AN ANALYSIS OF EXISTING NUTRITION, HEALTH, AND ECONOMIC INDICATORS AND IMPLICATIONS FOR THE DEVELOPMENT OF FOOD AND NUTRITION POLICY IN ETHIOPIA

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LIST OF ACRONYMS

ACC/SCN	Administrative Committee on Coordination (of the United Nations) Subcommittee on Nutrition
CSA	Central Statistical Authority
CHSD	Comprehensive Health Service Directory (of the MOH of Ethiopia)
DPT	Combined Diphtheria/Pertussis/Tetanus Vaccine
ENI	Ethiopian Nutrition Institute
EPI	Expanded Program on Immunization
FAO	Food and Agriculture Organization (of the United Nations)
GDP	Gross Domestic Product
IDD	Iodine Deficiency Disorder
MCH	Maternal and Child Health
MOA	Ministry of Agriculture (of Ethiopia)
MOH/PPD	Ministry of Health (of Ethiopia)/Planning and Programming Department
MOPED	Ministry of Planning and Economic Development (of Ethiopia)
NCHS	National Center for Health Statistics (of USA)
NFNS	National Food and Nutrition Strategy (of Ethiopia)
NRNS	National Rural Nutrition Survey (of Ethiopia)
NGOs	Non Government Organization(s)
PEM	Protein Energy Malnutrition
PHC	Primary Health Care
RRC	Relief and Rehabilitation Commission (of Ethiopia)
RHICES	Rural Household Income, Consumption and Expenditure Survey (of Ethiopia)
TGE	Transitional Government of Ethiopia
UNICEF	United Nations Children's Fund
USDA/ERS	United States Department of Agriculture/Economic Research Service
WHO	World Health Organization

CHAPTER I

INTRODUCTION

Background

Ethiopia is predominantly an agricultural country. The agricultural sector provides employment for about 80% of the country's 53 million people (1992 estimate), more than 85% of the foreign exchange earnings, and 40% of the nation's GDP (USDA/ERS, 1988). The recurrent droughts and mass famines have greatly affected the productivity of this sector during the past several years. The nation's agricultural production has been hurt not only by natural calamities but also by inappropriate government policies. As a result, for the last two decades Ethiopia has generally experienced a negative economic growth rate (USDA/ERS, 1988; Mersie, 1990; Von Braun, 1991).

At present, Ethiopia is in a food deficit situation, with unimaginably poor nutrition and health conditions. Domestic food production remained below consumption leading to food insecurity and decreased food availability. The nation's people have available approximately 1700 kilocalories (kcal) per capita per day. This level of intake is 20% below the estimated minimum daily per capita requirement of 2100 kcal for Ethiopia (Anonymous, 1989). Although the country has been facing such huge food and nutrition problems, no clear cut food and nutrition policies were adopted. In 1989 the National Food and Nutrition Strategy (NFNS) was prepared for Ethiopia for the first time, with the

overall long-term objective of ensuring food security for the entire population of the country. The primary strategy was specifically aimed at achieving food self-sufficiency and meeting an aggregate average intake of 2000 kcal per capita per day (Anonymous, 1989). This is about 95% of the minimum daily per capita requirement for kilocalories for Ethiopia.

Undernutrition and both acute and chronic malnutrition, however, continue to persist in Ethiopia without due government policy considerations. For instance, in 1992, about 64% of children under five years of age were stunted, and about 8% and 47% were wasted and underweight respectively. The figure on stunting, which indicates the extent of chronic malnutrition, shows a 4.2% increase over the 1983 figure of 59.8% (CSA, 1992b and 1993). This is a result not only of a lack of reliable information and resources, but also of a lack of policy considerations. The lack of reliable information disguises the wide-spread malnutrition problems. Furthermore, the actual problem of malnutrition is exacerbated and persists because of a lack of resources. The lack of appropriate policies as well as policy failures aggravate the deepening problems of malnutrition.

Rationale

The recommendations of the NFNS called for a series of studies that (a) identify the country's main nutritional problems and their main causes and (b) investigate the relationship between the persistent nutritional and health problems and the prevailing poor economic situations and indicators. Very recently a number of studies have been undertaken in the fields of both nutrition and health, as well as on food consumption and expenditure patterns, as a response to the suggestions of the NFNS. In addition to the 1982/83 National

Nutrition and Health Surveys, the 1992 National Rural Nutrition Survey (NRNS) and the subsequent studies undertaken have greatly increased the data and information base on nutritional conditions of the country.

There still exist at least two broad categories of information gaps in Ethiopia. First, there is a lack of adequate and reliable data, and a lack of consistency in their form and source. Second, comprehensive analyses of the existing data are deficient. The second issue is the subject of this study. Nutrition professionals should be able to analyze and interpret the existing data and present possible policy implications of these data to the policy makers so that they are willing and able to devise means to alleviate the prevailing nutritional and health problems. Hence, any step undertaken to fill this gap may call for a policy consideration and may initiate political willingness to devise and implement appropriate policies on the part of the policy makers.

Statement of the Problem

The nutrition situation in Ethiopia has not shown improvement over the past decades mainly because of the lack of policy considerations from the government. There is also a lack of comprehensive analyses of the existing nutrition, health, and economic conditions which is believed to be one of the reasons for the lack of policy attention. Moreover, there has been a need for studies which identify possible policy implications. Hence, the problem of the present study has emerged. In other words, there is a clear need for an analysis of the existing nutrition, health, and economic status indicators and identification of policy implications so that policy makers may accordingly be able to develop and/or modify appropriate food and nutrition policy for Ethiopia.

Purpose and Objectives of the Study

The major purposes of this study were to both analyze selected existing data on nutrition, health and economic status indicators and to indicate policy implications and issues to be considered for the development of food and nutrition policy in Ethiopia. To accomplish the purposes of this study the following objectives had to be attained:

1. identify and select certain existing data on nutrition, health and economic status of the country including prevalence of malnutrition, health care availability, incidence of illnesses and production trends from appropriate institutions;
2. identify and compare the differences in nutritional status, health, and economic indicators over time, by region, and by selected socioeconomic groups;
3. determine the extent and nature of nutritional and health problems and constraints prevailing in the country;
4. determine and establish relationships between/among the nutrition and health status indicators and the economic condition indicators;
5. identify the main factors associated with these problems indicating the possible interactions among the factors; and finally
6. identify some policy issues and address actions to be undertaken based upon the analysis of existing nutritional, health, and economic status data.

Research Hypotheses

The hypotheses tested in this study which will be reported separately in chapters four and five are stated as follows:

1: The nutritional status of the population of Ethiopia has deteriorated over the past decade as suggested by anthropometric measurements of children under 5 years of age.

2. There is a difference in the nutritional status of the population from one region to another and from one socioeconomic group to another.

3. Parental child care will have a significant impact on the nutritional status of a child.

4. There is a relationship between the nutritional status of children and

a) the health care provision (and their health status),

b) the socioeconomic conditions in which they live,

c) the production and prices of food, particularly of staple foods, and

d) the mother's cultural/ethnic background.

Assumptions

The following two general assumptions were made as related to the source and reliability of the data retrieved for this study:

1. that adequate and appropriate data on nutrition, health, and economic conditions of the country are collected, retrieved or stored, and managed by one or more of the following institutions:

- Ethiopian Nutrition Institute (ENI),
- Ministry of Health (MOH),
- Central Statistical Authority (CSA), and
- Ministry of Planning and Economic Development (MOPED).

2. that these data are reliable enough to assist in the analysis which may lead to an appropriate nutrition policy for the country.

Scope and Limitations

The scope of this study included the following:

1. Most of the national and regional data on nutrition, health, and economic conditions of the country have been retrieved from ENI, MOH, CSA, MOPED and some national and international organizations such as the RRC[1] and UNICEF respectively. The researcher accomplished this during the 1993 summer period by returning to Ethiopia from Oklahoma State University for six weeks.
2. The data to be analyzed covered secondary and/or published data obtained mostly from national and regional surveys conducted over the past years.

Limitations of the study were:

1. Some data were available in time series while others were available only for certain years. In addition, data were retrieved from different institutions collected by different surveys from different populations.
2. The researcher did not have any control over the quality and reliability of these data, because they were retrieved from existing data sources. The main data source for this study is the 1992 NRNS. The National Nutrition Surveys had appropriate data collecting methodologies, however, most surveys have used different populations and samples with different regional coverage. Over the past 10 years, regional administrative setups have been restructured more than three times making longitudinal regional comparisons very difficult.
3. Selection and retrieval of the data were limited by the bureaucratic

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[1]RRC-the Relief and Rehabilitation Commission is an independent government institution established in 1974 as a response to the widespread famine in Ethiopia during the 1974 Sahel famine. It has been actively participating in nutrition intervention programs through its early warning system.

management of certain institutions. Particularly, the retrieval of household raw data, which could be very helpful for some detail analysis, was not possible.

