



Gender-based assessment of Science, Technology and Innovation ecosystem in Ethiopia

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ABSTRACT

The development of a country is primarily based on the progress made in science, technology and innovation (STI), and the equitable contribution of both men and women in the STI ecosystem. However, there is a big gender gap in the ecosystem as the participation of women is very low in science, technology, engineering and mathematics fields. This study assessed the gender dimension of science, technology and innovation eco-system in Ethiopia. Both primary and secondary sources of data were used. The primary data were collected from key informants, and reports of various UN agencies, Ministry of Education (Ethiopia), Ministry of Science and Higher education (Ethiopia) and journal articles were among the major secondary sources reviewed. The study found out that the participation of women in the STI ecosystem was low in Ethiopia. Undergraduate female students who were studying science and technology (Engineering and technology; natural and computational sciences; medicine and health science; and agricultural and life sciences) comprised 31%, 29.4%, 30.7%, 31.4% and 34.4% of the student population in 2014/15, 2015/16, 2016/17, 2017/18 and 2018/19, respectively. In 2014/15, 2015/16, 2016/17, 2017/18 and 2018/19, the percentage of postgraduate female students in science and technology were 30.8%, 19%, 14.7%, 15% and 15.6%, respectively. Among the academic staff of higher education institutions on duty in 2017/18 academic year 19.3%, 11.2% and 6.9% of the women were holders of first, masters/speciality and PhD/ sub-speciality degrees in science and technology fields of study, respectively. The participation of women in research and industry that requires higher skills were also very low. The low level of women's participation in STI ecosystem was attributed to various challenges such as lack of academic preparation for science, technology, engineering and mathematics (STEM) fields, attitude toward science fields (stereotype that science is for men), lack of women's self-confidence, lack of women role model scientists, lack of adequate support from higher education institutions and gender disparity in employment. Therefore the collaborative effort of the STI stakeholders especially ministries of education, science and higher education, technology and innovation, schools and higher education institutions is essential to implement policies and strategies of the country related to gender equality. Moreover, the international and regional cooperation has to be strengthened in order to secure funding for women's education and research in science and technology.

Key words: Gender; Ethiopia Higher Education; Science, Technology, Engineering, Mathematics

RÉSUMÉ

Le développement d'un pays repose principalement sur les progrès réalisés dans le domaine de la science, de la technologie et de l'innovation (STI), et sur la contribution

équitable des hommes et des femmes dans l'écosystème des STI. Cependant, il existe un écart important entre les sexes dans l'écosystème, car la participation des femmes est très faible dans les domaines des sciences, de la technologie, de l'ingénierie et des mathématiques. Cette étude a évalué la dimension de genre de l'écosystème scientifique, technologique et d'innovation en Éthiopie. Des sources de données primaires et secondaires ont été utilisées. Les données primaires ont été recueillies auprès d'informateurs clés, et les rapports de diverses agences des Nations Unies, du ministère de l'Éducation (Éthiopie), du ministère de la Science et de l'Enseignement supérieur (Éthiopie) et des articles de revues ont été parmi les principales sources secondaires examinées. L'étude a révélé que la participation des femmes à l'écosystème STI était faible en Éthiopie. Les étudiantes de premier cycle qui étudiaient les sciences et la technologie (génie et technologie; sciences naturelles et informatiques; médecine et sciences de la santé; et sciences agricoles et sciences de la vie) représentaient 31%, 29,4%, 30,7%, 31,4% et 34,4% en 2014/15, 2015/16, 2016/17, 2017/18 et 2018/19, respectivement. En 2014/15, 2015/16, 2016/17, 2017/18 et 2018/19, le pourcentage d'étudiantes de troisième cycle en sciences et technologie était de 30,8%, 19%, 14,7%, 15% et 15,6%, respectivement. Parmi le personnel académique des établissements d'enseignement supérieur en service au cours de l'année académique 2017/18, 19,3%, 11,2% et 6,9% des femmes étaient titulaires de diplômes de premier, de maîtrise / spécialité et de doctorat / sous-spécialité dans les domaines d'études scientifiques et technologiques, respectivement. La participation des femmes à la recherche et à l'industrie qui nécessitent des compétences plus élevées était également très faible. Le faible niveau de participation des femmes à l'écosystème des STI a été attribué à divers défis tels que le manque de préparation académique pour les domaines des sciences, de la technologie, de l'ingénierie et des mathématiques (STEM), l'attitude envers les domaines scientifiques (stéréotype selon lequel la science est pour les hommes), le manque de soi des femmes. confiance, manque de femmes scientifiques modèles, manque de soutien adéquat des établissements d'enseignement supérieur et disparité entre les sexes dans l'emploi. Par conséquent, l'effort de collaboration des acteurs de la STI, en particulier les ministères de l'éducation, des sciences et de l'enseignement supérieur, de la technologie et de l'innovation, des écoles et des établissements d'enseignement supérieur, est essentiel pour mettre en œuvre les politiques et stratégies du pays liées à l'égalité des sexes. En outre, la coopération internationale et régionale doit être renforcée afin d'assurer le financement de l'éducation des femmes et de la recherche scientifique et technologique.

Mots clés: sexe; Enseignement supérieur éthiopien; Science, technologie, ingénierie, mathématiques

INTRODUCTION

Science, technology and innovations (STI) are important contributors to sustainable development. UN Secretary Report (2013) indicated that 'STI has been proved to be an important prerequisite for the social and economic transformations that enable sustainable economic growth, human development and poverty eradication'. The successful implementation of Sustainable Development Goals (SDG) will also be realized with the support of STI. Studies that have documented the contribution of STI-based

strategies to economic and social development (Giovannini *et al.*, 2015; UN, 2019), indicated that countries that employed and promoted STI have exhibited more economic development (Bokova, 2012; Ihueze *et al.*, 2015). Hence, because of the crucial role of STI, the African Union has taken it as part of its development strategy Agenda 2063 (Bobadoye, 2015).

In sub-Saharan African countries like Ethiopia, technology and innovation has played a significant role in improving the livelihood of their citizens. Science, technology and

innovation has improved the health and the working and living condition of people, and it also contributes to increase their income and amount of leisure time (Amha and Mekuriaw, 2008). Above all, in a country where food insecurity prevails and is impacted by climate change, the need for science, technology and innovation is enormous.

