

Women's Participation in Science and Technology in Indonesia

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1. Introduction

The gender dimension of science and technology (S&T) has captured attention of late, and has appeared on the agendas of international and regional fora as well as national governments (Achmad and Hermawati, 1999; Huyer, 2004; UNESCO, 2007). The gender dimension describes the way in which culturally organized differences between men and women interact with historically and socially diverse scientific and technological practices, and their meanings. This scientific and technological cultures and practices shape gendered social relations and, in turn, are shaped by them (UNESCO, 1996). This article reviews the development of the issues on gender in S&T within the context sustainable and equitable development in Indonesia, with the focus on the issue of gender in S&T education, careers, position of women and men at decision making or policy formulation, and gender differential impact studies of technology for community.

1.1 Current Situation

Indonesia is the world's largest archipelago, consisting of five major islands and about 13,700 islands scattered over 5,120 kilometres. The archipelago is on a crossroads between the Pacific

and the Indian Ocean, and bridges two continents, Asia and Australia. This strategic position has influenced the cultural, social, political, and economic life of the country. Right now, Indonesia has 33 provinces with more than 300 ethnic groups and more than 250 native languages, with the official language is Bahasa Indonesia. Indonesia has the largest Muslim population (85.58%) in the world. The population has tended to increase every year and the number of men and women is almost equal.

Indonesia is the fourth most populous country in the world. Based on Population Census 2010, the population was 237,556,363 people with 119,507,580 men and 118,048,783 women, producing a sex ratio 101. In 2014, the population increased and estimated about 253,609,643 people (July 2014 est.), with the composition of men and women 50.02:49.98. The population composition has remained constant for the last few years. However the population growth rate is decreasing in recent years, namely 1.49% for the period 2000-2010 as compared to 2.31% for the period 1971-1980. The fertility rate were also constant for the last five years (since 2010) at 2.4. and a bit decrease at 2.3 in 2013 (The World Bank, 2015).

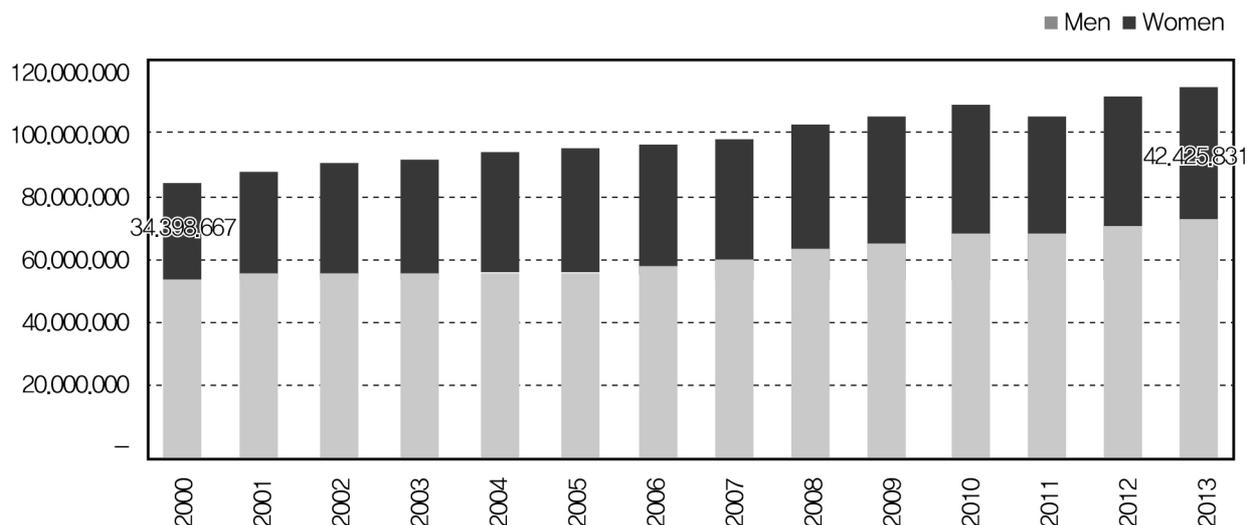


Figure 1. Trend of Indonesian labor force by gender (2000-2013)

Source: BPS. Indonesian Labor Force Survey 2000-2013

For the last 13 years, there is an increasing trend of Indonesian labor force for both men and women. The number of women workforce increased by 23.3%, while men increased by 26.9% (Figure 1). Considering this figure, creating more jobs is being the most challenging issue for sustainability of Indonesian economy.

In the economic context, the value of Gross Domestic Product (GDP) in 2013 reached US \$ 868.3 billion. The growth in the gross domestic product (GDP) slowed to 5.16% in 2014 compared to 6.2% in 2012. The biggest contributors to GDP were manufacturing sectors at about 21.66%, agricultural sector at about 13.18 % and trade, hotel and restaurant at about 13.68%. Creating more jobs is the most challenging issue for Indonesia, particularly by strengthening and deepening the manufacturing sector through advancement of science and technology capacity.

