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**TITLE** Food Security and Its Determinants in Jigjiga District of Ethiopia

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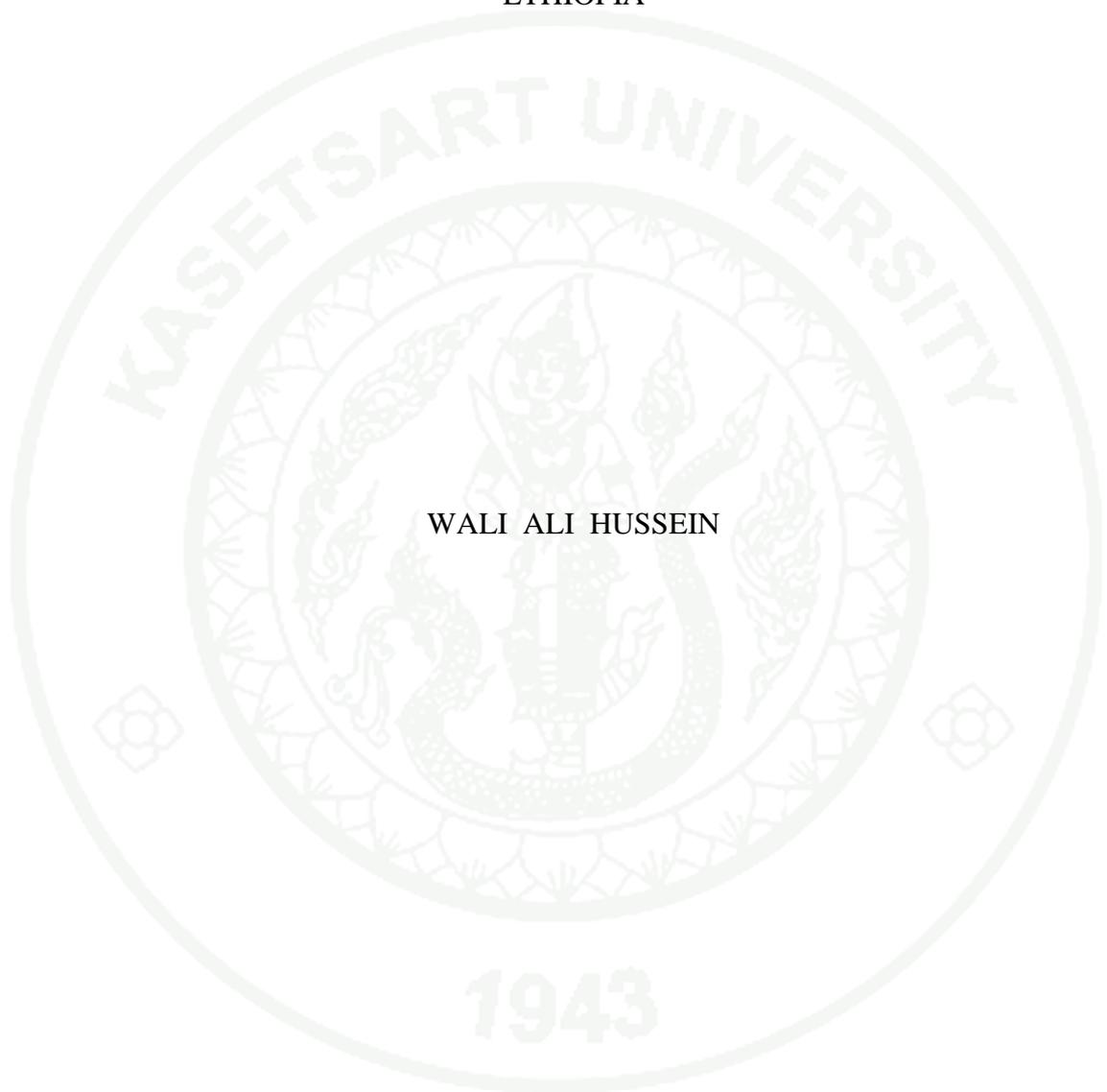
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THESIS

FOOD SECURITY AND ITS DETERMINANTS IN JIGJIGA DISTRICT OF  
ETHIOPIA



WALI ALI HUSSEIN

A Thesis Submitted in Partial Fulfillment of  
the Requirements for the Degree of  
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Wali Ali Hussein 2012: Food Security and Its Determinants in Jigjiga District of Ethiopia. Master of Science (Agricultural Economics), Major Field: Agricultural Economics, Department of Agricultural and Resource Economics. Thesis Advisor: Assistant Professor Penporn Janekarnkij, Ph.D. 49 pages.

This study was carried out to identify food security and its determinants in Jigjiga district of Ethiopia. Data used in this study were collected from one hundred sixty rural households in the study area using stratified sampling technique. An empirical analysis based on a logit model was employed to analyze the primary data. The results of the showed that 63% of the households were food secure while 37% were found to be food insecure.

Among various factors included in the logit model, six were found to be statistically significant determinants of household food security. Variables such as: total household income, technology, extension, access to credit and veterinary service were found to have positive influence. While agro-ecology affected the food security of the households in lowland negatively. Access to technology, extension, veterinary and credit would increase household food security in the study area by 84%, 46%, 36% and 141% respectively. It is therefore recommended credit services and agricultural technology supply should be highly strengthened in the study area. The strategy directly focusing on agricultural economy in the district under the agricultural development-led industrialization policy should be continued.

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Student's signature

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Thesis Advisor's signature

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Wali Ali

March, 2012

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## LIST OF ABBREVIATIONS

ADLI	=	Agricultural development Lead Industrialization
AE	=	Adult Equivalent
DA	=	Development Agents
DERGUE	=	The Socialist Ruling Body of Ethiopia
ENHRI	=	Ethiopian Nutrition Health Institute
ETB	=	Ethiopian Birr
FAO	=	Food and Agriculture Organization
GDP	=	Growth Domestic Product
Ha	=	Hectare
MoARD	=	Ministry of Agriculture and Rural Development
NGO	=	Non Governmental Organization
PA	=	Peasant Association
SSA	=	Sub-Saharan Africa
TLU	=	Tropical Livestock Unit
UN	=	United Nations
UNDP	=	United Nations Development Programme
USAID	=	United states Agency for International Development

# CHAPTER I

## INTRODUCTION

### Statement of the Problem

Ethiopia is one of the most famine-prone countries with a long history of food shortages that left a significant proportion of population food insecure traced back to 1960s (Ramakrishna and Demeke, 2002). According to Negatu (2004), the last major drought of 2002/2003 in the country had affected 30 million people, contributed to 40% of the total population in that particular period. Drought has become frequent and more severe in recent years. It is one of the most important triggers of malnutrition and food insecurity in the country (Dominguez, 2010).

In Ethiopia, the dimensions, determinants, and consequences of food security problem differ widely within the country. Somali region of Ethiopia is one of the regions of the country most affected by recurrent drought and food security problems (United States Agency for International Development, 2011). In this region, Jigjiga district, the study area, is facing unrelenting food shortages and food security problems. In 2010, Ministry of Agriculture and Rural Development (MoARD) reported that 30% of the people in Jigjiga area were in need of food emergency.

In recognition of the problem, Ethiopian government formulated a long-term strategy to reverse the food insecurity situation of small scale rural farmers. The government policy is to adopt the agricultural development-led industrialization strategy (ADLI), which takes agriculture as its point of departure and growth engine (Alemu, Oosthuizen, and Van Shalkweyk, 2002).

Food security strategy is the major component of the ADLI policy. The first version of the food security strategy was issued in 1996 and revised in 2002 and 2005 highlighting the government's plan to address causality and effects of food security Problem in the country. The strategy envisages developing an agriculture-based economy by raising production and income of farmers. It was implemented in all food insecure districts of Ethiopia including Jigjiga area.

Jigjiga district administration has been implementing the food security programme since 2004. The program was directed at improving availability and access of food for the rural households. The rationale of the program at district level was strengthening the provision and access of credit, extension services, veterinary services, improved agricultural inputs, income and other services to the rural households in the district in order to improve food security situation, improved.

Wond and Macaulay (2010) suggested that program implementation by itself is not the final step. The question of how these policy factors affect food security of the households and food security situation in Jigjiga district remained unanswered for policy makers in the district and the country. Taking this fact into consideration, this study was proposed to identify food security status and its determinants among rural households in Jigjiga district.

In the study area, agriculture is the main stay of the households, though it takes place at subsistence level. This is attributed to repeated cycles of droughts in the country as mentioned above. This study used cross sectional household survey data of 2010 production year. Even with erratic rainfall in eastern Ethiopia during 2010, Jigjiga district farmers managed to obtain a normal harvest of cereal crops from their farms (The Lutheran World Federation, 2010).

### **Objectives of the Study**

The general objective of the study was to look for proposed objectives improving food security situation of Jigjiga district. The specific objectives were:

1. To assess the food security status of rural households in Jigjiga
2. To identify factors affecting rural household's food security in the study area

### **Expected Output**

This study would provide an insight and understanding for policy makers and programme administrators in Jigjiga district about what factors have more effect on food security of the households, and what policy variables should be strengthened. Domestic as well as international NGO's working on rural development related projects can also use the results of the study to target those in need and food insecure in the area. Moreover, the study will provide bench mark information to students and researchers interested in the topic for further study.

