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Research Article

DETERMINANTS OF IRRIGATION PARTICIPATION DECISION OF FEMALE IN ETHIOPIA; ACCESSIBILITY MATTERS (IN WEST SHEWA ZONE, BAKO TIBE WOREDA)

***Tasfaye Fikadu Fayisa**

[1]Economics Department, Wollega University, PO Box 395, Nekemte, Ethiopia
[2]Economic Analyst, Gada Consulting PLC, Nekemte, Ethiopia

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Abstract

In almost every country women tend to participate in labor force less likely than men due to many reasons. However, there is also gap among females themselves on how much time they spend on labor time attributable to age, education and any characteristics of females. The study assessed determinants of female irrigation participation using probit model based up on data obtained from sampled population of randomly selected Dembi Dima and Dembi Gobu kebeles of Bako Tibe Woreda. Accordingly, of all included variables in the probit model, age, presence of young child at home, household size, land and accessibility of land to irrigation significantly affect female irrigation participation while education of female, sex of household head and extension services are found to be insignificant even at 10% of level of significance. Above all, accessibility of land to small river is the main determinants of irrigation participation since there are few female whose land is proximate to river and not willing to participate.

Keywords: Female, Determinants, Irrigation Participation, Ethiopia.

INTRODUCTION

From theory of labor supply, the labor force participation rate is defined as the proportion of the population ages above 15 that is economically active. People who are economically active are those who are either employed or unemployed. Someone being in a working age that do not have a job and are not looking for it is not economically active (Esteban *et al.,* 2017). In the guidelines specified by the ILO (2018), employment also includes self-employment, which means that in principle, the labor force includes anyone who supplies labor for the production of economic goods and services, independently of whether they do so for pay, profit or family gain. Unpaid activities should be included if they lead to services or goods produced and consumed within the household and they are the prime contribution to the total consumption of the household. In almost every country women tend to participate in labor force less likely than men (Esteban *et al.,* 2017) due to many reasons. These are women's secondary role in the labor force along with home responsibilities, women's additional and supplementary (with male if head is male) wage earning in the household, less education, lack of family planning and women spend on child care are few among many (MacDonald and Peters, 2018). Similarly, in Ethiopia women's participation in rural institutions and markets is lower than that of men in Ethiopia(FAO (2019). For example, Females comprise 45 percent of the total agricultural labor force; however, 56 percent involved in agricultural work are unpaid workers, virtually, employed by family members at the peak of the agricultural season. Women are more likely to be paid in cash if they are employed in the non- agricultural sector, and they are also more likely to work for someone outside the family and 44 percent of women are self-employed (UNDP, 2018).

Corresponding Author:** ***Tasfaye Fikadu Fayisa
Economics Department, Wollega University, PO Box 395, Nekemte, Ethiopia.

However, recently this gap has been reduced due to many reasons. These are Maternal health, reduced fertility, structural change in the economy- it is believed that there is U –shaped relationship between female participation and economic growth, changes in social norms and cultures (Esteban et al,2017). Female labor force participation is highest in the poorest and richest countries in the world and it is the lowest in countries with average national incomes. While high female labor force participation rates typically in developing countries reflect poverty it is driven by women's increasing educational attainment and the opportunities to work that are made available in developed country. In Ethiopia, in the year 1990 to 2018, the lowest and highest female labor force participation were scored during 1994 and 2005, 66.0402 and 74.4 respectively (ILO, 2018). In other words, with in three decades growth of female labor force participation is 12.12% which is relatively lower compared to the global female labor force participation rate has remained fairly stable, from 52.2% in 1992 to 51.4% in 2012 declining slightly for the total female working-age population but large in percentage (IBID). Though variables attributable to female for labor force participation decision could be seen from different facets this study wants to see in small scale irrigation in Bako Tibe woreda of West Shoa Zone. That is, it will answer factors attributable to on participation decision of females on irrigation. Is it from female characteristics or household level characteristics or exogenous to both? Therefore, this article will describe and investigate determinants of female labor time allocation on farm activities specifically on irrigation.

LITERATURE

Determinants of labor force participation

According to labor-leisure optimization theory, labor participation rate is considered together with expected market wage and the value women give to the time they spend for housework. Neoclassical theory states thatlabor supply is the

choice between work and leisure and is an increasing function of real wage for individuals. Labordemand is a decreasing function of real wage. Neoclassical theory is based on the assumption of free market competition. On the other hand, labor seeking theory states that neither employees nor firms have full information about labor market. Labor seeking theory has the alternative cost of sacrificing free time as well as getting information. It accepts the existence of unemployed individuals and empty job positions which corresponds to these individuals. In the literature female labor force participation in developing countries is affected by (World Bank, 2011, ILO, 2018, Gronau ,1973)

Female labor time allocation and household characteristics

Household characteristics that affect Female labor time allocation is mainlyincome of household. Though the relationship between female labor force participation and income can be studied one by one the widely investigated is the relationship between female labor force participation and economic development, virtually taken as U shape. The basic, stylized argument of U shape is that when a country is poor, women work out of necessity, mainly in subsistence agriculture or home-based production. As a country develops, economic activity shifts from agriculture to industry, which benefits men more than woman (Goldin, 1995). Subsequently, education levels rise, fertility rates fall, and social stigmas weaken, enabling women to take advantage of new jobs emerging in the service sector that are more family-friendly and accessible. At a household level, these structural shifts can be described in the context of the neoclassical labor supply model: as a spouse's wage rises, there is a negative income effect on the supply of women's labor. Once wages for women start to rise, however, the substitution effect will induce women to increase their labor supply. Essentially, the U shape hypothesis proposes that female participation rates are both the cause and consequences of economic development. As more women enter the labor force, economies can grow faster in response to higher labor inputs. At the same time, as countries develop, women's capabilities typically improve, while social constraints weaken, enabling women to engage in work outside the home (MacDonald and Petersen, 2018). Hence, female labor force participation are highest in poor countries, where women are engaged in subsistence activities, and fall in middle-income countries because of the transition of (mainly) men to industrial jobs. As education levels improve and fertility rates fall, women are able to join the labor force in response to growing demand in the services sector. However, there has been debate on the validity of this hypothesis, particularly on its robustness to different data sets and methodologies. One study finds that the U-shaped relationship is not robust once dynamic generalized method of moments (GMM) panel data techniques are employed (Gaddis *et al.,* 2015). Though the U shape relationship between income and female labor time allocation is at macro level, income of household and/or nonfarm activities at micro level also basically affects female labor time allocation on farm activities though the direction of change will depend on sources of income. For example income of household can enable households to have capacity to buy inputs and accessible to information (FAO, 2019) whereas income from non-farm activities would have a negative relationship with probability of participation (Chilot, 2016). This is because Household head that earns off-farm income may have little time to participate in farming activities in small holder irrigation schemes. Another determinant of female labor force participation is sex. In most literature men are more likely to participate in the labor force than women (ILO, 2018). They claim that traditionally men's work is on productive, marketable and outdoor job.

Female labor time allocation and female characteristics

Female labor time allocation and Educational attainment: One of the strongest determinants of labor market outcomes in both developed and developing countries is educational attainment. From a supply-side perspective, education has animportant impact on an individual's decision to participate in the labor force (Cazes *et al.,* 2013). According to ILO (2018), People with more education are more likely to participate in the labor force than people with less education. The difference in labor force participation due to education is higher for female than men. For example in 2017, the participation rate of men ages 25 to 54 withat least a college degree in US was 9 percentage points higher than the rate for men without a college degree. For women, the differencewas 13 percentage points. For both sexes,the growth of female labor force participation between educated and uneducated is more female than men (Congress of the United States, Congressional Budget Office, 2018). For OCED countries the difference in laborforce participation between people with more education and people with less education hasgrown. Between 1990 and 2017, the share ofmen with at least a college degree increasedfrom 27 percent to 33 percent and the shareof women with at least a college degreeclimbed from 23 percent to 38 percent (Tasseven *et al.,* 2016). Gronau (1973) also found that education played an important role in determining the market wage, but concluded that the rate of return on education was underestimated due to a negative correlation between education and true residuals in the wage equation.

