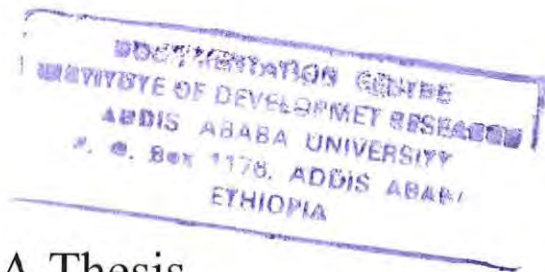


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Small-scale irrigation and rural livelihood diversification
in north-eastern Ethiopia: a case study of Alawuha
irrigation scheme in Gubalafto woreda, North Wollo.



M.A Thesis

By

Derbew Kefyalew Abegaz

June, 2009

Addis Ababa, Ethiopia

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ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

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JUNE, 2009

ADDIS ABABA, ETHIOPIA

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SCHOOL OF GRADUATE STUDIES**

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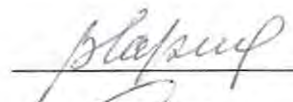
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DEDICATION

In loving memory of
MY FATHER, KEFYALEW ABEGAZ
Died in JULY 1998

AND

MY G/FATHER, Biru NURAHUN
Died in September 1999

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LIST OF ABBREVIATIONS

ADB	African Development Bank
ADLI	Agricultural Development Led Industrialization
ANRS	Amhara National Regional State
CRS	Catholic Relief Service
CSA	Central Statistical Authority
FGD	Focus Group Discussion
FHHs	Female Headed Households
FTC	Farmers Training Centers
FSP	Food Security Program
Ha	Hectare
IWSM	Integrated Water Resources Management
LPM	Linear Probability Model
m.a.s.l	Meter above sea level
MHHs	Male Headed Households
MoARD	Ministry of Agriculture and Rural Development
NFE	Non Farm Economies
NMSA	National Metrological Service Agency
NGO	Non Governmental Organization
PA	Peasant Association
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PSNP	Productive Safety Net Program
Qt/ha	Quintal per hectare
RNFE	Rural Non Farm Income
SEARAR	Sustainable Environmental and Agricultural Rehabilitation for Amhara Region
SSA	Sub-Saharan Africa
SSI	Small-Scale Irrigation
TLU	Tropical Livestock Unit
WUE	Water Use Efficiency
WARDO	Agricultural and Rural Development Office
WUA	Water User Association

Abstract

The study was envisaged with the objectives of investigating extent and determinants of rural livelihood diversification at household level and exploring contribution and constraints of irrigation for rural livelihood diversification in Gubalafto Woreda taking Alawuha small-scale irrigation as a case. For this purpose a two- stage stratified sampling procedure was employed to select 113 sample households from two sample kebeles. Data were gathered using structured questionnaire, FGD and key informants interview through semi-structured checklist. Extent of household livelihood diversification was estimated using livelihood diversification index and it revealed that out of the total 133 sample households, 61 households (54%) were found in the lowest income quartiles (less diversified) groups while the remaining 52 households (46%) were found in the top income quartiles (diversified). Descriptive statistics and binary logit regression model were employed for analysis.

The results of the study showed that on-farm, off-farm, non-farm, employment and migration were the major livelihood activities and income sources of sample households. However, there are important differences in the number of income sources and amount of return among sample households. The binary logit model results disclosed that among 17 explanatory variables included in the model, six (income from employment, farm experience, distance to market center, income from irrigated land, total size of irrigable land and income from off-farm activities) have significant effect on household livelihood diversification.

Small-scale irrigation has a vital role on rural household livelihood diversification but the study disclosed that Alawuha irrigation scheme has constrained by different technical, management and socio-economic problems. These calls, policy interventions that are spearheaded by the government in order to enact, implement and follow up policies geared towards sustainable use of the scheme. Moreover, due attention and policy consideration has to be given by government to those significant variables which have a potential impact in determining household livelihood diversification in the study area.

1. Introduction

1.1 Background of the study

Ethiopia's economy is among the most vulnerable in sub-Saharan Africa and is heavily dependent on the agricultural sector, which has suffered from recurrent droughts and extreme fluctuations of output (AfDB, 2003). One reason for this extremely low income is the high dependence of the population on low-input, low-output (and shock-prone) agriculture for their living (Devereux et al, 2003).

Agricultural growth continues to play a major role to rural poverty reduction in developing countries (Mellor, 2001 cited in ADB et al, 2007). Although the sector remains important but rural people are looking for diverse opportunities to increase and stabilize their incomes. Hence, the rural economy is not based solely on agriculture, rather on a diverse array of activities and enterprises. Much recent thinking on this subject is based on the concept of livelihood diversification as a survival strategy of rural households in developing countries' (Ellis, 1999).

Indeed agricultural growth will improved in Ethiopia if long-term strategies involve diversification away from rainfall-dependent livelihoods (Dessalegn, 1999). The unreliable and erratic rainfall along with recurrent drought which occur every 3-5 years in northern Ethiopia and every 8-10 years for the whole country leads to substantial decline in agricultural productivity (Haile, 1988 cited in Lemma, 2006).

According to Ellis (2000), rural livelihood diversification plays a crucial role in reducing poverty as it increases employment and generate substantial amount of income to improve rural household well-beings. To diversify rural livelihood, intensification and diversification are expected to become the major sources of future agricultural growth and poverty reduction, where irrigation plays an important role (ADB et al., 2007; Balihuta et al, 2005).

As endorsed in the Agricultural Development-Led Industrialization (ADLI) and food security strategy of the Ethiopian Government, small-scale irrigated agriculture takes the crucial role in efforts of livelihood diversification. Increased access to irrigation and less dependency on rain-fed agriculture is taken as a means to increase food production, employment generation and self-sufficiency for rapid population growth rates in the country (MoFED, 2005).

The livelihood of the majority of the population in the Amhara National Regional State (ANRS) is attached to rain-fall dependent mixed crop and livestock production. Predominantly, income measures show that north eastern parts of the ANRS are among the poorest parts of the Region (Ludi, 2002).

The study area, Gubalafto Woreda as part of this region is no different in its production mode and level of household income. The households in the area rarely produce enough food, even in years of good rainfall, to meet their family's needs and they face a range of obstacles to sustain livelihood. To this end, Government and non-government organizations have promoted small-scale irrigation to improve rural household livelihoods at national level.

Besides, the Amhara National Regional State (ANRS) has also formed the watershed base Integrated Water Resources Management (IWRM) committee under the Head of the council of the Region. This organizational set up reaches to Keble levels. The primary objective is to enhance the role of Small Scale Irrigation (SSI) in utilization of integrated water resource on the basis of using local people labour, skills and money (Muluken, 2005).

Small Scale Irrigation (SSI) has been given priority, and it is envisaged that it will bring social equity, that it will be economically and/or financially viable, technically feasible and environmentally sustainable (Mekuria, 2003). The benefit of irrigated agriculture is broad based with increase in production of both field and cash crops and supporting growth of non-farm activities in the rural economy and provided households with greater choices in their livelihood activities.

Therefore, there is a pressing and urgent need to address problems of rural household livelihoods through targeting access to and efficient utilization of irrigation water on economically and environmentally sustainable basis along with coordinated and carefully sequenced asset rebuilding efforts in the area.

1.2 Statement of the problem

According to Million (2007) local communities have their own rationale in following any kind(s) of livelihood strategy; whether the outsider perceives it as bad or good. Their rationale is pegged on the local realities. The types of livelihood activities practiced and strategies followed by a household may lead to either sustainable (desirable) or unsustainable (undesirable) livelihood outcomes. Poverty and food insecurity are among the main undesirable livelihood outcomes (Degefa, 2005).

Another study, focus on livelihood diversification implies a process of broadening of income and livelihood strategies away from purely crop and livestock production towards both farm and non-farm activities that are undertaken to generate additional income via the production of other agricultural and non-agricultural goods and services, this includes the sale of labour or self employment in small enterprises (Hussien and Nelson, 1999).

In Ethiopian context, majority of the rural households have based their livelihoods on agriculture (Yared, 2002 and Getahun, 2003). However, the characteristic of the agricultural sector is associated with low level of productivity which resulted in highly unreliable and unpredictable production mode. Its productivity is generally constrained by low input and output technologies, high population pressure, environmental and natural resource degradation, weak institutional capacity and inadequate infrastructure which in turn perpetuate poverty and food insecurity (Getahun, 2003; FDRE, 2003 cited in Misganaw, 2008).

Rural livelihoods are therefore extremely affected by external shocks. In most parts of the country, subsistence agriculture and pastoralism which depend on rainfall bear risks where rainfall is low and highly variable in many areas. However, in the study area crop and livestock production remain overwhelmingly the most important livelihood activity with the inherent challenges of climatic variation and declining productivity of the sector. To make the situation worse as indicated by Dercon (2007); Dessalegn (1999), share of income to total income of households from off-farm and non-farm activities is low.

Generally, rural livelihood activities and income sources involve a combination of two or more sources of income, crop production supplemented by off-farm income-earning activities returns to each individual activity are too low and too unreliable. Thus, unfavorable outcome occur because the productive resources available to households are inadequate to generate reliable production or income (Devereux et al, 2003).

As a way out to improve the well-beings of rural community it calls for the use of the country's high irrigation water potential to augment the productivity of the sector that reduce farmer's vulnerability through diversified income sources (Seleshi et al, 2005).

Ethiopia's irrigation potential is estimated at 3.7 million hectare, of which only about 190,000 ha (4.3% of the potential) has been actually irrigated. Gubalafto Woreda is also endowed with several water resources and irrigation projects particularly small-scale irrigations have been implemented and supported by governmental and Non-Governmental Organizations (NGOs) (Hassen et al, 2005).

Studies indicate, investment in irrigation contribute to agricultural growth and reduce poverty directly by permitting intensification and diversification, increased farm outputs and incomes; increased agricultural employment and reduced local food prices which as a result improves overall household incomes. Irrigation also reduces poverty indirectly from the multiplier effects on growth in non-farm sectors. The potential returns from irrigation investment are generally higher than those from comparable investment in rain-fed agriculture (Dessalegn, 1999).

Measures to harness contributions of small scale irrigation include pre-conditions of access to irrigation water; a minimum viable farm land size; access to markets and credit; and skills on crop selection and crop diversification. A cohesive and co-operative community based management entities are also required to successfully operate and maintain community irrigation systems and contain negative environmental impacts.

In addition, irrigated agriculture cannot function in isolation as an effective means for poverty reduction. A complementary package of interventions from research and extension need to enhance potentials of small-scale irrigation. However, studies on the above mentioned remedies to constraints of small scale irrigation have not been observed in the study area.

Irrigation development has been given emphasis and many studies about its contribution have concealed this process. However, its contribution to different rural livelihood activities has not been adequately studied and documented. Differences in extent of livelihood diversification (income sources and their share to total income) among households have rarely been empirically investigated in local context.

Other studies linked livelihood diversification and resource use to emphasize agro-ecological, market and infrastructure conditions. Even studies at local level provide little documented data on the extent to which the so far developed irrigation schemes have been effective in meeting their objectives of addressing food self-sufficiency and reducing levels of poverty through diversification of household income sources.

The high water resource endowment, long experience of irrigated agriculture and developed irrigation facilities make irrigation a vital input for improving productivity and buffer the effects of variable rainfall. To this effect, the study aimed to curb the knowledge gap through investigation of obscured facts about rural household livelihood diversification by blending measures of income with livelihood activity.

1.3 Objectives of the Study

The major objective of the study is to assess contribution of small-scale irrigation to rural livelihood diversification through diversified household income sources in two Keble's of Gubalafto Woreda in north Wollo administrative zone of Amhara National Regional State (ANRS);

Specifically the study sets out:

1. To assess the extent of rural livelihood diversification;
2. To assess constraints of small scale irrigation in the study area.
3. To identify determinants for rural household livelihood diversification

1.4 Research Questions

The study will address the following research questions:

1. What is the extent of livelihood diversification at household level?
2. What is the contribution of small-scale irrigation to diversify household income sources?
3. What are the major constraints of Alawuha small scale irrigation?
4. What are the determinant factors of rural household livelihood diversification?

1.5 Significance of the study

This study, which attempts to investigate the extent of livelihood diversification and identify determinant factors for livelihood diversification on the rural households of the study area, has some importance. Firstly, it provides clue to the current controversies and discourses in the academic world about rural livelihood diversification strategies relationships with agricultural development. Thus the study improves the understanding of the problem at the local level.

Secondly, the findings of this study identify determinants of livelihood diversification on the rural households for further remedy. On the other hand, the study discerns the unsustainable practices and constraints of the small scale irrigation scheme in the area. By so doing, it could uncover the causes and constraints to such practices, and forwards corrective measures for implementation both at the study site and elsewhere where there are identical problems.

Thirdly, the findings of this study can show the contribution of irrigation to rural livelihood diversification. This could help in policy implementation and institutional interventions to reduce the vulnerability levels as well as efforts in combating poverty.

Thus, the findings of this study can serve as a good input for sustainable utilization and management of the country's resource base in general and its water resources in particular.

1.6 Scope and limitation of the study

In general, the limitations of the study are the delimitation of the study area to a single Woreda, one irrigation scheme and 113 sample households. Since there is a financial and time resource constraint, inter-temporal variations are not taken care-off in this study; hence cross sectional data is used.

1.7 Organization of the paper

This research report comprises six chapters. Chapter one presents introduction and statement of the problem as well as objectives and significance of the study. This part also includes the delimitation and limitation of the study. The second chapter provides review of related literature pertaining to the problem under investigation. Various publications having diverging and converging views in different school of thought as well as empirical findings by other scholars that are pertinent to the problem were critically read and presented.

Research methodology is presented in chapter three. In this chapter, the study design; types and methods of data collection; sampling method and procedures are presented in detail. Methods of data analysis that were adopted to investigate the problem are also described in this chapter. The fourth chapter shows description of the study area and the study population. Location and physical settings of the study area are displayed based on available data form secondary sources. Besides, socio-economic and demographic background of the study population is also presented in the chapter.

Chapter five provides results and discussion of the study. This is the main body of the paper which presents results of data analysis and their interpretations. It presents the extent of livelihood diversification through livelihood diversification index in the rural households of the area; the determining socio-economic, demographic and institutional household characteristics to livelihood diversification and constraints of the small-scale irrigation scheme in the study area. The last chapter provides conclusion and implications of the study.

2. REVIEW OF RELATED LITERATURE

The following section presents an overview of the salient issues of livelihood diversification and small-scale irrigation. Thereafter, tries to cover perspectives on the relationship between small-scale irrigation and livelihood diversification through agricultural productivity and highlight few empirical studies done on determinants of livelihood diversification. Finally, it presents the conceptual framework drawn from the theoretical perspectives on household livelihood diversification

2.1 Concepts and Definitions

2.1.1 Rural livelihoods diversification

Livelihood diversification has been defined in several ways as it is emerging from debate of different scholars in its definitions and processes. Diversity (i.e. the exploitation of multiple assets and sources of revenue) is an intrinsic attribute of many rural livelihood strategies. Livelihoods are diverse at every level, for example, members of a household may live and work in different places engaging in various activities, either temporarily or permanently. Individuals themselves may rely on a range of different income-generating activities at the same time (DFID 2001; Warren, 2002).

Others defined diversification as a change in away from an existing pattern of activity, and so diversification is not only the path to a new livelihood outcome, but may also be the agent of social and cultural change. Diversification helps to reduce risks, especially those related to seasonality in rain-fed agriculture (Devereux, 2000).

Furthermore, diversification can be a part of a household strategy of combining sequentially or in parallel activities that contribute to the accumulation of wealth at different points in the life cycle of the household. Though the reasons why people diversify have been extensively debated: is it spreading of risks, out of poverty and/or an element in an entrepreneurial strategy (Ellis, 1998), diversification may be an indication of increased vulnerability, where it is a response to the failure of previous livelihood strategies, or it may be the path to accumulation and investment in the future, leading to a cumulative improvement in livelihood outcomes over time (Devereux, 2000).

Rural livelihoods diversification has generally occurred as a result of an increased importance of off-farm wage labor in household livelihood portfolio or through the development of new forms of on-farm/on-site production of non-conventional marketable commodities. In both cases, diversification ranges from a temporary change of household livelihood portfolio (occasional diversification) to a deliberate attempt to optimize household capacity to take advantage of ever-changing opportunities and cope with unexpected constraints (strategic diversification).

Therefore, the increased recognition that rural livelihoods are multi-occupational and cross-sectoral have become the fundamental starting point for critically reflecting upon the rural development policies of today (Ellis, 1999). The reason for focusing on livelihoods and processes of diversification is that the analysis includes those at the bottom of the pile, such as, for example, the landless and the poor. The debate and above all the interpretations of processes of diversification as received much criticism. Partly this critique relates to the actor-structure debate (agency and capabilities) and partly with issues of governance and institutionalization (Ellis, 2000:23-28).

Classical structural transformation theories define the process involved in diversification as a proportional decline in the agricultural sector; in its contribution to national output and employment, and the rise of the manufacturing sector. Specialization is an important mechanism in the process, as is the concomitant expansion of markets as the principal institution to integrate and facilitate the activities of the producers, the savers and the investors (Berg, 2004 in Josi, 2005).

However, according to Ellis (2004), while people in the countryside of developing countries gain their livelihoods in a variety of ways, this range of income earning activities is often combined with, or linked to, agricultural production. Besides it is also widely believed that an important driver of the rural non-farm economy (RNFE) is agricultural growth. The focus has therefore remained on increasing farm incomes and supplementing this with efforts to enhance skills, improve access to credit and productive assets which would enable poor people to diversify into small enterprise, trade and agro-processing etc. Likewise a slowdown in agriculture can lead to a decline in RNFE activity.

