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**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***

BY

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DECLARATION

I Hawku Reda Kumanit, here by declare that the thesis entitled “*Impact of the Women and and Ploughing Program on income and land Productivity of female headed households A case study in five(5) tabis of Ganta-Afeshum district in Eastern Tigray Ethiopia*” submitted by me for the award of the Degree of Master of science in economics of Mekelle University, through the Department of Economics is original work and it has not been presented for award of any other Degree, Diploma, Fellowship or Other similar titles of any other university or institution.

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Abbreviations and Acronyms

ECC: Ethiopian Catholic Church

ECS: Ethiopian Catholic church secretariat

FHHs: Female Headed Households

ADCS: Adigrat Diocesan Catholic Secretariat

CSI: Caritas Secours International

ADCS-FSP: Adigrat Diocesan Catholic Secretariat Food security Project

TPLF: Tigray People's Liberation Front

GDP: Gross Domestic Product

LPT: Livelihood Profile of Tigray

TLU: Tropic Livestock Unit

FDRE: Federal Democratic Republic of Ethiopia

MOFEDE: Ministry of Finance and Economic Development Ethiopia

SDPRP: Sustainable Development and Poverty Reduction Program

UNDP: United Nations Development Program

NNM: Nearest Neighbor Matching

KM: Kernel Matching

RM: Radius Matching

SM: Stratification Matching

Table of Contents

Page Number

Abbreviations and Acronyms	iii
Tables and Figures	vii
Abstract	1
CHAPTER ONE	2
1. INTRODUCTION	2
1.1 Background of the study	2
1.2 Statement of the Problem	4
1.3 Objectives of the Study	6
1.3.1. General objective of the study	6
1.3.2. Specific objectives	6
1.4. Research Hypotheses	6
1.5 Research questions	6
1.6 Scope and Limitations of the Study	7
1.7 Significance of the Study	8
1.8. Organization of the Thesis	8
CHAPTER TWO	9
2. LITERATURE REVIEW	9
2.1. Defining Impact Evaluation	9
2.2. Conceptual frame work	9
2.2. 1 Women and ploughing program:	11
2.2.2 Awareness creation activities on 'women of the ploughing taboo:	12
2.2.3. Training and oxen distribution/supply to beneficiaries	12
2.3. Factors in Crop production	13
2.4. Building an Asset (at Household and Community level)	14
CHAPTER THREE	17
3. DATA SOURCE AND METHODOLOGY OF THE STUDY	17
3.1. Data source	17
3.2. Sample size and sampling technique	17
3.3. Data Analysis	19

3.3 Definition of variables and hypotheses	26
3.3.1 Dependent variable.....	27
3.3.2. Independent or explanatory variables.....	27
CHAPTER FOUR	31
4. ANALYSIS AND DISCUSSION	31
4.1 Description of the Study area	31
4.2 Descriptive statistics of the data set.....	34
4.2.1. Household characteristics of the sample survey.....	34
4.2.2. Households' family size with by group of category	35
4.2.3. Educational status of household heads	36
4.2.4 Farm size (CPF-crop production filed) by group of respondents.....	37
4.2.5 Size of livestock in terms of TLU by group of respondents:	38
4.2.6 Distance from nearest market center:.....	38
4.2.7 House ownership of respondents:	40
4.2.8 Income of the sample households:	41
4.2.9 Crop production and productivity by group of category	44
4.2.10 Female headed household numbers of years binge as head	46
4.2.11 Descriptive statistical analyses of discrete variables	46
4.3. Econometrics model of Impact Analysis Results:	50
4.3.1. Determinates of participation in women and ploughing program	52
4.3.2 Propensity Score Matching (PSM) Methods	57
CHAPTER FIVE	60
5. SUMMARY, CONCLUSION AND RECOMMENDATIONS.....	60
5.1 Summary	60
5.2 Conclusion and Recommendation	61
6. References:	65
7. Annex:	68

Tables and Figures

Table: 1 illustrating the proportion of male & female household heads the study area

Table 4.1 Family size by groups of respondents

Table 4.2 Level of education by groups of respondents

Table 4.3.The Mean difference and t-test of continuous variables

Table 4.4 Descriptive statistics of discrete variables among respondent households

Table 4.5 List of variables to be included in the econometric model

Table 4.6 Variance inflation factor (VIF) for continuous variables

Table 4.7 Contingency coefficient for discrete variables

Table 4.8 the logistic regression model Estimation the determinant of participation in women and ploughing program in Ganta-Afeshum study areas

Table 4.9 Propensity Score Matching of ATT Effect of NNM, RM, KM and SM methods

Figure: 4.1: Marital states of both group participant and non participant

Figure: 4.2 Family sizes by both categories

Figure 4.3: Land ownership by group of categories

Figure: 4.4 Market distance from Home by group categories in Kilometers

Figure 4.5 Net incomes from Crop production in 2004E.c harvest

Figure 4.6 Income from livestock seals

Figure 4.7 share of Income source by group of categories

Figure 4.8 Crop harvest income comparison by group of category:

Figure 4.9 Access to extension service comparison by group of category:

Abstract

The study examined the impact of the Women and Ploughing Program on income and land Productivity of female headed households. Data for the study was obtained from 235(100 treated and 135 none treated groups) female headed households from five (5) tabis of Gantafeshum werdeda of Eastern Tigray, Ethiopia.

In this research analytical model selected for this study was binary logit model, which significantly identifies the influences of participating in Women & ploughing program. The propensity score matching approach aims to build matched pairs of comparable participants and non-participants that show a similarity in terms of their observable characteristics. Thus, to support the result obtained from regression analysis the impact of women and ploughing program on income and land productivity FHs are examined using econometric PSM method.

Results of the econometric model indicated the relative influence of different variables on participation in women and ploughing program of the total fifteen (15) explanatory variables included in the model eight of the variables (8) were found to show significant relationship with participation in women and ploughing program. Accordingly, these include family size, TLU, distance to the nearest market, access to oxen and farming skills, supply of Oxen & farm tools, training on Ploughing and agronomic practice, house ownership, female headed household numbers of years being as head, and access to extension service found to be positively significant relationship with participation in women and ploughing program.

Propensity score matching (PSM) results show that participation in women and ploughing program contributes positively to female headed farmers' annual income earning on average by Birr 2728.70, 2,505.22, 2,609.52 and, 2,363.40 for NNM, RM, KM and SM respectively than that of non participants in the program and explains analyze the income difference between women and ploughing program participants and non participants.

It is possible to conclude income and productivity differential among female headed households can be explained as a result of participation and non participation in women and ploughing program. Participation in women and ploughing program puts female headed households at the heart of decision making on farming time, weeding, crop harvesting, and crop seed selection and like. Besides, participants in the program can grasp the entire crop left over which give an opportunity to boost their TLU holding.

Regional and local government can benefit female headed households who own land through women and ploughing program as one package of extension approach. Therefore Government and partner NGOs should work closely on this issue to scale it up the experiences and field good practices gained in ADCS food security project and of the total cultivated land in the region 1, 299,598 ha, of which 183,362 ha (14%) is owned by female headed households. This gives apple ground to devise a program to make productive the land in the hands of female headed households at regional level through Women & ploughing program.

Key Words: *Female headed households, land productivity, supply of farm tools and oxen*

CHAPTER ONE

1. INTRODUCTION

1.1 General background

Since the fabric of Ethiopia agriculture is the foundation of the country's economy, accounting for half of gross domestic product (GDP), 83.9% of exports, and 80% of total employment. All most all the fields assumed to be cultivated have been plagued by oxen 'Ploughing'. In Ethiopia Traditional cultivating crop fields using two oxen 'Ploughing' is a centuries-old tradition, but have always been within the domain of men (LEISA Magazine, 2000). Particularly women and ploughing is considered as cultural taboo which left women not to participate and make decisions on their plots of land to produce cereals.

The Federal Democratic Government of Ethiopia has declared its unequivocal commitment to the development of women with the announcement of the National Policy on Women in 1993 (referred to as the Women's Policy), and the promulgation of the new Constitution in 1994. The Women's Policy primarily aims to institutionalize the political, economical, and social rights of women by creating an appropriate structure in government offices and institutions so that the public policies and interventions are gender-sensitive and can ensure equitable development for all Ethiopian men and women. Consistent with the above policy, Article 25 of the new Constitution guarantees all persons equality before the law, and prohibits any discrimination on grounds of gender. In addition, Article 35 reiterates principles of equality of access to economic opportunities, including the right to equality in employment and land ownership Women watch UN (2008).

In Ethiopia approximately 27 million people are living in poverty. Given the lack of access and control over resources and many discriminatory traditional customs, women comprise a majority of those living in absolute poverty. Gender differentials persist at all levels, as reflected by social indicators. Seventy- five percent of women are illiterate. Even though primary education is being promoted, early marriage of girls reduces their chance of having access to higher education {75% of Ethiopian girls marry before the age of 17and approximately 13% between the ages of 17 and 21 years} Women watch UN (2008).

Adigrat Diocesan Catholic Secretariat (ADCS) is a non-profit making faith based organization, mandated to coordinate and facilitate all pastoral, social and development activities of the Ethiopian Catholic Church in the Diocese of Adigrat. It covers the Tigray Regional State and the zone two of the Afar Regional State (ADCS strategic plan, 2011). Accordingly In partnership with the Ethiopian Catholic Secretariat and the Adigrat Catholic Secretariat, and following a problem identification and project formulation workshop on January 2003 with representatives of the beneficiaries and local government administrations, ADCS, Caritas Belgium, worked out project entitled “**Food security Project**” which is funded by the Belgian Survival fund (ADCS, 2003).

The first phase of the project aimed were at improving the livelihood of poor rural households in eight tabias, three of which are in Gulomakda wereda and five in Ganta-Afeshum wereda, East Tigray, Ethiopia. As agriculture and animal husbandry was the only available livelihood strategy to these households, the project aimed were at a diversification and upgrading of the agriculture and animal feed and income (irrigated home gardening, improved crop production, increased available livestock feed, cattle breed improvement, bee keeping and poultry husbandry) and a rehabilitation of the agricultural lands like that of gully rehabilitation. To enable the female-headed households and women, in general, to participate in the project, the project envisages better access to potable water, milling infrastructure and women ploughing facilities. The 1st phase of the project period was from September 2003 to September 2008, currently the second phase of the project is undergoing.

As a result in FSP-ADCS project “Women and ploughing”¹ have given a special attention and has been implementing the program starting from September 2003 ADCS food security second phase Project document (2008). During the ploughing programme, farmers were interviewed and the ploughed fields were checked for level, depth of ploughing and their general condition, provided with necessary skills and subsidized farm tools and oxen. For the past 7 years, ADCS has successfully worked on the ‘women and ploughing’ taboo ADCS project report (2008). Through a continued effort of awareness creation activities and community discussions, the communities’ mentality towards the ‘women and ploughing’ issue slowly changed. With this

¹ Women and Ploughing is a program in Food security Project of ADCS: which supports female headed households in providing training oxen ploughing skills to women and provides subsidized oxen, farm tools and other supportive activities to increase income and productivities of female headed households.

intermediate result, the project aims to empower women further so that they can fully participate in and benefit from agricultural production.

The proportion of female headed households is increasing both at national and regional level. It is estimated that over 30 % of all the households in the Tigray are female headed households, although there exist important differences from one area to another Meehan.F, (2004). However in the project area some 34 % of the farming households were found to be female headed households. Women play important roles as producers of food, managers of natural resources, income earners, and caretakers of household food and nutrition security. Therefore, any food security intervention should pay special attention to the interests and needs of women (Quisumbing & Meinzen-Dick, 2001).

1.2 Statement of the Problem

Ploughing with two oxen is a centuries-old tradition in Ethiopia, however has been always within the domain of men. Understanding the situation of women, the Tigray People's Liberation Front (TPLF) started to sensitize women to plough their plots beginning from 1981. Many women have no chance to learn ploughing while their husbands are alive. As a result after the death of their husbands, women with one ox followed the tradition of sharecropping with a man who also owned oxen LEISA Magazine (2000). Female headed households get very limited benefit from the plot of land they own. This because women did not farm their own plot of land rather they give it out in terms of tiwfirity (share cropping and giving away the entire straw). The other point is also farming time is highly compromised during land preparation, crop harvesting and trashing, as a result defiantly affects productivity negatively.

One problem very particular to the project area is the situation of female headed households, which make up 34 % of all households in the area: ADCS project document, (2003). Next to the fact that there is one labour force missing from these female headed households, they are also limited in their agricultural production because of the '**ploughing taboo**'. Traditionally, women in Tigray are not allowed to manipulate oxen for ploughing their croplands and for threshing crops. Therefore, women household heads, who have cropland, are forced to enter into an agreement with a male farmer for accessing ploughing facilities. Usually, such an agreement involves the payment of half the crop's harvest or/and all the straw harvested from the plot

(ADCS project document: 2003).² As a consequence, female headed households get much less benefits from their rain feed croplands than male headed households.

Similarly Holden and Mintewab (2000) cited previous studies to show that gender-specific variations in land productivity do exist. For instance, land productivity on plots controlled by women was lower than that on plots controlled by men in Ghana and productivity decreased by 30% on female plots as compared to male plots in Burkina Faso. In line with the above argument, if 30-34% of the land owned by female headed households and it is less productive, there should be interest of research area to identify the root causes and go for solutions at macro level as a policy direction.

Finally to dig out the root causes for less productivity to check whether kinship contracts, involving blood-related or in-law of male, are less efficient may be as a result of their trite point of agreements. It is true when female headed households give their plots for sharecropping or straw, they have limited power to make decisions on timing to prepare the land, planting, weeding, and collection of the harvest from the field. The partner usually concerned on the straw and may not give attention to the land to prepare it on time and to invest maximum effort. Similarly they usually start farming the plots after they finished their own. In line with this female landlords are less able to evict inefficient family based partners; particularly in these are blood-related kin or in-law tenants. Then productivity differential between female male households may be explained by the fact that female landlords have more blood-related kin and in-law tenants that are less efficient do to the fact that have limited power on decisions of farming time, weeding, crop harvesting and like. Besides as accepted norm of the culture when a husband dies his brothers expected to undertake farming activities for the families of died brother on the bases of share cropping or/and straw. And as time has taken the above justification, how the women and ploughing program of food security project intervention of ADCS improves the life of the participant in holding physical asset and productive factors is the main problem to be address in this research.

² Straw is a very important livestock feed resource in the project area

1.3 Objectives of the Study

1.3.1. General objective of the study

- The major objective of this study is to investigate the impact of the Women and Ploughing program on income and productivity of female headed households in Ganta-Afeshum Woreda of Eastern zone Tigray Ethiopia.

1.3.2. Specific objectives

1. To describe livelihood related factors under which female headed households in the study area, of the women and ploughing participants and non-participants.
2. To investigate the link between Women's skill of ploughing and subsidized farm tools and oxen supply in income and land productivity of female households. It is intended to see how a woman's ploughing skill affect productivities and contribute to their income level.
3. To identify and measure factors influencing participation of women in the program.
4. Finally recommending the possible suggestions on how to upgrade the program to extend to other area and to realize Women and ploughing program can be as part of the extension package of the government.