Female labor time allocation and marital status: Married men are more likely to participate in the labor force than men who are not married, whereas married women are less likely to participate than their unmarried counterparts. Presence of young children also affects women labor force participation. Having children under the age of 5 at home is related to the labor force participation of women but not men and varies with marital status. Married women with young children are less likely to work than married women without young children, whereas unmarried women with young children are more likely to work. The above stated some of those demographic factors are influenced by policies though it has very little applicability for rural areas.

Female labor time allocation and Institutional setting (laws, protection, accessibility and Norms)

Norms and culture: Social norms and culture circumscribe the extent to which it is possible or desirable for women to enter the labor force. Socially assigned gender roles have often been institutionally enforced. And this is still the case today (Alesina, Giuliano and Nunn 2013). In most countries around the world, especially in developing country, there are restrictions on the types of work that women can do, virtually restricted to home. In rural areas, in most parts of the country, women are deeply involved in most aspects of agricultural production, marketing, food procurement and household nutrition; however there is a view widely held that "women do

not farm". This cultural perception remains strong even though numerous agricultural tasks are regarded as women's work, including weeding, harvesting, preparing storage containers, managing all aspects of home gardens and poultry, transporting farm inputs to the field and procuring water for household and some on-farm use. Women often dominate in the cultivation of horticulture, especially vegetable crops. Such crops are commonly grown on small plots in the vicinity of the house, or in the compound (Mogues *et al.,* 2009). In spite of social norms being persistent, there is also proof that large changes are possible. Research in this area shows that social norms and culture can be influenced in a number of non-institutional ways, including through intergenerational learning processes, exposure to alternative norms, and activism which propelled the women's movement (Fernandez, R. 2013) which would probably be confined to urban areas.

Accessibility: Government of Ethiopia adopted its ADLI policy in 1993. In the context of this strategy, the government commenced in the early 1990s a big push to disseminate agricultural packages to farmers, which included fertilizer, improved seeds, credit, and the provision of extension services. The main government institutions responsible for planning and implementing agricultural policies and projects are MoANR, and recently, MoLF at the federal level, and the corresponding regional bureaus and zonal and *woreda* offices (Mogues *et al.,* 2009). An agriculture sample survey conducted by CSA in 2013 revealed that at the national level, on average, more than half of sample crop growers reported that they received crop production related advisory services. However, the percentage share of female holders who received such advisory services was about 13 percent lower than that of male holders who received these services (CSA, 2013). Access to credit is also one of the biggest barriers to the irrigation sector's expansion in Ethiopia. For small-scale farmers, finance is not readily available, and some struggle to afford even the cheapest irrigation equipment. A number of NGOs and MFIs work with small-scale farmers to help them secure financing for irrigation pumps and equipment, but their financial capacity is also limited. The institutions that are supposed to provide financial services in rural areas are Micro Financial Institutions (MFIs) and rural saving and credit associations (RSACCOs). Other financial institutions like commercial banks are not accessible for most rural men and women.

The Microfinance Proclamation 40/1996 added the possibility for MFIs to provide deposit-taking services. Despite these efforts in March 2015, there were only 24 MFIs providing financial services in rural areas. Their penetration ratio is still low, with less than 4 percent of the national population being served (FAO, 2019). Accessibility to information is another determinates affecting labor time allocation. The sources of information are different for male and female. A sample survey by Aregue *et al.* (2010) found that the sources of agricultural and non-agricultural information generally depend on gender differences. Men depend mainly on formal information sources while women mostly exploit informal sources of information. In addition to gender differences, wealth status also influences the kind of knowledge and sources of skill for farmers. Another important accessibility problem is technology. Some of the indicators of modern technology application are improved seeds, fertilizers, agricultural chemicals (such as herbicides, pesticides, etc.). In almost all the indicators of technology and input use, female heads are less likely to use or adopt improved technologies and use less input. Plots of male heads are more likely to be applied with chemical fertilizer, improved seeds and herbicides, while plots of female heads are more likely to be applied with manure and limited improved seeds (CSA, 2013). In this way, Only 2 percent of agricultural land is irrigated and applied with pesticide, with plots of male heads more likely to be irrigated and applied with pesticide (EDRI & IFRI, 2012). Irrigation technologies are supply driven and technically focused. Little technical consultation is done by farmers who rely on indigenous knowledge instead, and therefore have limited access to innovations. Klasen (2017) has carried out on what explains for uneven female labor force participation levels and trends in developing countries. The study shows that there is heterogeneity in different countries with regards to female labor force participation. The study revealed that there is female labor forcerising strongly in Latin America, while improvements were modest in the Middle East and female participation even fall in South Asia. It dis proofed that the the relationship between economic growth and female labor force participation is claimed to be U shaped. It did say nothing about irrigation. Sorsa and others (2015) undertook determinants of female labor force participation in India using both binary probit model and ordinary least square. The study found that unlike BRIICs or OECD countries, education and incomes are negatively correlated with female labour for participation in India. Moreover, lacks of jobs, social and cultural factors are variable that kept women outside the labour force in India. Other determinants relate to infrastructure, access to finance, labour laws and rural employment programs. It did not show its relation with irrigation.

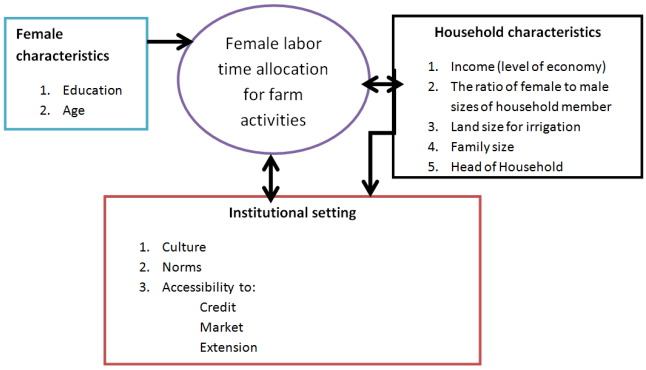


Figure 1. Conceptual framework

ChilotYirga adopted two –stage Heckman model to analyze determinants of female participation on irrigation and ordinary least square to see its effect on income. According to the study, income, gender, access to market information and health condition of households are profound determining factor for participating in small scale irrigation schemes. The investigation added that irrigation participation, family labor force, livestock ownership and access to marketinformation and credit are positively and significantly associated with household income. The study did not include the effect of irrigation on labor force participation. Many studies (for example Bunclark, 2010) have found that the major determinants of female's labor time allocation in small holder irrigation schemes are mainly due to socioeconomic dimensions of households, the institutional and technical factors. Conceptual framework in Figure 1 above shows that factors affecting female labor time allocation are female characteristics , household characteristics and institutional set up. Income of household the ratio of female to male in the

household, land size, head of house hold and family size can affect labor time allocation from the view of household characteristics. Culture, norms and accessibilities in terms of market, information, extension service, credit and technology are issues related to institutional set up. Peculiarities related to female like age, education whether head or not can affect also female labor time allocation on farm activities. The way how family size and land size affect labor time allocation is straightforward. The higher land size the higher irrigation. The higher family sizes the higher labor time allocation of female on farm activities because larger family size needs high demand for food and expenditures. However, since the study is on female labor time allocation on farm activities, composition of female-male also matter. The lower female to male ratio the more labor time a given household needs female time at home for food preparation and vice versa. Income affects labor time allocation of female farm activities. The higher income the capacity of farm to buy inputs and hence higher time allocation. It also affects accessibility to information and market. But, this would be applicable largely for medium scale irrigation. Most small scale irrigation is on pieces of land and just to improve income of household. Thus, labor time allocation affects also income of household. Female labor time allocation on irrigation also depends up on whether female is head or not. For instance, the study by Chilot (2011) shows those male headed households are 38% more likely to participate in irrigation practices than female headed households. This is because the latter suffer from lower income, poor financial asset and faced a shortage of labor and market information. Thus, women in female headed households frequently ended up renting or sharing out their land

RESEARCH METHODS

The study employed cross-sectional research design because it is better and more effective for obtaining information about the current status or the immediate past of the case under the study. It is also appropriate and suitable to use data collection tools such as questionnaires, interviews, focus group discussion, field observation and document analysis. Since the study wants to answer whether irrigation increases the amount time female spend on farm activities or not quantitative data analysis was used. Moreover, as was discussed under sampling method, mix of random and purposive ways of sampling method were used and hence quasi-experimental design.

