Impact of Household Extension Package on Food Security and Income of the Rural Households in Tigray: The Case of Kilte Awlaelo Woreda

By

Tsegu Gebretsadik

A Thesis Submitted to the School of Graduate Studies
Addis Ababa University

In Partial Fulfillment for the Degree of Master of Arts
in Regional and Local Development Studies

Addis Ababa University
School of Graduate Studies

Impact of Household Extension Package on Food Security and Income of the Rural Households in Tigray: The Case of Kilte Awlaelo Woreda

By
Tsegu Gebretsadik

Department of Regional and Local Development Studies

Approved by Board of Examiners:	**Signature**
1. _____	_____
Chairman of Graduate Committee	
2. Bayene Tadesse (Dr.)	_____
Advisor	
3. _____	_____
Examiner	
4. _____	_____
Examiner	

ACKNOWLEDGEMENTS

I am indebted to some individuals and institutions in conducting this study. Firstly, I want to express my gratitude to my advisor Dr. Beyene Tadesse for his devoted intellectual guidance. My sincere appreciation also goes to my former advisor Dr. Mulat Demeke who has been very understanding and kind enough in sharing me his personal resources.

My thanks also go to the Tigray Bureau of Agriculture and Rural Development, for providing me unreserved study leave offer, and to the Faculty of Regional and Local Development Studies of Addis Ababa University and its staffs for facilitating my study and shaping my career.

My especial thank goes to Ato Hagos Adhana who spent his precious time in analyzing my collected data. I am also indebted to Ato Haileslassie Wores and Ato Berhane Ghiday for sharing me their valuable personal resources.

This research work would have not been successful without the help of W/ro Shefena Gebretatyos, Ato Berhe Arkebe, Ato Mehari Gebremedhin, and Ato Ataklti Hagos.

Finally I am thankful to my wife Werknesh Tessema for bearing in my absence handling our children.

TABLE OF CONTENTS

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

LIST OF TABLES

Page

ACRONYMS AND ABBREVIATIONS

ATVET	Agricultural, Technical and Vocational Education and Training
BoNARD	Bureau of Agriculture and Natural resources Development
CSA	Central Statistics Authority
DA	Development Agent
DPPC	Disaster Prevention and preparedness commission
EDRI	Ethiopian Development Research Institute
EEA/EEPRI	Ethiopian Economic Association/Ethiopian Economic Policy Research Institute
FDRE	Federal Democratic Republic of Ethiopia
FTC	Farmers' Training Center
HH	Household
KAW	Kilte Awlaelo Wereda
Kcal	Kilocalorie
NGOs	Non Governmental Organizations
NRST	National Regional State of Tigray
OKAWARD	Office of the Kilte Awlaelo Wereda Agriculture and Rural Development
PADETES	Participatory Demonstration and Training Extension System
TBoFED	Tigray Bureau of Finance and Economic Development
TBoPED	Tigray Bureau of Planning and Economic Development
UN	United Nations

ABSTRACT

The study is conducted in three tabias of Kilte Awlaelo Wereda, Tigray Region, to assess the impact of the household extension package on food security and income level of the beneficiary households. Data were collected by interviewing 120 sample households (55 package beneficiaries and 65 non beneficiaries) and from secondary sources. The quantitative assessment was supplemented by qualitative data collected from the sample households and different community members. Simple descriptive analysis was made usingSPSS software.

The study results show that the package beneficiaries have achieved relatively better food security and income levels as compared to the non-beneficiaries. The introduction of integrated household package increased crop output by one quintal per hectare and an average net income of birr 482 per household. The available kilocalorie per person per day from own production was found to be 1,485 for the package beneficiaries and 1,066 for the non-beneficiaries. As compared to the national standard, 2200 kilocalorie per adult equivalent per day, package beneficiaries and non-beneficiaries fulfill only 68% and 48.5% respectively. Thus, although there is improvement in production and income of the beneficiaries, own production is not sufficient to uplift the food insecure households.

In addition to own production, households in the study area were participating in "Food For Work" activities through the Safety Net Program.. Consequently, the total calorie available to the package beneficiaries raised by 889 kilocalorie per person per day and that of the non- beneficiaries by 401 kilocalorie per person per day. Average income per person per year was also increased by birr 206 and 178 for the package beneficiaries and non-beneficiaries respectively. Therefore, the results show that, on average, the package beneficiaries seem to fulfill their minimum calorie requirement and able to earn 67% of their daily income requirement from all sources. The food calorie available to and income of the package beneficiaries exceeded from that of the non-beneficiary by 41% and 18% respectively. However, in absolute terms there are households who could not still even cover a quarter of their calorie intake and income requirement.

Moreover, the study findings indicate that the problems attributed to low farm outputs and consequently to food insecurity and poverty are mainly associated with low application of production enhancing technologies, dependency on unreliable and erratic rainfall and small land holding size. The reasons for low application of technological inputs were shortage of supply of improved seed varieties and animal breeds, and the escalating price of fertilizer and shortage of rainfall. The land holding is also too small to enable households to lead their life and 2.5% of the households were landless. Therefore, improving supply of better yielding and drought tolerant crop varieties, improving livestock packages, vigorous development and expansion of irrigation, and creation and expansion of non-farm employment opportunities are possible areas of intervention to improve food insecurity and to reduce poverty in Kilte Awlaelo Wereda.

CHAPTER ONE

INTRODUCTION

1.1 Background

"Ethiopia had been a self sufficient in staple food and classified as a net exporter of food grains till the late 1950s" (Alemayehu, 1988, cited by Debebe in Yared 2001:83). However, since 1960s, food supply has failed to meet the demand of the growing population and the country has been facing perennial hunger and poverty. Different study results have revealed that the causes of food shortage, among others, are severe environmental degradation, lack of appropriate technology, and lack of inputs, lack of non-farm employment opportunities, poor development of infrastructure, recurrent drought and ineffective policies.

The subsistence agriculture with little access to appropriate technologies and alternative employment opportunities caused to a persistent increase in food shortage and heavy reliance on food aid. According to government official documents, in the Years 1985-2000, an average of 700,000 metric tons of food aid per annum were imported to meet the food needs of the country (FDRE, 2002). The same source shows that on average 10.3% of the population were affected by drought in the Years 1981-2001. On average, 6.2 million people of which 1.11million from Tigray region, were relief foods assisted from 1994 to 2003 (DPPC, 2003, cited in Food Security Program,

the peak year where
2 million at national

ıreas of the country,
:ob, Atsbi-wenberta,
, Enderta, Alamata,
m, Tanquabergele,
he 1994 household
were reported to be
e enough to support
Welfare Monitoring
ıolds in Tigray suffer
areas (CSA, 2004a).
ecurity problem has
n the drought prone

ırty, the Ethiopian
evelopment-oriented
ırity strategy is the
ress the supply and
asing food crop and
oduction enhancing

technologies and increasing purchasing power of households through increasing the households' income by promoting non-agricultural income generating activities and diversifying agricultural incomes. The current food security strategy, among others, gives focus to the moisture stress and chronically food insecure areas among which Kilte Awlaelo Woreda, the concern of this study, is one.

1.2 Problem Statement

Different Agricultural extension systems have been implemented in Ethiopia since 1960s. As repeatedly mentioned in the literature agricultural extension programs during the imperial period were operational in very limited areas and end up benefiting the landlords. During the Dergue regime, the focus of agricultural extension and other services were directed to the few producers' cooperatives and state farms, too (Befekadu and Berhanu, 1999/2000, Ebrahim, 2005). Participatory demonstration and training extension system (PADETES) intervention has been launched as of 1994/5. Unlike the other extension programs and projects which failed to make change in the production and productivity of the majority small holder farmers, has penetrated deep to the rural areas and to some extent succeeded to increase food production using some technologies, mainly improved seed variety and fertilizer (Ebrahim, 2005). PADETES followed a package approach (a group of items such as inputs, credit and methods/practices packed together as a single unit). However, PADETES was not exempted from problems. The

problems experienced during the PADETES implementation include the blanket implementation of inputs, involvement of extension agents in non extension activities and quota system targeting, which end up with enforcing farmers to practice what they did not believed in. Thus, almost all of the projects and programs implemented for decades were not that much significant in terms of improving the level of food security and poverty of the vulnerable rural households. Hence, food security problem is still a big problem in the drought prone areas in particular. This calls for massive intervention. Since 2002, the Ethiopian government has launched a food security program through out the country to ensure food security at household level with in three to five years time. United nations, Bilateral and other Non Governmental Organizations have been assisting the efforts.

The food security program and strategies have targeted mainly to ensure food security to the chronically food insecure moisture deficit and pastoral areas. Based on the National Food Security Program and Strategies, the National Regional State of Tigray has launched an integrated household focused extension package program to reduce household food insecurity and to increase the income of the poor farming households in the region in general and in the sixteen drought prone woredas in particular. The integrated household package aims at engaging farmers in adopting a number of technological packages to help them increase their farm output and household income. The menu of packages has been developed from which farmers can have options to choose depending on the availability of family

1.5 Research Method

1.5.1 Sources and Method of Data Collection

Primary data used in this study was collected from rural household survey in three 'tabias'[1] of Kilte Awlaelo Woreda the Tigray Regional State. The woreda was selected because it is one of the drought prone areas of the region and accessible. The data were gathered by employing a combination of different methods. The primary data were obtained from the sample extension package beneficiaries[2] and non-beneficiaries[3] through individual interview and group discussions with different community members and key informants. The community representatives were selected with the help of development agents and tabia administrators and made to include elderly, religious leaders and women.

Structured questionnaire was employed to collect qualitative and quantitative data from the sample household heads. Using the questionnaire (Appendix-1) detailed information on households' demographic and socio-economic characteristics, livestock and crop packages, input utilization and application, participation in non-farm activities, income of beneficiaries and non-

[1]Tabia is the lowest administrative unit next to wereda.
[2] Package beneficiaries are : (1) vulnerable households who are entitled to receive the required amount of credit money to purchase the recommended package/technology enabling them food secure in the specified time. (2) 3% of the interest rate of the loan taken by the beneficiary households is paid by the government (3) If the households were not able to repay the loan due to natural calamities (loss of animal or crop failure), the government will pay from its budget on behalf of them.
[3] Non-package beneficiaries are households who are not subsidized but can get extension and credit service through the conventional way.

beneficiaries were assessed. Secondary data were also collected from Tigray Bureau of Agriculture and Rural Development at all levels.

A two-stage cluster random sampling was used to select the studied 'tabias' and sample households. i.e., the three 'tabias' (one from the five relatively moist areas and two from the ten dry areas were selected randomly. After the three 'tabias' (Negash, Genfel and Aynalem) were identified, 40 households from each 'tabia' were selected from the package beneficiaries and non-beneficiaries depending on their proportional size. As the 'woreda' is fully dominated by 'Weina dega' (sub moist and semi-arid) agro ecology the 'tabias' almost represents each other in the 'woreda'. The number of households selected for the study was 120 (55 package beneficiaries and 65 non package beneficiaries. This figure could seem small but thc agro-ccology and socio-economic characteristics of the households are similar. Due to this homogeneity among the households, generalizing about the population from the sample households did not affect the reliability of the outcome of this study.

Before the actual survey was conducted, the questionnaire (for package beneficiaries and non package beneficiaries) was translated into tigrigna language. The sample frame of the package beneficiaries and non-beneficiaries were arranged to be prepared in each 'tabia' in advance. Nine enumerators were recruited through the cooperation of the Office of Kilte

To this effect, the households' annual production was netted out by deducting input costs. The income in terms of monetary value was calculated by converting the crop outputs from own produce and the grains and edible oil obtained from food for work using their market prices. The average household income earned from all sources was also compared with the millennium development goal/ objective (1 US Dollar/day/person), which is localized to 3birr/ person/day in the Ethiopian context.

1.6 Limitation of the Study

The study was confronted with budget constraint. Thus, it was restricted to limited area coverage and sample size (one woreda with 120 sample households). Secondly, the analysis was made based on the households' own estimations of crop production and income. Thirdly, the study was based on a one-time survey and could not capture the variability in harvest due to variability of rainfall at different times. Yet effort was made to the maximum possible to collect reliable data and to cover broader socio-economic and demographic aspects of the households. The primary data collected by interviewing the sample households were supplemented by focus group discussion with different community members, key informants and secondary data from relevant offices.