As agricultural specialization can start from an initial diversification move, also livelihoods diversification can eventually lead to some form of household specialization. For instance, in particular circumstance migratory wage labor may result so cost/effective to push the household away from conventional on-farm activities. Conversely, the identification of a particular niche commodity (e.g. mushrooms) may lead the household to invest all its labor and other assets in it, disregarding both conventional farming activities and wage labor.

As a matter of fact, this has reinforced the view that investment in agriculture is the main route to poverty reduction especially in areas where agriculture is the main sector of the national economy, like Ethiopia. The changing scenario of agriculture has forced the farming community and policy makers in agriculture to search for a more remunerative and viable production portfolio. The diversification of agriculture towards non-food grain and high value commodities has been the right answer for it, because these commodities have potential of income augmentation, employment generation, poverty alleviation and export promotion.

Hence, for the purpose of this study the author accept the definition of diversification at the individual or household level, 'livelihoods diversification', simply meaning to add new activities. These can include agricultural or non-agricultural work, work for one's self or for an employer, home based work or work at other places. Rural livelihood diversification could be described also as the process by which rural households construct an increasingly complex portfolio of activities and assets, in order to survive and to improve their standard of living (Ellis, 2004).

2.1.2 Small-Scale Irrigation in Ethiopia

Ethiopia is endowed with potential water resources but the estimates of the irrigation potential vary from one source to the other, due to lack of standard or agreed criteria for estimating irrigation potential in the country. The earlier reports for example according to World Bank (1973) as cited in Rahmato (1999) show the irrigation potential at the lowest 1.0 and 1.5 million hectares; 3.7 million hectare according to MoWR (2001), and the highest according to Tilahun et al (2004), on the order of 4.3 million hectares potential irrigable area.

The 12 river basins covered by Ethiopia have an annual runoff volume of 122 billion m³ of water (Seleshi et al, 2005). Seventy five percent of this total run-off flows to Sudan, Egypt and finally to the Mediterranean Sea. Out of the remaining 25 percent, 15% goes to Kenya, 6% to Somalia, 1% to the Red sea and thus only 3% remains in the country. Presently, irrigated area in the country accounts only for 5% of the total land suitable for irrigation and about 1/3 of this is located in the Awash Basin (MoWR, 2001).

Irrigation is the artificial application of water on to cropland for satisfying the water requirement necessary for growing crops. The history of irrigation water use for agriculture dates back to the early civilization of mankind. However, as noted by Peter Stern (1979) cited in Lemma (2004), irrigation developed during the first half of the twentieth century was universally beneficial. Irrigation encompasses the technical disciplines of conventional irrigation, supplemental irrigation and water harvesting (FAO, 1987).

It is categorized as small, medium or large-scale depending on the area irrigated, scale of operation and type of control or management. But the criteria for this category may vary from country to country. For example, in India the irrigation scheme of 10000 ha is classified as small while in Ghana the largest irrigation is 300 ha (Smith, 1998 cited in Lemma, 2004). Irrigation projects in Ethiopia are identified as large-scale irrigation if the command area is greater than 3,000 ha and they are usually established and run by the state, medium-scale if it falls in the range of 200 to 3,000 ha and managed by state firms and parastatal enterprise, and small-scale if it covers less than 200 ha of land mainly owned and managed by peasants organized into community groups or water-use associations (Dessalegn, 1999; Fuad, 2001 and Seleshi et al, 2005).

In addition to the above classification the new classification developed by Lempérière includes the dimensions of time and management. According to this system four different types of irrigation schemes in Ethiopia are distinguished as traditional, modern communal, modern private and public. Small-scale irrigation schemes in Ethiopia are understood to include traditional small-scale schemes up to 100 ha and modern communal schemes up to 200 ha.

However, we also see a 'traditional' spate irrigation scheme in, for instance Tigray, of up to 400 ha (MOWR, 2002 cited in Seleshi et al, 2005). Though small irrigation were started after the catastrophic drought in 1973 to improve food security and better livelihoods by producing cash crops (Workicho, 2006), currently more attention has been given by government and NGOs to the development of such schemes and are becoming popular in Ethiopia due to various advantages they have over medium and large-scale schemes.

Thus after establishment, small-scale schemes are usually "handed over" to water use associations (WUAs) for management, operation and maintenance with the support of personnel from regional bureaus. The focus on large-sale irrigation development and neglect of small-scale schemes was reversed after 1991. More emphasis has been given to the development of small-scale irrigation schemes and improvement of farmer-managed traditional schemes (Brihanu et al, 2003)

They require lower investment cost, which can be managed by farming communities; there is no population displacement involved since they do not involve construction of dams and reservoirs; they are less demanding in terms of management, operation and maintenance. They do not inflict

land tenure and resettlement problems; they do not cause adverse environmental impact; they allow wider diffusion of benefits and they permit farmers to learn irrigation techniques at their own pace in their own way (Dessalegn, 1999).

Traditionally, farmers have built small-scale schemes on their own initiative, sometimes with government technical and material support. They manage them through their own water users association or committees (MoWR 2002). Water users associations have long existed to manage traditional schemes. They are generally well organized and effectively operated by farmers who know each other and are committed to cooperate closely to achieve common goals.

According to Mekuria (2003), in Ethiopia, most smallholder irrigation is based on river diversions, small reservoirs and diesel-operated motorized pumps. Some private farms in Ethiopia also apply modern irrigation technologies like drip and sprinkler irrigation technologies. Based on the recent restructuring, federal level responsibilities with respect to development, planning and development of large- and medium-scale irrigation projects fall within the mandate of the MoARD.

The small-scale irrigation and water harvesting schemes are planned, implemented and governed under the MoARD at the federal level. The institutional set-up and accountability issues vary from region to region, and are not stable. As a result, there is confusion on mandate, resulting in some cases of scheme failure due to lack of accountability. Some of the regional bureaus' mandates involve planning, designing and construction of small-scale irrigation schemes and handover to another bureau for management, operation and maintenance.

2.1.3 Livelihood Diversification and Small-Scale Irrigation

Natural resources are fundamental assets in rural livelihoods, but access to them needs to be viewed through the same lens of widening options and opportunity as livelihood diversification itself. Natural resource management regimes that inhibit exchanges, substitutions and transactions also inhibit livelihood diversification with negative consequences for their long run quality and sustainability (Ellis et al., 2004).

As FAO (2000:16) identified, smallholder irrigation has brought many successes to farmers, among others the major includes; First, it enabled farmers to grow high value crops and increase their income hence improve their livelihoods. Second, the schemes helped in reducing the rural to urban migration by offering the rural population an alternative source of employment. Third, in arid areas where drought is frequent phenomenon irrigation helped as strategy to cope with the problem. Fourth, with more integrated approach smallholder irrigation can be the basis for other rural infrastructure to be developed in areas, which could otherwise have remained without roads, telephones, schools and clinics. Fifth, smallholder irrigators have developed a commercial mentality as a result crop yields and farmer incomes have gone up manifold.

Hence, irrigation is the most common means of ensuring sustainable agriculture and coping strategy with periods of inadequate rainfall and drought. Moreover, irrigation permits farmers to grow moisture- sensitive, high value crops and crops that will improve their diet. In areas where there is high frost problem, irrigation is used as protective measure. The extent to which water resources will contribute to sustainable livelihoods will depend on availability, the nature of rights of access, the system of management and the technology with which the resources are

exploited. There are numerous problems, however that can be caused by poor design, construction and management of irrigation systems; salinization and water logging are the main ones (Bitew et al, 2005).

Improvement in access to irrigation water serves as a powerful tool to diversify livelihoods and reduce vulnerability for smallholder producers (Gebremedhin et al, 2003). There are five key dimensions how irrigated agriculture contributes to socioeconomic uplift of rural communities. These are production, income, consumption, employment, food security, and other social impacts contributing to overall improved welfare (Hussain, 2004)

Irrigation with higher yields can allow countries to grow more of their own food and be less dependent upon imports especially in view of the common occurrence of droughts in the region. Hence, development of the agricultural sector in general and irrigation in particular would be an obvious solution (Desta, 2004).

However, in areas where communities and households depend to a great extent on agriculture for their livelihoods, access to irrigation is a necessary, but not a sufficient condition for poverty alleviation. Access to other production inputs and services by the poor and marginal farmers is also important to enhance benefits of irrigation for poverty alleviation (Hussain, 2004).

2.2 Empirical studies

Studies on analysis of determinants of livelihood diversification at household level focus on personal attributes and household characteristics, social, institutional and natural environment. All of these factors are highly interwoven. The body of literature dealing with these factors with in the country is very few to be investigated in detail. In view of this, limited number of empirical studies are reviewed giving due emphasis to studies undertaken in African countries to show the salient issues determining households livelihood diversification status.

Study in the Côte d'Ivoire revealed that households endowed with insufficient productive agrarian capital, land and livestock to absorb their household's full labor endowment are compelled to seek out off-farm or non-farm income sources in the absence of complete and well-functioning markets in land and livestock(Matlon 1979 cited in Fistum et al, 2007).

Other study undertaken in Eastern Nigeria, in determinants of livelihood strategies, concluded income diversification is negatively associated with household head sex. Unlike in rural areas, female-headed households tend to have more income sources in urban areas. While, higher rainfall diversification leads to pursuit of multiple income sources as would be expected since diversification may be pursued in response to risk such as income variance. Positive association between rainfall variability and income diversification may imply that the latter may have been used as a risk management strategy. Finally the same study suggested, access to credit appears to improve conditions for diversification in rural areas, but not so in urban areas. The rural finding underscores the possibility that credit constraints prevent households from engaging in lucrative diversification options in rural areas.

Impact study carried out by Desta (2004) revealed that contribution of irrigated agriculture to income is about 70 % in the highly irrigated villages as compared to 60 % in two other low irrigated areas. At the same time, the absolute size of agricultural income is also the highest in the highly irrigated village despite the lower landownership size and cultivated holding by more than 30 % over the low irrigated village. The share of agricultural income (in terms of both owned and cultivated land) is also found to increase with the increase in irrigation intensity of the village. The highly irrigated village has higher per hectare agricultural income by over 50% over the low irrigated village.

Also in Fuad (2002) cash crop economy with important cash flow offers a wide range of off-farm income possibilities as compared to subsistence farming. About 45% of farmers involved in cash crop production are engaged in income generating off-farm activities while only 13 % are from the non-cash crop producers.

2.3 Conceptual framework

This section explains the conceptual framework used to analyze the determinants of livelihood diversification in the rural community. There are two types of diversification strategies; intra-sectoral and inter-sectoral. Intra-sectoral is agricultural diversification, such as the introduction of new crops into farming systems or farmers investing in livestock. The notion of livelihood diversification focuses on inter-sectoral diversification, an expression of the fact that rural people's livelihoods straddle different economic sectors. But in this study livelihood diversification refer to the both intra and inter-sectoral diversification because of the multiplier effect of agriculture sector in rural Ethiopia. Rural people do not specialize in crop production, fishing, forest management or livestock rearing to the exclusion of other sources of income.

Rather they combine a range of activities and occupations to construct a diverse portfolio of activities (Dercon and Krishnan 1996 cited in Fistum et al, 2007 and Ellis, 2000).

Moreover, household level livelihood diversification is majorly determined by household's access to different productive resources. Thus, among the many factors irrigated agriculture plays a crucial role to sustainable livelihoods of rural communities. Improvement in access to, utilization and management of irrigation water serves as a powerful tool to diversify livelihoods and reduce vulnerability for smallholder producers (Gebremedhin et al, 2003). The major aspects that link irrigated agriculture to livelihood diversification at household level include production, income, consumption and employment.

Hussain (2004) noted that irrigation benefit the poor through raising yields and production, lowering the risk of crop failure, and generating higher and year-round farm and non farm employment. Furthermore, it enables smallholders to adopt more diversified cropping patterns and to shift from low-value subsistence production to high-value market-oriented production, which increase income of household.

It is impossible to generalize that only accessing irrigation water to rural poor solves the problems of food insecurity and income shortage through livelihood diversification. Moreover, there are other household characteristics (i.e. demographic, socio-economic and institutional) and external factors (i.e. Policies, macro-economic environment, culture...) that shape households livelihood activities, which in turn determine the livelihood diversification situation of rural household.

To this end the following conceptual framework (See Figure1) is developed to show the process in which how livelihood diversification at household level realized. Moreover, the complex and interrelated demographic, socioeconomic and institutional variables that are expected to determine livelihood diversification at household level are explained detail in the methodology section.

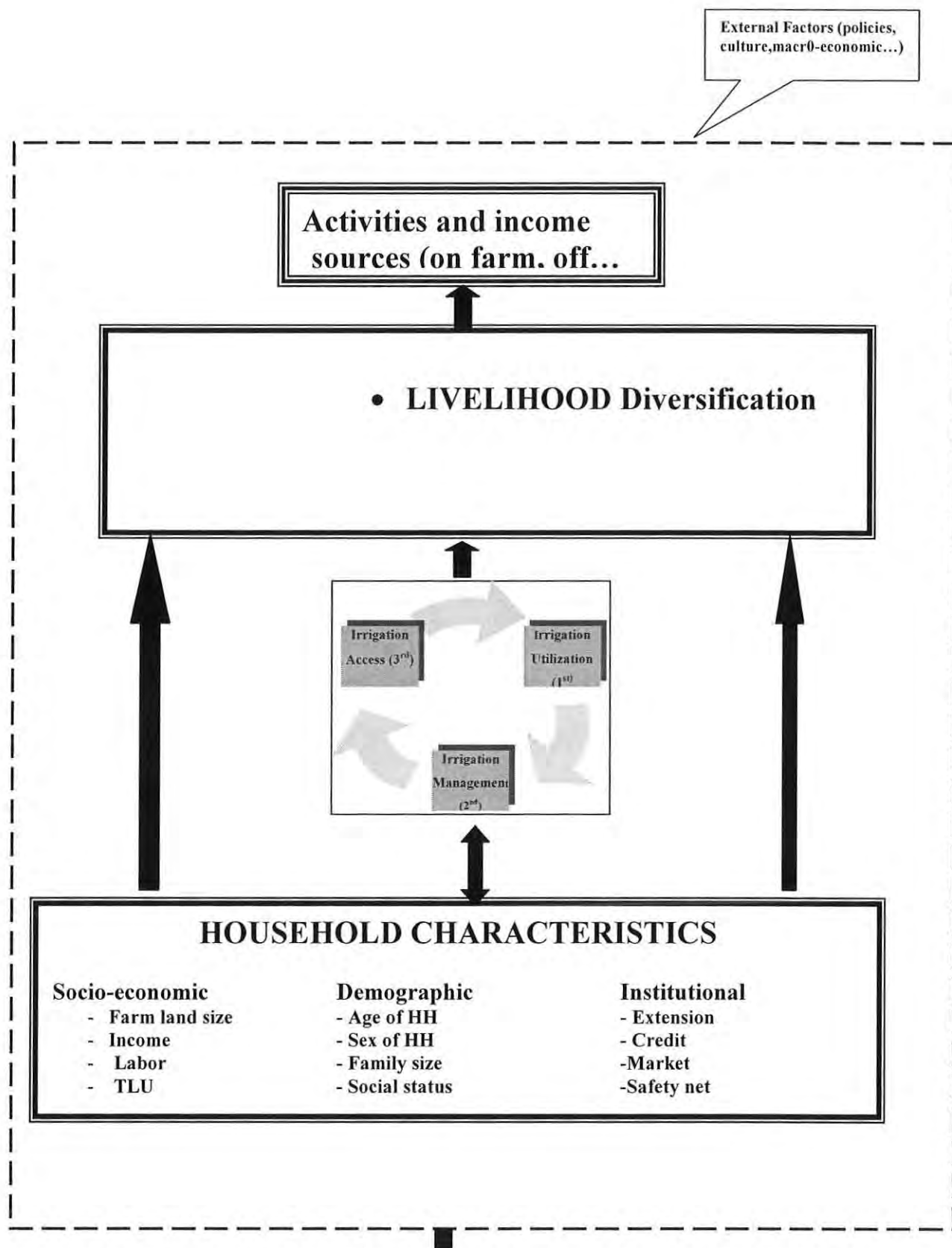


Figure 1. Conceptual framework for household livelihood diversification

Source: Own formulation, 2009

3. Research Methodology

This section presents and discusses the research methodologies that were used in the study. It also provides detailed description of sample households' selection process, sampling techniques and methods of data analysis.

3.1 Sources and Methods of Data Collection

The data collection was done efficiently through a structured questionnaire to collect the required data from selected sample households during the 2008/2009 production year. The questionnaire was first pre-tested and modified before the execution of the survey (See the questionnaire in *Appendix V and VI*).

Training on methods of data collection and the contents of the questionnaire was conducted. Three enumerators were recruited from the study area and trained for 3 days. The enumerators who stationed in the survey areas administered the structured questionnaires under the continuous supervision of the researcher. The survey was carried out from February to March 2009.

Moreover, the study employed Focus Group Discussion (FGD) and key informant interviews to clearly capture issues in livelihood diversification of the rural community in the study area. This was conducted with water users Association (WUA) and Keble's officials, staff of the Woreda Agriculture and Rural development Office, Sirinka Agricultural Research Center (SARC), Cooperatives and water desk office and other NGO staffs working in the area. The nature of the data includes identification of income sources, listing of income sources based on degree of importance, contributions and constraints of irrigation water management. Thus, the primary data were supplemented by secondary data whenever necessary from governmental organizations.

3.2 Sample Size Determination

There are several approaches to determine the sample size. These include using a census for small populations, imitating a sample size of similar studies, using published tables, and applying formulas to calculate a sample size.