1.4. Research Hypotheses

This research work conceptually hypothesizes Women's skill of ploughing and subsidized farm tools and oxen supply have no adverse effect in income and land productivity of female head households. The differences between female headed households income and land productivity is not explained by the participation in women and ploughing program.

Hypothesis (Ho): There is no difference between female headed household's income and land productivity of women & ploughing program participants and non participants of food security project of ADCS.

1.5 Research questions

This research work employed and extracted the following questions in qualitative and quantitative data collection and analysis during the course of the research work.

- What are the factors for female headed households to have less monitoring and enforcement capacity to Contract choice for there own plots of land to explain the productivity differential?
- Is Women's skill of ploughing and subsidized farm tools and oxen supply has effect in income and land productivity on female headed household's owned plots?
- What is the benefit of female headed households in participating in women ploughing program?
- Do female headed households who participate in women ploughing have difference income, productivity and empowerment with those who did not participate in the program?
- What impact does bring the intervention of ADCS food security project in women ploughing program in the locality in the female headed households in eliminating women and ploughing taboo?

1.6 Scope and Limitations of the Study

The research aims to investigating the impact the training given to develop Women's skill of ploughing and subsidized farm tools and oxen supply to female headed households in income and land productivity of female households in food security project which is implemented by ADCS in five tabias of Ganta-Afeshum wereda, East Tigray, Ethiopia from September 2003 to September 2008, although currently the second phase of the project is undergoing.

It is common for researchers to become weak with a lot of short comings during conducting research. The degree and intensity of the problems vary among researchers based on the type the research. Obviously, these problems will become motivated if the area under study is a new one or when there is no related works (if any very few.) On this regard, the researcher is handicapped by absence of previous related works could have been a great deal of importance to the research work. In this research the main refferces documents regarding women and ploughing program are the project document only.

1.7 Significance of the Study

The research is important mainly in two aspects: first it helps to understand how ‘ploughing taboo’ affects female headed household’s income and their plot of land productivity. Besides it digs out prevailing factors and constraints that female headed households facing in the study area and it’s consequence in overall land productivity and income of the households. The research investigates the link between Women’s skill of ploughing and subsidized farm tools and oxen supply in income and land productivity of female households. On top of that the study assertively intended to see how providing women’s skill development of oxen ploughing and support of subsidized oxen and farm tools encourages female headed household’s empowerment economically.

Secondly the study vitalizes and attempts to investigate how supply of training to women on oxen ploughing for female headed households enhances land productivity . In this regard the research investigated how important policy implication that gives to strengthening women’s land rights and providing training on oxen ploughing may not only be good for equity and empowerment of female headed households but also for effective and efficient land use that is owned by female headed households.

The Last but not the least the study is expected to serve as a pass finder for those persons who are interested to conduct further research on the same area that could help to address the prevailing problem in the region and in the country.

1.8. Organization of the Thesis

The Thesis is organized into five parts. The first part deals with introduction as chapter one. The second chapter reviews of conceptual as well as empirical literatures pertinent to obtained in the research topic.. Chapter three exclusively deals with general features of the study area i.e. site selection and description and the research methods pursued (econometric model specification) and variable verification. Estimation of the models and empirical analysis of the major findings and discussion, which is regarded as the main body of the thesis, is described in chapter four. Finally, the conclusion and recommendations forwarded is presented in the last chapter.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Defining Impact Evaluation

Program impact evaluation of an intervention or program directed at attaining certain results grips measuring the outcome of the treatment of the program or intervention of the program. Intervention can refer to training programs, or participation in the treatment of the program, changes in regulations, policy changes, introduction of new programs, and application of systems, transfer payments, adoption of technology, or others.

The outcomes to be measured vary from intervention to intervention and include increased income/expenditure, enhance productivity, improved student enrollment, reduction in incidence of disease, poverty reduction, or empowerment. Impact evaluation would thus involve measuring changes to the outcome of interest as a result of the treatment under consideration. The major point of interest in impact evaluation is the need to establish the causal relationship of treatment and outcome (Cobb-Clark and Crossley, 2003; Cameron and Trivedi, 2005, p. 861).

2.2. Conceptual frame work

Under this section an attempt is made to discuss some of the concepts used in this study such as gender farming, gender role, factors of land ownership and household headship.

The propensity score: is defined by Rosenbaum (1983) as the conditional probability of receiving a treatment given pretreatment characteristics: Matching is non parametric method that is widely used in the impact evaluation literatures. Matching methods aid in creating counterfactual from the control group the basic assumption when using a counterfactual is that the untreated sample approximate the treated sample if they had not been treated, i.e., $(y_{0i} / I=1)$ Heckman *et al.* (1998) is critical and must hold true. The conditional independent assumption (CIA) argues that treatment is random and conditional on observed variables. This assumption implies that the counterfactual outcome for the treated groups is the same as the observed outcomes for the non treated group given the control variables (x). In the present case, this means that the counterfactual income is the same as the income level that would have existed if the household

had no participated in women ploughing program. This assumption rules of selection in to the program and gains from participation in women ploughing program on the basis of unobservable.

The CIA requires that the set of X 's contain all variable the jointly influence the outcome with no treatment, as well as the selection in the program. However, matching of households based on observables may not be feasible when the dimension of control variables is large. To overcome this problem of dimensionality, Rosenbaum and Rubin, (1983) argued that one can match a long single index variable given by the propensity score, $P(x)$, which summarized multi-dimensional variables. For the propensity score matching (PSM) to be valid, the balancing properties need to be satisfied. It is intuited that two households with the same probability, women ploughing program participants placed in treated and untreated women ploughing program (non participant) the sample is equal proportions.

The propensity score is estimated by a binary choice model, in this paper is represented by a binary logit model. Once the propensity score P_{score} is estimated, the data is equal spaced P_{score} interval, implying that within each of these intervals, the mean P_{score} of each conditioning variable is equal for the treated and control households, known as the balancing property. In which case a certain distance between household with and without participation in women ploughing program must be accepted.

According to the World Bank report (2011) female headed households (% of households with a female head) in Ethiopia was measured at 26.10 %. In Ethiopian context female headship is defined as women who takers of the family, but have no husband (her husband may be died or divorced from her), however she may have with her old parents, children, or orphans that she looks after them. And this becomes higher towards northern Ethiopia where the migration of male and war existed longer. On the other side if a woman is a bread winner and takes decisions of overall household administration it is defined as a female head household, is a world wide common definition. It seems that female headed households are more common in situations of poverty, in societies with a high level of male labour migration, and in situations where general insecurity and vulnerability prevail, and where in female ratio domination exists.

Prior to the 1975 agrarian reform, in most parts of the country, peasants gained access to land through inheritance or through corporate groups consisting of individuals tracing their descent from a certain ancestor. The most common and significant social relationship in most of rural Ethiopia was that of landlord-tenant. In most of northern Ethiopia, women had the right of inheritance and receiving land as gifts. Ruling class women had also the right of purchasing land (Hoben, 1973; Crummey, 1981). In 1995 Ethiopian Constitution and the federal land laws, efforts are made to ensure a more equal access to land for both women and men. The 1995 constitution underlined the state ownership of both rural and urban land. Land is defined as the property of the people, but is administered on their behalf by the state. In practice land is state property, and the people are only entitled on the land when it is in their possession; land cannot be sold, exchanged or mortgaged (FDRE, 1995).

In Ethiopia particularly in Northern Ethiopia the word farming denotes the activity of ploughing and sowing (Frank, 1999). And Ox-plough technology, providing the backbone of farming, has existed remarkably unchanged for thousands of years (Astake and Gebresenbet, 1998). In all areas of plough cultivation in Ethiopia, there is a cultural taboo against women ploughing and sowing (Eva, 2008). With the exception of these two tasks, women in rural Ethiopia participate in every aspect of production work, such as weeding, harvesting and postharvest activities (Mebrat, 2005; Yigremew, 1999). Besides farming, women in rural areas are supposed to be engaged in operations such as threshing, milling, cooking, collecting of wood and water and carrying out domestic chores. Studies also show that when women are supported and empowered, all of society benefits. Their families are healthier, more children go to school, agricultural productivity improves and incomes increase. In short, communities become more resilient (http://www.thp.org/what_we_do/program_overview/empowering_women).

2.2. 1 Women and ploughing program:

In this research work a new technical word may be ‘women and ploughing’ according to the project document this includes a group of activities: Women and Ploughing is a program in Food security Project of ADCS: which supports female headed households in providing training oxen ploughing skills to women and provides subsidized credit based oxen, farm tools and other

supportive activities to increase income and productivities of female headed households (ADCS project document: 2003).

2.2.2 Awareness creation activities on ‘women of the ploughing taboo:

Women and ploughing activities are a number of activities which have been organized in the program in order to raise awareness regarding the negative impact for women of the ploughing taboo. First a small discussion with Tabia leaders, priests and other ‘opinion leaders’ being conducted and then awareness creation done by an open-air public gathering where everybody can speak out on the issue. These continue to follow and support them through extension support on different agricultural topics, gathering of yearly harvest data and follow-up field crops. As much as possible, these beneficiaries consulted as resource persons during the organization of awareness creation activities and the organization of practical training programs in the project Tabias ADCS project document, (2003).

2.2.3. Training and oxen distribution/supply to beneficiaries.

Following the organization of the awareness creation activities, it is an important step to be part of the beneficiary and program. As beneficiary they are expected to be interested in taking a subsidized credit for a ploughing ox. Disposing already of their own ploughing ox but willing to just participate in the training program and be part of other support. Each of these households receives the visit of an extension worker to check their household situation before they are eligible to be included as a beneficiary for this activity.³ A special Tabia committee established to accompany the activity. These committees are responsible for the organization of the technical training programs for the women farmers and to provide them with continuous support. The technical training programs are given each year during the months of January and February (some two to three months before the start of the ploughing season). The training is given by male farmers, but also by beneficiaries from the first round training and it includes an exposure visit to neighboring Tabias in order to see the achievement of women farmers there.

³ This household check is included to verify whether the household really is a female headed household and already owns an oxen or not

During the months February - April, usually the program assists the women beneficiaries with the purchase of their oxen. These purchases are spread over a period of several weeks, to avoid creating a price increase in the market. As much as possible, all ploughing oxen are bought locally, to avoid increasing the total number of animals in the project area. Together with their oxen, the women also receive some straws to feed their oxen during the first months, until the end of the rainy season. The Tabia committee and the program extension workers support each new beneficiary throughout the ploughing time and the crop growing season. The first installment for credit repayment is expected after the crop harvest (November – December) ADCS project document, (2003).

Provision of oxen through Tabia Revolving Funds is also one mechanism and become main strategy of the program. Provision of ploughing oxen to women beneficiaries are financed by the Tabia revolving funds take the credit for the purchase of their ox directly from the Tabia revolving funds and also have three years to return it (with interest). All the beneficiaries have the possibility to participate in the technical training program (the same as for the other beneficiaries) and they are equally benefited from the support provided by the Tabia committee and the project's extension workers ADCS project document (2003). To strengthen women's knowledge on general crop production techniques, three training sessions are organized in each of the Tabias. Topics dealt within the training courses include soil fertility management, selection of good seed materials, plant protection against pests or diseases and the handling of crops after harvest.

2.3. Factors in Crop production

For agricultural production, we focus on the value of crop production per hectare assuming that the value of crop production by household w on plot p is determined by: the amount of inputs (labor, oxen power, fertilizer, seeds) used; the land management practices (manure or compost, burning, contour plowing, reduced tillage, intercropping) used ; natural capital of the plot (biophysical characteristics and presence of land investments); tenure characteristics of the plot (how plot was acquired, i.e., whether allocated in prior land distribution, inherited, leased sharecropped in almost all cases, received as gift, or borrowed; the household's endowments of physical capital (land, livestock, radio reflecting access to information as well as wealth, human capital (education, age, and gender of household head, size of household), the financial capital

(use of credit and accumulation of savings), and social capital (assets in form of relationships, indicated by participation in programs and organizations); the household's income strategy (primary and secondary income sources); the village-level factors that determine local comparative advantages (agro-ecological conditions, access to markets and infrastructure, and population density).

In Woredas Ganta-Afeshum and Gulomakda, the average net crop production for land-owning households in the project area is 410 kg per year (average of the data for Ganta-Afeshum and Gulomakda Woreda). This leaves $1,750 \text{ kg} - 410 \text{ kg} = 1,340 \text{ kg}$ of grains to be purchased annually. Households that require the assistance of another farmer for ploughing their own cropland (male headed households without an ox and female headed households with potential) normally have to pay half the crop harvest as a payment for the ploughing service. Hence, they have a net grain production of 205 kg per year. The 'less dynamic' households (male headed and female headed) rent out the cropland over which they have user rights, usually with a $2/3 - 1/3$ sharecropping agreement (2/3 of crop production for the farmer that works the land, 1/3 of crop production for the household that has got the user rights over the land) ADCS project document, (2003).

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Such an agreement leaves these households with a net grain production of 137 kg per year. So they need to purchase the remaining 1,613 kg of grains from the market. Landless households (having no rainfed grain production of their own) have to purchase the full 1,750 kg of grains from the market. Of course, this is only a theoretical calculation. Total household expenditure will also include many other expenses, such as payment of taxes and credit reimbursements; purchase of items such as oil, matches, clothes and school materials for children. The objective here is not to give a complete calculation of all household expenses and how different categories of households cover them, but rather to assess somewhat objectively for which households the food security situation is most precarious ADCS project document: (2003).

2.4. Building an Asset (at Household and Community level)

Tigray developed a Comprehensive Community and Household Asset Building Approach (CCHABA) is a holistic approach to improve and develop the economic and natural resource

base of the economically disadvantaged and ecologically fragile areas and people in the region. It specifically enables to improve the food security situation of the target households by increasing their productivity through improved technologies in their livestock and crop production, small-scale irrigation and better natural resource management (CCHABA.2003).’⁴

Building an asset is generally defined as accumulating or owning ‘a stock of financial, human, natural or social resources that can be acquired, developed, improved and transferred across generations. It generates income or consumption, as well as additional stock’ (Ford 2004). In the current poverty-related development debates the concept of assets or capital endowments includes both tangible and intangible assets, with capital assets of the poor commonly identified as natural, physical, social, financial and human capital (Moser.C & Stein. A, 2011).

Regional Bureau of Agriculture and Rural Development indicate that a household in rural Tigray produce grains that cover only 38 % of what is necessary to be food self-sufficient.⁵ Complementary to crop production, livestock husbandry is the main source of income for households living in the rural areas of Tigray. In spite of high number of livestock in the region the benefits obtained from livestock remain below expectation, because of low productivity which is mainly attributed to the low quality of animal breeds, insufficient veterinary services and lack of animal feed. Limited income source diversification and livelihood options have kept rural households in Tigray trapped in their dependency upon unreliable (because mostly rain-fed) and not very productive agricultural activities. Because of all these factors, the households in rural Tigray are very vulnerable to external shocks (such as drought). During each shock, the already limited household and community assets are further depleted, aggravating the households’ food insecurity situation and vulnerability and making it very difficult to develop sustainable livelihood mechanisms.

