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Participation of Women in Engineering & Technology Education and Employment

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Abstract: ***Engineering and Technology Education is a means to sustain and accelerate the overall development in a country and it has a direct effect on individuals' productivity and earnings as well. But the problem is there is gender disparity in distribution especially in developing countries among educational branches. In Ethiopia, despite significant improvements in the last couple of years, women are still under-represented in engineering and technology. Since the share of Ethiopian women in science and technology programs in higher education has been low, the governments apply a policy to stream 70% of all university entrants to be in the science and technology track indirectly to increase their entry into these fields. Even if this types of policy is applying, their participation in engineering and technology education and employment is very low proportion. The main purpose of this study is an attempt to assess trends and share of women in the field of engineering and technology regarding to their share of enrollment, employment and professional positions from the period 2000 -12 based on available secondary data collected from different sources. The collected quantitative data were analyzed by using descriptive data analysis techniques. Result from the data shows that there is low share of women in engineering and technology enrollment, employment and professional position status as compared to male in the country. Even if the share of enrollment of women in higher education is on improved status, their share of enrollment in engineering and technology filed is quite low that on average below 30 percent per year. In addition, this grate disparity and low participation of women in engineering and technology invites further investigation regarding to what is the reason behind.***

Key words: Women, engineering and technology, enrollment and employment, Ethiopia

I. INTRODUCTION

Ethiopia is found in eastern part of Africa. The total population accounts 102.4 million with life expectancy of 65 years and GNI per capita is $1750 in 2016 [11], [29] and women accounts half of the population.Since education is a means to sustain and accelerate the overall development in a country and it has a direct effect on individuals' productivity and earnings as well [30], the Ethiopian government has adopted a new Education and Training Policy in 1994. The policy focuses on increasing access to educational opportunities with enhanced equity, quality and relevance stared in 1997/98 with the long-term goal of achieving universal primary education [31] and is governed by Ministry of education. Ethiopia school enrolment in 2015/ 2016 at the age 7-18 is male at primary level 64.3% and at secondary level 5.5% as well as female at primary level is 64.2% and secondary level 5.8%. Tertiary education enrolment rate in 2014 of male is 10.94% and 5.28% female [32]. Total literacy rate in the same year was 64.1 %[12].

Women were totally excluded from education life for long time history of Ethiopia. There were strong social and cultural pressures for girls to marry before 14 years old. Virginity before marriage was highly valued and unmarried girl over 14 year was stigmatized. Girls are socialized to be shy and obedient and not to speak in front of adults, particularly in front of men. The focus is on her future role as respectful wife and good mother, hence they didn't went to school, even they went because of various problem such as harassment , violence [1] and their own natural phenomena of adolescence age , they dropout from school. This situation again leads to low employment participation in countries development. Hence to encourage women in education and employment participation, Ethiopian government policy has supported affirmative action for women since its beginning in 1994. Since the time women started to come out of domestic chores in Ethiopia, they have made significant contribution in all spheres of activities vital to the country development [27]-[28].

However, still, women are underrepresented in engineering and technology education and employment [3], [9], [5], [17], [18]. There are various factors for this under representation. Such as studies by [2], [8], [21], [14] [13], [25] found high school educational background, family education and lack of role models have an impact on decision to study engineering and technology. Studies [16], [19], [17], [24]; [6], [22], [23], [26]found that employment participation of women engineering and technology is low and is male dominated sector. However, there are few study about participation status of women in engineering and technology in Ethiopia. This indicates that there is research gap in the study area which need more research investigation. Thus, the objective of this study is to examine the trends and share of women in engineering and technology education and employment participation with the help of secondary data.

II. METHODOLOGY OF THE STUDY

In this study secondary data from Ethiopia Ministry of Education statistics annual abstract report and National Assessment [10], [28] were taken to analyze the trends and share of women participation in engineering and technology education and employment.
Result analysis of this study has done through the following procedure.

