRDPs experts were examined.

2. Survey results

On a five point scale, the necessity of GIA being included in the regulations of NRDPs was rated very highly with an average of 4.5 points. Amongst GIA experts it was rated at 4.6, whereas amongst NRDP experts it was rated at 4.2, suggesting that GIA experts consider the need for GIA more strongly.

Regarding the appropriate criteria for selection of GIA target projects in the NRDPs, the extent to which the research theme and contents of the R&D programme impact citizens' everyday lives and the potential knock-on effects of the results of the research were rated as the most appropriate criteria, both scoring an average of 4.3 out of 5, followed by the proportion of women lead researchers with 4.2, and the budget

scale with 4.0.

In response to the question of the NRDP fields most appropriate for GIA, nine out of the total nineteen fields listed scored more than 4.0 on average in the second survey, namely: *Life Sciences; Food, Agriculture, Forestry and Fisheries; Health and Medicine; Information and Communication Technology; Environment; Construction and Transport; Brain Science; Cognition, Emotion and Science; and Humanities and Society in Science and Technology*. They all have the common point that they are directly connected to human life and health, and highly relevant to everyday life.

The question of whether the budget system of the NRDPs should be considered in the selection of target programmes was answered in the affirmative by 58.3% of respondents. However this dropped to 18.3% for the consideration of the budget system at the level of sub-programmes, and 23.3% at the level of specific projects¹⁾.

As for the implementation procedure for GIA, experts have placed priority on evaluating the stages of programme design and programme selection.

Concerning the relevance of GIA at each stage of development of the NRDPs, experts have responded that GIA is relevant to all three listed stages of development, with the research development stage rated highest. Likewise, all three stages are considered important in the selection of GIA target projects, with the research development stage ranking highest again.

For the section on indices for analysis and assessment respondents

1) Translator's note: Each NRDP is divided into sub-programmes which allocate funding to a number of specific projects.

assessed two proposed indices: index A, which has been used as a guide for overseas gender-sensitive research, and index B, which is a revised index of GIA suggested by the MOGEF. All eighteen items of index A received positive reviews with higher than 4.0 out of 5 on average, and the items of index B also received high level of support with around 4.0 on average in both the first and second surveys.

When asked about the most appropriate time for production and submission of GIA reports to the MOGEF, the most common response was during the stage of research and programme design, scoring 4.4 and 4.6 on average in the first and second survey, respectively.

As for steps to strengthen the GIA in NRDPs, the item on the development and advertisement of gender-sensitive/ gender-innovative research guidelines scored highest, with 4.5 on average. All other items also received higher than 4.0 on average.

Lastly, in the question of what should be included in the performance objectives (indices) in the gender budget paper, the proportion of women in the committee for project selection appears the highest, scoring 4.6 on average, followed by the proportion of women in the committee for project design with 4.5 out of 5.

VI. The Ways to Strengthen GIA in the NRDPs

This study has developed a methodology and sought ways to strengthen GIA in the NRDPs. In so doing, it has identified suggestions to improve the gender equality of policies of the NRDPs, as well as the level of women's representation in the relevant programmes. Based on the literature review and the results of the expert survey, the policy suggestions can be summed up into four: the revision of regulations related to the NRDPs; suggestions on the implementation system and procedures for GIA in the NRDPs; the development of checklists and an index for analysis and assessment; and the setting-up and management of performance indicators for GIA and gender budget.

1. Revision of regulations related to the NRDPs

The *Primary Idea* of the Basic Framework for Science and Technology is stated as to enable the innovation of science and technology in harmony with the natural environment and social ethical values based on human dignity, and to create a driving force for economic and social development. In particular, rigid gendered division of labour hinders women from taking active part in the field of science and technology, and as a result women's experiences have not been sufficiently reflected in the processes of science and technological development. This study therefore suggests that the *Primary Idea* which is stipulated in the Article 2 of the Basic Framework for Science and Technology should be revised to include the resolution of social inequalities in order to tackle inequalities undergone by marginalized groups, such as women, in the field of science and technology.

Technology impact assessment (TIA) is an institution which makes ex-ante evaluation on the expected effects of the development of new technology on the economy, society, culture, ethics, and environment; the results of which are reflected in the policy planning. Gender tends to be disregarded or neglected in the field of science and technology, and yet science and technology R&D makes a significant and gendered impact on the lives of women and men. By considering the physical, social and cultural differences between women and men, the level of general citizens' satisfaction about the outcomes of science and technology R&D could be enhanced. Hence it is suggested that Article 14, *Technology Impact Assessment and Technology Level Assessment* of the Basic Framework for Science and Technology be revised to consider gender in the operation of TIA.