The wealth analysis conducted as a part of the livelihood profile for the Eastern Plateau Livelihood Zone indicates that the principal determinants of wealth in the area are the surface area of land cultivated and the number of livestock owned by each household. Based on these

⁴ Tigray Region Food Security Coordination Office, Comprehensive Community and Household Asset Building Approach (CCHABA) for improved food security in Tigray, 2003.

⁵ Tigray Regional Bureau of Agriculture and Rural Development. Five Year Strategic Plan (1999 -2003, Ethiopian Calendar).

criteria, households in the zone were categorised in 4 classes: ‘very poor’, ‘poor’, ‘middle’ and ‘better-off’. The regional food security strategy for Tigray, formulated in 2003, is called the CCHABA. This strategy starts from the observation that depletion of households’ and communities’ productive assets is the major cause for food insecurity in the region. To break the trend of continuous asset depletion, the CCHABA proposes an optimal balance between household-asset building interventions (aimed at bringing immediate benefits for local households) and community-level interventions (aimed at recovering community assets).

Having this concept ADCS-FSP developed also a special scheme that can address particularly women headed households that is Women and plowing program. This basically aimed at bringing immediate benefits for local women households, and in long run to scale it up around the community and near by tabis and districts.

CHAPTER THREE

3. DATA SOURCE AND METHODOLOGY OF THE STUDY

3.1. Data source

The data source for the study was both primary and secondary sources. In this research work primary data related to female headed household characteristics, socioeconomic, household basic consumption, female headed household size plot of farm land, female headed household participation in oxen ploughing facilities, participation on skill development of oxen ploughing and agronomic practice, participation in extension package program and coping strategies, participation in access to subsidized oxen and farm tools by the project ,asset holding, access to micro credit & saving services, extension service, poverty perception and other relevant information was collected. Secondary information was collected from published and unpublished documents of national, regional, district, and ADCS food security project. Besides; different reports from relevant organizations were collected necessarily to support/consolidate the primary data.

3.2. Sample size and sampling technique

Data collection scheme covers five tabis and was stratified to capture difference in Agricultural potentials (inputs), access to drinking water and irrigation, access to social services, access to health crevices, access to road, costs incurred in mill and transportation, house ownership, livestock holding, & educational expenses etc . Thus, once the population survey (female headed households) was categorized as participants and non participants in women & ploughing program, in the five tabis. List of all female headed households of participant and non participant obtained from each stratified five tabia and once the proportion of sample from each tabias calculated a random sampling technique was implemented in order to select **100** respondents from participant category and **135** from non-participant category. The number of respondents in each tabias was decided based on proportionate sampling. The district has a population of 118,043 people (2005) there is a structural disequilibrium between the male and the female part of the population (48 % versus 52 %). The average household size in the area is 4.38 persons ADCS project document (2009).

Table: 1 illustrating the proportion of male & female household heads in the study area

S/n	Household heads in the Study Area (Ganta-Afeshum)				Stratified Sampling		
	Tabia	Male headed HH	Female- headed HH	Total HH	235	Participant	Non Participant
1	Beati – May Mesanu	724 (59 %)	512 (41 %)	1,236	33	14	19
2	Bukot – Nehebi	2,648 (78 %)	765 (12 %)	3,413	94	40	54
3	Dibla – Seit	1,025 (65 %)	552 (35 %)	1,577	42	18	24
4	Golah – Genahiti	742 (54 %)	634 (46 %)	1,376	38	15	22
5	Sassun – Beithariat	626 (66 %)	320 (34 %)	946	28	12	16
	Total	5765(67%)	2783 (33%)	8,548	235	100	135

Source: Wereda administration office and computed Sample size 2013

Data was collected from the project beneficiaries those female headed households that participated in women's ploughing skill development and received subsidized oxen and farm tools. Similarly to see the clear impact of the project program data were collected from female head households in the area that did not participated in the program of women's ploughing skill development and received subsidized oxen and farm tools in the first phase of ADCS-food security project. In this study area female headed households are about 2783 (33%) of the total households and in the first phase of the project about 532 (19.12% of the total female head household in the tabias) female headed households received women's ploughing skill development and subsidized oxen and farm tools ADCS project document,(2009). Accordingly; sample size of 235 female headed households (8 % of the total female headed households in the study area) were selected through stratified systematic random sampling method and include in the survey.

For the research structured interview questionnaire was design to obtain response from the participating and non participating individuals female headed households in the interview. The structured questioner was pre-tested on the field following enumerators training. For this purpose 10 enumerators were participated who completed secondary education and familiar with the

culture and language of the community. Appropriate training, including field practice, was given to the enumerators to develop their understanding regarding the objectives of the study, the content of the questionnaire, how to approach the respondents and conduct the interview collect quality data. Pre-testing of the questionnaire was carried out with the enumerators and depending on the results; some adjustments was made on the final version of the questionnaire based on the pre-test result.

Besides, personal observations and informal discussions with female headed households who participate in the program and non participants were conducted to generate primary information. In relation to that secondary data was obtained from government offices and other relevant organizations.

3.3. Data Analysis

When ever the baseline data is missing to conduct impact analyses using DID (difference in difference) is impossible. Therefore the research was applied logit model and PSM to generate the missing data through matching on observable characteristics of treated and non treated group. This gives counterfactual of the treated group and possible to undertake or measure change in intervention of the program. The study was based on quantitative data analyzed by using descriptive statistics such as percentages, frequencies, mean and standard deviation and econometric model. Besides, t-test and χ^2 were also employed to test the continuous and discrete variables, respectively. STATA- version 10 was used to analyze data. Analytical model selected for this study was binary logit model, which significantly identifies the influences of participating in women ploughing program of food security project ADCS. Logit and Probit models overcome such drawbacks as both are based on a commutative distribution function. And it is true that various Participation/adoption studies so far done on crop, livestock, soil conservation etc. have used Probit and Logit models for identifying the impact of independent variables on dependent variables. However, as of Aldrich and Nelson, (1984), the outputs of Probit and logit models are usually similar. Even though their outputs are similar the logit model is easier in estimation. It is also appropriate to express the probability of participation and the intensity of use after participation in the program. Due to this fact, selecting binary logit model was thought to be appropriate for this research work.

To measure the impact of an intervention policy or a program needs to measure outcome of the intervention or treatment. To see outcomes to be measured differ according to the type of intervention and can include income, expenditure, asset holdings, student enrollment, effectiveness of a treatment, poverty reduction, gender empowerment, and like. To indicate or examine the impact of women & ploughing program implemented as a component of ADCS food security project on the participants (beneficiaries); it needs the states of non-beneficiaries/participants on women ploughing program. Accordingly Propensity Score Matching (PSM) technique was adopted as it is very commonly used by many researchers (Gonzalez et al., 2009; Rosenbaum and Rubin, 1983; Ravallion, 2001; Gilligan et al, 2006). The appropriate evaluation of the impact of the program requires identifying the average treatment effect on the treated (ATT) defined as the difference in the outcome variables between the treated households and their counterfactual (Gonzales et al., 2009). In this context, if Y represents the outcome variable and if D is a dummy variable that takes the value of 1 if the individual was treated and 0 otherwise.

$$ATT = E(Y_i^T - Y_i^C | D = 1) = E(Y_i^T | D = 1) - E(Y_i^C | D = 1) \dots\dots\dots \text{Equation (1)}$$

The fundamental evaluation problem in estimation of impact (using eq (1)), is that it is impossible to observe a person's outcome for with and without treatment at the same time.

While the post-intervention outcome $E(Y_i^T | D_i = 1)$ is possible to observe, however, the counterfactual outcome $E(Y_i^C | D = 1)$ i.e. the effect of the treatment on the ith household does not use the treatment is not observable in the data. Then the evaluation problem is characterized by missing data. A solution to this problem is to construct the unobserved outcome which is called the counterfactual outcome $E(Y_i^C | D_i = 1)$ i.e. the outcome participants would have experienced, on average, had they not participated (Rosenbaum and Rubin, 1983), and this is the central idea of matching. According to Rosenbaum and Rubin, the effectiveness of matching estimators as a feasible estimator for impact evaluation depends on Conditional Independence Assumption (CIA) assumption.

In matching the fundamental assumption, Conditional Independence Assumption (CIA), states that treatment assignment (D_i) conditional on attributes (X_i) , is independent of the post programme outcome (Y_i^T, Y_i^C) . In formal notation, this assumption corresponds to $(Y_i^T, Y_i^C) \perp D | X_i$

This assumes statistical independence of (Y_i^T, Y_i^C) and (D) conditional on (X_i) . This assumption means that given (X_i) , one can use the counterfactual outcome in the treated group as the same as the observed outcomes for the non-treated group. This implies that non-participants' outcome approximates (counterfactual) the outcome level of participants had they not participated. This is achieved by grouping households from the sample users of the treated individuals and non treated individuals which show a high degree of similarity in their variables (X_i) . Households representing one matched pair which are the same as to each other except for their use of the treatment variable.

Thus, the conditional average effect of treatment on the treated can be expressed as follows,

$ATT = E(Y_i^T - Y_i^C D = 1, X) \dots\dots\dots \text{Equation (2)}$

The ATT in equation (2) can then be written as:

$$ATT = E(Y_i^T - Y_i^C | D = 1, X) = E(Y_i^T | D = 1, X) - E(Y_i^C | D = 1, X)$$

The problem with equation (2) is that if the number of the set of conditioning variables (X's) is high, and thus the degree of complexity for finding identical households both from treated and control groups becomes difficult. To reduce the dimensionality problem in computing the conditional expectation, Rosenbaum and Rubin (1983: 41–55) showed that instead of matching on the base of X 's one can equivalently match treated and comparison units on the basis of the “Propensity Score” defined as the conditional probability of receiving the treatment given the values of X', notationally expressed as

$$P(X_i) = \Pr(D_i=1|X_i) \dots\dots\dots \text{Equation (3)}$$

Where: $\Pr(\cdot)$ Probability, the logistic cumulative distribution.

$D_i=1$ if the subject is treated and 0 otherwise

X_i = a vector of pre-treatment characteristics.

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The participation in the women & ploughing program is a dependent variable, which is dichotomous taking on two values, one if the female headed household is participant in the program and zero otherwise. Estimation of this type of relationship requires the use of qualitative response models. In this regard, the non-linear probability models, logit and probit models are the possible alternatives. Therefore, a Logit or probit model will be used to estimate the propensity score $P(X)$ to predict programme participation.

But in estimating the propensity scores all explanatory variables that simultaneously affect participation and outcome were included. Although, a linear probability model may generate predicted values outside the 0-1 interval, which violates one of the basic tenets of probability, to avoid these problems and produce relevant empirical outcomes, the most widely used qualitative response models is to employ logit and probit models (Amemiya, 1981). Upon estimation of the propensity score, a matching algorithm must then be defined in order to estimate the missing counterfactual outcome for each treated observation.

Other interesting about to employee probit and the logit models are commonly used in studies involving qualitative choices. The probit probability model is associated with the cumulative normal probability function, whereas, the logit model assumes cumulative logistic probability distribution. The advantage of these models over the Linear Probability Model is that the probabilities are bound between 0 and 1. Moreover, they fit best the non-linear relationship between the probabilities of the dependent variable and the explanatory variables, that is one which approaches zero at slower and slower rates as an explanatory variable (X_i) gets smaller and smaller and approaches one at slower and slower rates as X_i gets larger and larger. Gujarati (1988), Feder et al., (1985), and Aldrich and Nelson (1984) have recommended probit model for functional forms with limited dependent variables that are continuous between 0 and 1, and logit models for discrete dependent variables.

To Analyze the magnitude of multicollinearity by considering the size of the $VIF(\hat{\beta}_i)$. A common rule of thumb is that if $VIF(\hat{\beta}_i) > 5$ then multicollinearity is high. However there is also 10 has been proposed. Accordingly see the degrees of multicollinearity to the hypothesized explanatory variables were checked for the existence of multi-collinearity problem. There are two measures that are often suggested to test the existence of mulit-collinearity. These are: Variance Inflation Factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables. In this study, variance inflation factor (VIF) and contingency coefficients were used to test multicollinearity problem for continuous and dummy variables respectively.

According to Maddala (1992), VIF can be defined as:

$$VIF(X_i) = \frac{1}{1 - R_i^2}$$

Where, R^2 is the square multiple correlation coefficients between X_i and the other explanatory variables. The larger the value of VIF, the more troublesome it is. As a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if R_i^2 exceeds 0.95), that variable is said to be highly collinear (Gujarati, 1995). Similarly, contingency coefficients were computed for dummy variables using the following formula.

$$C = \sqrt{\frac{X^2}{n + X^2}}$$

Where: C =is contingency coefficient, χ^2 =chi-square value and n = total sample size. For dummy variables if the value of contingency coefficient is greater than 0.75, the variable is said to be collinear (Healy, 1984 as cited in Mesfin, 2005).

As already noted, the dependent variable is a dummy variable, which take a value one or zero depending on whether participation and not participation in the women and ploughing program. However, the independent variables were of both types, that is, continuous or categorical. In the analysis of studies involving qualitative choices, usually a choice has to be made between logit and probit models. Logistic and probit formulations are quite comparable, the main difference being that the former has slightly fatter tails; that is, the normal curve approaches the axes more quickly than the logistic curve. A logistic distribution (logit) has got advantage over the others in the analysis of dichotomous outcome variable in that it is extremely flexible and easily used model from mathematical point of view and results in a meaningful interpretation. Hence, the logistic model is selected for this study. Therefore, the cumulative logistic probability model is econometrically specified as follows:

$$P_i = F(Z_i) = F(\alpha + \sum \beta_i X_i) = \frac{1}{1 + e^{-Z_i}}$$

Where:

P_i == is the probability that an individual will make a certain choice (participating in women and ploughing program and not participating in the program) given X_i

e ==denotes the base of natural logarithms, which is approximately equal to 2.718;

X_i == represents the i th explanatory variables; and

α & β_i == are parameters to be estimated

It is possible to state logistic model to write in terms of the odds and log of odds, which enables one to understand the interpretation of the coefficients. The odds ratio implies the ratio of the

probability (Pi) that an individual/household would choose an alternative to the probability (1-Pi) that household would not choose it.

$$(1-P_i) = \frac{1}{1+e^{z_i}}$$

When it is written in the natural logarithm of the equation

$$Z_i = \ln\left(\frac{P_i}{(1-P_i)}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m$$

Propensity score matching is a method that improves on the ability of the regression to generate accurate causal estimates by the virtue of its non-parametric approach to the balancing of covariates between the “treatment” and “control” group. The conventional approaches to assessing the impact of an intervention on using with and without method, has essentially been hampered by a problem of missing data. Due to this problem, the impact of intervention cannot be accurately estimated by simply comparing the outcome of the treatment groups with the outcomes of control groups (Heckman *et al.*, 1998). The propensity score matching approach aims to build matched pairs of comparable participants and non-participants that show a similarity in terms of their observable characteristics. This is achieved by grouping households from treated individuals and non- treated individuals simply which shows a high similarity in their explanatory variables. Thus, to support the result obtained from regression analysis the impact of women and ploughing and outcome scheme are examined using econometric PSM method.

Choice of matching algorithm According, Becke and Ichano (2002) Estimation of the propensity score *per se* is not enough to estimate the ATT of interest. This is due to the fact that propensity score is a continuous variable and the probability of observing two units with exactly the same propensity score is, in principle, zero. Various matching algorithms have been proposed in the literature to overcome this problem. The methods differ from each other with respect to the way they select the control units that are matched to the treated, and with respect to the weights they attribute to the selected controls when estimating the counterfactual outcome of the treated.

