



A gender-based assessment of Science, Technology and Innovation ecosystem in Mozambique

N. GIVÁ and L. SANTOS

Faculty of Agronomy and Forestry Engineering, Eduardo Mondlane University, Av. Julius Nyerere, Campus Universitário 3453, P.O.Box 257, Maputo, Mozambique

Corresponding Author: 3ngiva@gmail.com

ABSTRACT

Participation of women in Science, Technology and Innovation (STI) remains low, despite several initiatives globally. The African Agenda 2063 recognizes Women, Science and Technology as key tenets of the Sustainable Development Goals. This study provides a status of Mozambique's gender based STI ecosystem to enable targeting the gaps for mainstreaming gender within higher education, enhancing the performance of higher education institutions in training the next generation of workforce. Methodology approach consisted of review of gender National policy documents and gender oriented STI initiatives, analyses of existing database to capture trends on women's participation in STI education and research; and interviews with key informants from relevant government institutions, selected higher education and research institutions. Findings indicate an increasing trend of women participation over the years with greater preference for Arts and Humanities than Science and Technology. The gender-based STI ecosystem is weak in Mozambique, and policies and strategies are yet to be operationalized with appropriate implementation instruments. Funding opportunities are sparse, mainly secured by the public sector and international organizations. There is limited collaboration between knowledge based institutions and industry. We recommend that beyond promoting initiatives to increase women participation and access to STI, there is a need to revise the current setup of the national education system to allow students' make better-informed decision in the selection of Higher education stream. An integrated and harmonized policy and implementation plan among responsible government sectors is needed to stimulate diversified funding through seeking solutions and technologies that are both society and market driven.

Keywords: Gender, higher education, Mozambique, Science, Technology and Innovation

RÉSUMÉ

La participation des femmes aux sciences, à la technologie et à l'innovation (STI) reste faible, malgré plusieurs initiatives à l'échelle mondiale. L'Agenda africain 2063 reconnaît les femmes, la science et la technologie comme les principes clés des objectifs de développement durable. Cette étude fournit un état de l'écosystème STI du Mozambique basé sur le genre pour permettre de cibler les lacunes pour l'intégration du genre dans l'enseignement supérieur, améliorant la performance des établissements d'enseignement supérieur dans la formation de la prochaine génération de la main-d'œuvre. L'approche méthodologique a consisté en un examen des documents de politique nationale sur le genre et des initiatives STI axées sur le genre, des analyses de la base de données existante pour saisir les tendances de la participation des femmes à l'éducation et à la recherche sur les STI; et des entretiens avec des informateurs clés d'institutions gouvernementales compétentes, de certains établissements d'enseignement supérieur et de recherche. Les résultats indiquent une tendance à la hausse de la participation

des femmes au fil des ans avec une plus grande préférence pour les arts et les sciences humaines que pour les sciences et la technologie. L'écosystème sexo-spécifique de la STI est faible au Mozambique et les politiques et stratégies doivent encore être opérationnalisées avec des instruments de mise en œuvre appropriés. Les possibilités de financement sont rares, principalement garanties par le secteur public et les organisations internationales. La collaboration entre les institutions fondées sur la connaissance et l'industrie est limitée. Nous recommandons qu'au-delà de la promotion des initiatives visant à accroître la participation des femmes et l'accès aux STI, il soit nécessaire de réviser la configuration actuelle du système éducatif national pour permettre aux étudiants de prendre des décisions plus éclairées dans la sélection des filières d'enseignement supérieur. Une politique et un plan de mise en œuvre intégrés et harmonisés entre les secteurs gouvernementaux responsables sont nécessaires pour stimuler un financement diversifié par la recherche de solutions et de technologies à la fois axées sur la société et le marché.

Mots-clés: Genre, enseignement supérieur, Mozambique, Science, technologie et innovation

RESEARCH APPROACH

Science, Technology and Innovation (STI) has been highlighted as an important driving force for countries' socio-economic development (Osagie and Alutu, 2016; Zavale, 2017). Initiatives promoting gender equality, Science Technology and Innovation policies targeting both men and women are recognized as fundamental to reducing poverty and ensuring equitable development (Nakayiwa *et al.*, 2016; African Agenda 2063). However, participation of women in STI has remained low worldwide regardless of the several initiatives geared towards supporting greater engagement of women especially in research for development (UN – Interagency Task Team, 2019). Studies report an increasing access of women in academy overtime but there is still greater imbalance of male and female academics in higher rank levels (Bagilhole, 2000; Subbaye and Vithal, 2017). For instance, among UK higher education institutions, women constitute 44.5% of all academic staff (ECU, 2014), however, only 12 % of professors in science subjects are females (Howe-Walsh and Turnbull, 2016). In Europe percentage of women with professorial roles was about 20% in 2013 (Subbaye and Vithal, 2017) while in Australia and USA this figure reaches 25% (Morley, 2014). This is equally true in

sub-Saharan Africa (SSA) where statistics indicate a progressive gender parity of women academic staff in higher education institutions but at a slow rate (Home-Walsh and Turnbull, 2016; Subbaye and Vithal, 2017). However, percentage of women with professorial roles remain low, particularly in key areas of STI, where figures indicates 8 % in Nigeria, in Tanzania 12 % and 15% in Uganda (Morley, 2005; Subbaye and Vithal, 2017).

Mozambique had 7030 researchers in 2016, from which only 28.9% were female. PhD trained researchers account for 14.8% of total researchers in the country of which 11.3% are male (11.3%) and only 3.5% female. There is a continuous increment of percentage of women in academia over the years; however, the gap between men and women is significant despite several policies on gender equity in higher education (António and Hunguana, 2013). Therefore, academic leaders such as The Forum for Women Vice Chancellors in Africa (FAWoVC) are devoting efforts to develop initiatives to increase participation of women in Science, Technology and Innovation in Africa. Founded in 2017, FAWoVC is an umbrella group of female university leaders in Africa created to spearhead gender responsive training in higher education institutions and

to increase the enrolment of female students in STEM, as well as galvanize women to take up leadership positions. Accordingly, FAWoVC recognizes that mainstreaming gender within higher education is of paramount importance for enhancing the performance of higher education institutions in their countries' development through enabling them to fulfil their mandates to train the next generation of talents to drive the continent forward.

This study provides the status of gender-based STI ecosystem in Mozambique to act as the benchmark against which the impact of future gender-based STI interventions can be assessed. It expands the scope of analysis of gender parity from students' enrolment rates to academic staff in HEIs. Specifically the study assesses the current STI ecosystem in the country, mapping key actors and their roles, interactions, policies, and partnerships. It also identifies the gender-based capacity gaps, challenges, opportunities and future prospects that are the basis to recommend strategies to increase participation of women in STI in Mozambique.