This study applied a simplified formula provided by Yamane, (1967) to determine the required sample size at 95% confidence level with degree of variability = 0.05 .

$$n = \frac{N}{1 + N(e)^2} \dots\dots\dots (1)$$

Where n is the sample size, N is the population size (total household size), and e is the level of precision.

Thus, the sample size determined under this procedure was found to be 350. However, due to observable homogeneity in the background characteristics of the target population (i.e., only 2 rural *kebeles* of the district were covered) and due to resource constraints, only 113 households were considered as overall sample size for this study.

3.3 Sampling Technique

For this particular study a two-stage sampling procedure was implemented. Out of eighteen irrigation potential kebeles of the Woreda, two kebeles, namely Lay Alawuha (*Derogiber*) and Tach Alawuha (*Lastegerado*), were selected in the first stage using a purposive sampling technique, for the reasons that theses two adjacent Kebles neighbors the irrigation scheme and for their accessibility.

LS 3A

In the second stage a total of 113 household heads were selected through systematic random sampling from the respective list of farmers in the two kebeles using proportionate sample size determination techniques. Selection of starting point from the farmers' list was by a lottery system. Then, respondents were selected by a fixed interval until the desired sample size was obtained.

3.4 Measuring Livelihood Diversification

Based on survey data, income source of sample households was identified and prioritized. Rural household income shares from different income sources were estimated with respect to income diversification. Because there is an agreement that Livelihood 'diversification' should not be documented or measured in terms of the number of income sources in a household, but on the degree of reliance on multiple sources (Ellis, 2000). A household, for example, may have half a dozen or more different sources of income, but 90% of the total may come from just two of them.

Level of Livelihood diversification was computed using diversification indices to see whether patterns in income diversification differ among the sample households. The income shares data from the survey was used to estimate diversification indices. The diversification index is defined as the square of summation of the reciprocal of proportional contributions to total income. Higher values of the index imply a more diversified income and the more probable a household to be diversified and vice-versa. In the study sample households categorized as lower level and higher level in terms of their livelihood diversification status after listing their score rank by descending order into four quartile groups.

Thus, the average income source share of the first 50% (Quartile 1 and Quartile 2) of households was considered to be the less diversified and the rest 50% (Quartile 3 and Quartile 4) household was considered to be more diversified group.

Livelihood Diversification Index is given as:

$$LDI_Y = \frac{1}{\sum_{j=1} X_j^2} \text{-----} (1)$$

Where,

LDI_Y Indicate Livelihood Diversification index Y

X_j Income shares from major livelihood activities

3.5 Analytical Procedure

In this study, descriptive (such as mean, standard deviation, sum and percentages), frequencies and cross tabulation were computed. Independent Samples T-test was used for the purpose of comparison of mean differences between diversified and less diversified households.

3.5.1 Model specification

The study utilized a probability model specified with extent of rural livelihood diversification as a function of series impediments that help or hinder livelihood diversification among sample households, as it is indicated below by explanatory variables. The dependent variable is dummy variable, which takes a value of zero or one depending on whether or not a household lies on higher or lower diversification index (*i.e. 1=diversified, 0= other wise*).

Linear probability model (LPM), Logit or Probit models can be used to estimate dependent dichotomous variable. Although linear probability model is the simplest method, it is not logically attractive model in that it assumes that the conditional probability increases linearly with the value of explanatory variables. Unlike linear probability model, Logit model guarantees that the estimated probabilities increase but never step outside the 0-1 interval and the relationship between probability (P_i) and explanatory variable (X_i) is nonlinear (Gujarati, 1995).

Thus, a logistic model was used to identify the determining factors of livelihood diversification at household level.

The functional form of logit model is specified as follows, Gujarati (1995)

$$P_i = E(Y = 1/X_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_i)}} \quad \text{----- (1)}$$

For ease of exposition, we write (1) as:-

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

The probability that a given household is diversified is expressed by (2) while, the probability for less diversified is:-

$$1 - P_i = \frac{1}{1 + e^{Z_i}} \quad \text{----- (3)}$$

Therefore we can write:-

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

Now, $(P_i/1-P_i)$ is simply the odds ratio in favor of diversification. The ratio of the probability that a household was diversified to the probability of that it was less diversified

Finally, taking the natural log of equation (4) we obtain:-

$$L_i = \ln \left[\frac{P_i}{1-P_i} \right] = Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \text{-----} (5)$$

Where P_i = is a probability of being diversified ranges from 0 to 1

Z_i = is a function of n explanatory variables (x) which is also expressed as:-

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \text{-----} (6)$$

β_0 is an intercept

$\beta_1, \beta_2 \text{-----} \beta_n$ are slopes of the equation in the model

L_i = is log of the odds ratio, which is not only linear in X_i but also linear in the parameters.

X_i = is vector of relevant household characteristics

If the disturbance term (U_i) is introduced, the logit model becomes

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + U_i \text{-----} (7)$$

3.5.2. Definition of Variables and Hypothesis

Dependent Variable

Diversification index: is a dichotomous dependent variable in the model taking value of 1 if a household lies on a higher index (*diversified*) and 0 otherwise.

Independent variables:

Various socio-economic and household characteristics variables are expected to affect rural livelihood diversification in the study area. The major explanatory variables hypothesized to influence positively or negatively on the household to diversify their income sources or not are described below.

Sex of the household head (SEXHH): Women households are discriminated in the use of improved technologies and information from extension service. Due to this reason female households are limited to diversify their employment and income source portfolio than the male households. Therefore, it is hypothesized that women household head have negatively related with diversification index than male household head.

Farm experience (FARMEXP): This refers to the total number of years the respondent has spent in farming. With longer experience in farming, a wide knowledge and experiences are gained on the operation and conduct of traditional agricultural activities and methods of production. Moreover, older persons are more risk averters, and mostly they intensify and diversify their production activities. As a result, the chance for such household to higher diversification is high and thus will have a positive relation.

Location of the farm land (KEBELE): This variable refers to the location of the farm household land in one of the two kebeles namely Lay-alawuha (Derogiber) and Tach-alawuha (Lastie-gerdo). The shortest distance of irrigated farm land from the source facilitates farm households to easily access the irrigation water that in turn result positive effect on production. As it is known access to this natural resources base (land and water) is fundamental to the survival and livelihood of the households in the rural areas. Therefore, it is hypothesized that those households located in Lay-alawuha have a better chance to livelihood diversification.

Total Household Labor (TOTALHHLABOR): Labor is one of the factors of production. Family labor plays an important role, particularly in rural families. Therefore, the household with more agricultural labor, which would participate in agricultural, non and/or off farm activities, results in more diversified production and hence more income source. Increase in the availability of labor has positive influence in terms of increasing production diversification and have positive contribution to higher index.

Total Cultivated Land size (TOTALCULTLAND): this refers to the total land owned by a household in the area. Since, cultivated land is used for production of diversified crop for consumption and cash sources; it has direct relationship in increasing product diversification and higher income source. Therefore, total cultivated landholding and higher diversification index are positively related.

Total Irrigable Land Size (TOIRLAND): This variable refers to the total irrigable cultivated farmland in hectare (owned, shared and rented) allocated for annual and perennial crops, vegetable and for homestead farming activities. It has a direct relation with crop production. A larger size of irrigable cultivated land implies more production and availability of more income. Hence, size of irrigable cultivated land was expected to have positive impact on household livelihood diversification.

Extension Service (EXTENSIONHH): Extension service play important role for rural farmers in terms of providing advice and information through extension agent on how to use different improved agricultural technologies which increase production diversification and income source. Therefore, it is hypothesized that, farmers who have higher contact with extension agents would have a better chance to increase income source share and therefore better off in terms of diversification index than those with less contact.

Credit Service (CREDITHH): Institutional loan plays an important role in agricultural production. Farmers who have access to credit will able to diversified production due to use of agricultural inputs which would enhance income source share and ultimately increase diversification index indicating the positive relationship of credit and diversification portfolio.

Income source share from irrigated farm (INCOMIRI): Farm households who participate in irrigated agriculture would able to increase crop production through applying crop intensity (growing two to three crops per year) combined with market oriented cropping pattern (crop diversification) and which enables them to increase income as well as employment portfolio.

Therefore, it is hypothesized that income source share from irrigated farm would have positive relationship with diversification.

Income from Off-Farm activities (INCOMOFF): The success of households and their members in diversifying income source is supported by their ability to get access to off-farm job opportunities. In this regard, households participate in those activities are better endowed with additional income source. Hence, it is hypothesized that total income from off-farm activities is positively associated with household diversification.

Income from Non-Farm activities (INCOMNON): It is annual non -farm income in Birr¹ that a household head or his family members earn from non- farm activities. Moreover, non- farm income is a means to have more cash that is available to livelihoods of farmers. It provides cash to buy food grains and non-food items required for household members. Therefore, in this study it was hypothesized in that non-farm income is positively associated with household livelihood diversification.

Income from irrigation (INCOMMIGRATION): Income source share from irrigation farm: This variable refers to income source share of the household from irrigated crop produce only. Since most of the farmers get most of their income, among other things, from sell of cash crops produce, this variable is hypothesized to have positively influence on household livelihood diversification.

¹ Birr is the Ethiopian national currency, currently has an exchange rate of 1 US \$= 11.47Birr

Income from employment (INCOMEMP): This variable represents the amount of income earned in cash or in kind, during the year through employment (i.e. safety net and other employment in non agricultural fields). Increased income source other than on-farm in the households enables the households to diversify their livelihood, thus this variable is hypothesized to have positively influence on household livelihood diversification.

Total Number of livestock owned (TOTALTLU): Irrigation will ensure availability of fodder for livestock that results a household to possess more number of livestock. Since households with more livestock obtain more milk, milk products and meat for direct consumption, particularly during food crisis, large size livestock owners could have higher diversified income source. The livestock is also used as the major employment opportunities for rural household members. Therefore, it is logical to expect that a higher value of livestock increase the probability to have higher diversification.

Cash crop (CASHCROP): It has been suggested that policy support to increase farm production, as well as to encourage switching from low-price subsistence crops to high-price cash crops would improve in the return livelihood of farm households. Farmers who diversify production and include high value cash crops are able to offset the risk of crop failure and hence face less financial and subsistence constraints. Crop diversification including cash crops is hypothesized to be positively related to household livelihood diversification.

Distance of Households from the market center (MARKETDIS): Rural Households who have proximate distance to market centers will explore the possibility of growing crops that are high in demand and experience production of high-quality produce. Hence, it is hypothesized that those households near from the market centers will relate positively to livelihood diversification.

4. Description of the study area

4.1 Location of the study area

North Wollo is one of the eleven administrative zones of the Amhara National Regional State (ANRS). Its capital, Woldya, is located 360 kms away from the capital of the region, Bahir Dar, and 521 kms from Addis Ababa in the north-eastern part of the country. Agriculture is dominated by cereal-based farming systems. The zone is one of drought prone, low potential with severe environmental degradation and known by provoked chronic food insecurity and famines (Eyasu, 2000). North Wollo comprises ten woredas namely, Gubalafto, Habru, Kobo, Delanta, Dawnt, Meket, Wadla, Bugna and Gidan and its capital Woldia as one district.

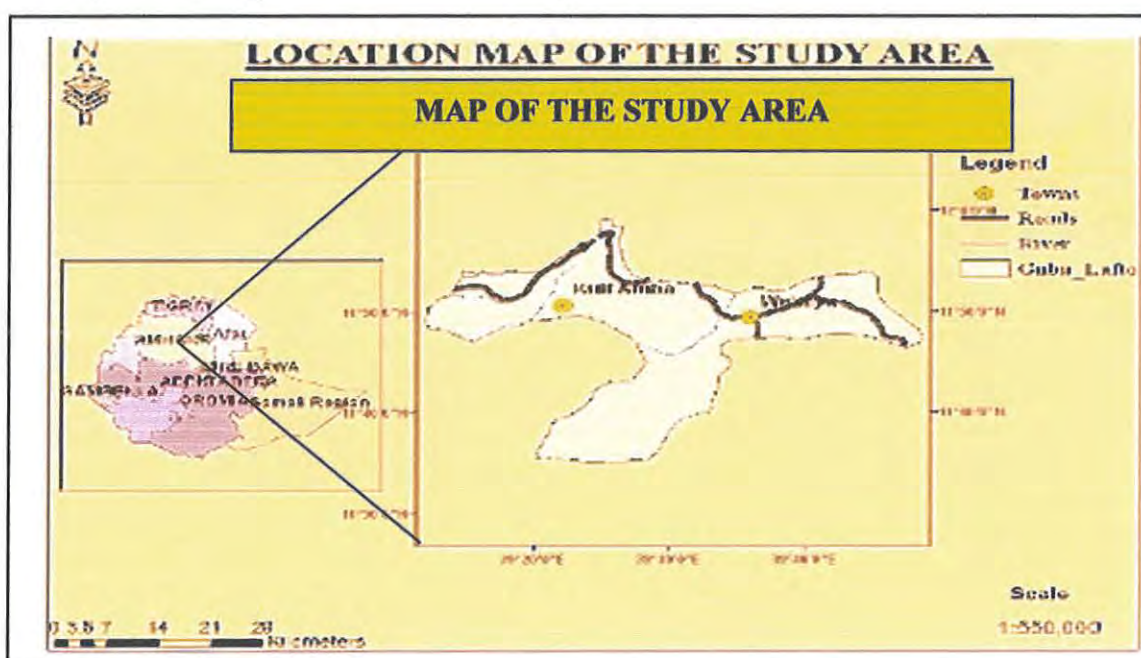


Figure 2 Map of the study area

Source: Own formulation using available data

The study Woreda (i.e. Gubalafto) consists of eighteen kebeles that surrounded the zone capital, Woldia. For the purpose of this study two adjacent Kebles neighboring the Alawuha small scale irrigation scheme are selected. Furthermore, detail description about Alawuha small scale irrigation scheme is presented in section 4.7.

4.2 Population on the woreda

According to the 2007 census of the country, the total population of the Gubalafto woreda is about 139,800, of which 70,732(50.6%) are males and 69,068(49.4) are females. The majority of the population 134,915(96.5) of the population of the woreda are living in the rural areas while 4,885(3.5%) are urban dwellers (CSA, 2007).

Drought induced food insecurity has been recurrent phenomena exacerbating the vulnerability of resource poor farm households in the area. Off-farm employment opportunities are very limited. As a consequence, the migration of the people has become a practice (Ramakrishna and Assefa, 2002).

4.3 Topography of the woreda

The topography of the woreda consists of a chain of mountains, hills, valleys and cliffs that exposed the natural resource for severe degradation mainly due to erosion. Valley bottom and plateau are suited to agriculture. Generally, flat land and land with gentle slope is scarce and fragmentation and smaller land holding is common.

4.4 Climate of the woreda

The woreda has a moderate agro-climate ranging from 2300 to 2800 masl. The annual rainfall of the woreda is one the lowest in the region and generally receive annual precipitation lower than annual evaporation. Besides, rainfall is usually inadequate, short in duration poorly distributed and highly variable between and within seasons. Agriculture is rainfall dependant, consequently, recurrent drought and frequent crop failure; due to the erratic, unpredictable and low amount of rainfall; are common phenomena resulting to chronic food shortage and poverty (Wondimu et al., 2005). To solve this, small farmers in the area traditionally have been used rivers, springs, ponds, ground water, and dams as the major sources of irrigation water for long time.

4.5 Farming System of the area

Agriculture is the main economic activity and livelihood sources the people of the study area. It is characterized by mixed farming that includes both crop production and livestock rearing.

Crop production is the main important components of the agricultural activities on which most of the rural people engaged in and depend on their living. The main crops grown in the study area are *teff*, sorghum, chick pea, season, lentils, *abish*. In addition, different vegetables are grown such as orange, mango, avocado, coffee, papaya, tringo, lemon, chat and gesho.

In the study area, production of high-yielding maize and sorghum dropped sharply. This necessitated a major shift in the cropping pattern to short-cycle and low-yielding crops such as *teff*, maize, sorghum and pulses later during the *meher* season. Failed *belg* fields were similarly used for planting *meher* crops, following the start of the *kiremt* rains.

As a result, the area under long-cycle maize and sorghum declined drastically, while that of *teff* increased substantially due to poor *belg* season rainfall (MoARD, 2009). However, the production of these crops is very much limited to areas which have access to irrigation schemes. Although, the production of horticultural crop is not well developed in the area, market opportunity for horticultural crops increased from time to time especially to the main city of the Woreda (Woldia).

In moisture stress areas like Gubalafto, the amount of crop harvested is strongly related to the size of cultivated land and moisture availability. Accordingly, the intent to increase crop output by farm households largely relies on expanding farmlands and distribution of farm land for different crops.

Besides, weakening of draft power, moisture stresses, untimely rainfall, and crop pests (such as *Yequele Wof*, bush crickets, stock borer), weeds (mainly congress weed, etc) and disease like sorghum chaffer were listed as a major constraints in the crop production system of the area (SC UK, 2004).

Moreover, livestock production is the other vital agricultural activity in the study area. Livestock are considered as the important livelihood assets and used as sources of food, income, draught power, transporting goods. The major livestock reared in the woreda includes cattle, sheep, goats, donkey, camel and poultry.

4.6 Social services of the woreda

4.6.1 Education

According to the woreda education office, in order to achieve universal education to the citizen of the woreda, a number of schools are constructed and a lot of students are attending their education at primary and a secondary levels. There are 60 primary and 4 secondary schools in the woreda. The total number of students enrolled and continued their education is 31,044, of which 16,289 and 14,755 are males and females respectively. The main problems for the expansion of the education sector are school drop outs because of drought, inadequate school furniture, lack of trained high school teachers, lack of books and laboratory equipments.