However, they all provide consistent estimates of the ATT under the CIA and the overlap condition. The most commonly applied matching estimators are described.

Nearest neighbor matching (NNM): each treated observation is matched with an observation in the control group that exhibits the closest propensity score. In nearest neighbor matching, it is possible that the same household in the control group can neighbor more than one household in the treated group. There for, after matching the difference between their incomes is calculated as the average effect of participation in women ploughing program on household income and productivity.

Kernel matching (KM): This is another matching method whereby all treated units are matched with a weighted average of all controls with weights which are inversely proportional to the distance between the propensity scores of treated and controls (Becker and Ichino, 2002). Kernel weights the contribution of each comparison group member, so that more importance is attached to those comparators providing a better match.

Radius matching method: is each treated unit is matched only with the control unit whose propensity score falls in a predefined neighborhood of the propensity score of the treated units. If the dimension of the neighborhood (i.e. the radius) set to be very small it is possible that some treated units are not matched because the neighborhood does not contain control unit. On the other hand, the smaller the size of the neighborhood the better is the quality of the matches.

Stratification matching method (SMM): the data set is divided in to intervals, having on average the same propensity score. The treated and control groups within that intervals are placed under one block, and the mean difference of the outcome between the treated and control observations for that stratum.

3.3 Definition of variables and hypotheses

Hypothesis (Ho): There is no difference among women & ploughing program participants of food security project of ADCS and control groups in their income and land productivity of their plot of crop field.

3.3.1 Dependent variable

Participation in women ploughing program is the dependent variable⁶. It is represented by 1 if the household head participated in the program and 0, otherwise. In other words, (**Treatment variable**): the treatment variable used in this study is household participation in the women ploughing program. It is binary response (1= participate in the program, 0=not participating in the program).

3.3.2. Independent or explanatory variables

The explanatory variables of importance in this study are those variables, which are thought to have influence on women ploughing program participation. These include household's personal and demographic variables, farm characteristics, household economic variables and institutional variables.

Female headed households' Age: Older female headed households are in position to remain in their traditional practices and are expected to be less responsive to women ploughing program participation. In other words, it is in line with aged a farmer can become more or less risk adverse to participate than any young farmers. Ho: it is hypothesized old age is positively to affect participation.

Family size: Number of family members affects the participation in programs which require labor-intensive activities such as ploughing, weeding, harvesting crops, thrashing crops, watering and etc. So it is expected that this variable affects the participation positively. Therefore Ho: it is hypothesized higher family size affects the participation negatively.

Farm size: The land sizes the farmers who have relatively large size is more initiated to participate in women ploughing program. In this study area the expectation was positive relationship with those who have large land size with participation in the program. Ho: Hypothesis large farm size to affect negatively participation in women and plowing program.

Tropical Livestock Unit (TLU): Is measured Tropical Livestock Unit (TLU). Livestock ownership is expected to be positively related to the participation/ adoption, because it serves as

⁶ Dependent variable is a variable which is influenced (positively/negatively) by explanatory or independent variables.

alternative for wealth status (Freeman *et al*, 1996 and Habtemariam, 2004), thus, assumed to be positively affected to participate in women ploughing program. Ho: it is hypothesized larger TLU affects participation in women and ploughing negatively.

Participation in off/non-farm activities: households who have better off farm income are expected to have less participation in labor intensive activity. Income earned from outside agricultural activities increases the farmers' financial capacity and increases the probability of investing on new capital intensive technologies (van Den Ban and Hawkins, 1996; Asfew *et al.*, 1997). Therefore, higher off farm activities are expected to affect participation in women ploughing program which is more labour intensive negatively. Ho: it is hypothesized the higher availability of off-farm income generating activities affect women and ploughing participation positively.

Distance from market center: in this research which is defined in kilometers to the nearest market it is likely to influence women ploughing program participation negatively. the nearest to market centers for female headed households they are more likely to participate in off farm income generating activities and less participate to labour intensive agricultural crop farming activities. Therefore distance nearness was expected to negatively influence participation in the program and vies verse. Therefore Ho: it is hypothesized nearness to market centers affect participation in woman and ploughing program positively.

Absence of Oxen and women Skill of Ploughing in female headed household: in this research female headed households having land but constrained with ploughing oxen and farming skills seek more to participate in the women ploughing program to increase their income from their plots of crop land. Accordingly in this research this variable is expected to have positive relationship with dependent variable ADCS Project document, (2003). And Ho:it is hypothesized absence of oxen and women's skill of ploughing affects negatively participating in women and ploughing program.

Supply of Oxen, farm tools and Skill of ploughing: in this research ADCS food security program support to female headed households in providing training oxen ploughing skills to women headed households , providing subsidized oxen, farm tools and treaning on agronomic practices to female household heads increase participation in women ploughing program and

enhances income and productivities of female headed households. Therefore it is expected to have positive relationship with dependent variable. Accordingly, Ho: it is hypothesized supply of oxen; farm tools and skill of ploughing to female headed households affect negatively participation in women and ploughing program.

Level of education: formal education of household head and highest education in the family will increase the farmer's ability to obtain process and use information relevant to the participation/adoption of technologies (Lemma et al., 2012; Ahmed *et al.*, 2008). Therefore level of education is expected to increase the probability of participation in the program. Her Ho: hypothesized higher level of education affects negatively participation in women and ploughing program.

WPP-attitude: it is defined attitude of community towards Women and ploughing program activities. In the research area women and ploughing has been a taboo for centuries. Women are not allowed to plow with oxen, but as a result of the program intervention to break the taboo from the public and in order to raise awareness regarding the negative impact for women of the ploughing taboo work is done particularly to female headed households. The perception of female headed household of the on the community to the level of attitude towards women and ploughing program affects negatively the participation in the program. If the female headed household perception of the community towards women and ploughing taboo is high she is more likely not to participate in the program and vies verse. Ho: it is hypothesized female headed household perception towards community's understanding about women ploughing taboo if it is bad, it affects positively participation in women and ploughing program.

Crop production of pervious years: In this case harvest gained in 2000/1G.c is expected to influence positively to participate in women and ploughing program. Her the assumption is if female headed households value the income obtained from crop productions is high; they are more likely to participate in the program in order to double their income or gains from which was previously gone away by Tiwifirti. Ho: it is hypnotized higher previous crop harvest affects negatively participation in women and ploughing program.

Animal feed access: the relationship between inadequate supply of feed and participation in women and ploughing program was hypnotized positively. Here underling logic is if female

headed households wish to have livestock or have critical problem of animal feed shortage they are more likely to get ride of Tiwfirti⁷ which left them with out crop left over as a result it has positive relationship with women ploughing program participation. Ho: hypothesized shortage of animal feed affects negatively in participation in women and ploughing program.

House ownership: in this research for female headed households ownership of house was expected to increase their likelihood of participating in women and ploughing program. Hence it is expected to have positive relationship. Therefore Ho: hypothesized house ownership affects negatively participation in women and ploughing program

Female headed household numbers of years being as a head: the higher numbers of years binge as head of the house was expected to have positive relationship with women and ploughing participation. The higher the number of years as head of the house gives an opportunity to realize she have to work hard to meet the needs of the household in every aspect. Among many needs, is to increase food availability their by to boost harvest of crops from their own field. Hence a female headed household was expected increase their participation in the program as the number of years increases binge head of the house. Ho: it is hypostasized female headed household numbers of years binge as head have negative effect in participation in women and ploughing program.

Access to extension service: Extension visits or availability of extension services is perhaps the single most important variable (predictor) that emerged significantly in most of the research work on technology transfer, adoption and participation Lemma *et at.*, (2012) . Thus, it is expected that participation in different extension activities increase a female headed household's likelihood of participation in women and ploughing program. Therefore Ho: it is hypothesized access to extension service affects negatively participation in women and ploughing program.

⁷ 'Tiwfirti' is a system of agreement which existed traditionally to give a plot of land to other to plough the land on the bases of sharecropping and straw

CHAPTER FOUR

4. RESULT ANALYSIS AND DISCUSSION

In this chapter, both descriptive and econometric results are presented and discussed. The descriptive analysis employs the tools such as mean standard deviation, and percentage. In addition, t-test chi square statistics were employed to compare participants and non-participants of women and ploughing program with respect to some explanatory variables. Econometric analysis was conducted in order to identify the socio-economic, demographic and institutional factors affecting participation in women ploughing program by using logit model and, propensity score matching (PSM) was also for identifying factors whether there are significant differences between participants and non-participants in terms of the income.

4.1 Description of the Study area

According to the population and housing census of 2007, Tigray has a population of 4.314 million, consisting of 49.2% male and 50.8% female population. 19.5% of the total population is estimated to be urban inhabitants while the remaining are rural inhabitants. Of agriculture in terms of employment is estimated to be 80% of the labor force and the sector is mainly dominated by small holder farming households who are with little market orientation. In the region from 2006/7 production year to 2009/10 production year on average 1, 299,598 ha of land had been cultivated annually.

Ganta-Afeshum is found in Eastern Zone of Tigray National Regional State. The Woreda is located on the geographical coordinates of 14° 24' and 14° 21'N Latitude and 39°13' and 39° 37'E Longitude about 115 Km far away from Mekelle to the North, and the main road to Axum and Zalambesa is across by this Woreda. It is bordered with Gulomekada, Hawzien, Saesie-Tsaeda Emba, and Ahferom Woreda's in the North, South, East, and West, respectively (WOARD,2006). Population size of Ganta-Afeshum is, 102765 Out of the total population 48607 are males and 54158 are females. Men headed households are 11047 and 11309 women headed household among the 22356 of the total households (WOoARD report, 2012). The woreda has 48 schools at different levels i.e. 11 (1-4 grade), 33(1-8 grade) and 4 (9-12 grade), and the woreda has 16 health posts and 5 health station gave consisted.

Given the climatic conditions of the Adigrat area, only one production cycle of rain feed crops is possible each year. The most popular crops in the area are barley, wheat, maize and ttef. Wheat and barley are often intercropped, in a mixture called hanfets. Limited numbers of farmers also grow horse beans, chickpeas, sorghum and lentils. Average crop productivity is 879 kg of grains per hectare in Ganta-Afeshum Woreda. Combined with data for average land holding, this gives an average yearly crop production of 440 kg of grains per household per year in Ganta-Afeshum Woreda .

Farming system of the woreda is mainly depending on subsistence mixed Agriculture farming system both crop production and animal husbandry. According to WOoARD (2012), the total area of the woreda is 59293.09; from this 10800 is cultivated land, 2331.6 irrigated lands, 13996.2 area closure, 1429.7 grazing land and 21675.1 non used lands. The average farm size is 0.5ha per household. The research area is located in the project area of food security implemented by ADCS in five Tabias⁸ of Ganta-Afeshum wereda.

Woredas Ganta-Afeshum main intervention areas for the project situated in the Eastern Plateau Livelihood Zone which is characterized by a problem of structural food insecurity caused by high population pressure, erratic rainfall with an average of only 300 to 600 mm per year, poor soil fertility and a highly degraded natural resource base. The same report shows that own crop production for the ‘very poor’ and ‘poor’ category households in Eastern Tigray cover 43 % and 44 % of their annual food requirement respectively. Similarly the ‘middle’ and ‘better-off’ households produce crops that only cover 45 % and 54 % of their annual food requirement respectively. Besides their own crop production and the (very limited) consumption of their own livestock products, rural households in Eastern Tigray fulfill their food requirements mainly through the direct purchase of food products and through their participation in Employment Generation Schemes (food-for-work).

One problem very particular to the project area is the situation of female headed households, which make up 34 % of all households in the area ADCA, (2003). Next to the fact that there is one labour force missing from these female headed households, they are also limited in their agricultural production because of the ‘ploughing taboo’. Traditionally, women in Tigray are not allowed to manipulate oxen for ploughing their croplands or for threshing crops. Therefore,

⁸ Tabia is the smallest administrative unit of the government

women household heads, who have cropland, are forced to enter into an agreement with a male farmer for accessing ploughing facilities. Usually, such an agreement involves the payment of half the crop's harvest or all the straw harvested from the plot. As a consequence, female headed households get much less benefits from their rainfed croplands than male headed households. Women are a critical component of Ethiopia's rural economy and are engaged in agricultural production. They contribute significantly to off-farm production/employment, cash and food crops, subsistence farming, and reproduction of male agri-labour forces. Nonetheless they lack adequate access to extension services and should be considered a disadvantage. Confirming this, the GDP per capita for Ethiopian women is estimated at only half of that of men UNDP (2001). At the same time women's contribution to household income and production is crucial for fighting poverty.

Furthermore, women farmers also have less access to agricultural training programs and extension services than male farmers. Two factors explain this situation: In general, women in the project area have a lower educational level than men: 73.2 % of the female household heads are illiterate, compared to 46.5 % of the male household heads. As a consequence, women have less access to written information such as leaflets or agricultural extension manuals; when the project or the local authorities give extension services or when they organize a training session on a specific agricultural topic, it is always the household heads who are invited to participate. So, in male headed households, usually the male farmer gets extension service or is invited to participate in a training program, even if the training concerns assets or activities usually managed by women (poultry husbandry, for example). Thus, women living in male headed households never have the opportunity to improve their knowledge and skills by participating in a training program. Women household heads, in contrast, quite often participate in various training programs.

The wealth analysis conducted as a part of the livelihood profile for the Eastern Plateau Livelihood Zone indicates that the principal determinants of wealth in the area are the surface area of land cultivated and the number of livestock owned by each household. Based on these criteria, households in the zone were categorised in 4 classes: 'very poor', 'poor', 'middle' and 'better-off'. Tigray fulfill their food requirements mainly through the direct purchase of food products and through their participation in Employment Generation Schemes (food-for-work).

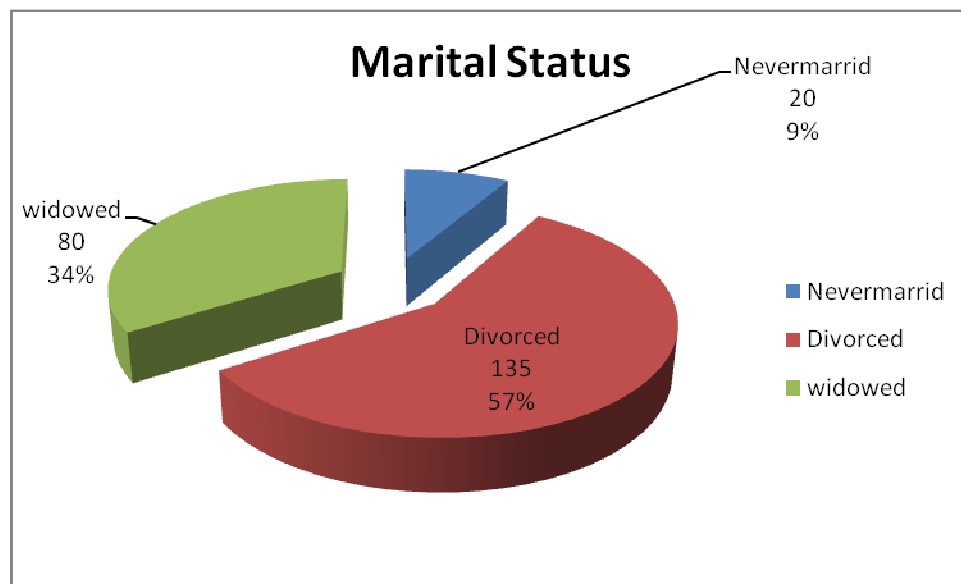
The income for the purchase of food products is generated by working as a daily labourer or by the sale of animals (for the ‘middle’ and ‘better of’ categories of households). Still other coping mechanisms include, for instance, the consumption of cactus fruits (especially during the rainy season, from June to August).