### **Scope and Limitation of the Study**

The study was specifically focused on factors affecting food security and geographically confined in Jigjiga district, which included midland and lowland agro-ecologies. It was a household level study that consisted rural households living in the above mentioned agro-ecologies of the study area. The study predominantly used one time period household survey particularly 2010/11 production year.

Furthermore, farmers were busy with their day to day farm activities and have put study in difficulty position. But it was only after extensive efforts made by the researcher, heads of peasant associations, and extension workers, which had convinced them to take part in the study.

### **Definition of Terms**

Food security is defined in this study as adequate availability and adequate access of food for households to meet minimum energy required as recommended by Ethiopian government for active and healthy life. In this definition, household can have access to food via production of crop and livestock, purchase, borrowing or gifts.

Food availability which is the supply side indicator of food security refers to adequate supplies of food grain and livestock products (meat & milk) available for the household. The second aspect of food security, namely food access refers to whether household has the means to acquire adequate food through purchase.

### **Organization of the Thesis**

The thesis is organized into five parts. The first chapter introduces research problem statement, objectives, expected output, scope, and limitation of the study. The second chapter reviews relevant literature about the policies and strategies of Ethiopia to address food security, definitions, measurements, and determinants of food security. The conceptual framework of the study is also included in the second chapter. In chapter three, research method covers description of the study area, analytical model, sampling design, and data collection procedures. Results, both descriptive and logistic regression are presented and discussed in the fourth chapter. The last chapter summarizes the findings of the study and draws recommendations.

## **CHAPTER II**

### **LITERATURE REVIEW**

#### **A Review of Policies and Strategies to address Food Security in Ethiopia**

In addition to climatic factors, Ethiopia suffered from misguided economic policies under the socialist Derg regime, which ruled from 1974 until 1991. When the Ethiopia Peoples' Revolutionary Democratic Front (EPRDF) replaced the Derg regime in 1991, a number of market-oriented reforms were implemented, some aimed at stimulating agricultural and rural growth (World Bank, 2004). For example, the country liberalized its foreign exchange markets and dramatically decentralized public administration to the district level. In rural areas, grain markets were liberalized and fertilizer markets opened up to participation from the private sector. In 1992, the Government of Ethiopia also established the agricultural development-led industrialization (ADLI) strategy, which emphasized the role of the agricultural sector as a catalyst for immediate food security improvement and long-term, broad economic growth.

ADLI's main thrust has been to: (1) improve agricultural extension services; (2) promote better use of land and water resources; (3) enhance access to financial services; (4) improve access to domestic and export markets; and (5) provide rural infrastructure. These all activities under ADLI were to ensure household food security in the country. The strategy focuses on improving the production and productivity of smallholder agriculture through generation, adoption and diffusion of suitable farm technologies in the form of improved inputs and farming methods, provision of credit, and rural asset building. In order to mobilize small farmers and dissemination of better farming practices, the development strategy has been operationalized via the participatory demonstration and extension training system. Food security strategy is the major component of the ADLI strategy. The first version of the food security strategy was issued in 1996, and revised in 2002 and 2005, highlighting the

government's plan to address causality and effects of food security in the country. The strategy envisages developing agriculture based economy by raising farm productivity and income.

In the study area, Jigjiga district administration, has been implementing the food security strategy since 2004 through an integrated approach. The interventions carried out to tackle the problems of food security in the district were provisioning of agricultural technological inputs, extension services, credit access, animal health services, employment generation activities, and other rural infrastructure development.

### **Definition of Food Security**

Food security is defined in different ways by international organizations and researchers. According to Kidane, Alemu, and Kundhlande (2005) there are close to 200 definitions of food security. Since the world food conference of 1974, definitions evolved from view points of ranging emphasis on national food security or an increase in supply of food to those calling for improved access to food in the 1990s. Improved access was redefined by taking into account livelihood and subjective considerations (Maxwell, 1996).

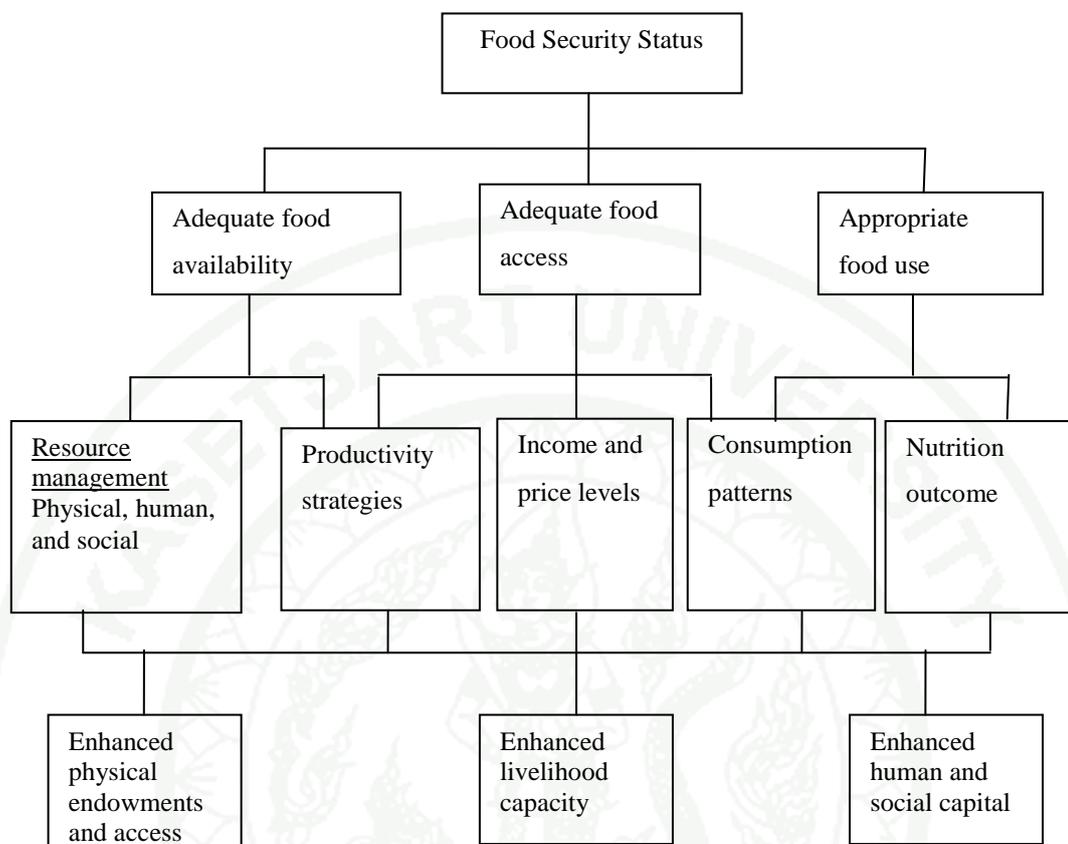
Definitions underwent another round of evolution after the 1996 world food summit, when the definition was broadly set as achieving food security "at individual, national, regional and global levels when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 1996). Currently, a synthesis of the above mentioned definition with the main emphasis on availability, access, and utilization of food, serves as working definitions in the projects of international organizations (Kidane *et al.*, 2005). Hence this study uses the above definition in the context of the study area with main focus on availability and access of food security. A review of applied definitions of food security for international organizations since 1970's is summarized in Table 1.

**Table 1** Definitions of food security

<b>Author/year</b>	<b>Definition of Food security</b>
UN (1975)	Availability at all times of adequate world supplies of basic food-stuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices
FAO (1983)	Ensuring that all people at all times have both physical and economic access to the basic food they need
World Bank (1986)	Access by all people at all times to enough food for an active, healthy life
UNICEF (1990)	Assurance of food to meet needs throughout every season of the year
FAO (1996)	When all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for active and health life

Eradication of hunger ranks high among international goals because food is essential for the health and human capacity needed to achieve Millennium Development Goals. Reducing the proportion of people who suffer from hunger by 50% for the year 2015 was one of the primary goals identified by the UN millennium project United Nations Millennium Project (2005). Figure 1 illustrates the food security framework proposed by the project.

According to the general framework, food availability is achieved when sufficient quantities of food are consistently available to all individuals within a country. Food access is ensured when a household and all individuals within it has adequate resources to obtain appropriate foods for a nutritious diet. However, access depends on income available to the household, distribution of income within the household, and price of food. Food utilization is the proper biological use of food, requiring a diet providing sufficient energy and essential nutrients.



**Figure 1** General framework of food security, UN Millennium Project.

Source: UN Millennium Project (2005).

Much of the studies on food security focus on developing and testing determinants of food insecurity at the household level (Maxwell, 1996). In food security literature, the determinants of food security are categorized into three groups within the framework of general definitions of food security. These include food availability, food access, and utilization. For example, food availability may be constrained by natural resource, technology, policies, inadequate agricultural inputs, and family size. On the other hand, access to food and its utilization could be constrained by economic growth, lack of job opportunities, lack of credit, inadequate extension services, and inadequate knowledge (Hoddinott, 1995). A number of studies made use various methodologies to identify determinants of food security in different parts of Ethiopia. According to these studies, gender, family size, level of education, ,

farmland size, ownership of livestock, income, and technology application, weather conditions, extension service, veterinary service, and credit, were identified as major determinants of food security (Ramakrishna and Demeke, 2002; Kidane *et al.*, 2005; Shiferaw, Kilmer, and Gladwin, 2003). Empirical literature relating to food security and its determinants in Ethiopia, and method of measuring food security, are discussed in the following sections.