The first half of the 20th century is considered as the beginning of application of modern science and technology in Ethiopia, along with the establishment of higher education institutions (Amha and Mekuriaw, 2008). Ethiopia established the Ministry of Science and Technology for the first time in 1975 as a commission and currently it has been renamed as Ministry of Innovation and Technology (MoIT). The Ministry was established with the aim of providing study-based recommendations to the Government of Ethiopia for adopting and revising policies, strategies, laws and directives for the development of STI that support the realization of the country's development objectives (Tesfa, 2015). The country applies STI as an instrument to achieve the long-term vision of the country to be among the middle-income countries (MoE, 2015).

One of the cross cutting issues in STI ecosystem is gender. In a country where gender inequality prevails, ensuring gender equality in all spheres of life is the corner stone for sustainable development. More importantly, ensuring gender equality in STI plays a crucial role in meeting the needs of the country through the contribution made by women. Despite this fact, gender imbalance exists in many fields particularly in higher education institutions in Ethiopia. Though various measures have been taken to redress the gender inequality by enhancing the participation of female students and instructors in higher education institutions in science, technology, engineering and mathematics (STEM), the result obtained has not been satisfactory as only few women are involved in such fields of study. Thus, this study assessed the status of women in STI ecosystem and explored the gender-based capacity gaps,

challenges and opportunities to participate in STI in Ethiopia.

METHODOLOGY

Both qualitative and quantitative data were used for the assessment. It was done with the data obtained from literature and primary data collected from key informants. The literature essential for this paper were accessed from different sources. Reports from Ministry of Science and Higher education (MoSHE) and Ministry of Education (MoE) were among the sources consulted. Policy documents and statistical data of student enrolment and academic faculty were also reviewed. In order to see the changes in students' enrolment of undergraduate and postgraduate programs in higher education institutions and Technical and Vocational Education and Training (TVET) colleges in the country, trend analysis was done. Comparisons between male and female students and academic staff in STEM fields in higher education institutions were made. The primary data were collected through phone calls and email correspondences. The data collection and analysis process is summarized in Table 1.

Findings

Higher education and STI in Ethiopia

Academic institutions are the prime source of knowledge and innovation at national, regional and international levels (Kearney, 2009) and key actors in STI eco-system. Higher education provides a conducive environment for the development of STI and a suitable exploitation of the full potential of STI to support sustainable development (African Union, n.d). Higher education in Ethiopia includes education programs offered as undergraduate degree for three, four or more years, second degree (Master's and speciality programs) and third degree (PhDs and subspeciality programs). The focus areas of higher education institutions of the country are teaching, research and community services (MoE, 2018a).

Due to the demand for skilled manpower in the country, the number of higher education

institutions has increased since 1992. Until 1992, there were only two Universities in the country, namely, Addis Ababa University established in 1950 and Haramaya University established in 1954. Between 1992 and 2009, 21 more universities were established and by the year 2013, the country had 33 universities (Gizaw, 2019). Currently there are 49 government and 128 accredited non-government higher education institutions in the country (MoE, 2018b).

The fields of studies given in higher education institutions in Ethiopia are divided into six

bands. Table 2 shows the classification.

The overall enrolment of students in Ethiopian higher education institutions are increasing. The number of undergraduate students in both Government (public) and non-government (private) institutions increased from 309,092 in 2008/09 academic year to 825,003 in 2017/18 (Figure 1). The proportions of female students increased throughout these years. The percentage of female students was 29% and 36.9% in 2008/09 and 2017/18 academic years, respectively.

Table 1. Process of data collection and analysis

Data collected	Method used to collect the data	Source of the data	Methods of data analysis
STI policy and strategies of Ethiopia	Document review	National Science, Technology and Innovation Policy of Ethiopia	Content analysis
STI actors in Ethiopia	Literature review	Report of UN agencies (UNICEF, UNDP) World Bank, AU	
Sex disaggregated data of enrolment of students at undergraduate and postgraduate level	Document review	Reports of Ministry of Education (MoE) of Ethiopia	Descriptive statistics (frequency and percentage)
Sex disaggregated data of academic staff by field of study		Reports Ministry of Science and Higher education (MoSHE) of Ethiopia	
Sex disaggregated data of enrolment of TVET students and trainers		Quarterly reports of higher education institutions	
Sex disaggregated data of researchers			
Participation of women in STI	Literature review	Journal articles	Content analysis
Gender-based capacity gaps, opportunities and challenges	Semi-structured interview checklist	Study participants	

Table 2. Programs of the Ethiopian Higher Education System

Band	Fields of Study
Band 1	Engineering and Technology
Band 2	Natural and Computational Sciences
Band 3	Medicine and Health Sciences
Band 4	Agricultural and Life Sciences
Band 5	Business and Economics
Band 6	Social Science and Humanities

The number of postgraduate (Masters and PhD) students also increased from 10,125 in 2008/09 to 76,795 in 2017/18 (Figure 2). In terms of female enrolment, only 11.3% of the students were female in 2008/09 whereas it increased to 18% in 2017/18 academic year.

In addition to producing qualified graduates, higher education institutions contribute to the STI eco-system by conducting research and publishing articles in reputable journals. According to Salmi *et al.* (2017), Ethiopian higher education institutions produce around 1,500 publications each year. There have also been improvements in the capacity of conducting research in Ethiopia. For example, the citable research documents, which were mainly conducted by faculties of higher education institutions in Ethiopia, increased from 774 in 2010 to 1552 in 2015 (SCImago Journal and Country Rank as cited in Salmi *et*

al., 2017). However, the contribution of the research in terms of knowledge generation for national development has been generally low and they lack responsiveness in addressing societal challenges (Nega and Kassaye, 2018).

Technical and Vocational Education and Training (TVET) in Ethiopia

Technical and Vocational Education and Trainings (TVET) has been taken as a means of supporting youth develop skills essential for engagement in various professions as well as promote entrepreneurship (AU, 2018). TVET are ‘those aspects of the educational process involving, in addition to general education, use of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge related to occupations in various sectors of economic and social life’ (UNESCO and ILO, 2002).