However, development of science and technology (S&T) in Indonesia has not been benefitted equally between men and women. The participation of women and men in education and employment, particularly in S&T are not equal yet. More men are engaged

in S&T arenas, particularly in R&D organisations and S&T services (Hermawati and Saari, 2011). The survey held by JICA (2011) shows that many Indonesians have moderate ideas on gender equality and women’s liberty, therefore many women earn a living as well as their husband or as breadwinners. Whereas, the view still persist that women should be dependent and undertake all domestic roles. Although less than 50 percent of Indonesian women are economically active, their level of protection within the economy also remains limited, particularly outside the agricultural sector where they constitute only 30 percent of salaried employees.

In the educational sector, the gap between boys and girls has narrowed in primary and secondary education. The percentage of illiteracy rate for females (aged 10 years and above) was higher compared to males, although the trend for the last five years has been decreasing for both men and women. In 2013, illiteracy rate for females was 7.69 percent and 3.23 percent for males. However, number of boys (age 7-12) who are not in school for the last five years are higher (0.69) than girls (0.47)

at the same age, whereas the number of girls aged 13-24 (30.71) who are not in school were higher than boys (30.46) (CBS, 2014).

Data on educational attainment of men and women aged 15 years and above on educational attainment in 2012, shows that women have less educational attainment than men (Table 1). There are many reasons for this phenomena, such as the persistence of early marriages, poverty, and other cultural aspects that pressure girls to quit school (Hermawati and Saari, 2011).

The health status is improving and women enjoy a greater life span than men, but Indonesian human development is still at medium rank. Life expectancy at birth for women and men in Indonesia increasing. In 2013, life expectancy for women was 72.9 years and 68.8 years for men, as compared to 2009, 71 years for women and 66 years for men (UNDP, 2014 & 2010). However, Indonesia still suffers from high infant mortality rate (IRM) and maternal mortality rate (MMR) among ASEAN Countries (Tables 2 and 3). The latest survey in Indonesia (CBS, SDKI, 2012) shows that maternal mortality

ratio increased very sharply in 2012, reaching 359 per 100,000 live births or increased 57 percent compared to 2008. Therefore, the government increased the budget service program for maternal health and reproduction by about 3% of the total health sector in the national budget of 2014. Furthermore, the development of S&T should benefit more women and infants in order to further reduce IRM and MMR.

The HDI rank of Indonesia has been over 100 from 2000 to 2014, which puts Indonesia in the category of medium human development, together with other ASEAN Countries, namely the Philippines, Vietnam, Cambodia and Lao People's Democratic Republic. According to Human Development Report (UNDP, 2014), Indonesia ranked 108th (0.684) out of 169 countries on Human Development Index and 98th (0.923) on Gender Development Index. However, others issues such as participation, access, and benefits of science and technology, in particular for women, are evident and will be discussed in this paper.

1.2 Government Policies on Gender, Science and Technology in Indonesia

Efforts towards national development have been made with the focus on the welfare of the people as well as in narrowing the gender gap between men and women's participation, boys and girls' participation across the country. The 1945 Constitution of the Republic of Indonesia grants equality to all citizens, in line with the Indonesian state philosophy Pancasila. Article 27 paragraph (1) of the Constitution stipulates: "Every citizen enjoys equal status before the law in government, and it is obliged to uphold them without exception". Paragraph (2) stipulates: "Every citizen shall have the right to employment and to conditions of life commensurate with human dignity". These policies are followed up with several laws and regulations such as Law No 2/1989 on the National Education

Table 1. Percentage of men and women 15 years and above by educational attainment (2012)

Educational attainment	Female	Male
Have not yet been to school	8.3	3.45
Have not yet completed primary school	14.79	13.01
Primary School	28.26	27.92
Junior Secondary School	20.68	21.32
Senior Secondary School	21.02	26.93
Higher Education	6.95	7.37

Source: BPS RI – National Socio-Economy Survey, 2012 in CBS. Profil Perempuan Indonesia, 2013

Table 2. Infant mortality rate among ASEAN countries (deaths per 1,000 alive)

HDI rank	Country	HDR 2014	HDR 2013	Asia-Pacific HDR 2012			
		Infant	Infant	Infant			
				Female		Male	
		2012	2010	2000	2009	2000	2009
Very High Human Development							
9	Singapore	2	2	2	2	3	3
30	Brunei Darussalam	7	6	6	5	6	6
High Human Development							
62	Malaysia	7	5	8	5	10	6
89	Thailand	11	11	15	10	19	13
Medium Human Development							
108	Indonesia	26	27	35	37	43	33
117	Philippines	24	23	26	23	32	29
121	Viet Nam	18	19	24	20	23	19
136	Cambodia	34	43	71	61	88	75
139	Lao People's Democratic Republic	54	42	55	40	71	52
Low Human Development							
150	Myanmar	41	50	54	47	70	61

Source: UNDP Human Development Report (HDR), 2012, 2013 and 2014

Table 3. Maternal mortality ratio (deaths of women per 100,000 live births) among ASEAN countries

HDI Rank	Country	1990	2000	2005	2008	2010
9	Singapore	6	15	9	9	3
30	Brunei Darussalam	29	24	25	21	24
62	Malaysia	53	39	34	31	29
89	Thailand	54	66	54	48	48
108	Indonesia	600	340	270	240	220
117	Philippines	170	120	110	94	99
121	Viet Nam	240	100	74	56	59
136	Cambodia	830	510	340	290	250
139	Lao People's Democratic Republic	1,6	870	650	580	470
150	Myanmar	520	300	230	240	200

Source: UNDP Human Development Report (HDR), 2011, 2013 and 2014

System of 9 years of compulsory primary education initiated in 1994, where parents are encouraged to send their children to school, both girls and boys,

to complete Junior High School at least.