### **Determinants of Household Food Security**

The debate in Ethiopia over the causes and determinants of food insecurity has fuelled highly contested viewpoints between the academic disciplines and in development thinking in general over the past few decades, giving rise to a proliferation of demographic, economic, and political emphasis across the food security literature (Devereux, 2001). Despite the root causes of the problem at the national and household level, the key factors in general can be grouped under three main types, as natural causes, socio-economic factors, and policy factors (Ramakrishna and Demeke, 2002; Shifferew *et al.*, 2003).

Demographic characteristics such as gender, age and education of the household head were found to influence food security positively (Shiferaw *et al.*, 2004; Muluken, 2005; Ramakrishna and Demeke ). Family size had negative influence on food security (Muluken, 2005). Since most of the farm households are small holder subsistence producers, an increase in number of persons of the household tends to exert more pressure on consumption than the labour it contributes (Paddy, 2003; Shiferaw *et al.*, 2003).

According to Nejafi (2003) and Muluken (2005), food production is increased extensively through expansion of area under cultivation while livestock provides, not only food for the producers but also other products which could be sold to provide food or income. Fertilizer is used by most studies as proxy for crop production technology. According to food security literature, subsistence farming, by its nature,

is production for direct consumption. Any farm input that augments agricultural productivity is expected to boost the overall production. This contributes towards attaining household food security (Brown, 2004 and Shiferaw *et al.*, 2003).

Income plays a key role in household's access to food. It enables households to modernize their production by giving them an opportunity to apply the necessary inputs, and reduce the risk of food shortage during period of unexpected crop failures through purchase. Muluken (2005) found that total annual income of the household and food security is positively related.

Access to extensions and veterinary services were identified to have impact on household food security in Ethiopia (Muluken, 2005; Kidane *et al.*, 2005). Availability of credit is another important variable that is mentioned in the literature. Households who have received credit had the possibility to fill the need for food (Debebe, 1995). Accordingly, this study investigated factors affecting food security, from availability and access perspectives discussed above.

### **Measurements of Food Security**

There is no fixed rule as to which measurement method to employ due to the diversified characteristics of food security and the different level of consideration. The decision to rely on a particular method usually depends on resource and time constraints, objectives of the study, availability of data, type of users and degree of accuracy required (Debebe, 1995). Any commitment to improve food security and nutrition carries with an important implication, namely the need to measure food security outcomes at household level.

Two methods of food security measurements have been widely used in most food security studies. One is to estimate gross household production and purchases over time; estimate the growth or depletion of food stocks held over that period of time; and presume the food that has come into the household possession and disappeared has been consumed (Maxwell, 1996). Another is to undertake a twenty-

four hour recall of food consumption for individual members of the household and analyze each type of food mentioned for calorie content.

Hoddinott (1999) outlines four ways of measuring food security outcomes, namely individual intake, household caloric acquisition, dietary diversity and indices of household coping strategies. Each method of measuring food security outcomes entails different methods of collecting and analyzing the data.

1. Individual intake. This is a measure of the amount of calories or nutrients consumed by the individual in a given time period.

2. Household caloric acquisition. The person responsible for preparing meals (the most knowledgeable person in the household) is asked a set of questions regarding food prepared for meals over specific period of time usually 7 or 14 days. This measure produces a crude estimate of number of calories available for consumption in the household.

3. Dietary diversity. One or more persons within the household are asked about different items they have consumed in a specified period, where it is suspected that there may be differences in food consumption among household members.

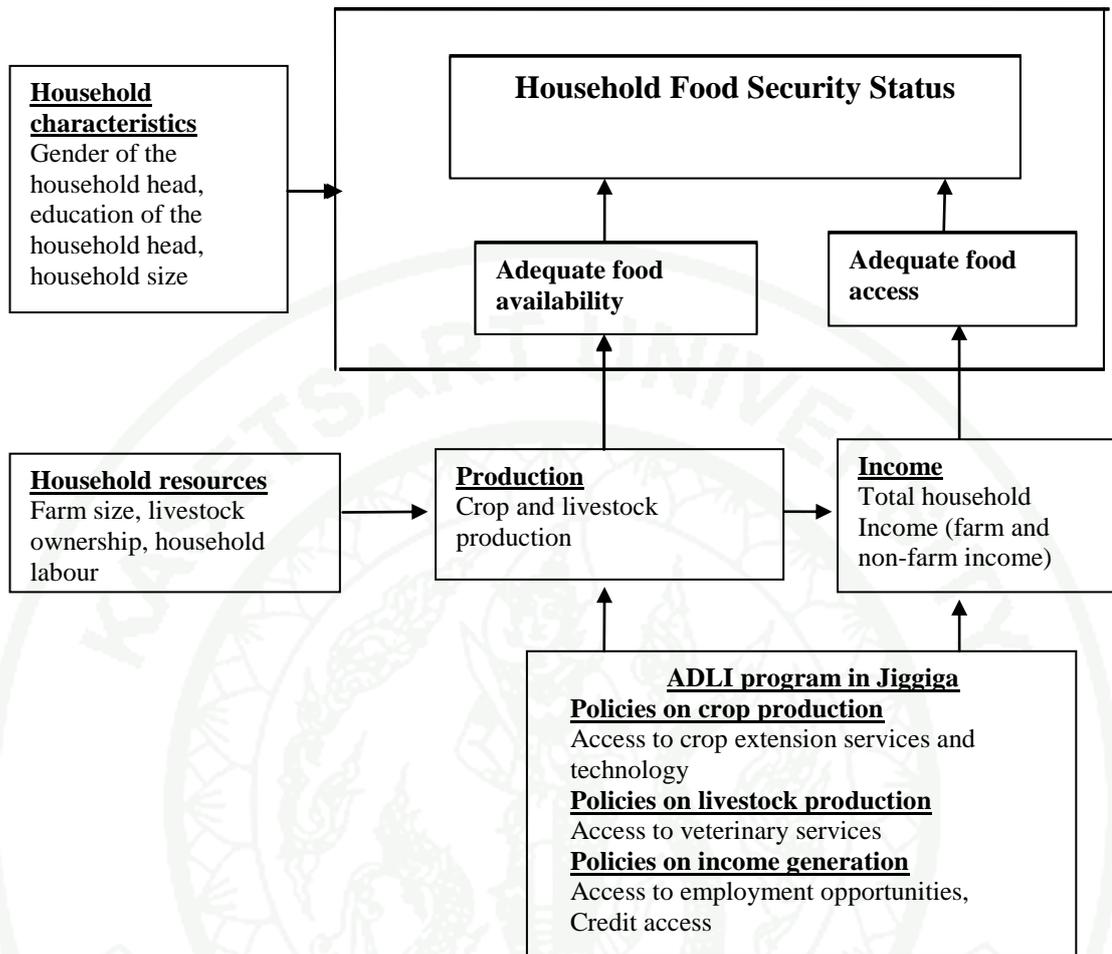
4. Indices of household coping strategy. This is an index based on how households adapt to the presence or threat of food shortages. The person within the household, who has primary responsibility of preparing and serving meal, is asked a series of questions regarding how households are responding to food shortages.

Food secure households are able to produce enough food such that all household members can lead a productive and healthy life. The food can either be owned, produced or the household can generate enough income to purchase all the required food items. Food security in this study was measured in terms of both household actual own food production and food purchased.

### **Conceptual Framework of the Study**

Based on the Millennium Goal of reducing hunger by 50% in the year 2015 and Agricultural Development Lead Industrialization (ADLI) policy of Ethiopia, the conceptual framework of this study is presented in Figure 2. The general framework represents initial concern of food security, which focused on global, regional, and national level food availability, access, and utilization. But it overlooked household level food security. The recent concept of food security has given more attention to households and individual level rather than international, national, and regional levels. This is because of increasing food production, supply and sufficiency at broader levels does not necessarily ensure food security at a household level which necessitated the inclusion of households at the centre of food security concept.

Household food security status was assumed to be the outcome of adequate availability of food from own production which depended on initial household's resource endowment; and adequate access through household income. Therefore, the relative importance of any of these pathways as a determinant of household food security, and policy factors were used by following conceptual framework below.



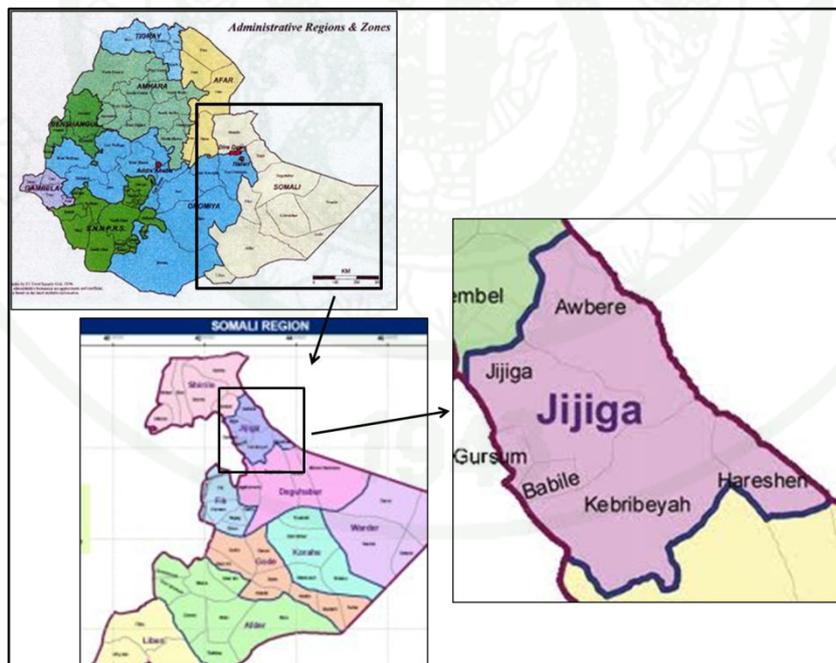
**Figure 2** Conceptual framework of the study  
Source: Adapted from UN Millennium Project (2005).