1.7 Organization of the Paper

The next part focuses on review of literature. In this part, definitions of concepts and measurements of food security are explained. In addition literature on agricultural technologies and extension intervention in Ethiopia in different periods are reviewed. Part three discusses the study area. Part four presents the descriptive analysis of demographic and socio-economic characteristics of households in the study area. It also includes situation analysis of extension and technology adoption, input supply and credit service and participation of households in non-farm income generating activities. More importantly this part of the paper explains the impact of the household package, on food security and income of the farming household. Lastly, part five summarizes the findings and forward some recommendations based on the study result.

CHAPTER TWO

LITERATURE REVIEW

2.1 Household Food Security

Until the 1970s, the term food security was concerned only with global and national food security situations. It is since the 1980s, that the household food security concept came into image. The evaluation or the paradigm shift from national and global to household and individual was based on the theoretical framework set by Sen's entitlement approach (Sen, 1981) that is shift from macro to micro and from production to access.

World Bank (1996) defines food security as "access by all people at all times to enough food for an active and healthy life" (Maxwell and Frankenberger, 1992: 68). This definition implies that food security comprises four dimensions. i.e. availability of adequate food, sustainability of the supply, physical and economic accessibility of food/entitlement and quality and safety of food.

The UN also defines household food security as "the ability of household members to assure themselves sustained access to a sufficient quantity and quality of food for active and healthy life" (Eshetu, 2000: 44). Literature on household food security contains numerous definitions. However, most of them adopted four core concepts: sufficiency, access, security and time.

2.1.1 Sufficiency

The concept of enough food or sufficiency is an ambiguous term. As indicated in literature, it refer to enough food, minimum calorie requirement and adequate to meet nutritional need. It concentrates more on calorie required not to survival but for an active and healthy life. This means, having enough to eat is not enough by itself rather it requires adequate calories for an active and healthy person on a sustainable basis (Zipperer, 1987, cited in Maxwel and Frankenberger, 1992).

2.1.2 Access/Entitlement

Sen (1981), the pioneer contributor to entitlement approach, demonstrated that a decline in food availability is neither necessary nor sufficient to create hunger. Access to food can be achieved through purchase even if households are not self sufficient from own food production.

Fore instance, some people argued that the causes of Wollo Famine in Ethiopia, in 1972 – 74, could illustrate the entitlement/access approach.

> *Availability of food, to some degrees, was guaranteed in neighboring regions from where food could have been taken to the former Wollo province. However, this did not occur as the purchasing power of the people had already been eroded. Traders, as a result of the market failure, were not attracted to bring food in from relatively surplus producing regions. On the other hand, it was also reported that grain was moved out of Wollo to other areas during the same period (Chisholm, et al, undated: 48).*

2.1.3 Security

Securing access to sufficient food is the third main concept of household food security. As mentioned above Wollo famine which was largely caused by failure to entitlement was also exacerbated due to a risk to secure sufficient food. According to Maxwell (1992), the risks to food entitlements can originate from many sources including variability in crop production and food supply, market price variability, risks in employment and wages, risks in health and morbidity and conflicts.

A risk to food insecurity has three dimensions: (1) the risk of exposure to crisis/shocks, (2) the magnitude or consequences of the crisis, and (3) household vulnerability to these crisis (Bohle, 1993; Alexander, 1992, cited by Chisholm, et. al, undated). The later dimension is categorized as an important aspect that is determined by the adequacy of households' capacity to cope up with crisis.

From this perspective, Oshaug (1995) identified three kinds of households:

- Enduring households (which maintain household food security on a continuous bases),
- Resilient households (which suffer from shocks but recover quickly and
- Fragile households (which become increasingly insecure in response to shocks (Maxwell and Smith, 1992: 33).

2.1.4 Time

Secure access to enough food at 'all times' is the fourth concept in understanding food security. When a household can cope with and recover from shocks and maintain its capacities at all times, sustainable food security is attained. The time dimension refers to the intensity and characteristics of food insecurity in terms of its duration and frequency (Chisholm, et al, undated). That is food security could be transitory or chronic. According to Maxwell and Frankenberger (1992) and World Bank (1986), chronic food insecurity is a long term- decline of in households' access to enough food. In other words, it is a sign of poverty and illustrates a structural deficit in production and lack of the ability to purchase.

Transitory food insecurity on the other hand implies a short-term (temporary) fluctuation in food production resulted from climatic changes and/or fluctuation in food prices or incomes.

2.2 Measuring Food Security

As food security is a multidimensional issue, it is determined by interrelated socio-economic, political and natural factors. Household food security is mainly affected by the process of economic status of the household and socio-economic situation of a given economy (Chisholm et, al, undated). Thus, it is a

complicated task to measure household food security in situations where there is no universally agreed yardstick.

Yet, Frankenberger (1992) has summarized the security indicators into process indicators and outcome indicators. The former indicator includes food supply and food access situation, and the later serves as proxies for food consumption. According to Frankenberger 1992 and Debebe 1995, the most common indicators of food security revolve around measures of food consumption. In practice the availability of food required in Kilocalories (kcal) equivalent is the benchmark measure for food security (Samson, 2002).

Food supply indicators provide information on the likelihood of shocks (including agricultural inputs, application of technologies, metrological data, resource endowment, market information and infrastructure, disease and pests, regional conflict and agricultural production data) that affect household food security.

However, these indicators are aggregated and are hardly used to monitor food security/ insecurity at household level (Debebe, 1995). The food access indicators show the coping mechanisms of households to meet their food requirement. Unfortunately, the indicators differ from locality to locality and from household to household (Frankenberger, 1992; Debebe, 1995). This implies that the food access indicator is not also a universally accepted unit of

measurement for food security but location specific. Furthermore, Frankenberger grouped outcome indicators in to direct and indirect indicators of household food consumption. They include the household budget expenditure, food consumption frequency, subsistence potential ratio (amount of food in calorie which a household can produce in a year), nutritional status, household perception of food insecurity and storage estimates (Frankenberger, 1992).

In this study, food consumption is therefore adopted to assess food security level by using household calorie acquisition. For this purpose, data on food availability (per capita food supply) is converted into calories using the nationally recommended level, 2200 kcal per adult equivalent per day and grain calorie equivalent conversation factors.

2.3 An overview of Agricultural Technology and Extension in Ethiopia

2.3.1 Technologies and Agricultural Development

Despite substantial efforts have been made by public and non public sectors to improve the performance of agricultural sector, it could not feed the growing population in poor countries such as Ethiopia. Food insecurity is still a major challenge for millions of people. The cause for the low yield of peasant agriculture, among others, is low application of improved agricultural

farming households. This is because technology adoption is mainly affected by the institutional capacity to generate and disseminate the technologies coupled with natural factors (drought, pests and diseases) and the household's personal characteristics (Tenkir, et al, 2004).

Technologies must be technically feasible, economically viable and socio-culturally acceptable so as to transform the traditional agriculture and thereby to alleviate problems of poverty and food security (Habtemariam 1996, cited by Dejene M. 2000).

2.3.2 Extension

Extension can play a crucial role in agricultural transformation by disseminating improved technologies, know how and timely information to farmers. World Bank defines extension as "the process of helping farmers to become aware of and adopt improved technology from any source to ensure their production – efficiency, income and welfare" (Ponniah, et al, undated: 1). Extension intervention in Ethiopia has passed different epochs and approaches. These can be discussed in relation to the different political regimes exercised in the country.

areas. That is, these comprehensive projects failed to bring any change in production and productivity of the small-scale peasant farming mass. Its benefits largely went to the landlords, which rather induced eviction of the peasant farmers. To alleviate this problem Minimum Package Program (MPP) was designed and extension centers were opened following the main high way road to provide extension service to the small-scale farmers. Later, Extension Project Implementation Department (EPID) was established to run the program.

However, poor farmers were not beneficiaries of the program for lack of collateral for the credit, and the extension service was restricted to few sites to provide essential services. As a result these programs too could not influence the farming system of the country, consequently agriculture remained in its traditional stage.

2.3.2.2 Extension Intervention During the Dergue Regime (1974 – 1991)

After the Dergue came to power, Ministry of Agriculture (MoA) was restructured. EPID was dissolved and the extension activities were decided undertaken by the departments organized by commodity-based set up. Extension centers were closed and the Development Agents were assigned at the woreda agricultural offices. In 1980s, a project called Peasant Agricultural

Development Project (PADEP) was launched with the external assistance (Befekadu and Berhanu, 1999/2000, Ebrahim 2005). This program was emphasized on introduction of institutions such as producers' cooperatives and service cooperatives, awareness creation on soil and water conservation and distribution of inputs. Training and Visits (T & V) approach was used to disseminate the new technologies (EEA/EEPRI, 2005).

However, PADEP too, was not successful like the previous comprehensive and minimum package projects. The major reasons include; (1) the majority of farmers were neglected as emphasis was given to the few producers cooperatives and state farms, (2) political instability and (3) lack of budget (EEA/EEAPRI, 2005, Befekadu and Berhanu, 1999/2000, Ebrahim, 2005).

2.3.2.3 Extension Intervention Under the Current Government

a) Participatory Demonstration and Training Extension System (PADETES)

After critically evaluating the past extension approaches and programs, a new extension approach called participatory, demonstration and training extension system (PADETES) was developed in 1995 as a National Extension Intervention Program (NEIP). This extension approach has incorporated the positive aspects of SASACAWA Global (SG 2000), the training and visit

extension system and the PADEP program approach. Unlike the previous programs and approaches this extension approach was born locally and run by government budget. PADETES follow a package approach (a group of separate items packed together as a single unit).

Despite of all the removal of all input subsidies since 1997/98, application of fertilizer increased from 3,527 tons in 1995 to 216,876 tons in 1999; utilized improved seeds increased from 1,104 to 171,778 tons in the same period; the value of credit that began 8.1 million has reached 150.2 million (Assefa and Gezahegn 2004).

According to Ebrahim (2005) the package program results increasing crop yield. For example, yield of maize, wheat, teff and sorghum is two to four times greater than the conventional practice; participating farmers in the program increased from 32,000 in 1995 to about 4.2 million in 2002; number of development agents (DAs) increased from 2500 in 1995 to 15,000 in 2002. PADETES has succeeded to penetrate deep to the rural areas and to some extent increase the production and productivity of the adopter farming households. However, it has not been exempted from problems. The problems experienced during the program implementation were: shortage of transferable technology, shortage of inputs, market problem, lack of sound credit system, involvement of extension staffs in non extension activities and loose linkage of research and extension (Ebrahim, 2005). Blanket

recommendation of inputs such as fertilizer and improved seeds was also one of the big problems (EEA/EEPRI, 2005). Too low extension workers to farmers' ratio and ambition, based on annual quota system that lacked technicality in technology transfer also were the other problems.

b) Household Extension Package

To rectify the above-mentioned problems of PADETES, agro ecology based and market oriented menu of packages are developed to overcome the blanket recommendation of inputs and to monitor the outcome of the extension packages on household food security. The localized and household based extension packages have been implemented since 2002/2003. Farmers select from the menu of packages based on their family labour, land holding size, livestock possession and market conditions.

Corrective measures have been taken among which bringing together the different stakeholders who were previously organized separately have become under one organizational setup so as to facilitate the supply of inputs, technology transfer and marketing. i.e. for example, in the study area, Tigry region, bureau of agriculture and natural resources, agricultural research center , cooperative promotion and agricultural inputs food security desk, and DPPC are organized under the bureau of agriculture and rural development, Marketing agency is also established as an independent office to work closely

with the bureau. Farmers who involved in the household based extension package are expected to secure their food requirement within 3-5 years. Evaluation of the performance of this extension system is the subject of this paper.