Definitions of Terms

The following definitions of terms are furnished to provide clear meanings and concepts of terms as used in the present study:

1. -2 Z score: Individual's (anthropometric) measurement value which is two standard deviations (S.D.) below the median value of the reference population (the NCHS standards) based on the following formula (WHO, 1983):

$$\text{S.D. score} = \frac{\text{Individual's value - median value of reference population.}}{\text{S.D. value of reference population}}$$

2. Protein-energy malnutrition (PEM): The most prevalent form of malnutrition in developing countries resulted from deficiency of both protein and energy intakes.

3. Stunting : Malnutrition indicator in children defined as low height-for-age (below -2 Z score).

4. Wasting: Malnutrition indicator in children defined as low weight-for-height (below -2 Z score).

5. Underweight: Malnutrition indicator in children defined as low weight-for-age (below -2 Z score).

6. Marasmus: Severe form of protein-energy malnutrition caused by inadequate intake of food in general and deficiency of energy in particular. It is a form of starvation.

7. Kwashiorkor: Severe form of protein-energy malnutrition caused primarily by inadequate intake of protein and also of energy. The main diet of a child is comprised of carbohydrates.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Nutritional problems which affect a wide range of population of the less developed countries are related to and, in most of the cases, caused by poverty. Currently, poverty and malnutrition coexist in these countries. Ethiopia is not an exception, because both poverty and malnutrition are widespread phenomena. Malnutrition manifests itself as a risk to nutritional and health status which can be relieved by many policies and programs. Since malnutrition is a cross-sectional problem and nutrition itself is a multi-disciplinary field, the solutions to the problem should accordingly be a multi-disciplinary approach.

Food and Nutrition Problems in Ethiopia

Introduction

Ethiopia is the third most populous country in Africa, after Nigeria and Egypt, with an estimated population growth rate of 2.9% per year (Anonymous, 1989). Food production fell in the later 1970s and 1980s by an estimated 30% short of national self-sufficiency (ACC/SCN, 1989; Anonymous, 1989). This

clearly indicates that per capita food production has been on the decline over the past 20 years. In other words, population growth rate has outstripped the average annual growth rate of aggregate output (Mersie, 1990) in general and that of cereal production (Von Braun, 1991) in particular.

Famines

Ethiopia has been in a food deficit situation over the past several years with recurrent droughts and famines. Famine in the pre-1980s was only a transitory phenomenon, but it has become a structural problem in the 1990s (Webb et al., 1992).

The history of famine in certain localities and pocket areas has been recorded very long ago in the history of Ethiopia (Maletnlema, 1986; Brun and Latham, 1990; Webb et al., 1992). For instance, Webb et al. (1992) summarized a chronology of 39 periods of Ethiopian droughts and famines starting from 253-242 B.C. up to 1990-1992. The recurrent and deepening famine of 1984-85, which affected about 6-8 million people and left over 500,000 dead (Maletnlema, 1986; ACC/SCN, 1989; Brun and Latham, 1990; Webb et al., 1992) is the most recent memory of great human losses. The northern regions, namely Tigray, Wollo, and Eritrea (Eritrea became an independent country in 1992), were almost always the most affected parts of Ethiopia with an average of 32%, 24%, and 24% of their respective populations suffering from famine during the 1984-85 famines (Anonymous, 1989).

Webb et al. (1992) tried to provide answers to some famine related questions including "Which population groups are most seriously affected?" during famines and "What makes them more vulnerable than others?" and above all "What role does drought play in affecting the food supply system of the country

and in causing famines?" The authors stated that the impacts of famines varied by household according to income and asset base. The bottom third of poor farmers were more vulnerable to famines than the upper third of poor farmers who coped relatively better. Droughts were found to have a strong positive correlation ($r = 0.76$) to the declines in domestic production and to food insecurity. The authors indicated that interactions between policy failures and socioeconomic, health and environmental factors were associated with the famine problems. Policy failures intensify the impacts of droughts and worsen the famine conditions (Webb et al., 1992).

Malnutrition and Undernutrition: Extent and Nature

The problem of malnutrition in Ethiopia has two distinct aspects: acute localized malnutrition resulting from drought in some years, and chronic malnutrition resulting from poverty-related factors affecting all parts of the country. Although chronic malnutrition is a more wide spread problem than acute malnutrition, the international and national attention and resources were diverted towards the latter problem (Timmer et al., 1983; CSA, 1993).

Food insecurity, socioeconomic characteristics and nutritional status. The overall food intake in Ethiopia, especially of the rural segments as reviewed by Agdew (1992), is precarious. The intake of energy is particularly inadequate. The minimum annual per capita requirement for food consumption in Ethiopia is estimated at about 155-204 kilogram (kg) of grain equivalent. The RRC estimate usually used for relief purposes is 204 kg which is computed to be equivalent to the minimum daily per capita requirement of 2100 kcal (Gebremeskel, 1992b).

Marketing constraints exaggerated by inappropriate policies, as in the past, greatly affect the purchasing power of households. It was found that a 10% reduction in cereal production resulted in an average price increase of 14% (Webb et al., 1992). Food prices are high in most Ethiopian cities, particularly in Addis Ababa. Since 1974 food prices continued to increase. By 1992 prices of main staple cereals reached about 500% of the 1974 prices. At the present time food costs generally account for one-fourth to two-thirds of the total living costs. The poor urban consumers and the rural poor who constitute about 60% of the population spend around 60% of their income on food, and they still attain a daily intake of only about 1500 to 1700 kcal per capita. The demand elasticity of food was estimated at 0.67 (Agdew, 1992; Gebremeskel, 1992a).

Musgrove (1989) reviewed a number of studies that indicated that income is the main determinant not only of the quantity of the family's diet, but also of its quality. The relation between income and malnutrition is inverse, so that the lower the income of a family the higher is the prevalence of malnutrition, especially of the protein-energy type (Musgrove, 1989).

According to ACC/SCN (1992), trends in food prices and the prevalence of children underweight follow the same direction. Moreover, it was found that the changes in food prices preceded changes in the prevalence of children underweight by approximately three months. Therefore, food prices can be used as an early warning for designing appropriate intervention programs. The relationship between food prices and nutritional status has a great importance both at the national level and at the household level. In the Wollo region in Ethiopia between 1982-1988, a negative linear association between monthly changes in child mean weight-for-height and monthly changes in grain price has been found. The relationship was stronger during drought periods and the effect was even higher for the poor households (ACC/SCN, 1992).

Ethiopians' food consumption is highly influenced by cultural and social behaviors as well. Foods are grown and consumed in most cases based not on their nutritional values but on the traditionally accepted satisfying capacity or sustaining capacity of grains. Moreover, it has been noted that although peasants are producers of most animal products in the country, they consume little animal protein from these sources. Live animals and dairy products are used for markets as sources of income. The marketed products are usually used for consumption by the urban population. Animal products provide less than 10 and 20% of the kilocalorie and protein supplies in Ethiopia (FAO, 1980). This does, of course, not apply to the pastoralists who use animal protein foods as the main source of their diet. There are also differences in food preferences and consumption among the different regions and ethnic groups of the country (Agdew, 1992).

The food supply system of the country is as complex as the cultures and agro-climatic conditions. The northern highlands predominantly depend on grain crops, while the southern regions also grow and use root and cash crops. It has been found that both per capita food intake/expenditure and the proportion of income spent on food vary from region to region, from one income group to another, and according to household size (Gebremeskel, 1992a).

Protein-Energy Malnutrition (PEM). The nutrition situation in Ethiopia has been deteriorating over the past three decades. This is evident from the ENI survey of six villages done in 1966 which indicated that the average caloric intake was 1890 kcal per capita per day (Maaza, 1973). However, the per capita kilocalorie consumption in recent years is only 1700 (Anonymous, 1989). Although energy requirements vary according to factors such as the activity level, age, climate and body size, the FAO/WHO expert committee estimated

world average requirements at 3,000 kcal/day for adult men and 2,200 kcal/day for adult women (FAO, 1973). Based on equations recently developed by FAO, the National Research Council stated energy allowances for adult men from 2,300 to 2,900 kcal/day and for adult women from 1,900 to 2,200 kcal/day for use in the USA (National Research Council, 1989).

According to the 1983 Rural Nutrition Survey (second round), about 37% of Ethiopian children under five years of age were malnourished based on mean weight-for-age less than -2 Z scores of the NCHS standard (CSA, 1992b). The results of the survey also indicated that about 60% of the children were classified as stunted (mean height-for-age less than -2 Z scores). The prevalence of wasting based on the same standard was estimated at about 8%. During the 1980-986 period the percentages of children under five years of age suffering from mild-moderate and severe malnutrition were 33% and 8% respectively (Grant, 1989).

In 1992 about 64% of children of the same age were stunted (low height-for-age); 7.6% were wasted (low weight-for-height) and 47% were underweight (low weight-for-age) (CSA, 1993). This higher rate of malnutrition among children in Ethiopia is in accordance with several studies that suggested the existence of strong relationships between malnutrition and poverty in general and low income in particular.