## CHAPTER III

### STUDY METHODS

#### Location and Description of Jigjiga

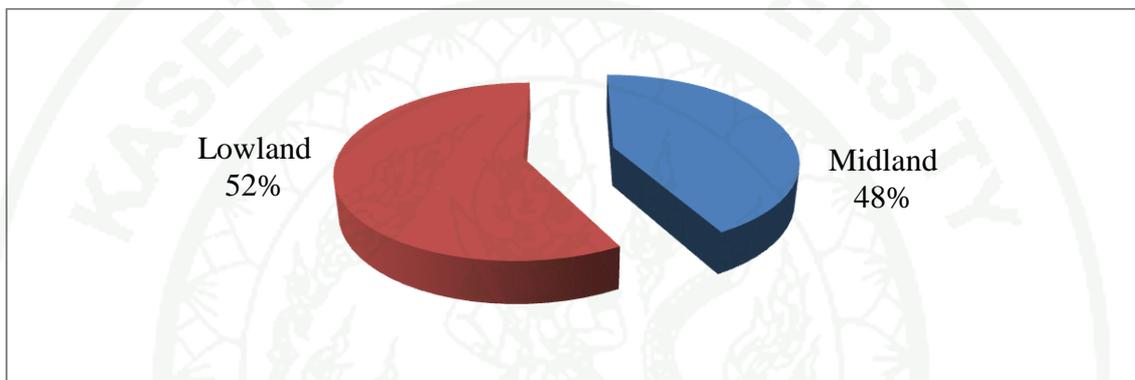
Jigjiga Woreda lies between 90° 2' 0" N to 90° 42' 0" N North latitude and 42° 29' 00" E to 42° 13' 00" E East longitude (Figure 3). It is located at about 650 km to the east direction of Addis Ababa, the capital city of Ethiopia. The mean monthly minimum temperature varies from 5.8°C in November to 14°C from July to September and mean monthly maximum temperature varies from 25°C in July to 29°C from March to April. The area experience bimodal type of rainfall classified as short rain season (from July to September) and main rain season (from March to April) (Jigjiga Zone Office of Agriculture, 2001).



**Figure 3** Map of Ethiopia showing the location of Jigjiga district

Source: Elizabeth (2007)

The topography of Jigjiga ranges lowland to midland agro-ecologies. Based on altitude and cropping system Peasant associations are classified as either midland or lowland (Somali Region Bureau of Investment, 2005). The total number of households in the study area was 7403 households, out of which 3113 (42%) households were in the midland area and 4230 (58%) of them were from lowland of the district (Figure 4). Furthermore, farmers were organized into 20 Peasant Associations, ten from each agro-ecology.



**Figure 4** Households in Jigjiga based on agro-ecology

Mixed farming such as crop production and livestock rearing are commonly practiced. Maize, sorghum, wheat, and barely are the major crops grown. Cereals generally constitute 89% of the total cultivated area and 91% of the production. In addition to crop farming cattle, sheep and goats are main livestock reared (Eshetu and Teriessa, 2000).

## **Sampling, Data, and Data Collection**

### **Sampling**

A two stage sampling procedure was employed to select 160 households in rural Jigjiga district. The study area was classified into two strata; midland and lowland based on its agro-ecology. Of all the 20 peasant associations (PA'S) in both agro-ecologies all were included: ten PA's from each area. Probability proportionate to sample size was employed for the selection of 96 households from lowland and 67 households from midland. A structured questionnaire was administered to those 160 households selected.

### **Data**

Data on the basic characteristics of the households in terms of demography, resource endowment, crop production and livestock production were collected. Household demographic characteristics data collected was gender, age, education of the household heads, household size, and the agro-ecology in which a household lived. Household resource endowment data on farm size, livestock owned, and total household income, were collected. Household food balance sheet data included own production crop and livestock food produced, borrowed, purchased, and received as gift. Furthermore, data on access to extension services, credit, fertilizer, and veterinary services, were also collected.

### **Data Collection**

Data pertaining household level were collected through structured questionnaire. Enumerators who completed three years college training, native to the area, fluent speakers of local language, and working in the area as development agents, were recruited. One day training about the objectives of the study and contents

of the questionnaire was given. Then the questionnaire was pre-tested and adjusted. Household survey was conducted during May-July, 2011 under continuous supervision of the researcher.

### **Household Food Balance Sheet**

Following Shimaless, Janekarnkij, and wangwachirakul (2011); and Shifferew *et al.* (2003), food security in this study was measured in three steps. Firstly, food supply at household level was determined by compiling a Food Balance Sheet for each sampled household. Secondly, the food supply at household level calculated in step one was used to calculate calories available per kilogram per adult equivalent (AE) per day for each household. The calculation is as follows.

$$TNEA = NGA + NLFA + NOFIP$$

where TNEA = total net energy available in kilo calorie/year/household

NGA = net grain available in kcal/year/household

NFLA = net food from livestock available in kcal/year/household

NOFI = net other food items in kcal /year/household

The government of Ethiopia has set the minimum acceptable calorie requirement per AE per day at 2,100 (Federal Democratic Republic of Ethiopia, 2001). It is employed as a cut-off value between food secure and food insecure households in the study. Households who managed to attain at least 2,100 kilo calorie per AE per day are considered as food secure, and those households who have energy per AE per day below the minimum allowance are deemed as food insecure. The computed result for all 160 households is shown in the appendix.

### The Analytical Model

This study employed the logit model, the dependent variable in this case, food security, was a binary variable which took a value one if a household was found to be food secure, zero otherwise.

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

Where e is an exponential term,

$P_i$  is the probability of household i being food secure. It is 1 if a household is food secure, otherwise 0.

Y is the observed food security status of a household.

$X_i$  is household i's a set of explanatory variables

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

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

From equation (1) the probability of a household being food insecure is given by  $(1 - P_i)$  which can be written as:

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

Therefore, the odd ratio, i.e.,  $\frac{P_i}{(1 - P_i)}$  is given by equation (3) as

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

Which is the odd ratio in favor of food security, it is the ratio of the probability that a household would be food secure ( $P_i$ ) to the probability that a household would be food insecure  $(1 - P_i)$ .

Finally, taking the natural log of equation (3) and assumed to be linear we obtain:-

$$L_i = \text{Ln} \left[ \frac{p_i}{1 - p_i} \right] = Z_i \quad (4)$$

$L_i$  is log of odd ratio which is assumed linear in both variables and parameters.

If the disturbance term is introduced, the logit model in equation 4 will becomes:

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon_i \quad (5)$$

In equation (5), the term  $\beta_i$  are parameters to be estimated-  $X_1$  to  $X_n$  are explanatory variables which represented: household characteristics, household resources and characteristics of government program provided at household level.

From the estimated logit model the marginal effects of each explanatory variable on household food security can be calculated as follows:

$$\frac{\partial P_i}{\partial \chi_i} = P_i (1 - P_i) \beta_i \quad (6)$$

### **Definition of Variables and Working Hypotheses**

Once the analytical procedure and its requirements specified, it was necessary to identify potential explanatory variables and describe their measurements. Different variables were expected to have effect on food security status of the households in the study area. The definition of variables and their expected signs are discussed in detail in the following paragraphs.

### **The Dependent Variable of the Model**

Household food security status, a dependent variable in the model is a dichotomous variable representing household food security status. It was represented in the logit model by 1 for food secure household, and 0 for food insecure household.

### **The Independent Variables of the Model**

The independent variables expected to have association with the food security status of the households were selected from available literature. A household characteristic such as gender of the household head was expected to have positive relation with food security status if the household head is male. In the study area male-headed households were expected to have more access to resources than female-headed households. It was assigned 1 for male-headed household and 0 for female-headed households.

Age of the household head also affects food security of the rural households. The older the household head, the more know-how s/he accumulates in farming and weather forecasting. As a result, the probability of household being food secure was expected to increase the older the age of the household head.

Household size was hypothesized to have negative association with the food security of the household. Most of the farm households are small holder subsistence producers, increase in number of persons of the household, will increase food requirement and tends to exert more pressure on consumption than the labour it contributes (Paddy, 2003). Household size was measured in Adult equivalent.

Education is an additional factor which is thought to influence the food security status of the households. Educational level of the household head could lead to awareness of possible advantages of modernizing agriculture by means of modern inputs, enable them read instructions on fertilizer packs, and diversification of incomes which, in turn, would enhance household's food supply (Nejafi, 2003). Educational status of the household head in this study was measured in years of schooling.

Farm size measured in this by total hectares of farm land a household owned is an important resource for food production. Hence it was hypothesized it would have

positive relationship with food security of the household. Farmers who have large farm land are more likely to have to be food secure than those with smaller farm size.

Livestock ownership also measured in tropical livestock unit (TLU), is livestock holding of the household. Households who possess large livestock holding produce more meat and milk for direct consumption and could be more food secured.