2.4 Factors Affecting Technology Adoption

The objective of the extension package program is to increase farm production and productivity through creation of awareness and technology adoption. However, the adoption decision of farmers and intensity of use of improved technologies are determined by many factors. The factors documented in literature include farming household specific characteristics, available farm resources, access to credit, information and market. For example, EDRI conducted a rural survey in 2001/2002 covering 1920 households in four regions (Tigray, Amhara, Oromia and Southern People and Nationalities) to evaluate the progress made in adoption and diffusion of agricultural technologies through PADETES. The result of the analysis shows that:

- Farmers with larger land holding are more likely to adopt technologies as compared to those with small land holding.
- Older farmers have lower probability of adopting new technologies.
- Information (extension contact) is found to be crucial determinant for technology adoption.

- Literacy level, proximity to extension service center and availability of family labour have shown positive relationship with rate of technology adoption (Assefa and Gezahegn, 2004).

Another study on technology adoption (Tesfaye Zegeye et al, 2000) in two districts of Gojam (Yilmana Densa and Farta) came up with the result that complementary inputs, participation in demonstration fields and access to credit were found to be the explanatory variables of technology adoption. In addition, regardless of land holding size and participation, contact with the extension agent raised the probability of adoption (Tenkir et al., 2004).

Findings of a study conducted outside of Ethiopia (Midhil District, Nepal) to assess the impact of foreign aided project in technology adoption and food security and to identify factors determining adoption of improved technology in small scale farmers show that adoption decision was strongly influenced by the availability of credit, extension service, years of enrolment in education, level of income, active participation of beneficiaries in the process of program implementation and farm size were found to be explanatory variables of the technology adoption. More importantly, farmers who were engaged in non-farm income generating activities were better adopters than the resource poor farmers (Bahadur and Seigfried, 2004). This could be probably due to better availability of cash for input purchase.

2.5 Impact of Extension Package on Farm Productivity and Household Food Security

Food insecurity problem at a country and the farming household levels is a serious problem in Ethiopia. On average, 700,000 metric tons of food aid have been imported to meet the food need, which is 10% of the domestic production for the years 1985 – 2000 (FDRE, 2002).

According to the CSA Welfare Monitoring Survey (2004), over 31% of the households in the country suffered from food shortage. 46.9% of children were stunting. 8.3% and 37.1% were wasting and under weight respectively. The survey result also showed that the problem was more serious in rural areas for all cases.

To reduce food insecurity and poverty, the government of Ethiopia has launched sets of actions among which extension package program is one. The main objective of the undergoing extension package program is to enable the subsistence farmers to produce sufficient food to satisfy their families' consumption requirements. To this end, different technologies/ inputs and other essential service have been provided to farmers that could augment agricultural productivity which in turn contribute to attain household food security. Due to the increase in input supply and extension services, increment in production and productivity of cereal crops per unit area has

been observed. For example, the survey data of the national survey conducted by the EEA/EEPRI (2005) covering a sample of 4,585 households, indicated that there is yield differentials between the extension package intervention and the conventional practice on major cereal crops. That is the mean yield harvested by extension package beneficiaries for barley, maize, sorghum, *teff* and wheat show an increment of 6.4%, 26.3%, 22.2%, 6.8% and 10.3% respectively as compared to the production of the non beneficiaries on these crops (EEA/EEPRI; 2005). In the same source, it was indicated that out of the sampled households (N=4585), 23% responded that their production increased by up to one fourth and 21% responded their production increased by two to three folds due to application of technological inputs.

Results of a survey conducted in Hitosa and Dodota Sire weredas of Oromia region also revealed that house holds who practiced the extension package had better food self sufficiency status than the conventional practitioners (Hailu Ejara, 2000).

A study made in Benishangul Gumuz region also came up with results that show extension package beneficiaries had better harvest than non-beneficiaries. For example, the beneficiaries' harvest for the crops maize, sorghum and *teff* was 50.2, 33.3 and 5 quintal/hectare. The corresponding figures for the non- beneficiaries were 22.5, 14.4 and 4.8 quintal/hectare. Further more the study indicates that the extension beneficiary households

consume more calories (1206.92/person/day) than the non-package beneficiaries (622.22/person/day) (Hailu Kassaye, 2000).

According to the EEA/EEPRI study report (2005) taking own produce and an average family size of 6persons/ household, 57% of the farmers participated in the extension package and 71% of the non-participant farmers were found to be food insecure. Thus, despite some improvements in the production and productivity with the extension package beneficiaries; food insecurity is still a major challenge for the Ethiopian farming households.

Whatsoever it is, the results of different study imply that though food insecurity is still a serious problem, those who participated in the extension packages have better food security status. It could be presumed that, the food security level differentiation among the participants and non-participants in the extension has been caused due to application/adoption of improved technologies. However, food security is a multi dimensional issue and could be also affected by factors other than technologies. Therefore, analyzing and identifying the factors that affect household food security can help for policy makers and development practitioners to work towards maximizing the out put of extension package intervention and thereby food security is ensured and poverty is reduced.

CHAPTER THREE

GENERAL BACKGROUND OF THE STUDY AREA

3.1 Location and Physical Characteristics

Tigray Region has five administrative zones, which are further sub-divided into 35 woredas (districts). The particular study site, Kilte Awlaelo Woreda (KAW) is located in Eastern Zone of Tigray, at about 50 kms to the North of Mekelle (Regional capital) along the Mekelle-Adigrat main road. KAW has 15 rural administrative localities called 'tabias'. Each 'tabia' has its own administration unit called 'baito'. The total area of the woreda is 987.32 kilometers square (SCA, 2004b). Data obtained from OKAWARD indicate that the land use pattern of the woreda is classified as cultivated land 19283 hectare, range land 4796 hectare, forest land 6698 hectare and the rest (67,985 hectare) is either unproductive or occupied by houses, roads, waterways, etc.

The altitude of the woreda ranges from 1900-2300 meters above sea level. The rainfall season in the woreda extends from late June to August. However, KAW is one of the drought prone areas of the region and the country as well. The average annual rainfall for the years 2000-2005 is 443.7mm. The lowest and highest rainfall data recorded at the woreda is 241.5mm in 2002 and 560

mm in 2005 respectively. In general, the rainfall pattern was erratic with uni-modal distribution and offers highest intensity in July.

3.2 Demography

According to the available sources, the population of the woreda is estimated to be 117,862 in 2005 (CSA, 2005). Out of the total population, 60,330 (51.2%) were female. About 70.3% of the population lives in rural areas. The rural household heads in the woreda were 21,676 of which 7157 (33%) were female (OKAWARD, 2003). According to the population projection made by the Tigray Bureau of Finance and Economic Development (TBoFED), the age distribution of the rural population in the Woreda was 44.3% under 15 years, 52.2% between 15-64 years and 3.5% were 65 and above. Based on this data the dependency ratio of the rural population is about 91.6%.

3.3 Extensions and Agricultural Production

Like in the other drought prone areas of the region, agriculture in Klte Awlaelo is only subsistence, which is unable to secure adequate food supply, and cash for the farm households' yearly expenditures. Farmers grow different food and cash crops and rear livestock including beekeeping and poultry. The dominant crops grown in the area include wheat, barley, *hanfets*, and *teff*. The irrigated land accounts 752 ha (3.9% of the cultivated land). According to the key

community member informants, the major problems of agriculture in the woreda are erratic and shortage of rainfall, poor soil fertility pests and diseases.

Based on the livestock study by the woreda in 2003, the livestock population was 13,048 oxen, 46,188 non-ox cattle, 46,418 small ruminants and 13,036 equines. There were also 6,644 beehive and 42,733 poultry (OKARD, 2003). This shows that on average a household owns 0.6 oxen, 2.1 non ox-cattle, 2.14 small ruminants, 0.6 equine, and 0.3 beehive and 2 poultry.

All the fifteen 'tabias' in the woreda have a farmers' training center (FTC) with three Development Agents (DAs) one each for crop, livestock and soil & water conservation expert. At least two of the DAs were diploma graduates from the Agricultural, Technical, Vocational Education and Training (ATVET) colleges in the country. In addition, there were nine home agents working for the fifteen FTCs. Out of the 21,676 farming households in the wereda, the households involved in the household based extension package program were 12,254. It is also planned to engage additional 6,934 households in 2006. According to OKAWARD the remaining 2,488 households were already food secure.

Despite the fact that fertilizer utilization is increasing at national level (Tenkir, et al, 2004), in Tigray region as well as in Kilte Awlaelo Wereda (KAW)

the trend is decreasing mainly due to the escalating price of the fertilizer. On the other hand, the application of improved seed has no regular trend. The amount of improved seed utilized varies from time to time depending on the market (supply) and rainfall situations.

Table 1: Fertilizer and improved seed utilization (1999 – 2005)

Year	Fertilizer Application (Qt)		Improved seed (Qt)
	KAW	Regional	KAW
1999	2375	124260	1305
2000	1786	115360	1455
2001	1239	113180	258
2002	1240	100910	281
2003	1209	101730	2752
2004	1734	8897	905
2005	1441	81700	1639

Source: TBARD, OKWARD, 2006

Table 2: Price of fertilizer (2002 – 2005)

Year	KAW		Regional average	
	DAP	UREA	DAP	UREA
2002	275	245	272	221
2003	285	262	235	212
2004	305	272	312	280
2005	363	316	388	341

Source: TBARD, OKARD, 2006

Crop production in the woreda has been very low due to lack of appropriate technology and shortage of rainfall. The later can be illustrated from the production harvested in 2002 and 2005; when there was very low rainfall and some distribution of rainfall respectively. On the other hand, irrigation

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Demographic and Socio-economic Characteristics

4.1.1 Family Size and Age Distribution of Households

Food security level of households is affected, among others, by the family size and age distribution of household members. That is, the more the working labour in the household; the more the family members can contribute to the household's income. On the contrary, if the family size of households, particularly in the age group of 0-14 and 65+ years is large, the household's food security status will be negatively affected. In KAW, the survey result showed that the average age of the household heads was 42.2 years and 26% of the households were women headed. The average family size of the households was also found to be six.

Table 5: Distribution of Sample household heads by type and gender

Household Type	Gender		
	Male	Female	Total
Package Beneficiary	40 (72.7)	15 (27.3)	55
Non-Package Beneficiary	49 (75.4)	16 (24.6)	65
Total	**89 (74.2)**	**31(25.8)**	**120**

Source: 2006 Survey by the author

Figures in parenthesis are percentages

The average family size of the rural areas of KAW exceeds the regional rural average (4.5 according to CSA, 1995) by 1.5 per household. The dependency ratio in the rural areas of the wereda was 118%, which means for every 1 economically active person, there are 1.2 dependent persons.

Table 6: Age structure and sex distribution of members of sample households

Description	Age group (in years)			Total
	≤14	15-65	65+	
Package Beneficiary				
Female	75	83	3	161
Male	98	72	2	172
Sub Total	173	155	5	333
Non-Package Beneficiary				
Female	99	86	0	185
Male	107	89	1	197
Sub Total	206	175	1	382
Grand Total	**379**	**330**	**6**	**715**

Source: 2006 survey by the author

4.1.2 Educational Status of Households

Educational level of households was assessed to see whether there is any relation with technology adoption/input utilization particularly improved seed and fertilizer. However, the result revealed that education level of the farming households has not influenced the input utilization.

Table 7: Distribution of household heads by level of education and gender

Description	Level of Education				
	Illiterate	1-4 grade	5-8 grade	9-10 grade	Total
Package Beneficiary					
Female	12	3	0	0	15
Male	15	18	6	1	40
Sub Total	27	21	6	1	55
Non-Package Beneficiary					
Female	12	2	1	1	16
Male	20	15	11	3	49
Sub Total	32	17	12	4	65
Grand Total	**59**	**38**	**18**	**5**	**120**
%	49	32	15	4	100

Source: 2006 survey by the author

As can be seen from Table 7, nearly half of the household heads were illiterate. Furthermore, illiteracy is more for the women as compared to men.

4.1.3 Land Holding

The average land holding in the study area was 0.8 hectare. The land holding of households ranges from 0.0 to 1.75 hectare. Only one third of the households had greater than a hectare while the majority had less than a hectare. Furthermore, 2.5% of the farming households were landless. In general, the land holding size is too small to sustain the rural households under the prevailing level of technology.