METHODOLOGY

Study methodology included review of existing gender policies and strategies and respective results and impacts in the Education, Science and Technology related sectors, of reports on gender and higher education and of STI initiatives in the country (Table 1). Analyses of existing databases in the relevant government sectors and in the HEIs were carried on to assess female participation in HEIs in STI related areas and in research. Interviews¹ were conducted using different formats, face to face, skype, emails and phone call interviews. In total 11 key informants from relevant ministries, higher education institutions (HEIs) and other relevant stakeholders were interviewed (Table 1). Five HEIs geographically distributed in the country were part of this study, three public universities (Eduardo Mondlane University (UEM) in the South, Lúrio University (UniLúrio) in

the North, and a higher Polytechnic Institute of Manica (ISPM) in the Center) and two private universities (A Politécnica and Higher Education Institution Dom Bosco (ISDB) both located in Maputo -South).

For the data collection and analysis of women participation in Higher Education and STI initiatives over a 10 years' period were taken into account, however, where data were unavailable, a five year period was considered. The analysis aimed at characterizing trends of women participation in Higher Education in general and in STI related areas in particular, as well as the main actors promoting gender equity in Higher Education and initiatives to attract more women for STI related areas. Five HEIs were selected to capture institution's leaders' perception about how their institution is performing regarding gender equity, the initiatives undertaken to promote gender equality and STI appreciation by female students and academic staff, the kind of collaboration and partnership built and what they consider as best practices, opportunities and challenges.

Findings and Discussion

Science, Technology and Innovation ecosystem in Mozambique: Policy overview and gender perspective. Mozambique is a signatory to various international and regional conventions that promote the principles and practices of gender equity and equality. Noteworthy is the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW); the Beijing Declaration and Platform of Action; Millennium Development Goals for Sustainable Development; the Sustainable Development Goals (SDGs) and the SADC Protocol on Gender and Development. The national gender policy and strategies' framework for Human and Social Development, Higher Education (HE), Science, Technologies and Innovation (STI) Systems are informed and take into consideration these treaties.

81 ¹with key informants from Ministry of Education and Human Development (MINEDH), from Ministry of Science, Technology and Higher and Vocational Education (MCTESTP), National Research Institutions, National Funds for Research (FNI) and five selected HEIs across the country

Table 1. Summary of data collection process

Data/Information collected	Method	Source or contact person
Gender policies and strategies in higher education; Priorities and interventions National debate about national education system and S&T	Literature review	Ministry of Education Ministry of Science and Technology, Higher Education and Vocational Education National Fund for Research five HEIs (2 Public and 1 private universities, 1 polytechnic, 1 Technical-vocational institute) Peer review articles
Overall number of admissions and graduates by sex % of admissions and graduates in STI by sex Number of researchers by sex Number of academic managers by sex Gross research expenditure	Compilation of secondary data and Descriptive statistics analysis	MCT and MCTESTP databases Annual reports (2011-2018) Data provided by the 5 HEIs case studies (UEM, UniLúrio, ISPM, ISDB and A Politécnica)
Mapping of existing Gender and STI initiatives, main actors and their contribution Women participation in STI initiatives, best practices, challenges and results on improving gender in STI	Documents analysis Semi-structured interviews Triangulation	Annual Reports Key informants at National Directorates in MINEDH and MCTESTP, FNI, National Research Institutions and other relevant Stakeholders (e.g. World Bank) Top managers of the selected HEIs, and gender focal points Websites

The Science and Technology sector was distinguished as important by the Government in the year 2000 when a new Ministry of Higher Education, Science and Technology was created. The aim of this new government unit at that time was (1) development of a skilled workforce, (2) expansion and equity of access to quality higher education, (3) development of technologies and (4) identification of Mozambican's resources and products that could serve as development factors. Since then and during the last 20 years, this Ministry went through two reorganization processes. From 2005 to 2015 it changed its focus and was renamed Ministry of Science and Technology (MCT). The Ministry coordinated the implementation of the S&T strategy and had

functions related to regulation, coordination, development, monitoring and evaluation of science and technology in the country. During this period, higher education sector was under the responsibility of the Ministry of Education. In 2015, the Ministry was reconfigured again by re-integrating the higher education and expanding it to include technical and vocational education, and as such, being renamed as the Ministry of Science, Technology, Higher and Technical-Professional Education (MCTESTP). Arguments in favor of the last reorganization include the need to deliver scientific and technological solutions for the main strategic development priorities of the Government's Five-Year Program, the Action Plan for Poverty Reduction (PARPA), Agenda

2025, and other national development strategies and plans. The five-year government plan [2015-2019] emphasizes the need to develop human and social capital through promotion of an inclusive education system with actions and policies that promote gender equity. Along with the National Strategy for Science, Technology and Innovation [2010-2016], a Higher Education Strategic Plan [2012-2020] and a Gender Strategy for Education and Human Development [2016-2020] were developed. While the strategies for science technology and innovation and higher education are articulated within the MCTESTP the implementation of gender strategy for education and human development sector is coordinated by the Ministry of Education and Human Development. Current Gender Strategy for the education sector [2016-2020] broadens the concept of “education” by recognizing primary, secondary, vocational and higher levels. It also recognizes the specificities of the higher education subsystem, although does not include specific actions that respond directly to the dynamics of students, academic staff, managers and leaders in HEIs (H. Monteiro, personal comm. November 2019). A strategy for gender equity in higher education [2018-2023] has been drafted and is in process of approval. It is recognized that there is a need for

greater articulation between the two ministries (MCTESTP and MINEDH) as the challenges of gender equity and women participation in science, technology, engineering and mathematics (STEM) start during primary and secondary education. Studies in the region also sustain this view, for instance, Osagie and Alulu (2016) contend that gender equity in science and technology should be nurtured in secondary levels’ students by designing training programs that stimulate confidence and assertive skills.

Women access and participation in HE and STI in Mozambique.

In Mozambique higher education system is characterized by a range of HEIs, which includes public and private universities and polytechnics. In 2017 there were 52 HEIs, consisting of 19 public and 33 private ones operating in the country (MCTESTP, 2017). Mozambique’s gross enrollment ratio in higher education has been increasing in recent years from 3.9% (2.96% of females) in 2009 to 7.3% (6.5% females) in 2018. The increment has been consistently higher for males than for females (Figure 1).

