Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.8, No.3, 2017

Female Headed Households' Participation in Peri-Urban Modern Small-Scale Irrigation Projects in Ethiopia, The Case of Kobo Town

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Abstract
This study was intended to identify the determinant factors influencing female headed households' participation in peri-urban modern small scale irrigation projects in kobo town, Ethiopia. To achieve this objective both primary and secondary data were consulted. Purposive sampling was used to select the study town and irrigation sites where as simple random sampling technique was employed to select 333 household heads (both participants and non-participants). Primary data were collected from the sample female household heads through structured questionnaires. Moreover, Key informant interviews, Focus Group Discussion and personal observation were also used for triangulation. Descriptive and econometric techniques were employed for data analysis. Binary logit model was used to identify determinants of peri-urban modern small scale irrigation participation. Our analysis discloses that, educational status of the household head, family size, Total Livestock Unit, access to credit service and distance from the nearest market centres have significant and positive impact on participation. While age of the household head and distance to irrigated farm are significantly and negatively associated with participation. Hence, for better participation of female headed households, development of irrigation projects should consider the above mentioned determinate variables in to account.
Keywords: female headed households, modern small scale irrigation, participants, non-participants

Introduction

Ethiopia is the least urbanized country; in 2013, Ethiopia's degree of urbanization was 19% (World Bank, 2015). On the other hand, the national rate of urbanization is over 4.1% higher than the African growth rate of 3.9%. The major contributing factor for such urban growth is "Population Explosion"; due to high rate of natural increase in urban areas, excessive rural-urban migration and transformation of rural settlements into urban areas. Rapid urbanization results for a phenomenon commonly described as the "urbanization of poverty" or "urbanization without growth" as it has not been accompanied by equitable economic growth. As a result, Ethiopia is trapped in the circumstances of high prevalence of urban poverty, rapid increase of urban population where the urban poor are facing vulnerability in various issues; poor sanitation, inadequate shelter and overcrowding (70% of urban population live in slums), high proportion of vulnerable women, youth, children, elderly and destitute with very low incomes and high risk of disease for many residents (Ministry of Works and Urban Development, 2007; UN-HABITAT, 2008).

Recently in Ethiopia, urban poverty has been growing at a rapid rate than rural poverty. Though decreasing through time, the prevalence of poverty in Ethiopia can be considered as one of the worst in the world. According to the World Bank (2015) report, the National absolute poverty headcount for urban areas in 2000, 2005 and 2011 was 36.9%, 35.1% and 25.7% respectively.

In a given community some groups in the poverty band are particularly vulnerable to food insecurity. As of the Federal Democratic Republic of Ethiopia's food security strategy document (1996 and 2002 in Messay, 2010), in Ethiopia the most food insecure segments of urban population include; unemployed low income households in the informal sector, the elderly, disabled and sick, female headed households, street children and urban poor vulnerable to economic shocks as well as HIV/AIDS victim families. According to Sharp et al (200) in Patricia and Erin (2006), in Ethiopian highlands being a female headed household means having a chance of 35% of being destitute, compared with a chance of only 8% of being destitute for male headed household members.

In Ethiopia gender inequality has a long and deep rooted History (UN-HABITAT, 2008). Women in Ethiopia occupy the law status in the society; they are socially and economically discriminated against. Moreover, they have also less access to education and other income generating facilities than men due to cultural restrictions. In Ethiopia, women account around half of the population; as of CSA (2014) report, in 2007 women account 49.5% of the total population and contribute mainly to food production and others, but they have not shared the fruits of development equally with their counterpart. As stated in World Bank (2008) report, in Ethiopia on average women are responsible for about 40 to 60 % of all agricultural labour and 70% of household food production. Agriculture is thus, central to women's livelihoods.

The incidence of female headship is believed to have increased worldwide and a high proportion of

these households are found to suffer from poverty. Causes for the occurrence and proliferation of female headship vary from economic and social transformation to conflict and displacement (Chant, 1997). Compared to international standards the proportion of female headed households in Ethiopia is high, with 19% of the households being female headed. Ethiopia has the fifth highest percentage of female headed households among 22 African countries for which such data is available. Moreover, due to socio-economic conditions pushing female heads to migrate to urban areas, widowhood and divorce, urban areas in Ethiopia have a strikingly higher proportion of female headed households than rural areas; 33 and 17% respectively (Kodama, 2006).

Due to their vulnerability, female headed households need to be especially targeted with agricultural development programs for food security to be properly addressed. Ethiopia has a significant potential of irrigation both in terms of the available land and water resource. The estimated total irrigable land of Ethiopia is 5.3 million hectares (Awulachew et al., 2010 in Beyan, 2014). Hence, after 1991 when the current government took power, development and expansion of small-scale irrigation and rainwater harvesting strategies both at peri-urban and rural areas become central to Ethiopia's policies and strategies (Nugusse, 2013). Small scale irrigation is the practice of irrigation covering an irrigable area of less than 200 hectares with technologies effectively operated and maintained by farmers (Kinfe, 2012).

As the study area is drought prone, moisture deficit and the people are food insecure, efforts have been made by Kobo Girana Valley Development Program (KGVDP) and Amhara Water Works Construction Enterprise office to expand the practice of modern Small scale irrigation (both sprinkler and drip) since 2003. As stated in KGVDP (2015) document, since the commencement of the program, 1794 hectares of land have been irrigated and benefited 5744 households; 3844 male headed and 1900 female headed households.

Though women are mentioned as centres of policies are strategies in different food security documents, female headed households in Ethiopia have significantly lower take-up rates of irrigation as compared to men (Ministry of Agriculture, 2011). Specifically, in the study area out of the sample 333 female headed households, only 113 (33.9%) were participants. The remaining non-participants were forced to sharecrop out their land based on half-half basis losing around half of the yields in the process. Moreover, these non-participant households have limited decision power on timely land preparation, planting, weeding and collection of harvests. Accordingly, this study assessed the determinant variables that affect the participation of female headed households' in peri-urban modern small scale irrigation projects.