In the woreda, 53.3% of the responding households reported that they were engaged in sharecropping and renting of land. The land less who possess oxen

modified to be accountable to the Bureau Head (Appendix-13) but not exercised until the completion of this research work.

At the woreda level the extension service is given by 45 DAs in the 15 farmers training centers (FTCs) and monitored by two supervisors and the extension team leader stationed at 'woreda' office. Farmers were trained in the FTCs to upgrade their ability of utilizing the newly introduced packages. In addition, extension messages have been conveyed using model farmers, field visits by arranging farmers' days and some times during meetings.

The households' perception of the DAs visit to assist farmers on implementing improved techniques of agriculture was assessed in this study. The responding households reported that DAs generally did not visit individual households for advice or to show how to implement the new packages at the field level. If a package beneficiary is interested to use a new technology, training is given at the FTC on how to implement the techniques and technologies. In general, the households were not satisfied with the DAs though their number grew from one to three per 'tabia'.

In the regional strategic plan (BoANRD, 2003), it is clearly indicated that the selection of extension package beneficiaries shall be on voluntarily bases. But only 3/4 of the participants participated in the package program voluntarily due to benefits gained from the packages in the past years (45.5%) and for

better access to credit (14.5%), which often leads to additional income in the future. Where as, 25.5% of the participants participated in the program unwillingly. Those who responded to participate unwillingly did not object the whole package program but some package components such as modern beehive that has been considered as a precondition for other components in the woreda for the last two years. According to the respondents, the DAs/'tabia' administrators use an enforcing mechanism by prohibiting the non-package beneficiaries from participating in "Food For Work" activities so that they will participate in the extension package and fulfill the target given to them by the wereda.

Table 10: Reasons for Participation of Households in Extension Package

Reasons for participation	Tabia			Total	%
	Negash	Genfel	Aynalem		
Benefited from previous years	12	6	7	25	45.5
Motivated by demonstration results	0	5	3	8	14.5
To access credit services	0	7	1	8	14.5
Coercion	8	4	2	14	25.5
Total	**20**	**22**	**13**	**55**	**100**

Source: survey 2006

The technologies being adopted by farmers in the woreda include improved seeds, fertilizer, dairy cow, modern beehive with accessories and improved poultry. Improved wheat seed, poultry and cross -breed cows were the most liked inputs/technologies by the farmers. As can be seen from Table11, improved wheat seed was adopted by 62% of the package beneficiaries and

As can be seen from Table 11, farmers discontinued to use modern beehive due to absconding of the bee colony. They also stopped use of improved chicken production due to attack of the chicken by wild animals and birds. Reasons of non-adopters for not applying the technologies include unreliable rainfall (for fertilizer), lack of supply (improved animal breeds and seed), lack of credit and lack of information about the importance of the inputs in that order.

The application rate of fertilizer and improved seeds differ from a farmer to another. About 75% of the fertilizer users apply as per the rates recommended by the DA while 25% of the households apply less because it is expensive. Similarly, for improved seeds, 62% of the users apply as per the recommended rate, 27% apply less and 5.6% apply more than the recommended rate for the reason that if seeding rate increases crop can rapidly cover and compete out the weeds. The remaining 5.4% of the respondents do not have information on the rates recommended by the DA.

4.3 Input Supply and Credit Service

Availability of input supply and rural credit service are the basic preconditions for agricultural production and productivity. The yield enhancing technologies in crop and livestock sub sectors, and the credit provided to farmers in the study wereda are discussed below.

4.3.1 Input Supply

Crop Package

The inputs provided to farmers include improved seed (wheat, Teff, maize and barley), fertilizer (DAP and UREA), herbicide and pesticides, and recently water harvesting and irrigation equipment/ materials (treadle pump, plastic, cement and drip). Fertilizer utilization in KAW and in the region as a whole showed a decreasing trend and this is probably due to the escalating price of fertilizer (see Table 2). Where as the improved seed utilization fluctuates from time to time depending on the availability (supply from the private seed multiplication enterprises, research centers and individual farmers). Otherwise, the price for seeds was stable at least for the last five years (2001-2005) i.e., the average price for improved wheat, teff and maize was birr 245.00, 380.00 and 222.00 (OKAWARD) respectively for the indicated years as the government subsidizes it.

To alleviate the problem of shortage of improved seed supply, the woreda designed a strategy to multiply the seed on volunteer individual farmer's plot by arranging a contractual agreement on future prices (adding 15% on top of the market price of that particular product). The amount of fertilizer and improved seed applied differs among those of package beneficiaries and non-package beneficiaries. The study revealed that the non-package beneficiaries use more fertilizer (23 kg/ha.) than the package beneficiaries (19kg/ha).

Similarly, improved seed application rate of non-package beneficiaries was 33 kg/ha. while that of package beneficiaries was 22kg/ha.

Table 12: Average Inputs Utilization per household (2005)

Type of Household	Inputs Utilized (in kg.)/HH			
	Improved Seed		Fertilizer	
	Wheat	Teff	DAP	UREA
Package beneficiary	18	0	8.2	10.3
Non package beneficiary	26	0.4	12.3	10.7

Source: 2006 Survey

As shown in Table14, the package beneficiary households received a loan of birr 94 and 58 per household for improved seed and fertilizer respectively. The corresponding figures of the non- package beneficiaries were birr 2.00 and birr 17.00 per household. However, the improved seed and fertilizer utilized by the package beneficiary households is less than that of the non-package beneficiaries. This could be (1) due to the divertion of the loan to other unintended packages or misallocating the loan for unproductive purposes by the package beneficiaries and (2) due to past experience and awareness of the non-package beneficiaries on the importance of the inputs.

Livestock package

The livestock package components include dairy, poultry, fattening and bee keeping. Dairy cows such as Friesian and crossbreed cows through artificial insemination (AI) service are highly demanded by the farmers particularly in pre-urban areas. However, the supply is very limited and as an option local

heifers and the Barka /Begait heifers/ (from western Tigray) have been distributed. The Begait cows have better performance in some areas (similar agro-ecology they came from). But, farmers in KAW were complaining that they were less important and hence some farmers sold them out.

Fattening of cattle and/or small ruminants is another profitable package as confirmed by the respondents. The fattening could be from farmers owned animals or purchased ones by credit. The beneficiaries (credit takers) are expected to fatten three cattle or 15-18 small ruminants in a year, but the farmers did not practically implement it. When they fatten an ox, they use the ox for ploughing and sell during the slack period. When they were promised to fatten small ruminants for the creditor, they kept them at home hoping that they will give to offspring.

Modern beehive with its accessories was massively introduced to the farmers in the KAW because, based on the area specialization strategy, honey was planned to be the primary product followed by highland pulses (secondary product) (TBoARD, 2003).

However, significant numbers of respondents were not happy by the action of the KAWARD office. Some farmers even sold the subsidized beehive back to the woodwork shops at a cheaper price. Some also kept them at home idle and requested the responsible office to take them back. The beneficiaries

4.3.2 Credit Service

It is highly believed that credit service enables smallholder farmers to purchase modern inputs and thereby increase farm production. In the study area credit is given mainly by Dedebit Credit and Saving Institution (DECSI) and to some extent by Farmers' Service Cooperatives (for seed and fertilizer only).

Under normal conditions, DECSI charges 12.5% interest rate for clients and demand group formation to serve as collateral. However, in the currently launched program, household based extension package, the regional government agreed with DECSI that 3.5% of the interest is to be paid by government as a subsidy for the package beneficiary farmers. In addition to this, the government promised to repay the loan on behalf of those who failed to repay the loan taken due to failure of crop or animal loss by natural calamities.

Thus, package beneficiary farmers were not obliged to form a group for collateral purposes. The survey result shows, 31% of the package beneficiaries and 25% of the non-package beneficiaries took a loan (credit) in 2005.

Table 13: Proportion of credit recipient households (2005)

Household type			Tabia			Total	%
			Negash	Genfel	Ayanlem		
Package beneficiary	Credit received	Yes	8	3	6	17	31
		No	12	19	7	38	69
		Total	20	22	13	55	100
Non Package beneficiary	Credit received	Yes	9	1	16	16	25.4
		No	11	15	23	49	74.6
		Total	20	16	29	65	100

Source: 2006 survey

The non-package beneficiaries used the total credit for the purpose they took. Where as, out of the package beneficiary households, only 64% used for the intended purpose but 21% used in partial and 15% did not used at all for they promised to the creditor.

Out of the package beneficiaries who took loan, 92% repaid in partial and the rest 8% in full. Similarly the non-package beneficiaries repaid 93.3% in partial and the remaining 6.7% in full. However, it could be too early to comment on the loan repayment status because the repayment period for modern beehive with accessories, dairy cow and irrigation equipment (such as drip, water pump etc.) was fixed to be three years, four years and five years, respectively. Loan taken for animal fattening, improved seed and fertilizer was repaid in one-year time (TBANRD, 2003).

4.5 Impact of Extension Package on Household Food Security and Income

4.5.1 Impact on Household Food Security

The crop output analysis shows productivity and production of the package beneficiaries exceed from that of non-package beneficiaries by 1.05 quintal per hectare and 3.2 quintal per household respectively. The later figure could mean package beneficiaries cultivate or have relatively larger farmland size. Comparing the before and after intervention within the package beneficiary themselves, the productivity per hectare of the after intervention exceeds from the before intervention by 4.6 quintal/ha. This result shows the effectiveness of the extension package.

The total crop production harvested by the sample households for the year 2005 was 11.5 quintal/HH and 8.3 quintal/HH for the non-package beneficiaries and package beneficiaries respectively. Similarly, the before intervention production for the package beneficiaries was 6 quintal/HH.

Table 16: Crop Production by Package and Non package Beneficiaries (2005)

Type of crop planted	Household type								
	Package beneficiary						Non-package beneficiary		
	Before intervention			After intervention					
	Cultivated land (ha)	Production (qt)	Yield (Qt/ha)	Cultivated land (ha)	Production (qt)	Yield (Qt/ha)	Cultivated land (ha)	Production (qt)	Yield (Qt/ha)
Rainfed	**45.75**	**312.32**	**6.8**	**51.32**	**398.25**	**7.8**	**49.37**	**404**	**8.2**
Cereals	**45.0**	**308.80**	**6.9**	**46.70**	**351.15**	**7.5**	**45.70**	**387.6**	**8.5**
Wheat	16.06	124.75	7.8	15.88	131.95	8.3	16.88	179	10.6
Barely	8.25	62.60	7.6	8.5	73.0	8.9	11.25	70.75	6.3
Hanfets	10.06	72.95	7.9	9.06	80.75	8.9	8.19	73.71	9.0
Teff	8.4	33.52	4	11.31	62.0	5.5	7.38	51.65	7.0
F.Millet	1.5	5.5	3.7	0.81	3.50	4.3	0.19	1.00	5.3
Maize	1.44	3.25	2.3	0.94	6.50	6.9	1.39	10.0	7.2
Sorghum	0	0	0	0.19	1.50	7.9	0.44	1.5	3.4
Pulses	**0.76**	**3.5**	**4.6**	**4.63**	**47.10**	**10**	**3.65**	**16.40**	**4.5**
Chick pea	0.38	1.5	3.95	0.56	3.75	6.7	0	0	
F. pea	0.25	1	4	0.25	1.0	4	0.125	0.75	6
Horse bean	0.125	1	8	0.69	12.3	8	0.22	2.0	9
Vetch	0	0	0	3.125	30.0	6.4	3.3	13.62	4
Irrigation	**2.51**	**15.3**	**6**	**4.1**	**238.10**	**58**	**1.90**	**127.5**	**67**
Maize	1.6	10.3	6.3	2.63	124	47	1.05	54.50	57.2
Tomato	0.25	5	2.0	0.125	25	200	0.125	20.50	164
Potato	0.63	0	0	0.88	79	89.8	0.50	47.50	95
Pepper	0	0	0	0.44	10.10	23	0.21	5.0	23.8
Total	**48.25**	**327.6**	**6.8**	**55.40**	**634.35**	**11.45**	**51.27**	**540.5**	**10.5**
Average/HH	**0.88**	**6.00**		**1.00**	**11.50**		**0.79**	**8.30**	

Source: 2006 survey by the author; *HH=Household*

The level of calorie available to a household is a crucial indicator of the status of food security. Thus, the total households' production was converted in to calorie equivalents. Converting the harvested production into calories has passed through different stages. It followed by first converting all grain types into quintal and then converting the quantity in to calorie equivalent based on the Ethiopian Health and Nutrition Research Institute's food composition table. Thereafter, the available kilocalorie per adult equivalent per day was computed.