Indonesia also ratified several ILO conventions concerning freedom for union and protection for

the right to organize, abolishment of Forced Labor, equal pay for men and women for equal value of work, and equal remuneration. Ratification of various conventions as an effort to protect human rights in Indonesia also exist as the commitment of government in fulfillment of human rights, women's rights and children's rights. However, even though Indonesia has committed itself to several international legal instruments through the ratification of conventions, there remains a gap between policy and implementation.

In 2000, a Presidential Instruction Number 9 on Gender Mainstreaming in National Development was issued and instructed to all government departments and non-departments agencies as well as provincial and district governments to implement gender mainstreaming in planning, implementation, monitoring and evaluation of all development policies and programs. Consequently, all steps of development should be gender responsive, i.e. planning, organizing, implementing, monitoring and evaluating, in national development policies and national development programs. Since then, gender working groups were built in every government ministry and institution.

In 2008, the Ministry of Home Affairs Regulation no. 15 Year 2008 on Guidelines for Implementation Mainstreaming Gender in the region (especially for local government and local development) was issued. Since 2009, through the Ministry of Finance Regulations, gender responsive budgeting has been implemented, particularly at ministerial level. Gender responsive budgeting is needs to be supported by gender-impact assessments and implemented by the Ministries in cooperation with national research institutes and universities.

Participation of women in parliament and political parties as well as representation in decision making institutions have been issued. Law No. 10/2008 stipulates that there must be at least 30 percent representation of women in Parliament and that each party must have 30 percent of female candidates.

However, the ratio of women participation has not been reached yet, and it does not immediately change the male-dominated and patriarchic political systems of Indonesia.

To enhance the role of women in national development, the Indonesian government demonstrated its commitment to the advancement of women through the creation of a national mechanism. The State Ministry for the Empowerment of Women was built in 1978 to improve the status of women in the family and society, as well as the participation of women in development. It has become today's State Ministry of Women's Empowerment and Child Protection (SMWC). Through the support of SMWC, Women's Study Centers and Gender's Study Center were established, and have grown in both public and private universities. By 2005, there were more than 132 Women's and Gender's Study Centers in Indonesia, who conduct research, advocacy, and training on gender related areas (Kementerian Koordinator Bidang Kesejahteraan Rakyat Republik Indonesia, 2008). To support the implementation of gender mainstreaming in S&T, a gender working group was built in all S&T institutions, including at the Ministry of Research and Technology and Indonesian Institutes of Sciences.

2. Approach of the Study

The approach of the study involves scanning of national and international reports and documents related to women and gender in science and technology in Indonesia. Data were collected mostly up to five years from 2010-2014, however, not all data are available for every year. Sources of information and data for this study came from several institutions, among others are: government offices, including Board of Centre for Statistics, ministries and non-ministerial institutions, UNDP, and internet websites. Interview with gender experts were also done to enrich the findings from the secondary data.

Table 4. Number of new students at university level by sex and type of program

Type of Program	2006/2007	2007/2008	2008/2009	2009/2010	2011/2012*	2012/2013*
Diploma						
Total	143,479	191,833	161,485	173,875	148,512	147,204
% Female	53.61	53.50	56.56	54.19	56.26	57.14
Graduate						
Total	555,923	838,187	778,992	786,777	879,159	932,461
% Female	48.52	48.72	50.74	51.34	47.04	49.62
Master's and doctoral						
Total	40,309	54,150	50,209	59,126	115,164	65,971
% Female	45.23	46.03	45.51	45.23	50.28	47.18

Source: Ministry of National Education, Statistics at Higher Education, 2000-2011

*Ministry of Education and Culture. 2014. Indonesia Educational Statistics in Brief, 2011/2012–2012/2013

3. Gender Data on Science and Technology

Where are women and men in science and technology (S&T) in Indonesia right now? Are women acquiring S&T education, obtaining jobs and achieving promotion at a rate equivalent to that of men? Data and information needed to answer those questions are scarce, fragmented and not easy to evaluate. Available data taken from various institutions shows that in general, Indonesia has made much effort in minimizing the gender gap in S&T, although the under-representation of women in S&T remains obscured in the absence of comprehensive and accurate national data. The following description will be an overview of the current state concerning gender in S&T higher education, research and development institutions, and S&T policy makers.

3.1 Gender in Higher Education of S&T

The number of female and male new students who are enrolled in universities is increasing every year. However, the higher level of education, the smaller the proportion women enrolled compare to men. Percentage of women with diplomas (completed three years at higher educational programs) are higher than men, whereas they are fewer at graduate level (completed four years at university level) than men. In master's and doctoral programs women are still

under-represented compared to men (Table 4).

In general, number of female registered students are almost equal to that men counterpart. Yet, the number of women is less than men in studying science and engineering at the university level. Number of women who were enrolled at higher education is lower than men, particularly in engineering (Tables 5 and 6). This phenomena is still prevalent now and requires further research on the main reasons why women are fewer than men in these subjects. JICA (2011) identified that most of the students tend to take courses in accordance with gender roles; for example, girls tend to choose social sciences and boys tend to choose technical sciences (JICA, 2011). In a similar pattern to enrolled students, number of women who graduate from diploma were higher than men, but women who graduate at higher level (graduate, master's and doctoral degree) were lower than men (Table 7). The higher level of education, the less proportion of women graduated from higher education compare to men.