Description of the Study Area

Bako Tibe District is found in Western Shewa Administrative Zone, Oromia Regional State, about 250 km west of Finfinne ; 125 km from Ambo , zonal capital city and 81 km east of Nekemte city at latitude of 9.12^0 & longitude of 37.05^0. The districtborders, East Wollega in the south and West, HorroGuduru Wollega in North, Chaliya and Illu/Galan District in the East (ARDO, 2018).

Sampling Technique and sample Size

To arrive at representative sample, two stage probability sampling technique were employed next to the first non-probability district selection. The district has 32 kebeles administrative units, for which four (4) kebeles are under urban administration while the remaining twenty eight (28) kebeles are under rural administrative.

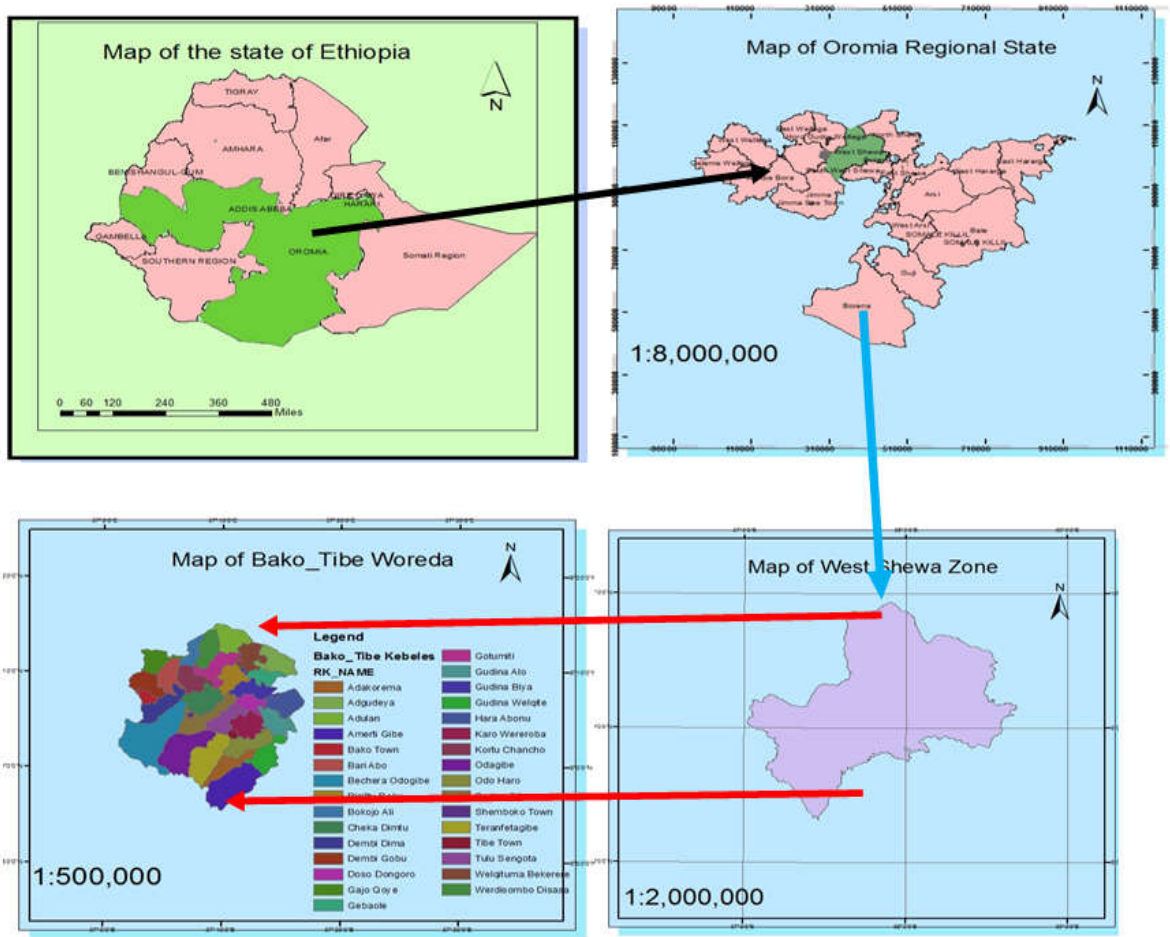


Figure 2. Map of the study area

Ecologically, Out of these rural kebeles, fifteen (53.5%) kebeles are found in lowland agro ecologies while that of midland is ten (35.7%) kebeles and three (10.8%) are in the highland kebeles are found in the highland agro ecology (ARDO, 2018). Hence, these ecology are going to be the base for stratification. However, irrigation is practiced in low lands mainly and midland and no irrigation at all at highlands. Accordingly, only low lands and midlands were sources of respondents. To decide whether both ecological zones are going to be used or not two issues should be focused here. The first one is about treatment model. Except in variable under focus (irrigation here) treatment and control group must be homogeneous -if not the result will be misleading (Wooldridge, 2002 and Veerbeck, 2004). This is because if that is not the case, the difference in outcome would be not necessarily as a result of the variable under focus. In this way we have to confine to either ecological zone if there is evidence that there is heterogeneity across ecological zone which is automatic- if not why strata come first? The second one is the issues of representativeness which implies the use of both ecological zone and contradicts to the first issue. According to Kothari (1990) the claim that both strata should be included is when one is aimed at comparison between the strata which is not the case in this study. Hence, using simple random sampling low land was selected.

Now, low land has 15 kebeles. Since all are almost similar, two kebeles are selected randomly: Dambi Dima and dambi Gobu kebeles. Both together have 7511 total population, 3735 male and 3775 female and 1553 households (CSA, 2007). Of these households 310 households engaged in irrigation while the remaining 1243 are not. According to Ajay and Micah (2014) there are four ways of calculating proportional sample size: Cochran (1963, 1975), Yemane (1967) and Rao (1985) while Cochran sample is applicable for large population, Rao is for field survey to estimate the prevalence rate of specific event or cases or disease. In this case only Yemane (1967) will be used. The following table summarizes how total sample size determined using Yemane (1967) formula is distributed to each kebeles proportionally. Using Yemane formula at 5% level of signifance and total target population, female member household (N), sample size (n) was:

$$n = \frac{N}{1 + N(0.0064)} = \frac{1553}{1 + 1553(0.0025)} = 318$$

Table 1. Sample size

Kebeles		Female HH	Percentage of total	Sample	Percentage
DambiDima	Irrigated	158	10.2	33	10.5
	Non irrigated	683	43.9	140	43.8
	Total	841			
DambiGobu	Irrigated	152	9.8	31	9.7
	Non irrigated	560	36.1	114	36
	Total	712			
Total		1553		318	100

Data Collection Methods

The study used only primary data source. The primary type of data source was collected by structured interview, after converting questionnaire to Afan Oromo. The researcher used structured interview because it's convenient to mitigate non-response. Moreover, some respondents are illiterate and cannot fill questionnaire and hence structured interview was the best method. The secondary data wasused gathered from irrigation Bureau of Bako Tibe woreda that were used only in literatures. Carefully collected primary data was inserted to Microsoft excel in such a way that it would be suitable for STATA to draw objectively consistent analysis using both descriptive and inferential analysis.

Descriptive Analysis

The descriptive statistical method would include a comparison of variables (both dependent and independents) between female engaged on irrigation and not engaged on irrigation. This was done by variance, mean, percentage value, graphs, charts and tables and. This is to the extent common feature of both group (treated and non-treated) other than the variable under focus.