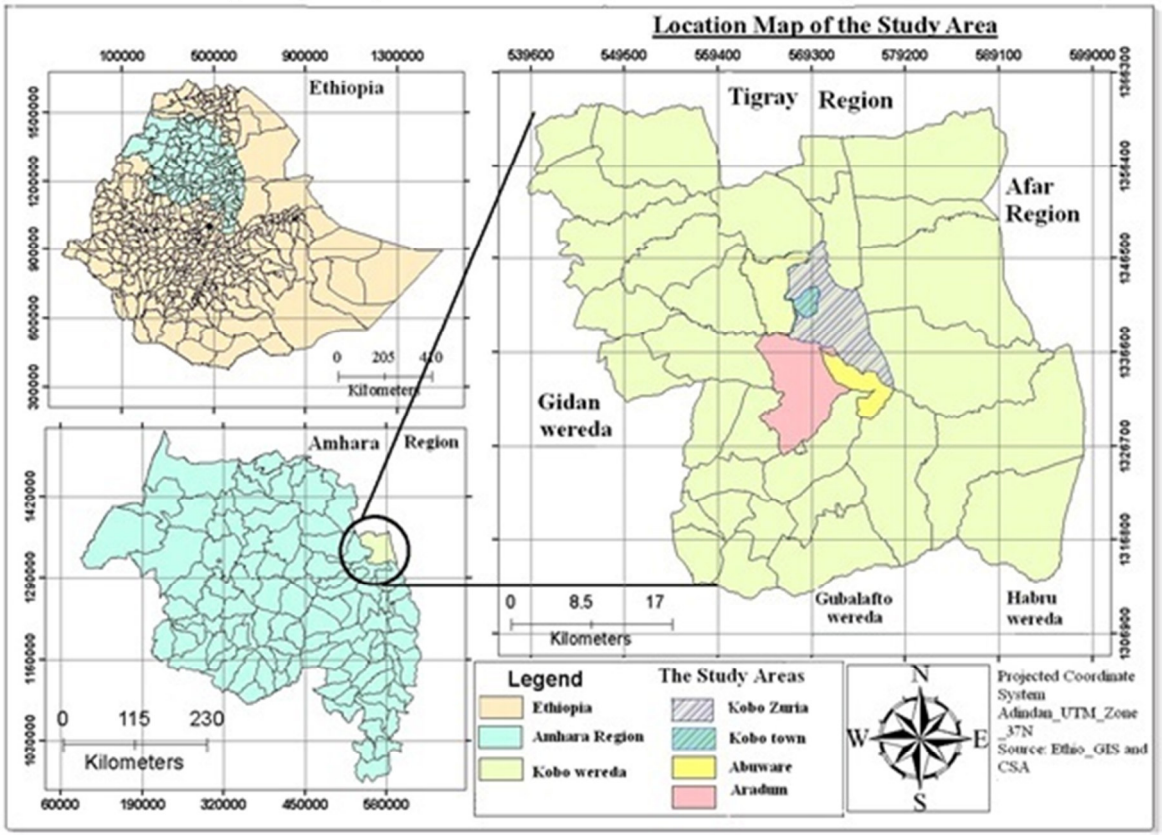
Material and Methods

Study Area Description

This study was conducted in Kobo town and its surroundings. The town is the administrative centre of Raya Kobo *Wereda* (district) and Kobo town administration with five *Kebeles* (lowest administrative unit in Ethiopia) administered by a mayor. It is located in the North-eastern tip of Amhara National Regional State, North Wollo administrative zone, Ethiopia (Goitom, 2009).

The town lies on Addis Ababa-Mekelle national highway, about 570 kilometres north of Addis Ababa (the national capital) with a geographical coordination between 11°54'04" N and 12°20'56" N latitude and between 39°25'56" and 39°49'04" E longitude. The landscape of the *Wereda* is characterized by a broad fertile plain (65%) while the rest 20%, 6%, 5% and 4% are mountainous, rugged, gorges and swampy respectively. In the study *Wereda* altitude ranges from 1400-3100 m above mean sea level where the average elevation is 1500 m above mean sea level (Goitom, 2009).

Figure 6; Location map of the study area



The study *Wereda* has a total human population of 239,504 of which 120,383 (50.26%) are men and the remaining 119,121 (49.74%) are women. Out of the total population, 33,135 populations (20.15%) are urban dwellers; of these urban dwellers male and female population constitutes 16311 (49%) and 16824 (51%) respectively. Kobo has a population density of 119.7 people per square kilometre with a total area of 2001.57 km^2 (CSA, 2011).

Agriculture practiced in the suburban areas serves as the main economic stay and means of livelihood to the majority of the town's people. It is characterized by traditional mixed farming as it includes both crop production and livestock rearing, dependent mainly on rainfall. The main crops produced through rainfall are cereals (*Teff*, sorghum and maize) and pulses (chick peas). *Teff* is a very fine like cereal scientifically known as Eragrostis tef. Furthermore, as of 2003, horticultural crops (onion, tomato, pepper) and fruits such as mango and avocado are being produced through modern small scale irrigation (Goitom, 2009).

The agro-climatic feature of the district is characterized by three agro-ecological zones locally known as; "*Dega*" or Temperate (10.7%), "*Weyna Dega"* or Sub-tropical (61.8%) and "*Kolla"* or Tropical (27.5%). It experiences low and erratic rainfall with mean annual rainfall of 670 mm with a maximum of 252.1mm recorded during August. The main rainy season occurs from July to September while the small rainy season is from January to April. The temperature varies from a minimum of 19°C to a maximum of 33°C annually with mean annual temperature of 23.1°C (Goitom, 2009).