Regional distribution of malnutrition as evidenced from the 1992 National Nutrition Survey indicates that 15 of the 22 regions surveyed showed stunting levels of more than 60%; only one region had a stunting level below 50%. Only two regions had a wasting prevalence below 5%, while five regions had wasting above 10% (CSA, 1993). These facts indicate that both stunting and wasting in particular and malnutrition in general are of national concern in Ethiopia and are not confined only to a few regions.

Kwashiorkor and marasmus, the severe forms of malnutrition, are also prevalent in Ethiopia, especially during famines. According to a study conducted in the Wollo administrative region during the 1974 famine, while marasmus was predominant among large numbers of children, kwashiorkor also occurred to a considerable extent among children of the region (Shewandagn et al., 1977). Kwashiorkor is most likely encountered among populations that are dependent upon certain plant foods such as cassava, sugar cane and cooking bananas that are deficient in protein. Marasmus is most likely to occur in Ethiopia because of the general poverty situation where total amounts of available food are severely inadequate but with moderate protein (Foster, 1992).

Micronutrient Deficiencies. The main micronutrient deficiencies in Ethiopia include vitamin A deficiency, iodine deficiency disorders (IDD) and anemia. Vitamin A deficiency resulting from low dietary intake of Vitamin A and carotene rich foods, from malabsorption, and concurrent parasitic infections was identified in about 1-1.5% of all children. A higher prevalence of vitamin A deficiency was found in pastoral areas (1.6%) followed by cropping agro-ecological zones and a lower prevalence was found in cash crop producing areas (0.4%). No incidence of vitamin A deficiency was recorded in 'enset'[2] (false banana) producing areas (Zewdie, 1991; UNICEF/TGE, 1993).

The prevalence of IDD is estimated at about 26% of the population of all ages, with a higher prevalence in females than in males (UNICEF/TGE, 1993; Zewdie and Teshome, 1993). According to a nationwide goiter survey, a gross goiter prevalence rate of 4.1% and a visible goiter prevalence rate of 1.6% were

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[2] 'Enset' Enset ventricosum, is a plant which resembles a banana plant without bearing an edible fruit, hence 'false banana'. It is commonly cultivated in south central regions of the country as a semi-permanent crop for the production of starchy food mainly derived from the corm and pseudo stem (Agdew, 1992).

found in children under five years of age. The prevalence is very high among schoolchildren in the order of about 30%. The problem of IDD was recorded as being endemic in certain areas associated with higher rates of neonatal deaths, stillbirths, and miscarriages (UNICEF/TGE, 1993; Zewdie and Teshome, 1993).

The problem of nutritional anemia is considered the least important deficiency (of the four worldwide most important forms of malnutrition targeted by WHO) in Ethiopia with a prevalence rate ranging from 5-8%. This prevalence rate is very small as compared to data from other developing countries and is a low prevalence even by developed country standards (UNICEF, 1990). One of the reasons for low prevalence of iron deficiency anemia in Ethiopia is that 'tef', one of the staple cereals, is very high in iron content. Although iron deficiency anemia is not considered a public health problem among the general population in Ethiopia, it is highly prevalent among pregnant and lactating women (17.4%). Women from pastoral areas had higher rates of anemia (20%) compared to grain producing areas (UNICEF/TGE, 1993).

Malnutrition in the Refugee Camps in Ethiopia. The conditions of refugees are the consequences of long-term economic policy failures. This is particularly true in the eastern African countries including Ethiopia and Somalia. Ethiopian refugees in neighboring countries and refugees in Ethiopia suffer from nutritional deficiencies as a result of the absence of adequate rations (Wolgemuth, 1993). Starvation and nutrient deficiency diseases are common in refugee camps in Ethiopia. A recent example is the damaging insufficiency of rations among the Somali refugees fleeing civil war to eastern Ethiopia. The level of acute protein-energy malnutrition (PEM) among children under five in the camps was estimated at 23%. The under five death rate in 1988-89 was estimated at 46 per 1000, i. e., about double the normal rate for the non-refugee

population in Ethiopia and Somalia. Refugees were subsisting on only an intake of 1463 kcal per capita per day (ACC/SCN, 1991). Toole and Bhatia (1992) reported a peak of 26% prevalence of acute PEM in March 1989 in Harti-sheik A camp, the largest refugee camp in eastern Ethiopia. The prevalence rate had decreased to 15% by June 1989. Nutritional deficiencies included clinical scurvy which was affecting between 1 and 2% of refugees in Harti-sheik A camp, attributed to a diet deficient in vitamin C. Anemia was also a serious nutritional problem affecting Somali refugees in all 35 camps (ACC/SCN, 1991; Toole and Bhatia, 1992).

The Causes of Food and Nutrition Problems

Natural calamities and man-made causes, including the lack of or inappropriate implementation of policies and the armed conflicts, underlie both the famine problems and the prevalence of chronic malnutrition. The conditions that contributed to famine were: "proneness to climate-driven production fluctuations, lack of employment opportunities, limited household asset base, isolation from major markets, low level of farm technology , constraints to improvements in human capital, and poor health and sanitation environments" (Webb et al., 1992). For instance, the effect of crises in drought-affected regions was found to depend primarily on the income and asset base of households. The poor, i. e., the bottom third of the households, were the most affected by drought-related production fluctuations. The correlation between fluctuations in food consumption and domestic food production was as high as 0.76 in Ethiopia. Domestic food consumption was found to relate to drought and to change in total rainfall. National food production falls by an average of 4.4% for every 10% decline in rainfall (Webb et al., 1992).

Income distribution relates both to production and consumption. Drought year yield per hectare of wealthier (top third) households was three times higher than yields of poor households; wealthier households consumed on the average about 500 kilocalories per capita per day more than poor households (Webb et al., 1992).

The underlying factors influencing chronic malnutrition include: household food security, health status and child care and feeding practices; preceded by income, prices, markets, water, sanitation, hygiene, education, and female work-load (CSA, 1993). All of these factors are related to and aggravated by a lack of or by inappropriate implementation of different policies.

Health Problems and the Health Care System in Ethiopia

Health and Nutrition: The Synergistic Effect

Health and nutrition are highly related and have a synergistic effect on the human host. Malnutrition affects health status and decreases the resistance of the host to infection by diminishing the body's immune response. Infectious diseases exaggerate the existing malnutrition by affecting the intake of and/or utilization of food and nutrients (Abeyratne and Poleman, 1983; Foster, 1992).

Foster (1992) stated this synergistic effect as follows:

> faulty nutrition can lead to poor health, and poor health can lead to faulty nutrition. It is a vicious circle or, if you prefer engineering terminology, a feedback loop. Similarly, good nutrition can lead to better health, and good health reduces the tendency toward bad nutrition.

Health Care Package and Coverage

The health situation and health care systems are poor in Ethiopia. Both the urban poor and the rural segment of the Ethiopian population, especially the young children and women of child bearing age, suffer from the predominant health problems. The rural health survey conducted in 1982/83 indicated that about 30% of the population have some sort of illness (Elias, 1992). The top five causes of total out-patient morbidity are acute upper respiratory infection, malaria, helminths, gastritis and duodenitis, and infections of skin and subcutaneous tissue, in this order (MOH/PPD, 1991).

Earlier studies conducted during the late 1950s and early 1960s as reviewed by Buschkens and Slikkerveer (1982) have indicated almost similar patterns and orders of prevalences of certain diseases. But, infectious eye diseases/trachoma and syphilis were listed among the top diagnoses in earlier studies.

Some selected health statistics support the fact that health status is poor in Ethiopia. For instance, infant and child (1-4 years) mortality rates were estimated at about 110 and 160 per 1000 live births (Mersie, 1990; MOH/PPD, 1991; CSA, 1993; UNICEF/TGE, 1993). The crude birth rate is 47 per 1000, with low birth weight (less than 2.5 kg) estimated at 11%. The crude death rate is 8.7 and the overall life expectancy at birth is 52 years (male 51 versus female 53 and urban 55 versus rural 52) (MOH/PPD, 1991; Elias, 1992; UNICEF/TGE, 1993).

The health care system in Ethiopia is organized at six levels: (a) national referral medical centers (6 hospitals), (b) regional hospitals (18), (c) rural hospitals (65), (d) health centers (160), (e) health stations (2,222), and (f) community health services (10,000) (MOH/PPD, 1991; Elias, 1992).

Currently one rural hospital gives services to an estimated 780,000 people, and each health station to an estimated 300,000 people. In addition, there are about 17,000 health personnel who care for nearly 3,000 people each. The ratio of population to medical doctors is more than 30,000. These health facilities and health personnel have a potential coverage of about 45% of the population (MOH/PPD, 1991; TGE, 1991; Elias, 1992; UNICEF/TGE, 1993). But, the effective coverage of the health system as a whole is greatly reduced by inadequate availability of budget and poor infrastructure of these facilities. Moreover, these facilities are highly concentrated in very few cities.