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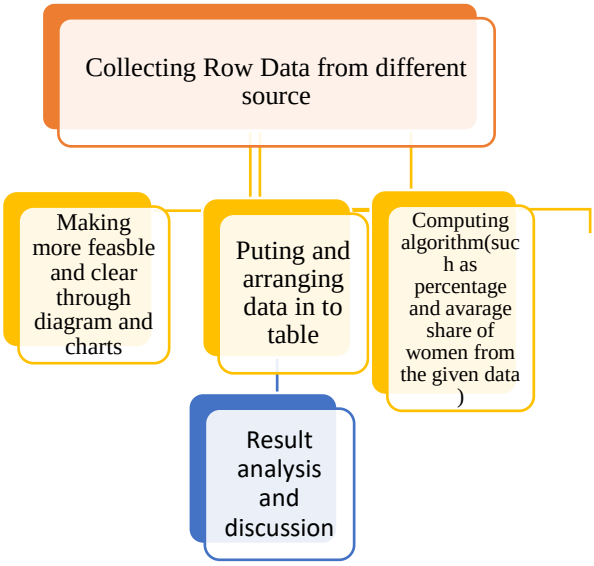


III. RESULTS AND ANALYSIS

Ethiopian Education system is structured by different stages which is kindergarten, alternative basic education, 1st cycle primary education (grade 1-4), 2nd cycle primary level from grade 5-8, 1st cycle secondary level grade 9 and 10, 2nd cycle secondary education level (preparatory school grade 11 and12), Technical and vocational education and training (TVET) , Undergraduate degree , Master degree and Ph.D education level. Hence, in this study researchers going to investigate about participation of women in engineering and technology education and employment from preparatory school (grade 11 and 12) share of enrollment since this education level is the base for joining to higher education institutions.

Table-I: Trends of Women Enrollment in Preparatory School Program

Year	Enrollment			
	Boys	***Girls***	***Total***	***% girls***
1995E.C (2002/03)	56367	22274	78641	28.32%
1996E.C (2003/04)	68,330	25,065	93,395	26.83%
1997 E.C (2004/05)	67,413	25,070	92,483	27.1%
1998 E.C (2005/06)	91,889	31,794	123,683	25.7%
1999 E.C (2006/07)	117,000	58,219	175,219	33.23%
2000E.C (2007/08)	130,533	62,911	193,444	32.52%
2001E.C (2008/09)	146,547	58,713	205,260	28.6%
2002E.C (2009/10)	156194	86886	204,308	42.5%
2003E.C (2010/11	169,571	118,645	288,216	41.165 %
2004E.C (2011/12)	172,268	156,724	328,992	47.64%
Average				**33.36%**

Source : [28]

The trends of share of female in preparatory school (grade 11 and 12) given in table-I, shows experience of improvement with fluctuation through time. The percentage of female students during 2011/12 has sharply increased and has reached 47% but when we observe the average percentage share of female 33.36% which show the there is some existence of gap.

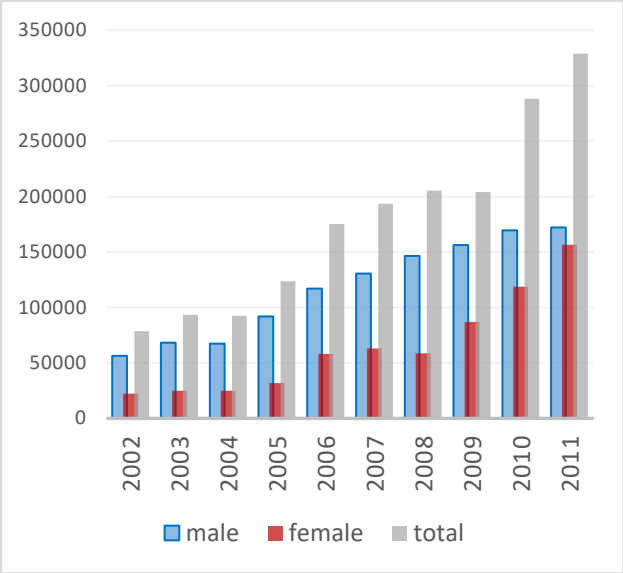


Fig. 1. Women students' enrollment in preparatory school program

Figure 1 clearly show, the share of female students in in preparatory school (grade 11 and 12) improved in the last ten years. This is due to some affirmative action taken for girls able to join in preparatory school.