Inferential Analysis

Inferential analysis was based up econometric analysis. Econometric analysis would have the time female spend on farm activities both irrigation and non-irrigation as dependent variable and dummy irrigation variable along with other covariates as independent variables. Hence, Econometric model is like determinants of female labor time allocation on farm activities. Most model such kind employ binary dependent variable and are at micro level taking dependent variable as participated or not. In this study dependent variable is dummy variable whether female participated or not on irrigation. Once, dependent variable is determined, explanatory variables are explained as follow.

1. **Age of the household head (AG):** It is a continuous variable, defined as the farm household female age is the number of years from the date of birth to the day of the survey interview date in full year. Those household heads having a higher age due to a good farm experience will have much better association with more participation , and it will be hypothesized that household heads with certain age range may have more participation.

2. **Cultivated area of land (CL):** It is a continuous variable which is the total irrigated area of land by the household. It is measured in hectares. Larger firms might benefit from economies of scale, but larger farms can also practice less intensive forms of agriculture, which will result in higher female labor force participation

3. **Agricultural labor input (AL):** This refers to the total number of family members of the household who have directly involved on the farm activity measured in adult. It is measured by the number of all family members who will be involved in farm activity. The more the labor force utilized for the farm production process the less female come out of home. Therefore, agricultural labor will be hypothesized to have a negative impact on female labor force.

4. **Educational level (EDU)**: The number of years or the highest grade completed by the household head during the survey period. Household heads who attend more level of education will be expected to have more exposure to the external environment and accumulate knowledge of farm practicing. They have a better ability to identify the

problem of their farm income as well as analyze its costs and benefits. Therefore, it will be expected that those farmers who are advanced in school level have better opportunity for agricultural participation (Lelissa, 1998, Beyene, 2000; Tesfaye and Ayenew, 2016).

5. **Household size (HHS):** It is a continuous variable, defined as the total number of members living together in family during the survey period. Those households having a large number of family sizes may need higher crop production and will affect positively the female labor force participation.

6. **Sex of the household head (SEX):** this is a dummy variable that assumes a value of"1" if the head of the household is female and "0" otherwise. These are related to women's lack of control over economic resources and the nature of their economic activity". With this background including the existing gender differences; female headed households will have mobility, participate in different meetings and have more exposure to participate in labor force.

7. **Extension service (EXTN):** It is a dummy variable which measured whether the household used the extension program or not during survey period. Households those who will be used extension service during their sugarcane production process would expect to increase the probability of farm productivity.

8. **Accessibility of Land:** Is dummy variable measuring whether land is proximate to the source of river or water. It means it does not require farmers to invest large capital to use the river.

Following the specifications in Gujarati (2004) dependent variable of the probit model takes binary response, i.e. y=1 if a given female is irrigators and y=0 if not. In terms of probability it can be written as:

$$P(Yi = 1|X) = Pi \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

$$(Yi = 0|X) = 1 - Pi \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

This simply shows that the probability that a given household irrigators is $Pi$and theprobability that they are non- irrigators is $1 - Pi$

This can be written in equation form of probit distribution as;

$$P(Yi = 1|X) = E(Yi = 1|X) = \frac{1}{1 + e^{-(\beta' X_i)}} = \beta' X_i \quad \ldots 3$$

$$Pi = \frac{1}{1 + e^{-(\beta' X_i)}} = \frac{e^{(\beta' X_i)}}{1 + e^{(\beta' X_i)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

$$1 - Pi = \frac{1}{1 + e^{(\beta' X_i)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5$$

$$\frac{pi}{1 - pi} = \frac{1 + e^{(\beta' X_i)}}{1 + e^{-(\beta' X_i)}} = e^{(\beta' X_i)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

$$Ri = \ln\left(\frac{pi}{1 - pi}\right) = \beta' X_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 7$$

Equation 7 is used for probit model with multivariate independent variable X and Limited dependent variable Yi.

RESULTS AND DISCUSSION

In this chapter results and discussions of the study have been presented. Descriptive analysis virtually relies up on comparing female irrigators and non-irrigators in terms of irrigation participation along with the time they spend on farm activities. Econometric method of inferential analysis focused on determinants of irrigation and its impact on female labor time allocation.

Determinants of Female Farm activity Time

Demographic Factors

1) **Age of respondents:** Age of respondents (females) was considered in that different ranges of ages would not have equal experiences, exposure to technology, accessibility to information, level of education and so on which would affect irrigation participation decision and the time they allocate for irrigation. Though age was asked in open ended form on questionnaire, using STATA command conversion the study used in the form of range. The bellow table 2 reveals ranges of age structure. Accordingly, the largest percentage of respondents lies in the range 25-39 in years where as the smallest lies in the range 10-24 in years. Respondents whose age between 25 and 39 comprises 71% and the remaining two ranges are only 29%. This implies that it is possible to say that there were few youth female who was interviewed and the greatest proportion of respondents are adults. On the other hand, the average age of all respondents is 37.37 years. If we see age structure using irrigators and non- irrigators (Table 6) on average non- irrigators are younger than irrigators. The average age of all irrigators is 49.36 years where as for all non-irrigators is 34.36 years. The difference between irrigators and non-irrigators in terms of age is14.96 years which is highly significant.

Table 2. Age of Respondents

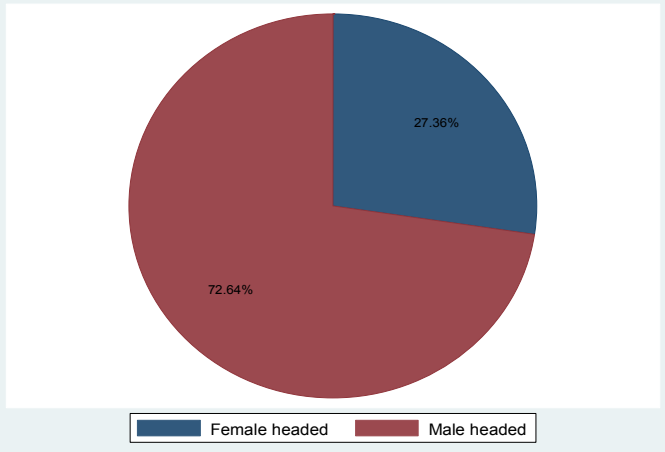
Age	Frequency	Percentage	Cumulative
10-24	9	2.8	2.8
25-39	226	71.07	73.9
40-60	83	26.13	100
Total	318	100	

Source: Own field survey, 2020

The relatively older irrigators may emanate from the issues of land ownership. If we see the relationship between age and land, it reveals that older person have land (slight linear relationship in between). This is due to the fact that there was no recent land ownership reform in Ethiopia and it is straight forward that inheritance or/ and share of land of father to son/daughter is very rare. However, it can be shown that those who do have received extension services are relatively younger than who don't receive. The average age of extension services recipients is 36 year where as for non- recipients is 39 years with age difference 14.94 on average which is highly significant. This indicates that extension service recipients (relatively younger) are proximate to technology. Besides, there is gradual positive relationship (data not shown) between age of female and

household size which indicates that older female has relatively higher family size

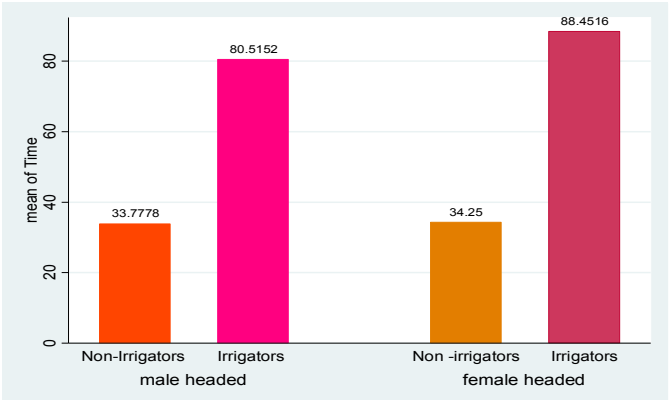
2) **Sex of household head:** Another variable that was supposed to affect female labor time allocation on farm activity is whether they head household or not. As can be seen from figure 3, the majority of household heads where femaleshave been interviewed were males (72.6%) while the rest (27.4%) were females. This finding make parallel with the fact that male are traditionally heads of households, particularly in rural areas (ILO,2018). The all faceted direction power of households, except home food preparation, usually vests on males provided that they are capable of supporting and sustaining one or more individuals within the household. However, in the event when the male dies, becomes incapacitated or divorces, woman can assume the role although they tend to face tough challenges under such circumstances. This is because female headed households are more vulnerable to different kinds of problems than the male headed ones. Especially when husband die females search for sources of feeding and schooling children since there is no sustained sources of income in the rural area.