The national priority in health strategy is given to the public health care (PHC) program. The PHC program constitutes an expanded program of immunization (EPI), maternal and child health (MCH), control of diarrheal diseases, control of communicable diseases, health education, water and sanitation, diagnosis and treatment, and essential drugs (MOH/PPD, 1991; Elias, 1992; UNICEF/TGE, 1993).

Nutrition Policy for the Vulnerable Population Groups

Malnourished and Underfed Children

Children as a group, and those in the age range of 12-23 months old, are the most vulnerable of all population groups to undernutrition (Foster, 1992; CSA, 1993). A child in a poor country is at a higher nutritional risk for a number of reasons. Mayer and Dwyer (1979) indicated poor health conditions which aggravate the nutritional problems, and poor sanitation, hygiene, and water as the underlying reasons. In addition, a child's nutritional status is dependent upon his caretaker's knowledge of nutrition and feeding practices. Most feeding

practices in a poor country are inadequate because of poor quality and quantity of diet and lack of time for preparation and attention by the caretaker. The period during weaning is crucial for children in poor communities because this is the time when infants are moved from breast milk towards other foods of inferior quality and minimum protein insufficient for rapid growth.

Children between the ages of 1 and 5 are the most likely to suffer from protein energy malnutrition, especially in the rural areas. The estimated infant mortality rate of 250 and under 5 mortality rate of 370 per 1000 in rural Ethiopia (Agdew , 1992) are higher than the national averages. The national averages of infant mortality and under five mortality rates are estimated at 110 and 270 per 1000 respectively (Elias, 1992).

Women and Nutritional Risk

Preschool children and women of childbearing age are the most vulnerable to malnutrition in developing countries. During times of extreme food shortages and famine, women and children are always the most at risk of severe malnutrition (Foster, 1992). Available information on the prevalence of maternal malnutrition shows that about 10 to 38% of women in Ethiopia are affected (UNICEF/TGE, 1993). As indicated above, women in Ethiopia are more affected by iodine deficiency disorder and nutritional anemia than men. These risks of poor nutritional and health conditions for women are increased for reasons which include the following:

- lack of decision making power and control over resources,
- little or no education,
- greater work burden including traveling long distances to fetch water andcollect fuel wood,

- family responsibility and nurturing the household especially during war and famine, above and beyond engaging in agricultural production,
- displacement as a result of civil unrest and famine; women are usually left behind giving care to children and older people, and
- harmful traditional beliefs and activities including food taboos for pregnant women, early and arranged marriage, and marriage by kidnap (Foster, 1992; UNICEF/TGE, 1993).

Food and Nutrition Planning, Policy and Programs: Past and Present Experiences

Introduction

The issues of food and nutrition policy were recognized as early as the mid-1930s when the Assembly of the League of Nations considered the importance of taking active measures to improve nutrition and thereby to improve the health and economic conditions of populations. The Mixed Committee of the League of Nations (established in 1935) recommended that "a nutrition policy, the ultimate goal of which was to ensure that all sections of the population obtained an adequate diet, be adopted by governments of all nations" (League of Nations/the Mixed Committee, 1937). The Food and Agricultural Organization of the United Nations was given a mandate to deal with food and nutrition policy right after its formation in 1945 at the Quebec Conference (Aylward and Jul, 1975).

Food and Nutrition Policy Planning

Although the responsibility of determining a nutrition policy falls in the hands of the body politic, health specialists, nutritionists and economists are generally called upon to advise the planners and policy makers (Mayer and Dwyer, 1979). Health specialists, nutritionists and economists should be consulted because, "Nutrition policy formulation needs to distinguish between those factors which directly affect nutritional status and those which do so indirectly" (Abeyratne and Poleman, 1983).

Several definitions of food and nutrition policy, sometimes with confusion in the terminologies, have been used. One definition offered by the Director of FAO's Nutrition Division in 1972 was: "A food and nutrition policy is a complex set of educational, economic, technical and legislative measures designed to reconcile at a level judged feasible by the planner food demand, food supply, and nutritional requirements" (Mgaza, 1980; Hruby, 1983). The four different terms which are usually interchangeably used are: 'food policy', 'nutrition policy', 'food and nutrition policy', and 'nutrition and food policy'. According to Hruby (1983), who agreed with the above general definition, "to use the term food policy only subordinates the nutritional aspect to the food aspect, the use of the term nutrition policy only again indicates a more humanitarian approach without a proper attention to the important technical part of the problem" (Hruby, 1983).

Therefore, the use of the term food and nutrition policy is preferable. Defined in whatever terms, food and nutrition policy should be an integral part of the overall national development strategy which may be formulated as an effort to overcome problems such as increased food prices, intensification of unemployment, income and food problems. A sound national food and nutrition policy should, therefore, provide a long-term solution for the persisting

malnutrition problems in the so called third world countries (Mayer and Dwyer, 1979).

Nutrition and Related Agricultural and Food Policies

Nutrition policy is related to and affects food and agricultural policies. The nutrition policy in turn operates mostly in the policy environment made up by food and agricultural policies (Schmandt et al., 1980). Food policy may be concerned with malnutrition, nutrition intervention programs such as fortifying foods, distributing supplements, and so forth. But it can also operate within the supply side to increase food production and to provide infrastructure for improved transportation and distribution (Gittinger et al., 1987).

Berg and James (1987) emphasized the need for incorporation of consumption and nutrition considerations in the analysis and formulation of food policies. Nutritional risks are affected by many agricultural and food policies and programs which also can ultimately influence nutritional status of the population. Those policies and programs which alter patterns of crop production, prices, basic needs, food availability and distribution, income levels and health status are also expected to influence nutritional status by affecting the entitlement to food in the household (Pinstrup-Andersen, 1981; Berg and James, 1987).

Nutritional Consequences of Agricultural and Food Policies and Programs

The nutritional consequences of market intervention policy may be threefold; a positive or negative change in the quantity of food retained for self-consumption and influences both in relative prices for and incomes of the poor.

According to Scandizzo and Tsakok (1985), those market interventions which favor cash crops or those policies which directly or indirectly affect the amount of production may negatively affect the quantity of food retained for self-consumption and finally nutrition. Both Berg (1986) and Timmer (1986) indicated that in spite of the great potential influences which food polices have on the nutritional status of people, they have failed in most developing countries because nutritional considerations are largely neglected in food policy analyses.

Brun and Latham (1990) have reviewed a number of case studies of agri-cultural projects that assess impacts on food availability, nutritional status and health. The review indicates, for instance, that the pilot irrigation scheme in Haiti and a water resource development project in Thailand resulted in a very significant increase in household production, income, housing status and literacy rate, however, no beneficial effects on food consumption or nutritional and health status were attained. The authors also indicated that there has been a very limited success in the attempts to include nutritional goals in development programs so far.

FAO (1984) case studies support the above suggestion that agricultural projects aimed at raising levels of living in their target areas were designed without explicit consideration of nutritional objectives. In all but one of the six case studies reviewed, improved nutrition as a development objective was not explicitly stated. As a result, they failed to improve nutritional status of the people, particularly of the poor. The FAO findings have stated that policies such as credit, pricing and land reform have a negative relationship to nutritional improvements in some countries. For instance, two project case studies in Kenya demonstrated the negative nutritional consequences of the agricultural projects. Both the Integrated Development Program in Machakos and the Smallholder Tea Growers Project in Kericho which were focused on cash

cropping had two-fold impacts on nutrition. Firstly, they excluded most of the rural poor, small farmers and landless which were the malnourished, from the project benefits. Secondly, they were biased against the food crops as compared to the cash crops, which decreased food supply (FAO, 1984).

Kennedy and Pinstrup-Andersen (1983) cited some studies which assessed the nutritional effects of agricultural projects in Colombia. These projects have resulted in higher incomes to the farmers but had weak income-calorie relationships. According to the authors the income elasticity of demand for calories was estimated at about 0.1%. Even projects which were directed at malnutrition continued to face nutritional problems, although they showed economic growth as demonstrated by four direct intervention programs in four countries (Berg, 1987). The economic development itself neglected a great portion of the population in some of the programs. These programs, however, teach us lessons on the importance of multi-sectoral and multi-disciplinary approaches to nutritional problems. Such approaches have resulted in better nutritional impacts as compared to both direct intervention programs and broad based rural development projects. These projects have integrated nutrition issues with other development objectives to a certain degree.

Incorporating Nutritional Considerations into National Policies, and Rural Development Planning and Programs

Nutrition intervention programs have been the traditional approach to overcome the problems of malnutrition. These nutritional interventions yielded benefits for some aspects of malnutrition, but they are not the long-term solutions for the persisting nutritional problems.