From table-II, the trends of share of women in higher education is very low in the last 10 years which is an average of 24.98%. This is due to various factors social, cultural, economic and personal factors which is beyond the scope of this study which needs further investigation. However, there was a better improvement of share of women during the year 2001, 2008, and 2011 which is around 28%.

Table-II: Trends of women and Man Enrollment in Ethiopian Universities

Year	Enrolment			
	Man	***Women***	***Total***	***%Women***
1993 E.C (2000/01)	35932	9594	45526	21.07%
1994E.C (2001/02)	32279	13517	46796	28.88%
1995E.C (2002/03)	57321	18676	75997	24.57%
1996E.C (2003/04)	59352	18375	77727	23.64%
1997E.C (2004/05)	70388	21267	91655	23.2%
1998E.C (2005/06)	70388	21267	91655	23.2%
1999E.C (2006/07)	79465	25108	104573	24%
2000E.C (2007/08)	206336	64020	270356	23.67%

2001E.C (2008/09)	229489	91338	320827	28.46%
2002E.C (2009/10)	319327	115332	434659	26.5%
2003E.C (2010/11)	344137	123706	467843	26.44%
2004E.C (2011/12	353163	138708	491871	28.2%
2005E.C (2012/13)	553848	166141	719989	23%

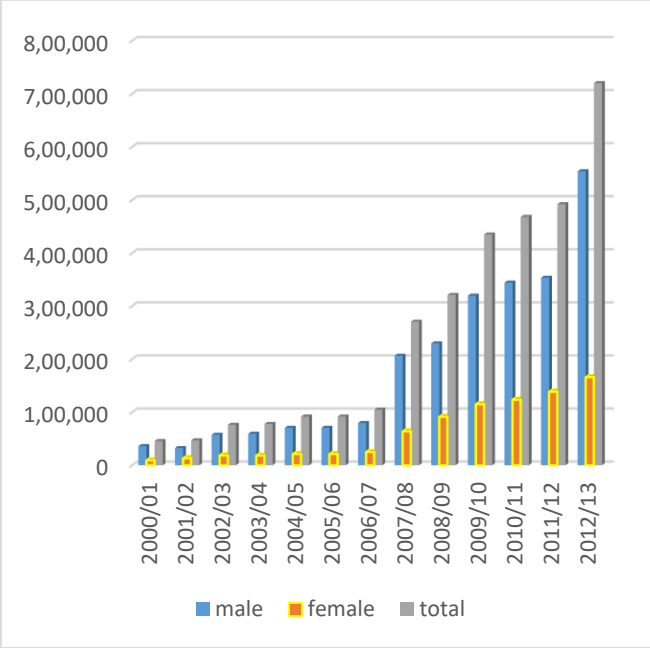


Fig. 2. Share of women' enrollment in Ethiopian Universities

Figure 2 which is constructed [28] from table-II shows, the enrollment status of trends of women in in Ethiopian higher education which indicates there is high gender disparity in enrollment in this level of education.