Number of women lecturers in 2014 was only 41.53 percent (72,805 lecturers) from the total number of lecturers at public and private universities. Similar situation also exist for data on professorship at higher education. Women who hold professorship

at higher education are also very few. The total number of women who hold professorship in 2012 were only 787 as compared to total of 3610 men, or only 17.9% of all professors (Pappiptek-LIPI, 2013).

Beside students, lecturers and professors, there are also technicians and administration staff who work at higher educational institutions. In 2012,

number of female technicians who work at higher educational institutions were about 1,179 compared to about 3,039 men (Pappiptek LIPI, 2013). Similar situations also exist for data on administration staff, where number of women as administration staffs less than men. Women account for about 4,227 compared to about 7,251 men.

Table 5. Number of registered students by program and sex

Sex	2011/2012			2012/2013		
	Diploma	S1	S2/S3/Post-PhD	Diploma	S1	S2/S3/Post-PhD
Male	475,871	2,144,442	168,644	343,550	2,298,432	158,316
Female	661,157	1,997,219	169,337	507,008	2,378,298	136,539
% of F	58.15	48.22	50.10	59.61	50.85	46.31
Total	1,137,028	4,141,661	337,981	850,558	4,676,730	294,855

Note: S1, S2 and S3 refer to undergraduate, master's and doctoral programs, respectively.

Source: Indonesia Educational Statistic in Brief 2011/2012, 2012/2013

Table 6. Percentage of female enrolled at university level by subject

Subject of Study	2001/2002		2002/2003		2003/2004		2008/2009	
	Total	% of F						
Math and Natural Sciences	88,728	50.18	92,455	43.3	312,905	56.2	86,912	65.62
Engineering and Technology	126,059	21.52	420,966	27.3	596,982	30.6	665,787	27.41
Agricultural Sciences	191,524	40.92	152,115	46.4	176,197	46.4	119,460	39.02
Medical Sciences	64,260	60	74,418	50.4	97,514	52.6	340,588	76.75

Source: Statistics for Higher Education, Ministry of National Education 2000-2004; Perspektif perguruan tinggi di Indonesia tahun 2009, Ministry of National Education, 2010.

Table 7. Number of graduates from university level by sex and type of program

Type of Program	2007/2008	2008/2009	2009/2010	2011/2012*	2012/2013*
Diploma	61,218	150,216	174,967	204,355	97,597
% of Female	54.63	56.99	65.08	58.50	56.98
Graduate	212,521	458,083	434,551	485,559	665,384
% of Female	45.95	46.90	54.55	49.82	49.15
Master's	17,059	40,082	43,729	48,346**	44,335**
% of Female	44.22	44.36	43.04	42.31	47.33
Doctoral	1,687	3,983	1,765	N/A	N/A
% of Female	39.12	39.26	29.12	N/A	N/A

N/A: Not Available

Source: Ministry of National Education, Statistics at Higher Education, 2000-2011

*Ministry of Education and Culture. 2012. Indonesia Educational Statistics in Brief 2011/2012 and 2012/2013

**Includes number of master's and doctoral graduates.

3.2 Gender in S&T Employment

3.2.1 Participation of Men and Women at R&D Institutions

Data as of September 2014 on researchers working at public R&D institutions shows that total number of women researchers were lower than men in all levels of researcher's leadership (Table 8). Based on the level of education, the majority both of male and female researchers at senior and middle

leadership positions have master's degrees.

Total number of female researchers has been increasing from 2004 to 2014. At the same time, the number of male researchers has decreased (Table 9). This phenomenon shows that more women were attracted to work as researchers in public R&D institutions. Further research needs to be conducted in these particular areas.

Table 8. Researchers (aged 25-65) working in public R&D institutions based on sex, education, and leadership (2014)

Education	Researchers				Grand Total
	Senior	Middle	Young	Beginner	
Men	752	1,734	1,463	1,475	5,424
Diploma 2	1	1			2
Diploma 3	1	7	3	2	13
Diploma 4	1	2	6	15	24
Undergraduate	109	563	503	1,068	2,243
Master's	307	813	839	375	2,334
Doctoral	333	348	112	15	808
Women	250	899	1,145	1,200	3,494
Diploma 2	1	1			2
Diploma 3	N/A	4	1	1	6
Diploma 4	N/A	1	5	8	14
Undergraduate	55	313	346	896	1,610
Master's	106	428	720	292	1,546
Doctoral	88	152	73	3	316
Total	1,002	2,633	2,608	2,675	8,918

Source: Pusbindiklat Peneliti LIPI, September 2014

Table 9. Number of male and female researchers in government R&D institutions in Indonesia based on educational attainment

Education	2005		2006		2010		2014*	
	Female	Male	Female	Male	Female	Male	Female	Male
Doctor	251	1,147	296	1,057	274	900	316	808
Master's	1,182	2,511	1,298	2,727	1,329	2,185	1,546	2,334
Undergraduate	1,668	4,382	1,749	3,987	1,798	2,981	1,632	2,282
Total	3,101	8,040	3,343	7,771	3,401	6,066	3,494	5,424

Source: Survey Report of Government R&D 2004, 2005, 2006 Ministry of Research and Technology (MORT) and *Pusbindiklat LIPI, September 2014

The data are also classified by fields of study and leadership levels of researchers. Based on fields of study, the majority of male (1,649) and female (1,135) researchers come from agriculture, environment and veterinary backgrounds, or 30.58% of women and 32.48% of men have this background. The second biggest group of researchers have engineering and technology backgrounds, with men numbering about 957 (17.64%) and women about 372 (10.64%). The smallest number has studied art, with only 5 men, and 1 woman.