4.6.2 Health sector

According to the woreda health office, the health coverage of the woreda reaches 100%. In Gubalafto woreda, there are 32 health posts, 4 health centers and 4 cluster health centers. The top diseases of the woreda are tuberculosis, malaria, internal parasitic worms, and diarrhea.

4.6.3 Credit services

In Gubalafto woreda, credit services play pivotal role for the purchase of seed and oxen. The main sources of credit are ACSI, the region food security office and cooperatives. These credit sources give services at different interest rates. For instance, ACSI and commercial bank give services at 12% and 7.5% interest rates respectively. The numbers of beneficiaries of credit services are decreasing year to year. In 1998 and 2000, there were 689 and 291 beneficiaries respectively while in 2001 the beneficiaries are 278 taking a total of 809,000.00 birr.

4.7 Alawuha small-scale irrigation

Alawuha is located about 535km along the way from Addis Ababa to Mekelle town in Gubalafto Woreda of north Wollo administrative zone in Amhara National Regional State (ANRS), north-eastern parts of Ethiopia. The human habitation of the area is defined by the Alawuha river and its tributaries along which all arable land is located, where mainly sorghum, Teff and chick pea are grown under rain-fed conditions, as well as food crops such as Teff and maize as well as cash crops like pepper, onion, sugarcane, tomato and others are grown under irrigated agriculture. Alawuha River is streamed from different tributaries of north Wollo highlands from west and sheds to the east low land plateau which bisects Kobo Woreda to the north and Gubalafto Woreda to the south.

The area has an altitude of 1450 masl, 930mm average annual rain-fall with minimum and maximum temperature of 15°C and 31°C respectively. Alawuha small-scale irrigation was diverted from Alawuha River in 1998 by Sustainable Environmental and Agricultural Rehabilitation for Amhara Region (SEARAR). The scheme has a discharge rate of 720 liters per second and has cemented diversion structure across the river and encompasses primary and secondary canals.

The irrigation water is diverted from the river by the diversion weir and conveyed through the primary canal that extends to the farm land 6 km from the source and divided in to six secondary canals having 1.5 km length each from the primary canal. Finally it is distributed to the farm land from secondary canal to the farm land via tertiary and quaternary earth canals.

According to Gubalafto Woreda Agriculture and Rural Development Office (ARDO) irrigation and drainage case team, the scheme irrigates a total of 296 hectare (ha) farm land for about 1461 households from which 1294 male and 167 female households reside in two kebele's of Gubalafto Woreda; namely Lay-alawuha (Derogiber) and Tach-alawuha (Lastie-gerdo) peasant associations.

The irrigated area is characterized by well-drained loam soil and surrounded by Kobbo and Habru woreda from north, Kiladame Keble from south, Woldia town from west and Hara town from east. The shortest distance of irrigated farm land from the source is 0.5km at Lay-alawuha Keble while the longest distance is 7.5km found at Tach-alawuha Keble. The well-being of rural livelihoods in the study area is endangered by seasonality, drought and moisture stress. To cope with the above mentioned stresses and shocks as well as maximize and protect income, rural households in the study area pursued a number of strategies where irrigation water was one of the most essential inputs, such as: diversification of livelihood activities; reliance on in-kind income and savings; and self-sufficiency in food.

Generally, rain-fall in the study area is unreliable and unable to meet water requirement of the crops, agricultural production is declined from time to time due to moisture stress and frequent drought that leads farmers to live with extreme poverty and vulnerability. Because of these, farmers in the study area have long years of experience in the utilization of different irrigation water technologies ranging from water harvesting to river diversion though most of their water management and utilization is so traditional and inefficient.

5. Result and Discussion

5.1 Extent of household Livelihoods Diversification

Diversity is closely allied to flexibility, resilience and stability. In this sense, diverse livelihood systems are less vulnerable than undiversified ones; they are also likely to prove more sustainable over time precisely because they allow for positive adaptation to changing circumstances (Ellis, 1999). In this study, sampled households are categorized as first, second, third and fourth income quartiles in terms of their score of livelihood diversification indices.

According to the survey result, more households (30.1%) are grouped under less diversified (first quartile) income group where as lower proportion of sample households (22.1%) fall under better diversified (fourth quartile) income group from the total sample households. Meanwhile, equal proportion of households are grouped under the second and third income quartile, each constitutes 23.9%.

Besides, the livelihood diversification index estimation indicates that quartile one score the lowest index value (1.0831) and become the poorest quarter in terms of extent of livelihood diversification (i.e. in terms of total amount of income and number of income sources) while quartile four score the highest index value (4.5896) and is the richest cohort. This implies household income and income sources are more diversified as we go from the bottom (first) quartile to the top (fourth) quartile.

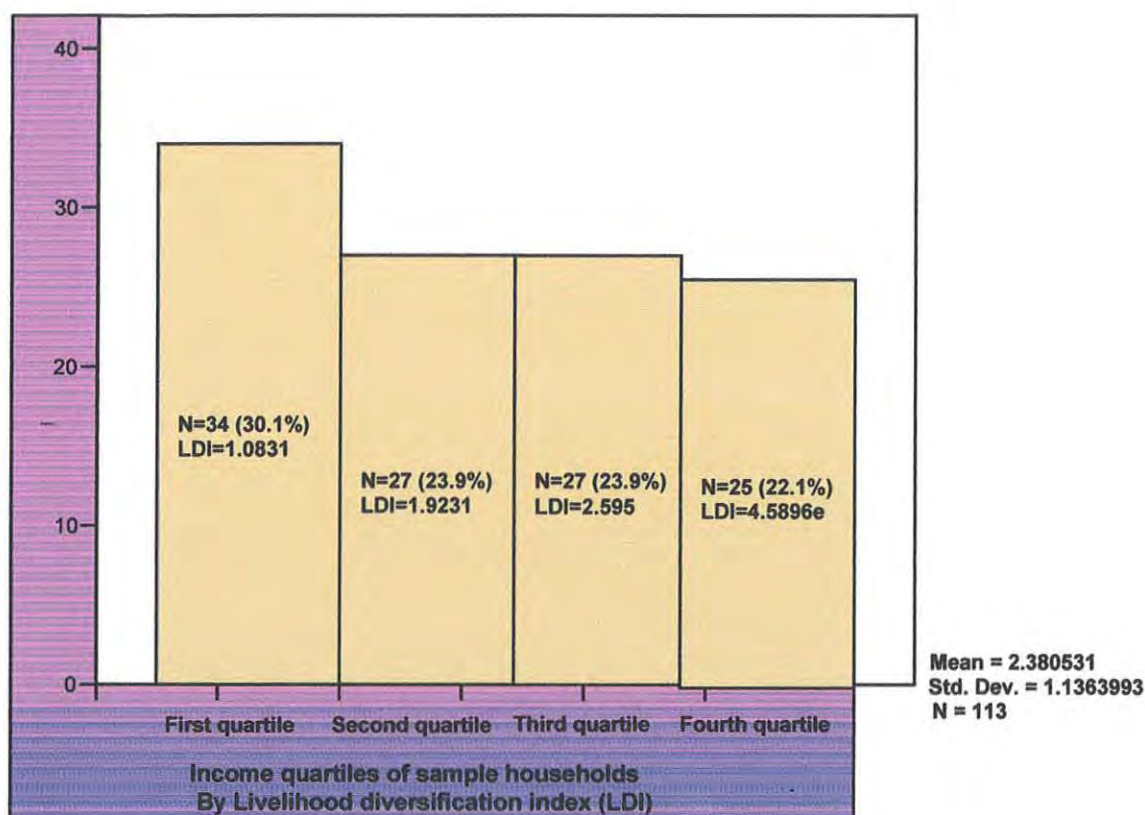


Figure 2. Bar chart for Income quartiles of the sample households

Source: Own Survey, 2009.

On the other hand, on-farm, migration, employment, non-farm and off-farm activities were the major livelihood diversification activities of sample households with proportional income shares of 58.14%, 18.97%, 9.44%, 8.20% and 5.26% respectively. As shown in the table 1, on-farm activities are the dominant livelihood strategies of the study area where its income share ranks first in each income quartile.

However, the shares of each income sources vary across income groups. The level and the type of income diversification strategy may depend on the access to and availability of different income generating activities, which may in turn depend on a household's geographic location, access to factor markets, human and social capital, and recurring policy changes (Ersado, 2006). The share of income

from each income sources across the income ranges in all income Quartiles is indicated in Table 1.

Table 1 Compositions of Sample household income share %age

Income sources	Income quartile				Total
	I	II	III	IV	
	N=29 (24.8%)	N=26 (23%)	N=31 (23.0%)	N=27 (24.8%)	N=113 (100%)
Rain-fed agriculture/crop	0	21.5	15.4	22.2	18.6
Irrigated agriculture/crop	1.80	20.6	29.6	27.4	25.1
Livestock	28.7	12.9	11.8	16.8	14.5
Sub-total On-farm	30.5	55.1	56.8	66.4	58.1
Off-farm	3.56	1.22	8.55	5.43	5.26
Non-farm	35.6	7.82	5.66	7.66	8.19
Local migration	0.00	0.00	0.00	0.671	0.212
Remittance	21.4	29.9	18.9	8.22	18.8
Sub-total migration	21.4	29.9	18.9	8.89	18.9
Safety-net	8.55	6.02	9.47	11.7	9.19
Non-farm employment	0.427	0.00	0.634	0.00	0.244
Sub-total employment	8.97	6.02	10.1	11.7	9.44
Total	100	100	100	100	100

Source: Own survey, 2009

The first income quartile implies less diversified while the fourth quartile implies more diversified. However, for this study those households who lie on the first and second quartiles are considered to be less diversified (n=61) and those who lie on the third and fourth quartiles are more diversified households (n=52) simply for ease of explanation to extent of household livelihood diversification. The former makes 54% while the later 46% of the total sample households respectively.

Furthermore, a close look at the quartile groups enables one to identify the following common features between the 1st category of less diversified (Quartiles I and II) and 2nd category of diversified (Quartiles III and IV): First, share of income from on-farm, off-farm and employment livelihood activities for the 1st category showed relatively less percentage share as compared to 2nd category. Second, income shares from migration and non-farm activities have a higher share for the total income in the 1st category than in the 2nd category.

Hence, a detail description for the reasons and justifications of each income source, on the bases of their demographic, social, and physical and farm characteristics of sampled households towards the two income groups will be presented in the subsequent sections.

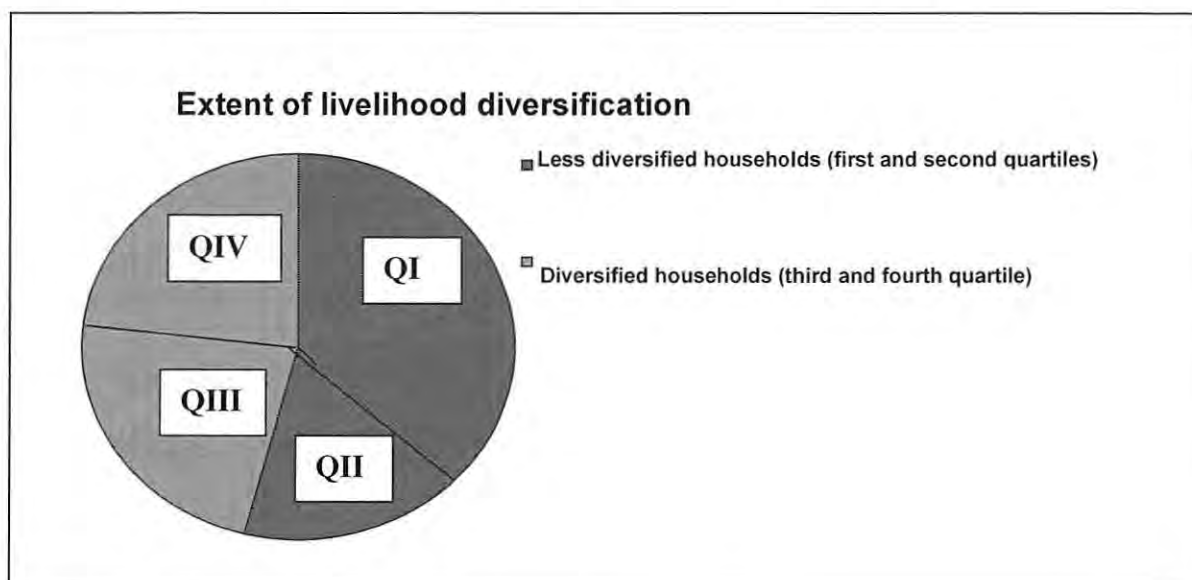


Figure 3. Pie chart representation of the income quartile groups

Source: Own Survey, 2009.

5.2 Demographic, Socio-economic and Farm Characteristics

There are a number of distinctive household characteristics that determine the extent of livelihood diversification in rural households. This section presents the basic characteristics of sample households and their access and contribution to household livelihood diversification in Alawuha area. Consequently, different demographic, socioeconomic, biophysical characteristics of the sample households along with their access to credit and extension services (institutional) versus the extent of livelihood diversification are discussed as follows.

5.2.1 Demographic Characteristics

5.2.1.1. Sex, Marital status and Religion

The majority of the sample household (75.2%) were male headed households while the remaining 24.8% of the respondents were female headed households (Table 2). In the study area like other northern parts of Ethiopia, agriculture is the basis for rural livelihoods and most households are engaged in on-farm activities. However, there are cultural barriers towards access to and participation of women in productive assets and decision making processes as compared to men.

Thus, the result of livelihood diversification index by the sex of the household head indicated that among all households who diversified their sources of income 71.2% belong to male headed households while the remaining 28.8% were female headed. On the other hand, among all non diversified households 79.6% were male- headed, while the remaining 20.4% were female-headed households. Besides, percentage figures for female headed households reveal larger tendency to diversify (28.8%) their source of income than less diversified groups (i.e. 20.4%). But, the chi square test showed no significant association between household head sex and extent of livelihood diversification.

Regarding the marital status of the households, about 66.4% of sample households were married while 7.1%, 19.5% and 7.1% were unmarried, divorced and widowed respectively, (Table 2). According to the survey result and the chi-square statistics, marital status of the sample households showed no significant systematic association with the extent of livelihood diversification.

Concerning the religion of the household, survey result showed 61.1% and 38.9% were Christian and Muslim respectively. While livelihoods do not greatly vary between the two religious groups, one important difference is the tendency for the Muslim households to have a close relative working in the Middle East countries such as Saudi Arabia, Dubai...Such a persons sends remittances on a regular basis. Moreover, during disasters they send significant sums of money to help out their family in the area.

Besides, Muslim households are recognized for their more number of working days in the given month and they are more likely to engage in on-farm and off-farm activities. In parallel traditionally engage in non-farm activities such as petty trading. So, household's religion was expected to associate with extent of livelihood diversification.

The result of this study confirmed unlike the Christian households, greater proportion (44.1%) of Muslim households fall under the diversified households' category than to be less diversify (33.3%), (Table 2).

Table 2 Summary of sex, religion and marital status of Sample households

	Extent of Livelihood diversification						χ^2 Statistics
	Diversified		Less Diversified		Total		
	N	%	N	%	N	%	
Sex of the household head							1.078 ns
Male	42	71.2	43	79.6	85	75.2	
Female	17	28.8	11	20.4	28	24.8	
Religion of the household head							1.366 ns
Muslim	26	44.1	18	33.3	44	38.9	
Christian	33	55.9	36	66.7	69	61.1	
Marital Status of household head							2.586 ns
Married	36	61.0	39	72.2	75	66.4	
Unmarried	6	10.2	2	3.7	8	7.1	
Divorced	12	20.3	10	18.5	22	19.5	
Widowed	5	8.5	3	5.6	8	7.1	

Source: Own survey, 2009

Note: ns: Not Significant

However, similar to the sex of household heads, there is no significant systematic association between religion affiliations of household heads with the extent of livelihood diversification.

Table 3 Summary for Social status of Sample households

	Extent of Livelihood diversification						χ^2 Statistics
	Diversified		Less Diversified		Total		
	N	%	N	%	N	%	
What is your social status in the community?							
Religious leader	6	5.3	3	2.7	9	8.0	10.385**
Cabinet member	0	0	3	2.7	3	2.7	
Ordinary resident	36	31.9	41	36.3	77	68.1	
Model farmers	17	15.0	6	5.3	23	20.4	
Other	0	0	1	.9	1	.9	

Source: Own survey, 2009

Note: ** Significant at 5%

Concerning social status of households' showed a significant systematic association with the extent of households' livelihood diversification (i.e. at 5 % of significant level), (Table 3). This implies that household participation in social and political affairs of the community granted farmers with an opportunity to access reliable information, resources (credit) about different livelihood strategies, which as a result enabled them to better engage in different income generating activities.

5.2.1.2. Educational Status and Household size

The survey result showed that, 48.7% of the sample household heads were literate, while 51.3% were illiterate. The result also indicated that households that diversified (25.7 %) their income sources are more literate than less diversified households (23%). However, chi-square result revealed no systematic association between educational status and extent of livelihood diversification of the sampled household heads, (See Table 4).

Empirical studies show that educational attainment of household head is strong determinant of diversification (Barrett, et al., 2001a cited in Ersado, 2006). Degefa 2005, on his turn also shows that education status of household heads and household livelihoods have a direct linkage.

Educated farmers are able to use modern agricultural technologies, perform farming activities based on cropping calendar and manage resources properly and thus generally be less vulnerable to shocks and risks. All these factors induce farmers to diversify their income sources and design different livelihood strategies. However, the argument here does not totally disregard the importance of indigenous knowledge and life time experience in the livelihood system.

