THE FOOD SECURITY ROLE OF AGRICULTURE IN ETHIOPIAN: A HOUSEHOLD LEVEL ANALYSIS

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Abstract

Data from Ethiopia are used to analyze the food security role of Ethiopian agriculture. A low average daily food energy supply and wide prevalence of under-nourishment reveals that a significant share of the Ethiopian population live under conditions of chronic hunger. From the analysis of the historical consumption data it is shown that there is a high probability of national food consumption shortfall below a trend level. Land quality and rainfall are the major determinants of rural farm households' income. The results strongly signify the importance of reducing land degradation, improving soil fertility. A move away from the rainfed agriculture and access to and use of water for irrigation is the only viable way out for the future Ethiopian agriculture and sustainable food security. The result of the analysis of income elasticity of food consumption shows that elasticity of food nutrient intake is relatively higher for rural than urban households implying that improved farm income would lead to a consumption of better quality food. To enhance the food security role of the agriculture certain interventions are imperative. These include improvement in policies and measures including land tenure security, enhanced functioning of market system, investment in infrastructure, incentive for producers through input delivery and price support, enabling farmers' participation, aggressive actions on environmental rehabilitation, and use of water resources for irrigated agriculture.

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1. INTRODUCTION

1.1 Background

The agricultural sector in Ethiopia plays important economic, social and environmental roles. The sector is a source of livelihood for over 80% population residing in rural areas. It contributes about 50% to the national value of production. Supply of raw materials to the country's agro-industrial sector, and foreign export earnings are important roles attributed to the agricultural sector. In terms of structure, the smallholder mixed farming systems largely dominate the agricultural sector in Ethiopia. In the low lands and some coastal areas pastoral farming systems are dominant. Currently, private commercial farms are operating besides the state farms. Recovering from bad images and experiences of the 1970s and 1980s, cooperative farms are gradually coming to the scene. Farmers' services cooperative are also being established to promote collective bargaining power and to enhance service delivery to the farmers. Urban and peri-urban agriculture in Ethiopia is at its infancy. The urban agriculture, though small in its share plays a vital role in providing food for households and supply to the market. Urban households engage in poultry, dairy, sheep and goat farming, and vegetable production.

The conventional approach to measure the role of the agricultural sector does not encompass all what ought to be appreciated regarding this sector. It is the interest to fill this gap that motivated the Role of Agriculture (ROA) research project. The research is meant to provide an insight and methodology on how to identify measure and value the non-commodity roles of the Ethiopian agricultural sector. The research output will have significance in terms of implications for revisiting and enhancing agricultural support policies and strategies that would increase the commodity and non-commodity roles of the sector and contributions to social welfare. This paper reports on the state of condition of food security, identifies, assesses, and measures the food security roles of the Ethiopian agricultural at the household level.

b. Objectives of the study

The broad objective of this study is to reflect on the existing reality of the state of condition of food security in Ethiopia, measure and value the role of the agricultural sector in food security. The specific objectives of this module are to:

- Review and describe the food security situation in Ethiopia;
- Identify the positive roles of Ethiopian agriculture in ensuring food security;

- Measure and value the food security role that agriculture plays at the household levels.
- Draw policy implications for the agricultural development policy and strategy by way of assessing the determinants of the positive role of food security.

2. METHODOLOGY

2.1. The concept of food security and role of agriculture

The concept and definition of food security has been around now for quite a long period. There is an understanding that any single measure is not sufficient as food security involves a number of aspects: availability, access, outcomes in terms of physical measure like poverty and vulnerability; all these are different aspects of food security and one cannot accurately get a true picture of the food security situation of an entire population or a household without looking at more than one measure. In its simplest form, food security has been defined as" access by all people at all times to the food needed for a healthy life" (SUAS, 1995). As FAO is quoted by Beirerle (2002) and World Food Summit of 1996 by Valdes (2002: p.2) "food security exists 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 an active and healthy life."

In a normally operating agricultural system, agriculture plays many vital functions in the path of economic growth. It serves as a source of food to satisfy both the domestic and international food demands. The food security role of agriculture can be attained by availing food from domestic production and/or by supplying foreign exchange required to access food available through trade. A well functioning agricultural system requires effectively operating agricultural input and output market systems that facilitate two-way relations between the agricultural and non-agricultural sectors. Agriculture provides food and raw materials for the urban dwellers and urban-based economic and service sectors. When agricultural productivity rises and surplus is produced, the sector serves as a source of labor and capital used for growth in industry and other sectors. An adequately productive agriculture is a source of food security to not only rural but also urban households. Sufficient food production enables urban households to access food at a reduced cost and ensures their food security, provided that they have sufficient purchasing power. Likewise, well-functioning industry and service sectors provide agriculture with necessary inputs and services and serve as a market outlet. Such a dynamic interaction makes agriculture responsive to and beneficiary of the advancements in science and technology.

2.2. Approach to measurement of household level food security role of agriculture

In addition to the national level dimension of the country's food security, household food security is of considerable importance. Despite aggregate sufficiency of food supply, in many conditions of underdeveloped economies like Ethiopia unequal access to food and undernourishment of the sections of a population is a widely observed phenomenon. In order to assess the role of agriculture for household level food security, in this study income elasticity of food consumption and expenditure was proposed to investigate whether elasticities are different according to the sources of household income. The objective of the food security module here is to look at how agriculture plays a role in increasing food security by increasing food consumption of households. One way of approaching this is to ask a question: "Is income increase associated with higher agricultural output more effective in promoting food consumption at the household level than higher income related to non-agricultural income sources?"

The analysis of a household level food security aims at investigating whether consumption effects of income gains from agriculture versus non-agriculture in food insecure households differ. Theoretically, this can be done by observing improvements in the consumption or the food security position of all households at an income level below a certain acceptable standard and then see what the benefits would be in terms of food security as poverty is reduced and income increases, from improvement in the consumption. That would help see the extent to which household food security can be enhanced by an improvement in productivity and income from agriculture. This thinking is based on the assumption that for a poor household, when income increases and with improving health, increase in expenditure could certainly improve its nutrition. On the other hand, based on analysis of household behavior and empirical observations, there is an argument that when income of poor households increases, they do not immediately start spending money on more food. They first spend money on heath or improving housing or clothing and they remain with inadequate diet for some time. When they cross an income threshold, they start spending money to improve their diet by purchasing or consuming higher quality food items. At that point, the composition of their diet will vary and increase reaching adequate food basket. The food security role of agriculture for urban households can be attained when agriculture can supply food at a cheap cost to the urban dwellers. If an urban household has a high proportion of food expenditure, reduced food price following increase in agricultural production can have a positive impact on its food security.

The nutrient intake of the i^{th} individual depends on the food intake of that individual, and the household environment. It needs to model demand equations for per capita expenditures on different foods items and per capita nutrient intake. Linear approximations to these relations are provided as indicated below (Gaiha, 2003):

$$Z = K P + n H + dE + qV + u, \quad (1)$$

$$L = M P + sH + j E + oV + v \quad (2)$$

Equations (1) and (2) specify different sets of measures of nutrient intake. In equation (1), different components of food expenditure, denoted by vector Z, are considered. Such equation has been used in several studies to estimate elasticities of expenditure on various food groups with respect to income [3]. In equation (2), the focus is on nutrient intake (e.g. calories, proteins, fat, iron), denoted by vector L. The right side variables include product prices, denoted by vector P; total household expenditure (as a proxy for income), denoted by H; household endowments in terms of human and physical assets, denoted by E*;* village endowments in terms of infrastructure, denoted by V; K, M, are coefficient matrices; n, d, q, s, j, o, are row vectors of coefficients; and u, and v are vectors of stochastic terms.

The food nutrient (e.g. calorie) elasticity with respect to income derives from the price and demand elasticities of demand for food items and technical coefficients measuring calories content of each food item (Sadoulet and Janvry, 1995). These authors argue that there are substitutions between quantity of calories and quality of food as income increases leading to a shift to higher nutrient cost foods. As a result income elasticity of calorie intake is smaller than the income elasticity of food expenditure. Estimates made by Kundsen and Scandizzo (1982) quoted in Sadoulet and Janvry (1995) for five less developed countries had found income elasticities of calories in the range of 0.53 to 0.74 for the lowest income quartile. On the other hand, Behrman and Deolalikar (1987) (also quoted) (Gaiha, 2003) estimated nutrient – expenditure elasticities in South India and found that these elasticities are not different from zero: as income rises, consumers shift to higher food quality and higher nutrient cost foods. Strauss and Thomas (1990) using data from Brazil and Subramanian and Deaton (1992) quoted in Gaiha (2003) with data from India have challenged the previous result. They have found that the calorie expenditure relation is positively sloped for the lowest three quartiles of per capita expenditure. While this elasticity is less than that for food expenditure, it is significantly different from zero, in the 0.25 to 0.30 range in the lowest expenditure decile in Brazil and 0.30 to 0.50 in rural India.