Since 2005 the Indonesian Institute of Sciences also promoted research professorships for their senior researchers. Data taken from the Center for Researcher Development, Education and Training at Indonesian Institute of Sciences shows that until September 2014, there were about 206 research professors, with 34 female and 172 male research professors.

A survey performed by Ministry of Research and Technology (2012) noted that technicians and other supporting staff at public R&D institutions were also included in the data on human resources. There were only 794 women technicians as compared to 2,978 men technicians. A similar situation was also found for other supporting staffs, with the number of women (1,635) smaller than men (3,756).

3.2.2 Participation of Men and Women in Manufacturing Industries

The only data available for this sector is in 2010. The data are classified based on working category or occupation, namely administration (19.86%), researchers (49.38%), and technicians (30.76%). The number of women as researchers and technicians is smaller than men. Women tend to be more involved in administration work as shown in Table 10.

Table 10. Involvement of men and women in the manufacturing industry based on job categories. 2010

Job Category	Total*	As a percentage of total R&D employment*	As a percentage of each occupation by sex*
Administration	1,790	19.86%	100.00%
Male	586		32.74%
Female	1,204		67.26%
Researchers	4,450	49.38%	100.00%
Male	2,977		66.90%
Female	1,473		33.10%
Technicians	2,771	30.76%	100.00%
Male	1,964		70.86%
Female	808		29.14%
Grand Total	9,011	100%	

Source: Survei Litbang Industri Manufaktur 2011, Pappiptek LIPI
Note: *estimated values

Table 11. Representation of men and women at the House of Representatives in Indonesia

Period	Women		Men		Total Number of Members of Parliament
	%	Total Women	%	Total Men	
1971 - 1977	7.8	36	92.2	424	460
1977 - 1982	6.3	29	93.7	431	460
1982 - 1987	8.5	39	91.5	421	460
1987 - 1992	13.0	65	87	435	500
1992 - 1997	13.0	65	87	435	500
1997 - 1999	10.8	54	89.2	446	500
1999 - 2004	9.0	45	91.0	455	500
2004 - 2009	11.27	62	89.3	488	550
2009 - 2014	18	101	82	459	560
2014 - 2019	17.32	97	86.3	463	560

Source: DPR RI Sekretariat 2011, 2014

3.2.3 Participation of Men and Women in S&T Policy

(a) Parliament (Legislative Body)

Available data on gender in S&T policy structures shows the under-representation of women in parliament, ministries and other institutions. Representation of Women in the Parliament from different period can be seen in Table 11.

Women's representatives in parliament tend to hold posts that are traditionally seen as 'soft' (i.e. relating to women's issues) so that the distribution of female members in the commissions of the national

legislature reflects traditional patterns for dividing responsibilities between men and women (Hermawati and Saari, 2010). Table 12 shows women's representation is relatively low in 'priority' commissions which deal with economics, poverty and politics, which are significant in determining executive programs and budgets. The proportion of women in commission on research and technology (commission seven) is increasing but is still low, at only 13% of commission seven.

Table 12. Percentage of members of Commissions of the Indonesian Parliament by gender (2009-2014 and 2014-2019)

Commission	2009-2014		2014-2019	
	Female	Male	Female	Male
1. Defence, International Affairs, and Information	15.56	84.44	14.28	85.72
2. Home Affairs, Regional Autonomy, Bureaucracy and Land Affairs	25.45	74.55	10.41	89.59
3. Constitution and Law, Human Rights, and Security	7.27	92.73	11.32	88.68
4. Agriculture, Estate, Forestry, Sea Resources, Fishery, and Food	10.91	89.09	13.72	86.28
5. Transportation, Telecommunications, Public Works, Housing, Village Development, and Less Developed Region	10.91	89.09	18.51	81.49
6. Trade, Industry, Investment, Cooperatives, Small and Medium-Scale Enterprises, and Public Enterprises	12.00	88.00	18.75	81.25
7. Energy, Mineral Resources, Research and Technology, and Environment	9.09	90.91	13.00	87.00
8. Religion, Social, and Women Empowerment	22.92	77.08	19.56	80.44
9. Population, Health, Manpower, and Transmigration	42.55	57.45	34.69	63.31
10. Education, Youth, Sports, Tourism, Arts, and Culture	26.00	74.00	23.52	76.48
11. Finance, National Development Planning, Banking, and Non-bank Institutions	20.00	80.00	12.76	87.24
Total number of people	101	459	97	463

Source: DPR RI Secretariat 2011, 2014.