With longer farming experience, wide knowledge, skills, and attitudes are gained on the operation and conduct of agricultural activities and methods of production. The farming system of the rural area in general is characterized by its complex, diverse and risk averse strategies.

So, farmers with longer experience are more decisive and critical in calculating risks. It is likely that farmers with longer farming experience will be ready to take appropriate measures for diversifying their livelihood and income sources. In this regard, farm experience refers to the number of years the household involved in farming as a means of living.

Thus, the survey result disclosed the mean years of farm experience are 30, 32 and 28 for total sampled household heads, diversified and less diversified groups respectively. The mean years of experience for diversified households was higher than that of less diversified households, (Table 4). However, the t-statistics result revealed that there is no significant mean difference between the two groups of households in average year of farm experience.

According to the survey result, the mean size of the sample households was 5.03 persons which are above the national average family size of 4.9 persons per household (CSA, 2007).

Table 4 Summary of education, farm experience and Household Size of Sample households

	Extent of Livelihood diversification						χ^2 Statistics
	Diversified		Less Diversified		Total		
	N	%	N	%	N	%	
Educational status by category							
Illiterate	30	26.5	28	24.8	58	51.3	0.011 ns
Literate	29	25.7	26	23.0	55	48.7	
Educational status							
Illiterate	31	27.4	28	24.8	59	52.2	3.963 ns
Read and Write	22	19.5	16	14.2	38	33.6	
Primary Education	6	5.3	7	6.2	13	11.5	
Secondary Education	0	0	3	2.7	3	2.7	
	Mean	SD	Mean	SD	Mean	SD	t-statistics
Farm experience	32.10	12.14	28.37	12.58	30.41	12.42	1.566 ns
Household Size	5.19	2.15	4.87	2.11	5.04	2.13	0.787 ns

Source: Own survey, 2009

Note: ns: Not Significant

The mean household size of diversified and less diversified was 5.18 and 4.87 persons with standard deviation of 2.15 and 2.11 persons, respectively, (Table 4). There exists a slight difference in mean household size of the two categories of households as the former category has a relatively larger mean size of households than the later. Nevertheless, the t-test result showed that there is no significant mean difference in the mean household sizes between the two groups.

5.2.2 Socio-economic and Farm characteristics

5.2.2.1. Size of Farm land

The study result revealed the mean owned farm land size for the total sample households is 1.23 hectare with standard deviation of 0.77 hectare. It also showed that the mean owned land size holding for diversified and less diversified households is 1.13 and 1.33 hectares with standard deviation of 0.48 and 0.99 hectare respectively. The t-test for two groups showed no significant mean difference between two groups of households. This was also observed in all types of lands tenures arrangements namely share-in land and shared-out land, (Table 5).

Cultivated land is used for production of crop for purposes of both consumption and sale; which has direct relationship in increasing production and income. However, farmers in the focus group discussion agreed that land is very scarce and getting scarcer from reasons of population increase and the enormous impact of land degradation. Thus, this problem further worsens the situation, coupled with the recurrent drought and moisture stress in the area. In the study area agricultural activity mainly depends on rainfall.

Table 5 Summary of Farmland characteristics of sample households

	Extent of Livelihood						t- Statistics
	Diversification						
	Diversified		Less Diversified		Total		
	Mean	SD	Mean	SD	M	SD	
Size of owned land	1.13	0.48	1.33	0.99	1.23	0.77	-1.356 ns
Size of share-in land	0.96	0.65	0.98	0.62	0.97	0.63	-.122 ns
Size of share-out land	0.81	0.44	0.81	0.17	0.81	0.35	-.038 ns
Total Size of rain fed land	1.36	0.74	1.60	1.93	1.47	1.44	-.879 ns
Total Size of irrigable land	0.44	0.31	0.30	0.20	0.38	0.27	2.628*

Source: Own survey, 2009

Note: * Significant at 10 %, ns- Not Significant

As the survey result disclosed, sample households in the study area have both rain-fed and irrigated lands; but the sizes of land for diversified households cultivated under rain-fed is larger than land under irrigation; with an average of 1.47 ha and 0.38 ha respectively. This shows that irrigable lands are scarce in the area. It is expected that households enjoy the maximum benefit of irrigation with larger sizes of irrigated land. As it can be seen from the Table 5, the result showed that farm land area coverage under irrigable land for the diversified households was greater than the less diversified ones. Besides, there is a significant mean difference (i.e.10% significant level) on the size of irrigable land between the two groups. This implies that access to irrigation has a significant role for household livelihood diversification in the study area.

However, the size of irrigated land owned by the sample households alone may not clearly indicate the effect on extent of livelihood diversification. Thus, this calls for further assessment on basis of utilization in-terms of type of crop production and amount of income.



Figure 3 Irrigated farm land in the study area

In sum, land itself is not a determinant of livelihood diversification in Alawuha area; rather, the ability to maximize production is a much more critical factor that distinguishes households within the community in the study area. Farmers can produce cash crops in their irrigated land; they are able to irrigate their cereal crops in dry years so benefit from good production when prices are higher. Moreover, they are likely to have productive livestock which benefit from the higher moisture content of crop residue and better grazing.

5.2.2.2. Livestock Ownership

In the study area, next to crop production, livestock makes momentous bestowal to the livelihoods of farmers and considered as a source of self-reliance against income shocks. Livestock are generally kept in Gubalafto Woreda include cattle, goats, sheep, donkeys and

mules. Bees and poultry are also other enterprises practiced very widely in the area. Livestock are maintained in the study area for draught power, milk, meat, egg, and mainly for market purposes. They are also considered as a productive asset for the household.

Moreover, diversification of livestock holding is the prime strategy in all the cases where farmers traditionally practice to minimize the risk of vulnerability to recurrent drought that occurs in the study area. Keeping various herd structure at a time, serves as a good buffering strategy to cope with crop failure that occurs very repeatedly in the area.

Table 6 Livestock ownership by sampled household farmers

Livestock ownership in TLU	Extent of Livelihood diversification				t-statistics
	Diversified		Less Diversified		
	Mean	S.D	Mean	S.D	
Camel	0.27	0.67	0.39	0.92	-0.784 ns
Oxen	1.03	0.72	1.09	0.73	-0.417 ns
Cows	0.64	0.74	0.70	0.73	-0.428 ns
Heifers	0.43	0.58	0.39	0.59	0.347 ns
Bull	0.24	0.46	0.29	0.42	-0.575 ns
Calves	0.40	0.70	0.52	0.80	-0.817 ns
Goats	0.19	0.33	0.24	0.47	-0.558 ns
Sheep	0.04	0.13	0.05	0.23	-0.219 ns
Donkeys	0.36	0.35	0.30	0.34	0.915 ns
Mules	0.04	0.23	0.03	0.15	0.297 ns
Total	3.65	3.29	3.98	3.21	-0.551ns

Source: Own survey, 2009

Note: ns: Not Significant

Woreda report 2008, indicated that there are on average 2.7 cattle per household and 2.3 shoats; but the survey result of this study suggests they are higher in number. However, the mean herd size in Tropical livestock Unit (TLU) (Annex 1) for the less diversified households (i.e. 3.98) was slightly greater than that of the diversified households (i.e. 3.06) and the independent sample t-test for the mean difference showed no significant difference between the two groups, (Table 6).

Unlike the herd sizes of the two income groups, mean of total household income from the sell of livestock for the diversified group (970.00 birr) is greater than the less diversified group (548.89 birr). Hence, economic value of livestock ownership is more exhibited among the diversified group of households, (Table 7). The t-test for their mean difference showed no significant difference between the two groups.

Table 7 Income from sell of livestock by sampled household farmers

Income category	Extent of Livelihood diversification				Total		t-Statistics
	Diversified		Less Diversified				
	Mean	SD	Mean	SD	Mean	SD	
Sell of Livestock	970.12	1658.68	548.89	1510.90	768.82	1596.77	-1.407ns
Sell of Livestock by products	16.81	42.23	16.41	58.41	16.62	50.38	-0.043ns

Source: Own survey, 2009

Note: ns: Not Significant

5.2.2.3. Labor availability

In the study area, labor is an important resource in the farming community. Agricultural based rural households mainly depend on family labor for their different livelihood activities. More labor force implies the potential of a given household to be involved in different income generating activities and in turn diversify its livelihood from income sources.

Table 8 shows, the mean total labor in ME (see annex II) of the sample households was found to be 2.73 with standard deviation of 1.29. The mean value of labor for diversified and less diversified households was 2.77 and 2.68 with standard deviation of 1.28 and 1.3 respectively. The result indicates that households group that diversified their livelihoods has relatively more family labor than the less diversified ones. As indicated in Table 8 for the analysis carried out however, the t-test showed no significant mean difference between the two groups.

Therefore, further investigation with regard to the ratio of labour to land in order to assess the available excess labor force in the household that can be economically utilized in diverse activities to generate income is important to uncover its influence on livelihood diversification.

Table 8 Total Household Labor by sampled household

	Diversified		Less Diversified		Total		t-statistics
	Mean	SD	Mean	SD	Mean	SD	
Total Labor	2.77	1.28	2.68	1.30	2.73	1.29	0.354 ns

Source: Own survey, 2009

Note: ns: Not Significant

5.2.2.4 Total Income Sources of Households

Depending on the mix of different livelihood activities and the extent to which the activities contribute to the household total income, households have been grouped into diversified and less diversified households. The analysis was described in terms of livelihood activities and the income share each livelihood activity contributes.

As it is common in the other part of the rural highlands of Ethiopia, the majority of the household in the study area make their livelihoods from crop and livestock production. It was observed that one or more members of the households engage in other livelihood activities other than on-farm activities (i.e. Off-farm, Migration, employment and Non-farm activities).

Table 9 Annual Mean incomes of the sample households

Type of Household Income sources	Diversified		Less Diversified		Total		t-statistics
	Mean(in Birr)	SD	Mean (in Birr)	SD	Mean (in Birr)	SD	
On-farm	4271.70	4838.62	2073.07	3089.74	3221.03	4225.95	2.849***
Off-farm	493.22	959.44	57.59	171.45	285.04	733.75	3.288***
Non-farm	460.00	853.26	427.03	1225.36	444.25	1043.00	0.167ns
Migration	986.44	3306.13	1074.07	4279.62	1028.32	3785.42	-0.122ns
Employment	754.74	989.14	246.66	988.69	511.95	1016.98	2.728***
Total	6966.11	6454.46	3878.44	6143.11	5490.59	6467.77	2.599***

Source: Own survey, 2009

Note: *** Significant at 1%, ns: Not Significant

As far as this study is concerned, livelihood activities that are sources of household income in the study area can be classified into five main groups. This includes; income from on-farm activities (Rain-fed and irrigated food and cash crop production, sales of livestock and livestock products), income from off-farm activities, income from non-farm activities, income from migration (local migration and remittance) and income from employment sources (safety net and other employment), (Table9).

Total annual income of the sample households was range from 120 to 41, 630 birr with mean annual income of 5490.59 birr and standard deviation of 6467.77 birr during the survey year. While the annual mean income of diversified households was found 6966.11 birr with standard deviation of 6454.46 birr.

This was greater almost by two folds than the less diversified households mean annual income which was found to be 3878.44 birr with standard deviations of 6143.11 birr. Besides, the result of the t-test revealed that there is a significant mean difference on the amount of annual mean income earned between the two household groups at 1% significant level.

Further analysis on the mean difference between the two household groups with regard to major sources of income in the households showed that there is a significant mean difference on the amount of mean income generated from livelihood activities of on farm, off-farm and employment at 1% significance level. It was observed from the survey result that on-farm activities are the most important source of income in the study area for both groups followed by activities of migration and employment.

The study confirms the findings of Adi (2005), in his study on determinants of agricultural and non-agricultural Livelihood strategies in rural communities by taking evidence from eastern Nigeria. He pointed out that despite high incidence of diversification in eastern Nigeria; agriculture is not in any significant decline. This is against the backdrop of the recent de-agrarianization thesis (agriculture skeptic) as they more likely to see diversification as responding to the failure of agriculture.

Hence, livelihood diversification is mainly based on farm activity in the study area but off-farm, non-farm and migration income sources are also contribute to livelihood diversification. Moreover, detail scrutiny on each income generating activities by households in the study area is presented as follows:

On-farm income sources: - In this livelihood activity, crop production and livestock rearing are considered as the major source of income for majority of the household. Sales of crop, livestock and livestock products were found to be an essential practice undertaken by the majority of households to generate income. According to the focus group participants' response, food crops constituted the largest share of crop production while cash crops (vegetables, fruits and perennial crops) have limited shares.

Moreover, as detailed investigations proceed for such differences showed that, crop production is highly related to households' production pattern through rain-fed and/or irrigation use. Hence, in later sections detailed assessment on the contribution of irrigation to household income diversification is dealt.

Conversely, as similar to other parts of north eastern Ethiopia, the study area is prone to recurrent drought induced famine and food insecurity became a common phenomenon. Thus, sole reliance on crop and livestock production as a major income source has become a risky business. To make up for shortfalls, rural household heads in the study area are engaged in multitude of livelihood activities apart from on-farm activities to diversify alternative income sources.



Figure 4 Sugarcane production as on-farm income source

Migration Income Source: - It is one of the most important rural livelihood strategies. People move from place to place in search of employment and income to improve their living standard. Households in the study area perform migration ranges from local to abroad areas in order to improve their livelihood by earning more income.

The survey result illustrated that about 22.1% and 9.7% of respondents of diversified and less diversified households respectively reported migration to other areas as one important livelihood activity to earn income and improve their wellbeing, (Table 10). Temporal migration to other places in search of jobs as a daily laborer is a common phenomenon practiced among farmers of the Woreda. Labour migration from January to March is usually got to its peak.

The shortest destination for most seasonal migrants is inside the Woreda, mostly Woldia town but sometimes it can reach to Raya-Kobo and Afar Region. Besides, according to participants of FGD, households with better income sources particularly those of Muslim send their daughters or family members to Middle East countries, which in turn made them to benefit from a remittance income source. One man participant reported during FGD that he received ETB 2,000 when he lost his oxen in a landslide.

Off-farm income sources: In the study area, the most common off-farm activities are sale of fodder (particularly maize and sugar cane by-products), sale of eucalyptus tree, sale of fuel wood (stalk of sorghum, charcoal, fire wood), rent out draft power and pack animals. Key informants and focus group discussants indicated that these activities generate limited amount of household income and the survey result on household income amount also confirms the share of off-farm income source is the lowest as compared to other income sources, (Table 10). According to the survey result, out of the total sample household heads, only 27.4% reported involvement in off farm income generating activities. Besides, the survey result disclosed that diversified households (20.4%) were found to engage in off-farm activities than less diversified (7.10%) households, which clearly showed the role of off farm activities to livelihood diversification.

Moreover, crop residues particularly from maize and sugarcane are the most palatable and important sources of food for animals for this reason they are very expensive and farmers tend to sell at higher price to earn better income. Marketable items such as onion, sugarcane, pepper, and others are practiced mainly brought from small-holder farmers, and transported either by vehicle or donkey back to the market center mainly at Woldia and Hara towns in order to make a margin of profit. In return, items such as sugar, coffee, soap, salt, tobacco, and others are bought from wholesalers in Woldia and sold to rural households at village level in the smallest unit possible.

Thus, off-farm activities are used also as a coping strategy during times of drought, but the income sources that can be tapped are likely to be low in return in the area. The result of the chi-square analysis confirmed the existence of significant systematic association (at 5% significance level) b/n involvement in off-farm activity and their extent of livelihood diversification (Table 10).

Table 10 Involvement of the sample household head in off-farm and non-farm activity

	Extent of Livelihood diversification						χ^2 Statistics
	Diversified		Less Diversified		Total		
	N	%	N	%	N	%	
Involvement on off-farm activities							8.273**
No	36	31.9	46	40.7	82	72.6	
Yes	23	20.4	8	7.1	31	27.4	
Involvement in non farm activity							3.207*
No	42	37.2	46	40.7	88	77.9	
Yes	17	15.0	8	7.1	25	22.1	
Involvement in migration activity							6.287**
No	34	30.1	43	38.1	77	68.1	
Yes	25	22.1	11	9.7	36	31.9	

Source: Own survey, 2009

Note: ** Significant at 5%,* Significant at 10%

Non Farm income sources: - Ellis (1998 and 2000), suggested nowadays non-farm activities are becoming the important sources of income and food security for many rural people in many developing countries. Diversification into non-farm income sources is growing over time and now accounts for a considerable share of household income. Many studies in rural Africa revealed the positive association between non-farm diversification and household welfare. Non farm income refers to non-agricultural income sources. It includes income that arises from out side of agriculture sector. In the study area like that of off-farm income sources this sector of livelihood activities are not developed.

The survey result showed that commodity trade, wholesale or retail of fruit and vegetables, carpentry; food processing, embroidery, hair dressing, handcraft and blacksmith are the most common sources of income on this regard. As it is indicated in above Table 10, only (22.1%) from the total households engage in non-farm income activities. Like the case on off-farm income activities the diversified households (15%) in the study have better involvement in the non-farm income generating activities than the less diversified households at (7.1%).

The chi-square result showed that there is a systematic association at 10% significance level between households' engagement on non-farm activities and extent of livelihood diversification. The scope of utilizing these activities to diversify household income sources appears to be limited as access to institutional services like credit are tied to on-farm activities and require collateral as prerequisite.