Research Design

Research designs are the specific procedures involved in the research process; data collection, measurement, data analysis and report writing (Kothari, 2004; Creswell, 2012). This study adopted the cross- sectional survey technique to collect primary data as a survey technique is popular and ideal mode of observation in the social sciences. On a cross-sectional survey design data are collected from samples at one specific point in time. According to Babbie (1990), surveys are suitable for descriptive, explanatory or exploratory studies. They are especially ideal for studies that have individual people as units for analysis. Similarly, this study centred both the individual and the household as units of investigation and analysis. The head of the household (females) served as the chief respondent to whom the study questionnaire was administered.

To effectively asses the determinant variables that affect participation of female headed households' in peri-urban modern small scale irrigation projects, a combination of qualitative and quantitative research methods was used. The core argument for a mixed method design is that the combination of both forms of data provides a better understanding of a research problem than either quantitative or qualitative data by itself. Mixed method

designs are procedures for collecting, analysing and mixing both quantitative and qualitative data in a single study or in a multiphase series of studies (Creswell, 2012).

Nature of Data and Method of acquisition

Both primary and secondary sources of data were used to address the research questions. Primary data was collected from sample female household heads (both participants and non-participants) through structured questionnaires. This method was preferred among the other techniques because it could reach to the relatively large number of respondents. Most of the items of the structured questionnaire were closed ended with some partially open ended items. The data were collected through trained assistants and by the researcher after conducting the appropriate test on the constructed questionnaires. Moreover, Key informant interviews and Focus Group Discussion (FGD) and personal observation were also employed. All the interviewees were administered with the consent of the respondents.

Key informant interviews were administered by the researcher himself with semi-structured open ended questionnaire to elderly female headed households, irrigation water users' association leaders, heads of local institutions and other resource persons.

Focus Group Discussion was held to gather information pertaining to controversial issues related to participation. Accordingly, by preparing checklists and triangulating issues, subsequent discussions were held by forming three groups (composed of a minim of seven members) from the three study *kebeles*. It enabled them to freely express their opinion.

As indicated in Kothari (2004), to eliminate subjective bias, to relate the information obtained under mentioned methods to what is currently happening and as it is relatively less demanding of active cooperation on the part of respondents, personal observation was also held on irrigation sites, irrigation water users' association meetings and homes of respondents.

For reference purpose or to use as benchmarks against which the findings of a study may be tested, secondary data sources like books, articles and other unpublished reports related to the issue were also consulted.

Sample Size and Sampling Techniques

Multi-stage sampling design was used to select sample respondents. Accordingly, in the first stage, the study town was selected purposively due to its familiarity to the researcher and wide implementation of modern small scale irrigation projects. In the second stage, out of 41 modern small scale irrigation projects located in the study *Wereda*, 15 irrigation sites situated in three *kebeles* namely Kobo Zuria, Aradum and Abuware were selected purposively; due to their accessibility, proximity to the study town and number of irrigation beneficiaries. These irrigation sites covered 946 hectares of land and are benefiting 2367 household heads of which 1619 (68.40%) are male headed and 748 (31.60%) are female headed households. In the second stage, to obtain representative samples, the sample size was determined through Creative Research Systems (CRS), 2012 online sample size determination software. The size was calculated using 95% confidence level and 4% margin of error (confidence interval). As a result, 333 female headed households (44.52%) who are beneficiaries of peri-urban modern small scale irrigation; both participants (113) and non-participants (220) proportionate to their number were incorporated in this study through simple random sampling technique. The Water User Association members' registry was used as a sampling frame. On the other hand, purposive sampling method was also used to select key informants and Focus Group Discussion members.

Data Analysis

Descriptive statistics techniques such as arithmetic mean, percentage and standard deviation were used to analyse household's characteristics. Furthermore, for the purpose of examining the statistical association between the independent variables (physical, social, economic, demographical and institutional and or organizational) and the dependent variable participation, binary logit model was used. Binary logit model was preferred to be used in this study as results derived from linear regression analysis may lead to fairly unreasonable estimates when the dependent variable is dichotomous. Therefore, the use of the logit or probit models is recommended as a universal remedy of the drawback of the linear regression model (Gujirati, 1995 in Mequanent and Esubalew, 2015). The choice between logit and probit is, however, difficult as they are similar in most applications. Therefore, there is no binding reason to choose one over the other but for its comparative mathematical and interpretational simplicity logit model was chosen for this study.

The choice of variables in empirical participation studies has often lacked a firm theoretical basis. Cognizant to this, the independent variables used in this model were derived based on review of related literatures, past findings, experts and researcher's knowledge and familiarity about the farming system of the study area. Accordingly, the following potential explanatory variables were considered for the study. These are physical (farm size, nearness to market centre, distance to irrigated land), social (social networks), economic (Total livestock holding, oxen ownership, non- farm participation), demographical (age and education of the

head, family size, family labour force) and institutional and/or organizational (access to credit facility, market information and extension service).

The model assumes that the dependent variable (participation) is a dummy variable (given a value of 1 if the household participates and 0 otherwise), there is also a latent unobserved, continuous variable that determines the value of (Ŷ).

The participation equation/the logit model is specified as;

$$P_i = \left(Y = \frac{1}{X_i} \right) = \frac{1}{1+e^{-z_i}} = \frac{e^{z_i}}{1+e^{z_i}} \quad \text{..... (1)}$$

Where, e is an exponential term,

P_i= is the probability of an individual i to make a certain choice (to participate or not to participate). It is 1 if a household participates, otherwise 0.

Y= is the observed participation of a household.