Other data on men and women representation in Parliament for the period of 2014-2019 also shows that there are only 7 women in budget committee compared to 87 men. In the legislation committee, there are 7 women only and 43 men. The number of women in the household committee is 11 and the number of men is 42. The ethics committee only consists of 11 men. Committee for inter-parliamentary cooperation consist of 36 men and 14 women.

The above data shows that affirmative actions are needed in the parliament, in order to fulfill “the politics of presence”. Further strategies to enhance the representation of women in Parliament among others are increasing the representation of women in political parties.

(b) Ministers and Vice Ministers (Executives Bodies)

The total number of cabinet members (Ministry Offices) in 2014 was 34. Female ministers among those number is 8 (23.53%), and in fact it is the

highest number of female ministers compared to other government regimes. Ministries which are now led by women include Ministry of Foreign Affairs, Maritime and Fisheries, Environment and Forestry, Health, Social Affairs, Women’s Empowerment and Child Protection, State Own Industry, and Coordinator Minister for Human Resources Development and Culture. Figure 2 and Table 13 shows the increasing trend of female ministers from several periods.

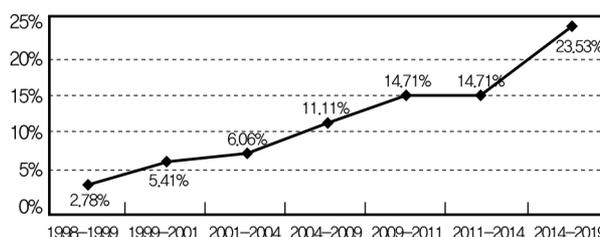


Figure 2. Percentage of female ministers since 1998 in Indonesia
Source: Data processed from President Office and CBS 2011 and DPR 2014

Table 13. Share of female ministers in Indonesia

	1998-1999	1999-2001	2001-2004	2004-2009	2009-2011	2011-2014	2014-2019
Total ministers	36	37	33	36	34	34	34
Women	1	2	2	4	5	5	8
%	2.78	5.41	6.06	11.11	14.71	14.71	23.53

Sources: Data processed from President’s Office and CBS 2011

Table 14. Number of decision-makers in government offices based on rank and gender

Rank	2010		2011		2012		2013		2014	
	M	F	M	F	M	F	M	F	M	F
1st Echelon	528	49	415	109	510	103	502	127	456	123
2nd Echelon	1,866	266	1,721	491	1,744	448	2,355	676	2,390	757
3rd Echelon	8,809	1,950	3,236	1,049	5,606	1,739	7,674	2,375	8,146	2,669
4th Echelon	28,933	8,023	6,015	2,588	13,176	5,360	22,085	8,765	24,698	10,323
5th Echelon	6,842	2,153	275	62	1,470	381	3,316	972	4,796	1,377
Total	9,396	2,488	2,332	860	4,501	1,606	7,186	2,583	8,097	3,050
%	79.06	20.94	73.07	26.93	73.70	26.30	73.56	26.44	72.64	27.36

Sources: BKN, 2015

Available data on the number of female decision-makers at ministries and non-ministerial agencies tend to increase every year as shown in Table 14. Number of women and men at all echelons in 2014 almost doubled from 2012.

(c) National Research Council

The under-representation of women also exists at eight committees in the National Research Council (NRC). The total number of members of NRC for the period 2012-2014 was 55 persons with the composition of 7 women and 48 men. The following table shows that female members mostly engaged in social and humanities and health committees.

Table 15. Members of Committee at the National Research Council (2012-2014)

Technical Committee	Female	Male
1. Food and Agriculture	1	6
2. Energy	0	7
3. Information and Communication Technology	1	6
4. Transportation Technology	0	7
5. Defence Technology	0	7
6. Health and Medicines	2	5
7. New Materials	0	7
8. Social Humanities	3	3

Source: DRN, 2012 (SK Menteri Ristek No 72/M/Kp/I/2012)

4. Gender Differential Impacts of Technology

For whom has science and technology advanced so far? There are many lessons from all over the world, both developed and developing countries, that systematic ignorance still exists where the interest of social groups such as women are excluded from the decision-making process addressing problems that need scientific and technological attention (Khennas, 2000; Mahat, 2004; UNESCO, 2002).

Two case studies are presented as examples of S&T benefits to the communities, particularly to women in Indonesia. They are renewable energy projects and appropriate technology in rural areas. Description of the projects as well as its benefits to women are as follows.

4.1 The Case of Renewable Energy Project

About 28 million families in Indonesia use charcoal, firewood and other biomass for cooking, and about 20% of households or about 50 million people are un-electrified, particularly those who live in rural and remote areas. People who live in these areas mostly burn firewood or charcoal for cooking energy and use traditional stoves for cooking activities. There have been many studies conducted by universities, government as well as non-governmental organizations regarding the use of traditional stoves. Traditional stoves cause a number of health hazards especially to women and children. Some of the health problems faced by women based on the studies are related to the effects of smoke, heat and wood collection. Some health problems are: acute respiratory diseases and cataracts caused by smoke, cough, burns, reduced fertility, allergic reactions, fungal infections, malaria, snake bites, severe fatigue, backache, and miscarriage, etc. (Energia, 2007).