Employment Income Source: This livelihood activity represents the amount of income earned in cash or in kind, during the year through employment that includes Safety net and other farm

and non-farm employment opportunities (day laborers) in near by cities particularly Woldia and Hara towns. As it is indicated in the above Table 9, the total annual income from Employment of the sample households was found 511.95 birr with standard deviation of 1016.98 birr. From this the lion share is obtained from safety net program, which will be disused in the later section. Meanwhile, the annual mean income earned from employment for diversified households was (754.74 birr). This amount is greater than the less diversified group which was only (246.66 birr). Besides, the result of the t-test revealed that there is a significant mean difference on the amount of annual mean income earned from employment between the households groups. This shows diversified household groups have the ability to increase income earning activities.

5.3 Households' access to different services

5.3.1. Access to Extension service

In a country such as Ethiopia, where the majority of the farmers are illiterate, agricultural extension plays a significant role in assisting farmers to identify and analyze their production problems, raise awareness and seize opportunities to make informed decisions. Hence, the effectiveness of the various production inputs partly rely upon the availability of sound agricultural extension services at community levels. The Woreda Agricultural and Rural Development Office (WARDO) is the sole organization providing the service of agricultural extension to farmers in the area.

Two to three development agents are assigned at each Farmers Training Center (FTC) of each *kebeles* to give trainings, technical support and advice in areas of crop and livestock production and natural resource management. Thus, all these efforts add up to attain increased agricultural

(on-farm) productivity that will in effect results better livelihood diversification status among the rural households and encourage farm households to take informed decisions to involve in other income generating activities.

Table 11 Summary of Institutional characteristics of sample households

	Diversified		Less Diversified		Total		X ² Statistics
	N	%	N	%	N	%	
Have you received any type services from FTC?							
Yes, I have	18	15.9	19	16.8	37	32.7	0.280ns
No, I haven't	41	36.3	35	31.0	76	67.3	
Have you received irrigation related training?							
Received	18	15.9	15	13.3	33	29.2	0.102ns
Not received	41	36.3	39	34.5	80	70.8	
Do DAs visit provide technical support for you in the last 12 months?							
Yes	55	48.7	41	36.3	96	85.0	6.598***
No	4	3.5	13	11.5	17	15.0	
Have you got any benefit from the DA's visit?							
Yes, I have	40	35.4	28	24.8	68	60.2	2.991*
No, I haven't	19	16.8	26	23.0	45	39.8	
Have you participated in safety net program?							
Yes, I have	28	24.8	8	7.1	36	31.9	13.839***
No, I haven't	31	27.4	46	40.7	77	68.1	
Have you participated in irrigation training?							
Yes, I have	8	7.1	15	13.3	23	20.4	3.516*
No, I haven't	51	45.1	39	34.5	90	79.6	
Have you got benefit from irrigation training?							
Yes, I have	7	6.2	15	13.3	22	19.5	4.554**
No, I haven't	52	46.0	39	34.5	91	80.5	
Are you member of water use association?							
Yes	14	12.4	11	9.7	25	22.1	0.185ns
No	45	39.8	43	38.1	88	77.9	
Have you received formal credit during the last 12 months?							
Yes, I have	27	23.9	14	12.4	41	36.3	4.799**
No, I haven't	40	35.4	32	28.3	72	63.7	
What was the purpose of credit?							
Livestock rearing	18	43.9	6	14.6	24	58.5	14.070**
Local trade	4	9.8	0	.0	4	9.8	
Purchase of agricultural input	1	2.4	0	0	1	2.4	
Rearing and local trade	2	4.9	0	0	2	4.9	
Local trade and input purchase	0	0	1	2.4	1	2.4	
Oxen purchase	2	4.9	7	17.1	9	22.0	

Source: Own survey, 2009

Note; NS- not significant, * Significant at 1%, ** Significant at 5%,* Significant at 10%**

As indicated in the Table 11, about 85.0% of the sample households responded that they have had visits by development agents. Out of this 48.7% diversified households and 42.5% of less diversified households indicated to have been visited by Development Agents. The chi-square test result showed that there is significant systematic association between households visit by the development agents and the extent of livelihood diversification at 1% significance level.

In the study area, the FGD participants indicated their sources of information were Development Agents, relatives and neighbors, community leaders and NGOs in order of their importance. But, most farm households complained about the inconsistency of Development Agents visit, training sessions, input deliveries, etc.



Figure 5 Community maintenance work at irrigation canal

5.3.2. Participation in Productive Safety Net program (PSNP)

Productive Safety Net Program (PSNP) is a major program designed to address the basic food needs of food insecure households. The objectives of the program are to provide food transfers to the food insecure population in selected chronically food insecure Woreda in a way that prevent asset depletion at the household level and creates asset at the community level (PSNP, 2006). To this effect, *Gubalafto* is one of the chronically food insecure Woredas in the Amhara National Regional State and targeted farmers have been participating in the Productive Safety Net Program since 2004/05.

The study results showed that 31.9% of sample households from the total sample households have participated in the Productive Safety Net Program during the past three consecutive years. Moreover, more than 24.8% of diversified and 7.1% less diversified households has been involved in the Productive Safety Net Program (See Table 11). As can be seen from the result, larger proportions of diversified group are involved in the Productive Safety Net Program, as participation in the program became another income source and enhanced households' income. Thus, the result proves its positive contribution towards household livelihood diversification.

Besides, most of the safety-net program has been emphasize on irrigation related works like canal maintenance, flood control, earth canal construction, etc. Hence, the chi-square analysis showed systematic association between participation in the productive safety net program and extent of livelihood diversification of sample households at 1 % significance level.

5.3.3. Access to Credit Service

Credit is one of the productive resources to fulfill financial requirement. In the study area both formal and informal sources provide credit services. The major sources of credits in the area include Amhara Saving and Credit Institute (ACSI) and Agricultural Cooperatives. The credit services are for purposes of purchase of oxen, goats and bee hives and in some cases, small-scale petty trade. Thus, it was assumed that households who have access to credit services can improve households' income through undertaking different livelihood activities. However, as indicated in Table 11, it was found that less than half of the sample household heads (36.3%) reported that received credit service in the 2008/09 production year.

Moreover, involvement in credit scheme between the two groups illustrate that of (23.9%) diversified households were involved in the credit scheme as compared to the less diversified households only at (12.4%). The results of chi-square test showed that there exist a systematic association between households' access to credit service and extent of livelihood diversification. Besides, participants in the FGD mentioned the need for collateral, repayment schedule and the absence of risk allowance issues of the credit scheme as the major constraints.

5.3.4. Access to Market centers

Proximity to market center creates access to additional income by providing off-farm/non-farm income generation opportunities, readily access to farm inputs and better prices for agricultural outputs. Consequently, access to markets results in better income to households. It was, therefore, expected that households closer to market centers have better chances to diversify their livelihood. Access to markets in this study is measured by households distance to the nearest market center in hours.

Table 12 Distance of the market center (in hours) for the sampled households

	Diversified		Less Diversified		Total		t-statistics
	Mean	SD	Mean	SD	Mean	SD	
How long is your place of residence from Wolldiya market							-1.993**
	1.98	0.630	2.25	0.75	2.10	0.70	

Source: Own survey, 2009

Note: ** Significant at 5 %

Table 12 shows the results of the two groups in relation to the effect of market distance on extent of livelihood diversification. The mean difference was significant at 5 %. Moreover, the mean distance of less diversified households from local market is considerably greater (2.25 hour) as compared to diversified households of (1.9 hour). This result is in line with the assumption stated above.

5.4 Irrigation and Livelihood diversification

The major livelihood activities in the study area are related to the irrigated agriculture. Irrigation is direct input for Food and cash crops production as well as fodder production. It has also an in-direct role for seasonal off-farm and non-farm income generation opportunities. As it was learnt in the FGD, the few off-farm and non-farm activities include carpentry, petty trading, retail of fruits and vegetables in shops, baking and selling bread or engagement as daily labour in irrigated agriculture as the activity demands more labour. Hence, in the following section, the contribution of irrigation towards livelihood diversification and the major constraints in the use of irrigation are discussed in detail.

5.4.1 Contribution of Irrigation for livelihood diversification

In a considerable number of cases, rural poverty is caused by worsening access to irrigation water. Irrigation water is an asset and its availability increases or reduces household capacity to produce income in combination with other assets. It largely contributes to food security of the rural population (Seleshi et. al, 2007).

Apart from irrigated agriculture, almost every non-farming livelihood activity of the rural poor needs water (Ellis, 2000). Irrigation contribution in the area is highly related with the agricultural production pattern of the farm households in the area. Thus, detailed discussion on the role of irrigation to agricultural diversification (i.e. Crop production and Livestock production) is presented as follow.



Figure 6 Alawuha irrigation primary canal

5.4.1.1 Irrigation use and Crop production

Irrigation is a means by which agricultural production can be increased through intensification of crops and improve households income through diversifying crops from low to high value crops. In this regard, as discussed earlier in the description of the study area section, farm households in the area have a long dated experience of growing crop for various purposes. The major contributions of irrigation towards livelihood diversification are pronounced on crop production through diversification and intensification. Before directly embarking on detail description of the topic, first let's have a close look at the crop production pattern of sample households.

Food grain production

As mentioned earlier Sorghum, *teff*, chickpea and maize are the dominant food grain crops produced in the study area. Among these sorghum, *teff* and maize are major source of foods /staple food/ for most households. For the total sample households, the sizes of land cultivated under rain-fed for the production of food grains is larger than land under irrigation. For instance, in diversified households average land size for food grain production under rain-fed and irrigation is 1.374 ha and 0.478 ha respectively. This indicates larger tendency of food grains cultivation under rain-fed condition.

Table 13 also shows that average land size under irrigation for food grain crops is 0.308 ha for less diversified households while diversified households utilized 0.478 ha of land for the same purpose. This might relate to larger total land size under irrigation for diversified households. With regards to food grain production, there is significant mean difference of total land size under irrigation between less diversified and diversified households. This contributes to the fact that households with access to irrigation, creates the opportunity to produce crops more than once in a year which as a result increases amount produced and the income earned in a unit area.

In the study area, *Teff* and maize are grown under conditions of both rain-fed and irrigation which can be considered as the important crops for future intervention. These two crops have attributes of high market value and productivity. The t-test shows that there is a significant mean difference in land sizes under irrigation for food grains under irrigation (*Teff* and maize) between less diversified and diversified households is significant at 5% and 10% level respectively.

Table 13 Area Cultivated under Rain-fed and Irrigated Agriculture

Average grain food crop land holding in ha	Extent of livelihood diversification				t-Statistics
	Less diversified		Diversified		
	Mean	SD	Mean	SD	
Under Rain-fed					
Sorghum	0.740	0.903	0.623	0.417	0.883 ns
Teff	0.791	0.701	0.747	0.430	0.401 ns
Chickpea	0.026	0.168	0.004	0.033	0.953 ns
Total	1.557	1.486	1.374	0.677	0.839 ns
Under Irrigation					
Teff	0.112	0.156	0.225	0.262	-2.797**
Maize	0.196	0.163	0.253	0.208	-1.625*
Total	0.308	0.267	0.478	0.394	-2.693**

Source: Own Survey, 2009

Note: *, ** Significant at 10% and 5% level, ns-Not significant

Particularly, *Teff* is the only crop cultivated under both rain-fed and irrigation. In addition to the grain value the straw is major feed for livestock. *Teff* has benefits of high market value, long storability and high resistance to disease or pests. However the crop requires high labour, traction power and fertilizer inputs. The benefits from the enterprise are limited for reason of low productivity mainly from lack of improved seeds and production technologies in use.

As the study results indicate *Teff* has an important role for household livelihood diversification. Other crops normally grown under irrigation in other areas are not cultivated in the study area. Identifying the underlying reason could be good area for further study. On the other hand, maize has high level of production per hectare and is the most important source of animal feed that can be sold at higher price. It is also easy to apply irrigate maize fields than other food grain; hence, it is dominantly cultivated under irrigation. The climate and type of soil are also very conducive for the production of the crop.

On the other hand, farmers largely focus on the use of local varieties for food grain crops such as sorghum and chickpea under rain-fed condition. This can be seen from the Table 15; the less diversified households have relatively higher mean land size for sorghum and chickpea as compared to diversified households. In contrast, farmers who devote irrigated land for the production of high market value food crops such as *teff* and maize and other cash crops are able to diversify their livelihood.

Table 14 Total grain food Crops Production (Qt) in 2008/9 cropping season

Amount of food grain crops (Quantity in Qt.)	Extent of Livelihood diversification				t- Statistics
	Less diversified		Diversified		
	Mean	SD	Mean	SD	
Sorghum	4.242	3.526	4.173	2.863	0.114 ns
Teff	3.134	2.323	3.705	1.986	-1.403 ns
Chickpea	0.062	0.402	0.036	0.267	0.417 ns
Total rain-fed food crops	7.439	5.221	7.914	4.233	-0.531 ns
Teff	0.588	0.757	1.330	1.383	-3.549***
Maize	3.202	3.608	4.433	4.393	-1.629*
Total under Irrigated land	3.789	3.857	5.763	4.867	-2.392*

Source: Own Survey, 2009

Note: *** Significant at 1% level, * Significant at 10% level, ns-Not significant

Regarding the total amount of produce, the average amount of food grain produced under irrigation in the year 2008/9 cropping season is higher for diversified households with the mean value of 5.76 quintals than the less diversified households having the mean value of 3.79 quintals (Table 14). The t-test also revealed that mean difference in average production of food grain crops under irrigation between the less diversified households and diversified households is significant at 10%. Further, there is a higher mean difference in teff and maize production under irrigation among less diversified and diversified households at 1% and 5% significance level respectively. The reason for mean difference between the two household groups might attribute to the use of crop intensification which supplemented with improved management and input use than less diversified households.

Table 15 Household Income from Rain-fed and Irrigated food grain crop Sales (Br)

Income source from the sale of grain food crops	Extent of livelihood diversification				t-Statistics
	Less diversified		Diversified		
	Mean	SD	Mean	SD	
Under Rain-fed condition					
Sorghum	223.68	543.33	266.52	480.39	-0.444 ns
Teff	623.33	868.28	1033.75	1049.94	-2.266*
Chickpea	0.00	0.00	7.14	53.45	-0.991 ns
Sub-total rain-fed	847.02	1305.76	1307.41	1166.51	-1.975*
Under Irrigation					
Teff	11.40	86.09	189.11	607.76	-2.185*
Maize	298.95	1185.32	717.86	1737.75	-1.499 ns
Sub-total under irrigation	310.35	1192.4	906.96	2069.29	-1.882*

Source: Own Survey, 2009

Note: *Significant at 10% level, ns-Not significant

The capacity of farmers on farm management and efficiency to use irrigation water will have an effect on the total out put of the irrigable farm land. As indicated in Table 15, the estimated annual mean income obtained from rain-fed cultivation was higher than income obtained from irrigated cultivation for diversified households with annual mean birr of 1307.4 and 906.9 respectively. The reason for this variation was, as indicated in the previous section, area of crop cultivated under rain fed was much higher than the land cultivated by using irrigation water.

The annual mean sub-total income obtained from sale of crops was based on farmers' estimation of market price during the study periods. As it is indicated in the Table 16, above there is a significant mean difference at 10% between less diversified and diversified households in their sub-total income from the sale of food crops cultivated under both rain-fed and irrigation condition.

Cash crop production

As far as this study is concerned, cash crop refers to vegetable and fruit crops produced through irrigation for the purpose of market to increase household cash income. Because of this, farmers in the area produce high valued horticultural crops such as pepper, onion and sugarcane. The extent of cash crop production in the study area is very limited as compared to food grain crops. This is more evident in terms of area coverage. Few farmers grow fruits that include banana, papaya, mango and avocado on small land sizes on along the boundaries of farm land. In comparison, onion and pepper stand out as the major cash crops.

According to the survey, most farmers do not cultivate their irrigable plots all in all for cash crops. Number of reasons was raised during household survey and focus group discussion sessions among which include shortage of water (long turns), lack of knowledge and skills on the management, fluctuation of market prices and low commitment from the participants. Due to these reasons there is significant mean difference at 1% between diversified and less diversified households in the size of land cultivated devoted for cash crop production.

Table 16 Cultivated Area for Cash Crop Production (ha)

Cash Crop types	Extent of livelihood diversification				t-Statistics
	Less diversified		Diversified		
	Mean	SD	Mean	SD	
Pepper	0.014	0.044	0.054	0.144	-1.967*
Sugarcane	0.002	0.017	0.015	0.052	-1.753*
Onion	0.020	0.066	0.068	0.115	-2.709***
Total	0.036	0.080	0.141	0.204	-3.615***

Source: Own Survey, 2009

Note: *** Significant at 1% level, * Significant at 10 % level, ns-Not significant

As indicated in Table 16 above, the average farmland cultivated for cash crop production through out the cropping year is higher for diversified households as compared to the less diversified with mean values of 0.141 ha and 0.036 ha respectively. As survey results in Tables 16 and 17 indicate, the production of pepper, onion and sugarcane take the lion's share in both area coverage and income. In terms of area coverage there is mean difference between less diversified and diversified households at significant at 1% and 10% respectively.

Onion is largely cultivated in the study area. Key informants mentioned reasons of availability of local onion seed, easier field management, and the virtues to withstand diseases as compared to other vegetables. Sample respondents noted that they do not grow fruits because they require long time to mature and lack of seedlings.

The survey results confirmed that cash crop production is limited to few vegetables and only a few farmers planted fruits like mango, avocado and papaya. However, the t-test also revealed that there is a significant mean difference at 1% on income obtained from sale of cash crop between diversified versus less diversified households.