Further, there is a need for more statistics to identify gender features in the NRDPs, and to enable the collection of such statistics the format of research proposals needs to be revised. The results of the expert delphi survey suggest that the priorities for GIA in the NRDPs be placed in the fields of *Life Science; Food, Agriculture, Forestry and Fisheries; Health and Medicine; Information and Communication Technology; Environment; Construction and Transport; Brain Science; Cognition, Emotion and Science; and Humanities and Society in Science and Technology*. When the need for gender-sensitive research is identified in the relevant field, researchers should include an implementation plan for gender-sensitive research in their research proposals. The Rules of Management of the National Research and Development Programmes need to be revised to reflect this.

2. Suggestions on the implementation system and procedures for GIA in the NRDPs

The MSIT has performed the general management and conducted the budget policy of most of R&D programmes so far. In order to transform the NRDPs, which are an essential part of science and technology policy, so as to further the goal of gender equality, a department responsible for policies related to gender innovation needs to be established within the MSIT. Also, in order for the MSIT to strengthen GIA and systematically implement gender mainstreaming, a committee for gender innovation needs to be established in each department.

The following order is suggested for the implementation procedure of GIA in the NRDPs: the selection of the target programme, write-up and submission of GIA report and gender-sensitive research proposal (optional), notification of feedback, the submission of plans reflecting the feedback, the management of these plans, and the incorporation of GIA results into a gender budget, as illustrated in the table below.

Authorities	Steps	Contents
Responsible department (report to MOGEF)	Programme selection	Selection of targeted programmes considering the goals of gender equality in each department (Every December)
Responsible department (report to MOGEF)	Write-up and submission of GIA report and gender-sensitive research proposal (optional)	<ul style="list-style-type: none"> - GIA proposal on the relevant programme (incl. explanatory documents such as the programme proposal) - Gender-sensitive research proposal included in project design process. * By following February
MOGEF	Notice of feedback	Evaluation sent to the responsible minister(department) after examining the GIA proposal, such as: No need for improvement, Acceptance of the self-suggestions for improvement, Further suggestions for improvement, etc. * By following April Feedback procedure concludes when evaluation states No need for improvement or Acceptance of the self-suggestions for improvement.
Responsible department (report to MOGEF)	Submission of reflection plans	Plan detailing the department's response to the feedback submitted to MOGEF. * By following May
MOGEF	Management of reflection plans	Manage and monitor whether the relevant minister(department) has accepted and implemented the plans. * Until the following December
Responsible department	Write-up of gender-budget proposal	Gender-budget proposal, reflecting measures for gender equality based upon the GIA * By following May

3. Development of check-lists and an index for analysis and assessment

This study has proposed a checklist for the selection of GIA-target programmes in the NRDPs based on the results of the expert Delphi survey. In order to implement GIA for NRDPs, different analysis methods are necessary depending upon the agents of implementation; an index for the civil servant in each department responsible for the GIA report and a separate index for researchers involved in the NRDPs to use when writing-up gender-sensitive research proposals. Drawing on the Delphi survey of experts, this study has made suggestions of GIA check points and items to be used for gender-sensitive research proposals, which are a revision of the GIA index of the MOGEF to reflect the characteristics of the NRDPs.

4. Setting-up and management of performance indicators for GIA and gender budget

In order to institutionalize gender innovation in R&D for science and technology and to enhance gender equality in the NRDPs, a performance index based on GIA results should be incorporated into the gender-budget proposal and constantly monitored. From 2018 the MOGEF can compel each minister to make use of GIA and gender budgeting to further the goal of gender equality. The manual for the writing of gender-budget proposals should be modified to include performance objectives (indicators) to measure to what extent and in what ways the relevant programme has achieved the goal of gender equality, and it is further recommended that quantitative data be collected with analysis of recipients by gender.

Combining the results of expert survey done in this study and the suggestions for policy improvements to lessen gender inequalities in the field of science and technology made in previous studies, the performance objectives(indicators) are suggested to include the following five elements. Firstly, the provision of gender training for the civil servants in charge of the NRDPs, programme managers in research institutes participating in the NRDPs, and researchers involved in the NRDPs. Secondly, the level of gender equity in the human resources of the research programme. It is suggested that the objective set the minimum proportion of women as 30% amongst lead researchers and 40% amongst co-researchers. Thirdly, the development of programmes specifically targeting women researchers. This includes a new researcher programme to support women researchers both in early career and mid-career. The number of women researchers participating in such programmes should also be set as an objective. Fourthly, procedures to support and expand gender-sensitive research. The government should provide incentives to researchers who have chosen to undertake gender-sensitive research, and the number of gender-sensitive research projects should be included into the performance objectives(indicators).