Due to the danger of wood fires and traditional stoves, several organizations have introduced renewable energy programs for rural communities, particularly for poor women. Previous studies shows that there are three programs and projects related to renewable energy, namely Improved Cook Stoves (ICS), solar cooking technology, and micro-hydro projects for rural electricity and women's economic empowerment (Hermawati, 2012; Hermawati, 2013; Utami, 2013). Those projects were introduced to solve the problems mostly faced by women as well as aimed at empowering women and reducing the time needed for cooking and collection of firewood.

Solar cooking technology was introduced by the

Technical Implementation Unit, Energy Laboratory of the Agency for the Assessment and Application of Technology (BPPT) in 1995. More than 1,000 participants, men and women, joined the training of making and using the solar oven. About 497 solar ovens have been made and disseminated to the participants in 37 regencies of Indonesia. In some villages, the solar oven has not yet achieved the success rate at the commercial stage as well as the implementation stage, due to some technological problems and its high dependency on solar energy. But in some villages, particularly in barren areas, solar ovens are more appropriate and they are used for daily cooking (Hermawati, W. 2012).

The Improved Cook Stoves (ICS) program began in 1986, introduced by Dian Desa Foundation (YDD), located in Yogyakarta. Since then the ICS has been implemented not only within households but also at small and medium scale industries in more than 10 provinces in Indonesia. The ICS not only provides improved stoves which can reduce fuel consumption up to 50 percent but also reduces health problems caused by heat and smoke. One of the improved cook stoves with a chimney has been used by Palm Sugar Industries since 1986. Women, as the main users of the stove, are also involved in maintaining the stove as well as making new designs of the stoves. YDD has been incorporating women's needs in the stove training and technical development programs. Along with the implementation of the ICS, the kitchen improvement training was also introduced to rural community. At present, YDD has declared as an accreditation body for ICS. It is also found now days that ICS programs more sensitive toward women's concerns and there is a tendency for more and more households to use ICSs for their daily cooking activities (Utami, 2013; Hermawati, 2012).

The project was considered as one of the best practices due to its multiple benefits for households, particularly for women. The major positive impacts

were related to the improvement of women's health, reduction of environmental problems and increase in the productivity of the industry. Other contributing factors to the success of the project were that the project used a participatory approach in implementing their activities. Therefore, men and women were invited to make their own improved cook stove by themselves. YDD only provided technical assistance. Innovation of the ICS is in putting two holes with high chimney at the end of the stove, this allow smoke to get out from the chimney, and made the kitchen smoke-free and clean. The ICS was made from local, freely available materials; mud and clay, sometimes combined with bamboo or rice straw for greater strength. The ICS has two holes for two pans. The stoves were built by incorporating user ideas. It is therefore, the performance of the stove deals with efficiency, evaporation time, specific consumption of wood and power output. Therefore the main advantages of using the improved cook stoves are; reduced fuel consumption up to 50 percent, thus reducing time for collecting firewood, reduced health problems due to exposure to heat and smoke as well as other risks caused by firewood collection activities. ICS projects greatly benefitted women in terms of activities at home or in the industry.

Another example is the Micro-hydro Project at Gunung Sawur Village in Lumajang District. Gunung Sawur Micro-hydro Electric Project was identified as the other best practices in the field of renewable energy. The village of Gunung Sawur located under the Mount Rinjani in Lumajang District, East Jawa Province. It has about 200 households and until 1990, Gunung Sawur has no electricity.

The project was selected as one of the best practices since it aimed at reducing the workload of women living in remote areas by providing affordable electricity for households and micro enterprises (generated from micro hydroplants). It also sought to lift women's status by undertaking educational

program, adult literacy classes, skill-enhancing training programs, and micro-credit. Compared to other rural communities in East Jawa, until 1993, Gunung Sawur has no electricity. Majority of the people today are working in agriculture and animal husbandry. In 1993, with the help of Mr. Sucipto (a local engineer graduated from Brawijaya University), a micro-hydro project (120 kWh) was implemented with the self-funding from the community. The development of micro-hydro also involved the community—both men and women. They incorporated women's needs in the design of electrical hubs and lighting in the house. The price of the electricity was cheaper compared to the price of electricity from the state company (Hermawati, W., 2013).

After the project was run and all households had electricity, it showed that to a great extent, the society, including men, women, and children gained benefit from the project. The greatest benefit from the project was in the form of improvement of their status in society, their welfare, good environment and good relationship among communities in the village, particularly in managing the micro-hydro project. There has been an intensive and good relation among local leaders, young generations, and religious leaders as well as other community in the village. At present, the micro-hydro project is managed by two women and three men.

4.2 The Case of Appropriate Technology in the Rural Areas

The application of technology in the rural areas brings many changes to the society including women. The Appropriate Technology Development Center, Indonesian Institute of Sciences (P2TTG-LIPI) has been implementing appropriate technology programs in more than 10 provinces in Indonesia since 1985. The technology is more focussed on empowering society, men and women, in rural areas, particularly for men and women who have small or

micro-enterprises and located in villages below the poverty line. The biggest funding for these projects come from government. Type of technology introduced to the community mostly related to income generating activities, improvement of environmental quality, and enhancement of household's welfare. Activities in introducing appropriate technology include Innovation in Home Gardening, Post Harvest and Food Processing activities, Skill Training (sewing, cooking, carpentry, etc), home hygiene, environmental protection, drainage and sanitation, and small business management practices.