In this study, determinants of consumption (level of expenditure and nutrient intake) are analyzed using a general model:

$$C = f(Z)$$

In the interest of estimating income elasticities of consumption and nutrient intake, natural log of consumption and some of the explanatory variables are derived. To benefit from a large sample size (n) of cases analyzed, variables with significant number of zero values are not transformed into log. A linear form of the model is estimated:

$$Ln(C_i) = \beta' Z_i + \varepsilon_i$$

Where C_j represents per capital expenditure on food or per capital nutrient intake of house hold i, and Z_i denotes a vector of house hold characteristics and other determinants of consumption, β is a coefficient and ε_i a random disturbance term. ε_i is assumed to be normally, identically and independently distribute with μ (0, σ2). Actual household income is expected to have two components, permanent and transitory. Permanent income can be predicted from a regression model in which the right hand side variables include household endowments and other factors. Using this predicted/ permanent income as an independent variable, depending on how variable different income sources are, their coefficient(s) in a regressing model would reflect the effect of transitory components of income. This argument was held by Gahia (2003). Hence, two levels were followed in estimating the consumption and nutrient intake elasticities. In the first step permanent income (represented by household expenditure) was predicted from the regression equation. In the next step, the predicted level of income (expenditure) was used as explanatory variable in the consumption equations. The reasons for taking expenditures as proxy for income are well established. As households most often tend to underestimate their income, and expenditure is thought to be reflecting revealed consumption, household income is represented by expenditure.

Choice and derivation of variables used in the regression:

Dependent variables: Two dependent variables are identified to estimate the regression function. These are per capita food consumption expenditure and per capital nutrient intake (calories, protein, fats). Conversion factors for nutrient contents of food items established by the Ethiopian Health and Nutrition Research Institute (EHNRI, 1995-1997) are used to compute nutrient contents of the food items consumed. The food consumption expenditure and nutrient intake encompass the

values and nutrient amount of all food consumed (own produced, food purchased and that obtained from wage in kinds in off-farm employments, food aid, and gift and other transfers).

***Explanatory variables**:* To estimate income elasticity of food consumption expenditure and nutrient intake, the following relevant explanatory variables are identified and used in the model.

Household characteristics: households do have differences manifested in sets of characteristics including size, composition, age structure, sex, religious affiliation, ethnic groups, occupation, etc. that affect the pattern of demand and consumption. In order to study the impact of household structure on food consumption, the number of dependents in the households (members with age less than 18 and above 65 years old) is included along with the working members of the households (members with age between 18 and 65 years inclusive). Age of household head is included. The impact of gender was captured by taking the sex of household head. To allow for non-linearity of the relationship between household size and consumption, square of household size was included in the regression. For the urban households religious and ethnic groups were entered as dummy variables. This information, unfortunately, was not available for the rural households.

Educational attainment: The highest grade of educational attainment of household head (both male and female) and percent of literate members in the households are also hypothesized as important variables that could affect food consumption expenditure and quality of food consumed.

Occupation and employment: employment status is related to occupation of household members. This is particularly so for the urban households. In the case of rural, there are limited numbers of households who are engaged in or earning from off-farm employment. The number of income earners in the households is included.

Endowment of productive resources: in the case of urban households, capital assets of private business including few households who are involved in farming is taken as explanatory variable. For the rural households cultivated land owned, value of live asset (livestock), family labor force, number of oxen owned are included to reflect the impact of productive resources.

Agro-ecological factors: for the rural households two variables reflecting agro-ecological features related to farm plots are recorded. These are farmers' judgment of the level of soil quality/fertility and rainfall availability and distribution during the growing seasons. As data is variable on plot bases, certain value weights were given

for soil quality to construct land fertility index for households. In the same manner the rainfall availability and distribution as assessed by the farmers were given some weights also considering plot sizes to construct rainfall sufficiency index for a household. These two variables are entered in the income regression function to capture impacts of agro-ecological factors on farm income.

Measures of wealth: for the urban households proxy variables reflecting the wealth status of households (value of furniture and household items), type of house owned or rented are included. For rural households value of livestock owned and value of expenditures made on physical assets like house are included in consumption model.

Infrastructure: for rural households relevant data on access to infrastructure is not easy to acquire. The only variables entered in income prediction equation as a proxy for infrastructure are the distance to the nearest farm input distribution center and access to the agricultural extension service. For urban households model variations in the level of infrastructure facilities and access to information are accounted for by entering dummies for the towns included in the study.

2.3. Data

Two data sets, for urban and rural, collected by the Faculty of Business and Economics at the Addis Ababa University are used for analysis in this study. The data were collected from 1472 urban households sampled from 7 major towns in the country during 1999/2000 in the 5th round survey project. Similarly, the rural data were collected during the 5th round rural household survey conducted in 1999/2000. 1681 households sampled from 18 woredas found in the four major regions in the country - Tigray, Amhara, Oromia and Southern Nations and Nationalities were covered in the survey. Other secondary data sources used in this study include the Central Statistical Authority, the National Bank of Ethiopia, and FAOSTAT.

3. OVERVIEW OF AN ASSESSMENT OF FOOD SECURITY AT NATIONAL LEVEL

3.1. Food Security Indicators

Meeting food requirements of the growing population is one of the major development policy concerns and challenges in contemporary Ethiopia. The significance of food production for a household level and the national economy is quite well documented. The World Bank data (2000) shows that the share of a household income spent on food in Ethiopia is 72% as per estimates made during 1996. Despite efforts made to

improve food production through increased use of chemical fertilizers and improved seeds, any notable improvement in national food production has not been yet attained. The country continued to depend on food imports to a lesser extent and mainly on food aid. The proportion of people in food poverty (people unable to attain their minimum nutritional requirements) is reported to be 52% of the rural population and 36% of the urban population (MEDaC, 1999). The World Development Report's indicators for the year 2000/2001 revealed the prevalence of child malnutrition (% of children under age 5) being 48% during the period 1992- 1998 in Ethiopia.

National food security relates to the overall food availability for a country. The level of domestic food production, amount of food import (both commercial and food aid) contribute to the national food security. The positive role of the agricultural sector in terms of ensuring national food security is measured by its contribution to the domestic food production and, hence, reducing dependence on food imports. There are established indicators used to assess the level of national food security. Various indices and indicators have been developed to measure the state of national level food security. These measures include food production, nutritional intake and quality, income distribution, factors of access to food, etc [1]. Relevant indicators used are the per capita food and nutritional availability and distribution (see annex Table 1). Land use and per capita arable land, consumer price index (reflecting changes in the cost to the average consumer of acquiring a fixed basket of goods and services), food price index as sub-index of the consumer price index are computed to indicate the level and trends of access to food. A Gini coefficient is also computed to measure the extent to which the distribution of income consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution [2]. Paved road (% of total roads) is one of the indicators of access to food that affects costs and prices of food in a country. Different indicators of poverty are computed - national poverty headcount, per capita GDP and GNI, life expectancy, rates of mortality, prevalence of child malnutrition (weight for age and height for age of under-5 children).

Estimates provided by FAO[2] are based on calculation of the amount of food available in the country (national dietary energy supply) and a measure of inequality in distribution derived from household income/ expenditure surveys. Considering different food types, cereals, roots and tubers, dietary calorie supply per person was computed. Index of variability of gross food production is computed as follows: the coefficient of variation (or index of variability) of a variable *x* is defined as the ratio of its standard deviation to its mean. This coefficient is computed from a 16-year time

[2] Reference can be made to the Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) for core indicators of food security and nutritional status in Ethiopia.

series of gross per capita production index using FAOSTAT data for Ethiopia. This variable presents gross or net production indices on a per capita basis. Production quantities of each commodity are weighted by 1989-91 average international commodity prices and summed for each year. To obtain the index, the aggregate for a given year is divided by the average aggregate for the base period 1989-91 and then divided by the related index of population. Index of variability of food prices is computed using Food Price Index obtained from World Development Indicators 2002.