In the words of Timmer et al. (1983):

> ...the approaches used to improve nutritional status have frequently been simplistic and oriented to very short-run, palliative interventions; thus they divert attention and resources from broader strategies with a better chance of effecting long-term improvements in the nutritional status of the poor.

Although opportunities for long-term solutions lie in the context of agricultural and rural development projects and polices, these opportunities have not been realized by most programs and policies (discussed above).

Since the problems of malnutrition have not been solved by either nutrition intervention programs or by broad-based agricultural policies and rural development projects, there is a need for explicit consideration of nutritional goals and objectives in the processes of agricultural and rural development project planning and policy analyses. FAO termed this type of development strategy as a 'middle course' between the two approaches (FAO, 1984). Regarding the need for the nutritional consideration at the project level, Pinstrup-Andersen (1981) suggested that "if improved nutrition is to receive the same recognition as other goals of agricultural and rural development projects, it must enter into the decision-making process on project design at an early stage of the project cycle ". The interrelationships and coordination among agricultural and food policies, nutrition intervention programs, and their possible impacts is depicted by the following schematic presentation (Figure 1).

The inclusion of nutritional objectives in project analysis may involve three stages: desk review, initial assessment and in-depth study, as identified and tested by FAO case studies. The desk review may consider all existing information on the cause, extent and nature of the nutritional problems, the extent and potential effect of the proposed projects on nutrition and the availability of resources both human and capital. The initial assessment stage can enter in the

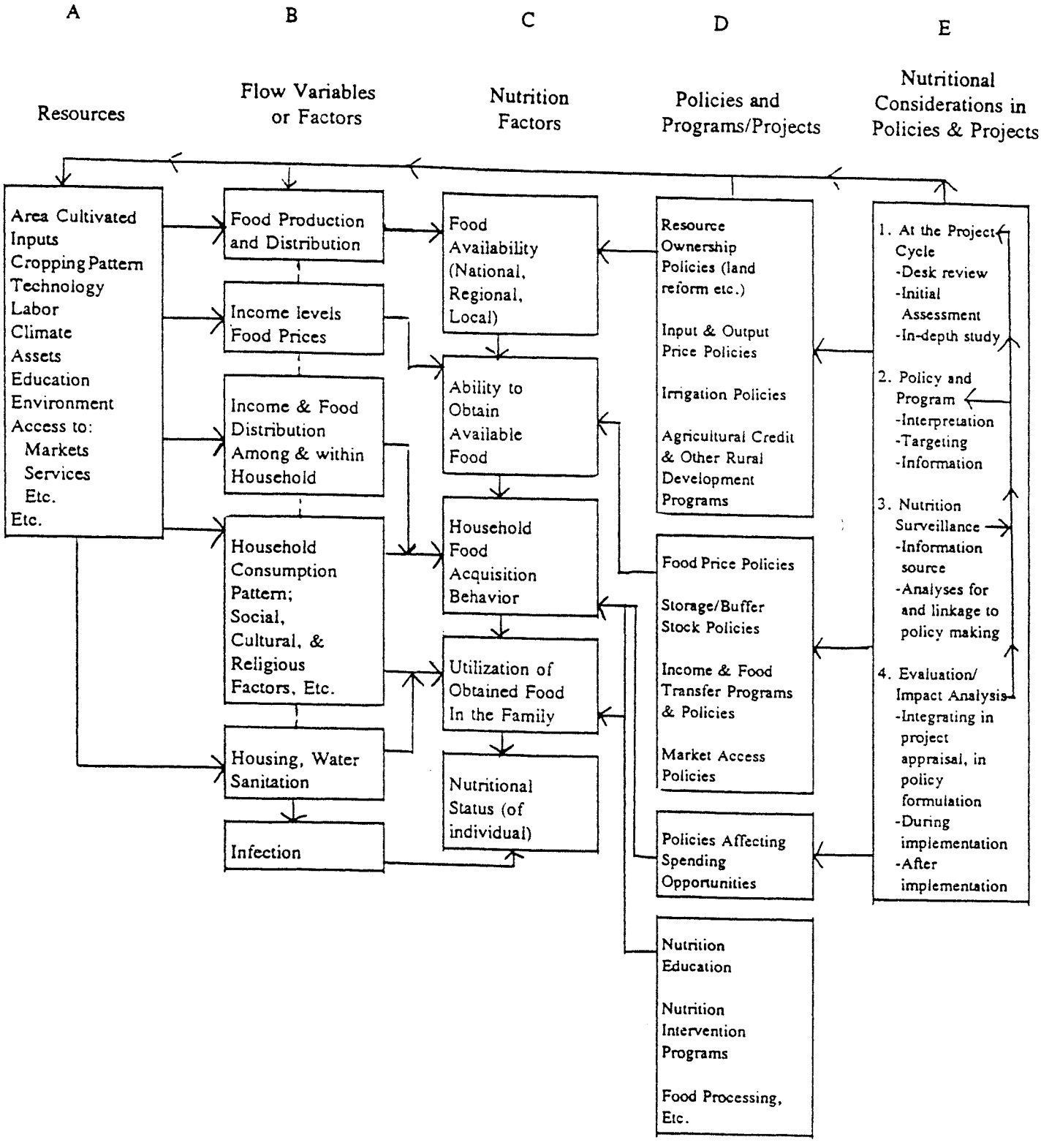

Figure 1. Partial schematic view of the relationship of main agricultural and food policies and programs with nutritional status.

Source: Extracted and modified from Kennedy and Pinstrup-Andersen, 1983; Figure 4.1 and Mason, et al., 1984; Figure 1.1.

project cycle at the project identification stage. Specifications of the major food and nutritional problems in the project area and of the target group and identification of the relationship of these nutritional problems to national policies can be considered here. The formulation of nutritional objectives may enter at this stage. The in-depth study involves the collection and analysis of additional data whenever there is insufficient data. This corresponds to the preparation stage of the project cycle (FAO, 1984).

Food policies are mainly concerned with the balance between availability of food (the supply side) and the requirement for food (the demand side). Food policy instruments at these two levels must be modified for the inclusion of nutritional considerations. From the supply side we have policies that promote domestic food self-sufficiency and price stability. These policies can contribute to overcoming chronic food-insecurity and malnutrition if they are able to improve income and employment levels of the poor farmers and landless laborers on the one hand and the levels of food security stocks on the other hand. These supply side policies should, however, be integrated with the food policies of the demand side. The demand side food policy issues include increasing knowledge of the nutritional status of the population in general, and of the vulnerable groups in particular; improving entitlement of food by the poor through lowering prices and increasing command of the poor over food availability. These two sets of food supply and demand issues as identified by Ellis (1992) are effected through appropriate food subsidy and employment creation policies at the one hand and through food and income transfer programs at the other hand respectively.

The Ethiopian Context

Because nutrition is perceived not as a sector, but as a multi-disciplinary field across sectors, it necessitates a multi-disciplinary and multi-sectoral approach in its planning and policy design. In the Ethiopian context, nutrition has been a concern of many institutions. The Ethiopian Nutrition Institute (ENI) has contributed significantly to the promotion of nutritional concerns since its establishment in 1962. The ENI is especially responsible for many national nutrition intervention programs including the development of infant supplementary weaning food, 'faffa' (Tesfa-Mariam, 1990; Elias, 1992).

The Relief and Rehabilitation Commission (RRC) has also played a great role not only in promoting nutritional concerns but also in saving lives during critical periods of famine through its early warning surveillance, aid coordination and food distribution activities. The Central Statistical Authority, the Ministry of Agriculture, non-governmental organizations (NGOs) and other institutions also have contributed to the improvement of Ethiopia's nutrition conditions either as information sources, as implementing agencies or both (Tesfa-Mariam, 1990).

Prior to 1974, policies and programs were focused mainly on raising production of export crops. But as a response to the 1974 famine, policies have been reoriented from irrigated farming for export crops toward smallholder agriculture. The post-1974 policies were based on centralized planning and mass ownership of assets. Accordingly, a great proportion of agricultural investment was diverted to the state farms sub-sector, which contributed less than 6% of the total crop production (Von Braun, 1991). The short comings of the centrally planned policies of the 1970s and 1980s and their consequences were indicated by Von Braun (1991) as follows:

> Although an extensive procurement and distribution system of

> basic staples existed to assure access to food, the new policies (of the 1970s and 1980s)[3] proved incapable of forestalling either a continued decline in domestic cereal production (which has fallen at an annual rate of 4 kilograms per capita from the 1960s), or the 1984/85 famine.

In fact, Ethiopia has a relatively well planned and organized central (government owned and operated) storage and distribution system. Moreover, Ethiopia set up Africa's first early warning system in 1977, operated by the RRC, an agency which received much praise for its early-warning and aid coordination activities (Von Braun, 1991).