Income plays a determinant role of the household's ability to secure food. It enables households to modernize their production by giving them an opportunity to apply the necessary inputs, and reduce the risk of food shortage during period of unexpected crop failures through purchase.

Fertilizer is used by most studies as proxy for technology. According to literature, subsistence farming, by its nature, is production for direct consumption. Any farm input that augments agricultural productivity is expected to boost the overall production. This contributes towards attaining household food security (Brown, 2004).

Access to extension services such as knowledge transfer, short trainings delivered by government development agents to the farmers also affects food security in the study area. Its expected access to extension services will have positive effect on food security status of the households (Muluken, 2005) Veterinary service was also expected to influence household food security positively (Eshetu and Teriessa, 2000).

Credit received is a dummy variable taking values 1, if the household had access to credit, 0 otherwise. Credit is an important component in small farm development programmes, in the study area, farm households who had easy access to credit has possibility to buy food. Hence, it was expected credit to have positive impact on food security. In a total twelve independent variables were included in the logit model. Descriptions of variables are summarized in Table 2 below.

**Table 2** Description of variables in the logit model

<b>Variable</b>	<b>Description</b>	
<b>Dependent variable</b>		
Food security status	Food secured households with 2,100 Kcal/AE/day (if household is food secure =1, otherwise =0)	
<b>Independent variable</b>		<b>Expected sign</b>
GENDER	Gender of the household head (if household head is Male =1, otherwise =0)	+
AGEHH	Age of the household head	+
HHSIZE	Number of a household members measured in adult equivalent ratio(AE)	-
EDU	Education of a household head(number of schooling years)	+
FARMSIZ	Farm size of a household (Measured in number of hectare)	+
TLU	Livestock ownership of a households in tropical livestock units	+
TOTALINC	Total income of the household in Ethiopian birr	+
TECHN	Technology use of a household (It is 1 if a household has access, otherwise =0)	+
AGROECO	Agro-ecology in which a household located (if the household is midland =1, otherwise =0)	+
EXTENSION	Access of a household to extension services(if a household gets the services =1, otherwise =0)	+
VETERINARY	Access of a household to veterinary services(if household has access to the services =1, otherwise=0)	+
ACCESSCREDIT	Credit received (if household received it =1, otherwise=0)	+

## CHAPTER IV

### RESULTS AND DISCUSSION

#### Household Demographic Characteristics

A summary of statistics of the demographic characteristics of sampled households presented in Table 3 below, shows male headed households account 97% in midland and 94% in lowland. Female headed households in both midland and lowland agro-ecology are 3% and 6% respectively. The average age and household size are (40 years and 4.3 AE) in midland area and (38 years and 4.7) in lowland respectively. Regarding educational status in the study area, 13% of households in the midland and 12% of households in lowland, were found to be illiterate. Whereas 81% of household heads in midland and 84% of those in lowland had completed their primary education, only 6% of midland and 4% of lowland household heads were junior school graduates.

**Table 3** Demographic characteristics of the sample households in Jigjiga district

Households characteristics	Mid land	Low land	Total
Gender of household head			
Male	65 (97%)	87 (94%)	152 (95%)
Female	2 (3%)	6 (6%)	8 (5%)
Age (years)	40	38	39
Average household size (AE)	4.3	4.7	4.5
Educational level of household heads			
Illiterate	9 (13%)	11 (12%)	20 (13%)
Elementary school education	54 (81%)	78 (84%)	132 (83%)
Junior school education	4 (6%)	4 (4%)	8 (5%)

Source: Household survey results (2011)

### Households' Ownership to Farmland, Livestock, Income and Labour

Households' farm size and livestock holding form an important source of livelihood under the subsistence-agriculture (Nejafi, 2003; Kidane *et al.*, 2005). According to Table 4, the average farmland holding size, livestock, income, and labour of the sampled households in midland were found to be 5.1 ha, 9.6 TLU, 798 birr respectively, whereas it was 4.1 ha of farm size, 9.5 TLU of livestock, and 1299 birr of income in lowland agro-ecology. Farmland size appears very high in both midland and lowland when compared with figure of the national average of 1 ha per household (Central Statistical Agency (CSA), 2006). Furthermore, 90% of midland and 96% of lowland respondents have reported to have enough labour for farm activities. On the other hand, 10% of midland household and 4% of lowland did not have enough labour.

**Table 4** Households ownership to farm size, livestock, income and labour

Households resources	Midland	Lowland	Total
Average farm size (ha)	5.2	4.6	4.9
Average livestock (TLU)	9.6	9.5	9.6
Average income (ETB)	898	1299	1089
Enough household labour			
Yes	90%	96%	149 (93%)
No	10%	4%	11 (7%)

Source: Household survey results (2011)

### Access of Households to Fertilizer, Extension, Veterinary and Credit Services

Access to technology, extension, veterinary and credit to the households in the study area plays important role for households to be food secured. As Table 5 shows in midland 52%, 66%, 19%, and 11% of sampled households in midland agro-ecology had access to fertilizer, extension, veterinary, and credit services respectively. In the

lowland agro-ecology 38%, 65%, 11%, and 10% of households have access to technology, extension, veterinary, and credit respectively.

**Table 5** Households' access to fertilize, extension, veterinary, and credit services based on agro-ecology

<b>Type of services</b>	<b>Midland</b>	<b>Lowland</b>
Access to technology (Yes %)	52	38
Access to extension (Yes %)	66	65
Access to veterinary (Yes %)	19	11
Access to credit (Yes %)	11	10

Source: Household survey results (2011)

### Food Security Status of Households in the Study Area

Food security in this study was defined as adequate availability and adequate access of food for households to meet minimum energy required as recommended by Ethiopian government for active and healthy. The result of the study shows that among total 160 sample households, 101 are food secure (63%) and 59 are food insecure (37%). Agro-ecologically, 46 (69%) of midland households and 55 (59%) of households in lowland are food secure. Whereas 21 (31%) of households in midland, and 38 (41%) of those in lowland, are food insecure. There is more percent of food security of households in midland than in lowland.

**Table 6** Food security status of sampled households in Jigjiga district

Food security status	Midland	Lowland	Total
Food secure	46 (69%)	55 (59%)	101 (63%)
Food insecure	21 (31%)	38 (41%)	59 (37%)
Total	67 (100%)	93 (100%)	160 (100%)

**Source:** Household survey results, 2011.

### Determinants of Food Security in Jigjiga District

An econometric model, logistic regression, was employed in order to identify the most important factors which determine household food security from the hypothesized potential variables. Twelve independent variables included in the logit model in order to identify the most important factors which determine household food security in Jigjiga district. Of the total twelve variables included in the model, only the significant variables were selected. These are technology, total income, agro-ecology, extension, veterinary service, and access to credit. The results of the estimates and the marginal effects of each variable determining on food security are presented in table 7.

The regression result shows a positive relationship between technology and the probabilities of a household food security, implying that the likelihood of food security increases with the farmers' use of technology. The marginal effect of use of technology and food security is found to be 0.84. This means one percent increase in use of technology on farm production increases the likelihood of a household being food secure by 84 percent.

Food security is an issue of income either income from one's own production of food, or income earned from activities that allow access to food through purchase. As can be seen in Table 7 total household income has a positive and statistically significant relation with food security. However its impact seems quite marginal. This might be caused by high unemployment rate in the area (CSA, 2010).

Agro-ecology in which the households' farmland located was found to have negative and statistically significant influence on household food security in the study area. According to Table 7, the marginal effect indicates that a unit shift from midland to lowland decreases the probability of the household being food secure by 96 percent. One possible explanation is that as one moves from midland to lowland in the study area rainfall and vegetation cover become lesser. This reduces crop production of the household and hence food security.

Access to extension services is another factor that has a positive correlation with the probability of a household being food secure. The marginal effect of access to extension services is 0.46. This indicates access to extension services increases the probability of a household being food secure by 46 percent among the sample households.

In agreement with hypothesis of the study, access to veterinary services was found to have significant and positive influence on household food security. This means households whom their livestock had access to animal health services produced more milk and meat. The marginal effect of access to veterinary services on the probability of household food security in the study area found to be 0.36, which

means the probability of the household being food secure increases by 36 percent when a household's livestock have access veterinary services.

The result of the logit model showed that access to credit is highly significant and positively correlated with household food security. The result is completely in agreement with prior expectation. This might be the fact that households who have opportunity to get credit would build their farm production capacity through purchase of agricultural inputs. Moreover, as the marginal effect of this variable shows, households who have access to credit increase their food security status by 141 percent.

**Table 7** The maximum likelihood estimates of the logit model

(N=160)					
<b>Variable</b>	<b>Coefficient</b>	<b>Std. Error</b>	<b>Z-Statistic</b>	<b>Prob.</b>	<b>Marginal effects</b>
C	-8.764	3.280	-2.672	0.0085	
TCHN	3.627	1.199	3.026	0.0025	0.84
TOTALINC	0.005	0.003	1.648	0.0993	0.0012
AGROECO	-4.111	1.775	-2.316	0.0205	-0.96
EXTENSION	1.381	0.850	1.626	0.1040	0.46
VETERINARY	1.966	0.765	2.570	0.0102	0.36
ACCESSCREDIT	6.071	0.765	4.419	0.0000	1.41
Mean dependent var.				0.631250	
LR statistic (6 d f)				141.3297	
Probability(LR stat)				0.000000	
McFadden R-squared				0.670916	

Source: Household survey results (2011)

## **CHAPTER V**

### **CONCLUSION AND RECOMMENDATION**

#### **Conclusion**

Food security in this study was defined as adequate availability and adequate access of food for households to meet minimum energy required as recommended by Ethiopian government for active and healthy life. By following the conceptual framework of the study factors that affect food security were household characteristics, household resources and ADLI's policy variables.