Source: Own field survey, 2020

Figure 3. Female and Male headed Household

That is why, based up on sampled data, female headed irrigators spend their time (88.4516hrs per week) on farm activities more than male headed irrigators (80 hrs per week) on average (Figure 4). In contrast female headed irrigators have average lower labor force (2.96) than male headed irrigators (3.24) (Appendix 3).



Source: Own field survey, 2020

Figure 4. Mean time on household head

This implies that female headed irrigators having lower average labor force spend relatively long farm time. However, the difference between female headed and male headed of non- irrigators on how much time they spend on farm activities is negligible and their labor force is almost equivalent (data not given). Though insignificant still female headed exceed. On average female headed household spends one hour labor time on farm activities than male headed. This is just to give bird's eye view of female labor time allocation on farm activities attributable to who heads the household. But, another more sound figure and pertinent to objective of the study is comparison of farm activity time of female irrigators and non- irrigators regardless of who heads households. In line to this, female irrigators (households where at least one adult female is there) spend more than double of female non- irrigators (Table 6). On average female irrigators spend 84.4 hrs per week whereas non –irrigators spend 33.9. In fact since this time includes irrigation and non-irrigation farm activities for irrigators, the difference is very much sound. Hence, irrigators household have more farm activity time than non-irrigators household regardless of who heads it. The difference between them is 50.477 hours per week. This difference is highly significant since p value is very low. However, it does not mean the nature of household heading would not affect the time female spends on farm activities.

3) **Labor force:** According to CSA (2007) all persons aged ten years and over who were effectively involved or available to be engaged during the reference week are considered as economically active. This study has used definition as base reference. Accordingly, (Table 3) the largest percentage is female having two labor force appeared 111 times having 34.9% and the smallest percentage female having large labor force is labor sized 6 appeared three times having 0.94%. The average labor force is 2.4 for all sample size. If we see in terms of irrigators and non-irrigators, the former has more labor force than the latter on average. The average labor force of irrigators is 3.4 whereas for non-irrigators 2.2. The mean difference of labor force between irrigators and non – irrigators is 0.88. However, this difference is highly significant. Though seems not plausible, but good statistical figure is comparison of labor force with standard working day. To explain let me bring average labor force of irrigators to time they allocate for farm activities and compare standard working day of Ethiopia. Since we don't know the time non-irrigators allocate for irrigation, I confine myself to irrigators alone. Irrigators have 3.4 labor forces on average which is equivalent to 136 hours per week according to standard working day (8hr per day/ per person). This time includes both irrigation and non-irrigation. From table 6, irrigators together spend 84.4 hr per week.

Table 3. labor force structure of respondents

Labor	Frequency	Percent	Cumulative
1	64	20.13	20.13
2	111	34.91	55.03
3	103	32.39	87.42
4	33	10.38	97.8
5	4	1.26	99.06
6	3	0.94	100
Total	318	100	

Source: Own field survey, 2020

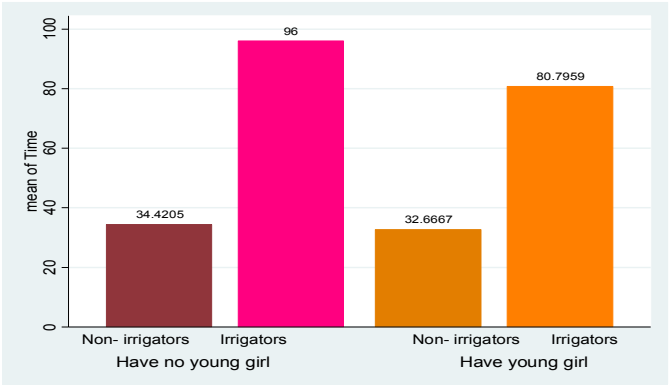
4) **Household size:** According CSA census (2007) in West Shewa zone, the average household size in both rural and urban area was 3.6 whereas for urban area was 4.8 persons. In rural area this size was 5.0. In this study it was found to be 5.6 persons. In addition, as shown on table 3, the high percentage (25.79) is households having five household sizes whereas the smallest percentage (0.94) is households having 9 persons size. However, the smallest and largest percentage according to CSA (2007) was households having 1 person and 8 people respectively. If we see household size in terms of irrigators and non-irrigators, irrigators (6.45) are more populous than non-irrigators (5.49) on average. The household size between them is 0.976 which is significant.

Table 4. Household size of respondents

Size	Frequency	Percent	Cumulative
3	8	2.52	2.52
4	67	21.07	23.58
5	82	25.79	49.37
6	64	20.13	69.5
7	64	20.13	89.62
8	26	8.18	97.80
9	3	0.94	98.74
10	4	1.26	100

Source: Own field survey, 2020

5) **Presence of young:** Whether young girl whose age is less than 10 years is available at home or not is also another variable that could determine the amount of time female spends on farm activities. According to figure 5, female irrigators that has young girl at home have less farm activity time than female irrigators that have no young girl. The same is true for non-irrigators though the size of difference is different. On average, female irrigators that have no young girl spends 96 hrs per week whereas for those with young girl is 80.79 hrs per week. This may be due to the fact that in the rural area households virtually have no servant that care for child and it is female that is responsible for it and which prohibits them from outside activities.



Source: Own field survey, 2020

Figure 5. Mean time over existence of young girl at home

Socio-Economic Factors

1. **Education of Respondents:** As can be seen from table 4, all respondents have at most elementary level education.The majority (35.2%) of respondents are illiterate. Only quarter of them have one grade level education and one percent received eighth grade level. The average education level of respondents is 1.5 grades. There is also almost equal between irrigators (1.6) and non-irrigators (1.4). This difference, however, is not significant.

Table 5. Education of respondents

Education	Frequency	Percent	Cumulative
0	112	35.2	35.2
1	85	26.7	61.9
2	53	16.6	78.6
3	27	8.5	87.1
4	17	5.4	92.4
5	15	4.7	97..1
6	5	1.6	98.7
8	4	1.3	100
Total	318	100	

Source: Own field survey, 2020

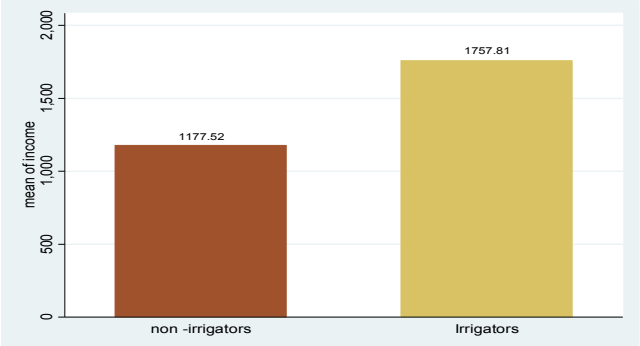
2. **Land size:** Total 318 respondents together operate farm activities on 385.75 hectares of land together. Of these, irrigators operate their activities on 90 hectares while the remaining non-irrigators are on 295.75 hectares. That is 20.1 % of total sample size (irrigators) have owned 23.3% of total hectares of land for all respondents. The average land cultivated of total respondents is 1.2 hectares. This land township ranges from half hectare to three hectares. The majority of respondents (24.76%) owned 1.75 hectares of lands where the minor (0.31%) is an individual having 2.5 hectares of land. However, 97.18 percent of smallholders (small farms) in the area cultivate less 2 hectares of land while 47.34 percent of the farmers cultivate less than 1hectare. In terms of irrigated and non-irrigated, on average irrigators have 1.4 hectares of land where as non- irrigators have 1.16 areas of land. This difference is significant at less than 1% (Table 6).