Table 17 Average income source from the sale of cash crops (Birr)

Income source from the sale of cash crops	Extent of livelihood diversification				t-Statistics
	Less diversified		Diversified		
	Mean	SD	Mean	SD	
Pepper	117.54	600.93	462.54	1626.31	-1.501 ns
Papaya	0.00	0.00	17.86	133.63	-1.009 ns
Banana	0.00	0.00	82.32	273.05	-2.276*
Mango	0.00	0.00	7.14	53.45	-1.009 ns
Avocado	0.00	0.00	6.25	46.77	-1.009 ns
Sugarcane	33.33	145.57	97.39	345.31	-1.289 ns
Onion	176.32	657.25	501.43	984.53	-2.068*
Tomato	0.00	0.00	14.29	106.90	-1.009 ns
Total income from cash crops	327.19	923.12	1189.22	1907.24	-3.066***

Source: Own Survey, 2009

Note: *** Significant at 1% level, * Significant at 10% level, ns-Not significant

Accordingly, the result of the study highlights that households with high rate of cash crop production under irrigation condition are able to improve their annual income through cash crop production thereby improves their livelihood.

5.4.1.2 Cropping Pattern

Cropping pattern refers to intensification and diversification of agriculture in favor of high-value crops, namely fruits, vegetables, fodder production and other products. Intensification of agricultural production (use of a greater amount of resources such as labor, inputs, etc. for a given land area to get higher out put) and diversification of income sources through cultivating crops under different farming system to adapt uncertainties/vulnerability of traditional rain-fall dependent agriculture (Hussein and Nelson 1999 as cited in Warren, 2002).

In drought prone areas, like the study area, where rainfall is very low and unreliable, irrigation is one means by which agricultural production can be increased by intensifying crops (if the same plot of land is cultivated more than once in an agricultural year to increase production) and diversifying crops from single crop farming to multiple crop farming, which result in improvement in households income.

However, from Table18 below, the maximum level of crop intensification in the study area using irrigation water is twice a year. According to the result from the survey data, out of the sample households (72.6%) are able to cultivate twice a year by using irrigation. Of these households about 42% belong to the diversified household while 31.0% sample households belong to less diversified households. The chi-square test shows that there is a significant systematic association between households' livelihood diversification and crop intensification.

Table 18 Cropping intensity under irrigation condition for the year 2008/09

Cropping intensity	Extent of livelihood diversification				Total		X ² Statistics
	Less diversified		Diversified				
	N	%	N	%	N	%	
Once a year	22	19.5	9	8	31	27.4	7.199***
Twice a year	35	31.0	47	41.6	82	72.6	

Source: Own Survey, 2009

Note: *** Significant at 1% level

On the other hand, the cropping pattern is rather diverse as households cultivate a mix of crops. The cropping pattern in the study area implies that, the shift in farm household's crop choice decision towards highly priced and diverse crops could have a positive effect on the households' income. It provide adequate income sources and keep households operate a set of livelihood activities.

5.4.2. Constraints of Alawuha irrigation scheme

The contribution of irrigation to household's livelihood diversification is paramount as it enhances crop and livestock production. Irrigation is an essential input to meet household needs for range purposes. However, many challenges still remain unresolved. Issues related to institutional and management aspects are discussed below.

5.4.2.1. Institutional and management issues

Irrigation Water Use Associations (WUA) are formal entities (at times act as cooperatives) formed by households who have access to irrigation to strengthen the bargaining power. The Ethiopian government has the 147/91 proclamation to allow 10 or above people to form a cooperative. Based on the new proclamation, this association is intended to engage in provision of credit, agricultural input and output marketing and other services to members.

However, there is no active and formally registered irrigation Water User Association (WUA) for the scheme. Due to this reason input supply and marketing development in the study area is very low. Besides, there is weak extension and credit support on strengthening the technical know-how and input supply. Problems that plagued the services include frequent change of experts, low supervision and assistance.

For the study area, Yewuha Abat is in charge of irrigation water management committee which allocates distribution of water on a rotational basis. The informal institution is organized by Woreda and Kebele offices of Agriculture and Rural Development. The institution consists of 25-35 members as a group of irrigation users. A group consisting of 2-3 could form locally called ketena. Each group and ketena selects its leader and/or coordinator.

The institution has a committee member consisting of chairperson, treasury, and secretary where the gender composition in the institution is biased in favour of men. This show, similar to household decision making, decision with respect to collective property is dominated by men. The gender bias could stretch to undermine the prospects of women to utilize the benefits of irrigation.

The institution commands responsibilities of developing by-laws, designing/ planning program for turns among users, collecting fines, collecting water-use fees, coordinating repair and maintenance works of the scheme, resolving water use conflict, organizing users based on irrigable area and facilitates the transition of the informal institution to irrigation users associations. Well-managed irrigation systems are those which control the spatial and temporal supply of water so as to promote agricultural production growth.

Poorly managed irrigation systems waste water and energy, deplete or pollute water resources, fail to produce good crops and/or pose the danger of land degradation. As indicated by key informants, the Alawuha irrigation scheme is not judged to fair as well-managed system. Problems of sedimentation or siltation in canals, defective canal designs, irregular maintenance, water-logging on farm lands, recurrent conflict (water theft and competition) in peak seasons, limited know-how and skills on crop selection (water consumption and market value) and overall low productivity prevail in the area.



Figure 7 Water logged farm land

It was observed that there are no experts at Woreda and Keble level. The scheme as a result is managed by farmers' traditional skill and knows how. The management problems in the scheme have hindered steady utilization of irrigable land for production. The scheme does not collect water use fee but if collected would be used for maintenance and repair of the scheme. Moreover, the services of agricultural extension, credit and NGOs working in the area are yet to identify the priority and needs of irrigation users. It is clearly evident that the water management in the area is very poor and some waterlogged plots can be observed as one moves around the scheme in the area.

5.5. Econometric Results

This section of the study is devoted to the presentation of results of econometric analysis (i.e. binary logistic model) on the determinants of livelihood diversification in the study area. To identify determinants, as discussed earlier in the methodology section, binary logit models were used. A number of factors were postulated to influence the extent of households' livelihood diversification. With highly significant model chi-square statistics (X^2) 85.33 values (with 17 degree of freedom) and a 106.46 log likelihood ratio, the model achieved 84.1% correct prediction. Figures for correctly predicted diversified and less diversified households were 92.6% and 70.8% respectively.

Table 19 The maximum likelihood estimates of the binary Logit model

Variables	Coefficients	Sig	Exp(B)
SEXHH	0.152	0.840	1.164
KEBELE	0.705	0.318	2.025
TOTALHHLABOR	0.091	0.726	1.095
EDUCAHH	-0.500	0.504	0.607
TOTALCULTLAND	0.052	0.822	1.053
TOIRLAND	2.861*	0.076	17.487
EXTENSIONHH	0.985	0.270	2.679
CREDITHH	-0.217	0.765	0.805
INCOMIRI	0.000*	0.100	1.000
INCOMOFF	0.002*	0.064	1.002
IINCOMMON	0.000	0.104	1.000
INCOMMIGRATION	0.000	0.332	1.000
INCOMEMP	0.003***	0.000	1.003
TOTALTLU	0.078	0.528	1.082
CASHCROP	0.257	0.773	1.293
FARMEXP	0.054**	0.050	1.056
MARKETDIS	-1.064**	0.043	0.345
Constant	-41.959	0.998	0.000
R Square Value	0.478		
-Log likelihood ratio	106.469***		
Correctly predicted	84.1		

Note: ***, **and * are significant at less than 1%,5% and 10% probability level respectively.

Source: model output

Before proceeding to conduct the analysis, the problem of multicollinearity among explanatory variables was checked by using Variance Inflation Factor (VIF) and contingency coefficient tests for both continuous and dummy variables that are hypothesized to influence the extent livelihood diversification.

Among continuous explanatory variables total annual income was found to be in a serious multicollinearity problem (tolerance=0, $R^2=1$ and $VIF=\infty$) with on-farm income, off-farm and non-farm income. Normally this occurrence is not surprising because share of the total annual income is a summation of total on-farm income, off-farm and non-farm income. Thus, due to this problem total annual income was excluded from econometric model analysis.

As it is presented in the attached annex (i.e. Annex III) the value of VIF for each continuous variable, prove that the problem of multicollinearity was not serious among variables, as VIF values are less than 10. Similarly, Annex IV shows that multicollinearity was not a serious problem between discrete variables.

The binary logit model identified a total of seven significant variables out of seventeen hypothesized variables. Among the factors considered in the model, six variables are found to have a significant and positive influence on the extent of livelihood diversification of the households. These variables include Total Irrigable Land size (**TOIRLAND**), Income from Irrigation (**INCOMIRI**), Income from Off-farm (**INCOMOFF**), Income from Employment (**INCOMEMP**), Income from Non-farm (**INCOMNONF**), and Farm experience (**FARMEXP**).

The remaining one factor i.e. Market distance (**MARKETDIS**) is found to have a significant and negative influence on the extent of livelihood diversification of the households (See Table 22). The interpretation and discussion of these significant variables are presented as follow.

Total Irrigable land (TOIRLAND): this refers to the total irrigable land size owned by a household in the area. Since, irrigable land is used for production of crop for consumption as well as for market; it was hypothesized that it has direct relationship in enhancing product diversification and higher household income.

The model result showed, this variable was found to have positive and significant (at 10%) influence on household livelihood diversification. With the assumption that other factors remaining constant, increase in total irrigable land size of households by one unit, has the likelihood probability of households to diversify their livelihood by a factor of 17.487.

Market distance (MARKETDIS): market distance has been found to have negative influence on livelihood diversification significant at 5%. It was expected that households nearer to market centers have better opportunities to diversify their livelihood than households found farther from market centers. Thus, the result was in agreement with the hypothesis stated. The odds ratio other factors remaining constant, in favor of livelihood diversification increases by factor of 0.345 if market distance decrease by one unit.

Farm experience of Household Head (FARMEXP): Farm experience of the household head was found significant at 5% and it has positive influence livelihood diversification of the households. This implies that, other things remaining constant, as the farm experience of the household heads increase the likelihood to diversify their livelihood increase by a factor of 1.056.

This might relate to the fact that as the experience of household head in farming increases, the knowledge on farming system increase, thus the capacity to accumulate assets or intensifying and diversifying livelihood income sources would also increase.

Off-farm income (INCOMOFF): The empirical findings indicate that off-farm income have positive influence on livelihood diversification. Off-farm income has increased the extent of household livelihood diversification. As expected in the hypothesis, amount of off-farm income has positive influence to livelihood diversification significant at 1%.

The possible explanation is that households who involved in off-farm income generating activities other than on-farm activities are able to diversify their livelihood. Thus, if other factors are kept constant, the odds ratio in favor of diversification increases by a factor of 1.002 as income from off-farm sources increases by one unit.

Income from irrigated farm (INCOMIRI): Farm households who participate in irrigated agriculture would able to increase crop production through crop intensification (growing two to three crops per year) and crop diversification (multiple crop grown in season) which enables them to increase income as well as employment opportunities. Therefore, it was hypothesized that income from irrigated farm would have positive relationship with higher diversification.

In line with the hypothesis income from irrigated farm was found to have a positive and significant influence household livelihood diversification at 10%. This implies, keeping all other variables constant, increase in a unit of income from irrigable land would result in an increase in the probability of livelihood diversification by the factor of 1.000. Hence, an increase in income

from irrigation on the household improves the extent of livelihood diversification. The farmers unusually use irrigation system for the cash crop production.

Income from Employment (INCOMEMP): In study area, where farmers face frequent crop failure and sales of livestock and livestock product are inadequate, income earned from other income generating activities other than agriculture will be an important means for acquiring more income and diversify their livelihood.

Consistent with the hypothesis, income from employment was found to have a positive and significant influence on farm livelihood diversification at 1%. This entails, other variables being constant, an increase in a unit of income from employment would result in an increase in the probability of household's livelihood diversification by the factor of 1.003.

The above discussed econometric results give important evidence regarding variables, which need to be considered and given emphasis during interventions in order to overcome the challenges of livelihood diversification.

6. CONCLUSION AND IMPLICATIONS

6.1 Conclusion

This section of the study presents what has been learned from the findings of study as conclusion and forwards possible implications for various stakeholders and development actors to address these problems. This study was conducted in north eastern Ethiopia, Gubalafto Woreda, in two Kebles, of Alawuha irrigation scheme. First, the study investigated extent of rural livelihood diversification and then identified determinant factors that affect diversification at household level. At last, constraints and contribution of irrigation water for rural household livelihoods diversification has been examined.

Clear understanding of the status of livelihood diversification strategies would provide a sound base on which to focus rural development policies and practical poverty reduction interventions. Accordingly, the study results identified the major livelihood activities that include on-farm, off-farm, non-farm, employment and migration in their order of importance.

Given the recurrent drought in the North Eastern Ethiopia in general and in the study area in particular, there are uncertainties and risks that are inherent to on-farm activities (crop and livestock production). The inadequacy of the returns to maintain the household for the entire year induces considerable proportion of rural households in the study area to engage in diverse livelihood activities to earn income from sources other than on- farm activities.

However, the study result from the livelihood diversification index indicated, the contribution of the income shares from these livelihood activities (off-farm, non-farm, employment and migration) to the total household income is low as compared to the income share from the on-farm livelihood activity. Thus, it can be concluded that less diversified households have fewer opportunities to diversify their income sources. Less diversified household unlike diversified household rely on such activities appears to boldly outline the indispensable role of on-farm livelihood activity to diversify households' income sources which as a result determines the extent of rural households' livelihood diversification in the study area.

The evidence from the study also suggested that crop and livestock production have a positive influence on the livelihoods diversification of households in the study area. Hence, access to and utilization of irrigated agriculture, have assisted farmers to obtain better income and alternative income sources. This explains the increasing importance of this on-farm activity in the livelihood of households (as evident from the logit model analysis result). In general, it is fair to conclude that access to and utilization of irrigation proved to be an important input for households' diversification from increase in incomes.

The findings of the study is in line with other studies elsewhere that revealed access to irrigation water enabled households to diversify their production pattern and intensify cultivation, which led to attributes of increased productivity and greater returns from on-farm activity. This higher return will in turn be invested on other income sources and livelihood activities. Hence, livelihood diversification differences in share income of households directly or indirectly links to irrigation. Therefore, irrigation is at the heart of rural household livelihoods and livelihood diversification in the study area.

Despite the important role of irrigation, there was no significant spill over effect to other livelihood activities and not enough to lift the other sectors and as expected it has not strengthened inter-linkages in the area. As the result shows, sample households in Alawuha irrigation scheme are food self in-sufficient as their annual income and production is very low. Relatively, the returns from irrigated agriculture have increased households income portfolio, but there is a room for improvement of irrigation systems in the study area. The potential for utilization of irrigation is are yet to be harnessed to levels of aspired economic benefits.

Owing to the consequence of increasing water demand coupled with poor cropping calendar, inefficient irrigation technology, lack of upgrading of irrigation structures, unfair irrigable land distribution, and apparent declining in water availability from reasons of canal damage and maintenance problems. Irrigation developments in Alawuha seem to be at a crossroads unless the critical challenges of equitable water access and recurrent conflicts are addressed.

Moreover, the result of the binary logit model indicates that, farm experience of household head, size of irrigated land, income from irrigated crop production, income from off-farm activities, income from employment and distance in hours to market center were the most important factors that determine extent of household's livelihood diversification in the area.

The study findings indicate that, small-scale irrigation has a vital role on rural household livelihood diversification through direct effects annual improved productivity and indirect effect of generating off-farm and non-farm employment opportunities. This is arguably validated that income share from irrigated crop production, employment and off-farm income sources have positive and significant influence on household livelihood diversification.

The debacle of rural livelihood diversification in the study area is complex and interrelated. The problem requires a multifaceted and all round interventions to improve and ultimately alleviate the challenge. For that reason, this study undoubtedly accepts that problems it can only be eliminated by broad-based and multi-pronged development efforts and programs against poverty.

6.2 Implications

On the basis of the results of this study, the following policy and development intervention implications are suggested so as to be considered in the future strategies and programs. As the foregoing sections underline, household livelihood diversification in the study area is determined by a number of socio-economic and institutional factors. Among these, the following are salient issues that surfaced out from the study results.

The poor performance of water management committee along with variation in benefits among rural households due to unequal access to irrigable land further reduce already limited performance of the scheme. The finding of this study disclosed that the limited access to water and irrigable land were the principal constraints for improving rural livelihoods. Therefore, redirection of institutional focus and pro-poor policies are necessary. Thus, proper irrigation management and empowered WUA are needed in order to maintain the infrastructure and ensure efficient utilization of irrigation water. These calls for, policy interventions that are spearheaded by the government in order to enact, implement and follow up policies geared towards sustainable use of small scale irrigation scheme.

Policy instruments that would help in sustainable use of these resources include empowering local communities through participatory community resource management, equitable land redistribution, rehabilitation and upgrading the scheme infrastructure; improve access to markets, credit and institutions to strengthen the WUA and extension services. These measures could rescue misuse and underused of the resources and enhance sense of ownership at local level. In this context, the scheme will have a great potential to benefit the rural poor and succeed to allow, diversification of livelihoods activities, improve food security, and increase economic returns.

As rural households in the study area diversify their income sources mainly through on-farm activities, Investment in irrigated agriculture will provide inter-linkage and thus support rural households to diversify away from pure adherence to rainfall based crop and livestock production. As the benefits provide, major stimulus to the off-farm and non-farm livelihood activities. Furthermore, investments in basic services, such as roads, credit, market, schools and health care are important not only to strengthen the role of irrigation but also to complement agricultural sector in the area as whole.

To this end, local, regional and national government as well as NGOs need to identify clear additional interventions that are demonstrably beneficial. In parallel, measures to ensure access to irrigation, supports and vitalizes the rural livelihoods which mainly rely on agriculture. Besides, developing market infrastructure, improving transport and communication system can offer also possibilities of increased access to availability of cheaper inputs and better output prices. The present works and commitments by the government in the area of social services improvement should not lose the present momentum, keeping people's priority at fore front.