This increase in gross enrollment ratio is the result of the emergence of new HEIs over the last 10 years. The introduction of evening courses

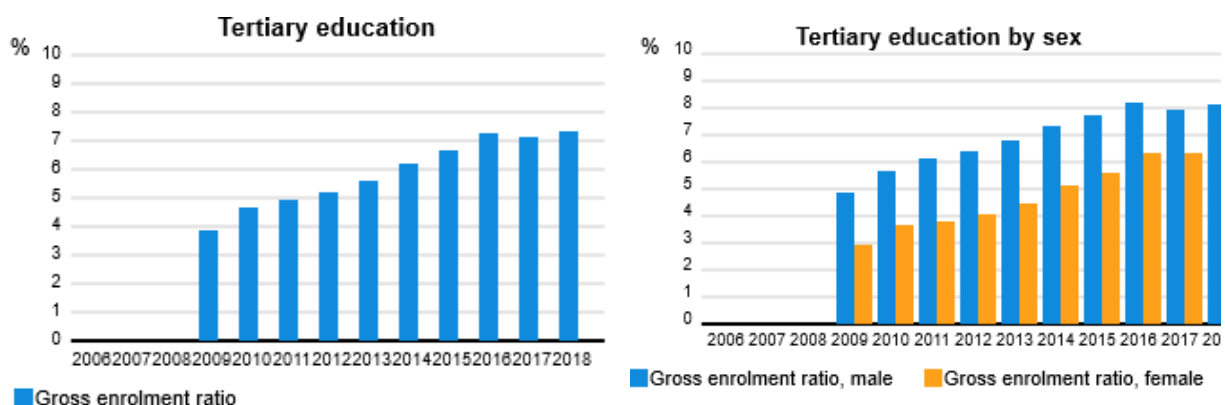


Figure 1. Gross enrollment ratio in tertiary education from 2009 to 2018
Source: UNESCO (2019)

in the major public universities (Pedagogic University and Eduardo Mondlane University) is another factor contributing to the rise in HE students. Evening courses provide opportunity for both adult male and female citizens, already employed and who have not had the opportunity before to attend HE to enroll in HE programs (António and Hunguana, 2013; Zavale *et al.*, 2017).

Admissions in Arts and Humanities (A&H) are consistently higher than in Science and Technology (S&T) over the last years (Figure 2), and gender equality is higher in A&H (40-50%) than in S&T (27-35%). It is also evident that there was a sharper increase over the years in A&H admissions when compared to S&T.

Despite the yearly incremental trend observed in female's admission, males continue to dominate. Percentage of female admissions in S&T has slightly increased over time as well as the number of female students admitted. However, percentage of female admissions in A&H have remained almost the same overtime despite the fact that number of females admitted increased in the same period. Similarly, number of graduates from HE (Figure 3) are higher for

both males and females in A&H than in S&T programs. Although the number of graduates in S&T related programs is relatively higher for male students, the overall number of graduates is low and the discrepancies between males and female students are high (Figure 3).

The low percentage of graduates may be a result of a significant number of dropouts due to unaffordability conditions or lack of awareness by students in high school about their preferences leading to wrong choices of areas followed. As part of the Mozambican education system students must choose between two courses of studies, S&T or A&H, when they finish 10th grade (INDE, 2007). For most students this choice process is not supported by any kind of vocational assessment or information about programs offered by HEIs. Both HEIs leaders and lecturers indicated that the choice is done too early, at a time when students have no clear idea of their professional orientation, the offering of programs or possible careers ahead. When students realize that they have done a wrong choice they are already attending an HE program and the range of choices is more limited.

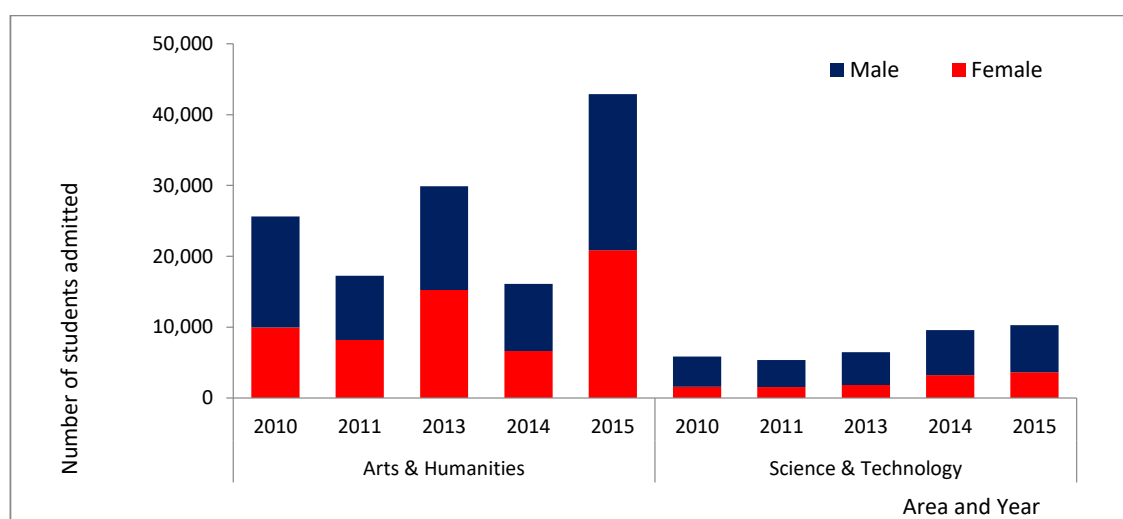


Figure 2. Admission in Arts and Humanities and Science and Technology programs by sex
Source: MCTESTP – National directorate for higher education (2019)

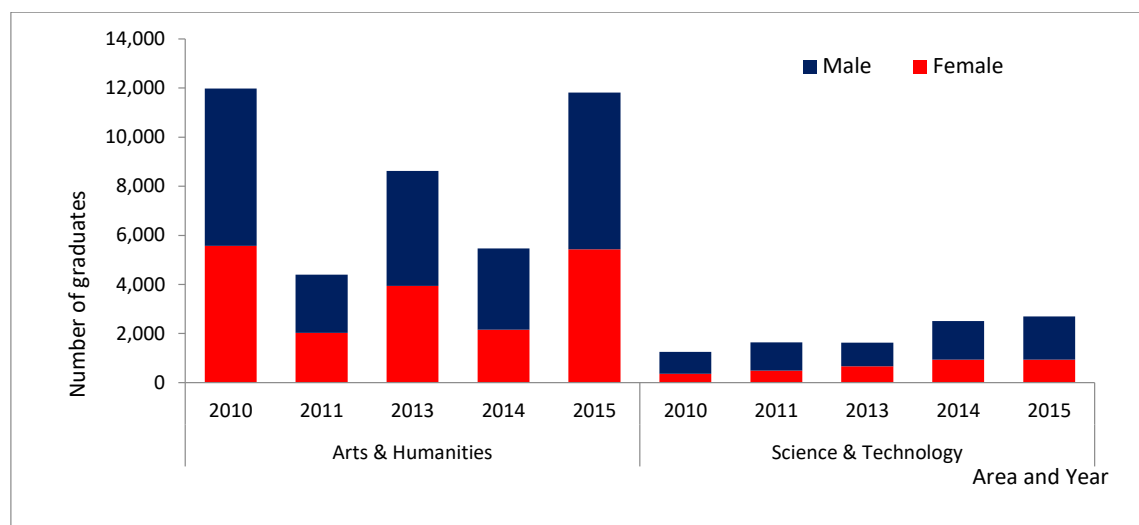


Figure 3. Number graduates in A&H and S&T disaggregated by sex
Data Source: MCTESTP – National Directorate for Higher Education (2019)

Students in 10th grade who choose the Arts and Humanities course of study cannot transfer to a S&T related program later on.