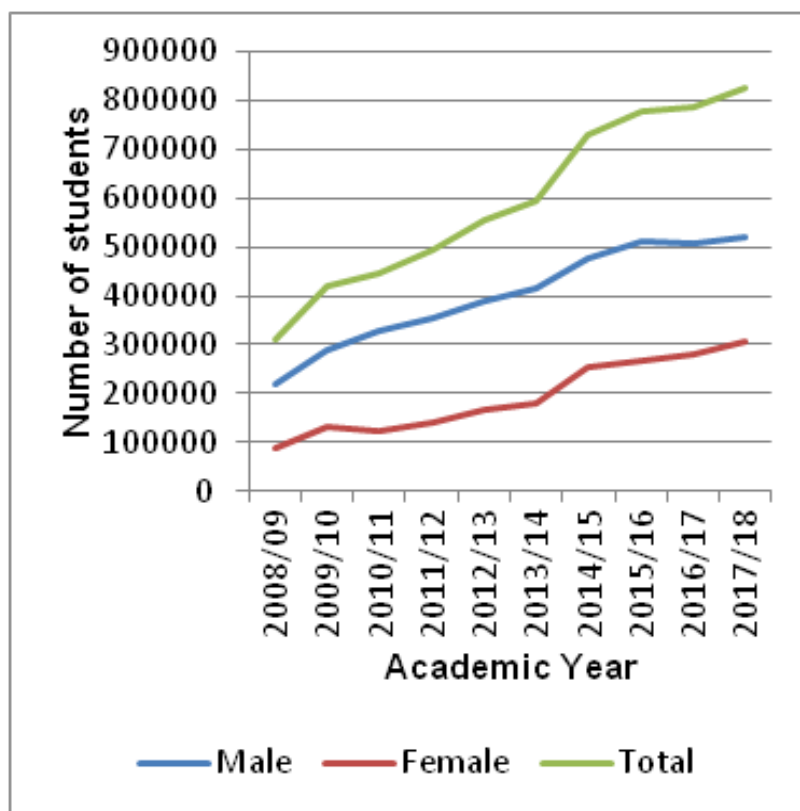


Figure 1. Trends in enrolment of undergraduate students

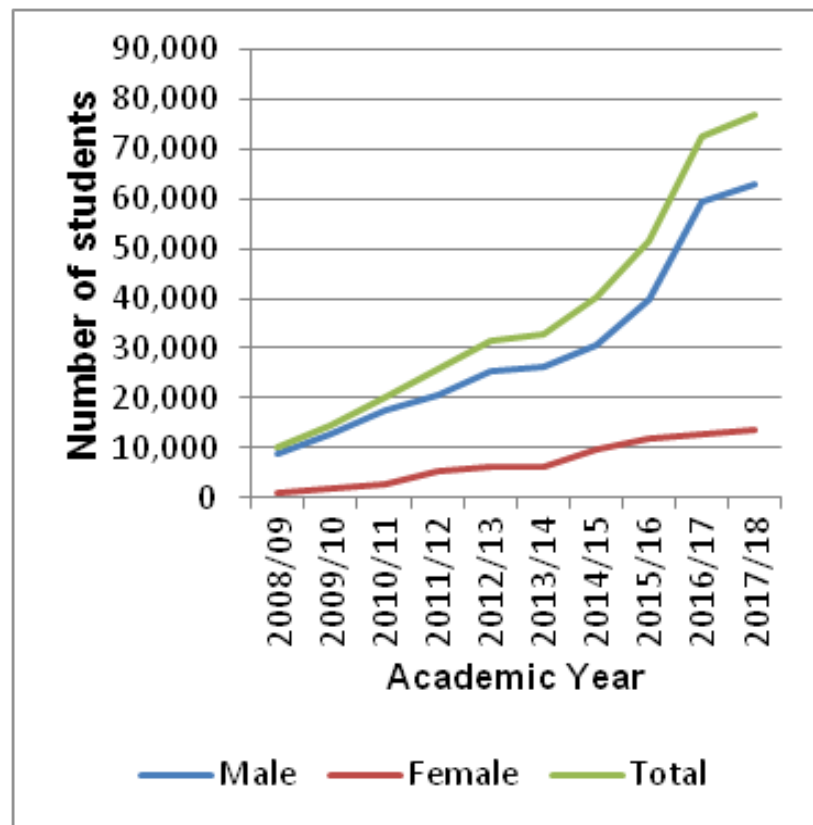


Figure 2. Trends in enrolment of postgraduate students

The emergence of Technical and Vocational Education and Training (TVET) in Ethiopia dates back to 1942 (Teklay, 2012). The first TVET institute was Addis Ababa Technical School which was named as Ecole National des Artes Technique during its establishment (Likisa, 2018). Since then different policies were enacted to promote TVET in Ethiopia, and in 1970s selected high schools were converted to comprehensive high schools where students could have both academic and vocational education (MoE, 2018a). In 2004, competency-based training was introduced to the TVET system in Ethiopia to respond to the skill needs of the labor market (Likisa, 2018). In 2008, the country developed national TVET strategy revising the older version which was prepared in 2002. The revised strategy was envisioned ‘to create competent and self-reliant citizens to contribute to the economic and social development of the country, thus improving the livelihoods of all Ethiopians and sustainably reducing poverty’ (MoE, 2008).

The importance of expanding and strengthening TVET has been justified because of the need to enhance the manufacturing sector and improve the employability of Ethiopian youth (Trines, 2018). Moreover, TVET in Ethiopia was designed to redress the challenges of poverty, unemployment, low technological development, and low productivity of the economy (MoE, 2008). It is categorized into five levels (level 1 to level 5) to provide relevant and demand-driven education and training (MoE, 2018b). An informant from Federal TVET Agency indicated that currently the fields of study in TVET are classified into eight major sectors: agriculture; industrial development; trade; health; culture, tourism and sport; mining; economic infrastructure; and community service. TVET is led by Ministry of Science and Higher Education. The overall implementation of the TVET strategy has been overseen by the Federal TVET Agency and a Federal TVET Institute has been working to produce competent TVET trainers.

Regional States of the country have their own TVET offices/agencies that are in charge of the TVET institutions in their respective regions. According to MoE (2017b) the country has 582 public and private TVET institutions.