Table 6. Cultivated land of respondents

Land (hectares)	Frequency	Percent	Cumulative
0.25	61	19.12	19.12
0.5	7	2.19	21.32
0.75	42	13.17	34.48
1	41	12.85	47.34
1.25	29	9.09	56.43
1.5	8	2.51	58.93
1.75	79	24.76	83.7
2	43	13.48	97.18
2.25	4	1.25	98.43
2.5	1	0.31	98.75
2.75	2	0.63	99.37
3	2	0.63	100

Source: Own field survey, 2020

3. **Income of respondents:** Respondents were asked how many birr they can get per month from all farm and non – farm activities. It is income from all sources.



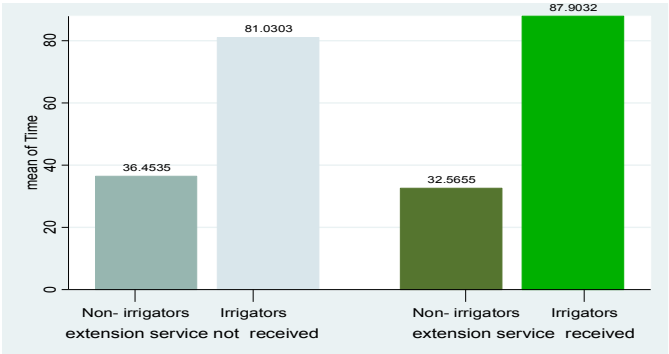
Source: Own field survey, 2020

Figure 6. Mean income over irrigators and non-irrigators

For irrigators it includes from products of irrigation and other farm activities. For non- irrigators income from selling crop and other like live stocks, chicken and others. Total respondents' together sale their products for less than half million (Table 7). Mean income per month for all sample is birr 1294.31. In addition, mean income of irrigators as figure shows is birr 1757.81 whereas for non-irrigators is birr 1177.52. The difference in income for irrigators and non-irrigators is 580 which is highly significant.

Female Labor Time Allocation to Farm Activities and Accessibilities

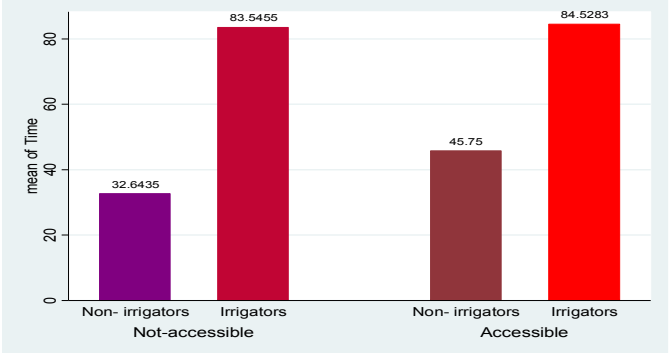
A. **Extension services:** Another variable that could be taken while comparing irrigators and non-irrigators is extension services. By extension services we do mean farm visits by extension expert, extension meetings (experience share) visit contact model (best) farmers and class room training. Accordingly, extension service received irrigators spends a little bit more time (87.903 hr per week) than those who did not received irrigators (81.03). It is also visible from figure 7 that the time that female spends on farm activities is relatively for those did not received extension services than received between non-irrigators.



Source: Own field survey, 2020

Figure 7. Mean time over extension service

B. **Accessibility of land to Irrigation:** The last variable that is supposed to be seen with irrigation is suitability of land for the irrigation. Sometimes river may cross land of a given farmer but, it may not be convenient for irrigation partly because it requires capital to dig out land for suitability. Oppositely in spite of suitability farmers may not engage on farm activities. In this way, according to figure 4.6 irrigators with accessible land have only a little bit more time than irrigators with inaccessible land.



Source: Own field survey, 2020

Figure 8. Mean time over accessibility of land

The difference cannot be greater than one hour per week. This is due to the fact that once, at initial time, inconvenient land is converted to suitable be in tradition or modern way it would not persistently affect irrigation time allocation since it is permanent. Table 7 presents the demographic characteristics of irrigators and non-irrigators households. The mean age for irrigators female was 49.3 years and non-irrigators 34.36 years. The difference between irrigators and non- irrigators was significant at less than 1%. The irrigators had larger land sizes of 1.4 ha compared to 1.16ha non-irrigators on average. The difference in holdings was significantly different at less than 1%. There was also a significant difference at less than1% level in the number of household size and labor force betweenirrigators and non- irrigators. The mean labor force and household size of irrigators are 3.1 and 6.4 respectively while for non- irrigators 2.2 and 5.4 respectively. However, there is no significant difference between irrigators and non-irrigators in terms of education.

Inferential Analysis

Pre – Result discussion issues

I. **Tests for endogeneity:** Endogeneity could arise, in this study, if unobservable factors that determine the time that females allocate for farm activities are correlated with the decision to irrigation. Equivalently it means, if there is correlation between the treatment-assignment errors and the outcome errors, there will be endogeneity. If there is no endogeneity, we would prefer to use one of the non-endogenous method estimators because they will give us the correct standard errors (Wooldridge,2010). If tests for endogeneity biases for its existence, to control for the endogeneity of treatment assignment, the estimator includes residuals from the treatment model in the models for the potential outcomes, known as a control function approach. We can also use instrumental variable if it satisfies criteria's of instrument (Wooldridge, 2010). Hence, it would better if endogeneity test is made. STATA result in treatment model will tell us whether there is endogeneity or not. Accordingly, the footer fromAppendix 8 tell us that likelihood test of independence equation of errors from treatment and outcome tells us we fail to reject null hypothesis of no endogeneity even at 10% level of significance. However, if we exclude major significant variables (presence of young girl and accessibility) from the treatment equation endogeneity test us that there is endogeneity (Appendix 9). Based up on this result we cannot use instrumental variable method of treatment model.

II. **Heteroscedasticity:** Standard probit and logit model assumes homoscedasticity in the latent variables (Verbeek, 2004; Wooldridge, 2010) . Test for heteroscedasticity in for limited dependent variables were explained by Wooldridge (2010) in section 15.5.3. If there is heteroscedasticity in the latent variable, error from the equation would be no longer independent of explanatory variables. This could be tasted using likelihood ratio test from STATA result once suspected variable correlated to error is put in appropriate command. In this study all variables are suspected and detected with heteroscedasticity. Appendix 6 shows this result. Null hypothesis of homoscedasticity is not rejected since the footer of this appendix that shows likelihood ratio test is not significant at reasonable level of significance.

Table 7.Comparison of irrigators and non-irrigators in continuous variables

	Variables	Irrigators		Non- irrigators		t test	P value	Both Irrigators and non-Irrigators	
		Mean	Total	Mean	Total			Mean	Total
1	Time allocated for farm activities per week	84.3594	5399	33.8819	8606	20.36	0.000	44.04	14005
2	Age	49.3	3157	34.36	8728	19.23	0.000	37.37	11885
3	Land	1.4	90	1.16	295.75	2.64	0.009	1.2	385.75
4	Labor	3.1	199	2.2	566	6.56	0.000	2.4	765
5	Education	1.67188	107	1.45669	370	0.91	0.364	1.5	477
6	Size	6.46875	414	5.49213	1395	5.06	0.000	5.688	1809
7	Income	1757.81	11250	1177.52	299090	5.8	0.000	1294.31	411590

Source: Own field survey, 2020

Table 8. Results of probit regression

Probit Irrigation age Land education Size sex ExServicePresenceofyoungchildAccessibilty

Probit regression Number of obs = 318
LR chi2(8) = 257.09
Prob> chi2 = 0.0000
Log likelihood = -31.137491 Pseudo R2 = 0.8050

Irrigation	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Age***	.2823906	.0573219	4.93	0.000	.1700418	.3947394
Land**	.6281864	.3203883	1.96	0.050	.0002367	1.256136
Education	-.1873858	.1332471	-1.41	0.160	-.4485453	.0737738
Size**	-.3430376	.1410223	-2.43	0.015	-.6194361	-.0666391
sex	.6025358	.3733276	1.61	0.107	-.1291729	1.334244
ExService	-.0542289	.3792798	-0.14	0.886	-.7976037	.6891459
Pres.youngchild***	1.626963	.4629196	3.51	0.000	.7196574	2.534269
Accessibilty***	1.94991	.3895429	5.01	0.000	1.18642	2.7134
_cons	-12.56019	2.375438	-5.29	0.000	-17.21596	-7.904415