Staff in the Ministry responsible for the HE national system are conscious about the gender differences in access to HE and stereotypes in the area preferences between males and females. During the interviews, they acknowledged the need to enhance dissemination of HE programs and the importance of establishing a mechanism for more informed choice by 10th grade students prior to their decision of taking S&T or A&H courses of study. The forthcoming gender strategy for equity in higher education [2018-2023]² takes into account this issue. Actions listed in this strategy to increase participation of women in the higher education include allocation of quotes for females, establishment of specific programs to prepare and incentivize female students for higher education and appreciation of science, technologies and related subjects. It also includes strengthening the criteria for scholarship attribution to address gender and sex discrimination. Additionally, the strategy acknowledges the need to enhance articulation and collaboration between the MINEDH and MCTESTP in promoting

initiatives that tackle the secondary schools' students professional growth particularly for 10th graders. Nevertheless, other African countries such as Nigeria undertook a more profound reform in the education system in order to accommodate adequate teaching and handling of science and technology subjects to allow acquisition of appropriate skills capabilities, competencies and change in students' mindset (Osagie and Alulu, 2016). Some of our interviewees also shared this view.

Interviewed key actors argued that apart from increasing dissemination of information about HE programs among students at secondary schools, more importantly there is need to establish a vocational assessment mechanism to support students in selecting HE programs. Some studies (e.g. António and Hunguana, 2013) suggest that the low preferences for S&T courses is influenced by the weak level of industrialization in the country and by an employment sector that is mainly driven by service providers. Therefore, there are expectations that the current growth of gas and mining industry will bring a different dynamic and more demand for S&T programs. Another factor mentioned as inhibiting participation

of women in the S&T fields is the limited existence of role models in these areas, poorly equipped laboratories and research fields, and low incentives for researchers compared to other employment sectors.

The percentage of females is slightly higher at graduation when compared at admissions, in particular for S&T. This suggests that females perform better than males. Darvas *et al.* (2014) and Zavale *et al.* (2017) also observed a positive trend in the female students' graduation rate. Although female students often face difficulties in accessing HE, once admitted the percentage of graduation is higher than the males, in particular in S&T courses.

When looking at women participation in S&T related programs it is clear the female preferences for health and wellness, agriculture, forestry and veterinary related programs is high (Figure 4). The number of female graduates increased more over time in health and wellness and agriculture programs. However, gender equality is worse in engineering and natural sciences related courses (less than 30%

of females) compared to other S&T courses (Figure 4) while in health the numbers of female and male students is more equitable (50% of females). In agricultural sciences, female participation is around 35%.

Gender strategies and women participation in Science, Technology and Innovation.

The Ministry of Science, Technology Higher and Professional Education acknowledges that women are under-represented in different sectors of science, technology and innovation. In 2016, the country had 7030 researchers of which only 28.9% were female. Researchers with PhDs levels account for 14.8% and only 3.5% were female. Despite the continuous increment over the years, the gap between men and women is significant (Figure 5). The number of male researchers is more than two times greater than female researchers at all levels. The percentage of female PhD researchers is lower than the ones with MSc and with BSc, suggesting that males are more able to advance their academic qualifications than females. This trend is equally true in other

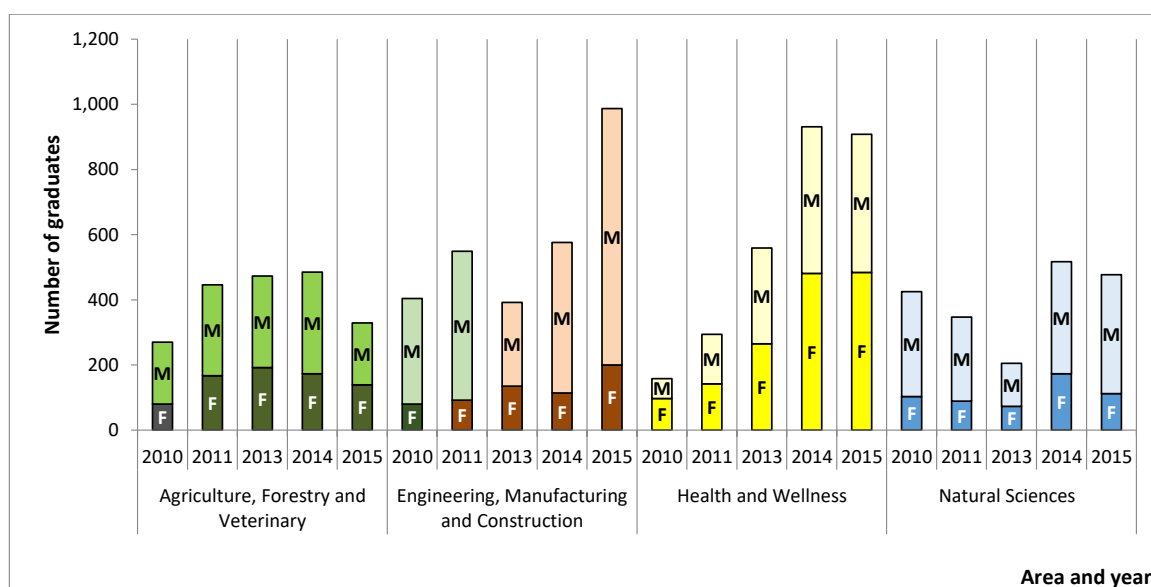


Figure 4. Number of Higher Education graduates in S&T courses

Source: Ministry of Education – Directorate for Higher Education (2012-2015) & MCTESTP- National directorate for higher education (2016)

regions of the world (Subbaye and Vithal, 2017) and some studies argue for a more inclusive promotion strategy by broadening the range of activities in promotion policies and processes beyond the focus on research. For instance, a study by Vithal *et al.* (2013) in the University of KwaZulu Natal advanced that including teaching in the promotion criteria contributes to equitable promotion outcomes.

The gender strategy [2012-2016] includes initiatives to encourage participation of females' students in S&T related subjects in order to influence an increase of university females' students in S&T programs. The strategy also includes initiatives to attract and retain women in key areas of science and technology. However, specific policy instruments that promote female participation in S&T areas are yet to be developed. This lack of operational instruments is acknowledged (H. Monteiro, personal comm. November 2019) and has been addressed in the new gender strategy for higher education [2018-2023] yet to be approved. Along the same line and reinforced by the SADC recommendation, there is ongoing work to constitute a women's forum for science, technology, engineering and

mathematic (STEM). This forum will not only act to support dissemination of work done by women in STEM areas but is also expected to increase promotion and appreciation of STEM by women for women, thus building the role model culture (H. Monteiro, personal comm. November 2019). The National Research Fund in their gender strategy (FNI, 2016) emphasizes the need to address specific obstacles to women's professional development in research and to eliminate the negative stereotypes and prejudices that have been rooted from the earliest times to bridge the male and female research gap. The strategy also emphasizes the need for stronger incentives to attract women to STEM related research courses. However, these objectives are yet to be transformed in systematic actions and adequate monitoring mechanisms for better and sustainable results. Some initiatives mentioned during interviews with key informants, such as the scholarship program for students interested in STEM funded by World Bank and implemented in collaboration with the Ministry of Science and Technology gives priority to women, but it ends up benefiting more men than women because a limited number of women fulfil the requirement.