The objectives of the study were to assess food security status and identify factors that determine household food security in Jigjiga district of Ethiopia. The findings of this study revealed that 63% of the households are food secure whereas 37% are found to be food insecure. Agro-ecologically 69% of midland and 59% of lowland households are food secure, compared 31% and 41% of food insecure lowland households. Factors identified as having significant influence on household food security by logistic regression model include access to credit, technology, veterinary, agro-ecology, total income, and access to extension services. Furthermore the marginal effect indicates that farmer's access to credit, technology, veterinary, and extension increase household food security in the study area by 141%, 84%, 36%, and 46% respectively.

#### **Recommendations**

This study recommends continuation of the government's Agricultural Development-led Industrialization (ADLI). Based on the findings of the study, major areas of intervention in order to improve food security in Jigjiga district should be:

Appropriate technologies need to be disseminated through a strong agricultural research and extension system. The lead technologies in this regard are fertilizer, and veterinary services. The extension system has federal and district dimensions. Core institutions responsible for implementing are: the Agricultural Technical and Vocational Education and Training centers and the Farmer Training Centers.

The result of the study also assured that access to credit played a key role for the household food security. Hence it is another key area of intervention that Jigjiga district administration should strengthen micro-finance institutions service delivery to the peasant association in need of it.

Rural households in the study area have very limited alternative sources of income (Lutheran World Federation, 2010). Hence, for these households to enhance their welfare in general and food security in particular, they must have diversified access to income alternatives. The study recommends for the district administration to establish and promote off farm income sources such as petty trade and rural enterprises, which are viable option to increase food security among the rural-agricultural households in the study area.

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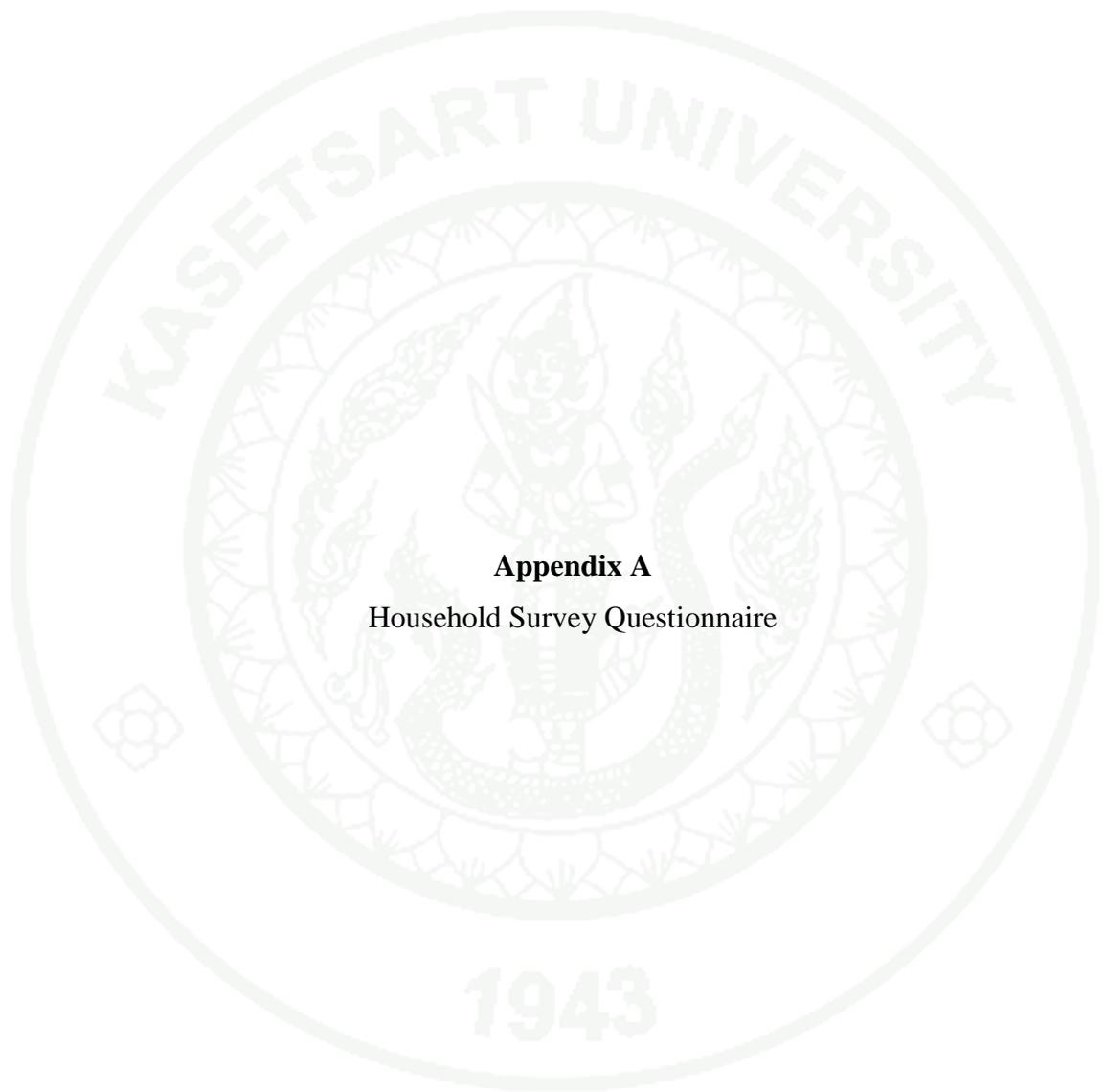
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**APPENDICES**



**Appendix A**  
Household Survey Questionnaire

## Survey Questionnaire

**Name of the Enumerator** \_\_\_\_\_

**Name of the Village** \_\_\_\_\_

**Name of the Peasant Association** \_\_\_\_\_

**Date of the Interview** \_\_\_\_\_

**Agro-ecology** \_\_\_\_\_

**Date started** \_\_\_\_\_

### I. Household Demographic Characteristics

#### 1. Would you tell me your household profile?

S/N	Name of the household members (1)	Kin relationship to household head (2)	Gender of the HH members Male-1 Female-0 (3)	Age  (4)	Years of School completed  (5)
1					
2					
3					
4					
5					
6					
8					

01=household head 02=wife 03=children 04=father 05= brother/sister 06= other relatives

### II. Household Resources

1. Do you have enough labour for your farm activity? Yes: 1 No: 0

2. If answer is no, how do you solve labour shortages?

a. Hiring daily labour

b. co-operating with other farmers

c. Others, please specify it \_\_\_\_\_?

3. How many plots /parcels of farm land in hectares do you have \_\_\_\_\_?

4. Do you own livestock? Yes=1, No=0

5. If answer to question no. 4 is yes, give details.

No	Livestock species	Quantity in number
1	Cattle	
1.1	Calf	
1.2	Weaned calf	
1.3	Heifer	
1.4	Cow	
1.5	Ox	
2	Shout	
2.1	Goat	
2.2	Sheep	
3	Equine	
3.1	Donkey	
4	Horse	
5	Chicken	

6. Do you use oxen for your farm operations? Yes=1, No=0
7. If yes to question No. 6 are your oxen enough for your farm operations?  
Yes=1, No=0
8. If you don't have enough oxen, how do you get additional oxen you need?
- Hire from some one
  - Exchanging for your labour
  - Others, please specify it \_\_\_\_?
- 9 Do you have enough feed for your animals? Yes=1, No=0
- 10 If answer is yes to question No. 9, what are the sources?
- Own grazing land
  - common grazing land
  - crop by products
  - Others, please specify it\_\_\_\_\_?
- 11 Is animal disease a problem to you? Yes=1, No=0
- 12 If yes to question 11 do you get enough drugs for your animals? Yes=1,  
No=0

### III. Agricultural production

#### 1. Crop and livestock production

Livelihood activity	Did your HH undertake take this activity? Yes: 1 No: 0	Production in Kg
<b>Crop production</b>		
Sorghum		
Maize		
Wheat		
Barley		
Oat		
Teff		
Chicken pea		
Horse bean		
Haricot bean		
Sesame		
Ground nut		
Tomato		
Onion		
Irish potato		
Sweet potato		
Peper		
T'khat		
If any other		
<b>Livestock production</b>		
Steer		
Ox		
Heifer		
Cow		
Doe		
Buck		
Ewe		

Ram		
Donkey		
Chicken		
Milk		
Butter		
Egg		
If any other		

2. For each crop grown in the year 2010 harvest, what is the total amount of land cultivated? Total amount produced, and consumed?

Crop	Area cultivated Kg	Sacks produced per hectare	Kg per hectare	Total Kg produced	How many Kg of food crop were			
					Consumed at home	Given away as a gift	Crop sold	Stored
Sorghum								
Maize								
Wheat								
Barley								
Oat								
Teff								
Chick pea								
Horse bean								
Seasame								
Ground								
Tomatoes								
Onion								
Irish potato								
Sweet potato								
Pepper								
T'khat								

3 Do you use irrigation for crop production? Yes=1, No=0

- 4 For how many months the amount food produced in the household is sufficient for the household consumption\_\_\_\_\_?
- 5 If it is not sufficient, how do you cover the gap?
- Purchase
  - borrow
  - food aid
- 6 Tell me the type and amount of food grains you purchased in 2010 household consumption?