4.2 Descriptive statistics of the data set

4.2.1. Household characteristics of the sample survey

The survey provided substantial information on the socioeconomic and demographic characteristics of the community. The sample survey involved a total of 235 sample households (100 households from the treated group and 135 households from the control group). Female Household's head age shows that the average age is 44.69 years with the minimum and maximum age from 20 to 80 years respectively. The mean average age of female headed household participants is 42.18 years which are lower than mean average of female headed household nonparticipants 46.48 years. In addition to this, female headed household s having with age greater than 65 years old are 23 which are 9.79% of the total sample size. This indicates most of female household head ages (90.77%) are in the productive range (15-64) years. Besides of the total female headed household in the sample 8.51% are never marrid, 57.45% are divorced while 34.04% widowed (see Figure 4.1 below).

Figure: 4.1: Marital states of both group participant and non participant

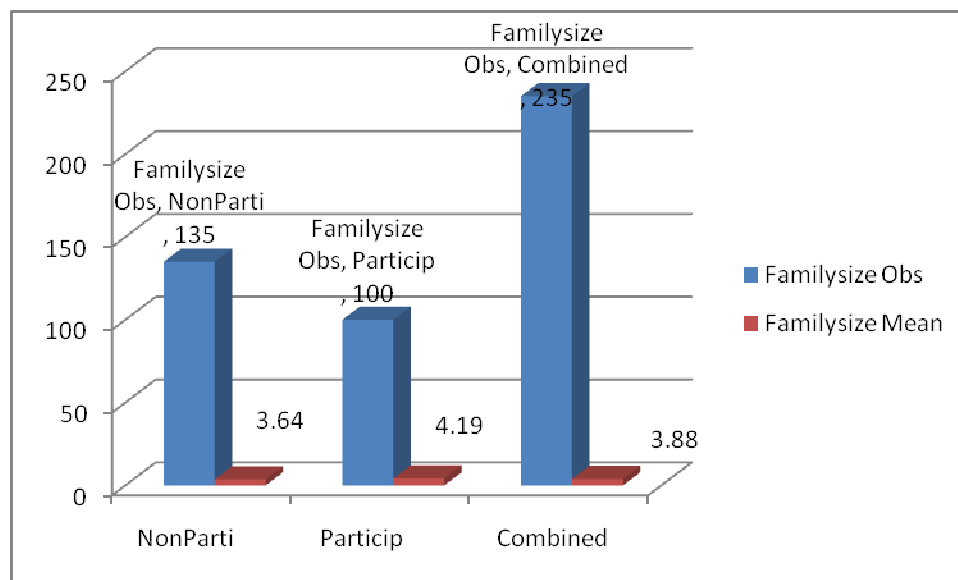


Source: computed from own survey, 2013

4.2.2. Households' family size by group of category

In the Figure 4.2 below, on average treated group households has a family size of 4.9 while the control group has 3.64. The highest number of family size has record 84%, 76.3% between 3-6 for participants and non participants respectively. For both treated and non-treated group, 79.57% of the total 235 sample survey lay between family size three and six. However, the highest percentage share with family size of 4 (29%) for treated group and 3 (31.11%) for non treated group. Comparing both groups using different categories 11% treated groups households have a family size of below three. Meanwhile, of the total non treated group family 22.22% has a family size of below three. In the second category, 28.89% of the control group family has with family size of five-eight while for treated group which is 40%. This highest family size has an advantage in supporting production enhancement. On the contrary, it has also a disadvantage of the consumption budget of the family. However, increasing in production and consumption of households depends on their age category.

Figure: 4.2 Family sizes by both categories



Source: Computed from own survey, 2013

The average family size of the sample survey is 3.88 and ranges from minimum household with family size one to household with maximum family size eight. The majority of households have

with family size three and four. To put in descending order of percentage a household with three family sizes has 26.38%, with four family sizes 22.55%, with five family sizes 18.3%, with two and six family sizes are 13.62% and 12.34% respectively (see table below 4.1).

Table 4.1 Family size by groups of respondents

Family Size	Participant	Nonparticipant	Total	%	Rank
1	4	5	9	3.83	6
2	7	25	32	13.62	4
3	20	42	62	26.38	1
4	29	24	53	22.55	2
5	22	21	43	18.30	3
6	13	16	29	12.34	5
7	3	2	5	2.13	7
8	2	0	2	0.85	8
	100	135	235	100.00	

Source: Computed from own survey, 2013

4.2.3. Educational status of household heads

Table 4.2 below shows educational status of the sample survey; from the total sample survey almost above 54.89% of the respondents are illiterate. From the total 54.89% illiteracy, the shares of participants and non participants are 47% and 60.74% respectively. The data indicates the line share of the sample household's 75.74% lies between illiterates and grade 4 of which 72%, 78.52% of them are participants and non participants respectively. This indicates that even if it is not significant, participants are still better than non participants in their educational status. Comparing the treated and non-treated groups they are almost similar educational status taking the range from illiteracy to grade four which is 72% and 78.52% respectively. However, when we compare educational level of participants and non participants from grade 4 (able to read and write) to grade ten (high school complete) there is a significant variation among them which is 53%, 39.26%, for participants and non participants respectively while combined is 45.11%. The level of education assort from no education to grade ten. This indicates that, in both group majorities of the households head are illiterate which is very challenging to accept new ideas and technologies so as to increase their skill which is important for agricultural farm

productivity. However it is observed on the participants above half of them 53% are educated which is expected to increase their level of accepting new idea and increases likelihood of participating in the program(see table 4.2 below).

Table 4.2 Level of education by groups of respondents

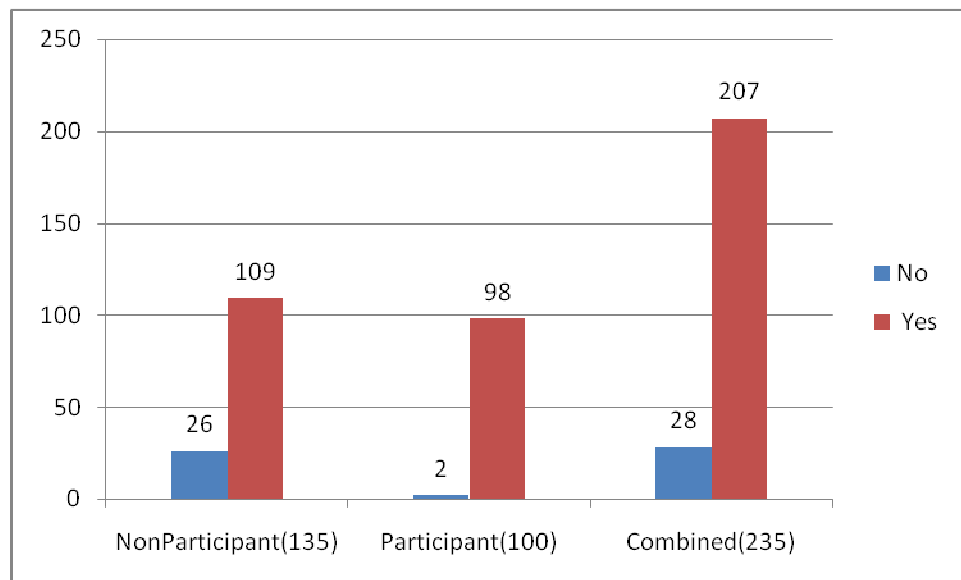
Level of education	Nonparticipant(135)		Participant(100)		Combined(235)	
	Number	%	Number	%	Number	%
Illiterate	82	60.74	47	47	129	54.89
Able to read and write	24	17.78	25	25	49	20.85
Primary complete	7	5.19	11	11	18	7.66
Junior complete	14	10.37	13	13	27	11.49
High school complete	8	5.93	4	4	12	5.11
	135	100	100	100	235	100

Source: Computed from own survey, 2013

4.2.4 Farm size (CPF-crop production filed) by group of respondents

Table 4.3 below shows us average farm land size holding of the sample survey is 0.39ha; from the total sample survey indicates the line share of the sample household's 88.09% of the respondents own land. From the total sample who owns land, the shares of participants and non participants are 98% and 80.74% respectively (see Figure 4:3). Land is perhaps the single most important resource as it is a base for any economic activities especially in the rural and agricultural sector. Hence the availability of enough amount of arable and/or usable land per household is seen as a potential for food self-sufficiency and investment for further economic progress. Thus, the average land sizes of overall respondents are very small only which is 0.42 ha, 0.37 ha for participant and non participant respectively. Accordingly it is more below the national average land size, which is 1.5ha and wereda average 0.5ha. The mean difference between both categories statistical test indicated insignificant at all probability level. However the result shows that women and ploughing program participants sample households have large land size than non women and ploughing program participants sample households.

Figure 4.3: Land ownership by group of categories



Source: Computed from own survey, 2013

4.2.5 Size of livestock in terms of TLU by group of respondents:

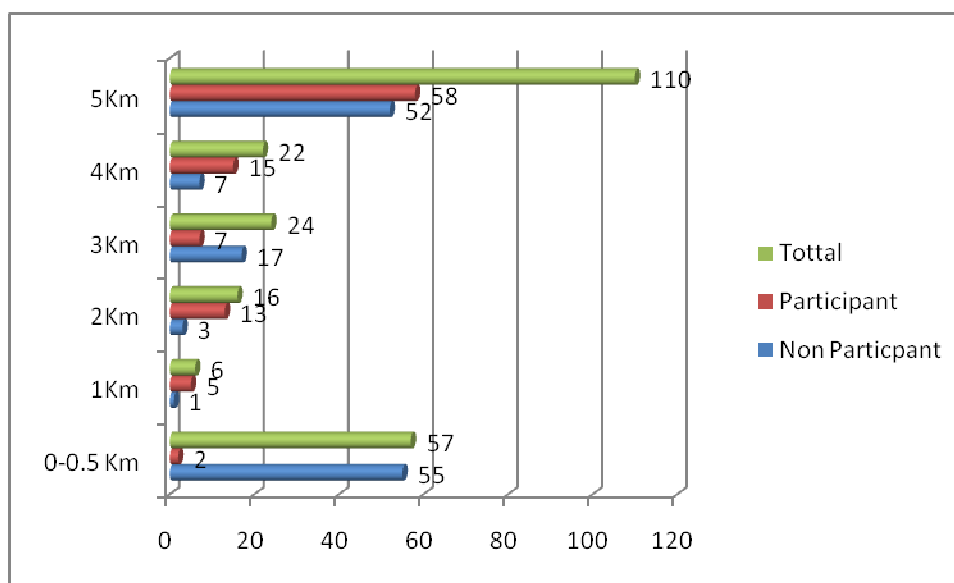
Table 4.3 below shows us the average numbers of livestock holding of the survey sample in TLU is 1.69 TLU; of which for the participant and non participant in the program is 2.50, and 1.08 TLU respectively. With regard to the average difference TLU owned by participants and non-participant sampled household is 1.4 TLU. And the mean difference in size of TLU was estimated to be statistically significant at less than 1% probability level (Table 4.3).

4.2.6 Distance from nearest market center:

From figure 4.4 and table 4.3 it clear to see that average survey household distance from their home to the nearest market center in kilometer is 3.2Km of which average distance of participants from home is 4Km while average distance of non participants is 2.6Km. The data indicates the line share of the sample household's 46.81% live at a distance of 5Km away from nearest market center of which 58%, 38.52% of them are participants and non participants respectively. On the other hand the data indicates households who live at market distance of 0-0.5Km are 24.26% of which 2%, 40.74% from participants and non participants respectively. In

line with this argument nears to market centers or semi urban areas increases being involved in off farm income generating activities and offsets for female headed households to participate in women and ploughing program which needs relatively intensive labor on farm activities. Accesses to market centers like that of semi urban centers are ideal for petty trade involvement. The other reason could be availability of transport access and industrial by products in market centers, which is hardly possible for remote rural areas. Hence, nearness to in distance from marketing center or semi urban centers has negative influence on participation in women and ploughing program and vice versa. The analysis of field data indicates that distance from market center has significant relation with participation and non participation in the program. The mean difference distance from market center of participants and non participants is 1.5Km and The presence statistical t-test result shows significant at less than 1% probability level. This result shows non participants the one's who are nearest to market centers while participants are the one's far away from market centers and semi urban centers (Table 4.3).

Figure: 4.4 Market distance from Home by group categories in Kilometers



Source: Computed from own survey, 2013

4.2.7 House ownership of respondents:

Land ownership and house ownership is vital to undertake agricultural activities mainly in rural areas. From the total survey sample households 77.2% have their own house of which 82%, 73.33% are women ploughing program participants and non participants of the program respectively. House ownership is expected to increase likely hood of participation in the program and the difference in house ownership between participants and non participants is about 8.67%. Non participant of the program who has no house are 26.67% while participants who have no house are 18% the data shows significant difference among the to groups treated and un treated group by the program. House ownership supports family's to own live asset , to collect straw, hay and other crop left over in the near by compound have the freedom to participate in agricultural activities. Hence women who own their private house in rural areas are more likely to participate in women and ploughing program.

Table 4.3.The Mean difference and t-test of continuous variables

Variables	Participant		Non Participant		Total		T-value	diff
	Mean	Std. D	Mean	Std. D	Mean	Std. D		
Age of HH	42.2	8.5	46.5	14.1	44.7	12.2	2.75***	4.4
Family size	4.2	1.5	3.6	1.5	3.9	1.5	-2.86***	-0.5
CPF size	0.4	0.4	0.4	0.5	0.4	0.5	-0.78NS	0
TLU	2.5	1	1.1	1	1.7	1.2	-11.03***	-1.4
Average OFI	3152.6	2942.7	3303	3102.8	3239	3030.2	0.38NS	150.8
Distance Market	4	1.4	2.6	2.3	3.2	2.1	-5.67***	-1.5
ICP2000/1G.c	1751.2	1711.9	1115	1438	1386	1588.5	-3.09***	-635.9
CP2004 in Quintals	5.1	3	3.3	2.7	4.1	3	-4.90***	-1.8
HI2004E.c	11195	4394	8251	3677	9504	4247	-5.58***	-2944
Annual Input cost	894.6	35.9	115.9	29.2	447.3	33.8	-16.98***	-778.7
ICP2004/5E.c	4905	3063	2867	2524	3735	2939	-5.58***	-2038
Livestock Income	3137	2578	2080	2300	2530	2474	-3.30***	-1057
CP in Quintal2004 E.c	5.12	3.0	3.28	2.71	4.1	2.98	-4.90***	-1.84
FH-years as head 2003	9.16	3.06	7.28	2.71	8.08	3.01	-4.95***	-1.87

Note: NS and *** non significant, 1% significant respectively; diff = mean (Nonparticipant) - mean (Participant) Source: computed from own survey, 2013

4.2.8 Income of the sample households:

From the table 4.3 the average annual income of the overall sample households is *9,504.00Birr* of which the average income of women & ploughing participants and non participants sample households is 11,195.00Birr, and 8251.00Birr, respectively. The result shows that average income of participants is much higher than non participants in women ploughing program on average by 2,944.00birr and statically significant at all levels. Hence the difference of income can be explained by participation in women ploughing program. In similar fashion survey sample households net average income from crop production is birr 3,735.00. However comparing net income obtained from crop production of participant and non participants in the program is 4,905.00Birr and 2,867.00Birr respectively. This result shows participant's net income is higher than non participants on average by 2038.00 birr. Thus, the difference in households' income is more related to participation to in the program and statistical t-test shows highly significant at less than 1% probability level (figure 4.4).