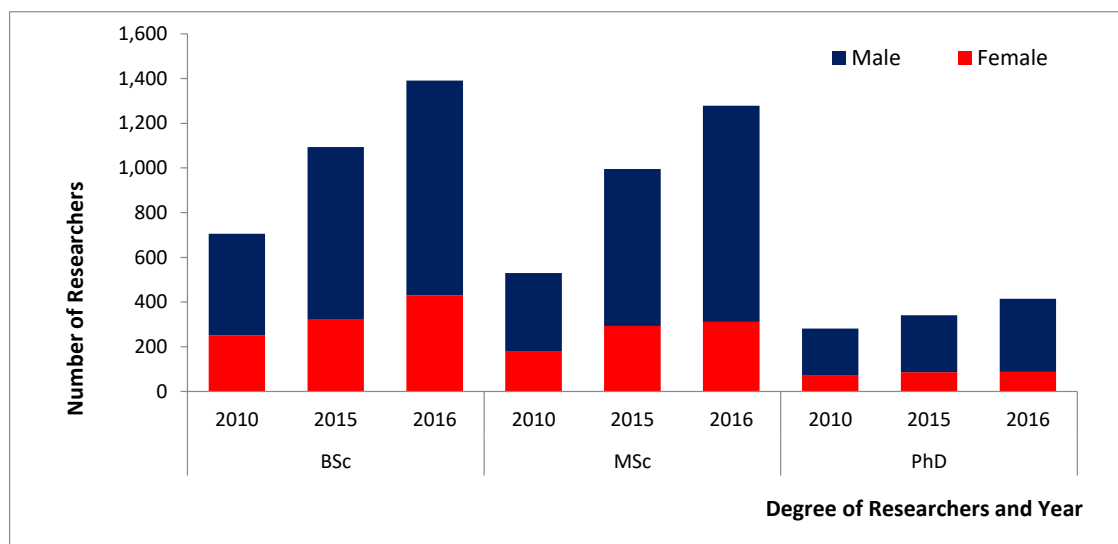


Figure 5. Number of Researchers by gender and academic degree
Data Source: MCTESTP, 2017

Mapping gender and Science, Technology and Innovation ecosystem in Mozambique.

Government institutions are the main actors shaping the STI ecosystem in Mozambique (Figure 6) by providing the policy framework, which in turn is informed and to some extent driven by international development agencies. Higher Education Institutions (HEIs), research institutes and technical-vocational education (TVET) are primarily responsible for the foundation of knowledge but the conditions on which these institutions operate do not allow exploration of their potential due to limited financial resources.

Contrary to in developed countries where private sector has an expressive role in funding research and development, in Mozambique most of the research money comes from the public sector and international agencies. Apart from direct funding of public HE, TVET and research institutions, government established two important mechanisms that influence directly S&T and women participation in it: National Research Fund (FNI) and Scholarship Institute (IBE).

Scholarship Institute (IBE) is a key actor in ensuring gender equity in the HE, responsible for the planning, allocation, coordination and scholarship management for academic training inside the country and abroad. In awarding scholarships, IBE considers gender by offering half of the scholarships to girls. However, this measure not always results in a desired outcome because it often happens that girls do not fulfill the scholarship requirements. Additionally, there is a government recommendation that out-of-country scholarships should be for the natural sciences related courses. This constitutes an obstacle for girls as they often graduate in social sciences and humanities. Asagie and Alutu (2017) reported similar findings in other African countries and factors associated with it includes lack of self-confidence, stereotypes, discouragements and sometimes-unclear

understanding of what math and science is all about.

Research National Fund (FNI) is another key actor in STI and gender ecosystem. The FNI includes a gender dimension in the criteria for selection of fundable projects. In an interview with a key informant it was explained that the gender criteria is not yet applied in a way that gives priority to women for funds allocation. The criteria looks more in terms of the extent the proposed project takes into account gender in the team composition, the project beneficiaries and the project outcomes.

Donors and international funding agencies also play a key role in STI ecosystem in Mozambique. There are several initiatives funded by donors and international funding agencies (e.g. NUFFIC, DFID, World Bank) aiming at promoting gender strategies in higher education institutions such as universities and polytechnic institutions with the major aim of increasing women participation in science and technology. Technical and Vocational Education and Training (TVET) schools receive donors' funds with the aim to develop and implement gender equity initiatives through programs to increase opportunities for young girls to enter TVET as well as assisting vulnerable students remain in schools and better integrate in the society.

Research expenditure by scientific area reveals that funding in STI is concentrated in a few areas. Biomedical and agricultural related areas have higher expenditure compared to engineering and technology (Figure 7).

Then the question is whether the money spent in the specific scientific area reflects the importance of the scientific area through the number of researchers or influence on attracting more researcher to the scientific area. Either way it emphasizes the need for more attention to other scientific areas. On the other hand, data about

the expenditure by sector (Figure 8) highlights that HEIs and public research institutes are the ones spending more money on research with an incremental trend, while the private sector does not spend much in research. An interesting

factor to explore could be the reason influencing the decreasing trend of research expenditure in the private sector and the increasing financing to the NGO sector between 2009 and 2015.