Although there are no special programs for women, women participation in skills training and technology implementation tend to stereotype activities, such as cooking and sewing. Women's empowerment of these programs have not been considering equal gender division of labour in the existing socio-cultural environment and monitor and evaluate with gender perspectives. The process of implementing appropriate technology into rural people's daily life is as follows:

- Feasibility study with a gender perspective in all steps including identification of technology needed and potential of raw materials to become an added value products
- Formulation of task force consisting of researchers, potential users and tutors
- Training and workshops for members of the group, mainly on (1) awareness of the advantages of technology in improving their life, (2) building skills in the use of selected technologies, and (3) providing information related to technology, funding, and networking
- Operational activities with guidance from the institution (P2TTG-LIPI)
- Gender responsive monitoring and evaluation

Intensive assistance is given to the recipient of

appropriate technology for the first of six months of the operational stage. Almost all subjects during the training will be implemented in this step. There are minimum of 3 men and 3 women as the instructor of the program for each village.

Results of the technology application show that women with appropriate technology skill training background can easily increase their income. Their productive hours are also increase to about 3-4 hours per day. However, in many village areas, the household activities which amount to about 5-6 hours are still considered as women's job, such as cleaning the house, cooking, washing, and taking care of the children (Hermawati, W. 2012). The question that has never been answered is "whether such kind of project is empowering women or just increasing women's burden or workload instead", although many women have said that they have more self-confidence and better communication capability after attending the training and workshops on appropriate technologies held by P2TTG-LIPI.

5. Discussion: Implications and Challenges

The status of Indonesian women and men in S&T is very much affected by the circumstances of their education, employment, technology infrastructure, and the socio-cultural aspects of the country. Education, including non-formal education is one of the key factors for empowering people, particularly women with knowledge, skills and self-actualization. These capabilities will enable women to participate as equal partners with men and be fully integrated in all field of development process including in S&T activities.

Opportunities to enter higher education in the science and technology field is open for competition. However, engineering and technology may not be attracting as many highly qualified female students as other professions, especially among female high

school graduates. In comparison, more female enrolled in math and natural sciences and medical science. Data on universities graduates shows that the number of women graduating from universities is almost in balance with men. However, support for women to enter higher education, such as graduate, master's and doctoral programs is still needed. For example, overseas training and study for master degree limits participants' age to 35, which is a major obstacle for women who plan to pursue graduate studies abroad. It is a hard decision to leave small children behind for the duration of study which usually takes a minimum of two years. Meanwhile, more women were attracted to work as researchers in public R&D institutions, but most of them have little background in natural sciences and engineering. The majority of women have agriculture, environment and veterinary backgrounds.

It is generally accepted that in the industrial sectors, many innovation have been made by women, such as in the field of herbal medicine, cosmetics, food processing and batik design (for clothing and home decorations). So far, research activities are conducted at public R&D institutions, where substantial research facilities mostly exist in the ministerial and non-ministerial agencies and public universities. Research activities in the private sectors are limited to a very few cases. Therefore, collaboration among government R&D institutions, universities and private sectors should be carried out in more effective ways. This strategy will open wide opportunities for women scientists and engineers to pursue their innovations in S&T.

Besides the advancement of women in S&T, there are also challenges faced by women who wish to enter the field of S&T. Among others are family responsibility. Many women with babies and small children difficult to leave the house without other people who will take care of their children, usually their family or nannies. Only a few offices have daycare units, and the cost is still relatively high

compare to their monthly income.

At this moment, a strong legal basis for women's empowerment as equal partner of men to act as agents of change in S&T development is in place, but considerable effort is urgently needed to transform the legal basis into reality in daily life.

Several impediments of women to enter S&T mostly relate to (1) the traditional culture, values including gender stereotyped attitudes, that do not support the participation of women and girls in S&T; (2) poor economic conditions, especially those who live in rural areas; (3) lack of gender responsive environment and policies that limits provision of women in S&T careers; and (4) lack of sex disaggregated data and statistics, making it impossible to adequately gain insight of key issues for women and gender in S&T, although the Indonesian policies and initiatives to stimulate women's entry in the S&T arenas are in place.

In general, women's empowerment programs, projects, services in S&T have not yet been incorporated into the agenda of many institutions.

The under-representation of women in the S&T decision making positions such as at ministerial and non-ministerial agencies, National Research Council, and Parliament, will lead to lack of women and gender perspectives among decision-makers and will have a direct impact on public policy that consequently neglects women's concern and needs (Hermawati, 2002). The scarcity of gender related data also has made ineffective policy implementation. At present, many of the development planners and policy makers still consider gender gaps as being a 'natural' phenomena and not a serious challenge to national development. Therefore, many of the programs and projects formulated by the government institutions still lack gender perspective.

6. Conclusions

In summary, although women are making some

progress in scientific and technological education and careers in Indonesia, but there is a long way to go before their education and career expectation can equal their male colleagues. Therefore a study on the role of women and men in S&T activities can be expanded by encouraging the development of gender indicators in S&T in government, private sectors, and universities, so that decision-makers can make appropriate decisions for their target. Further strategy to strengthen S&T national capacity across the nation is to integrate gender concerns into the design, implementation and evaluation of S&T policies, programs, and activities.

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