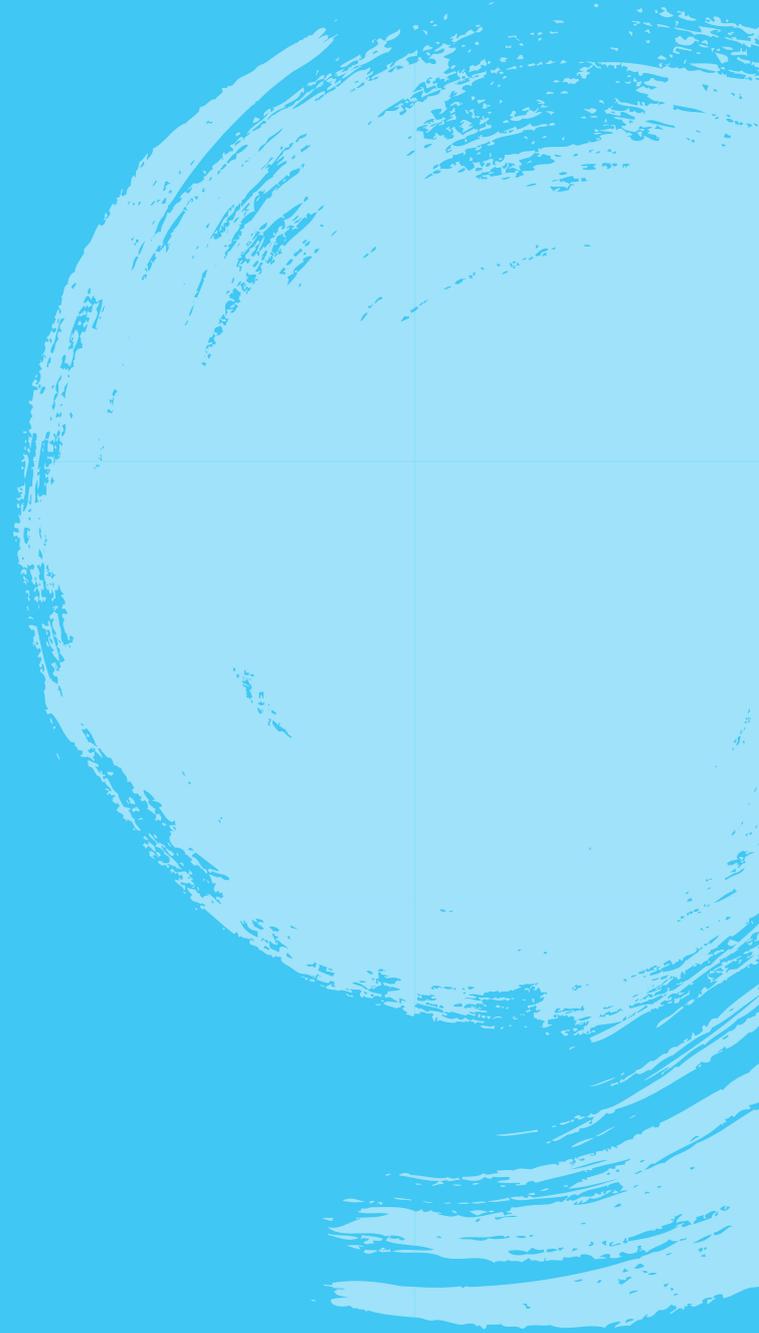
Finally, gender-balanced participation in all the committees of design, selection, and evaluation of research projects. The results of expert survey strongly emphasized that women should be able to take part in the design process of research projects. In order to make the NRDPs more gender equal, the rate of women's participation in the committees of project design, project selection, and project evaluation should be included as a performance objective.

If the above suggestions for enhancing gender equality are included into the performance objectives(indicators) and feedback from the GIA

of NRDPs is reflected into gender-budget proposals, the performance objectives(indicators) can be effective.

※ Abbreviations

- Bio-technology: BT
- Gender Impact Assessment: GIA
- Ministry of Gender Equality and Family: MOGEF
- Ministry of Land, Infrastructure and Transport: (MOLIT)
- Ministry of Science and Information Communication Technology: MSIT
- Ministry of Trade, Industry and Energy: MOTIE
- National Research and Development Programmes: NRDPs
- Research and Development: R&D
- Focus Group Interview: FGI
- In-Depth Interview: IDI



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