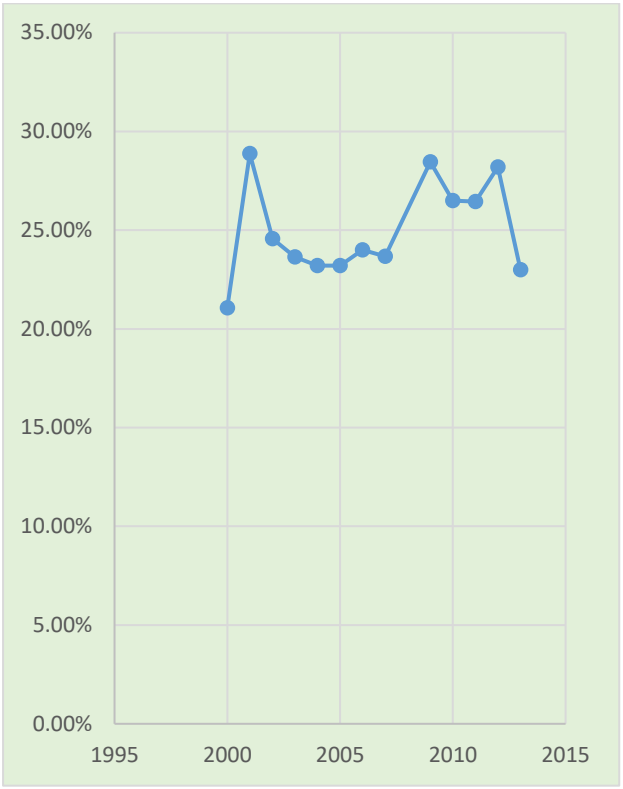


Fig. 3. Percentage of women enrollment in higher education from the total. Source: [28]

Table-III: Trends of Women in Higher Education Enrolment, and Graduation in Undergraduate and Post Graduate Program

Enrollment in Higher Education	Year							
	1997 E.C (2004/05)	1998 E.C (2005/06)	1999 E.C (2006/07)	2000 E.C (2007/08)	2001 E.C (2008/09)	2002 E.C (2009/10)	2003 2010/11	2004 2011/12
1.Under Graduate Degree								
1.1 Enrollment	138159	173,901	203,399	263,001	309,092	420,387	447,693	494,110
percentage of female students	24.0%	24.8%	26.0%	24.1%	29.0%	27.0%	27.0%	28.2%
1.2 Graduates	11,535	25,335	29,845	47,979	55,770	66,999	75,348	78,144
Percentage of female graduates	16.4%	16.2%	17.4%	20.7%	29.7%	23.4%	27.3%	25.3%
2.Post Graduate								
2.1 Enrolment	3,604	6,385	7,057	7,355	10,125	14,272	20,150	25,660
Percentage of female students	9.2%	10.0%	10.0%	10.5%	11.3%	11.9%	13.8%	20.2%
2.2 Graduates	1,126	1,388	2,671	2,664	3,257	4,873	6,250	6,162
Percentage of female graduates	9.0%	9.8%	9.4%	10.7%	12.3%	13.9%	14.4%	14.0%

Source: [28]

In figure 3, the percentage share of women enrolment from the total enrollment of higher education had shown increasing trend and falling in 2002, which constantly growing till 2008.

Again in table-III, trends of share of women in higher education enrolment, and graduation in undergraduate and post graduate program. From this the share of enrollment in undergraduate program is not that much improved but the share of graduation in under graduate program shows some improvement trend. Their share of enrollment in post graduate level is increased from 9.2 % to 20.2% in the last 8 consecutive years.

Table-IV: Trends of Share of Women Enrollment and Graduation in Undergraduate Program

Year	Under graduate Enrollment		Undergraduate Graduates	
	Female	*Total*	*Female*	*Total*
2004	33158	138,159	1892	11,535
2005	43127	173,901	4104	25,335
2006	52884	203,399	5193	29,845
2007	63383	263,001	9932	47,979
2008	89637	309,092	16563	55,770
2009	113505	420,387	15678	66,999
2010	120877	447,693	20570	75,348
2011	139339	494,110	19770	78,144
Mean	81989		11712	

Source: [28]

Table-IV shows, the trends of share of women student's enrollment and graduation in undergraduate program in terms of number from the total students which show increment but still low as compared to male students. Figure 4 also shows, share of women in post graduate program that indicates very low participation position.

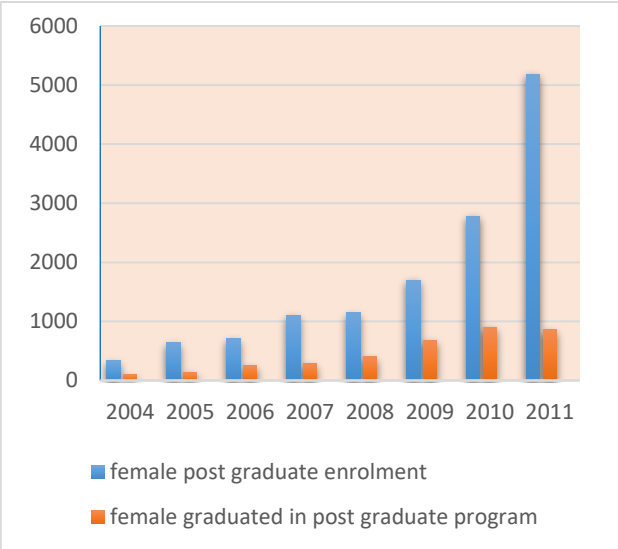


Fig. 4.The share of women students in post graduate program.