X_i= is the set of explanatory variables

Z_i=is a function of n-explanatory variables (X_i) which can be expressed in linear form as:

$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots \beta_n X_n$

From Equation 1, the probability of participation is given by $(1 - P_i)$ which can be written as Equation 2:

$$1 - \frac{1}{1+e^{-z_i}} = \frac{1+e^{-z_i}-1}{1+e^{-z_i}} = \frac{e^{-z_i}}{1+e^{-z_i}} \quad \text{.....(2)}$$

Therefore, the odds ratio $\frac{P_i}{(1-P_i)}$ is given by equation 3

$$\frac{P_i}{(1-P_i)} = \frac{1+e^{z_i}}{1+e^{-z_i}} \quad \text{.....4}$$

Now, $\frac{P_i}{(1-P_i)}$, is the odds ratio in favour of participation. It is the ratio of the probability that a household would be participant (P_i) to the probability that a household would be non-participant ($1-P_i$).

Finally, taking the natural logarithm of equation 3 and assuming linearity produces equation 4

$$L_i = \ln\left[\frac{p_i}{1-p_i}\right] = Z_i \quad \text{.....4}$$

Where, L_i is the logarithm of the odd ratio which is assumed linear for both variables and parameters.

If the disturbance term is introduced, the logit model in equation 4 is represented by equation 5

$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots \beta_n X_n + \varepsilon_i$ 5

Where, β_0= is the regression constant which implies the combined impact of these fixed factors on household participation.

$\beta_1, \beta_2, \beta_n$= is the partial regression coefficient for the independent variables 1, 2...., n respectively

X= is the number of independent variables and ε_i= error term.

From the estimated logit model, the marginal effects of each explanatory variable on participation can be calculated using equation 6.

$$\frac{\partial P_i}{\partial X_i} = P_i(1-P_i)\beta_i \quad \text{.....6}$$

Chi-square and t-test were employed to test the statistical significance of dummy and continuous variables respectively. SPSS version 23 and STATA version 12 software were used to organize and analysed the data.

Description of Explanatory Variables and Hypotheses

Age of the head: is a continuous variable (number of years of the household head). As older farmers are less likely to accept new farming techniques, we expect age of the head to have negative correlation on participation in peri-urban modern small scale irrigation projects.

Education of the head: We hypothesized that the level of perception about the importance or economic impact of modern small scale irrigation to be positively correlated with the level of education.

Family size: is a continuous variable referring to number of individuals residing together. As it serves as a form of family labour and irrigation is labour intensive, number of family members affects participation positively.

Family labour force: The presence of more working-age household members will favoured participation in labour demanding modern small scale irrigation projects
Farm size: land holding size (both irrigated and non-irrigated) is a continuous explanatory variable correlated with farmer's wealth and hypothesized to have positive correlation with participation.
Nearness to Market Centres*:* measured in kms from the household's living home to the nearest local market. Female headed households nearest to market centres are less likely to participate in modern small scale irrigation projects and more likely to participate in non-farm income generating activities.
Distance to Irrigable Land: is a continuous variable measured in kms and refers to distance between household's residences to irrigated land. It is hypothesized to have a negative relation with participation. Female headed households nearest to the irrigation schemes are expected to engage in irrigation as compared to far households.
Social Networks: it is a dummy variable (1 for members and 0 otherwise). Social network includes a amalgamation of variables such as membership and position in cooperatives, peasant associations and local institutions. Households with better position in social network may have better access to information, new technologies and inputs. This in turn positively affects participation.
Total Livestock Holding: It refers to the total number of livestock measured in Tropical Livestock Unit (TLU). TLU is calculated by multiplying the number of each type of animal by an appropriate conversion factor and then summation. As livestock ownership is a sign of wealth status, there is a positive relationship between livestock ownership and participation.
The availability of Animal traction power: is a dummy variable (1 for enough oxen and 0 otherwise). Oxen play a prominent for land preparation, cultivation and threshing of crops. Households who have oxen are able to cultivate their own land by themselves instead of entering into share cropping arrangement. As a result, it is hypothesized that, female headed households who have oxen will participate in irrigation.
Non-Farm Activities: is a dummy variable (1 if yes and 0 otherwise) which measure engagement of household heads in non-farm activities. Household heads that earns income from off-farm activity may have little time to participate in modern small scale irrigation projects. Hence, Off-farm activity is hypothesized to have a negative relationship with probability of participation.
Access to Market Information: It is a dummy variable, which takes 1 if the household has access to information and 0 otherwise. Households that have access to it are expected to participate. Hence, it is hypothesized that access to market information affects participation positively.
Access to Credit Facility: It is a dummy variable which takes a value of 1 if the household has access to credit and 0 otherwise. Access to credit facilitates economic growth by providing start-up capital to new technologies. Thus, it is hypothesized that households that have access to it have a better probability to get farm inputs, indicating a positive relationship with participation.
Access to Extension Service: It is a dummy variable which takes a value of 1 if the household has access to extension service and 0 otherwise. Extension service is a non-formal education and learning activity to acquire new knowledge and skill to agricultural activities. It is believed that as access to extension service is a source of information, knowledge and advice to farmers, it has a positive relation with participation.

Results and Discussion

Descriptive statistics of the explanatory variables

Out of the fourteen explanatory variables entered in to the model, output of the binary logistic model shows that only seven variables were found to be statistically significant determinants of participation. These variables are age of the household head, educational status of the head, family size, total livestock holding, distance to irrigated land, distance to the nearest market centres and access to credit facility.
Age: Age of the household head is one of the demographic variables that determines whether the household head is economically active or not. The minimum, maximum and average age of the sample household heads is found to be 25, 80, and 49.53 years respectively. On the other hand, the mean average age of participant and non-participants sample households head is 41.50 and 53.65 years respectively. As mean average age of participant household head is lower than the mean age of non-participant household heads, it can be said that there is a tendency for young household heads to engage in irrigation farming than older household heads. The t-test statistical association was found to be significant t (331) =-8.999, $p<0.005$ at 5% probability level. This significant value of the t-test signifies that participant and non-participant household heads are different in their age. Thus, compared with non-participants, participant households are younger.
Education: Generally, education as a means of creating awareness and element of human capital plays a prominent role in the decision of technology adoption including irrigation. For this study, the sample household heads were grouped as illiterate (who cannot read and write) and literate. As a result, the average illiteracy rate of the sample female headed households is 59.2 % (of which about 42.5 and 67.7% are participants and non-participants respectively). The remaining 40.8% of the sample respondents can read and write. The existed

significant variation in educational status between sample participants and non-participant household heads was found to be significant in chi-square test of association x^2(1, N=333) =19.699, p<.001. Hence, compared with non-participants, participant household heads were more likely to be literate.