In this exercise, knowledgeable people in the area of food security and nutrition were consulted to estimate the food security level in terms of the minimum daily calorie requirement per person. The 2200 calories per person per day level set by the Ethiopian Government was used as the minimum required for an active and healthy life. This level of calorie intake was calculated to require about 2.36 quintal of grain (cereals/pulses) per person per year.

Based on the aforementioned indicators and measurements, the lowest and highest kilocalorie/household/year were found to be 283,284 and 32,910,742 respectively. Only 16.4 of the package beneficiary and 4.6% of non-beneficiary households fulfill at least the minimum calorie requirement from own production. Where as, in absolute terms the majority (84%) of the households (78% of the package beneficiary and 89% of the non-beneficiary) have at least three months food deficit. The result also shows that even the 30% of the total

sample households (23% of the package beneficiaries and 35.4% of the non-beneficiaries) have nine months food deficit (Table 17).

Table 17: Distribution of Available Kilocalorie per household per year from own production (2005/2006)

Available Kcal	Type of HH		Total	
	Package beneficiary	Non package beneficiary	Sample Total	%
283284-1204499	13(23.6)	23(35.4)	36	30
1204500-2409000	18(32.7)	24(36.9)	42	35
2409001-3613500	12(21.8)	11(16.9)	23	19.2
3613501-4818000	3(5.5)	4(6.2)	7	5.8
4818001-32910743	9(16.4)	3(4.6)	12	10
Total	**55**	**65**	**120**	**100**

***Source: 2006 survey* by the author**

If we talk in average terms of the available calorie, nearly 68% of the package beneficiaries and 49% of the non-package beneficiaries able to meet their minimally required annual food from own product. As can be seen in Table 18, though the available kilocalorie per person per year (from own production) of the package beneficiaries increased by 39% of that of the non beneficiaries and by double from the before intervention, food deficit is still a big problem for the majority of households.

However, the grains obtained from food for work through the safety net program helped the all package beneficiaries to satisfy their calorie intake requirement. The non-package beneficiaries also improved their calorie intake requirement by18.2% due to the "Food For Work" activities (Table18).

Table 18: Average Available Kilocalorie per person per year (2005/2006)

Available Kcal by source	Household type		
	Package beneficiary		Non -package beneficiary
	Before intervention	After intervention	
From own production	250,147	542,182	389,152
From own product + from food for work	Na	866,594	535,423
Minimum calorie requirement/ person/ year	803,000	803,000	8030,00
Available Kcal as percent of minimum requirement:			
1. From own production	31.2	67.5	48.5
2. From own production + from food for work	Na	107.9	66.7

***Source: 2006 Survey* by the author**

Na: not available

4.5.1.1 Perception of Households on their Food Security Status

The quantitative data was supported by qualitative information by assessing the perception of households on their food security status. The respondents confirmed that the package beneficiary households were on a better position than before the intervention. They have also become better food secured than the non-package beneficiaries. According to the households' perception the number of households who could feed themselves throughout the year have increased from 2% (before intervention) to 16%(after intervention). Similarly, those who were able to feed themselves only for 3-6 months decreased from 42% (before intervention) to 15% (after intervention).

Table 19: Households' Perception on Food Security Status

Number of months food demand met for	Household type		
	Package beneficiary (N=55)		Non-package beneficiary (N=65)
	Before intervention	After intervention	
>12 months	1(1.8)	9 (16.4)	1(1.5)
9-12 months	14 (25.5)	16(29.1)	11(16.9)
7-9 months	15 (27.3)	22(40)	22 (33.8)
3-6 months	23 (41.8)	8(14.5)	29(44.6)
≤ 3 months	2(3.6)	0	2(3.1)

Source: 2006 survey by the author

The figures in parent thesis are percentages

4.5.1.2 Copping Mechanism in Times of Food Shortage

Farmers adopt different coping mechanisms to tackle the problem of food shortage. In the study area, the mechanisms practiced include participating in cash for work/ food for work, eating less preferred food like 'kollo' (toasted grain), sale of livestock, and reducing quantity/ number of meals.

Table 20: Coping Mechanism of Rural Households During Food Shortage (N=120)

Copping strategy	Degree of practice		
	Frequently	Rarely	Never
Reducing quantity of meal	17(14.2)	33(27.5)	70(58.3)
Reducing number of meals	11(9.2)	3831.7)	71(59.2)
Participate in cash/food for work	40(33.3)	38(31.7)	42(35)
Eating les preferred food	9(7.6)	25(21)	85(71.4)
Sale of livestock	1(0.8)	21(17.5)	31(25.8)
Migration in search of job	0	4(3.3)	50(41.7)

Source: 2006 Survey by the author

The figures in parenthesis are percentages

The highest frequently practiced coping mechanisms (Table 20) were participating in food/cash for work activities and reducing quantity of meal followed by reducing number of meals and eating less preferred food.

4.5.2 Impact on Household Income

The main objective of the extension package intervention is increasing the household income through introduction of integrated and complementary packages of crop and livestock including bee keeping and poultry. Attempts have been made to diversify the agricultural production and to provide complementary support for the agricultural production through mass based labour works of the safety net programs.

The household income obtained from crop production, livestock rearing and non-farm activities was assessed and compared among the package beneficiaries and non-package beneficiaries. The income obtained from crop production was computed by netting the revenue from different crops (rain fed and irrigation) less the variable costs (seed, fertilizer, and interest of the loan taken for purchase of the inputs). Plough oxen costs were not considered as the oxen less households acquire oxen for their ploughing operations through different arrangements including exchange of straw and/or pasture grazing for oxen service. There exists also a social tradition of giving oxen service by the haves to the have not.

The income from crop output was computed by converting the production in 'quintal' in to birr using the collected average market price from April 2005 – April 2006. Based on these computations, the net income of the package beneficiary households from the crop sub sector was birr 1056 per household (before intervention) and birr 2202 per household (after intervention) (Table 21). The non-package beneficiaries' income also was birr 1589 per household (Table 22).

The net income from a hectare of land was birr 2,186 for package beneficiaries and birr 2015 per hectare for non-package beneficiaries. The result shows that the income of the package beneficiary household exceeds by birr 565/HH and by birr 171/ha from that of the non-beneficiary household due to the introduction of household extension program. The income per hectare before intervention was as low as birr 1203 per hectare. The income per ha. in the after intervention period increased by nearly 80% from before intervention periods, but nearly 50% of the income increment per hectare comes not due to increase in productivity but due to the increment in market price of the farm outputs.

Table 21: Package Beneficiaries' Income (in birr) from Crop Production - 2005 (N=55)

Crop	After Intervention					Before Intervention
	Gross income	Cost of inputs (birr)		Total Net income	Average Net income per HH	Average Net income per HH
		Seed	Fertilizer			
Wheat	34,043.10	9,546.50	1,943.36	22,553	410	362.70
Barely	12,994.00	1,956.20	222.00	10,816	197	161.60
Hanfets	14,373.50	2,083.99	651.30	11,638	212	312.40
Teff	19,509.33	1,443.15	417.30	17,649	321	139.10
F.Millet	850.50	74.53	37.00	739	13	21.80
Maize	24,795.00	239.05	303.44	24,253	441	32.70
Sorghum	364.50	8.30	0	356	6	0.0
Chickpea	1,012.50	189.15	0	823	15	4.60
F.pea	277.00	118.15	0	159	3	2.80
H.bean	3,407.10	383.64	0	3,023	55	3.60
Vetch	4,060.00	570.94	0	3,489	63	0.0
Tomato	5,750.00	14.00	0	5,736	104	14.00
Potato	18,170.00	4,048.00	257.13	13,865	252	0.0
Pepper	6,060.00	29.04	0	6,031	110	0.0
Total	**145,666.53**	**20,704.77**	**3,831.53**	**121,130**	**2202**	**1055.50**

Source: 2006 Survey

Table 22: Income (in birr) of Non-package Beneficiaries from crop production - 2005 (N=65)

Crop	Gross income (in birr)	Cost of inputs		Total Net income	Average Net income per HH
		Seed	Fertilizer		
Wheat	46,182.00	6,874.45	2,268.95	37,038.60	569.80
Barely	12,593.50	2,817.99	0	9,775.50	150.40
Hanfets	13,120.38	188,403.00	337.49	10,898.90	167.70
Teff	16,252.53	876.15	505.80	14,770.60	227.20
F.Millet	243.00	17.09	0	225.90	3.50
Maize	12,255.00	617.22	76.39	11,561.40	177.90
Sorghum	364.50	13.39	0	351.00	5.40
F.pea	207.75	59.10	0	148.70	2.30
H.bean	554.00	122.32	0	431.70	6.60
Vetch	2,764.86	602.91	0	2,161.95	33.30
Tomato	4,715.00	14.00	229.16	4,471.80	68.80
Potato	10,925.00	2,300.00	195.20	8,429.80	129.70
Pepper	3,000.00	13.86	-	2,986.00	45.90
Total	**123,177.52**	**16,212.51**	**3,712.99**	**103,252.00**	**1588.50**

Source: 2006 survey by the author

Generally, it is known that milk in rural area is consumed at home. In this study result package beneficiaries and non-beneficiaries earned birr 94 and birr 185/HH respectively by selling raw milk. This could be due to proximity to towns. Except the center of Aynalem 'tabia' which is 11 kilometers far from the woreda capital, Negash and Genfel tabias have the opportunity to sell their product to Negash and Wukro towns respectively.

The income earned from non-farm activities particularly in terms of grain and edible oil was also converted into cash using the market price of these particular items in the proceeding year of this study. The contribution of crop, livestock and non-farm activities for the income of the whole sample households was 50%, 27.3% and 22.7% respectively.

In general, the average household income from all sources (crop, livestock and non farm) was birr 4,388 and 3,187 for the package beneficiaries and non-package beneficiaries respectively. This income is compared with the millennium development goal (1 US Dollar /person/ day), which is localized to be equivalent of 3 birr/person/day (MoFED and UN, 2004). In the Ethiopian context particularly in rural areas, where the household economy involves non-monetary transfer, which are difficult to account, the purchasing parity price is estimated to be birr 3/person/ day. Thus, the poverty line in the Ethiopian context is birr 1095/person/ year.

Region. The study results show that improved wheat and fertilizer are the dominant technologies adopted in the study area. Yet, the level of adoption was low. The low adoption rate or use of improved seeds and improved animal breeds was mainly due to shortage of supply while fertilizer use was constrained due to its high price and unreliable/erratic nature of rainfall in the area. This study revealed that 65% and 57.5% of the whole sampled households adopted improved wheat and fertilizer respectively. However, 9.2% and 18.3% of the households discontinued using the improved seed due to unavailability and fertilizer due to high price and unreliable rainfall. In general, fertilizer application in the woreda decreased from 2375 quintal in 1999 to 1441 quintal in 2005. Package beneficiaries use 19kg/hectare and non-beneficiaries use 23kg/hectare. In addition to the low application of technological inputs, the small size of land holding exacerbated the problem of food insecurity. The average land holding is 0.8 hectare per household. The minimum and maximum land holding is 0.2 hectare and 1.75 hectare respectively. The landless households account 2.5%. In enlisting the package beneficiaries, it is reported that 25.5% of the households were engaged to the program due to direct and indirect coercion mechanisms.

Kilte Awlaelo woreda is generally categorized as an area of high potential for honey production. Consequently, modern beehive with accessories was introduced massively in the last three years. However, the farmers were complaining this intervention. The sampled households argued that apiculture

is a risky business. The bee colony can easily disappear and the farmer could remain in vain. Some pocket areas are not also conducive for bee keeping due to lack of forage and water. Based on these arguments, the farmers were resisting to be engaged in that business. The resistance was reflected by sales of the modern beehive provided on subsidy or kept idle at home and requested the responsible body to collect them back and make the farmers debt free. Consequently, despite the fact that the credit money invested on apiculture by the package beneficiaries was larger than for livestock and crop packages, the return (income obtained) from apiculture was reported to be the smallest.