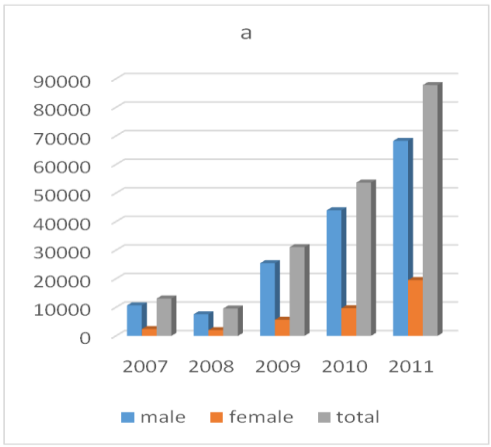
Table-V: Women Enrolled in Regular Undergraduate Engineering and Technology Education by Universities

Universities	Gender	Year				
		2007	2008	2009	2010	2011
Adama	Male Female Total	1443 379 1822	Na	4876 865 5741	5736 776 6512	5956 969 6925
Addis Ababa	Male Female Total	1205 408 1613	3164 1097 4261	2753 955 3708	2969 910 3879	7836 2799 10635
Adigrat	Male Female Total	Na	Na	Na	Na	173 207 380
Aksum	Male Female Total	38 8 46	73 13 86	226 55 281	857 362 1219	1794 1027 2821
Ambo	Male Female Total	Na	Na	281 54 335	785 148 933	785 148 933
Arba Minch	Male Female Total	1789 346 2135	752 276 1028	2931 711 3642	5496 1092 6588	6199 1362 7561
Assosa	Male Female Total	Na	Na	Na	Na	169 205 374
Bahir Dar	Male Female Total	2164 452 2616	Na	2768 749 3517	3548 1087 4635	4469 1358 5827
Bulle Hora	Male Female Total	Na	Na	Na	Na	58 26 84
Debre Birhan	Male Female Total	Na	122 45 167	44 6 50	917 411 1328	1503 785 2288
Debre Markos	Male Female Total	Na	Na	368 54 420	Na	2077 6112 688

Debre Tabor	Male Female Total	Na	Na	Na	Na	99 64 163
Dilla	Male Female Total	Na	Na	Na	Na	574 329 903
Meda Walabu	Male Female Total	Na	Na	38 15 53	535 170 7 05	1048 3711 419
Mekele	Male Female Total	1276 268 1544	Na	1753 293 2046	3497 825 4322	36757 904 465
Mettu	Male Female Total	Na	Na	Na	Na	85 41 126
Mizan Tepi	Male Female Total	Na	Na	482 72 554	860 287 1147	1486 6992 185
Sumera	Male Female Total	Na	Na	29 8 37	Na	109 184 293
Wachemo	Male Female Total	Na	Na	Na	Na	114 64 178
Wollega	Male Female Total	125 20 145	Na	332 80 472	1093 233 1326	2257 7292 986
Wollo	Male Female Total	Na	139 25 164	1127 158 1285	1572 353 1925	1477 2981 775
Defense	Male Female Total	Na	Na	531 10 541	531 10 541	531 10 541
Dire Dawa	Male Female Total	Na	158 37 195	806 558 1364	1413 686 2099	2313 10323 345
Ethiopian civil service	Male Female Total	328 39 367	Na	562 57 619	484 44 528	474 62 536
Gonder	Male Female Total	Na	Na	Na	1054 459 1513	2014 972 2986
Haramaya	Male Female Total	531 132 663	1254 148 1402	1438 205 1643	3506 651 4157	4692 861 5553
Hawassa	Male Female Total	838 175 1013	1899 368 2267	2214 448 2662	3833 673 4506	5070 1161 6231
Jijiga	Male Female Total	Na	Na	Na	851 186 1,037	1406 532 1938
Jimma	Male Female Total	935 167 1102	Na	1878 294 2171	3727 477 4204	6097 860 6957
Wolaita Sodo	Male Female Total	Na	Na	Na	694 192 886	1665 625 2290
Wold ia	Male Female Total	Na	Na	Na	Na	79 84 163
Wolkte	Male Female Total	Na	Na	Na	Na	209 258 467