As shown in the annex Table 1, the indicators provide the state of condition during recent years (1994–2000) on food consumption and nutrition, food availability, food access and its factors, and level of stability of food production and food prices. During the observation period, the dietary daily per capita calorie supply increased from 1656 kcal in 1994 to 2023 kcal in 2000 showing an increase by 22%. An average level during this period was 1800 kcal/day/person. 81% of this calorie supply comes from cereals, roots and tubers. The data shows that average calorie consumption is 15% lower than the usually cited minimum daily requirement per person of 2100 kcal. Undernourishment is highly prevalent and severe where 47.3% of the population is shown to be affected. Similarly, malnutrition of children under 5 years of age is very high (47% under weight and 51% stunted). Per capita dietary fat supply per day does not exceed 20 grams while protein supply slightly varied between 47 and 60 grams, an average during the period being 53 grams. During 1994 to 2000, the average cereal supply per person ranged between lowest 122 kg (in 1994) to 158 kg (in 2000) while average is only 135 kg. In fact the data shows that while food production capacity did not improve over a longer period of time, the population size increased at an alarming rate [4]. Reports contained in the draft National Food Security Strategy (FDRE, 1996) showing a trend of food availability indicates that as the Ethiopian population grew from 15 million in 1951 to 55 million during early the 1990s, the production of cereal food dropped on per capita basis by more than 25% from more than 200 kg in early 1950s to 150 kg by 1992. It provides a strong evidence of failing capacity of Ethiopian food production system to meet the food demands of the growing population.

Many indicators of access to food and factors that affect it are provided in annex Table 2. In the face of growing population, access to land is becoming among the critical factors of food production in the country. Arable land under annual crops per person is less than 0.20 hectare. Recent survey of over 8500 rural households by the Ethiopian Economic Association/ Ethiopian Economic Policy Research Institute (EEPRI, 2002) reveals that average national holding of cultivated land is 1.02 ha while the distribution shows that 63% of the studied households operate less than 1 ha. Among factors of access to food are the level of general consumer prices and food prices in particular.

The high prevalence of food insecurity in Ethiopia is also attributed to the low purchasing power of the population. Per capita GDP (constant 1995) is only 110 USD. Income distribution is significantly unequal as shown by Gini Index of 40 measured during 1995. Unequal distribution of income in the country reflects that there are disadvantaged groups of the society in terms of access to food and other basic needs of livelihood. Another major factor of access to food in Ethiopia is infrastructure and communication. Although recent efforts of construction of major highways are notable, Ethiopia's infrastructure and communication provisions are very low. If we consider road density as one of the indicators of market network, Ethiopia has the lowest road accessibility even compared to some African countries. The World Bank Data (2002) shows that in Ethiopia over a period of two decades (1970 to 1990) the road availability per million inhabitants grew from 250 km to only 550 km. Although many agricultural areas of the country have good surplus production potential, there are problems of access to roads for effective food movement between surplus producing and deficit areas, costly transportation. Lack of sufficient markets for produce limits the purchase and use of yield increasing farm inputs.

3.2. Trend of Grain Food Production

Grain production constitutes an important component of the total food availability in the country. Grain production and area cultivated for the pre and post 1991/92 periods is computed using the NBE 2000/2001 Annual Report. During the period 1974/75-2001/02 grain production amounted to 6.7 million tons and the average cultivated land used for grain is 6.36 million hectares (Table 1). Of the total, cereal production constituted the largest share both in terms of quantity area of cultivated land. During the period under consideration, the average cereal production amounted to 5.9 million tons followed by pulses and oil crops whose respective figures were 0.67 and 0.094 millions. The average cultivated land for cereals, pulses and oil crops were 5.27, 0.82 and 0.27 million hectares, respectively. Comparing the pre and post 1991 periods, there is a slight increase of production and area cultivated with grain. The rate of growth of area of cultivated land was 1.8 percent.

Table 1: Grain production and area cultivated during the two and half decades

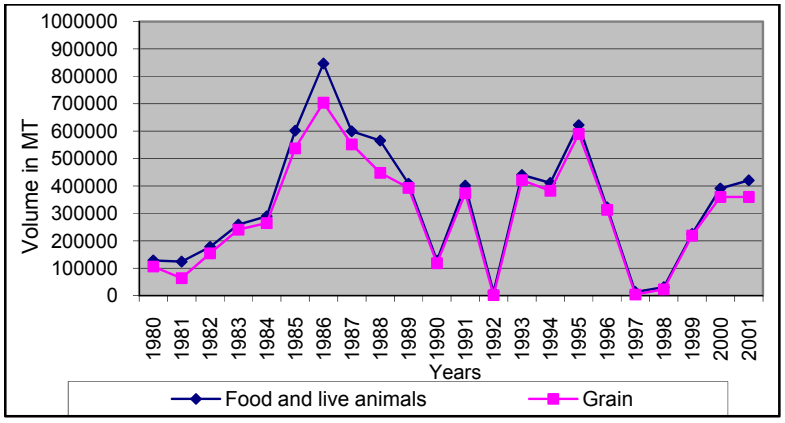
Period	Average grain production (million tons) and area of cultivated land ('000 ha)							
	Cereals		Pulses		Oil crops		Total	
	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Area
1974/75-'90/91	5.2	4,656.1	0.61	672.9	0.076	207.2	5.9	5,536.2
1991/92-'01/02	7.2	6,219.0	0.74	1,058.5	0.12	355.6	8.1	7,633.1
1974/75-'01/02	5.9	5,270.1	0.67	824.4	0.094	265.5	6.7	6,360.0

Source: Central Statistical Authority's various reports

3.3. Dependence on food imports

Ethiopia is categorized into the group of Low Income Food Deficient countries [5]. A huge food self-sufficiency gap necessitates a dependence on commercial food import and food Aid in Ethiopia. Three major data sources show the magnitude and trend of food import for Ethiopia. These are the FAOSTAT, the World Bank and the Reports of National Bank of Ethiopia. Observation of the data from different sources shows that there are some differences in the value and volume of food imported. The value of food import was on average about 203 million US $ (current) during 1980s and 147.4 million US$ (current) during 1990s (World Bank, 2000). The variation in commercial food import could mainly be due to the variation in the availability of foreign exchange and food prices. Foreign exchange earnings is very much dependent on the performance of the primary products' export market dominated by coffee, hides and skin, pulses and oil crops. Trend in commercial food import in Ethiopia over 20 years period (1980 to 2001) shows that the volume of import has been fluctuating from year to year (Figure 1). It rose by over 8 fold from its level around 100,000 MT in 1980 to over 800,000 MT in 1986. The average lies at about 400,000 MT per year.

Figure 1: Volume of food import-grain and live animals (MT)



Source: Computed from the Annual Report of National Bank of Ethiopia, 2000/01

The National Bank data on food import reports an aggregate of food and live animals, and imports of grain, which is part of the former. In fact import of grain constitutes the largest share, an average of 82%. The share of grain in food imports ranged from the lowest, 15% in 1992 to the highest, 97% in 1996 and 1999. The value of food import significantly varied in relation to the value of export of the country (see annex Table 3). Value of food import was on average 199.5 million USD during 1990 to 1995 and 172 million USD during 1990 to 2000. During these periods, accounting for debt repayment needs, the country's food import capacity was 370 million USD during 1990 to 1995 and 556 million USD during 1990 to 2000.

The food import capacity index (value of import divided by import capacity) shows that on average 65% and 44% of the import capacity was allocated for import of food during 1990 to 1995 and 1990 to 2000, respectively. This ratio is relatively high and implies the country's vulnerability to uncertainties of food import from the international market. One of the risk factors is the unreliability of the flow of export earnings. The county's major export earner primary product, coffee, faced an unfavorable world market following a drastic fall in coffee price in recent years. As per the National Bank's Annual Report (2000/01), recently earnings from export of coffee fell from a high of 2.8 billion birr in 1997/98 to 1.4 billion birr in 2000/01, a decline by 50%. The county's food trade balance is negative amounting to an average value of 193 million birr during 1990 to 1995, and 151 million during 1990 to 2000. This implies that a lot more is imported than the amount of food exported.

3.4. Food Security and Food Aid in Ethiopia

There is not a single and strong indicator of the precarious situation of food security in Ethiopia than the rising trend of dependence on foreign food aid. Due to insufficient food supply from domestic production, a significant proportion of the Ethiopian population continued to fail to meet basic food requirements. According to reports by USAID (1998, #1), the amount of Food Aid as a share of Ethiopia's foreign exchange earnings or export has grown from about 2% in 1954 to over 40% during 1995. Food aid has been a response to acute food shortages which occur mainly following drought seasons. Over the 14 year period from 1984 to 1998, eight incidences of drought were registered (World Bank, 2000).