The study result revealed that crop production of the package beneficiaries as compared to the non-beneficiaries has increased by one quintal per hectare and as result Kcal per person per day increased by 419. Average annual income from on-farm also exceeds that of the non-beneficiaries by birr 482 per household per year.

Furthermore, the "Food For Work" activities through the safety net program have improved the income of the households. As the participation of the package beneficiary households was higher than the non-beneficiary, much of the benefit goes to the package beneficiaries. Thus, the available calorie per person per day of the package beneficiaries and non-beneficiaries increased disproportionately; i.e., by 889 kcal and 401 kcal respectively. Similarly their

income also increased by birr 206 and birr 178 per person per year in that order.

As the survey results indicate, the package beneficiaries achieved better food security status and income level than the non-beneficiaries. In average terms, the package beneficiaries fulfilled their minimum calorie requirement from own production and grain obtained from food for work sources. However, it was noted that still some package beneficiaries were not able to fulfill even a quarter of their minimum calorie requirement. The package beneficiaries and non-beneficiaries were able to earn only 67% and 49% of the minimum requirement income per person per day respectively.

In general, though production per hectare and income of households are improved due to the household extension package, the on-farm income of the households is not sufficient enough to fully up lift the food insecure households in the woreda.

5.2 Recommendations

Based on the study findings, some recommendations that require due attention in the efforts to ensure food security at household level in Kilte Awlaelo Wereda are forwarded below.

1. Critical moisture stress combined with lack of appropriate technologies and small land holding size could not sustain the farming households in the wereda. Thus, development of irrigation schemes and expansion of non-farm employment opportunities to maximize the households' income is critically important.

2. Active involvement of stakeholders is decisive for smooth implementation and sustainability of any development program or project. Full participation of the subjects promotes flexibility and enables to take corrective measures. However, these have been practically undermined in the study area. Some times, farmers were even enforced to implement some packages they don't preferred. Thus:
    - Direct and indirect enforcement of farmers to implement the extension packages should be eliminated as it violates farmers right to decide for them selves. Promoting on-farm popularization and farmers' participation in the extension decision would help much.
    - Trustful relationship among the farmers and development agents should be prevailed.
    - Technologies have to be introduced to areas where they are rewarding and on demand driven bases.
3. Significant number of the households who were supposed to graduate food secured in 2005 could not even fulfill a quarter of their minimum

REFERENCES

Agren Gunnar and Rosalind Gibson (1968). Food Composition Table for use in Ethiopia, Part I. Swedish International Development Authority, Stockholm, Sweden and The Ministry of Public Health, Addis Ababa, Ethiopia.

Asfaw Negasa, Kisan, Gunjal, Wilfred, Mwangi, and Beyene Seboka (1997). "Factors Affecting the Adoption of Maize Production Technologies in Boka Area, Ethiopia", The Ethiopian Journal of Agricultural Economics, Vol. 1, No.2, 1997 (pp 52-73).

Assefa Admassie and Gezahegn Ayele (2004). Adoption of Improved Technology in Ethiopia, Ethiopian Development Research Institute, Report No.4, Berhanena Selam Printing Enterprise, Addis Ababa, Ethiopia.

Bahadur K.L and Siegfried B.(2004). Technology Adoption and Household Food Security. Analyzing factors determining technology adoption and impact of project intervention: A case of small holder peasants in Nepal, Paper prepared to present in The Deutscher Tropentag held on 5-7 October, 2004, Humboldt-University, Berlin.

Befekadu Degfe and Berhanu Nega (1999/2000). Annual Report on the Ethiopian Economy. Vol. I. The Ethiopian Economic Association.

Befekadu Degfe, et al (2000/2001). Second Annual Report on the Ethiopian Economy. Vol. II. The Ethiopian Economic Association.

BoPED (1989). Population Projection for Tigray Region, Mekelle .(Report).

Appendix 1: Household Questionnaire

This questionnaire is administered to collect data for the study titled impact of household extension package on food security and income level of the rural households in Tigray: *The case of Kilte Awlaelo Woreda.*

Tabia code----------

HH code----------

Name of enumerator----------Signature----------Date----------

Part one: Demographic and Farm Characteristics of Households

1.1 Name of Head of Household _____

1.2 Gender

Male = 1, Female = 2

1.3 Age

1.4 Religion

Orthodox = 1, Muslim = 2, Other =3

1.5 Household size _____(male____, female____)

1.6 Particularities of household members (including the head)

S. no	Age (in years)	Sex		Level of Education	Occupation (see code)	
		Male	Female		Main	Secondary
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

...Cont'd

S. No	Crop type	Cultivated land in (Tsimdi)*	Amount of major inputs used					Amount of output		Consumed (Qt)	Sold (QT)
			Seed (KG)	Fertilizer kg)		Pesticide (kg or lit)	Herbicide (lit)	Productivity /Tsimdi	Production in Quintal		
				DAP	UREA						
B	**Irrigation**										
1	Maize										
2	Tomato										
3	Potato										
4	Peper										
5	Barley										
6	Carrot										
7	Pulses										
8	Others										
	Spices										
1											
2											
3											
	Perennial crops										
1											
2											
3											

1.9 Crops grown and out put produced in the production season right before intervention (*Applicable for package beneficiaries only*)

S. No	Crop type	Cultivated land in (ha.)	Amount of major inputs used					Amount of output		Consumed (Qt)	Sold (QT)
			Seed (KG)	Fertilizer kg)		Pesticide (kg or lit)	Herbicide (lit)	Productivity /ha.	Production in Quintal		
				DAP	UREA						
A	**Rain Fed**										
	Cereals										
1	Wheat										
2	Barely										
3	Hanfets										
4	Millet										
5	Teff										
6	Maize										
7	Others										
	Pulses										
1	Haricot bean										
2	Chick pea										
3	Faba bean										
4	Others										
B	Irrigation										
1	Maize										
2	Tomato										
3	Potato										
4	Onion										
5	Barely										
6	Carrot										
7	Pulses,										
8	Other										

1.10 Asset possession of the household (✓ in the box) (*Before intervention is not applicable for non- package beneficiaries)*

S. No	Item	At present					Before intervention				
		1	2	3	4	>4	1	2	3	4	>4
1	Plough and accessories										
2	Ox										
3	Hybrid cow										
4	Local cow										
5	Heifer										
6	Calves										
7	Donkey										
8	Horse										
9	Mule										
10	Camel										
11	Treadle pump										
12	Motor pump										
13	Modern beehives										
14	Traditional beehives										
		<5	5-10	10-15	15-20	>20	<5	5-10	10-15	15-20	>20
16	Poultry										
	Local										
	Improved										
17	Goat										
18	Sheep										

1.11 Income earned from livestock in the last 12 months

Activity	Unit	Amount	Average unit price	Total income	Reason for sale
1. Sale of live herds/ birds					
1.1 ox	≠				
1.2 non ox cattle	≠				
1.3 small ruminants	≠				
1.4 chicken	≠				
1.5 bee colony	≠				
1.6 equines	≠				
2. Sale of animal by products					
2.1 Milk (raw)	Lit.				
- Cross breed cow	Lit.				
- Local cow	Lit.				
- Begait cow	Lit.				
2.2 Butter	Kg.				
Cross breed cow	Kg.				
Local cow	Kg.				
Begait cow	Kg.				
2.3 Honey	Kg.				
- Traditional beehive	Kg.				
- Modern beehive	Kg.				
2.4 egg					
- Cross breed hen	≠				
- Local hen	≠				
2.5 Small ruminant fattening	#				
2.6 Cattle fattening	#				

1.12 What do you perceive about the income obtained from livestock in 1997/1998 as compared with the before intervention? [ ]

(For package beneficiaries only)

Increased by one fourth = 1 Same = 5

Increased by half = 2 Don't know = 6

Increased by twice = 3 Decreased = 0

Increased more than twice = 4

1.13 Did any member of the household engaged in non-farm income generating activities in the last 12 months? [ ]

Yes = 1 No = 0

2.3 Could you tell the adoption status of the following inputs/ technologies? (✓ **in the box**)

Technologies/ Inputs	Application: Never tried = 1	Discontinued = 2	Restarted = 3	Still applying = 4
1. Improved seed				
1.1 Maize	☐	☐	☐	☐
1.2 Wheat	☐	☐	☐	☐
1.3 Teff	☐	☐	☐	☐
1.4 Barley	☐	☐	☐	☐
1.5 Sorghum	☐	☐	☐	☐
2. Artificial fertilizer				
2.1 DAP	☐	☐	☐	☐
2.2 UREA	☐	☐	☐	☐
3. Pesticide	☐	☐	☐	☐
4. Herbicide	☐	☐	☐	☐
5. Dairy				
- Cross breed on	☐	☐	☐	☐
- Begait	☐	☐	☐	☐
6. Modern Beehive	☐	☐	☐	☐
7. Improved chicken	☐	☐	☐	☐
8.Cattle fattening	☐	☐	☐	☐
9.Small ruminant "	☐	☐	☐	☐

2.3.1 If never started for some of the inputs, why? ☐

Low yield = 1, shortage of complementary inputs = 4,
Low out pout price = 2, unreliable/ unsuitable climate = 5,
Lack of information = 3, other(specify) ----------= 6

2.3.2 If application of some inputs is interrupted, why? ☐

Lack of credit = 1, shortage of complementary inputs = 5,
Low yield = 2, unavailable in the market = 6,
High labour demand =3, unreliable climate *=7,
Low out put price = 4, poor extension service = 8,
Other (specify) -------- = 9

* un reliable/ unsuitable climate = shortage and erratic rainfall diseases and pests, drought frost)

2.3.3 If you restarted applying some inputs, why?

Better access to credit = 1, High out put price = 2,
Supply of complementary inputs improved = 3,
Lower price of input = 4, Forced to do so = 5,
Other (specify) = 6,

2.3.4 If you are still applying some/ all of the technologies, why?

High out put price = 1, better access to credit = 4,
High yield = 2, to please the DA = 5,
Lower input price = 3, Other (specify) = 6

2.3.5 If you are still applying commercial fertilizer, what is the rate of application as compared to the recommended levels by the DA/ Woreda agricultural office experts

Same = 1, Less = 2, more =3, don't know = 4

2.3.6 If you are still applying improved seed, what is the rate of application as compared to the recommended level?

Same = 1, Less = 2, more 3, don't know = 4

2.3.7 If the answer for question 2.3.5 and/or question 2.4.6 is less, what is the reason?

Too expensive = 1, shortage of supply = 3,
Lack of awareness = 2, Wrong recommendation by the DA = 4,
Other (specify) = 5

2.3.8 How frequent was the extension agent visits you for assistance or supervision (on average) during the year?

Ones a week = 1, Twice a week = 2, Fortnightly = 3
Monthly = 4 Quarterly = 5 Didn't come at all = 6

Part Three: Input and Credit Service

3.1 Did you receive credit in 1997/98-production year?

Yes = 1, No = 0

3.1.1 If yes, please indicate the amount of credit money by purpose and source of credit?

Input	Amount of credit money	Source of credit
1. Fertilizer	_____ birr	_____
2. Dairy package	_____ birr	_____
3. Improved seed	_____ birr	_____
4. Chemical	_____ birr	_____
5. Fattening	_____ birr	_____
6.Agri. implements	_____ birr	_____
7. Irrigation equipment	_____ birr	_____
Total	_____ Birr	

3.1.2 If yes did you use the credit for the purpose you took to? ☐

Yes in full = 1, yes in partial = 2, No in full = 3

3.1.3 If yes, have you repaid the loans taken timely?

Yes = 1, No = 0, Partially repaid = 2, other = 3

3.1.3.1 If no or partially repaid, would you mention the reasons for defaulting? ☐

Low out price = 1,

The money spent for unproductive purpose = 2,

Crop failure/ livestock loss due to natural calamities = 3,

Other (specify) = 4

3.1.4 If yes, what could be your source of repayment ☐

From non farm in come = 1, selling non ox cattle = 4,

Selling food (grain) = 2, selling ox = 5,

Selling small ruminants = 3, other (specify) = 6

3.1.5 If no, what is the reason? ☐

Sufficient own fund = 1, fear of repayment = 4,

High interest rate = 2, Tedious process = 5,

Unable to get though interested = 3, Other (specify)----- = 6

3.2 Have you faced any problem in input supply in 1997/98 Production season?

No = 0, yes = 1 ☐

3.2.1 If yes, what is the problem? (✓ **in the box**)

	Untimely (late arrival) = 1	Poor quality = 2	Under weight = 3
Fertilizer			
DAP	☐	☐	☐
UREA	☐	☐	☐
Improved seed			
Maize	☐	☐	☐
Wheat	☐	☐	☐
Barely	☐	☐	☐
Teff	☐	☐	☐
Sorghum	☐	☐	☐
Beehive	☐	☐	☐
Irrigation equipment	☐	☐	☐

Part Four: Households` Perception on their Food Security Level

4.1 How many months of the household's food demand is met by the on farm and non – farm income?

4.1.1 Before intervention (*For package beneficiaries only*) ☐

>12months =1, 3-6 months =4,

9-12 months=2, ≤ 3 months =5.