Since the launch of the TVET program, it has expanded in terms of enrolment in which the number of students increased from 106,336 in 2004/05 to 352,144 in 2014/15 (MOE, 2018b). However, since 2014/15 academic year, the number of TVET students has declined. For example, the total enrolment decreased from a total of 352,144 in 2014/15 to 292,378 in 2017/18. The decline could be because of the fact that some regions did not report the number of students in the TVET institutions of their regional States on time (MOE, 2018b).

Women's participation in science, technology and innovation ecosystem

People all over the world have benefited from STI. The value of STI significantly increases when it supports women who have been disadvantaged throughout their life time. Giving the opportunity to women in the fields of studies such as science, technology, engineering and mathematics (STEM) contributes to have healthier families as well as they become more successful at their homes and in their career (Egne, 2014). Polcuch *et al.* (2018) justifies the need for gender equality in STI from the point of view that gender equality and access to science are recognized as human rights; the need for participating women in the scientific workforce to have sustainable development; and the contribution of women to come up with varied and society relevant research results. Moreover, STI policies and programs could not be effective unless they consider the concerns and abilities of both men and women (United Nations, 2011). Giving equal opportunity to women in STI is also justified as it assures better scientific and technological results and the best use of them (Lane, 1999), and the more inclusive the STI ecosystem, the more it becomes innovative and productive (National Academy of Sciences, 2006).

The Government of Ethiopia, with the aim of producing more graduates in the fields of STEM, developed a policy that 70% of students who join higher education should study natural sciences whereas the remaining 30% to enrol in social science fields. This policy has increased the number of science, technology and engineering students since its development in 2008. However, it has not been successful in terms of bringing gender equality in STEM fields of study. The new enrolment policy (70:30) excludes female students from science and engineering in higher education (Tsegai, 2010).

Figure 3 shows gender disaggregated enrolment of undergraduate program students in government (public) universities in Ethiopia in various fields of study from 2014/15 to 2018/19 academic years. The percentage of female students in the science and technology fields increased to some extent since 2016/17. In spite of this fact, there was big gender disparity among undergraduate students in such fields of study of the higher education institutions of the country. Female students comprised 31%, 29.4%, 30.7%, 31.4% and 34.4% in 2014/15, 2015/16, 2016/17, 2017/18 and 2018/19, respectively

The participation of females at postgraduate level, like in the undergraduate programs, was also lower than male students as shown in Figure 4. The proportion of female postgraduate students was lower than for male students since 2014/15 academic year. In 2014/15, 2015/16, 2016/17, 2017/18 and 2018/19, the percentage of female students in science and technology were 30.8%, 19%, 14.7%, 15% and 15.6%, respectively (Figure 4).

The gender disparity in science and technology fields of study was also observed in the academic staff of higher education institutions. The proportion of women, like the students, was by far less than that of the men. Figure 5 shows the number of women academic staff at public universities by field of study.

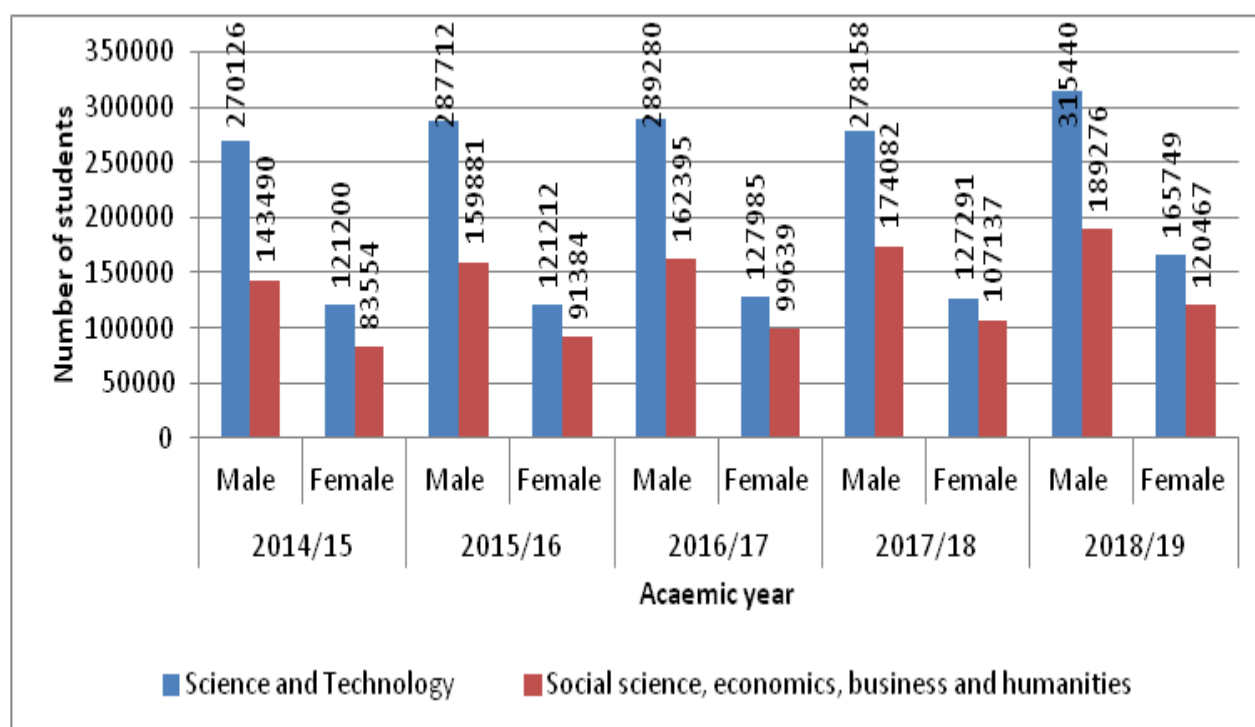


Figure 3. Enrolment in undergraduate programs in Government/public universities, by field of study and gender