The number of draught affected people who required foreign food aid is a major indicator of Ethiopia's national and household level food security crises. As per data obtained from DPPC's food security profile documented for various years, the trend of share of draught affected population in Ethiopia during the last 28 years rose from slightly over 8% in 1975 to 16% of the total population in 2003. During the period of

three decades there has never been a year in which some portion of the population was not affected. The growth rate of the share of population affected by draught was 2.6% until 1991, and increased to 4.63% per annum then after. As a result, recently food aid requirement to mitigate the impacts of drought and famine reached its highest level of 1.4 million MT in 2003 from its level of only 0.4 MT in 1990 [8].

3.5. National food consumption variability: risk of food consumption shortfall

Another aspect of national food security is the risk of fluctuation in food availability and consumption. Many factors influence the variability of food availability and consumption. Hence, probability of a food consumption shortfall was computed. The analysis aims at computing an index of food insecurity at a national level, and studying its determinants. As an index of *food insecurity* the probability for national consumption to fall below a certain threshold is used. Consumption is computed as *total nutrient intake* from "apparent consumption" of a set of food items (cereals, meat, milk, vegetable oils, pulses, roots & tubers, and sugar). The threshold is set at α of the long-term trend of national consumption [10]. Using a time series data for 40-years, the analysis and computation of index of food insecurity are made for two separate time frames: from 1961 to 2000, and from 1981 to 2000. In the analysis of food security index α is assumed to be 95% of the trend consumption.

The probability of a consumption shortfall given the historical data showing the trend of aggregate food consumption is computed following the procedure developed by Sadoulet and De Janvry (1995). The result is given in Table 2. The table provides indicators of the riskiness/stochastic nature of food security at the national level in terms of indices for various food items. Taking a 40 year period (1961 to 2000), the index of variability of food consumption is 7.2%, 10% and 9.1%, respectively, for calories, protein and fats. This variability corresponds to the probability that national consumption falls below a 95% of a long-term (trend) consumption which is 24%, 30%, and 29% for calorie, protein and fats intake, respectively. It implies that one has to expect the aggregate calorie consumption to fall below 95% of the trend once in 5 years, while more than 1 year out of 5 years in the case of both protein and fats consumption.

Table 2: Probability of a national consumption shortfall below 95% of trend

	40 years (1961-2000)		20 years (1981-2000)	
	Probability	**CV***	**Probability**	**CV***
Calorie	24.0%	7.2	10.2%	3.8
Protein	30.0%	10.0	23.8%	7.2
Fats	29.2%	9.1	30.5%	9.8

Standard deviation of the variable 100(C(t) - C(t)trend)/C(t)trend
Source: Computed from FAOSTAT.

Taking a shorter timeframe (1981 to 2000), the probability that calorie intake falls below 95% of trend consumption reduces to 10% probably showing that calorie intake in recent periods is less variable, while the risk of deviation is still higher for both protein and fats consumption with probability of 24% and 31%, respectively. This result seems to somehow comply with the results reported by Sadoulet and Janvery (1995) for African and Asian countries [6].

4. ANALYSIS OF HOUSEHOLD LEVEL FOOD SECURITY ROLE OF AGRICULTURE

4.1. Background

The interest of analysis of household level food security is to investigate how the agriculture contributes to household food security. Rural households produce own food and purchase from the market while majority of the urban households are purchasers of food. In urban areas, too, some households involve in agriculture mainly livestock and produce food for their own consumption and supply to the market. The urban and pre-urban agriculture is intensive in nature and can play an important role in ensuring food security. In predominantly cash crops producing areas, smallholder farmers sell cash crops (coffee, t'chat, fruits and vegetables, etc.) and purchase food grains from the market. The effectiveness of food market system is as much important as reliability of own food production. In urban areas food security of households is dependent on the income of the households. Availability of job opportunities for household members and an efficiently operating food market system are, therefore, crucial in improving access to food.

4.2. Review of Rural and Urban Income, Consumption and Expenditure

In order to preset the results of a household level food security role analysis in the right context, a brief review of the national household income consumption and expenditure (HICE) survey recently conducted (CSA, 1999/2000) is found relevant.

Household level income, consumption and expenditure: According to the survey, at a national level, households spending below 2,000 Birr annually are 8.0 percent of the total households while households who spend 12,600 Birr or more constitute 4 percent (Table 3). The remaining 87.8 percent spend between 2,000 and 12,559 Birr annually. In rural Ethiopia, households spending below 2,000 Birr are 8.0 percent of all rural households while those spending 12,600 Birr and more and between 2,000 and 12,599 birr, respectively, constitute 2.6 and 89.4 percent. The figure for the urban areas indicates that 7.4 percent of the urban population spends below 2,000 Birr annually while 13.3 percent spends 12,600 Birr or more. The majority (79.2 percent) of the urban households spend between 2,000 and 12,599 Birr per annum. Regarding the pattern of expenditure, at the country level, 52.5 percent of total household income is spent on food, while food takes a share of 57.3 percent and 35.9 percent of income in rural and urban households, respectively. The survey data also indicates that with the exception of a slight deviation in one or two expenditure groups, in general, the proportion of income spent on food tends to decline as income/ expenditure increases. Per capita calorie intake per day is 2,211, 2,292, and 1,738, respectively, at a country level, in rural and urban areas, respectively.

Table 3: Percentage Distribution of Households by Domestic Expenditure Categories at Country, Rural and Urban Area Levels by Survey Year

Reporting Level	Domestic Expenditure in Birr per Household per annum					
	Less than 2000		2000-12599		12600 or more	
	1995/96	1999/2000	1995/96	1999/2000	1995/96	1999/2000
Country	9.7	8.0	86.9	87.8	3.4	4.1
Rural	10.0	8.0	88.4	89.4	1.7	2.6
Urban	8.5	7.4	78.5	79.2	13.0	13.3

Source:- HICE 1999/2000 reported by CSA.

*The per capita expenditure and sources: T*he annual per capita average expenditure (all payments) at the national level is Birr 1,412 while per capita average domestic expenditure (excluding non-consumption expenditure) is found to be birr 1,223 (Table 4). The per capita annual average of all payments for the rural areas is birr 1,244, and 2,400 birr for rural. For rural households, 73.5 percent of the total receipt is from agriculture, while non-agricultural activities and wages and salaries each contribute to 6.0 and 3.3 percent of the total household receipts. Remittances and other transfers

incomes amounted to 17.2 percent of total receipts of rural households. In urban households, the majority of receipt is from non-agricultural activities and wages and salaries each contributing to 38.4 and 37.0 percent, respectively. Here, agriculture contributes only 3.1 percent of the total household receipts while remittances and other transfer incomes account for 14.0 percent of the total receipts.

Table 4: Per capita Expenditure Categories at Country, Rural and Urban Area Levels by Survey Year

Reporting level	Categories			
	Domestic Expenditure by Survey Year		All Payments by Survey Year	
	1995/96	1999/2000	1995/96	1999/2000
Country	1,222.56	1,222.45	1,319.08	1,411.80
Rural	1,136.59	1,109.92	1,210.30	1,244.00
Urban	1,696.52	1,921.02	1,918.83	2,400.71

Source: - HICE 1999/2000 reported by CSA

4.3. The Determinants of household income

The data on income and expenditure used in this analysis shows that total expenditure in rural areas averages at birr 3303, out of which 61% or 2015 birr is spent on food (including consumption of own produced food). In urban areas, average expenditure per household is found to be 8317 birr (excluding input costs for business activities) and 14957 birr (including business input costs). Expenditure for food accounts for 83% (excluding enterprise input costs) or 46% (if enterprise input costs are included in total expenditure). Regarding income distribution, 21.6% of the sample rural households spent below 1500 birr, 35.5% between 1500 birr and 3000 birr, 40.5% between 3000 and 10000 birr, and the remaining 2.4% spent over 10,000 birr. In urban areas it is in the order 5.15% below 1500 birr, 16.2% between 1500 birr and 3000 birr, 54.1% between 3000 birr and 10000 birr, and the remaining 24.7% of the sample households spent over 10,000 birr. The distribution shows that income poverty is more prevalent in rural than urban areas. In rural areas, the average per capita nutrient intake per day is found to be 2032 kcal, 55 grams of protein, and 16 grams of fat, while its is 2300 kacl, 63 grams of protein and 40 grams of fat per day in urban areas.

Regression models were estimated to study determinants of food consumption for both rural and urban households in terms of food expenditure and food nutrient intake. For rural households a two-step estimation procedure is adopted. First, the determinants of household income were analyzed. The result shows that variables included in the model significantly explained the variations in household income (adj.