Source: Own field survey, 2020
***, ** and * are significant at <1%,≤5 and <10%

Table 9. Marginal effects

Dprobit Irrigation age Land education Size sex ExServicePresenceofyoungchildAccessibilty

Probit regression, reporting marginal effects Number of obs = 318
LR chi2(8) = 257.09
Prob> chi2 = 0.0000
Log likelihood = -31.137491 Pseudo R2 = 0.8050

Irrigation	dF/dx	Std. Err.	zP>|z|	x-bar	[	95% C.I.	]
age	.0095054	.0062915	4.93	0.000	37.3742	-.002826	.021836
Land	.0211451	.0148374	1.96	0.050	1.21305	-.007936	.050226
educat~n	-.0063075	.0053798	-1.41	0.160	1.5	-.016852	.004237
Size	-.0115468	.0088279	-2.43	0.015	5.68868	-.028849	.005755
sex*	.0285895	.026575	1.61	0.107	.273585	-.023497	.080676
ExServ~e*	-.0018541	.0133359	-0.14	0.886	.625786	-.027992	.024284
Presen~d*	.1042552	.0463923	3.51	0.000	.399371	.013328	.195182
Access~y*	.224333	.0983879	5.01	0.000	.242138	.031496	.41717

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obs. P | .2012579
pred. P | .0130833 (at x-bar)

Source: Own field survey, 2020
(*) dF/dx is for discrete change of dummy variable from 0 to 1
z and P>|z| correspond to the test of the underlying coefficient being 0

In fact, when heteroscedasticity robust standard error regression is carried out, education became significant. Having this in mind if one suspects error from latent is correlated to education, which may cause heteroscedasticity, allow heteroscedasticity for education and test for it, still null hypothesis is acceptable (Appendix 7). Hence, together there is no heteroscedasticity problem.

Determinants of Female irrigation participation

A binary probit model was used to analyze the determinants of irrigation decisions. The dependent variable in this model is the binary variable: irrigated or not irrigated. Independent variables are determined based on the existing literature and survey questions. As a result age, area of land, education, size of household, sex ,extension service, presence of young girl whose age is less than 10 years, accessibility of land to irrigation are included in the model. However, both income and labor force were excluded from probit model since highly correlated to land and household size respectively. The correlation is more than 0.5 for both (data not shown). More over when we compare Akaike Information Criterion before and after removal of two variables, after has lower value. Akaike Information Criterion before and after are 82.84 and 80.27 respectively (data not shown). Hence, removal is acceptable from model specification criteria view point (Verbeek, 2004). The results show that the binary probit model performs well in explaining irrigation decisions (Table 8). Pseudo R^2 of 0.8050 indicates joint significance of all regressors coefficient estimates. Likelihood ratio is also highly significant which consolidates the joint adequacy of model. Of all included variables, age, presence of young child at home and accessibility of land to irrigation are highly significant-even at less than 1% level of significance. Land and household size are significant at less or equal to 5% level of significance. Education of female, sex of household head and extension services are found to be insignificant even at 10% of level of significance.Since extension services are virtually assisting services farmers on major crops like teff, maize wheat and others than cabbages, potatoes, tomatoes, sugarcane, Maize that irrigators focus on. For example it is possible to show that about 37.4% of total sample never contacted extension service workers. Moreover, sampled females are near Bako town. Merchants of different area near to Bako like Nekemte city, Gimbi town, Sire and Bako itself buy irrigation products at irrigation area. Up dated information about the market are these merchants instead of extension service. In case of education, since irrigators are relatively older, they may have basic writing skill using the so called 'golmassa' while young non-irrigators may have access to formal education. Hence, both have no significant difference in education. A study by Martey and others (2013) revealed that education, sex of household and extension services had no significant impact on irrigation participation decision. In fact, there were also additional variables that were insignificant (in Martey and other) study but, significant in this study like household size. In other way study by Abraham and others in Northern Ethiopia (2015) have shown that extension service had impact on irrigation participation and significant. The coefficient of age is positive and significant, revealing that young people are less likely to carry out irrigation. A one year increase in age of female would increases Z score by 0.28. Similarly, a one year increase in age of female significantly increases the likelihood of irrigation participation by 0.96%. This is due to the fact that, as explained under descriptive analysis, young female are less likely to have land for irrigation. More specifically older female have high probability of having land (does not mean separate land ownership certificate from husband) and can participate in irrigation. This result is against the result of some studies on determinates of irrigation, like, for example by Martey and others (2013) which claims that there is negative relationship between age and irrigation decision.

Another more important variable is accessibility of land to river/ water for irrigation. It is positive and highly significant which indicates that accessibility attracts female to spend their time on irrigation. This is due to fact that since rural area is with relatively low capacity to make land suitable for irrigation using canal, natural proximate of land to water is one of determinants affection irrigation decisions. The probability of participation inIrrigation by a female with access to river land was higher than those without access. The probability of participation in irrigation would increase by 22.4% with land accessible to river than those with no accessibility

Coefficient of presence of young girl whose age is less than 10 years is positive and highly significant.The probability of participation in irrigation would increase by 10.4% for a female having young girl at home than female haven't young girl at home. This implies that if females have young girl at home their responsibility for household at home dwindle and hence their time for farm activities rise. That is young girl share some responsibility of female like food preparation, water fetching, wood collection, keeping child so on. Coefficient of land is also positive and significant. That is, female (household where at least on female is present) who owned land relatively participates in irrigation than who don't owned. A one hectare increase in cultivated land would increase the probability of participating on irrigation of female by 2.1%. Household size was found to be negatively affecting participation decision and significant at 5% level of significance. A unit increase in household size significantly decreases the likelihood of the female participation by 1.6%. It is worthwhile to pose two issues regarding the relationship between household size and irrigation decision. Household size is the source of labor force. The higher household size the higher labor forces other things constant from theory of labor force. If the greater proportion of labor force is female there will be probability of irrigation participation by females. Hence, in this way, household size would be positively correlated to irrigation participation. On another way if the larger proportion of household size is out of working age even if young girl is present at home females are prohibited from participation in irrigation since they would be persuaded to home consumption. To identify which scenario is the case in the study area, it would be better to see ratio of household size to labor supply. The ratio of size to labor for all sample is 2.6 which indicates that household size exceed labor supply for each household on average. Therefore, the latter is the case in the study area.

CONCLUSION

Descriptive analysis shows that females that have longer farm labor time are females having relatively high labor force and high family size, older; females have no young girl at home, females whose land is accessible to river, females having relatively larger area of land and females with relatively high income. There is no significant difference between irrigators and non- irrigators of farm labor time allocation based up on

education. Similarly since irrigators are on average older and not proximate to information relative to non-irrigators, there is no significant difference between irrigators and non-irrigators attributable to information from extension service. Married young females arevirtually energetic. The study reveals that land owner ship go positively with age and participation in irrigation positively with land. Hence, married young females do not carry out irrigation due to the probability of having land is low. There is difference between female headed and male headed both among irrigators and non-irrigators. However, the difference between female headed and male headed on female farm labor time is greater for irrigators than non-irrigators. Female headed irrigators household have more farm activities time per labor force than male headed. This is because female headed irrigators having lower average labor force allocate higher labor time on farm activities than non-irrigators. Moreover, irrigators spend more farm activity time than non-irrigators. Econometric analysis shows that the probability of female participation in irrigation would increase with increase in age of females, with accessibility of land to irrigation, presence of young girl at home and with land size. However, it would decrease with the household size. Hence, age of female, accessibility of land for irrigation, presence of young girl at home land size of household and household size affects female irrigation participation and the time female spends on farm activities. Irrigation has impact on female labor time allocation on farm activities. This is because it significantly increases the time females spend on farm activities. The Augmented inverse-probability weighting model resulted that the average time that female spend on farm activities per week is 39.11 hours if none of sample size was irrigators. The average time if all females to irrigate is 20.54 hours per week more than this amount. Taken together, age of females, presence of young girl at home, labor force and household size with whom females live, the size and accessibility of land of household affect females decision on irrigation participation and then their time on farm activities. However, education of females, extension service and the nature of household head do not affect females irrigation participation and then their time on farm activities.