Source: MoE, 2016; MoE, 2017a; MoE, 2017b; MoE, 2018b; MoSHE, 2020

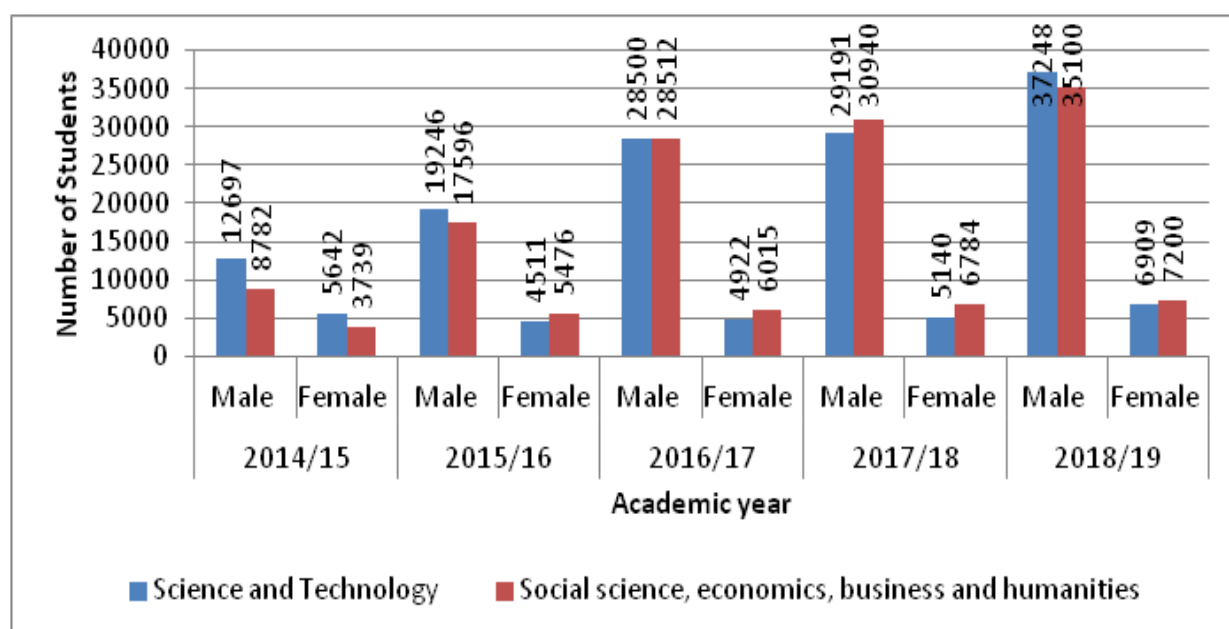


Figure 4. Enrolment in postgraduate programs in public universities, by field of study and gender

Source: MoE, 2016; MoE, 2017a; MoE, 2017b; MoE, 2018b; MoSHE, 2020

* Engineering and technology; natural and computational sciences; medicine and health science; and agricultural and life sciences

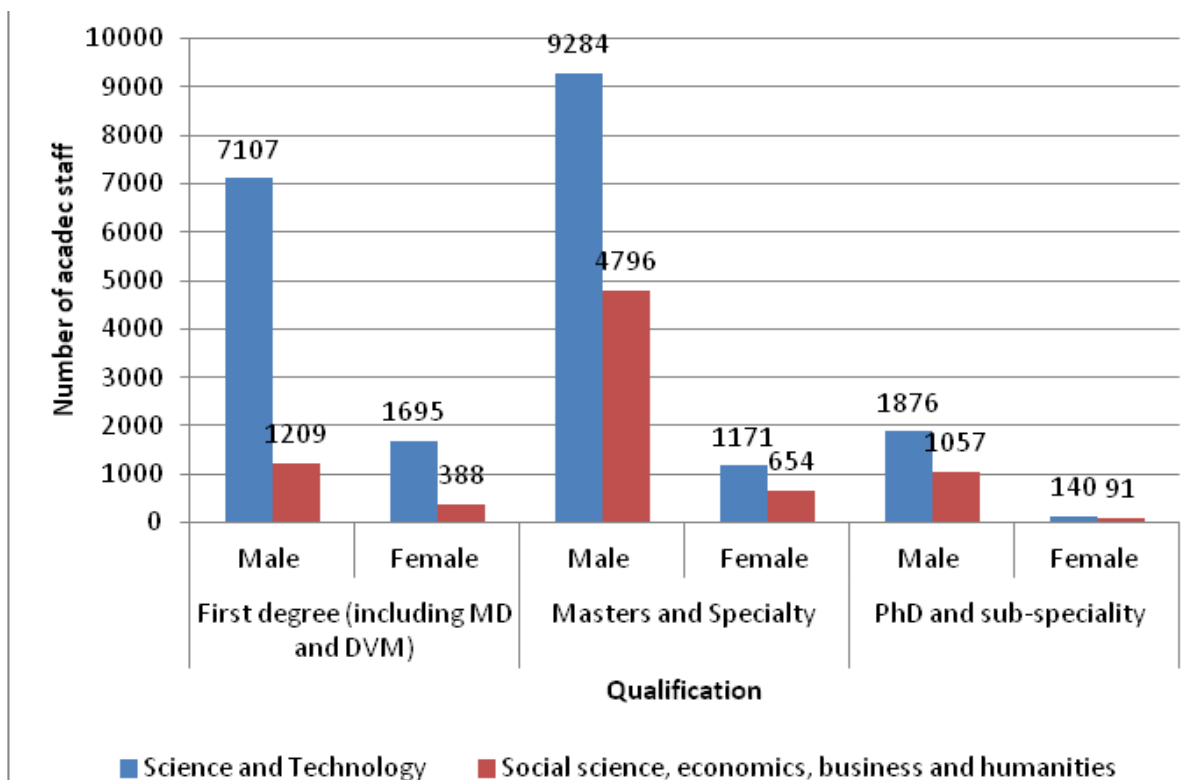


Figure 5. Number of academic staff at public universities, by gender and field of study (2017/18)

As Figure 5 shows the percentage of women academic staff decreased as the level of education increased. In science and technology fields of study, 19.3%, 11.2% and 6.9% of the women earned first, Masters/speciality and PhD/ sub-speciality degrees, respectively.

Unlike in the higher education institutions, the participation of female students in the TVET institutions was better than that of men. Figure 6 shows the number of students from 2013/14 to 2017/18 academic year. As Figure 6 depicts the number of female students was higher than for male students between 2014/15 and 2017/18. Among all the students, females constituted 51.3%, 52.4%, 51.9%, 51.3% and 50.8% in 2013/14, 2014/15, 2015/16, 2016/17, and 2017/18, respectively. Regarding TVET trainers, the trend analysis shows an increase until 2016/17. but the number of the trainers declined in 2017/18 (Figure 7). Considering the gender dimension, the number of women was very much less than that of men trainers.