R^2 = 58%). Level of education of farmers, access to land, oxen, household labour capacity and input, use of fertilizer significantly and positively influence income (annex Table 4). Distance to the nearest farm input supply center has a negative and significant impact, possibly through transportation costs and difficulty of getting information at the right time. Larger variations in rural household income are due to variation in land fertility and rainfall availability and distribution. The result shows that, for instance, an increase of land quality index by a unit results in an increase of income by 800 birr. Similarly, an increase in rainfall sufficiency index by a unit results in an increase of income by 4478 birr. The results once again signify the importance of improving soil fertility and reducing land degradation, and weather factors particularly rainfall for the Ethiopian agriculture and food security.

4.4. Estimate of household income elasticity of food consumption

Estimated/predicted household income is used to analyze food consumption models. Food consumption is analyzed in terms per capita food expenditure, calorie, protein and fat intakes. Different levels of analysis were considered (all sample, income categories – first, second, and fourth quartile, and first, and second decile). The summary of results of regression functions are provided in annex Tables 5 and 6 for rural and urban household models, respectively. For rural households, food consumption expenditure and food nutrient intakes increase with increase in household income. Access to cash loan positively affects consumption and food intake. Large family size reduces consumption expenditure and food nutrient intake as shown by a negative sign of the coefficient for square of household size. Similarly, an increase in the share of purchased food in total food expenditure reduces food consumption. For urban households income is a major and significant determinant of food consumption. Unlike in rural, age of household head quite often positively explain food consumption. Taking all sample together, employment in own business is found negatively related to food consumption expenditure and nutrient intake. The value of physical assets owned by a household reflects its wealth and, hence, positively influences food consumption. Unlike rural, in urban households level of education of a father (head) positively affects consumption. In general, there is variation of food consumption expenditure and level of nutrient intake among the studied urban households in different towns as can be seen from the coefficients of dummies for towns. This may reflect differences in food market network, income earning opportunities, infrastructures, and services, etc.

Summary results of income elasticity of food consumption are presented in Table 5. The result shows that elasticities are different between rural and urban households. For all sample households, elasticities of food consumption expenditure are similar

for rural and urban areas. However, calorie, protein and fat intake elasticities with respect to income are higher in rural than urban households. This may generally imply that improved income level of farm households would lead to consumption of better quality food signifying the food security role of agriculture at the household level. When the samples are disaggregated into income categories (1st and 2nd quartiles, 1st and 2nd decile lower income groups) all elasticities are higher for urban households than rural showing that increase in income of poorer households will lead to consumption of better quality food in urban than rural areas. However, for the 4th quartile (higher income categories) elasticities are significantly higher in rural than urban areas.

Taking similar income levels in both rural and urban areas, households whose per capita annual expenditure are equal to and below 300 birr (although distribution may not be the same in urban and rural areas), elasticities are slightly higher in rural areas. For rural households at this income level, elasticity of food consumption expenditure is 0.56, for calorie, 0.51, for protein, 0.53 and fat 0.41 all significant at 1%. For urban households of similar level of expenditure, elasticities of food expenditure is 0.83, of calorie 0.45, of protein 0.45, and for fat intake 0.28. This result shows that for the lowest income groups of *similar income levels*, elasticities (except that for food expenditure) are higher in rural than urban households. This somehow supports an argument of low-income elasticity of food consumption that when the increase of income is originated in agriculture, that elasticity would be higher. This may imply to what extent household food security may be enhanced by an improvement in productivity and income of the smallholder farmers.

Table 5: Estimates of income elasticity of food expenditure and nutrient intake by income source and income groups

Location and measures	Income group											
	All				1st quartile				2nd Quartile			
	Food exp	calorie	protein	fat	Food exp	calorie	protein	fat	Food exp	calorie	protein	fat
Rural												
Elasticity and t-value	0.57* (11.2)	0.62* (11.7)	0.67* (12.9)	0.61* (8.4)	0.64* (6.1)	0.50* (4.5)	0.57* (5.4)	0.28** (1.8)	0.58* (7.4)	0.54* (6.5)	0.57* (6.9)	0.44* (3.9)
Model, R^2	0.40	0.46	0.48	0.37	0.53	0.55	0.54	0.46	0.44	0.48	0.48	0.42
Urban												
Elasticity and t- value	0.57* (38.8)	0.33* (16.9)	0.35* (17.9)	0.42* (17.6)	0.98* (42.9)	0.76* (9.1)	0.86* (10.9)	0.84* (7.82)	0.96* (60.7)	0.61* (13.4)	0.70* (15.7)	0.70* (12.4)
Model, R^2	0.76	0.39	0.43	0.47	0.94	0.47	0.53	0.39	0.93	0.44	0.50	0.43
Rural												
Elasticity and t-value	0.48* (3.8)	0.47* (4.3)	0.48* (4.1)	0.44** (3.1)	0.54** (3.5)	0.45** (2.8)	0.52** (3.2)	0.32 (1.4)	0.63* (5.5)	0.50* (4.2)	0.58* (5.0)	0.27*** (1.7)
Model, R^2	0.14	0.19	0.27	0.12	0.58	0.60	0.58	0.54	0.54	0.55	0.54	0.47
Urban												
Elasticity and t-value	0.19* (5.2)	0.12* * (2.2)	0.13** (2.4)	0.13* (2.53)	0.98* (18.3)	0.92* (4.6)	0.74* (5.5)	0.88** (3.17)	0.98* (38.63)	0.83* (7.75)	0.94* (9.39)	0.85* (6.22)
Model, R^2	0.47	0.22	0.23	0.31	0.93	0.46	0.49	0.26	0.94	0.42	0.50	0.35

* Significant at 1%; ** significant at 5%; and *** significant at 10% prob. Sample size: Rural: all = 1062; 1st quartile = 294; 2nd quartile = 596; 1st deciles= 117; 2nd deciles = 239; Urban: all = 1380; 1st quartile = 345; 2nd quartile = 690; 4th quartile = 345= 1st decile = 138; 2nd decile = 276

Source: Author's own computation

5. THE INFLUENCE OF NATIONAL AND SECTORAL POLICIES ON FOOD SECURITY

Government development policies and strategies (both national and sectoral) are important for the realization of the role of agriculture for food security. They influence directly or indirectly domestic food production, level of food import, and food supply stability. The recent Ethiopian government development policies and strategies can be evaluated in terms of their impact on domestic food production and supply.

5.1. Macro and Sectoral Development Policies and Strategies

Analysis of the government's budgetary allocation shows that agriculture takes less support than it would deserve. During 1999/2000 and 2000/2001 investments amounting to 8.3 and 8.5 billion birr, respectively, were made in the economy. The share of investment in agriculture during these periods were 6.8 and 6.7%, respectively. According to the National Bank Data, during eight years covering 1992/93 to 2000/2001, the average share of agriculture in capital and recurrent expenditure were only 11%, 6%, respectively. According to Alemayehu (2002: p.38), compared to other sectors, the trend of domestic capital expenditure on agriculture shows a sharp decline, and neither loan nor assistance-based financing of the sector seems to be sustainable since both are characterized by an erratic movement. In the face of the huge national food supply gap and food insecurity crisis, overcoming food shortage will come only by appropriate policy reform and adequate budgetary support for the sector.

During the last four decades Ethiopia experienced varying paths of economic policy and development strategy. Agricultural development policy towards the end of the Imperial regime and before the political change of 1974 was based on localized integrated rural development projects that aimed at assisting smallholder farmers in supplying improved farm input technologies and better market institutions. Following the political change and land reform of 19974, the *Derg* turned land into public/state property where farmers had only user rights. The Derg (1974-1991) adopted the socialist economic model and established rural organizations to implement development (peasant associations, service cooperatives). Villegization, resettlement, administratively controlled agricultural product prices and product delivery quota system were practiced and had impacts on the performance of agriculture and food production. Since the economic policy and strategy focused on collective and large-scale commercial farms, there was a near total negligence of support for smallholder producers. Private production and free market operations were largely undermined. Constrained private sector development, added to the civil war, led to the widely

prevalent poverty and food insecurity, which culminated in the fall of the regime in 1991.