No	Type of food grain	Quantity in Kg	Total Kg
1			
2			
3			

- 7 Tell me the amount borrowed and repaid for the year 2010.

No	Type of food grain	Quantity in Kg	Total Kg
1			
2			
3			

IV. Use of agricultural inputs

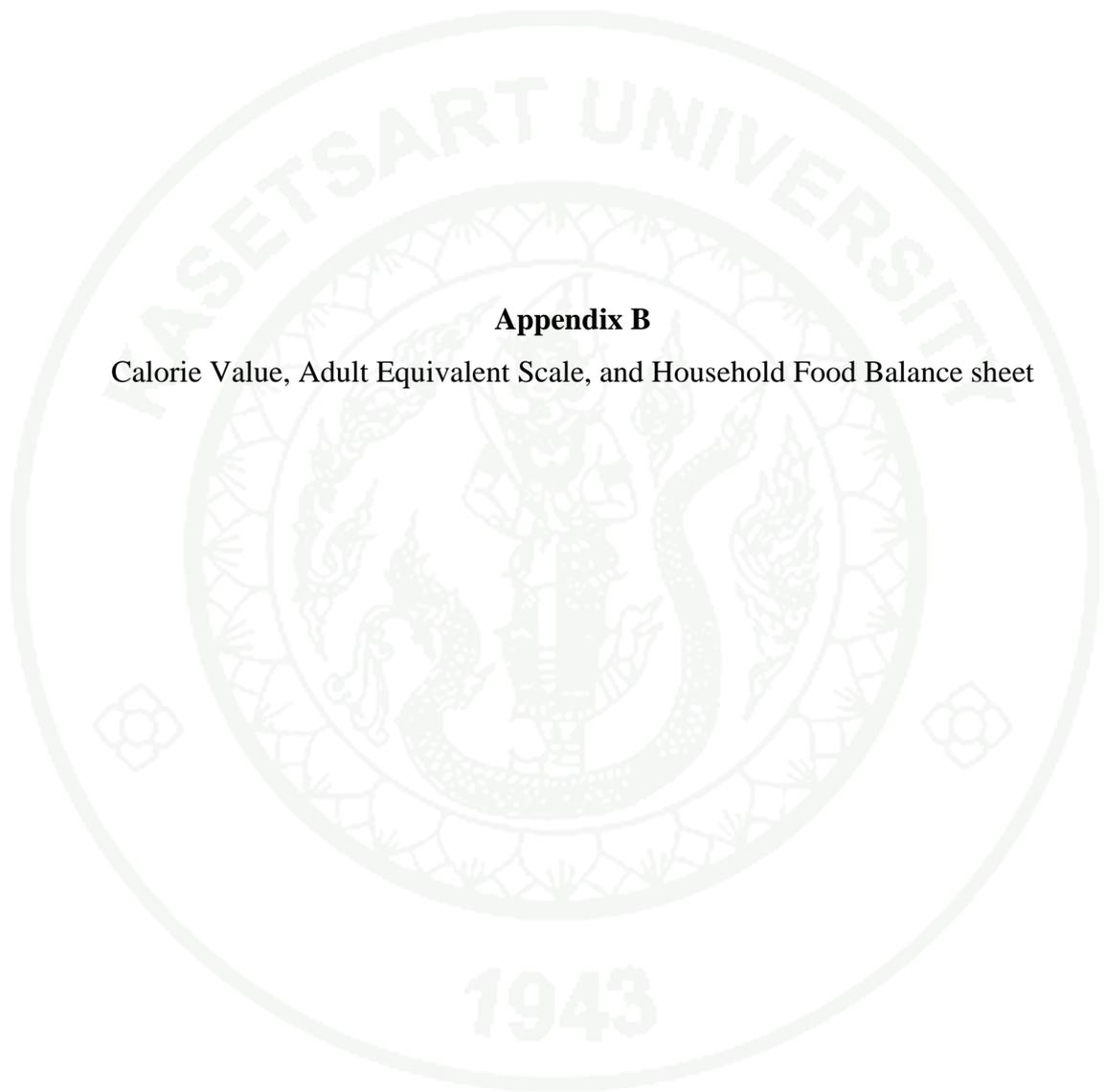
- What kind of fertilizers do apply?
  - Chemical fertilizers
  - Organic fertilizers
- If you use chemical fertilizers, what is the amount of fertilizer in kilogram you applied last harvest year\_\_\_\_\_?
- Do you use improved seeds on farm? Yes=1, No=0
- If no to above question, state the reasons
  - Not available( no supply)
  - Do not enough money to buy
  - Not familiar with it
  - If other reason, specify it\_\_\_\_\_?

V. Access to Institutional and social support networks

1. What is the nearest km to get to the market\_\_\_\_\_?
2. Do you get extension services? Yes: 1, No: 0
3. How often agricultural extension agents visit to you?
  - a. Once a month
  - b. Twice in a month
  - c. Once a cropping season
  - d. If any other, please mention it\_\_\_\_\_?
- 4 Have received credit for farm operations last harvest year? Yes: 1 No: 0
- 5 Did your household get any incentives from the government to enhance agricultural productions? Yess\_\_\_\_\_?. No\_\_\_\_\_?
- 6 How far do you travel to get social services
  - a. Schools
  - b. Clinic/health post
  - c. Roads
  - d. Telephone
  - e. Post
- 7 Please rank the following services that can improve your living conditions
  - a. Health services
  - b. Road construction
  - c. Schools
  - d. Drinking water
  - e. Farm credit
  - f. Employment opportunities
  - g. Provision of agricultural production technology
  - h. Supply of electricity

## VI. farm and nonfarm activities

<b>Description of activities</b>	<b>Did your HH undertake this activity?</b>	<b>Average income earned last production year(2010)</b>
<b>Sale of natural activities</b>		
Fire wood		
Charcoal		
Wild fruits		
Animal feed		
<b>Trading(buying &amp;selling)</b>		
Livestock(choat, cattle and camel)		
Food crops(grain and vegetable)		
Livestock products(milk, meat and butter)		
Khat		
Petty trading		
Any other		
<b>Employment/labour</b>		
Daily labour in construction		
Farm worker		
Pottery		
Animal herder		
Total HH Income(Birr)		



**Appendix B**

Calorie Value, Adult Equivalent Scale, and Household Food Balance sheet

**Appendix Table B1** Calorie value of food items consumed by sample households

<b>Food Items</b>	<b>Unit</b>	<b>Kilo calorie</b>
Teff	Kg	3589
Wheat	Kg	3623
Sorghum	Kg	3805
Maize	Kg	3751
Barley	Kg	3723
Peas	Kg	3553
Irish Potato	Kg	1037
Onion	Kg	713
Meat	Kg	1148
Milk	Kg	737
Egg	Kg	61
Butter	Kg	7364
Spaghetti/macaroni	Kg	3550

Source: Ethiopia Health Nutrition Research Institute (EHNRI) (2000)

**Appendix Table B2** Adult Equivalent (AE)

<b>Age Category(Years)</b>	<b>Female</b>	<b>Male</b>
<10	0.60	0.60
10-13	0.80	0.90
14-16	0.75	1.00
17-50	0.75	1.00
>50	0.75	1.00

Source: Ayalneh (2002)

**Appendix Table B3 Household Food Balance Sheet**

HHID	ProdCal.	Pur. Cal.	Borr. cal.	LVF. Cal.	T. Cal.	ADE.	D.CalHHPD	FSS
kara001	4844700	2031050	1143610	8844	8028204	3.8	5865.35452	1
kara001	3757800	918550	918550	0	5594900	4.8	3227.05119	1
kara002	4844700	2031050	1143610	8844	8028204	4.5	4942.71448	1
kara003	3395500	0	0	0	3395500	4.5	2090.50331	0
kara004	3757800	918550	918550	0	5594900	5.2	2976.40644	1
dacar001	4120100	918550	918550	0	5957200	4.5	3667.662	1
dacar002	3395500	918550	918550	0	5232600	4.5	3221.54841	1
dacar003	3033200	2174690	918550	4422	6130862	3.6	4731.51611	1
dacar004	6656200	0	918550	0	7574750	4.5	4663.53702	1
dacar005	5931600	1655950	1668750	0	9256300	4.5	5698.81484	1
dacar006	3033200	918550	918550	0	4870300	4.5	2998.49161	1
dacar007	4482400	737400	918550	0	6138350	4.5	3779.1904	1
dacar008	4120100	918550	918550	0	5957200	4.2	3932.79419	1
dacar009	3214350	918550	918550	0	5051450	4.2	3334.84073	1
Baali001	5207000	1293650	918550	0	7419200	4.5	4567.76974	1
Baali002	2579900	918550	918550	8844	4425844	3.9	3149.50649	1
Baali003	3214350	918550	918550	0	5051450	4.5	3110.02001	1
Baali004	3938950	918550	918550	0	5776050	4.3	3680.18477	1
dudahi001	7444100	1498955	2032750	35376	11011181	3.9	7835.74524	1
dudahi002	6640000	1299050	1743850	11055	9693955	5.1	5259.16452	1
dudahi003	377800	0	0	0	377800	1.8	591.46771	0
dudahi004	755600	884880	618470	0	2258950	5.4	1156.80451	0
dudahi005	1329050	884880	0	0	2213930	5.8	1054.88029	0
dudahi006	740100	3337500	0	0	4077600	3.6	3146.90334	1
dudahi007	264730	2031050	0	0	2295780	4.8	1324.17015	0
Hadaw001	750200	1099700	0	0	1849900	6.3	804.479235	0
Hadaw002	750200	1125300	0	0	1875500	5.6	917.563601	0
Hadaw003	7133700	0	0	0	7133700	3.8	5211.83562	1
Hadaw004	1125300	0	0	0	1125300	6.1	509.589041	0
Hadaw005	8136075	0	0	0	8136075	4.7	4793.68095	1
Hadaw006	4460800	1112500	737400	0	6310700	2.9	6066.52247	1
Hadaw007	2973200	737400	0	0	3710600	1.8	5809.15851	1
Hadaw008	2973200	737400	368700	0	4079300	4.2	2693.05166	1
Hadaw009	5198200	368700	558950	0	6125850	2.8	6102.96389	1
Hadaw010	750200	1099700	0	0	1849900	3.6	1427.66737	0
Hadaw011	2235800	737400	0	0	2973200	3.6	2294.57843	1
Hadaw012	4762500	737400	0	0	5499900	1.8	8610.41096	1
Hadaw013	4091100	0	368700	0	4459800	3	4141.90852	1
Hadaw014	4864900	737400	737400	0	6339700	3.4	5108.5415	1
Hodley001	8390150	0	0	0	8390150	7	3307.44062	1
Hodley002	2795650	934050	190250	0	3919950	6	1804.97295	0
Hodley003	924950	1112500	0	88440	2125890	4.4	1338.93245	0