Family Size: By employing a standardized Adult Equivalent Conversion factor, the family size was converted in to Adult Equivalent Factor. Accordingly, the minimum, maximum and average Adult Equivalent Factor of the sample respondents is 0.74, 5.40, and 2.2585 respectively. Furthermore, participant and non-participant households also exhibited a significant variation in average adult equivalent factor; 2.8657 and 1.9467 for participants and non-participants respectively. The result of t-test was found to be significant t (331) =6.928, p<0.005 at 5% probability level. This significant value of the t-test means participant and non-participant households have different family size. Thus, compared with non-participants, participant households are more likely to have large family size.

Participant household heads were also asked to evaluate whether they have enough family labour force for the practice of irrigation or not. Accordingly, about 34.5% of the sample participants mention their family labour force as inadequate for farm operation. In the study area, the main coping strategies to solve shortage of family labour during peak agricultural seasons are hiring daily labourers, help from relatives and friends and traditional mutual labour exchange. Local mutual labour exchange practice locally known as "*wenfel"* and help from relatives and friends locally known as *"debo/Jige"* are major copping strategy for labour shortage particularly for the poor households who cannot afford to hire agricultural labour. Thus, respondents who are facing the problem of labour shortage blamed poverty not to hire daily laborers as a major cause instead of labour availability.

Total Livestock Holding: Livestock provide milk, meat, eggs and other products for home consumption and income as well as serve as a financial buffer during stress. As per the Focus Group Discussion and key interview participants, livestock production had been the dominant production system until recently. However, recently livestock population per households has been dwindling; due to expansion of crop cultivation, shortage of communal grazing land and forced sale of livestock in periods of crises to buy food and livestock diseases. For this study, Total Livestock Unit (TLU) is calculated by multiplying the number of each type of animal by an appropriate conversion factor and then summation. As a result, the average TLU for the sample respondents is 1.27. Furthermore, significant difference was also observed in livestock ownership between participants and non-participants. For participant and non-participant households, the TLU is 2.79653 and 0.48909 respectively. The t-test statistical association was found to be significant t (331) =17.041, p<0.005 at 5% probability level. This significant value of the t-test means participant and non-participant households own different livestock holdings. Thus, compared with non-participants, participant households were more likely to rare large livestock.

Oxen play a prominent role not only for land preparation and cultivation but also for threshing of crops and the sale for beef. As per the Focus Group discussion and key informant interview, for timely land preparation and planting oxen ownership is important. Households who have ox are able to cultivate their own land by themselves instead of entering into share cropping arrangement. The survey data indicates significant differences in terms of oxen ownership among participant and non-participant households. Hence, the average oxen ownership of the sample participant respondents is 1.23 but none of the non-participants do have ox and farm equipment. Furthermore, among the participants only 7.8 % have reported to have 2 oxen and the remaining 26.1% have one ox.

Distance from the nearest market: The average distance from the sample households' home to the nearest market place (Kobo town) is found to be 5.8095 kms of which the average distance for participant and non-participant households is 7.5841 and 4.8980 kms respectively. Nearness to market centres pave the road for participation in non-farm income generating activities and offset female headed household's participation in labour intensive farm activities. Thus, it can be said that nearness to market centre is inversely associated with participation in irrigation. The t-test statistical association was found to be significant t (331) =5.568, p<0.005 at 95% level of significance. This significant value of the t-test testifies the distance variation between participant and non-participant households' residence to the nearest market centre. Accordingly, it can be said that compared with participants, non-participant households were more likely to reside near to urban centres.

Non-farm activities remain viable opportunities for female headed households who are suffering from shortage of land, declining agricultural productivity and income. The survey result depicts that small-scale business (petty trade of crops and manufactured goods), handcrafts (pottery, embroidery), charcoal and fire wood selling, preparation and sale of local foods and drinks such as tea, bread, *Tella* and *Tejj* were the dominants non-farm activities practiced by the sample respondents. *Tella* and *Tejj are* home brewed local alcohols.

Distance to irrigated land: The minimum, maximum and mean distance of sample female headed household's irrigation farm distance from their residence was 0.50, 9 and 4.1712 kms respectively. Moreover, the mean distance to irrigated farm is 3.1858 and 4.6773 kms for participant and non-participant households respectively. Thus, it can be said that participants are residing nearer to their irrigation farm land than non-participants.

Comparing irrigation participants from non-participants in terms of distance from their residence to irrigation farm, the t-test statistical association was found to be significant t (331) =-5.576, p<0.005 at 95% level of significance. This significant value of the t-test testifies the distance variation between participant and non-participant households' residence to irrigation farms. Accordingly, it can be said that compared with participants, non-participant households were more likely to reside far from their irrigation farms and reside near to urban centres.

Access to Credit Service: In general, due to lack of willingness to take credit (risk fearing) (47.7%), high interest rate (3%), lack of fixed assets for collateral (7.2%), inability to repay loan by members of borrowing group (2.1%) and no saving habit (11.2%), female headed households had limited access to credit facilities. Accordingly, only 96 (28.8 %) respondents (out which 66 were participants and the rest 30 were non-participants) had access to credit service mainly from Amhara Credit and Saving Institution (ACSI). Furthermore, non-formal local sources such as relatives, friends, local money lenders and *Iqub (*Rotating credit and saving groups) are also sources of micro credit for the community. The survey clearly shows that participant and non-participant households do not have the same access to credit services. The chi-square test statistical association was found to be significant x^2(1, N=333) =72.93 p<.001. This significant value of the chi- square test assures that participant and non-participant households have different access to credit services. Therefore, it can be concluded that compared with non-participants, participant households were more likely to have access to credit services. Thus, it can be said that access to credit affects participation positively as it lends a potential hand to purchase agricultural inputs and ploughing oxen.