After 1991 Ethiopia embarked on free market economy and adopted some economic liberalization policies. The development policy of the government in power has become Agricultural Development Led-Industrialization policy (ADLI). As a national economic development policy, ADLI is a strategy in which agriculture and industry are thought to be brought into a single framework of development where agriculture is viewed as an important vehicle for industrialization by providing raw materials, a market base, surplus labour and capital accumulation (MOFED, 2002). The basis of policy and strategy in the agricultural sector is to enhance productivity of the smallholder farmers by providing access to modern technology. The agricultural extension package is hoped to serve as a channel for providing incentives, supplying inputs to the farmers (seed, fertilizer and chemicals), technical support (demonstration of input uses and agronomic practices) and training. Currently, debate is widely going on in the country between various parties and the public around an issue "whether the ADLI strategy is a viable/feasible national development strategy".

Food security is among the government's priority areas of development strategy. Food security strategy was developed in 1996, and its updated version was provided in 2002. The adopted strategy relies on three aspects: increasing the availability of food through domestic production, ensuring access to food for food deficit households and strengthening emergency response capabilities of relevant institutions (FDRE, 2002). The strategy states that both the supply and demand side of the food equation i.e. availability and entitlement will be addressed at national and household levels (p. 8). It was also indicated that particular attention will be given to the diversity of food production zones in Ethiopia (areas with adequate moisture, moisture deficit and pastoral areas) to tailor options and strategies depending on the situations. Expansion of investments and activities in health, education and road facilities to rural areas as supportive mechanisms are emphasized in the rural development strategy.

The existing Ethiopian government took various economic liberalization actions aimed at bringing about overall economic development including that of agriculture. In assessing the effects of the liberalization, Almayehu (2002) noted two opposing tendencies with respect to the supply of food. On the one hand, increase in production of food crops was observed, whereas food import and food aid increased, on the other hand. From his examination of the link between macro-economic policy and agriculture he further drew the following major conclusions (p.31): 1) the link between priority given to macro-economic stability and agricultural development is weak, 2) fiscal and monetary policies are weakly linked to the agricultural sector, 3) macro-policy towards agriculture needs to move from the creation of incentive-

compatible environment, such as liberalization, towards policies aimed at tackling supply side issues (supply of fertilizer and related factors of production), stabilization of the market for agricultural produce and provision of regulatory and supporting services.

5.2. Major Impediments to attainment of food security in Ethiopia

Efforts made at improving the national and household food security are constrained by many and complex factors. In general terms, major impediments/factors can be summarized as follows.

I) Institutions

Among the many institutional factors that influence the performance of the Ethiopian agriculture, land policy is considered as one of the major. Land tenure policy and administration is a highly debated issue in present day Ethiopia. In addition to the inherent structural problems in the economy (e.g. undeveloped non-farm sectors and low urbanization rate), the land policy is criticized for hindering rural-urban migration and aggravating impacts of population pressure on land. The consequences can be the weakening of productivity of agriculture itself, and underdevelopment of alternative livelihood out of agriculture [7]. The problems of tenure insecurity in terms of national and household food security can be implied through declining land holding size per household and lack of adequate investment in land quality to increase food production [9]. Impediments to rural-urban migration means increasing rural population pressure resulting in lowering productivity of agricultural land in the absence of viable livelihood alternatives in rural areas and sustainable means of intensification of farming.

II) Lack of adequately functioning input and output market system

Lack of efficiently and effectively operating input and output market system is a major impediment to the development of Ethiopian agriculture and food production. As the country has varied ago-ecological and food production potential, a good amount of surplus food can be produced in some parts of the country while there exist food deficit in others. It has been experienced that due to weak transport and market links food cannot be sufficiently and easily transported to food deficit areas from surplus producing ones. The high transport cost and poor infrastructure networks in the country aggravate the negative terms of trade for farmers when they earn much less for their produce against rising cost of production. Facing falling grain prices after harvest, farmers could not afford to purchase or take input credits and use it

sustainability. Studies made on grain market (Mulat et al., 1998) and input use confirmed the existence and consequences of these problems. The national goal of improvement in food security calls for improvement in market policy and investment in infrastructure in order to reduce food transaction costs and enhance the incentive to produce more.

III) Degradation of the natural resources and the environment

Times and again it has been mentioned that the performance of the Ethiopian agriculture is very much dependent on nature. The potential of irrigation technology and various water resources for more food production is not yet exploited. The future of agricultural development and food security in this country depends on to what extent the production system moves from heavy reliance of rain-fed system, and the extent to which farming is integrated with sustainable soil conservation and fertility management. An extensive work and documentation in the Ethiopian Highlands Reclamation Study (EHRS) during the 1980s revealed that the rate of land degradation is so unbearable and alarming that it is a huge threat to the country's future food security and economic development at large. In view of such intolerable magnitude of environmental threat, the issue of soil and water conservation and environmental rehabilitation at large, always remains a critical factor agricultural development and food security.

IV) Lack of empowerment and farmers' participation in technology transfer and development

A persistent failure in the history of rural and agricultural development in Ethiopia is the inability to transmit better development ideas, technology and practices to farmers in participatory and accountable ways. Over the years, many development agenda and practices were prescribed in a top-down approach to the rural people and farmers. As has been observed times and gain, at the end of it, it does not take long before development actors, planners and policy makers find it and realize that the top-down approaches were not accepted by the people who were supposed to implement the "orders". Probably well-thought and designed programs and practices of high social benefit usually failed simply because farmers are not given the chance to ask "why", "where", "how" and "when" to practice, adopt, and use them given their circumstances. The development actors who are mandated to persuade or teach farmers at grassroots level are quite often incapable and irresponsible to the farmers. Many examples of weak technology transfer efforts to farmers can be found.

6. SUMMARY AND CONCLUSIONS

Despite a huge food insecurity challenge prevailing in the country, the agricultural sector in Ethiopia plays important economic, social and environmental roles. It is a source of livelihood for the country's over 80% population residing in rural areas. Close to 50% share in the GDP, supply of raw materials for industry and agro-industrial sector, and foreign export earnings are important roles attributed to the agricultural sector. The sector is dominated by the smallholder peasant agriculture. In the lowlands and coastal areas, pastoral farming systems are dominant. After the economic policy changes in 1991, private commercial farms are growing at a slow rate. Owing to poor urbanization in the country, the role of urban and peri-urban agriculture is at its infant. Under the condition of a normally operating agricultural system, the agricultural sector plays many vital roles in the path of economic growth. It serves as a source of food at a household, national level and international trade in food. Agriculture is expected to play a positive food security role both by availing food from domestic production and/or by supplying foreign exchange required to access food available through trade. Sufficient food production enables urban households to access food at a reduced cost and ensures their food security, provided that they have sufficient purchasing power.

The objectives of this study are: i) to review and describe the food security situation in Ethiopia; ii) to identify the positive roles of Ethiopian agriculture in ensuring security; iii) to measure and value the food security role that agriculture plays at the household level; and iv) by way of assessing the determinants of the positive role of food security, to draw policy implications for the agricultural development policy and strategy. In this study data from various sources are used for the analysis. Two data sets, for urban and rural, collected by the Faculty of Business and Economics of the Addis Ababa University during 1999/2000 are used for analysis in this study. Other secondary data sources used in this study include the Central Statistical Authority, the National Bank of Ethiopia, and FAOSTAT.

The national level food security assessment using various indictors shows that there is a huge food availability gap in Ethiopia. The single most important indicator of this fact is a large and increasing flow of foreign food aid to Ethiopia for decades. On average food aid amounting to 700,000 MTs is annually imported into the country. The food aid volume during 2002/2003 reached one of the largest at 1.4 million MT. The data also shows that at a household level many indicators of food supply, access and nutritional quality are not favorable. As the domestic food production fails to satisfy demand for food, a food balance gap has to be covered by food import, to a lesser extent. The value of food import significantly varied in relation to the value of

export of the country. The average value of food import was 199.5 million birr from 1990 to 1995 and 172 million birr from 1990 to 2000. Analysis of the food import capacity index (value of import divided by import capacity) shows that on average 65% and 44% of the import capacity were allocated for import of food from 1990 to 1995 and 1990 to 2000, respectively. This ratio is relatively high and implies the country's vulnerability to uncertainties of food import from the international market.

The probability of a national consumption shortfall below a trend level given the historical data of 40 years aggregate food consumption is 24%, 30%, and 29% for calorie, protein and fats intake respectively. The result implies that one has to expect the aggregate calorie consumption to fall below 95% of the trend once in 5 years, while more than 1 year out of 5 years in the case of both protein and fats consumption. Taking a shorter timeframe (1981 to 2000), the probability that calories intake falls below 95% of tend consumption reduces to 10% showing that calorie intake in recent periods might have been less variable compared to trend level, while the risk of deviation is still higher for both protein and fats consumption with probability of 24% and 31%, respectively. Analysis of sources of domestic food supply variability shows that fertilizer and rainfall significantly affect domestic food production. The positive and significant coefficient of the rainfall variable indicates that the agricultural sector is largely characterized by rain-fed dependent production system. The regression result also indicates the vital role of fertilizer to increase food and agricultural output. The negative and significant coefficient of the dummy variable for years of drought confirms that the recurrent draught has negatively affected the domestic food availability.