The percentage of women were 22.5%, 22.2%, 21.9% and 19.9% in 2014/15, 2015/16, 2016/17 and 2017/18, respectively.

Women in higher education and TVET institutions are also contributing in the research enterprises, and the percentages of women researchers increased considerably. In spite of this fact, females are still not adequately represented in the research endeavor. Female researchers were 13.3% in Ethiopia in 2014 (UNESCO Institute for Statistics, 2019, which was more than that of 2005 (i.e., 6%) (UIS, Education Database and Science and Technology Database, 2007 as cited in UNICEF, 2007). In terms of fields of study, the lowest percentage of women researchers was found in technology and engineering. In 2013, female researchers in Ethiopia were 12.2%, 7.1%, 26.1%, 7.6% and 13.2% in natural sciences, engineering and technology, medical sciences, agricultural sciences, and social science and humanities, respectively (UNESCO, 2015).

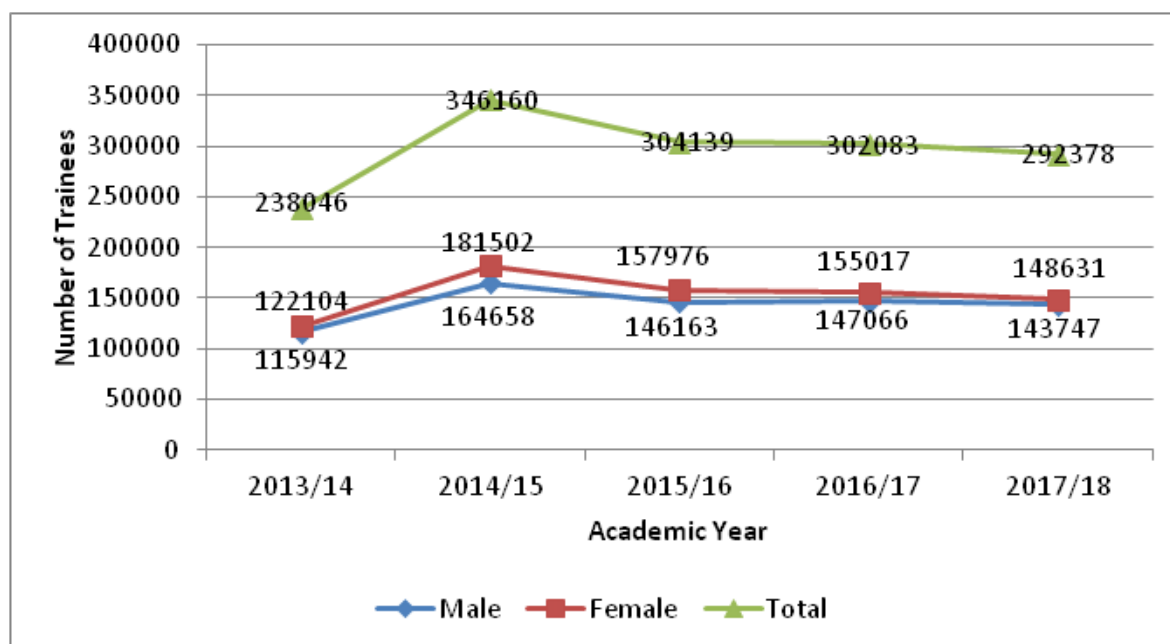


Figure 6. Trends in TVET enrolment by gender (2013/14- 2017/18)

Source: MoE, 2018b

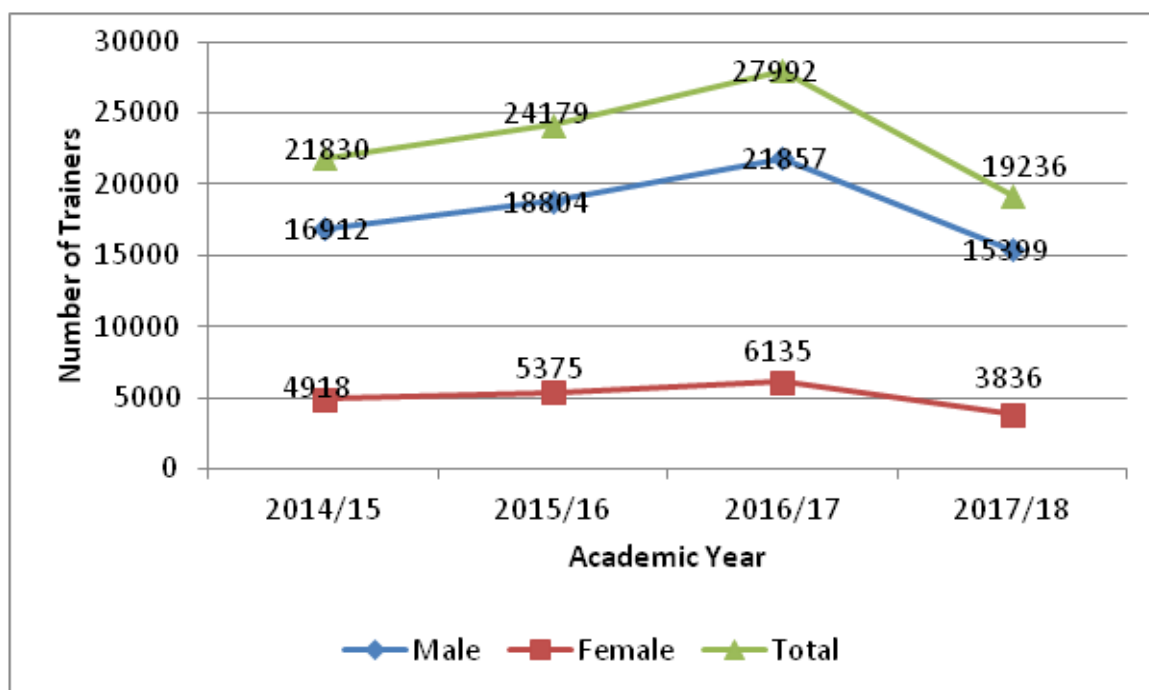


Figure 7. Trends in TVET trainers by gender (2014/15-2017/18)

Source: MoE, 2016; MoE, 2017a; MoE, 2017b; MoE, 2018

The participation of women in the industry sector, the other major actor in the STI ecosystem, has been also low in the country. Mostly women tend to participate in occupations that require less skills. Higher-skilled positions are occupied by men. For instance, it was reported that, in Ethiopia, the proportion of women that work as high-skilled production workers decreases as the tasks become more skill-intensive; 35% in textiles and garments and 15% in chemical and pharmaceutical industries (UNDP, 2018).