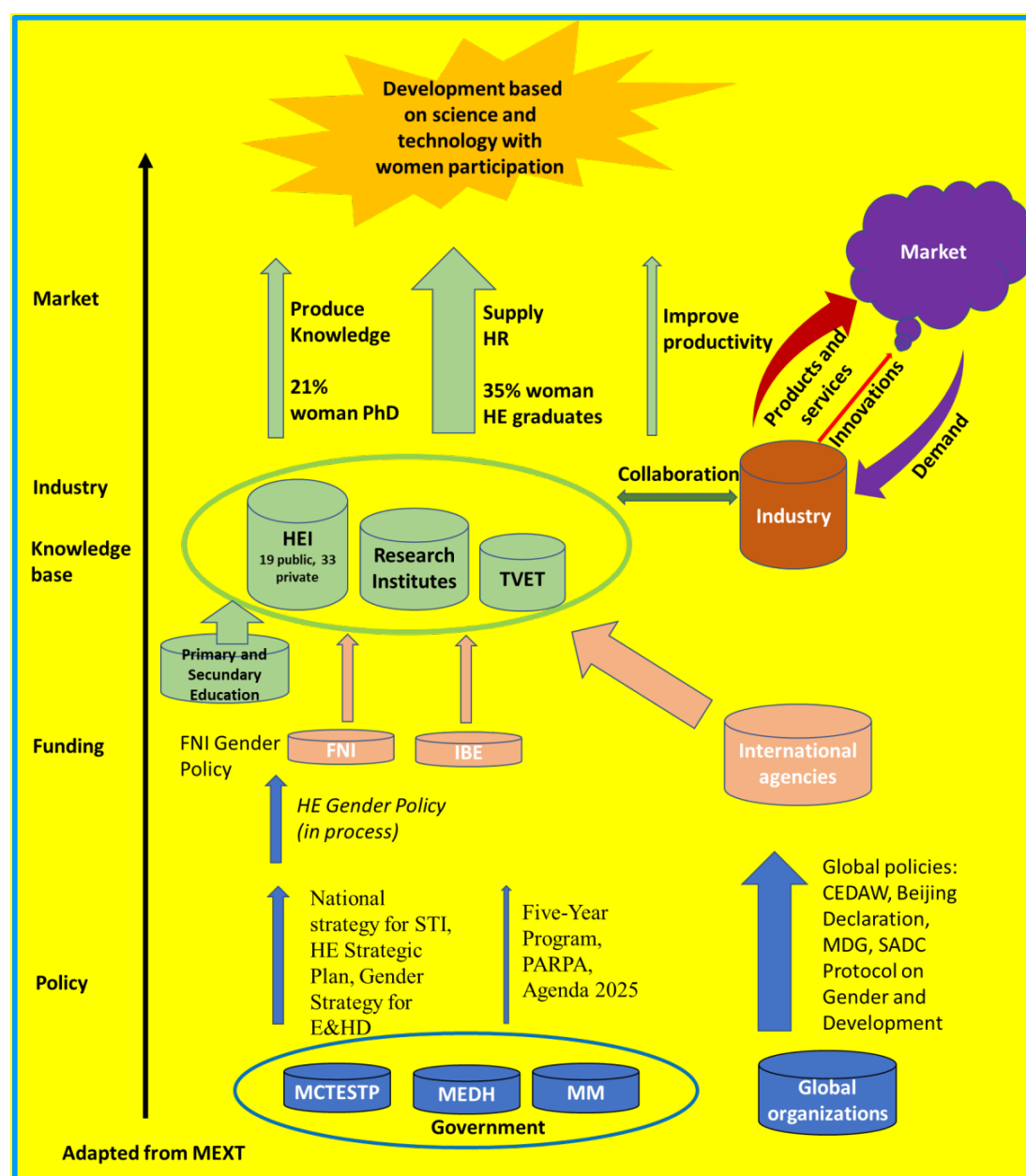


Figure 6. Gender based STI ecosystem in Mozambique

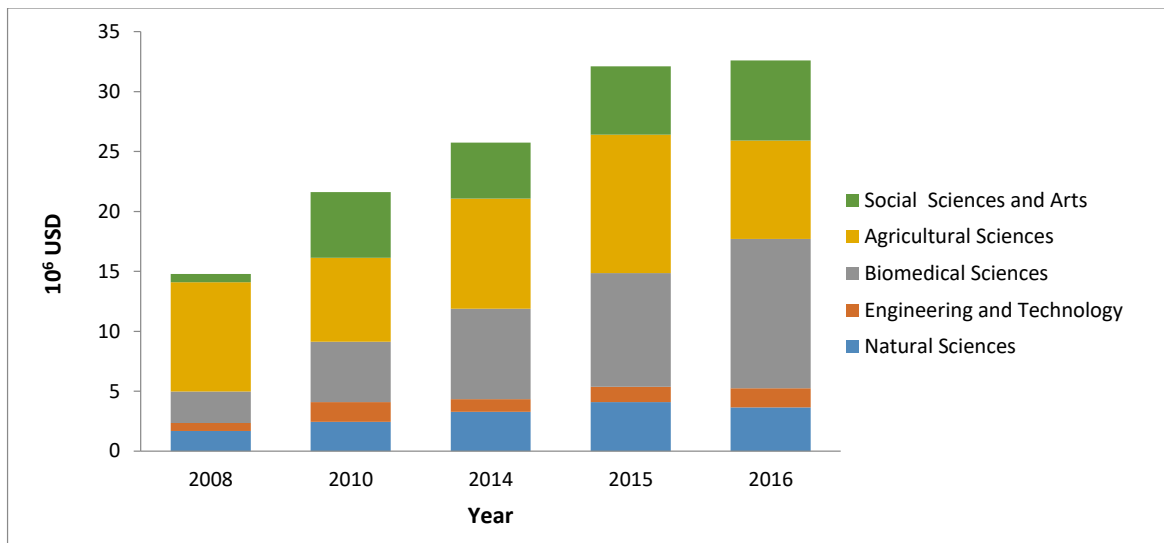


Figure 7. Research expenditure by research area
Data Source: MCTESTP (2017)

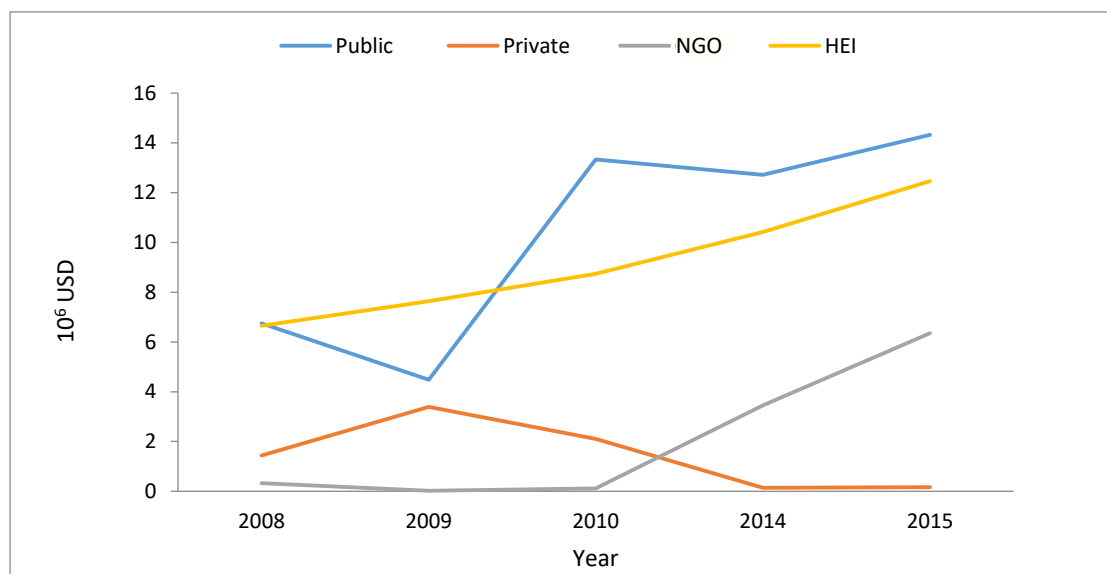


Figure 8. Research expenditure by sector
Source: MCTESTP (2017)

This observation is consistent with the findings of Zavale *et al.* (2017) that private companies in Mozambique hardly collaborate with HEIs. Among the surveyed companies, only 20% mentioned some kind of collaboration with HEIs and research institutes and these authors suggested, “companies are more incentivized by their internal needs for short-

term production than long-term innovations”. The few collaborations between companies and the few HEIs is mostly through exchange of forms of embodied knowledge, exchange of skills embodied in students, graduates or academics. The same study suggested the need to strengthening the collaboration between HEIs and private sector in curricula development and

provision of teaching to enable HEIs to better respond and provide students with skills that are relevant to companies, enabling students to spend part of their HE program time both at university and in companies. The weak collaboration between HEIs and private sector reduce the visibility and contribution from HE to science, technologies and innovations.