Again in 1989/90 the policies based on centralized planning were abandoned and replaced by liberalization of trade, price and ownership; but this response came too late to prevent recent famine. New polices are developing in the post-war Ethiopia in favor of market liberalization and decentralization of the economy. Now investment capital is invited and is becoming available from the international finance community. At present, the Transitional Government of Ethiopia is in the process of redefining and designing its food security agenda (TGE, 1991; Von Braun, 1991; Webb et al., 1992).

Summary

Malnutrition manifests itself as a nutritional risk which usually leads to malfunction, poor achievement in body size, hunger due to insufficient food, ill health, and even death. Poverty persists in societies and conditions where human resources are given less consideration than land and other physical

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[3] Words in the parenthesis are implied by the researcher.

resources. Malnutrition and/or undernutrition are both a cause and an effect of poverty under these same conditions and societies. Since poverty and malnutrition are positively correlated and coexist in less developed countries in general, and in rural subsistence sectors of these countries in particular, any development program aimed to overcoming poverty should also consider overcoming nutritional problems. To do this, nutritional objectives should be explicitly incorporated into the national policies of these countries, into their rural development planning process and at the particular project appraisal level.

The experiences of the past and present show that most rural development planning does not explicitly incorporate nutritional goals, but includes only , if at all, implicit implications of nutritional improvement. Furthermore, most rural development projects and agricultural and food policies have few positive effects on nutritional status of the rural poor. Still others have negative nutritional consequences.

McLean (1987) indicated that:

> Identifying nutritional risk enables governments to take steps to reduce that risk and to prevent malnutrition. If we are to develop or adjust policies and programs to improve nutritional status, we must identify the context in which deprivation occurs and do this in a way that planners can understand and use.

Any policies and/or programs concerned with overcoming malnutrition and/or improving the nutritional status of the people should influence the availability of food, access of the poor to the available food and the utilization of the food obtained by the household.

CHAPTER III

PROCEDURES AND METHODS

Research Design

Introduction

This study is based on existing data on national and regional nutrition, health and economic status indicators retrieved from various institutions. The data needs included: data on nutritional status of the population; health status and availability of health care facilities; household income, consumption and expenditure; production and prices of foods; and population and macroeconomic conditions. Data the researcher considered helpful for achieving the objectives and testing the hypotheses of the study were retrieved from different institutions.

The researcher identified the problem of the study and proposed a return to Ethiopia for retrieval of the data related to the problem. The proposed problem was approved by FAO, the Food and Agriculture Organization of the United Nations, which sponsored the researcher. The researcher traveled to Ethiopia in early June and retrieved the data June 15 to July 30, 1993. During the first week of this period, the researcher contacted the appropriate institutions and presented letters of support from Oklahoma State University and the researcher's own institution, the Ministry of Planning and Economic Development.

Data Sources

This study used secondary data from the following sources:

- The 1992 National Rural Nutrition Survey results: Stunting, wasting, underweight and socioeconomic characteristics,
- The 1988/89 Comprehensive Health Service Directory, selective information,
- The 1984 population census and macroeconomic data,
- The 1983 National Rural Nutrition Survey: Results of anthropometric measurements,
- Rural Household Income, Consumption and Expenditure Survey (May 1981 - April 1982),
- Retail price surveys of food items at selected markets, and
- Food production surveys: Trend data.

The instruments, data gathering methods and first hand data manipulation, coding and summarization were done mostly by the Central Statistical Authority. Most of the data are the results of national and regional surveys.

The 1992 National Rural Nutrition Survey (CSA, 1993) is the main source of nutritional indicators and of some health and socioeconomic information. The anthropometric measurements of the 1983 Rural Nutrition Survey (CSA, 1992b) were used to identify the trends in nutritional status over time. The 1988/89 comprehensive health service directory (MOH/PPD, 1991) and data from the Rural Household Income, Consumption and Expenditure Survey, 1981-1982 (CSA, 1988) were the other main sources of data for this study.

Primary Data Collection and Methods Used

Population and Sample. Different populations and samples were used as the basis for this study, however, most survey results covered households with infants, children under 5 years, and child bearing women. In some surveys (the 1983 and 1992 National Rural Nutrition Surveys and the 1981/82 Rural Household Income, Consumption, and Expenditure Survey) the population sampled was limited to the rural households of the country. This is especially true for data on nutritional status indicators, household income, consumption and expenditure data, and community level socioeconomic characteristics. Some data, however, because of their characteristics, are either limited to selected areas or cover the entire country both urban and rural. Data on health care are examples of the latter where health care facilities and coverage range from the referral hospitals in the capital to community health stations located at farmers' association (village) level. Food prices were collected from selected towns from all over the country.

Instruments and Collection of Data. Questionnaires and interviews were used in most surveys to collect the data. In the NRNSs, training was given at head office for coordinators and supervisors, and at regional levels for field interviewers. Questionnaires of the National Rural Nutrition Surveys specifically covered community variables, household particulars, and information on children under five years of age. Some data were gathered by actual measurements and/or by recording the physical observations. The Ministry of Health survey (Comprehensive Health Service Directory: 1988/89) was conducted by teams from the MOH headquarters.

Limitations of the data collecting methods and ultimately of the data include: (i), some regions were not covered by most surveys because of security problems, Tigray in the case of the 1983 Nutrition and the 1988/89 Health Surveys. The 1992 NRNS did not cover the Hararghe administrative region and nomadic populations, (ii), these surveys used different sampling techniques and administrative setups, (iii), the Ministry of Health Survey was primarily limited to surveying health facilities, and (iv), the NRNSs of 1983 and 1992 were different not only in their coverage but also in their measurement errors. The Central Statistical Authority performed certain statistical procedures to adjust for the differences in the random measurement errors between the two surveys.

A summary of the original data collection instruments, data gathering methods and the original data manipulation system and statistical techniques used for these surveys is provided in Table 1.

Data Analysis

Data Arrangement and Use of Computer Software

Data from different sources were reorganized and recorded based on the similarities of the primary data collection methods and the agreement in the period of collection. Then the data were tabulated using Lotus 1-2-3® software in order to facilitate the data analysis. The tabulated data were exported to the PC SAS® program for statistical analysis (SAS Institute, Inc. Cary, NC).

TABLE 1

SUMMARY OF THE COVERAGE, INSTRUMENTS, DATA GATHERING METHODS, AND STATISTICAL TECHNIQUES EMPLOYED BY DIFFERENT SURVEYS OF THE PRIMARY DATA SOURCES

Survey type and year	Coverage, population and sample	Instruments and data gathering methods used	Data analysis and statistical tools used	Standard references and cut-off used
National Rural Nutrition Survey, 1992	22 regions, 15,000 rural households	Survey questionnaire and interviews	Waterlow classification, ANOVA	NCHS, -2 Z score
Comprehensive Health Service Directory, 1988/89	All regions except Tigray, all health service units	Questionnaire, visit to all health service centers	dBase III, SPSS, Lotus 1-2-3 for data entry and statistical work	—
The 1984 Population and Housing Census of Ethiopia	All households of rural areas and urban centers (85%, covered)	Rural & urban questionnaire, defacto and dejure counting	Weighted average characteristics of rural and urban population	Whipple's and Myers' indices for age terminal digits preferences
National Rural Nutrition Survey , 1983	12 of the then 14 regions (equivalent to 22 regions)	Survey questionnaire and interviews	Waterlow classification, one way ANOVA	NCHS, -2 Z score
Rural Household Income, Consumption, and Expenditure Survey, May 1981-April 1982	12, 000 rural households, data over 1 year, report from 25% sub sample	Personal interviews and objective measurements	Computer main frame analysis, percentage distribution of households by characteristics	—

Organization and Procedures

Information and data needed to solve the problem of the study were identified, sorted, selected and retrieved from existing data sources. Results of the national surveys and selected area surveys from all over the country were used. The information available varied from single year data to data from the past three decades. The different data were reorganized, recorded, entered into a computer, and tabulated for analysis. Lotus 1-2-3® software was employed for data base management and PC SAS® software was used for data analysis. Various statistical tests were used and regression models were computed and fitted. The specific statistical tools used to achieve the objectives and test the hypotheses are discussed below.

The following specific hypotheses will be tested separately:

$H_0$1: There has been no deterioration in the nutritional status of children under 5 years over the past 10 years (from 1983 to 1992) in Ethiopia,

$H_0$2: There are no differences in the nutritional status of children under 5 years among the different regions and socioeconomic groups,

$H_0$3: Parental child care factors will have no significant impacts on the nutritional status of a child, and

$H_0$4: There are no relationships between the nutritional status of children and :

a) the health status of children,

b) the socioeconomic conditions in which children live,

c) the production level and prices of staple foods, and

d) the mothers' cultural/ethnic background.

Statistical analysis

The chi-square test and logistic regression analysis were employed to determine the differences in the nutritional status of children as related to the expected underlying factors. A comparison of the results of the 1992 National Rural Nutrition Survey to that of the 1982/83 National Nutrition Survey helped to achieve the second objective and test the first hypothesis. The nutritional status of children indicated by the prevalence rates below the -2 Z-scores of height-for-age, weight-for-height, and weight-for-age (of the NCHS reference) was compared between the two periods using the chi-square test.