Furthermore, crop specific recommendation should be generated with regard to irrigation frequency and amount of water required for the different soil types and slope for supplementary or full-fledged irrigated agriculture. Additional studies on irrigation water requirement for the different soil and crop types including indigenous methods of irrigation are viable directions. Last but not least, assessing other non-farm income sources like agro-processing and high return activities particularly for those who have no/limited farm land (mainly youth and women) is important as equally as access to irrigation. Otherwise, imposing the additional burden of maintaining irrigation systems, without strengthening institutions, removing market barriers, improving the access to basic resources (irrigation) as well as neglecting to create the enabling conditions for the rural poor to derive better incomes, will only force the poor in the area into further poverty.

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8. APPENDICES

Appendix I Conversion factors used in estimation of man-equivalent (ME).

Age Group	Male	Female
< 10	0	0
10-14	0.35	0.35
15-50	1	0.80
> 50	0.55	0.50

Source: Storck, et al. (1991)

Appendix II Conversion factors used in estimation of tropical livestock unit (TLU)

Livestock	Average Biomass (Kg)	TLU Equivalent
Camels	250	1
Cattle	175	0.7
Sheep/Goat	25	0.1
Horses/Mules	200	0.8
Donkeys	125	0.5

Source: Storck, et al. (1991)

Appendix III Variance Inflation Factors (VIF) of Continuous variables

Variables	R_j^2	VIF(x_j)
TOTALHHLABOR	0.175	1.21
TOTALCULTLAND	0.298	1.42
TOIRLAND	0.005	1.00
INCOMIRI	0.212	1.27
INCOMOFF	0.270	1.37
IINCOMNON	0.030	1.03
INCOMEMP	0.410	1.69
TOTALTLU	0.193	1.24
FARMEXP	0.011	1.99
MARKETDIS	0.321	1.789

Source: Model output

Appendix IV Contingency Coefficients for Discrete Explanatory Variables

	SEXHH	KEBELE	EDUCAHH	EXTENSIONHH	CREDITHH	CASHCROP
SEXHH	1	0.231	0.112	0.122	0.331	0.266
KEBELE		1	0.331	0.266	0.005	0.230
EDUCAHH			1	0.345	0.111	0.530
EXTENSIONHH				1	0.3421	0.030
CREDITHH					1	0.1130
CASHCROP						1

Source: Model output

Appendix V Questionnaire for the Formal Survey

I. General information

1. Questionnaire Number _____
2. Name of household head _____
3. Keble 1. Lastie 2. Dorogiber 3. Layalawuha
4. Village/gote _____
5. Date of interview _____
6. Enumerator's name _____ signature _____
7. Checked by _____ signature- _____

II. Demographic characteristics

8. Age of the HH _____ (yrs)

9. Sex 1. Male 2. Female
10. Total family size of the household including your self? _____
11. Ethnicity 1. Amhara 2. Oromo 3. Others (specify)
12. Religion 1. Islam 2. Orthodox 3. Others (specify)
13. Social status or responsibility 1. Religious leader 2. Political leader
14. Marital status of the household 1. Married 2. Unmarried 3. Divorced 4. Widowed
15. Farm experience (Number of years since started farming) of the household head in years?

5. Cabinet member 4. None 5. Other specify _____
16. What is the level of education of the HH head?
1. Literate 2. Illiterate.
17. If literate, indicate the level of educational status.
1. Read and writes
2. Primary school (1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th grade)
3. Secondary school (9th, 10th, 11th, 12 grade)
4. Other specify _____
18. Please list the age category and level of participation in farm activities of your household members.

Household members	Number	Type of Participate in farm activity				Remark
		Full time	Par time	Hired	Don't participate	
Male children ≤ 10						
Female children ≤ 10						
Male children 11-14						
Female children 11-14						
Adults male 15-59						
Adult female 15-59						
Adult male 60-64						
Adult female 60-64						
Male elders > 64						
Female elders > 64						
Total						

III. Socio economic and institutional characteristics

Land and water resources

19. Do you have your own land? 1. Yes 2. No
20. What is the total size of your own land in hectare (ha)?
21. What is the total area of farm land you cultivated in 2008/09?
22. Do you have irrigable farm land? 1. Yes 2. No

23. If yes, what is the total size of your irrigable land in hectare or local units? _____

Type of land	Number of plots	Size of land (ha)	Size of irrigated land	Size of rain-fed land
Own land				
Share in				
Shared out				
Rent in				
Rent out				
Total				

24. How you utilize your irrigable land? 1. For production 2. For rented out 3. For grazing 4. other (specify)

Constraints in irrigation water use

25. Is irrigation water adequate for the entire year? 1. Yes 2. No

26. Is irrigation water source is available for your farm land area? 1. Yes 2. No

27. What is the distance of your farm land from the irrigation water source?

plot	Distance from the nearest irrigation water source in meter	Size of farm plots (ha)	Time taken in hours from home stead
Plot 1			
Plot 2			
Plot 3			
Plot 4			

28. What are the major constraints in irrigation water use? (Rank)

No	Constraints in irrigation water use	Response		Rank top 5
		Yes	No	
1	Shortage of Irrigable Land			
2	Lack of sufficient (unavailable) irrigation water			
3	Lack of improved seed & fertilizer			
4	Labor shortage			
5	Incidence of Soil erosion			
6	Increased Pest and Diseases			
7	Lack of appropriate knowledge			
8	Lack of important farm implements			
9	Inconvenience irrigation scheduling			
10	Lack of capital			
11	Incidence of conflicts			
12	Injustice water distribution			
13	Inappropriate topography of farm land to irrigation water			
14	Incidence of soil salinity			
15	Other (specify)			

Crop production

29. Please list the type of crops you cultivated, their production and total income from the sale for the year 2008/09.

Type of production							
Rain-fed agriculture				Irrigated agriculture			
Crop types cultivated**	Area in ha.	Total production (Qt or Kg)	Income from sold (Birr)	Crop types cultivated**	Area in ha.	Total Production (Qt)	Income from sold (Birr)

**Sorghum=01 Teff=02 Maize=03 Wheat=04 Bean=05 Pea=06 Chickpea=07 Leen sed=08 Sunflower=09 Papaya=10 Orange=11 Banana=12 Cabbage=13 Swiss chards=14 Lettuce=15 Pine apple=16 Avocado=17 Sugarcane=18 Tringo=19 Lemon=20 Onine=21 Tomato=22 Potato=23 Gesho=24 Spices=25 Other specify

30. Do you produce enough for your family during last year? 1. Yes 2. No

31. If no, for how long does it last in months? ____ From ____ to Months.

Livestock ownership

32. Do you own livestock? 1) Yes 2) No

33. If your answer is Yes, List down the type and number of livestock you have.

Livestock type	Total population(use numbers)
Camel	
Ox	
Cow	
Heifer	
Young bulls	
Calf	
Goat	
Sheep	
Donkey	
Mule	
Poultry	
Bee hive	

VI Agricultural Extension services

34. Have you ever received any type of services from farmer's training center (FTC)? 1

Yes (2008, 2007, 2006) 2. No

35. Do development agents visited your farm and provide sufficient technical and consultation support to you during the year 2008/09? 1. Yes 2. No

36. If yes, how frequent it is?

37. Have you participated in the safety net program? 1. Yes 2.No

38. Have you participated in irrigation trainings?1.Yes 2.No

39. If yes, when? 1. 2008 2. 2007 3. 2006

40. Are you members of water use committee (association) in your area? 1. Yes 2. No

41. If your answer is yes to question No 28, is there any special benefit offered to you? 1. Yes
2. No

42. If your answer is yes to question No 29, what kind of benefit you obtained? 1.
Salary 2. Training 3. Additional irrigation water 4. Other (specify)

V. Credit services

43. Have you received formal credit during last year? 1. Yes 2. No

44. If your answer for question 28 is yes, would you please give us the following details?

Source	Total Amount in Birr	Purpose for credit

VI. Marketing

45. How long is your market place from your village of residence?

Market name	Rank the market place frequently used	Distance in hours	Type of services (for sale or purchase)
Wolodia			
Hara			
Kobo			
Others (specify)			

46. What major market problems you observe in your area?

Market problem	Response		
	Yes	No	Rank top 5
Markets far away from villages			
Price fluctuation			
Post-harvest price drops			
Inadequate transport facility			
Taxation of agricultural products			
Lack of post harvest storage facility			
Lack of recent market price information			
Other specify			

VII. Diversified income sources of rural Households

47. Please indicate the total income you obtained during last year from the following different income sources.

Income from Farm production

Income source from owned animals and animal products	Total sold	Reason for sale	Total annual income
Type of owned animals			
Camel			
Ox			
Cow			
Heifer			
Young bulls			
Calf			
Goat			
Sheep			
Donkey			
Mule			
Poultry			
Bee hive			
Livestock products			
Meat (kg)			
Milk(litter)			
Egg(number)			
Butter(kg)			
Skin(No)			
Hides(No)			
Other specify			
Total			

Income from Off-Farm activities

48. Please indicate the amount of income you earned from off-farm activities in the last 12 months?

Off-farm Activities	Annual income in birr
Sale of fuel wood or charcoal	
Sale of eucalyptus tree	
Sale of grass or fodder	
Sale of stone or sand	
Renting out oxen	
Sharecropping out land	
Renting out pack/ transport animals	
Others (specify)	

Income from Non-Farm activities or strategies

49. What amount of income did you earn from non-farm activities in the last 12 months?

Non-farm Activities	Annual income in birr
Trading of grains	
Trading of livestock	
Trading of fruit and vegetables	
Food sale	
Drinks sale	
Basket making	
Weaving	
Embroidery	
Carpentry	
Masonry	
Poetry	
Blacksmithing/metal work	
Hair dressing	
Traditional healers	
Traditional birth attendants	
Money lending	
Grain mills	
Others (specify)	

Income from migration

50. What amount of income did you earn from migration of your family members in the last 12 months?

Type of migration	Annual income in birr
Migration out of Keble for agricultural works	
Migration out of Keble for non agricultural works	
Remittance	
Others (specify)	

Income from different employment sources

51. What amount of income you obtained from the following employment opportunities for your household members during last year?

Type of employment	Annual income in birr
1. Agricultural related works	
Wage for rain-fed agricultural/farm activities	
Wage for irrigated agricultural/farm activities	
Wage for livestock rearing/herding	
2. Non agricultural works	
Employment in CFW/FFW/ safety net	
Day laborers	
Government employee	
Other (specify)	

52. Would you please list down the reason why your livelihood is based on different income sources?

No	Reasons	Yes	No	Rank
1	Due to natural and man made disasters			
2	Due to additional income			
3	Due to different forced challenges			
4	Due to creation different new alternatives			
5	Due to increased interest of family members			
6	Due to awareness creation by different institutions			
7	Other (specify)			

53. Do you believe that irrigated agriculture diversify your livelihoods by creating different income sources? 1. Yes 2. No

54. If your answer is yes for question number 42, would you please justify your reason?_____

Appendix VI Checklists for Focus Group Discussion (FGD) and Key informant

Interview (KII)

General

1. What are the major types of livelihood strategies and activities in the area?
2. Which livelihood strategies are the important sources of income in order of importance?
3. What is the role of access to irrigation to rural livelihood diversification?

4. What is the role of livelihood diversification to reduce poverty and vulnerability (livelihood security)?
5. What are the determinant factors for livelihood diversification?
6. Why do people diversify their income sources?
7. What are the major constraints of small-scale irrigation schemes?
8. What is the contribution of small-scale irrigation schemes for livelihood diversification?

Livelihood Diversification (strategies and activities)

Agricultural livelihood strategies

Crop production

1. What types of crop are grown in rain-fed and irrigated agriculture in the area in terms of area coverage and production?
 - Field crops (cereals and pulse crops)
 - Vegetable crops
 - Cash crops
2. Which crops are more marketable in your area in order of importance?
 - Field crops (cereals and pulse crops)
 - Vegetable crops
 - Cash crops
3. What types of cropping system are practiced in the Woreda in order of importance? (Crop diversity, crop intensity, crop rotation, alley cropping, intercropping, sole cropping...)
4. What are the main constraints and reasons for each cropping systems?
5. What is the influence of access to irrigation on cropping system in your area?

6. What is the influence of access to irrigation on crop production and employment opportunities for rural household in the area?

Livestock production

1. What types of livestock are being reared (kept) in the area?
2. What is the reason for different livestock rearing (kept) purpose? (For draft animals, pack animals, small ruminants)
3. What is the (effect) influence of access to irrigation water for your livestock rearing system? (fodder and drinking water availability)
4. Is there any change in the herd system due to access to irrigation water?
5. Which type of livestock is most important for source of income to purchase food in order of importance? (which livestock do you sell more often to purchase food? Rank in order of importance)

Irrigation

1. What are the sources of irrigation water?
2. What is the role and number of irrigation scheme water use association by sex?
3. What are the rules and regulation (bylaws) practiced by the irrigation scheme water association?
4. What is the base/ criteria (type) for irrigation water scheduling?
5. What are the major constraints or draw backs of to use irrigation water in order of importance?
6. What is the nature of conflict related to irrigation water and measures taken to resolve conflicts?
7. Is the irrigation water available throughout the year?

8. (how is water distribution handled for all beneficiaries? Who is more favored and who is not? Why?

Inputs

1. Which types of agricultural inputs are widely for irrigation used in the area?
2. Sources of inputs?
3. Purposes of input?

Credit

1. Sources of credit?
2. Purposes of credit?

Off-farm Activities

1. What are the major types of off-farm activities in the area?
2. What are the reasons for off- farm activities?
3. What is the status of off-farm activities in the area?
4. Which type of off- farm activity is the most important source of income in order of importance?
5. Which community members participate in off-farm activities?
6. What is the role of access to irrigation water for off-farm activities

Non-Farm Activities

1. What are the main types of non-farm activities in the area?
2. What are the reasons for non- farm activities?
3. Which type of non- farm activity is the most important source of income in order of importance?
4. What is the status of non-farm activities in the area?
5. Which community members are participated in non-farm activities?

6. What is the role of access to irrigation water for non-farm activities

Migration

1. Where do people migrate?
2. What is the importance of migration?
3. Which members of the household migrate?
4. How long is the duration of the movement?
5. When do people migrate?
6. What is the income /earn from migration?
7. Why do people migrate?

Livelihood security

1. What is the situation of rural household livelihoods?
2. What are the main causes for poverty and vulnerability in order of importance?
3. Which community groups are more vulnerable? (By sex, age, education status, farm experience, family size, landholdings, etc)
4. What are the mechanisms to alleviate poverty and vulnerability?
5. What type of livelihood strategies/activities are created due to access to irrigation?

Checklist for Woreda Experts

I. Physical Environment

1. Location
2. Area coverage of the Woreda
3. Agro ecology of the Woreda (Temperature, rainfall /intensity, frequency, season, amount/, latitude, altitude, longitude, distance, humidity.
4. Land use system of the Woreda

5. Average land holdings
6. Cultivated land under rain-fed agriculture
7. Cultivated land under irrigated agriculture
8. Type of irrigation schemes, their coverage,
9. Number of landless households by sex
10. Natural resources (forests/vegetation, soil, water)
11. Woreda irrigation potential
12. Type of irrigation schemes
13. Location of Alawuha irrigation scheme (Total beneficiaries, agro-ecology of the scheme, bylaws, total command area, major constraints, and irrigation related package, average discharge, knowledge or skill of development agents, role of the scheme for livelihood diversification.....)
14. Boundary of the Woreda including map
15. Total number of Kebles and number of Kebles having irrigation potential

II. Population and culture

1. Total population of the Woreda by sex, age
2. Ethnic composition
3. Religion, language and culture of the people in the Woreda

III. Economic condition

1. Major income sources (livelihood strategies/activities/) of rural people
2. Crop production(major crop types, their contribution to the household income and problems)
3. Livestock rearing (major types of animal, their contribution to household income and problems)

4. Extension services
5. Credit and input provision
6. Non farm activities (trading of grains, animals, food, drinks, carpentry, handicrafts, hair dressing, woodwork, metal work)
7. Off farm activities (sale of fuel wood, stone, grass activities, trees)
8. Migration situation
9. Reasons for farm diversification (crop, livestock), off farm, non-farm and migration for household income
10. Challenges/ constraints of farm diversification (crop, livestock), off farm, non-farm and migration in the area
11. Contribution of access to irrigation for livelihood diversification
12. Contribution of livelihood diversification to reduce poverty and vulnerability (livelihood security).

IV.Social services

1. Education (type of schools, number of students or enrollment ratio, distance, problem etc)
2. Health (facilities, coverage or beneficiaries, distance, problems)
3. Drinking water (type of sources, coverage or beneficiaries, distance, problems)
4. Infrastructure (types, distance, problems)
5. Market place (distance)

V.Conditions of livelihood diversification (strategies and activities)

1. Livelihood situation of the Woreda
2. Causes of poverty and vulnerability in the Woreda
3. Types of food insecurity reflected in the Woreda

4. Institutions (NGOs, privates, CSOs) and their role/ contributions for poverty reduction through accessing different income sources
5. interventions/ programs for food security
6. government policies, strategies and plans for food security
7. constraints for food security

CONSTRAINTS FOR LIVELIHOOD DIVERSIFICATION

1. What are the major constraints for crop production.....?
2. What are the major constraints for livestock production.....?
3. What are the major constraints/reasons in performing off-farm income generating activities.....?
4. What are the major constraints for non-farm.....?
5. What are the major constraints for migration.....?

Declaration

I, the undersigned, declare that the thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

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