Gender-based capacity gaps and challenges of women to participate in STI in Ethiopia

Scientists have uncovered the absence of significant biological difference in men's and women's ability to perform in science and mathematics (Ceci and Williams, 2007 as cited in Castillo *et al.*, 2014). Despite this fact, only few women participate in the STEM fields in Ethiopia. The low participation of women has been attributed to various gender-based capacity gaps and challenges. The major gaps and challenges are highlighted below.

Lack of academic preparation for science, technology, engineering and mathematics (STEM) fields. To be successful in science, technology, engineering and mathematics fields at higher education institution, it is essential to have preparation from the early stages of schooling. However, most females in Ethiopia do not get such opportunities since they are expected to engage in household activities. Due to this fact, they lack the preparation to join the fields of study that require strong background in science. A study conducted in Ethiopia among students of Addis Ababa University and Adama Science and Technology University confirms this notion. Among the students who were studying science, technology, engineering and mathematics, and social sciences, 75% and 85% of them respectively indicated that most Ethiopian female students show little interest towards hard sciences due to lack of academic preparation starting from the lower grades (Egne, 2014). In support of this Tamrat (2017)

asserts that the poor academic background of female students is the major obstacle for their success. A university lecturer, in an interview conducted, commented that due to the poor science methods of teaching at elementary school, many students especially females are not equipped with the required science knowledge and skill for their grade level.

Attitude toward science. The attitude of female students to science, technology, engineering and mathematics subjects is among the factors that hinder females not to choose these fields of study. Traditionally, natural sciences have been perceived as fields of study for men whereas humanities have been given to women (Francis, 2000) and scientists as predominantly male (Makarova *et al.*, 2019). Similarly, MoE (2014) and UNESCO (2018) also highlight the prevalence of stereotypes on girls and women to engage in natural science streams, technology and mathematics. An interviewee (statistics graduate) indicated that female students usually assume science field such as mathematics to be the most difficult subjects so they prefer to study social sciences. Based on the information obtained from women officials in MoIT of Ethiopia, Beyene (2015) also indicated that only few Ethiopia women participate in STI mainly because of the 'prevailing belief that science is not a suitable field for women'. The students' enrollment and the proportion of female academic staff in Ethiopian higher education prove point to this perception. For instance, among the public higher education students enrolled in 2018/19 academic year, 17.3% of female students were studying social science and humanity fields (band 6) whereas the percentage of female students in the same year who were studying Engineering and Technology (Band 1) and Natural and Computational Sciences (Band 2) were 16.2% and 12.4%, respectively. Regarding the academic faculty, among the staff members with postgraduate degree (Masters and PhD) the percentage of women in the fields of engineering and technology (Band 1) and Natural and Computational Sciences (Band

2) were 9.2% and 8.3%, respectively. On the other hand, about 11% of the female academic staff had postgraduate degree in social science and humanity fields (band 6) in the same year (2018/19).

Lack of self confidence. Due to various socio-cultural factors, women have not been considered as confident enough to perform challenging tasks. As science, technology, engineering and mathematics are taken as difficult subjects, women are not usually expected to study such fields. It is men who are assumed to have self-confidence and skills in fields like engineering (UNDP, 2018). Interviewed key informant mentioned that female students are not confident enough to study STEM fields at higher education institutions as they feel they are not good at it. A female faculty also indicated that females do not opt for STEM fields because they perceive that they may not be successful. Moreover, a woman respondent in a study conducted by Asmamaw (2017) commented that ‘women are not expected to excel in the sciences’. In support of this, MoE (2014) asserted that lack of self-confidence and existence of low expectations for girls to study sciences and mathematics make them avoid such fields. It has also been noted that the perception of faculty members of higher education institutions that women lack the ability to perform well in STEM fields has also made women not to be confident enough to study these subjects (Hafkin, 2016).

Lack of female role model scientists. Most often, in Ethiopia, men are those who are known for their expertise in the fields of science and technology. The low number of female professors in the country’s higher education institutions can be an indicator of such phenomenon. Due to this, female students do not usually have the opportunity to see successful women scientists who motivate females’ interest and self-confidence to join STEM at various levels. Women in academic institutions serve as a role model and their presence is crucial to recruit more women in

science fields (Kvach *et al.*, 2017) and they can help mitigate the negative stereotypes about women’s ability in STEM subjects (UNESCO, 2018). In spite of this fact, lack of women role model instructors and scientists who could inspire and inform female students has been a challenge (Samulewicz *et al.*, 2012; Mamo *et al.*, 2017). Hafkin (2016) also argues that scarcity of women instructors/role models has been a bottleneck for females not to opt for STEM in Ethiopia.

Lack of adequate support from higher education institutions. If students are to select STEM fields, there is a need for orientation and guidance during the admission choice process (Egne, 2014), including during their earlier career guidance during their studies. Universities are also expected to give sufficient support in all aspects in implementation of Government policies and strategies in relation to higher education. To this end, higher education institutions should increase the number of female students and reduce their attrition in STEM fields. However, some of the instructors at higher education are blamed for not implementing the policies and strategies that have been put in place. Wondimu (2004) argues that some of the measures such as affirmative action have not been supported by some officials and teachers of higher education institutions. It was also noted that low enrolment and high attrition rate of female students in STEM had also emanated from lack of support from instructors (Hafkin, 2016). Moreover, weak gender based guidance, counselling, information and lack of remedial learning programs have been the other challenges in efforts to bring gender equality in science and technology fields in Ethiopia (MoE, 2014). The tutorial sessions intended to support female students at higher education institutions, though it has benefits, has been given arbitrary without any guideline and needs assessment, as one informant explained.