**Appendix Table B3 (Continued).**

HHID	ProdCal.	Pur. Cal.	Borr. cal.	LVF. Cal.	T. Cal.	ADE	DCalHHPD	FSS
Hodley004	1876002	2962400	1487600	44220	6370222	7.1	2475.55504	1
Hodley005	2250600	5950400	0	88440	8289440	7.4	3069.02629	1
Hodley006	362300	1495700	0	0	1858000	2.2	2313.82316	1
Hodley007	1417425	1112500	0	0	2529925	2.7	2567.14866	1
Hodley008	1023880	937750	375100	0	2336730	4.9	1320	0
Hodley009	2237800	724600	0	70752	3033152	2.8	2967.8591	1
Hodley010	16198900	3728800	0	0	19927700	6.1	8950.2358	1
Hodley011	750200	1849900	0	0	2600100	4.6	1565.61794	0
Hodley012	1130700	2212200	0	0	3342900	2.4	3897.28942	1
Hodley013	4339650	2212200	0	0	6551850	5.8	3094.87482	1
Hodley014	2272200		0	0	2272200	3	2110.23915	1
Hodley015	750200	2230400	0	0	2980600	4.8	1719.16366	0
Hodley016	7556000	2266800	0	88440	9911240	4.5	6102.04094	1
Hodley017	2250600	4450000	0	26532	6727132	4.3	4336.58791	1
Hodley018	3751000	375100	0	0	4126100	2.4	4810.37598	1
Hodley019	4533600	0	0	0	4533600	1.8	7097.61252	1
Amodle001	4475600	0	0	123816	4599416	4.6	2769.48126	1
Amodle002	1875500	1287250	0	53064	3215814	5.9	1506.05971	0
Amodle003	4316050	375100	0	0	4691150	6.3	2040.07393	0
Amodle004	375100	0	0	0	375100	6.1	168.470694	0
Amodle005	2250600	0	375100	0	2625700	3.6	2026.39398	0
Amodle006	5658900	1125300	187550	0	6971750	1.8	10914.6771	1
Amodle007	45066000	0	0	0	45066000	5.4	23078.223	1
Amodle008	4877700	0	0	0	4877700	5.9	2284.36951	1
Amodle009	58662000	0	0	0	58662000	6.6	24351.1831	1
Gabo001	4136900	187550	562650	0	4887100	2.4	5697.58088	1
Gabo002	2261400	187550	187550	0	2636500	6.2	1174.51832	0
Gabo003	3376802	755600	755600	0	4888002	3	4539.58858	1
Gabo004	5653500	918550	549850	132660	7254560	4.5	4466.40603	1
Gabo005	5653500	945850	568050	132660	7300060	4.5	4494.41896	1
Gabo006	2277600	945850	568050	132660	3924160	4.5	2415.98276	1
Gabo007	4924900	568050	568050	0	6061000	6.2	2678.30314	1
Gabo008	750200	0	0	0	750200	5.1	406.998508	0
Garcire001	1500400	184990	184990	0	1870380	3	1737.0606	0
Gabo009	2961200	368700	368700	0	3698600	6.1	1674.90094	0
Baladka001	1350360	368700	549850	53064	2321974	4.8	1339.27844	0
Baladka002	2237800	1468400	1474800	33165	5214165	3.6	4024.05171	1
Baladka003	750200	260010	0	70752	1080962	4.5	665.514545	0
Baladka004	750200	912150	184990	35376	1882716	4.5	1159.12944	0
Baladka005	4450000	368700	918550	35376	5772626	4.5	3554.02555	1
Baladka006	4450000	368700	918550	35376	5772626	4.8	3329.56078	1
Baladka007	4450000	368700	918550	35376	5772626	4.7	3401.16424	1
Baladka008	1125300	549850	549850	70752	2295752	5.7	1113.22682	0

Appendix Table B3 (Continued).

HHID	ProdCal.	Pur. Cal.	Borr. cal.	LVF. Cal.	T. Cal.	ADE	DCalHHPD	FSS
Dabalwa001	13172500	0	0	0	13172500	3.9	9373.77691	1
Dabalwa002	10096500	0	0	0	10096500	5.9	4688.41421	1
Dabalwa003	17649700	0	0	0	17649700	3.6	13621.2232	1
Dabalwa004	6006400	1136100	0	0	7142500	5.8	3403.2162	1
Amadhle001	25965700	0	0	0	25965700	6.9	10309.9861	1
Amadhle002	5842946	0	0	0	5842946	4.5	3557.34916	1
Feedha001	1116500	0	0	0	1116500	5.4	571.757777	0
Hadaw0016	38050	0	0	0	38050	4.4	23.6924035	0
Hadaw0017	60340	1105925	0	0	1166265	5	645.504359	0
Hadaw0018	191355	30278	0	0	221633	3.6	168.670472	0
kara005	4482400	918550	918550	17688	6337188	4.2	4183.65275	1
dudahi008	4435200	918550	918550	195305	6467605	4.5	3981.90242	1
karay006	755600	0	0	0	755600	6.9	302.209779	0
Hadaw0019	3037850	1474800	368700	3685	4885035	3.5	3879.32102	1
Geel boob001	27263500	0	0	0	27263500	6.2	12145.4505	1
Baladka009	5243400	1667750	1108800	61908	8081858	5.2	4258.09168	1
Baladka010	2250600	1500400	2813250	22110	6586360	3.6	5083.04843	1
Baladka011	6649400	737400	924950	88440	8400190	1.8	13150.9824	1
Baladka012	3000800	543450	2374150	0	5918400	2.4	6899.91256	1
Baladka013	8124200	1474800	1106100	22110	10727210	6	4939.43133	1
Baladka014	3000800	2250600	1690650	0	6942050	5.4	3555.01216	1
Baladka015	188090	1442690	565350	0	2196130	4	1523.23912	0
Baladka016	3000800	1442690	1108800	0	5552290	4.8	3169.1153	1
Baladka017	3000800	54345	2936800	88440	6080385	6.1	2753.48579	1
Baladka018	4398800	1112500	1849900	33165	7394365	4.6	4452.42511	1
Baladka019	3000800	1500400	1875500	44220	6420920	5.1	3483.47755	1
karay007	3340900	0	0	184250	3525150	3	3273.87973	1
karay009	3746000	0	0	221100	3967100	5.9	1857.90891	0
karay010	2266800	0	0	280060	2546860	4.8	1468.98919	0
karay011	7118900	0	0	265320	7384220	3.6	5698.79992	1
karay012	4638250	0	0	184250	4822500	5.4	2469.59416	1
tulig001	5964600	0	0	191620	6156220	5.4	3152.58994	1
tulig002	1099700	755600	362300	0	2217600	3.6	1711.44125	0
tulig003	8526300	0	0	88440	8614740	5.9	4034.5346	1
tulig004	5589500	0	0	250580	5840080	5.8	2782.64681	1
tulig005	2641900	0	0	0	2641900	3.6	2038.89639	0
tulig006	5970000	0	0	0	5970000	3.6	4607.37025	1
tulig007	5589500	0	0	0	5589500	4.5	3441.28059	1
tulig008	1474800	0	0	0	1474800	3	1369.67727	0
tulig009	5607700	0	0	22110	5629810	4.4	3545.77862	1
tulig010	1320950	1474800	380500	0	3176250	3.6	2451.28304	1
tulig011	1380610	2036450	0	184250	3601310	3.6	2779.32472	1
tulig012	3022400	0	0	26532	3048932	3.6	2353.02489	1
tulig013	852630	1498400	1117900	0	3468930	3.6	2677.15995	1
tulig014	3335500	0	0	0	3335500	3.5	2648.79889	1
tulig015	5602300	742800	0	22110	6367210	3.6	4913.91858	1
tulig016	101447	0	0	0	101447	3.6	78.2921088	0

## BIOGRAPHICAL DATA

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