7-9 months=3,

4.1.2 At present ☐

- 12 months=1, 3-6 months=4,

9-12 months=2, ≤ 3 months =5

7-9 months=3,

4.2 How do you evaluate the following situations as compared with the before intervention? (✓ **in the box)** (***For package beneficiaries only***)

	Deteriorated =0	Same = 1	Improved = 2	Don't know = 3
4.2.1 Food consumption	☐	☐	☐	☐
4.2.2 livestock possession	☐	☐	☐	☐
4.2.3 overall income	☐	☐	☐	☐
4.2.4 Schooling	☐	☐	☐	☐
2.2.5 Clothing	☐	☐	☐	☐
2.2.6 Saving	☐	☐	☐	☐

4.3 What are your coping mechanisms in times of food shortage? (✓ in the box)

(The before intervention is applicable only for package beneficiaries)

S. No	Coping strategies	Before intervention			At present		
		Frequently = 1	Rarely = 2	Never = 0	Frequently = 1	Rarely = 2	Never = 0
1	Reducing quantity of meal						
2	Reducing no of meals						
3	Participate in cash/food for work						
4	Eating less preferred food						
5	Selling of livestock						
6	Skip eating the whole day						
7	Sale of fire wood and charcoal						
8	Sale of productive assets (non livestock)						
9	Migration in search of job						
10	With drawing children from school						

Appendix 3: Price of Outputs 2002 – April 2006

No	Item (output,	Price (birr/ Quintal				
		2002	2003	2004	2005	2006
1	Wheat (local)	232	210	232	264	258
2	Wheat (imported)	153	152	159	182	179
3	Teff (average)	244	254	265	319	314.6
4	Barley	191.5	203	162	170.40	178
5	F. millet	217	219	262	257	243
6	Maize	115	200	187	166	190
7	Horse bean	203	261	271	278	177
8	Field bea	205	268	276	278	277
9	Chick pea	210	252	254	260	270
10	Lentile	230	342	355	339	326
11	Vetch	190	200	200	203	203
12	Shallot	350	290	310	340	371
13	Garlic	620	920	640	530	517
14	Potato	210	180	180	230	217
15	Tomato	160	190	210	230	225
16	Pepper	117	177	166	155	433

Source: OKaward

Appendix 4: Seeding Rate (kg/ha) in Kilte Awlaelo Wereda

Crop type	Improved seed (kg/ha)	Local seed (kg/ha)
Wheat	150	170
Barley	125	135
Maize	28	36
Finger Millet	32	35
Sorghum	10	17
Horse bean	120	200
Field pea	160	170
Vetch	90	90
Chick pea	0	130
Teff	30	40
Hanfets	0	135
Potato	2000	2000
Tomato	0.25	0.25
Pepper	0.6	0.6

Source: OKAWARD

Farmers of the study area (for local seed)

Appendix 5: Minimum Average Energy Requirement Per Head (For rural areas)

Age group	Daily calorie requirement
< 1	570
1-5	1150
6-10	2000
11-17	2400
18-45	2400
> 45	2200
Pregnant woman	2600
Lactating woman	2900

Source: Deryke Belshaw, 1989

Appendix 6: Nutrition Based Adult Equivalent Conversion Factors

Age	Male	Female
< 1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	0.14	0.86
18-30	1.04	0.80
30-60	1.0	0.82
60^{+}	0.84	0.74

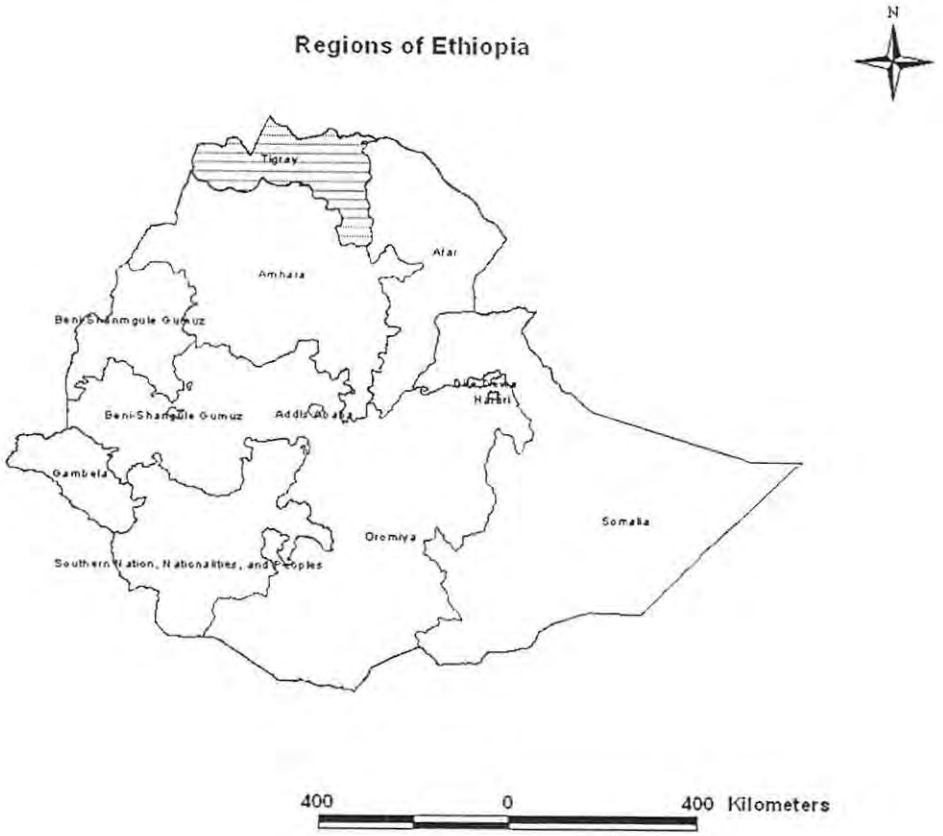
Source: Dercon, S., 1998.

Appendix 7: Projected Rural Population of Kilte Awlaelo Wereda, 2005

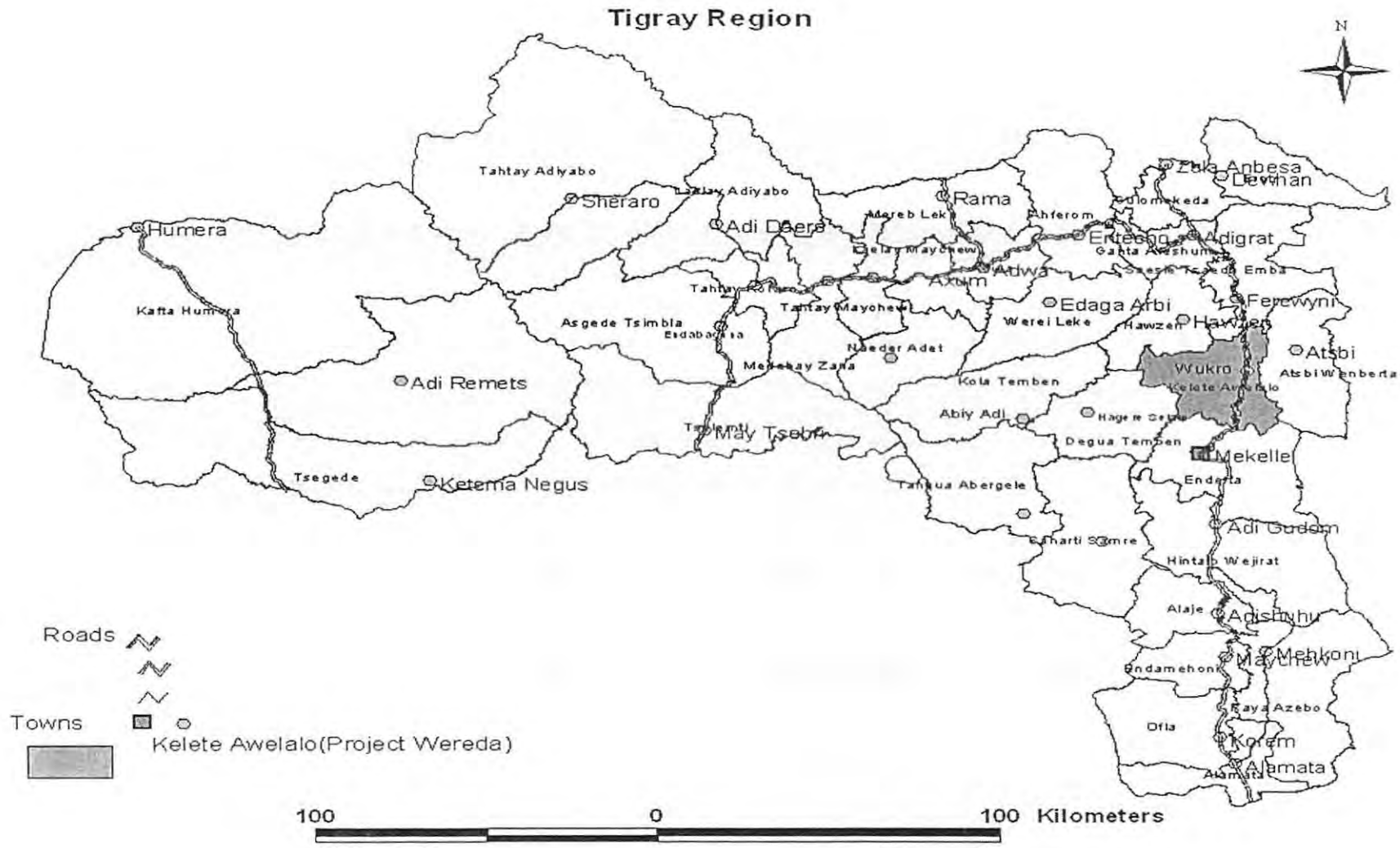
Age	Male	Female	Total	%
0-4	7,241	7,481	14,722	17
5-9	6,472	6,634	13,106	15.1
10-14	5,287	5,233	10,520	12.1
15-19	4,614	4,542	9,156	10.6
20-24	3,933	3,924	7,857	9.1
25-29	3,226	3,320	6,546	7.6
30-34	2,477	2,727	5,204	6.0
35-39	1,949	2,258	4,207	4.9
40-44	1,500	1,855	3,366	3.9
45-49	1,241	1,546	2,787	3.2
50-54	1,104	1,295	2,399	2.8
55-59	953	1,072	2,025	2.3
60-64	802	861	1,663	1.9
65-69	623	660	1,283	1.5
70-74	434	470	904	1.0
75-79	256	288	544	0.6
80+	169	171	340	0.4
Total	**42,291**	**44,337**	**86,628**	**100**