Result from the Regression Analysis

Female headed households in the study area are not participating and benefiting as expected in modern small scale irrigation projects. Out of the sample 333 respondents, only 33.9 % (113) are participants and the rest 66.1% (220) are non-participants who sharecrop out their land based on half-half basis losing around half of the yields in the process.

Women in Ethiopia play a critical role in different agricultural activities such as in land preparation, sowing, hoeing, weeding, harvesting, threshing and storing, household garden and livestock production (Ministry of Agriculture, 1992). Moreover, as Ethiopia is a multi-ethnic and multi-cultural country, women's participation in agricultural activities varies from place to place. For instance, women take part in different agricultural activities such as in land preparation, weeding, harvesting and storing but did not plough because of the "ploughing taboo" in Menz, Maqi Oromo and Sidama areas. Contrary to this, women equally participate in all agricultural tasks with men in Awra Amba community of Amhara region and Ganta-Afeshum District, in Eastern Tigray (Dereje, 2013; Hawku, 2014).

In the study area, though women spent much of their time in domestic chores (reproductive role), they also actively take part in different agricultural activities (productive role). Accordingly, out of the participant respondents, 1.2% participate in land preparation (such as clearing the fields, levelling and removing unwanted plants), 0.6% in planting of seedlings, 24.3% in manuring, 33.0% in weeding, 26.7 % in harvesting, 25.5% in threshing (preparation of the threshing ground, transporting the harvested crop to the threshing field) and 19.5% in storing. As they are culturally prohibited none of them participate in ploughing. As a result, Ploughing is done by the male members of the family like adult sons or male hired laborers. In Focus Group Discussion and key interview, the participants also emphasized that besides to physical, economical, demographical and institutional and/or organizational factors, the labour intensive and time consuming nature of household reproductive tasks made women not to have enough time to fully engage in irrigation.

To identify the determinants of participation, binary logistic regression model was used. Prior to the estimation of the parameters of the model, the collected data have been tested for multi co-linearity. Multi co-linearity happens when at least one of the independent variable has a linear combination of the others. In this study the effect of multi co-linearity was checked based on Variance Inflation Factor (VIF) and Contingency Coefficient (CC) for continuous variables and for discrete variables respectively.

For continuous variables, a rule of thumb having a Variance Inflation Factor below 10 are believed not to have multi co-linearity and a Variance Inflation Factor above 10 are obliged to the problem and should be excluded from the model (Gujarati, 2003). The computational result of the Variance Inflation Factor for this study confirmed the absence of association between the variables.

On the other hand, the value of Contingency Coefficient is a chi-square measure of association between variables and it ranges between 0 and 1. 0 indicating no association between the variables and values close to 1 indicating high degrees of association. As a rule of thumb a variable with Contingency Coefficient value less than 0.75 shows weak association and a value greater than it indicates a strong association of variables. In this study, the value of Contingency Coefficient of variables included in the model was below 0.75 that did not indicate the existence of multi co-linearity.

The goodness of fit of the model was measured by the count R^2 which shows the number of sample

observations correctly predicted by the model. The count R^2 is interpreted based on the principle that if the predicted probability of participation is less than 0.50, participation will not occur and if it is greater than 0.50 participation will occur. The model result of this study depicts that, the binary logistic regression model correctly predicted 68.77% of the sample respondents. The chi-square value (293.40) also indicates the goodness of fitted model. Thus, the model fits the data very well. The significant explanatory variables in the model are discussed and interpreted below.

Table 1: Result of binary logistic regression model for determinants of participation in irrigation

Variables	**Coefficients**	**Odd ratio**	**P value**
Age of the household head	-.1368262	.8721218	0.000***
Educational status of the household head	2.188602	8.922733	0.000***
Family size (Adult Equivalent)	.3846349	1.469078	0.084*
Total Livestock Unit	1.415663	4.119215	0.000***
Access to Credit	1.784469	5.956414	0.000***
Distance to irrigated land	-.3185664	.7271908	0.003**
Distance from the nearest market centers	.128299	1.136893	0.018**
Constant	1.402813		
Number of observations 333			
Pearson chi-square 0.0000			
Log likelihood -66.617529			
R^2 293.40			
Pseudo R^2 0.6877			

*, **, *** refers significant at 10%, 5% and 1% probability level respectively

Source: Computed from own survey data (2016)

As expected the binary logit model result declares the significant and negative association between household's head age and decision to participate in irrigation. The negative relationship reveals that the odds ratio in favour of the probability of participation in irrigation decreased by a factor of 0.87 as the age of the household increases by one year at 1% probability level, citrus paribus. Hence, older farmers are less likely to accept new farming techniques and take risks than younger household heads. It supports the finding of the previous research by Sithole et al. (2014).

Education creates awareness and helps for better innovation and invention through acquisition of information. It increases household's awareness about the possible rewards of modern agriculture in general and participating in modern small scale irrigation in particular. Accordingly, the econometrics model result indicates that educational status of the household head determines household's participation significantly and positively. Literate household heads were better participants than illiterate household heads. The odds ratio reveals keeping other variables as constant, the odds ratio in favour of participation increases by a factor of 8.922733 for those literate household heads. This finding is consistent with the finding of previous researches (Agerie, 2013; Nugusse, 2013; Muez, 2014 and Abebaw et al., 2015).