STI initiatives in HEI: The case studies of public and private universities and polytechnic higher institutes. This study zoomed on five HEIs for closer analysis of STI. These HEIs included the two public universities (UEM and UniLúrio), one private University (A Politécnica), and one public and one private higher Polytechnic Institution (ISPM and ISDB). University of Eduardo Mondlane (UEM) is the oldest public and largest university in Mozambique (founded in 1969) and has therefore the highest number of admission compared to other HEIs. Regardless of the years of existence, all studied HEIs are in process of formulating their gender policies and strategies, and only two (UEM and ISPM) have gender units aimed at coordinating gender issues within the university. Eduardo Mondlane University has an internal unit: the Gender Affairs Coordination Center (CeCaGe). This unit carries out activities in research, training and provision of gender related services to the university community (students and academic staff). The Manica Higher Polytechnic Institute (ISPM) created the gender unit in 2018, since then they have been engaged in promoting gender equity and equality at all levels of the ISPM. They are working on reinforcing and strengthening political and management will, through promoting equity and combating discrimination in access, remuneration, promotion and retention of employed women and men. A Politécnica only recently (2018) started work on gender legal instruments to better regulate the intervention and promote

gender initiatives in a systematic way. As a result, they created the gender coordination group that started by systematizing all gender related initiatives which will lead to the development of a gender policy. UniLúrio is in the process of creating a gender management Unit as part of their institutional action plan, which will also coordinate the formulation of gender policy [2019-2024]. ISDB strategic plan [2017-2021] includes “Gender Sensitivity and Awareness” as one of the main values of the institution with focuses on access, diversity in staff representation and the integration of gender and social inclusion aspects into the institutional curriculum and training modules.

Gender initiatives in the studied HEI include:

- Scholarships policies and programs that target women (UEM and A Politécnica). For example UEM allocates 50% of scholarships to female students. UniLúrio has a Scholarship Program [2018-2022] funded by African Development Bank (ADB) that has 82 out of 142 scholarships being female beneficiaries.
- Promoting career training for academic staff with special quotas/attention for women. UniLúrio through African Development Bank (ADB) is funding postgraduate (MSc and PhD) training for their staff. They have awarded six Masters Scholarships (five males and one female) and 13 PhD Scholarships (six female and seven male).
- Advocacy and promotion of women leadership in academia. Ensuring women participation in collegial boards (UEM, ISPM and A Politécnica) and other initiatives such as A Politécnica ‘girls move’ initiative funded by Danida where top institution managers participate as mentors to support mentees at different university units. They provide advice and professional orientation, the idea is to select mentors that are influential in the society to serve as role model.
- Development of research projects on topics such as violence against women, women’s

economic empowerment, gender-sensitive pedagogical practices, among others (UEM, ISPM, A Politécnica)

- Promotion and facilitating access to information through training and seminars to raise gender awareness on women's economic empowerment, gender planning and budgeting as well as life skills, for all university community at leadership level (UEM, ISPM). At ISPM some of these initiatives include gender training for teachers funded by NICHE Moz 230 project; gender-based decision-making awareness lectures for ISPM staff, seminars on Gender Equality and Equity and Women's Empowerment in the various forums involving students, teachers, community leaders and board members.
- Offering of Psychosocial Counseling Office benefiting all HEI community (UEM). The ISPM unit assists students and other academic community on issues related to sexual and reproductive health, gender-based violence, premature marriages, among others.
- Offering of vocational assessment to support students in the selection of HE program orientation. A Politécnica offers free vocational assessment and 60% of their technical vocational education's students are female.
- Outreach gender oriented programs with local communities offering opportunities for students engagement. ISPM offers entrepreneurship-training initiatives for young mothers and teachers; development and implementation of preparatory project for higher education entrance examinations for girls and people with special needs in secondary schools; A Politécnica final year students are involved in providing legal assistance to vulnerable people. UniLúrio adopts a Curriculum approach that favors contact with local communities. For instance, "One Student, One Family" program promotes knowledge transfer and community assistance in health and nutrition issues,

sanitation, and community related issues.

- Admission systems that target increasing number of girls that enter HEI. ISPM introduced 'affirmative action' in the entrance examinations mechanism to benefit women and increase the number of girls in higher education courses. ISDB has a positive clearance strategy and a mandatory percentage (30%) of girls through which it facilitates the entry of more girls into the institution by making use of a subsidized credit scheme and its scholarship program targeting vulnerable families. UniLúrio, as part of the ADB project, is developing a specific program in the STEM and Portuguese subjects to support preparation of 11th and 12th grade high school girls' students, to promote appreciation for STI areas and ensure better grades in the admission exams.

From the above HEI study cases, it is apparent that the country lacks gender and STI policies and strategies to enable concerted actions towards addressing gender disparity at both students and academic staff levels. Each HEI acted differently grabbing ad-hoc opportunities that emerged to address issues related to gender equity and increase women appreciation for STI. As advanced by Howe-Walsh and Turnbull (2016) institutions should have clear career guidance and support to help women navigate their careers to senior positions and gender affirmative actions (Tizikara *et al.*, 2019). Other studies argue for a broader spectrum of criteria to be included in the promotions policy and processes of academic staff in HEIs beyond those focused on research for better balancing the strengths offered by both male and female in the academia (Bagilhole, 2000; Subbaya and Vithal, 2017).

CONCLUSIONS AND RECOMMENDATIONS

Gender and STI is an emergent subject in Mozambique that is slowly gaining space and more attention both at national policy and in the

HEIs. The status of Mozambique's gender based Science Technology and Innovation ecosystem is incipient with following characteristics. First, recently created policies and strategies lack adequate implementation instruments, plans for systematic actions, and monitoring. Second, there is a weak integration and articulation between secondary, higher and technical and vocational education, i.e., between MINEDH and MCTESTP. Third, there is lack of diversified financing mechanisms oriented to gender and STI. Lastly, there is a very limited collaboration and partnerships between knowledge base institutions, industry and market of new technologies.