Source: [28],Na = data not available

Table-v show, the share of female student's enrolment in regular undergraduate program in engineering and technology education in 31 public universities from the year 2007-2011 which shows there is grate disparity and under representation of female engineering education participation even if there is some improvement. The pattern of engineering enrolment is various in each universities. Since some of the universities are new established recently there is no data give for them. Especially third generation universities started education 2003/2004 data is not available for them. Hence, Addis Ababa University, Adama University, Aksum university, Mekele University, Haramaya, Hawassa, Jimma, Arba Minch, Bahir Dar, Wollega and Defiance Universes are the old universities and the most Engineering and technology education provider. The summation of Engineering student in this universities are summarized in the following table 6 and figure 4 including enrolment in non- government university and collages.



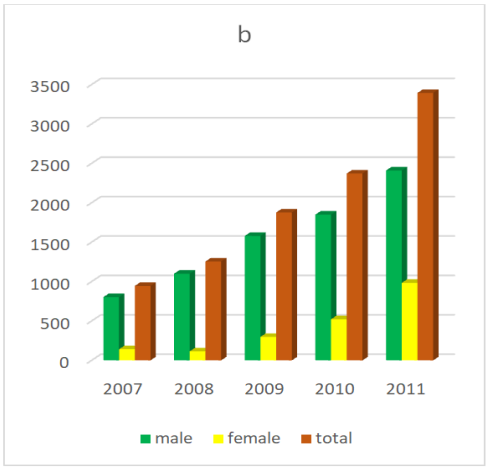


Fig. 5 a and b. trends and share of women regular undergraduate enrolment in engineering and technology education at government and non-government universities respectively.

In figure 5 a and b, on the bases of data [28], the share of women enrolment in engineering and technology education participation is increased from 18% during 2007 to 22.23% during 2011 in government universities and from 15% to 28% in non-government universities and colleges. However, there is gender disparity and women are underrepresented in engineering and technology education.

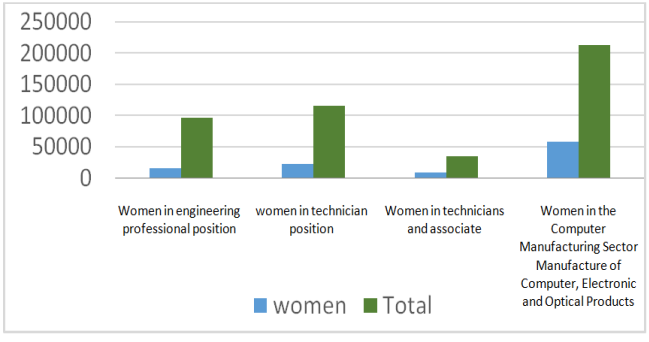


Fig. 6. Share of women from the total employments of engineering and technology fields

Figure 6 is constructed on the bases of data from national assessment [10] shows, the share of women in engineering and technology employment such as, technician position, engineering science, technicians and associate technician, computer manufacturing and others areas according to available data at national assessment 2013. The data shows that the share of women employees in this profession is very low but they are better in manufacturing employment.

IV. CONCLUSION

The finding of this study indicate that, women are underrepresented and there is grate disparities between male and female participation regarding to engineering and technology enrollment, graduation, employment and profession position in the field which is in line with the literature reviewed. This implies that problem needs attention so that give notice for the problem as well as creating awareness about the importance of engineering education starting from lower class through encouraging girls in science subjects and also take experience from other countries. In addition creating suitable environment for engineers at university level is necessary and there should be future research investigation in the field to identify the reason behind underrepresentation of women in engineering education and employment which can suggest sustainable solution for this problem.

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