Results of the analysis of determinants of farm income in rural areas show that level of education of farmers, access to land, draught oxen, household labor capacity and input, and use of fertilizer significantly and positively influence income. Distance to the nearest farm input supply center has a negative and significant impact, possibly through transportation costs and difficulty of getting information at the right time. Larger influences on rural household income are due to variation in land quality and rainfall availability and distribution. The data shows that, an increase of land quality index by a unit results in an increase of farm income by 800 birr. Similarly, an increase in rainfall sufficiency index by a unit results in an increase of income by 4478 birr. The results once again signify the importance of improving soil fertility and reducing land degradation, and weather factors particularly rainfall for the Ethiopian agriculture and food security.

The results of the analysis of income elasticity of food consumption show that consumption elasticities are different between rural and urban households. For all sample households, elasticities of food consumption expenditure are similar for rural

and urban areas. However, calorie, protein and fat intake elasticities with respect to income are higher in rural than urban households. This may generally imply that improved income level of farm households would lead to consumption of better quality food.

In assessing the impact of macro and sectoral policies on agriculture and food security, some previous studies concluded that: 1) the link between priority given to macro-economic stability and agricultural development is weak; 2) fiscal and monetary policies are weakly linked to the agricultural sector; 3) macro-policy towards agriculture needs to move from the creation of incentive-compatible environment, such as liberalization, towards policies aimed at tackling supply side issues (supply of fertilizer and other factors of production), stabilization of the market for agricultural produce and provision of regulatory and supporting services. In the context of this study, major impediments to a sustainable attainment of food security and growth of Ethiopian agricultural can be mainly related to five factors: Institutions (e.g. land tenure security), weakly operating input and output market system, degradation of the natural resources and environment base of the agriculture, lack of empowerment and farmers' participation in technology transfer and designing development agenda, and weak rural-urban linkages in production and consumption.

From the results of this study the following conclusions can be drawn:

1) There is a huge food availability gap in Ethiopia, which resulted in heavy dependence on food aid, and food import (which takes 40% to 60% of import capacity);
2) Analysis of historical consumption data reveals a high probability of national food consumption shortfall below a level of consumption trend.
3) Land quality and rainfall are the major determinants of rural farm households' income. The results strongly signify the importance of reducing land degradation, improving soil fertility and reduced dependence on rainfed agriculture by developing and using irrigation system for the Ethiopian agriculture and food security.
4) Income elasticity of consumption is found positive and highly significant in rural and urban households; and it defers by income categories. This may generally imply that improved income level of farm households would lead to consumption of better quality food.
5) The national goal of increased food security calls for improvement in relevant policies including land tenure security, a well functioning market system, investment in infrastructure in order to reduce food transaction costs, enhancing the incentive to produce more through strong support for producers, enabling farmers' participation and aggressive actions on environmental rehabilitation, and

development and use of water resources for agriculture. In addition, improving the linkages and exchange between rural and urban economies is imperative.

Note:

1) Indicators provided by the ROA central team (World Development Indicators 2002 and The FIVIMS indicators) are used to reveal/describe the level of food security at the national level.
2) A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus a Gini index of zero represents perfect equality, while an index of 100 implies perfect inequality.
3) Example, Murty and Radhakrishna (1981), Strauss (1982), and Pitt (1983) as quoted in Gaiha (2003).
4) Ethiopia's population which was estimated at 10 million at the beginning of 20 century is now 67 million in 2003. Projections show population size to reach about over 130 million by 2030.
5) Based on the FAO database which takes criteria that LIC are countries with per capita income of less or equal to US $785 in 1996.
6) Sadoulet and De Janvry (1995) quoted Valdes and Konandreas (1981) and reported that in comparative studies made for the periods 1961 to 1976, the probability of national consumption falling below 95% of trend consumption was found to be 20% to 27% in Asian countries and 37% to 42% in African Counties.
7) The Ethiopian Economic Association Annual Report on Ethiopian Economy, Vol. I, 1999/2000 has documented that for the period covering 1980/81 to 1997/98, the average growth rate of the agricultural sector was 1.6%, and during 7 observation years negative rates reaching up to –20.9% were observed.
8) The Food Security Strategy document (FDRE, 2002. p.7) also acknowledges that over the last 15 years the country was importing an average amount of 700,000 MT of food aid per annum.
9) Two joint studies recently conducted by the Ethiopian Economic Policy Research Institute and the World Bank (Deininger et al, 2003) confirmed that tenure insecurity is found to be among the causes for low investment in land augmenting technologies and poor development of the non-farm sector. The latter is due to the fact that farmers engaged in off-farm jobs have a fear of losing their land to administrative redistribution, as the land policy requires that farmers are not allowed to stay away from their localities for a long time.

10) Following Sadoulet and De Janvry (1995) the probability that national consumption falls below a certain percentage α of its long-term trend is given as:

$$\Pr(C < \alpha \hat{C}_t)$$

where $\hat{C}_t$ is the estimated trend consumption. This probability is estimated by historical data assuming that the error term u_t be normally distributed around the regression line. Under this hypothesis:

$$\Pr(C<\alpha\hat{C}_t)=\Pr\left[\frac{C-\bar{C}}{\sigma_c}<-\left(\frac{\bar{C}-\alpha\hat{C}_t}{\sigma_c}\right)\right]=\Pr\left[u=\frac{C-\hat{C}_t}{\hat{C}_t}<-(1-\alpha)\right]=\Pr\left[\frac{u}{\mathbf{I}_c}<\frac{-(1-\alpha)}{\mathbf{I}_c}\right]=1-F_{(1-\alpha)/\mathbf{I}_c}$$

where:

$\mathbf{I}_c = \frac{\sigma_c}{\bar{C}}$ and **F(.)** is the standard normal distribution.

Specifically, apparent consumption is regressed on a non-linear time trend:

$$C_t = a_0 + a_1\mathbf{t} + a_2\mathbf{t}^2 + u_t$$

Both the coefficients a_0 and a_1 were bootstrapped. Then the estimated residuals were worked on:

$$\hat{u}_t = \begin{cases} = C_t - \hat{a}_0 - \hat{a}_1\mathbf{t} - \hat{a}_2\mathbf{t}^2 & \text{if both the estimated coefficients were statistically different from zero at 5\% level} \\ \quad or & \text{otherwise} \\ = C_t - \bar{C} & \end{cases}$$

where $\bar{C}$ represents mean apparent consumption over the time horizon.

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Annex

Annex Table 1: Core Food Security and Nutrition Indicators for Ethiopia

Indicators	1994	1995	1996	1997	1998	1999	2000	Average
Dietary calorie supply per person (cal/cap/day)	1656	1686	1830	1799	1759	1851	2023	1800
Cereals, roots and tubers as a % of dietary calorie supply			80%	81%	81%	80%	82%	81 %
Life expectancy at birth, total (years)			..	43.3	..	42.4	42.3	42.7
Mortality rate, under-5 (per 1,000 live births)			..	166.2	..	..	178.9	172.6
Malnutrition, weight for age (% of under 5 that are underweight)		..	..	..	..	..	47.2	47.2
Malnutrition, height for age (% of under 5 that are stunted)	..	..	..	..	..	..	51.4	51.4
Food Availability								
Animal protein supply (gr/cap/day)	7	7	7	7	7	7	7	7
Cereals supply per person (kg/cap/yr)	123	122	135	134	132	138	158	135
Dietary fat supply gr/cap/day	20	19	21	19	19	20	21	20
Dietary protein gr/cap/day	47	50	54	53	51	54	60	53

Source: FAOSTAT

Annex Table 2: Factors of access to food and food stability

Access to food	1994	1995	1996	1997	1998	1999	2000	Average
Land use, arable land (hectares per person)	0.18	0.17	0.17	0.17	0.16	0.16	..	0.17
Consumer price index (1995 = 100)	91	100	95	97	100	106	106	99
Food price index (1995 = 100)	89	100	100	100	102	111	110	102
GINI index	..	40	..	..	..	..	..	40
Roads, paved (% of total roads)	15	16	15	..	14	13	12	14
Poverty headcount, national (% of population)	..	..	..	..	..	..	..	..
GNI per capita, PPP (current international $)	530	560	610	620	590	630	660	600
GDP per capita, PPP (current international $)	533	565	611	629	599	634	668	606
GDP per capita (constant 1995 US$)	99	102	110	113	108	113	116	109
Food Stability								
Cereals Dependency Ratio	16.1%	9.6%	5.3%	3.4%	7.5%	7.8%	12.4%	8.9%
Index of variability of gross food production (1985-2000)								6.3%
Index of variability of net food production (1985-2000)								6.4%
Index of variability of food prices (1985-2000)								33.9%
Alternative index of variability of gross food production (1985-2000)								5.9%
Alternative index of variability of net food production (1985-2000)								6.1%
Alternative index of variability of food prices (1985-2000)								7.5%