Source: TBoPED, 1998, and own computation

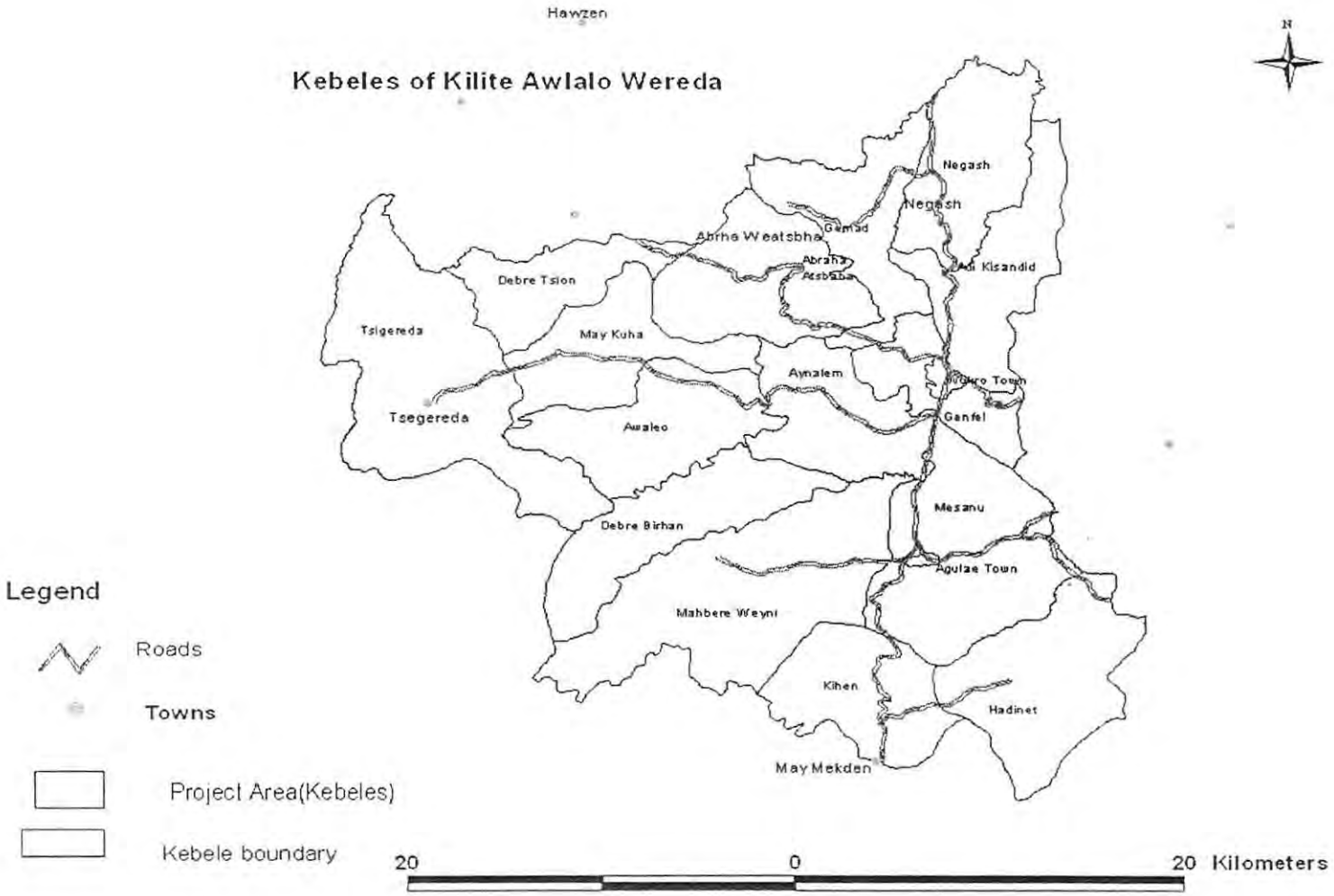
Appendix 9: Map of Ethiopia



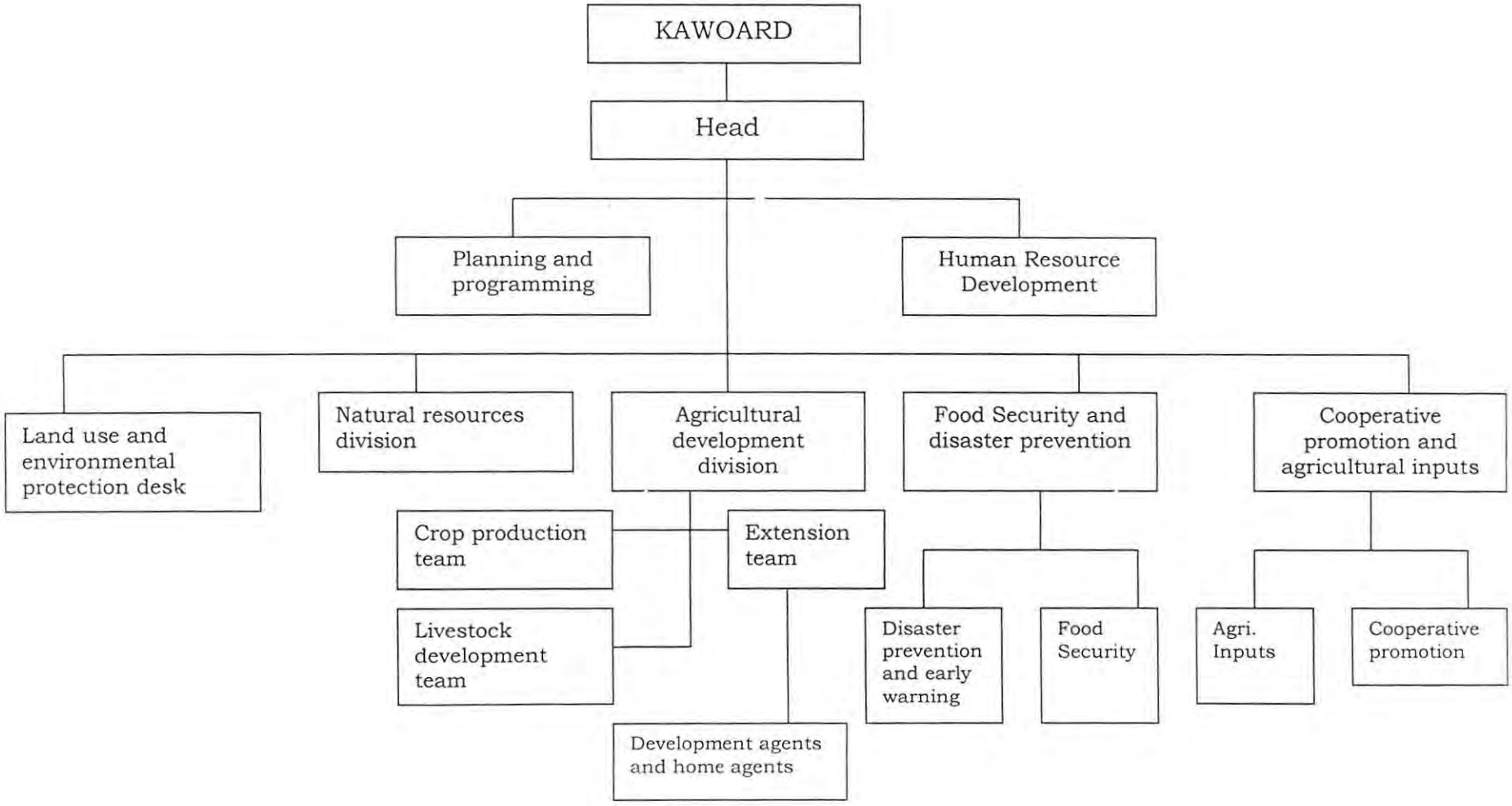
Appendix 10: Map of Tigray Region



Appendix 11: Map of Kilte Awlaelo Woreda

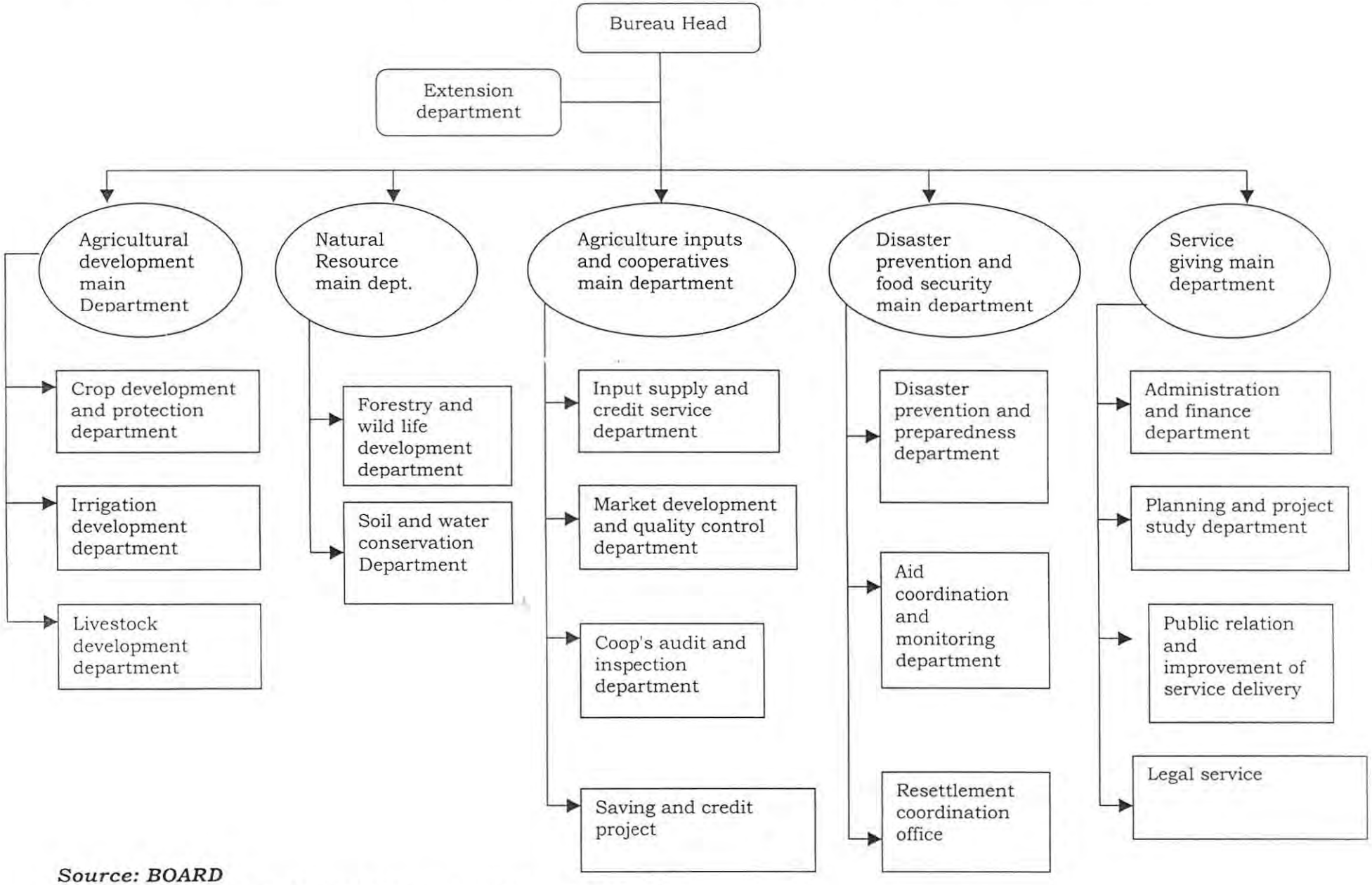


Appendix 12: Organizational Structure of Kilte Awlaelo Woreda Office of Agriculture and Rural Development



Source: OKAWARD

Appendix 13: Organizational Structure of Tigray Bureau of Agriculture and Rural Development



Source: BOARD

- ***The author apologises for mistakes committed in translation (if any)***

Declaration

I the under signed, declare that this thesis is my original work and has not been presented for a degree in any University, and that all sources of materials used for the thesis have be duly acknowledged.

Declared by:

Name Tsegu Gebretsadik

Signature _____

Date 30/07/06

Approved by Advisor:

Name Beyene Tadesse(PhD)

Signature _____

Date 31/07/06