Gender disparity in employment. Ethiopia is a country with a remarkable economic

growth. Despite this fact, the unemployment rate among female graduates attests to the prevalence of gender inequality in getting jobs in their fields of study. Considering the women unemployment during the period 2009 to 2013, Jote (2017) indicated that on average 26.6% of female electrical engineering graduates could not get jobs whereas the unemployment rate was only 15% among male graduates in the same field. Cognizant of this fact, MoE (2018a) in its education development road map stated that under the current pace of the manufacturing sector development, it was less likely to employ all current graduates of engineering fields. As a result, unemployment becomes higher among the engineering graduates than in other fields.

Opportunities and future prospects for women's participation in STI in Ethiopia

Though women have been disadvantaged in participating in STI ecosystem of the country, a number of opportunities have been put in place which could be used to motivate them to participate more competetively in STI. Since Ethiopia is a country striving to bring gender equality in all endeavors of life, in the policies and strategies designed, gender parity is among the priority areas.

The Growth and Transformation Plan II (GTP II) (2015/16-2019/20) of the country is one of the major documents giving emphasis on women's participation in the overall development of the country. One of the major targets of GTP II is 'Ensuring gender equality at all educational levels, creating conducive environment for female students, increasing number of female teachers, increasing gender equality in employment....', (Federal Democratic Republic of Ethiopia, 2016). The Higher Education Proclamation (Proclamation No. 650/2009) also dictates to increase the proportion of women in senior positions, and under taken affirmative action for students' enrolment into higher education institutions that gives special consideration for female students (Federal Negarit Gazeta, 2009). Furthermore, having considered gender issue among the

problematic areas of the education system of the country, the Ministry of Education Action Plan of the Education Sector Development Program (ESDP IV), has incorporates females' equitable access to education at all levels as one of its objectives (MoE, 2015). The higher education road map prepared in 2018 also proposes to further strengthen the affirmative action already in place to narrow the gender gap in higher education institutions. Moreover, one of the guiding principles of the national TVET strategy of the country is to let women have equal access to TVET, and the TVET institutions are expected to develop gender sensitive policies that women will not be discriminated against (MoE, 2008).

Since 2018/19 academic year, the Ethiopian Government in its higher education road map, changed the duration of all programs offered in higher education institutions. For example: programs that were taking three years to earn bachelor degree have been changed to four years. All the first year students take general courses so that females can have enough time to be familiar with the environment including the nature of the programs. If they are offered sufficient guidance and mentorship, they go for science and technology fields of study. The national STI ecosystem of the country also takes human resource development as one of the policy issues (Federal Democratic Republic of Ethiopia, 2012). Among the strategies to implement the human resource development is increasing the proportion of female students who enroll in science and engineering fields in higher education institutions. The increasing numbers of universities that give STEM in the country also offer opportunity for those who are interested to study in these fields.

CONCLUSION AND RECOMMENDATIONS

The STI ecosystem in Ethiopia has been given attention as it is considered key to achieve sustainable development in the country. The country has developed STI policy and the stakeholders of the eco-system are operating to realize the country's aim to be among the

middle economy countries. Higher education, as a key actor of the STI ecosystem, is contributing by producing competent graduates and researchers. Moreover, an extensive effort has been made to make the ecosystem inclusive so that women can take part in it. This is because participation of women in STI ecosystem is not only to give equal opportunity to them to attend STI fields of study in higher education institutions but also to enable them contribute to the development of technology and innovation. However, the percentage of women is very much less than men in STI ecosystem in Ethiopia. The gender disparity in the enrolment of both undergraduate and postgraduate programs and the employment opportunities in high skilled positions testify to this. It is hardly possible to find women with PhD degrees in STEM fields in most of the higher education and TVET institutions in the country. The low participation of women is attributed to various constraints/challenges. Therefore, it is critically important to work towards redressing the challenges so as to bring more women in the STI ecosystem in Ethiopia.

Recommendations

Despite the fact that the Government of Ethiopia has policies in place to achieve gender equality in the education sector and tries to create conducive environment to redress the prevailed gender inequality in the STI ecosystem, the gender gap remains big. The situation calls for a continuous effort to achieve the objectives set so that the participation of women in STI is enhanced. To do so, the following are recommended:

- Awareness creation among female students at early stages: female students have to be given orientation about STEM at school so that they develop interest and self-confidence towards the fields.
- Elementary school teachers have to contextualize science education to the real life situation of the students so that females will develop interest and positive attitude towards it.
- Affirmative action has to be given more attention in relation to admission of female students to higher education and recruitment of female faculty in STEM fields of study. Higher education institutions need to aggressively work to implement the affirmative action in STEM fields and the outcome of the affirmative action has to be regularly monitored and impact evaluated.
- Arranging freshman/fresh woman advising and mentoring, and organizing training to develop research skills of female students should be periodically undertaken.
- Gender awareness training has to be given to school teachers as well as instructors at higher education institutions to enable them to motivate female students develop interest in the fields of STEM.
- The success stories of female scientists (role models) in STEM have to be told to female students and schools and higher education institutions should invite these figures to inspire female students and boost their confidence to take science fields.
- Make research fund available to female academic staff in higher education and research institutions with a particular emphasis on researchers in science and technology fields, and reward those who excel in their performances
- Ensure women take advantage of travel to attend national and international conferences and workshops, and motivate and support them to present their research findings, and publish in reputable journals.
- Provide accommodation and other amenities to female students and academic staffs in higher education so that they have sufficient time to focus on their studies and research.
- Any academic support to female students (such as tutorial programs) have to be need-based (i.e., based on specific needs and gaps of female students) and has to be given in planned and organized ways.
- Strengthen international and regional cooperation to secure funding for scholarship and research grants for women
- Strengthen academia-industry linkage: the

linkage will serve to support the industry labour needs. Moreover, through equitable participation of women in manufacturing, women unemployment will be reduced.

- Promote visibility of women in STEM careers, especially in leadership positions in public offices, industries, business enterprises, higher education, and research institutions.

STATEMENT OF NO- CONFLICT OF INTEREST

The author declares that there is no conflict of interest in this paper.

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