The econometric result of the model confirmed that family size measured in Adult Equivalent was found to be positively and significantly related with the probability of participation. The reason for this could be the fact that active family labour force is an asset that can increases the probability of participation in irrigation; as irrigation is a labour intensive activity. The odds ratio implies that if other variables are kept being constant, the odds ratio in favour of participation increases by a factor of 1.469078 as family size increases by one unit of Adult Equivalent at a 10% probability level. This finding is in line with the findings of Abonesh (2006) and Nugusse (2013).

The binary logit model result depicts that the probability of participation was determined by livestock population significantly and positively. Female headed households with better number of Total Livestock units (TLU) were more likely to participate than those with less or no TLU. Other things kept being constant, the odds ratio 4.119215 for TLU shows that as the number of livestock units increased by one TLU, the odds ratio in favour of participation in irrigation will increase by a factor of 4.119215. This finding supports the finding of previous researches (Abonesh, 2006; Knife, 2012 and Agerie, 2013).

With regard to distance from the nearest market centres, the econometrics logit result confirms that distance from the nearest market centres has a significant and positive impact on probability of participation at 5% probability level. Female headed households residing around market centres have better access to off-arm activities, resulting for the less likelihood of participation in farm activities. Thus, participation increases as the distance from the nearest market centre increases. Keeping other variables held constant, the odd ratio of 1.136893 for market distance shows that participation increases by a factor of 1.136893 as the market distance increases by one kilometre. This result is contrary to the finding of Agerie (2013).

Distance to irrigated farm is another variable that affect the decision to participate in modern small

scale irrigation projects significantly and negatively. The further the households are from their irrigated farm, the less likely to participate in irrigation compared to those household situated near to their irrigated farm. The possible justification for this negative association could be opportunity cost of time lost in traveling to and from the irrigated farm. The model result depicts that, the odds ratio in favour of the probability of participation in irrigation decreased by a factor of 0.7271908 as the distance to irrigated farm increases by one km at 5% probability level, citrus paribus. Hence, households residing nearest to their irrigated farm are better participants than households residing far from their farm. It is consistent with the findings of Sithole et al. (2014) and Agerie (2013).

As access to credit service enables households to overcome their financial constraints related to timely purchase of modern inputs, many research findings in technology transfer, adoption and participation used access to credit as an important tool of analysis. In line with this, the logit model result of this study revealed that access to credit is significantly and positively correlated with participation. Households with better access to credit had a better probability of participation in modern small scale irrigation than those without access. The odds ratio implies that if other variables are kept being constant, the odds ratio in favour of participation increases by a factor of 5.956414 for those respondents who have access to credit services. Studies by Abonesh (2006), Agerie (2013), Sisay and Fekadu (2013), Bekele and Maryam (2014) and Muez (2014) also confirmed the positive relation between participation and access to credit service.

Conclusion

In Ethiopia, female-headed households are the most food insecure segments of urban population. Accordingly, female headed households need to be especially targeted with agricultural development programs for food security to be properly addressed. After 1991, when the current government took power, development and expansion of small-scale irrigation and rainwater harvesting strategies both at peri-urban and rural areas become central to Ethiopia's policies and strategies (Nugusse, 2013). Though women are mentioned as centres of policies and strategies in different food security documents, female headed households in Ethiopia have significantly lower take-up rates of irrigation as compared to men (Ministry of Agriculture, 2011). Specifically, in the study area out of the sample 333 female headed households, only 113 (33.9%) were participants. The remaining non-participants were forced to sharecrop out their land based on half-half basis losing around half of the yields in the process. Moreover, these non-participant households have limited decision power on timely land preparation, planting, weeding and collection of harvests.

Regression result of this study shows that participation in irrigation was significantly and positively determined by educational status of the household head, family size, Total Livestock Unit, access to credit service and distance from the nearest market centres. While age of the household head and distance to irrigated land are significantly and negatively associated with participation. Hence, for better participation of female headed households, expansion and development of modern small scale irrigation projects should consider the above mentioned determinate variables in to account.

The policy implication of this study is targeting female headed households to address their constraints can have a significant impact for active participation in modern small scale irrigation. This in turn can reduce poverty, improved food security and livelihoods of female headed households.

In order to enhance participation of female headed households in irrigation, we suggest the need of conducting further detail studies on identifying, evaluating and adoption of modern small scale irrigation technologies that would consider the existing labour burden of women.

Acknowledgements

Research for this dissertation was supported in part by Open Society Foundations (OSF). Moreover, the authors also gratefully acknowledge the financial support from Wollo University (WU) and thank the interviewed households. The opinions expressed herein are our own and do not necessarily express the views of OSF and WU.

References

Abebaw Abiyu, Mesfin Tebeje and Ermias Mekonnen (2015). Determinants of Small-Scale Irrigation Utilization by Smallholder Farmers' in Rift Valley Basin, Wolaita Zone, Ethiopia, *Journal of Natural Sciences Research* Vol.5, No.21, 2015, iiste.org/Journals/index.php/JNSR/article/download/27112/27796 accessed on 04/01/2016

Abebe Ejigu, Bihon Kassa and Gebremedhin Yihdego (2011). Determinants of Land Allocation to Irrigation and Its Wealth Effect; Evidence from Northern Ethiopia. *Journal of the Dry lands* 4(2): 310-319

Abonesh Tesfaye (2006). *The Impact of Small Scale Irrigation on Household Food Security; The Case of Filtino and Godino Irrigation Schemes in Ada Liben District, East Shoa, Ethiopia*, MSc thesis, Agricultural Economics, Haramaya University, Ethiopia

Agerie Nega (2013). *Determinants of Smallholder Rural Farm Households' Participation in Small Scale Irrigation and Its Effect on Income in North Gondar Zone; A Cross- Sectional Approach (Evidence from Dembia Wereda)*, MSc unpublished thesis, Mekelle University, College of Business and Economics Department of Economics

Babbie E. (1990). *Survey Research Methods*. Belmont; Wadsworth Publishing

Bekele J. and Maryam M.O (2014). Small-scale irrigation and household wages relationship; Proof from Deder district, Ethiopia, *International Journal of Irrigation and Water Management*, www.internationalscholarsjournals.org accessed on 31/12/2015

Chant S. (1997). Women-Headed Households; Diversity and Dynamics in the Developing World, Macmillan

Creative Research Systems (CRS). (2012). Sample Size Formulas for our Sample Size Calculator. http;//www.surveysystem.com/sample-size-formula.htm Accessed on January 25, 2014.