Source: FAOSTAT

Annex Table 3: Import capacity value of food import ('000 USD) and import capacity index for Ethiopia

Year	1995	1996	1997	1998	1999	2000	Avr. '90-'95	Avr. '90-'00
Import [a]	190,000	142,000	79,200	135,000	133,000	206,000	199,500	172,018
Import capacity [b]	636000	455000	914000	919000	765000	847000	369,833	556,273
Import capacity index (%)[c]	29.9	31.2	8.7	14.7	17.4	24.3	64.80	44.10

[a] Food imports (cereals, diary products, meat, oils) 1000 US$

[b] Export revenues minus debt repayment, 1000US$

[c] Import capacity index: (Food imports)/(Export revenues minus debt repayment), percentage

Source: FAOSTAT

Annex Table 4: Regression estimate of determinants of household income in rural areas

Explanatory variables	Unstandardized Coefficients		Stand. Coeffi.	t	Sig.
	B	Std. Error	Beta		
Constant	-2625	787.99		-3.331	.001
Educational grade of household head	85.683	30.242	.058	2.833	.005
Total farm input cost (birr)	3.823	.218	.500	17.515	.000
Total cultivated land (ha)	401.23	84.876	.120	4.727	.000
Distance to input supply (minutes)	-3.944	1.514	-.050	-2.605	.009
Land quality index	801.97	315.050	.051	2.546	.011
Number of oxen owned (No)	232.48	73.73	.075	3.153	.002
Rainfall sufficiency index	44782	876.30	.100	5.110	.000
Household labor force (ME)	203	52.86	.077	3.84	.000
Age of household head (year)	-1.01	4.77	-.004	-.211	.833
Sex of head (1= male)	14.65	175.65	.002	.083	.934
Region dummy, Tigray	503	292	.039	1.724	.085
Region dummy, Oromiya	877	192.30	.116	4.561	.000
Region dummy, SNNP	-37	230.88	-.004	-.159	.873
Fertilizer used (kg)	3.32	.96	.106	3.447	.001
Labor input in farming (MD/ha)	.570	.327	.035	1.740	.082
Y = Total household income (birr); F = 120.921 and significant at 1% probability level. R^2 adj = .57; N = 1322					

Source: Author's own calculations

Annex Table 5: (continued)

Explanatory variables	Income groups											
	4th quartile				1 decile				2nd decile			
	Food exp.	Cal	pro	Fat	Food exp	Cal	pro	Fat	Food exp	Cal	pro	Fat
Household income, ln	.48	.47	.48	.44	.54	.45	.52	..	.63	.50	.58	0.27
Cash loan taken	..	..	..	..	.15	.15	.15	.14	..	..	..	..
Family size square	..	..	..	..	-.19	-.18	-.20	-.17	-.11	-.13	-.09	-0.14
price index	..	-.11	-.12	-.12	-.3	-.62	-.46	-.95	..	-.39	-.33	-0.6
value share of purchased food (%)	..	.12	.23	..	-.5	-.28	-.11	..	-.48	-.32	-.18	-0.2
+	..	..	..	-.13	..	..	..	..	..	..	..	..
DUMYTIGR	..	..	..	..	-.6	-.64	-.64	-.75	-.56	-.55	-.58	-0.6
DUMYAMHA	-.16	..	..	.42						..		
DUMYSNNP	-.42	-.42	-.63	-.48	-1.3	-1.8	-1.9	-2.4	-.99	-1.5	-1.6	0.64
DUMYOROMY						..	-.73		-.47	-.47	-.62	..
Ln of per capita income	.56	.33	.35	.42	.99	.76	.86	.84	.96	.61	.70	.70
Age of household head	-.03	..	..	..	..	.10	.09	.11	..	..	..	..
Dum. occupation (1= private)	-.10	-.07	-.07	-.11	..	..	..	..	-.04	..	..	..
DUMYTIGR	..	..	..	..	..	..	..	..	..	..	.24	..
DUMYGURA	..	..	..	..	-.05	..	..	..	..	..	..	..
Dummy for house, 1 = rented	-.03	-.05	..	..	-.05	..	..	..	-.04	..	..	-.21
Dum. food shortage, 1= yes	-.03		-.14	-.20	..	..	..	-.23	..	..	-.05	..
Dum. religion (1 = Christian)	.03	..	..	..	..	.19	..	..	..	..	..	..
Ln of physical assets	.2	.10	.13	.11	.03	..	..	..	.03	..	..	..
father's education	..	.06	.07	..	..	.11	.08	..	..	.07	.06	..
DUMYAWAS	.03	.06	.14	.29	..	..	..	..	..	.06	..	.28
DUMYBHRD	.15	.22	.32	.34	..	..	..	..	..	.16	.26	.20
DUMYDESE	..	-.35	-.32	-.76	..	-.48	-.45	-.9	..	-.46	-.45	-.9
DUMYDIRE	.12	-.24	-.2	..	..	-.33	-.28	..	.04	-.32	-.28	-.2
DUMYJIMA	-.16	..	.13	..	-.06	..	..	..	..	..	.21	.18
DUMYMEKL	..	..	..	.	..	-.50	-.48	..	..	-.34	-.33	-.3
Number of income earners	-.03	..	..	..	..	..	..	.	-.02	..	..	..
Number of members	-.26	-.25	-.21	-.25	..	-.19	-.17	..	..	-.19	-.14	..
AG1865	.09..	..	..	..	..	..	..	..	.04	..	..	..
AG7TO17	..	..	..	.06	..	..	.13	..	..	.08	.08	..
AGUND7_1	.03	..	..	..	..	..	..	..	..	..	..	..

Source: Author's own calculations

Annex Table 6: Determinants of food consumption in urban areas (figures are only for significant variables)

Explanatory variables												
	4th quartile				**1 deciles**				**2nd deciles**			
	Food exp.	**calorie**	**protein**	**fat**	**Food exp.**	**calorie**	**protein**	**fat**	**Food exp.**	**calorie**	**protein**	**Fat**
Ln of per capita expenditure	.19	.12	.13	.13	.98	.93	1.08	.88	1.03	.83	.94	.86
Age of household head	..	..	..	.12	..	.23	.19	1.23	..	.13	.11	.17
Dum. Occup. (1= private)	-.2	..	-.13	..	..	..	..	..	..	..	..	..
Dummy ethnic group Amhara	..	..	..	..	-.14	..	..	..	-.08	..	..	..
DUMYTIGR	..	..	..	..	-.26	1.99	1.63	..	..	..	..	..
DUMYGURA	..	..	..	..	-.14	.55	..	1.07	-.06	..	..	.55
Dummy house, 1= rented	..	..	..	..	-.11	..	..	..	-.07	..	..	..
Dum. Religion (1 = Christian)	..	..	.	..	..	..	..	..	..	.23	.22	..
Ln of physical assets	.19	.21	.12	.20	..	..	..	..	..	..	..	..
father's education	..	..	..	..	..	.23	.18	..	..	.13	.09	..
DUMYAWAS	..	..	..	.28		..	..	..	..	..	..	..
DUMYBHRD	.27	.30	.39	.46	.19	..	..	..	..	..	..	..
DUMYDESE	..	..	..	-.57	.21	-.67	-.71	-1.4	..	-.46	-.39	-.89
DUMYDIRE	..	-.44	-.42	-.40	.22	..	..	..	..	-.4	-.35	..
DUMYJIMA	-.39	-.24	..	..				..	-.05	..	..	..
DUMYMEKL	..	..	..	..	.33	-2.21	-2	..	..	-.57	-.51	..
Number of income earners	..	..	-.26	..	..	..	..	..	..	..	..	..
Number of members	-.44	-.32	-.13	-.10	..	..	..	..	..	..	..	.
AG1865	..	-.13	-.13	..	..	..	..		..	..	..	.86
AG7TO17	..	..	..	..	..	..	..		..	.12	.17	.17

Source: Author's own calculations