To assess the differences in the prevalence of malnutrition in children among (a) the various age groups (6-11, 12-23, 24-35, and 36-59 months); (b) the different regions and zones (North, West, Central and South); (c) the selected socioeconomic groups (community agricultural systems: cereal, root, cattle, coffee, cereal plus root, cereal plus cash crop and others); and (d) the mother's ethnic background, chi-square tests were performed. This helped to test the second hypothesis and part (d) of the fourth hypothesis. The logistic regression procedure of the PC SAS® System was used to identify the differences in the prevalence of malnutrition by farming sizes for the different agricultural systems.

The nutritional status of children was also analyzed to assess if prevalence of malnutrition was correlated with the average duration of breast-feeding, average duration of exclusive breast-feeding or the period of introduction of solid foods. These variables are considered here as parental child care practices and were used for testing the third hypothesis of this study.

Correlation analysis was also employed to identify the amount, direction and strength of association of nutritional status with selected health and socio-

economic factors. Multiple regression analysis was used to determine the association of different health related and socioeconomic factors to the nutritional status of children. This helped to test the last hypothesis.

Based on this multiple regression analysis, a step-wise regression procedure was performed to identify the factors with greater effect on nutritional status and to build and fit an appropriate model. The dependent variable, the prevalence of stunting, used in the regression was originally in percentages. Since the percentages (of children below -2 Z score height-for-age of the NCHS standard) were with in the range of 30-70% it was transformed to arcsin square root transformation to attain normality (Steel and Torrie, 1980).

The three main dependent variables indicating the nutritional status of children under five years of age; namely, stunting (low height-for-age), wasting (low weight-for-height), and underweight (low weight-for-age); and other independent factors which were anticipated to be related to the dependent variables are given in the following data set (Table 2.)

TABLE 2

SUMMARY OF LISTS, DESCRIPTIONS, AND DATA SOURCES OF THE THREE DEPENDENT VARIABLES (STUNTING, WASTING AND UNDERWEIGHT) AND THE INDEPENDENT VARIABLES FOR 22 REGIONS OF ETHIOPIA

Variable number	Variable name	Description	Data source
1	ID number	1-22 Regions	—
2	Production of main crops (grains) (in million quintals)	1960/61 -1991/92 trends & Average estimates of 1988-1992	CSA time series and sample surveys
3	Total population (in millions)	1983 and 1992 estimates	CSA projection (1984 Census)
4	Population under 5 years of age	Total number of children under 5 in 1992 by region	CSA 1992 NRNS
5	Number of children covered by surveys	Total sample of 1983 and 1992 Nutrition Surveys in each region	1983 and 1992 CSA surveys respectively
6	Stunting (Nutritional status of children I)	Percent below -2 Z-score (low height-for-age)	CSA surveys 1983 and 1992
7	Wasting (Nutritional status of children II)	Percent below -2 Z-score (low weight-for-height)	CSA surveys 1983 and 1992
8	Underweight (Nutritional status of children III)	Percent below -2 Z-score (low weight-for-age)	CSA surveys 1983 and 1992
9	Number of health personnel	All doctors, nurses, and health assistants in each region	MOH 1988/89 survey

TABLE 2 (Continued)

Variable number	Variable name	Description	Data source
10	Number of hospital beds	Total number of beds in hospitals in each region	MOH 1988/89 survey
11	Infant Immunization status	Percent fully immunized (DPT) under one year	CSA, 1992 NRNS
12	Number of children with diarrhea	Percentage of children 1-4 years old with diarrhea during two week period before the 1992 survey	CSA, 1992 NRNS
13	Main agricultural products**	Agricultural products classified as: Cereals, Roots, Coffee, Cattle, Cereal+Roots, Cereal+Cashcrops, others	CSA, 1992 NRNS
14	Average household cultivated area** (farm size)	Average cultivated area per household in each region: 1=below 1/2 ha, 2=1/2-1 ha, 3=1.01-1.5 ha, 4=>1.5 ha (ha=hectare)	CSA, 1992 NRNS
15	Average retail prices of staple foods	Average retail prices of foods in selected towns in each region: 1982 & 1992	CSA and AMC surveys; 1982 & 1992 data
16	Breast feeding duration	Average duration (in months) of breast feeding	CSA, 1992 NRNS
17	Exclusive breast feeding duration	Average duration (in months) of exclusive breast feeding	CSA, 1992 NRNS

TABLE 2 (Continued)

Variable number	Variable name	Description	Data source
18	Availability of pure drinking water	percent of household with pipe water	CSA, 1992 NRNS
19	Introduction of solid foods	Average age of introduction of solids (milk versus other solids)	CSA 1992 survey
20	Mother's ethnic background**	Percent of children mal-nourished by mother's ethnic background	CSA, 1992 NRNS

Note: ** Data were not available by region for these variables. Therefore, these variables were used as groups and tested separately based on national aggregates.

CHAPTER IV

FOOD INSECURITY AND PREVALENCE OF MALNUTRITION IN ETHIOPIA

Production Trends and Food Insecurity

A close look at the production trends, especially of the staple grain (tef, maize, wheat, barley, sorghum, pulses and oil crops) production, may give an overview of the existing food insecurity and nutrition problems. This section of the present study is based on an analysis of staple grain production trends, because first and foremost agricultural production in Ethiopia is a subsistence system dominated by smallholders who produce and consume most of the country's food (Alemneh, 1990; Pausewang et al., 1990). Second, grain production is the main food source for consumption for the majority of population (more than 80% of the total staple food consumption, computed from CSA, 1988).

The grain production trend was positive and smooth during the 1960's with an average growth rate of 2.6% from 1960/61 to 1971/72. During the last 20-30 years grain production showed a marginal growth with great fluctuations from year to year beginning in the early 70's. Fluctuations in production became a characteristic feature of the agricultural sector in general and of the food subsystem in particular after the 1972/73 great setback in the positive trend in grain production (Figure 2 and Appendix A). This setback period matches with a

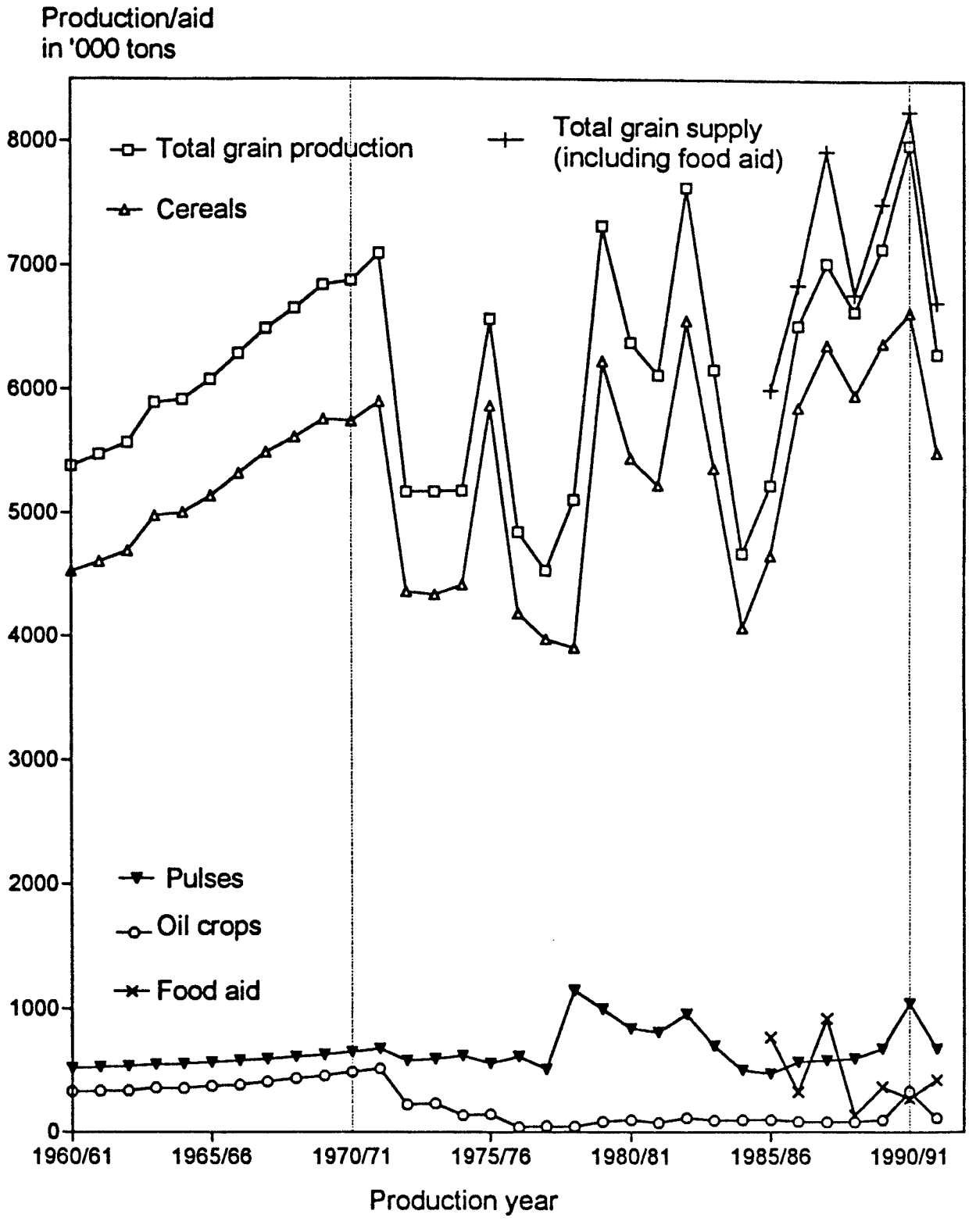

Figure 2. Trends of main food grain production and food aid in Ethiopia (1960/61 -1991/92)

Source: CSA, 1987, 1990, 1991, and RRC, Unpublished raw data.

sequence of rain failures during 1971-75 and resulted in famines which claimed a quarter of a million lives in Tigray and Wollo in northern Ethiopia (Webb et al., 1992).