Recommendation

Accessibility of land to irrigation is the most significantly affecting female irrigation participation. Hence, it would be better if government or NGOs working on gender and women empowerment works on how land would be suitable for irrigation so that the number of females participate on irrigation would increase. This might be through constructing canals for small scale irrigation since there is river and land alongside and at the same time not being utilized. Though irrigation increases the time females spend on farm activity, irrigators are old aged having land. Young females with low labor force and family size, but proximate to technology are idle resources in a situation where products of these irrigations are highly demanded and bought to the places by merchants nearby city Nekemete, towns like Gedo, Sire and even Gimbi. However, there are public lands proximate to river but not being utilized. Hence, it would be better if this land is temporarily given for them for irrigation purpose. Though sampled population is proximate to Bako town and hence irrigators are very much accessible to information about market and input utilization there is no full coverage of extension services. In fact, there might be full coverage of extension service on rain based farming. Therefore, it would be better if government increases the service coverage by extension workers working on irrigation.

REFERENCES

Abraham G, Addis A, Mesfin T (2015). The Impact of Small – Scale Irrigation on Income of Rural Farm Households: Evidence from Ahferom Woreda in Tigray, Ethiopia.

Alesina A, Giuliano P, & Nunn N (2013). On the origins of gender roles: Women and the plough. The Quarterly Journal of Economics, 128(2), 469-530.

ARDO (2018). Annual Report of Agricultural and Rural development office , unpublished , Bako Tibe Woreda

Aregu L, Puskur R. and Bishop-SambrookC (2011). The role of gender in crop value chain in Ethiopia. Paper presented at the Gender and Market Oriented Agriculture (AgriGender 2011) Workshop, Addis Ababa, Ethiopia,

Bekele Y, Nata T, Bheemalingswara K (2012). Preliminary Study on the Impact of Water Quality and Irrigation Practices on Soil Salinity and Crop Production, Gergera Watershed, Atsbi-Wonberta, Tigray,Northern Ethiopia, MEJS. 4(1): 29-46.

Bunclark L (2010). Rainwater harvesting: A suitable poverty reduction strategy for small-scale farmers in developing countries? A dissertation submitted to the School of InternationalDevelopment of the University of East Anglia in part-fulfilment of the requirements for the Degree of Master of Arts November 2010.

Cazes S and Verick(2013). The Labour Markets of Emerging Economies: Has Growth Translated into More and Better Jobs? Geneva and Basingstoke, UK: ILO and Palgrave Macmillan

Central Statistical Agency (2007). Population and Housing census , Addis Ababa

Central Statistical Agency (2011).*Report on Livestock and Livestock Characteristics*. Agricultural Sample Survey Volume II. Addis Ababa, Ethiopia

Central Statistical Agency (2013).National Labour Force Survey. Addis Ababa, Ethiopia

Chilot Y(2012). Effect of small-scale irrigation on the income of rural farm household: the case of LaelayMaichewdistrict , central Tigray Ethiopia

Congress of the United States (2018). Factors affecting labor force participation, Congressional Budget Office report: 2018

Ethiopian Development Research Institute and International Food Research Institute (2012). Gender differences in access to extension services and agricultural productivity; Ethiopian Strategy Support Program II. Addis Ababa, Ethiopia

Fernández R (2013). Cultural change as learning: The evolution of female labor force participation over a century. The American Economic Review, 103(1), 472-500.

Food and Agricultural Organization of United Nations (2019).National gender profile of agriculture and rural livelihoods, Addis Ababa, Ethiopia

Food and Agricultural Organization of United Nations. (2015). Gender and Land statistics: Recent developments in FAO's gender and land rights database.

Foodand Agricultural Organization of United Nations (2015).Gender equality in food security governance and agriculture: Reducing gender inequalities for increased food and nutrition security.

Gaddis I and Klasen (2015). Economic development, structural change, and women's labor force participation: A reexamination of the feminization U hypothesis. Journal of Population Economics.27:3 (2014): 639−681.

Goldin, C (1995). The U-Shaped female labor force function in economic development and economic history. In: Schultz, T. P. (ed.). Investment in Women's Human Capital and Economic Development.Chicago, IL: University of Chicago Press

ILO Bureau of Statistics.(2018). ILO Database on Labour Statistics, International Labour Organization.

Imbens G (2004),Nonparametric estimation of average treatment effects under exogeneity: A review. TheReview of Economics and Statistics 86:4–29

ImbensG andAngrist G (1994). Identification and Estimation of Local Average Treatment Effects, Econometrica 62, 467–476.

International Labour Organisation(2013). Decent work country profile: Ethiopia.

Kaleab B (2019). The impacts of irrigation and women diet, IFPRI discussion paper 01864, environment and production technology division, Addis Ababa, Ethiopia

Klasen S (2017).What explains uneven Female Labor Force Participation Levels and Trends in Developing Countries? , University of Göttingen, October 2, 2017.

kothariR(1990).Research Methodology : methods and techniques , new age international (p) limited, publishers, New Delhi

Lunceford J and Davidian(2004). Stratification and weighting via the propensity score inestimationof causal treatment effects: A comparative study. Statistics in Medicine 23:2937–60

MacDonald, Heather and Alan P (2018). Distance and labor force participation: Implication for urban and rural women; University of Iowa.

Makombe G, Namara R, Hagos F, Awulachew SB, Ayana M, Bossio D (2011). A comparative analysis of the technical efficiency of rain-fed and smallholder irrigation in Ethiopia. Colombo, Sri Lanka: International Water Management Institute.

Martey E, Asante O, Al-Hassan R and Dogbe C (2013). Factors influencing participation in rice development projects. The case of small holder rice farmers in northern Ghana. International Journal of Development and Economic Sustainability

MoA.(2011a). Natural Resources Management Directorates. Small-Scale Irrigation Situation Analysis and Capacity Needs Assessment, Addis Ababa, Ethiopia.

MoA.(2011b). Natural Resources Sector, Small-Scale Irrigation Capacity Building Strategy for Ethiopia, Addis Ababa, Ethiopia.

MOA-NRMD (2012).*Small Scale Irrigation Capacity Building Strategy for Ethiopia.*Addis Ababa.

Mogues.T, Cohen MJ, Birner.R, Lemma.M, Randriamamonjy.J, Tadesse.F, and Paulos.Z. (2009). Agricultural Extension in Ethiopia through a Gender and Governance Lens; Ethiopia Strategy Support Program 2 (ESSP2).Discussion Paper No.ESSP 007.

MoWR.(2002). Water Sector Development Programme 2002–2016.IrrigationDevelopment Program, Main report.MoWR, Addis Ababa, Ethiopia

SorsaP ,MaresJ,DidierM.,andRabate M (2015).Determinants of the low female labour force participation in India economics department working papers no. 1207

Tasseven O., Altas D. and Targut U. (2016). The determinants of female labor force participation in OECD countries, Internal Journal of Economic Studies, Volume 2, Issue 2, Turkey

Tsegazeab G. and Surajit G. (2016).The Impact of Small Scale Irrigation on Household Income in Bambasi Woreda, Benishangul-Gumuz Region, Ethiopia

UNDP (2018). Ethiopia National Human Development Report 2018; Industrialization with a Human Face

Verbeek M (2004). A Guide to Modern Econometrics. New York: John Wiley and Sons, Ltd

Wooldridge J M (2002). Econometric Analysis of cross section and Panel Data. The MIT press, London

Wooldridge J M (2010). Econometric Analysis of cross section and Panel Data. The MIT press, London

World Bank (2010). Gender and Governance in Rural Services: Insights from India, Ghana and Ethiopia. Washington, DC.

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