Actions by both HEIs and national level policies promoting gender equity and equality, stimulating and enhancing women appreciation and participation in STI are still very limited and recent, their impact and effectiveness are yet to be assessed. The current setup of the national system where students choose a S&T or A&H orientation after 10th grade, when not sufficiently prepared to take informed decision affects the appreciation and numbers of students in S&T.

The gender based STI in Mozambique is prominent in the policy and knowledge base dimensions. International agencies are the main funding source followed by the public sector while the private sector has very little contribution. Contrary to other countries where private sector has an expressive role in funding research and development, in Mozambique most of the research money comes from public sector or from HEIs and is skewed towards medical sciences and agriculture.

The prospect of constituting the STEM women's forum is seen as an important step to enhance women visibility; increase appreciation for STEM related programs, therefore contributing to increase participation of women in HE and

in STI programs in particular. It is therefore recommended to strengthen and expand already existing scholarship programs targeting females and mentorship starting in secondary school as a key strategy to be adopted. Finally there is need to establish an intrinsic collaboration with private sector find society oriented practical solutions and technologies that fit their interests and secure funding.

ACKNOWLEDGEMENTS

We thank RUFORUM and Forum for African Women Vice Chancellors for supporting this study. We express our gratitude to Prof. Rosânia Silva (A Politécncia), Dr. Sónia Maciel and Dr. Arlete Mulesiua (UniLúrio), Dr. Rosinda Cossa (ISDB), Dr. Yara Loforte (ISPM) and Prof. Carla Braga (UEM) for sharing their perspectives, initiatives and experiences in promoting gender equality in their institutions and for providing gender related information from their respective Higher Education Institutions and for comments in an earlier version of the manuscript. We thank Dra Helena Monteiro (DNCT) and Dra Ana Ruth Menezes (World Bank) for their insights and for sharing their valuable experience and perspectives on gender and STI in Mozambique. We also thank Prof. Eugénea Cossa and Dr. Calado Muianga (DNES) for providing national data and information regarding gender in Higher Education in Mozambique. Finally, we thank Irondina Cardoso for her assistance with data analysis.

STATEMENT OF NO CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

REFERENCES

- African Union Commission (AUC). 2015. Agenda 2063. AUC, Addis Ababa, Ethiopia. 24pp.
- António, E. and Hunguana, C. 2014. Relatório do Estudo sobre o Género no Ensino Superior

- em Moçambique. DICES-MINED, Maputo.
- Bagilhole, B. 2000. Too Little too Late? An assessment of national initiatives for women Academics in the British University system. *Higher Education in Europe* 25(2):134-145. DOI:10.1080/713669260.
- Darvas, P., Ballal, S. and Fedá, K. 2014. Growth and equity in Tertiary Education in Sub-Saharan Africa. *International Journal of African Higher Education* 1 (1): 85-13. <https://doi.org/10.6017/ijahe.v1i1.5645>
- European Commission (EC). 2013. She Figures 2012 – Gender in Research and Innovation: Statistics and Indicators. Luxembourg: European Union.
- Equality Challenge Unit (ECU). 2014. Equality in Higher Education: Statistical Report 2014. Accessed May 2020. <https://www.advance-he.ac.uk/knowledge-hub/equality-higher-education-statistical-report-2014>
- FNI. 2016. Estratégia de Género Fundo Nacional de Investigação. Maputo
- Howe-Walsh, L. and Sarah, T. 2016. Barriers to women leaders in academia: tales from science and technology. *Studies in Higher Education* 41 (3): 415-428 DOI: 10.1080/03075079.2014.929102
- INDE. 2007. Plano Curricular do Ensino Secundário Geral. Ministério de Educação e Cultura
- ISDB. 2018. Política de Igualdade de Género e inclusão social do ISDB. CNOP and MSM
- MEXT. 2019. For further reinforcing the Fundamental capacity for STI. Ministry of Science and Technology. Japan, <http://www.mext.go.jp/en/publication/whitepaper/title03/detail03/1420912.htm> Accessed on 22nd November 2019
- MCT- DPEC. 2013. Livro de dados [2009-2010]. Indicadores de Ciência e Tecnologia. Vol.II. Maputo
- MCTESTP. 2017. Relatório de indicadores sobre investigação científica e desenvolvimento experimental referente ao período 2014-2015. DPEC, Maputo
- MCTESTP. 2018. Relatório de indicadores sobre investigação científica e desenvolvimento experimental referente ao ano 2016. DPEC, Maputo
- Morley, L. 2005. Gender equity in Commonwealth Higher Education. *Women's Studies International Forum* 28: 209–221. DOI:10.1016/j.wsif.2005.04.008.
- Morley, L. 2014. Lost Leaders: Women in the Global Academy. *Higher Education Research and Development* 33 (1): 114–128. DOI:10.1080/07294360.2013.864611.
- Nakayiwa, F., Osiru, A., Shibu, A., Sam-Amoah, L.K., Ochuodho, J., Assogbadjo, A.F., Valeta, A.E., Sefasi, A. and Kalizang'oma, R. 2016. Developing Higher Education systems in Africa - Selected country views. *African Journal of Rural Development* 1 (2): 205 – 217.
- Osagie, R. and Alutu, A. 2016. Factors affecting gender equity in the choice of science and technology careers among secondary school students in Edo State, Nigeria. *International Education Studies* 9 (10): 231-236.
- República de Moçambique. 2003. Política de Ciência e Tecnologia. Maputo
- República de Moçambique. 2006. Estratégia de Ciência, Tecnologia e inovação [2006-2016]. Ministers' council 15 sessão, Junho 2006
- República de Moçambique. 2018. Política de Género e Estratégia de sua Aplicação. Maputo
- Subbaye, R. and Vithal, R. 2017. Gender, teaching and academic promotions in higher education. *Gender and Education* 29 (7): 926-951. DOI: 10.1080/09540253.2016.1184237
- Tizikara, C., Nakayiwa-Mayega, F. and Otto, F. 2019. Investing in women as drivers of growth: A gender-based assessment of the Science, Technology and Innovation ecosystem in Uganda. *African Journal of Rural Development* 4 (2): 261-281.
- UNESCO. 2019. Mozambique information. <http://uis.unesco.org/en/country/mz> Accessed on 26th November 2019.
- Vithal, R., Subbaye, R. and North, D. 2013.

- Valuing teaching in University academic promotions. *Alternation* 9: 318-342
- Zavale, N. 2017. Expansion versus contribution of higher education in Africa: University-Industry linkages in Mozambique from companies' perspectives. *Science and Public Policy* 45 (5): 645-660.
- Zavale, N., Santos, L., Manuel, L., Dias, M.L., Khan, M., Tostão, E. and Mondlane, A. 2017. Decision-making in African Universities demand rigorous data: Evidence from graduation rates at Eduardo Mondlane University, Mozambique. *International Journal of Education and Development* 52: 122-134.