On the other hand average off-farm income of survey sample households is birr 3,239.00 of which participants and non participants average off-farm income is birr 3,153.00 and 3,303.00, respectively. Though, there is no significant difference in terms of income from off/non-farm income. This result might be related to the unavailability of off/non-farm job opportunity in the study area. The difference is on average is birr 150.00 and statistical t-test shows insignificant at all probability levels (table 4.3).

Figure 4.5 Net incomes from Crop production in 2004E.c harvest

. ttest ICP2004, by (womenPP)						
Two-sample t test with equal variances						
Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
NonParti	135	2867.556	217.2331	2524.021	2437.906	3297.205
Particip	100	4905.15	306.3499	3063.499	4297.285	5513.015
combined	235	3734.617	191.7225	2939.05	3356.894	4112.34
diff		-2037.594	364.9548		-2756.627	-1318.561
diff = mean(NonParti) - mean(Particip)				t =	-5.5831	
Ho: diff = 0				degrees of freedom =	233	
Ha: diff < 0		Ha: diff != 0		Ha: diff > 0		
Pr(T < t) = 0.0000		Pr(T > t) = 0.0000		Pr(T > t) = 1.0000		

Source: Computed from own survey, 2013

From table 4.3, figure 4.5 and figure 4.6 it possible to see the main sources of household income are crop production live animal sales, and off-farm activities. The sample household shows the major source of cash average income is from crop production which is 3,735.00 birr (Figure 4.5). Sample household in both categories earned their cash incomes from three major sources; income from crops, income from sales of live animal and their products and incomes from off-farm activities. The significance of each income source in terms of its contribution to the annual cash income markedly differed between the two categories.

The average income from sale of livestock and their product is 3,137.00 birr for participants and 2,080.00 birr for non participants while combined average is birr 2,530.00. This result shows difference of birr 1057.00 among the two categories and the difference can be explained by participating in women ploughing and nonparticipating in the program. The result of statistical t-test shows, there is significant difference at 1% probability level (figure 4.6). Besides, it is natural to think if feed availability of the household increases; it leads increase in livestock holding and gains from livestock for given household. This do to the fact that; female headed households who participate in women ploughing program have better access to feed for animals as a result of straw collection from their own plot of land after crop harvest.

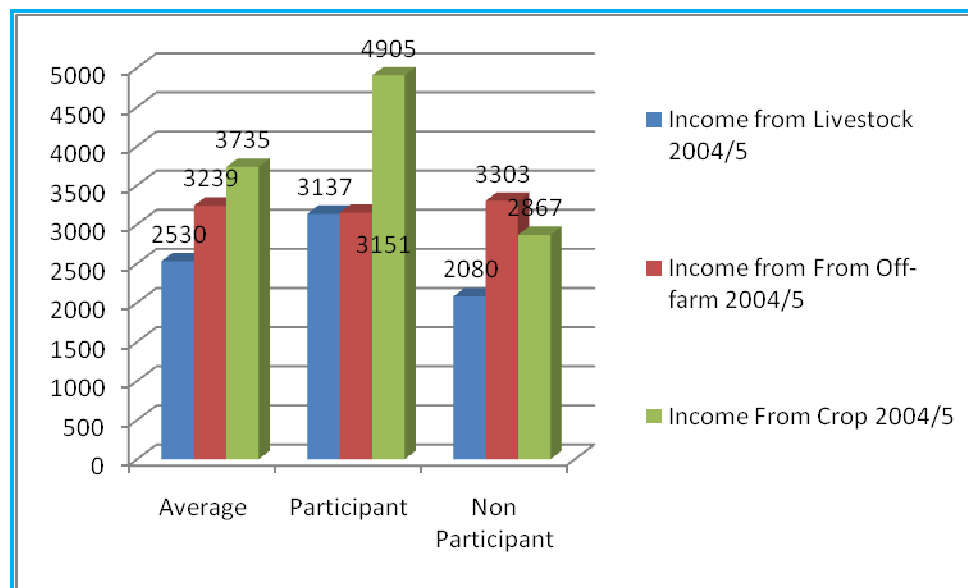
Figure 4.6 Income from livestock seals

. ttest Animalseals2004, by (womenPP)						
Two-sample t test with equal variances						
Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
NonParti	135	1082.222	148.817	1729.097	787.8881	1376.556
Particip	100	1872.8	246.1073	2461.073	1384.47	2361.13
combined	235	1418.638	137.2691	2104.296	1148.197	1689.08
diff		-790.5778	273.3668		-1329.164	-251.9911
diff = mean(NonParti) - mean(Particip)				t =	-2.8920	
Ho: diff = 0				degrees of freedom =	233	
Ha: diff < 0		Ha: diff != 0		Ha: diff > 0		
Pr(T < t) = 0.0021		Pr(T > t) = 0.0042		Pr(T > t) = 0.9979		

Source: Computed from own survey, 2013

In the figure below 4.7 clearly it is possible to see on average crop income is dominant one flowed by average income of off-farm activities in the area. For non participants their crop income and off farm income is more or less similar that shows their only limited off farm activities in the area in terms of income. Besides off farm income of participants and non participants is also more or less similar which indicates that; female headed households who participate in women ploughing program also engaged in limited off farm activities. Hence it possible to understand off-farm activity is not a factor to determine participation in women and ploughing program in the area.

Figure 4.7 share of Income source by group of categories



Source: Computed from own survey, 2013

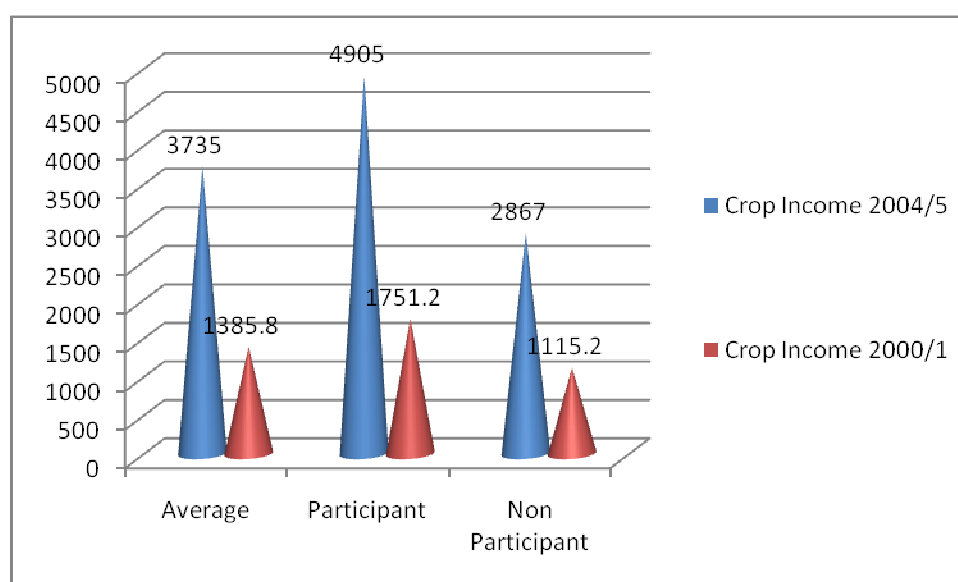
4.2.9 Crop production and productivity by group of category

Harvest income gained in 2000/1 was expected to influence positively to participate in women and ploughing program. The underling assumption was; if female headed households value the income obtained from crop productions is high; they are more likely to participate in the program in order to double their income or gains from which was previously gone away by Tiwfirti. Figure 4.8 shows us also average crop income in 2000/1 was 1386.00Birr of which participant and non participants income were birr 1,751.00, and 1115.00 respectively with a difference of 636.00Birr. And the mean difference is statistically significant at less than 1% probability level.

On the other side average survey sample households harvest income gained in 2004/5 was birr 3,735.00 of which participants and non participants were birr 4,905.00 and 2,867.00, respectively with a difference of 2038.00. Comparing harvest income of 2000/1 and 2004/5 of participants and non participants there is big difference. For instance participant's crop harvest income increased by 3,154.00birr at growth rate of nearly by double and all found to be statically significant. These big differences can be explained mainly as a result of participating in women ploughing program. as a result it is plausible female headed households who participate in

women and ploughing program can easily capture the entire harvest previously half of the crop harvest and entire straw has been gone away by Tiwfrti. Besides once they are motivated and value income gained from crop production; it is a big reason to enhance their agronomic practice and invest more effort to boost their income through utilization of extension services in their locality. More over they keep ploughing time, weeding time, harvest collection time and trashing according to proper farming calendar; which was previously highly compromised by the tents in Tiwfrti arrangement.

Figure 4.8 Crop harvest income comparison by group of category:



Source: Computed from own survey, 2013

Similarly from table 4.3 average survey sample household obtained in 2004/5E.c on average 4.04 quintals from average size 0.39 ha of land. Of which participants in the program obtained on average 5.12 quintals from average size of 0.41ha land they have. While non participants in the program obtained on average 3.28 quintals from average size of 0.37ha land they have. The difference 0.047ha of land holding size is statically insignificant at all levels of t-value. However the difference in production among participants and non participants on average is 1.84 quintals which is statistically significant at less than 1% probability level (Table4.3). This result shows us the line share of the variation on productivity can be explained by participation in

women and ploughing program, which is in line with income obtained from crop production of participant. Besides participants in women and ploughing households have the entire harvest and leftover straw, while non participants of the program have to give up half the crop harvest and entire straw which is vital to rear animals at home.

4.2.10 Female headed household numbers of years being as head

Female headed household numbers of years being as head: Above table 4.3 shows us from the total survey sample female headed households the number of years average being as head of the house on average were 8.03 years in 2003 G.c of which, participants and non participants 9.16 have found to have a positive relationship with women and ploughing participation. The higher the number of years as head of the house gives an opportunity to realize she has to work hard to meet the needs of the household in every aspect. Among many needs, is to increase food availability thereby to boost harvest of crops from their own field. With this argument it found to be a female headed household participation in the program increases as the number of years increases being a head of the house and the statistical t-test shows insignificant at all probability levels (table 4.3).

4.2.11 Descriptive statistical analyses of discrete variables

Attitude of community towards Women and ploughing Program: in a given community defined gender role affects participation in any practice: similarly perception an individual household towards community level of understanding about a given gender role also affects his/her decision to participate and not to participate in any program. In table 4.4 it is clearly indicated that; of the total sample survey households (209 households) 88.94% replayed community perception is not changed about women and ploughing taboo ;of which participants and non participants households are 90% and 88.15%, respectively. Respondents were asked to express their views as to who principally assigns gender roles in a given community and who changes that given gender role when they are observed not helpful? 88.94% of replied it is about the community who assigns gender roles in community but it about the individual to respect or not to respect (table 4.4). In the area of rural and agricultural development, the importance of social capital is perceived as a willingness and ability to work together. Rogers (1995) concludes

that: “The heart of the diffusion process consists of interpersonal network exchanges between those individuals who have already participated in a program and those who are then influenced to do so through peer education and experience sharing among friends. The result shows there is a little bit difference between participants and non participants of the program but it is statically found to be insignificant at all levels.

Absence of Oxen and women Skill of Ploughing in female headed household: in table 4.4 of the total sample survey female headed households 82.13 %(193) have replied they had problem of skill of ploughing and had no oxen to use for ploughing , of which participants and non participants in the program are 98% (98), and 70.37% (95) respectively. If the case is absence of Oxen and women Skill of Ploughing ,of female headed households, they seek to over come this problem to participate in the program , but if the case for instance is absence of land ownership or no access to land to plough the need to participate in the program may be not important because land access is important factor and statically found to be insignificant at all levels. The research result indicates female headed households having land but constrained with ploughing oxen and farming skills seek more to participate in the women ploughing program to increase their income from their plots of crop land.

Supply of Oxen, farm tools and Skill of ploughing: table 4.4 it is indicted that out of the total survey sample households 148(62.98%) had no access to supply of oxen , farm tools and ploughing skill of which participants and non participants are 23 (23%) and 125 (92.59%) respectively. Similarly of the total sample survey 87(37.02%) had access of which participants 77 (77%) had access to supply of oxen, farm tools and ploughing skill to participate in women and ploughing program. On the other side non participants 10(7.41%) had access to supply of oxen, farm tools and ploughing skill. Form the result strongly indicates if female headed households are supported by providing training oxen ploughing skills to women headed households, providing subsidized oxen, farm tools and training on agronomic practices it increase their likelihood of participation in women and ploughing program. The statistical t-test shows insignificant at all probability levels (table 4.4).