Creswell J. (2012). *Educational research; planning, conducting, and evaluating quantitative and qualitative research*, fourth edition, Pearson

CSA, (2012). *National population and Housing census of Ethiopia*, Addis Ababa, Ethiopia

CSA, (2014). *Population Stabilization Report Ethiopia*, Addis Ababa, Ethiopia

Dereje Kifle (2013). Gender role in agricultural production in some parts of Ethiopia: a brief review. *International Journal of Research in Applied Natural and Social Sciences* (IJRANSS) Vol. 1, issue 2, July 2013, PP49-52

FAO, (2011). *Women in Agriculture; Closing the gender gap for development*. Rome, Italy; FAO and Agriculture Organization of the United Nations

Goitom Sisay (2009). *Rural-urban marketing linkages and its implication for integrated development, the case of Kobo town and surrounding Kebeles*, unpublished M.A thesis, Department of Geography and Environmental Studies, Addis Ababa University, Ethiopia

Gujarati D. (2003). *Basic Econometrics* (4th ed). New York: McGraw Hill/Irwin

Hawku Reda (2014). *Impact of the Women and Ploughing Program on Income and Land Productivity of female headed households, A case study in Five (5) Tabias of Ganta- Afeshum District, in Eastern Tigray Ethiopia*, unpublished M.A thesis, department of Economics, Mekelle University, Ethiopia.

Kinfe Asayehegn (2012). Irrigation versus Rain-fed Agriculture; Driving for Households' Income Disparity, A Study from Central Tigray, Ethiopia, *Agricultural Science Research Journal* Vol.2(1), pp. 20-29, http;//www.resjournals.com/ARJ accessed on 23/12/2014

Kobo Girana Valley Development Program (2015). *Modern small scale Irrigation project beneficiary households up to 2015*, unpublished report, Kobo, Ethiopia

Kodama Y. (2006). Poverty Analysis of Ethiopian Females in the Amhara Region: Utilizing BMI as an Indicator of Poverty, *IDE Discussion Paper* No.80

Kothari C.R. (2004). *Research methodology; methods and techniques*, Second revised edition, new age international (P) limited publishers

Mequanent Muche and Esubalew Tadele (2015). Analysis of Household Level Determinants of Food Security in Jimma Zone, Ethiopia, *Journal of Economics and Sustainable Development,* Vol.6, No.9, 2015, pp.230-240

Messay Mulugeta (2010). Food Security Attainment Role of Urban Agriculture; a Case Study from Adama Town, Central Ethiopia. *Journal of Sustainable Development in Africa* Vol 12, No.3, pp.223-249, Clarion University of Pennsylvania, Clarion, Pennsylvania

Ministry of Agriculture (1992). "*A case study on Women's Access to agricultural Extension Service*, Planning and programming department, Addis Ababa, Ethiopia.

Ministry of Agriculture (2011). *Small scale irrigation situation analysis and capacity needs assessment*, Natural Resources Management Directorate, Addis Ababa, Ethiopia

Muez Haileleul (2014). *The Impact of Small-Scale Irrigation on Rural household Food Security, the case of Emba Alaje Wereda*, unpublished M.Sc thesis, Department of Economics, Mekele University, Ethiopia

Nugusse Zeweld 2013. *Food Security through Small Scale Irrigation; Case Study from Northern Ethiopia,* Masters unpublished thesis Ghent University, Belgium

Sisay Belay and Fekadu Beyene (2013). Small-scale irrigation and household income linkage: Evidence from Deder district, Ethiopia, *African Journal of Agricultural Research*, Vol 8(34), pp. 4441-4451, 5 September, 2013

Sithole N. L., Lagat J. K. and Masuku M. B. (2014). Factors Influencing Farmers Participation in Smallholder Irrigation Schemes: The Case of Ntfonjeni Rural Development Area**,** *Journal of Economics and Sustainable Development*, Vol.5, No.22, 2014, www.iiste.org accessed on 21/01/2015

UN-HABITAT. (2008). *Ethiopia Urban Profile*. United Nations Human Settlements Programme Regional and Technical Cooperation Division, UNON, Publishing Services Section, Nairobi, Kenya

UNDP, (2007/8). *Ethiopia highlights on Millennium Development Goals progress*.

World Bank, (2008). *Ethiopia Agriculture and Rural Development Public Expenditure Review 1997/98 – 2005/06.* World Bank; Washington DC, USA.

World Bank, (2015). *Ethiopia Poverty Assessment 2014*, Poverty Global Practice Africa Region, Report No. AUS6744

Notes

-Tropical Livestock Unit (TLU) is equivalent to 250 kg live animal weight. The conversion factors vary according to the type of livestock. Cognizant to this, Cows, oxen and Bulls =1.0, Heifers =0.75, Calves=0.2, Sheep and Goats=0.13, Mules/Horses=1.1, Donkeys=0.7 and Chicken=0.013

-Adult Equivalent is calculated for the years of age 0-1, 1-2, 2-3, 3-5, 5-7, 7-10, 10-12, 12-14, 14-16, 16-18, 18-30,30-60 and 60 plus as 0.33 and 0.33, 0.46 and 0.46, 0.54 and 0.54, 0.62 and 0.62, 0.74 and 0.70, 0.84 and 0.72, 0.88 and 0.78, 0.96 and 0.84, 1.06 and 0.86, 1.14 and 0.86, 1.04 and 0.80, 1.00 and 0.82, 0.84 and 0.74 for males and females respectively.