Table 4.4 Descriptive statistics of discrete variables among respondent households

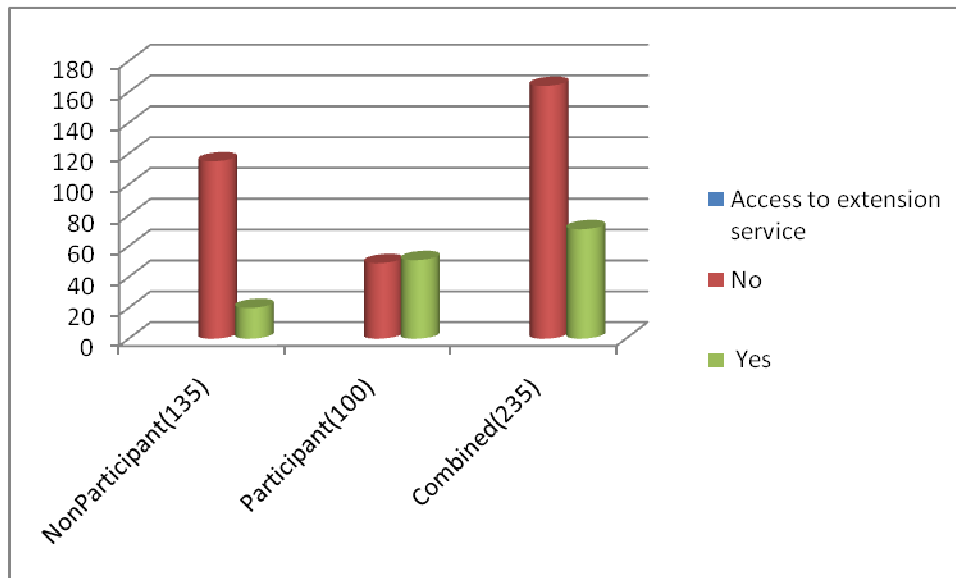
SN	Variables	Non Participant(135)		Participant(100)		Combined(235)	
		N	%	N	%	N	%
1	Absence of oxen Skill (What are the main reasons for giving out farming land to others?)						
	No	40	29.63	2	2	42	17.87
	Yes	95	70.37	98	98	193	82.13
2	Subsidized oxen, farm tools and WP - training(did you recived)						
	No	125	92.59	23	23	148	62.98
	Yes	10	7.41	77	77	87	37.02
3	WPP attitude of Community						
	No	119	88.15	90	90	209	88.94
	Yes	16	11.85	10	10	26	11.06
4	Level of education						
	Illiterate	82	60.74	47	47	129	54.89
	Able read and write	24	17.78	25	25	49	20.85
	Primary complete	7	5.19	11	11	18	7.66
	Joiner complete	14	10.37	13	13	27	11.49
	High school complete	8	5.93	4	4	12	5.11
5	Feed shortage for animals						
	No	56	41.48	18	18	74	31.49
	Yes	79	58.52	82	82	161	68.51
6	House ownership						
	No	36	26.67	18	18	54	22.98
	Yes	99	73.33	82	82	181	77.02
7	Landownership						
	No	26	19.26	2	2	28	11.91
	Yes	109	80.74	98	98	207	88.09
8	Access to extension service						
	No	115	85.19	49	49	164	69.79
	Yes	20	14.81	51	51	71	30.21

Source: Computed from own survey, 2013

Animal feed access: In Ganta-Afeshum, farmers used feeds such as crop residues mainly (barley, wheat and maize) natural pasture (hay, green grass, weeds and cactus) in front of, back yard of the house and inside the barn. The relationship between inadequate supply of feed and participation in women and ploughing program was expected to affect positively. Here underling logic is if female headed households wish to have livestock or have critical problem of animal feed shortage they are more likely to get ride of Tiwfirti which left them with out crop left over. In table 4.4 above shows out of the total sample survey households 68.51% have critical animal feed in their home. Comparing the two groups, participants in women and ploughing 82% of them replied they have critical animal feed while for that of non participants is 58.52%. Participants in the program have higher animal feed shortage than that of non participants may do to too reasons, the first place they have the oxen to use for ploughing that have to hold it through out the year that needs feed despite the fact they have the straw. The second justification is participants TLU holding is larger than non participants (table 4.3)

Access to extension service: Figure 4.9 below shows us from the total survey sample households 30.21% (71) have access to extension services of which 51 %(51), 14.81% (20) are women ploughing program participants and non participants of the program respectively. Access to extension services is expected to increase likely hood of participation in the program and the difference in access to extension services between participants and non participants is about 36.19%. Non participant of the program who has no house are 85.19% while participants who have no house are 49% the data shows significant difference between the two groups treated and untreated by the program (table: 4.4). Extension visits or availability of extension services is important tool that emerged significantly in most of the research work on technology transfer, adoption and participation. Thus, it is expected that participation in different extension events increase a female headed household's likelihood of participation in women and ploughing program and statically found to be insignificant at all levels.

Figure 4.9 Access to extension service comparison by group of category:



Source: computed from own survey, 2013

4.3. Econometrics model of Impact Analysis Results:

There are different methods of impact evaluation of various program interventions among the participant and non-participant groups. However, for this study logit model followed by PSM employed. Econometric analysis is conducted to the first objective to analysis factors that determine affecting of participation in women and ploughing program was conducted by binary logit model and for the second objective propensity score matching (PSM) were used to analyze the income difference between participants and non participants of female headed households through STATA software version 10. It is very important to say about the data in the regression analysis and its treatment about it's normality of the error term, the model specification, problems of multicollinearity, heteroskedasticity and like are checked out.

Table 4.5 List of variables to be included in the econometric model

Variable	Description	Variable type	Value
Age	Age of the FHHs	Continuous	Measured in years
Familysize	Family size	Continuous	Measured in number
CPFsize	Land size of the HHs	Continuous	Measured in Hectare
TTLU	Total tropical livestock unit	Continuous	Measured in tropical livestock unit
AverageOFI	Average off-farm income	Continuous	Measured in number (in Birr)
DistanceMarketCenter	Distance to market	Continuous	Measured in Kilometer
LackoxSkill	Access to oxen and skill to ploughing	Dummy	1=yes,0=no
SupplyofOFT	Supply of Oxen farm tools and training on Ploughing , agronomic practice	Dummy	1=yes,0=no
Level of educationFHH	Education level of FHHs	Dummy	Illiterate =0, Able to read and write=1, Primary complete=2 Joiner complete=3 High school complete=4
WPPattitude	Perception of female headed households towards Community attitude in women and ploughing (is good?)	Dummy	1=yes,0=no
ICP2001	Income from crop production 2001	Continuous	Measured in Birr
House ownership	FHH house ownership	Dummy	1=yes,0=no

Variable	Description	Variable type	Value
Feedshortage	Limited access to animal feed	Dummy	1=yes,0=no
FHheadyears	Female headed household numbers of years bing as head	Continuous	Measured in <i>years</i>
AccesstoExtentionservice	Access to extension service	Dummy	1=yes,0=no

4.3.1. Determinates of participation in women and ploughing program

Female headed farmers' decision to participate in women and ploughing program is determined by various, socioeconomic, demographic and institutional factors. Numerous literatures indicate a lot of explanatory variables, which have significance influence on adoption and participation. In view of this, efforts were made to include variables found relevant in the model in order to try to learn the response of the female headed farmers in the study area to the program. In this section, selected explanatory variables were used to estimate the logistic regression model to analyze the determinants of households' participation behavior on women and ploughing program. A logit model was fit to estimate the effects of the hypothesized explanatory variables on the probabilities of being participant or non participant. Before running the logit model all the hypothesized explanatory variables were checked for the existence of multi-collinearity problem. There are two measures that are often suggested to test the existence of multi-collinearity. These are: Variance Inflation Factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables.

The VIF values displayed in Table 4.6 have shown that all the continuous explanatory variables have no serious multi-collinearity problem. Similarly, contingency coefficients were computed for dummy variables. The values of the contingency coefficients were also low (Table 4.7).

Table 4.6 Variance inflation factor (VIF) for continuous variables

Variable	VIF	1/VIF
Female headed household numbers of years being as head	2.040	0.491
Farm size (CPF-crop production filed)	1.790	0.559
Total tropical livestock unit (TLU)	1.600	0.625
Age	1.380	0.726
Distance from nearest market center	1.360	0.736
Income from crop production in 2001 (ICP2001)	1.150	0.868
Family size	1.100	0.913
Average off farm income (AverageOFI)	1.090	0.921
Mean VIF	1.644	

(Source: computer output from own survey data, 2013)

Table 4.7 Contingency coefficient for discrete variables

Variable	la~Skill	Supply~T	Levele~n	houseo~p	WPPatt~e	Access~n
lackoxSkill	1.000					
SupplyofOFT	0.312	1.000				
Leveleduca~n	-0.043	0.062	1.000			
houseowner~p	0.141	-0.021	-0.113	1.000		
WPPattitude	-0.013	-0.018	-0.051	0.064	1.000	
AccesstoEx~n	0.234	0.263	-0.020	0.029	0.093	1.000

(Source: computer output from own survey data, 2013)

Based on above test, both the hypothesized continuous and dummy variables were included into the model. The binary logit regression model, result shows that out of the 15 explanatory variables which were hypothesized to affect participation in women and ploughing, eight (8) variables were found to be statistically significant. These include family size, TLU, distance to the nearest market, access to oxen and farming skills, supply of Oxen farm tools, training on Ploughing and agronomic practice, house ownership, female headed household numbers of years binge as head, and access to extension service found to be positively significant relationship with participation in women and ploughing program for female headed households (table 4.8).

Table 4.8 the logistic regression model Estimation the determinant of participation in women and ploughing program in Ganta-Afeshum study areas

Logistic regression			Number of obs	235		
			LR chi2(15)	206.280		
			Prob > chi2	0.000		
Log likelihood = -57.134115			Pseudo R2	0.644		
WomenPP	Odds ratio	Std.Err	Z	P>z	[95%Conf.Interval]	
Age	0.9912	0.026	-0.340	0.733	0.942	1.043
Familysize	1.3696	0.256	1.680	0.092*	0.950	1.975
CPFsize	0.3181	0.263	-1.390	0.165	0.063	1.605
TLU	3.2059	0.936	3.990	0.000***	1.809	5.682
AverageOFI	1.0000	0.000	-0.050	0.957	1.000	1.000
DistanceMa~r	1.3153	0.193	1.870	0.061*	0.987	1.753
lackoxSkill	8.0651	8.618	1.950	0.051*	0.993	65.481
SupplyofOFT	24.3975	13.935	5.590	0.000***	7.965	74.735
Leveleduca~n	1.1721	0.261	0.710	0.476	0.757	1.814
ICP2001	1.0002	0.000	0.930	0.355	1.000	1.000
Feedshorta~s	2.6309	1.594	1.600	0.110	0.802	8.627
houseowner~p	6.3556	4.129	2.850	0.004***	1.779	22.707
WPPattitude	0.4776	0.384	-0.920	0.358	0.099	2.310
FHheadyears	1.2293	0.150	1.690	0.091*	0.968	1.562
AccesstoEx~n	3.7860	2.018	2.500	0.013**	1.332	10.762

Source: Own survey data, 2013 (*, ** and ***, significant at 10%, 5% and 1 % level)

Family size: The result of the logit model showed that family size is positively related with the participation in women and ploughing program. The coefficients of this variable is positive and significant influence at 10% probability level, implying that as family size get's larger the probability of participating in women and ploughing program increase by factor of 1.3696 impaling being other things constant when female headed household's family size increase by one adult person, the probability of participating in women and ploughing program increases by 36%. Similarly keeping other things constant, if a female headed household is lass by one adult person the likelihood of being participate in the program decreases by a factor of 1.3696 .This means female headed households with higher family size are more likely to participate in the program than that of small family size.

Total tropical livestock unit (TTLU): The model result indicates that number of tropical livestock unit affected positively and significantly the probability of participating in the program at less than 1% probability level. This result shows that those female headed farmers with large number of tropical livestock units are more likely to participate in women and ploughing program, than those who own small number of TLUs. The positive association between participation and number of TLU indicates that flock size creates better opportunity to earn more income from livestock production. The income generated from livestock helps female headed farmers to invest in improved agricultural technology. Other things held constant, the odds ratio 3.2059 for number of TLU shows that, as the number of livestock units increases by one TLU, the odds ratio in favor of participating in women and ploughing program increases by a factor of 3.2059.

Distance from nearest market center: Market distance from nearest market center positively and significantly associated with the probability of participating in women and ploughing program at less than 10% probability level. The positive association suggests that the probability of participating in the program increases as the distance from market center increases. In another word, the implication of this positive relationship is that if the distance between female headed farmers' living home and the market area is longer, they have enough reason to participate in the programme because there is limited off farm activities in near by home. As market distance increases, farmers may incur more costs on transport, spend time and energy to engage in off farm activities, As result of this farmer engage in women and ploughing program. Hence, only those farmers in areas close to the market may have better for off farm activities and have less likelihood of participation in women and ploughing program. The odds ratio of 1.3153 for market distance reveals that, other things being constant, the odds ratio in favor of participating in the program increases by a factor of 1.3153 as the market distance increases by one kilometer (table 4.8).

Absence of Oxen and women Skill of Ploughing in female headed household: the result indicates this variable is positively and significantly associated with the probability of participating in women and ploughing program at less than 10% probability level. The positive association suggests that the probability female headed households having land but constrained with ploughing oxen and farming skills seek more to participate in the women ploughing

program to increase their income from their plots of crop land. The odds ratio of 8.0651 for absence of Oxen and women Skill of Ploughing in female headed household reveals that, other things being constant, the odds ratio in favor of participating in the program increases by a factor of 8.0651 as the female headed household reason for not to participate in the program was absence of oxen and lack of women's skill of ploughing (table 4.8). In other words if female headed households own land and constrained with oxen and skill of ploughing the likelihood of participating in women and ploughing program increases by the factor of the odd ratio.

Supply of Oxen, farm tools and Skill of ploughing: the result indicates this variable is positively and significantly associated with the probability of participating in women and ploughing program at less than 1% probability level. The positive association suggests that the probability female headed households participating in the program increases if it is supported with supply of Oxen, farm tools and Skill of ploughing. The odds ratio of 24.3975 indicates that, support to female headed households in providing training on oxen ploughing skills to women headed households , providing subsidized oxen, farm tools and training on agronomic practices increase their likelihood of participation in women ploughing program by a factor of 24.3975 than that of female headed households receive non of the support. In other words female headed households who didn't get any of the support decreases their likelihood of participation in the program by the factor of 24.3975 (table 4.8).

House ownership: House ownership positively and significantly associated with the probability of participating in women and ploughing program at less than 1% probability level. The positive association suggests that female headed households having house, increases the probability to participate in women and ploughing program. This because two main reason, in the first place house and land ownership is vital. Secondly house ownership is highly correlated with land ownership which main key factor to participate in agricultural activities then to women and ploughing program. The odds ratio 6.3556 indicates that, female headed households who own land have higher likelihood of participation in women and poughing program by a factor of 6.3556 (table 4.8).

Female headed household numbers of years being as head: the higher the years being as a head positively and significantly associated with the probability of participating in women and ploughing program at less than 10% probability level. The higher numbers of years being as head increases the likelihood of participating in women and ploughing program. The higher the number of years as head of the house gives an opportunity to realize she has to work hard to meet the needs of the household in every aspect. Among many needs, is to increase food availability thereby to boost harvest of crops from their own field. The odds ratio of 1.2293 indicates that, as the number of years being as headed increases by one year for FHH, the likelihood of participation in women and ploughing program increases by a factor of 1.2293 (table 4.8).

Access to extension service: access to extension service is positively and significantly associated with the probability of participating in women and ploughing program at less than 5% probability level. The positive association suggests that the probability female headed households participating in the program increases if it is supported with extension services. The odds ratio of 3.7860 indicates that, if female headed households increase their probability of getting extension service by one unit, it ultimately increases their likelihood of participation in women and ploughing program by a factor of 3.7860 (table 4.8). Access to extension service visits or availability of extension services is perhaps the single most important variable (predictor) that emerged significantly in most of the research work on technology transfer, adoption and participation Lemma *et al.*, (2012).

4.3.2 Propensity Score Matching (PSM) Methods

The researcher estimated the effect of female headed household's participation in women and ploughing program on household income based on cross sectional data available. In this study a propensity score matching (PSM) model was used to address the research question of the income difference between participants of women and ploughing program and non participant female headed households.

The main goal in using propensity score matching was to identify the average treatment effect on the treated (ATT). The utilization of PSM in the study, the researcher first estimates a logit regression in which the dependent variable equals, one if the household head participated in the

program, zero otherwise and then check the balancing properties of the propensity scores. The balancing procedure tests whether or not participants and non participant's observations have the same distribution of propensity scores. Whenever balancing test failed, the researcher tried alternative specifications. Therefore, specification used in this study is the most complete and robust specifications that satisfied the balancing tests.

Table 4.9 Propensity Score Matching of ATT Effect of NNM, RM, KM and SM methods

SN	Matching method	Number of matching observations		Mean difference (ATT)	Bootstrap Std. Err	t-test
		Treated group	Control group			
1	NNM	100	19	2728.700	1164.528	2.343**
2	RM	100	65	2505.223	720.370	3.478***
3	KM	100	65	2609.523	714.609	3.652***
4	SM	100	63	2363.400	794.369	2.975***

Note: NNM= nearest neighbor matching, RM=radius matching, KM= kernel matching, and SM=stratified Matching (***, ** significant <1%, and <5%) SOURCE: from PSM computer application

On the PSM estimated result of matching algorithms reported in table 4.9 , the overall result revealed after controlling for treatment effects of **NNM**, **RM**, **KM** and **SM** matching technique regression model (ATT), it is found that, on average, female headed households who where participants in women and ploughing program are higher annual income than that female headed households who are not participants in women and ploughing program by **2728.700 birr for NNM**, which is significant at less than 5% probability level, **2505.223 birr for (RM)**, which is significant at less than 1% probability level, **2609.523 birr for (KM)** which is significant at less than 1% probability level, and **2363.400 birr for (SM)** this is also significant at less than 1% probability level (Table 4.9).

In addition to that can see descriptive analyses of (table 4.3), if we take only income of participants of women and ploughing program crop production accounts for about 44% households share of total annual income. Therefore we can say change in household's income is the results we can say the change in households income or the differential can be explained by

participation in women and ploughing program. Consequently, the study results can provide evidence household income improvement in poor rural female headed households in crop production through better targeting female headed households in women and ploughing program, have an important causal impact on household income. Therefore, the result of the study is sufficiently helpful for drawing policy recommendations for further intervention in the subject area by policy makers and other concerned bodies.

CHAPTER FIVE

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study examined Impact of Women & Ploughing Program on Income and land Productivity of female headed households. This program is developed and introduced to the program area by ADCS-Food Security Program in 2003 G.c. This study was conducted in five tabis of Ganta-Afeshum district. This study identify factors influencing female headed household farmers' decision to participate in women and ploughing program and on how it influenced participant female headed household's income and their land productivity. Variation in participation among the sample households was assessed in view of various factors theoretically known to influence farmers' decision and participation behavior of new programs. These variables were categorized as household personal and demographic, socio-economic and, institutional factors. Result of descriptive statistics using t-test and chi-square tests indicated that most of the variables hypothesized to influence farmers' participation behavior were significantly related with participation to women and ploughing program.

Similarly, results of the econometric model indicated the relative influence of different variables on participation in women and ploughing program. In this study of the total fifteen (15) explanatory variables included in the model eight (8) of them were found to show significant relationship with participation in women and ploughing program. Accordingly, these include family size, TLU, distance to the nearest market, access to oxen and farming skills, supply of Oxen farm tools, training on Ploughing and agronomic practice, house ownership, female headed household numbers of years binge as head, and access to extension service found to be positively significant relationship with participation in women and ploughing program for female headed households (table4.8).

Bisides, propensity score matching (PSM) findings is also revealed that participation in women and ploughing program contributes positively to female headed farmers' annual income earning in the study area. The Propensity score matching estimation based on the objective to analyze the income difference between women and ploughing program participants and non participants'

households. The result revealed after controlling for treatment effects of on average, female headed households who were participants in women and ploughing program are higher annual income than that female headed households who are not participants in women and ploughing program by **2728.700 birr for NNM**, which is significant at less than 5% probability level, **2505.223 birr for (RM)**, which is significant at less than 1% probability level, **2609.523 birr for (KM)** which is significant at less than 1% probability level, and **2363.400 birr for (SM)** this is also significant at less than 1% probability level (Table 4.9). It shows the average net income for women and ploughing program participants are higher than that of non women and ploughing program participants and all have significant difference by all matching techniques.

5.2 Conclusion and Recommendation

Based on the research findings of this study, the following points are drawn as a conclusion and recommended to improve female headed household farmers' participation in women and ploughing program so as to enhance their participation in the program to boost their household over all income from their plot of land they own.

Generally the evidences in the study reveal that participation in women and ploughing program was found to be important to increase female headed households overall income and increases productivity of the land they own. It is possible to see and draw significant factors of determinant that found in the research result to enhance participation in women and ploughing program were providing training oxen ploughing skills to women headed households, providing subsidized oxen, farm tools and training on agronomic practices. The statistical t-test shows insignificant at all probability levels (table 4.4).

Previously it is indicated by different studies land owned by female headed households was less productive, and in Tigray particularly in eastern zone of Tigray female headed households are reach 30-34% and in the research findings in the research area indicates that 88% of the female headed households they have land to use for crop production, which means they have the land as inheritance from their parents, or given from their relatives, or have possessed the land from their late (died) husband however it was less productive because agreements (twifirti) was based on kinship contracts, involving blood-related tenants or brother in-law and this kind of agreements are found less efficient may be as a result of female headed households weak trite point to make their land productive because traditional norms, value and taboos. As a result

female headed households are less able to evict inefficient tenants; particularly in the study area blood-related kin or in-law tenants eligible to *twifirti*. This study also inline with existing analyses and it is possible to draw that *twifirti* adversely affected female headed households income and their land productivity.

Female headed households who give their plots of land for share cropping or straw, they have limited power to make decisions on timing to prepare the land, planting, weeding, and collection of the harvest from the field. The tenants are more concerned on the straw and may not give attention to the land to prepare it on time and to invest maximum effort; usually they start farming the plots after they finished their own. In more general perspective and when we look at it from policy direction taking the case at macro level in Tigray regional state; of the total rural households 694, 554 HHs in Tigray, 208,366(30%) are female headed households and of which 183,362 (88%) of them possess land if this research findings extended to see the whole picture of the region. In similar fashion applying average household land holding size which varies from place to place greatly. However taking the regional land holding on average to be 1ha it is possible to estimate of the total size of land possessed by female headed households. The total cultivable land of Tigray regional state is 1, 299,598 ha, of which 183,362 ha (14%) is owned by female headed households. This gives ample ground to devise a program to make productive the land in the hands of female headed households at regional level through Women & ploughing which this study examined its effectiveness and applicability in the ground.

Therefore productivity differential among female headed households is explained participation and non participation in women and ploughing program. Participation in women and ploughing program gives puts female headed households at the heart of decision making on farming time, weeding, crop harvesting, crop seed selection and like and over comes the challenge which is posed by accepted norm of the culture that is when a husband dies his brothers expected to undertake farming activities for the families of died brother on the bases of share cropping or/and straw. Besides the study found out of the many advantages gained by female headed households who participated in women and ploughing program it is key tool for strengthening women's land

rights , equity and empowerment of women headed households for effective and efficient land use.

Participation in women and ploughing program helped female headed households to enhance their productivity and increase over all household income. Table 4.3 gives us the average annual income of the overall sample households is *9,504.00Birr of which* the average income of women & ploughing participants and non participants sample households is 11,195.00Birr, and 8251.00Birr, respectively. The result shows that average income of participants is much higher than non participants in women ploughing program on average by 2,944.00birr and statically significant at all levels. Similarly, average survey sample households harvest income gained in 2004/5 was birr 3,735.00 of which participants and non participants were birr 4,905.00 and 2,867.00, respectively with a difference of 2038.00. Comparing harvest income of 2000/1 and 2004/5 of participants and non participants there is big difference. For instance participant's crop harvest income increased by 3,154.00birr at growth rate of nearly by double and all found to be statically significant. These big differences can be explained mainly as a result of participating in women ploughing program. As a result it is plausible female headed households who participate in women and ploughing program can easily capture the entire harvest previously half of the crop harvest and entire straw has been gone away by Tiwfrti. On top of that average numbers of livestock holding of the survey sample in TLU is 1.69 TLU; of which for the participant and non participant in the program is 2.50, and 1.08 TLU respectively. With regard to the average difference TLU owned by participants and non-participant sampled household is 1.4 TLU and this differential can be explained because of availability of animal feed from crop left over for who participate in the program.

Regional and local government can benefit their female headed households who own land through effective disdaining of a program that runs women and ploughing program as one package of extension approach as option to female headed households. Government and partner NGOs should work closely on this issue to scale it up the experiences and field good practices gained in ADCS food security project about women and ploughing. Finally there are some important points that may need further investigation. These issues may serve as points of departure for further research. This research was conducted in a pilot program which have

implemented in eastern zone of Tigray, which have high concentration of female headed households, small land holding size and very limited off farm income opportunities. While it may not work in low lands with female headed households who have large farm land size which needs intensive labor and in areas there is greater option to go for off farm income. Therefore to undertake careful scale up strategy will be pro amount importance to take is as development package for all districts in the region.

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7. Annex:

Table 1. Distribution of the land for different purposes in the study Wereda

S/N	Land distribution	G/afeshum in(ha)
1	Cultivated land	10800
2	Irrigated land	2331.6
3	Forest land	2802.4
4	Area enclosed land	13996.2
5	Grazing land	1429.7
6	Non used land	21675.1
	Total	53035

Source: (WOoARD, 2012)

Table: 2 Conversion Factors to Estimate TLU

Livestock Category	TLU	Livestock Category	TLU
Ox	1.00	Horse	1.10
Cow	1.00	Camel	1.25
Heifer	0.75	Sheep (adult)	0.13
Bull	1.00	Sheep (young)	0.06
Horse	0.75	Goat (adult)	0.13
Calf	0.25	Goat (young)	0.06
Donkey (adult)	0.70	Chicken	0.013
Donkey (young)	0.35		

Source: Storck, *et al.*, (1991)

Table: 3 Sample taken to the research work from each tabia by group of category

S/n	Sample Size		Stratified Sampling		
	Tabia	FHHs		Participant	Non Participant
			235		
1	Beati – May Mesanu	512	33	14	19
2	Bukot – Nehebi	765	94	40	54
3	Dibla – Seit	552	42	18	24
4	Golah – Genahiti	634	38	15	22
5	Sassun – Beithariat	320	28	12	16
	Total	2783	235	100	135

Sample computed from the data 2013

Logistic regression of the variables

Logistic regression		Number of obs = 235				
		LR chi2(15) = 206.28				
		Prob > chi2 = 0.0000				
Log likelihood = -57.134115		Pseudo R2 = 0.6435				
WomenPP	Odds Ratio	Std. Err.	z	P> z	[95% Conf. Interval]	
Age	.9912243	.025615	-0.34	0.733	.9422701	1.042722
Familysize	1.369579	.2558814	1.68	0.092	.9496321	1.975236
CPFsize	.3180595	.262695	-1.39	0.165	.0630195	1.605246
TLU	3.205915	.9362283	3.99	0.000	1.808732	5.682373
AverageOFI	.9999945	.0001029	-0.05	0.957	.9997929	1.000196
DistanceMa~r	1.31534	.192736	1.87	0.061	.9869877	1.752928
lackoxskill	8.065108	8.617536	1.95	0.051	.9933553	65.48106
SupplyofOFT	24.39749	13.93512	5.59	0.000	7.964605	74.73537
Leveleduca~n	1.172098	.2611648	0.71	0.476	.7573574	1.813958
ICP2001	1.000158	.0001703	0.93	0.355	.9998239	1.000491
Feedshorta~s	2.630879	1.594175	1.60	0.110	.8022634	8.627493
houseowner~p	6.355594	4.12912	2.85	0.004	1.778874	22.70739
WPPattitude	.4775766	.3841214	-0.92	0.358	.0987211	2.310341
FHheadyears	1.229317	.1501612	1.69	0.091	.9675858	1.561846
AccesstoEx~n	3.786014	2.01811	2.50	0.013	1.331849	10.76241

Estimation of the propensity score

Iteration 0: log likelihood = -160.27348
 Iteration 1: log likelihood = -75.29374
 Iteration 2: log likelihood = -62.249069
 Iteration 3: log likelihood = -58.059544
 Iteration 4: log likelihood = -57.179958
 Iteration 5: log likelihood = -57.134256
 Iteration 6: log likelihood = -57.134115

Logistic regression

Number of obs = 235
 LR chi2(15) = 206.28
 Prob > chi2 = 0.0000
 Pseudo R2 = 0.6435

Log likelihood = -57.134115

WomenPP	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Age	-.0088144	.0258417	-0.34	0.733	-.0594633	.0418345
Familysize	.3145036	.1868321	1.68	0.092	-.0516806	.6806878
CPFsize	-1.145517	.8259303	-1.39	0.165	-2.764311	.4732768
TLU	1.164998	.2920315	3.99	0.000	.5926262	1.737369
AverageOFI	-5.49e-06	.0001029	-0.05	0.957	-.0002071	.0001962
DistanceMa~r	.2740948	.1465295	1.87	0.061	-.0130977	.5612873
lackoxSkill	2.087547	1.068496	1.95	0.051	-.0066668	4.181761
SupplyofOFT	3.19448	.5711702	5.59	0.000	2.075007	4.313953
Leveleduca~n	.1587955	.2228182	0.71	0.476	-.27792	.5955111
ICP2001	.0001575	.0001702	0.93	0.355	-.0001761	.0004912
Feedshorta~s	.9673178	.605948	1.60	0.110	-.2203183	2.154954
houseowner~p	1.849335	.6496829	2.85	0.004	.5759803	3.12269
WPPattitude	-.7390306	.8043136	-0.92	0.358	-2.315456	.837395
FHheadyears	.2064586	.1221501	1.69	0.091	-.0329511	.4458684
AccesstoEx~n	1.331314	.5330434	2.50	0.013	.286568	2.37606
_cons	-11.79168	2.93254	-4.02	0.000	-17.53935	-6.044004

```
*****
Step 1: Identification of the optimal number of blocks
Use option detail if you want more detailed output
*****
```

The final number of blocks is 5

This number of blocks ensures that the mean propensity score is not different for treated and controls in each blocks

```
*****
Step 2: Test of balancing property of the propensity score
Use option detail if you want more detailed output
*****
```

The balancing property is satisfied

This table shows the inferior bound, the number of treated and the number of controls for each block

Inferior of block of pscore	Have your household received training on women and ploughing and agronomic pract		Total
	NonPartic	Participa	
.0341785	38	3	41
.2	9	5	14
.4	7	3	10
.6	4	20	24
.8	5	69	74
Total	63	100	163

Note: the common support option has been selected

**ATT estimation with Nearest Neighbor Matching method
(random draw version)
Bootstrapped standard errors**

n. treat.	n. contr.	ATT	Std. Err.	t
100	19	2728.700	1164.528	2.343

Note: the numbers of treated and controls refer to actual nearest neighbour matches

**ATT estimation with the Radius Matching method
Bootstrapped standard errors**

n. treat.	n. contr.	ATT	Std. Err.	t
100	65	2505.223	720.370	3.478

Note: the numbers of treated and controls refer to actual matches within radius

**ATT estimation with the Kernel Matching method
Bootstrapped standard errors**

n. treat.	n. contr.	ATT	Std. Err.	t
100	65	2609.523	714.609	3.652

ATT estimation with the Stratification method
 Bootstrapped standard errors

n. treat.	n. contr.	ATT	Std. Err.	t
100	63	2363.400	794.369	2.975

Photo