Grain production grew by an annual average of only about 1.9% from 1976/77 to 1991/92. Taking 1976/77[4] as the base (=100) year, the two periods of lowest food grain production over the past 15 years are 1977/78 (94%) and 1984/85 (96%). During these two periods production fell by about 6 and 24% respectively over previous years.

The growth of per capita grain production remained below the annual population growth rate showing a declining trend over the past 20 years (Table 3 and Figure 3). This indicates that Ethiopia has not been able to provide enough food for its ever expanding population. The trend shows that the gap has increased since 1960 and has accelerated more rapidly after 1971. Population has been growing at annual rates of 2.2 to 3.0% from 1960 to 1992 (Alemneh, 1990). Production showed equivalent growth only in the 60's. Per capita grain production over the last 20 years showed a 25% average deficit (with the highest deficit of 44% during the 1984/85 drought year) as compared to the minimum required annual per capita consumption of 204 kg grain equivalent. Total grain availability, however, has increased over the last few years by food aid and assistance. During the past 7 years, for which food aid data were available, the food grain deficit has decreased from an average of about 30% to around 6% when food aid is considered. The food aid received by the RRC and NGOs contributed, on the average, about 10% of the total food grain supply in the country over the last seven years (Figure 4).

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[4] 1976/77 is used as a base year because the researcher has made some adjustments in production and population data starting in 1976/77, by excluding Eritrea from the data. After 1976/77 there were no records of production or population for Eritrea, but the CSA has been using the same figure of 1976/77 production every year repeatedly. It was not reasonable to use that figure in this study. In addition Eritrea became an independent country since 1992.

TABLE 3

GRAIN PRODUCTION PER CAPITA AND POPULATION
FOR ETHIOPIA (1960/61 - 1991/92)

PRODUCTION YEAR	PRODUCTION PER CAPITA (Kg/Year)	PER CAPITA INDEX (1960/61=100)	POPULATION (MILLION)
1960/61	226.95	100.00	23.71
1961/62	225.09	99.18	24.30
1962/63	223.55	98.50	24.91
1963/64	230.66	101.63	25.53
1964/65	225.98	99.57	26.17
1965/66	226.56	99.83	26.83
1966/67	228.58	100.72	27.50
1967/68	230.34	101.49	28.18
1968/69	230.02	101.35	28.92
1969/70	230.50	101.56	29.67
1970/71	225.82	99.50	30.44
1971/72	226.96	100.00	31.23
1972/73	161.31	71.08	32.04
1973/74	157.19	69.26	32.88
1974/75	153.51	67.64	33.73
1975/76	189.60	83.54	34.61
1976/77	146.64	64.61	33.02
1977/78	133.56	58.85	33.95
1978/79	146.24	64.44	34.90
1979/80	203.61	89.71	35.88
1980/81	172.71	76.10	36.88
1981/82	161.04	70.96	37.91
1981/83	195.37	86.08	38.97
1983/84	153.39	67.59	40.07
1984/85	112.67	49.64	41.40
1985/86	121.83	53.68	42.79
1986/87	147.08	64.81	44.15
1987/88	154.05	67.88	45.45
1988/89	140.80	62.04	46.93
1989/90	147.37	64.93	48.36
1990/91	159.62	70.33	49.95
1991/92	121.58	53.57	51.57

Source: CSA, 1991: 1984 Population Census, CSA, 1987:
Production time series data; CSA, 1990 &1992:
Sample survey; CSA, 1992 production forecast;

Note: Production & population of Eritrea were not included
in the computation of the above data since 1976/77.

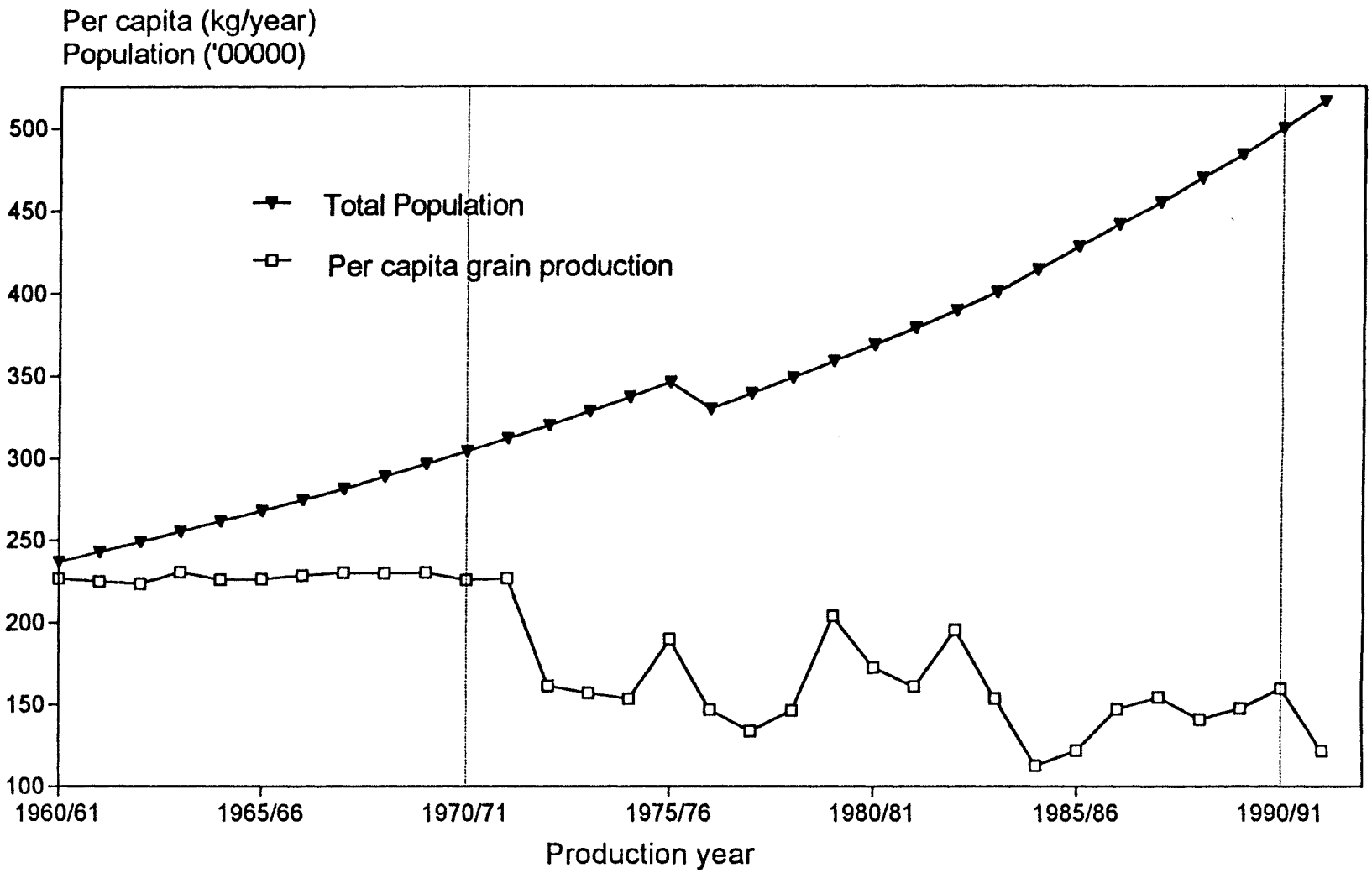

Figure 3. Trends of per capita main food production and population in Ethiopia (1960/61-1991/92).

Source: CSA, 1984, 1987, 1990, 1991, and 1992.

Note: a) Production and population of Eritrea were not included in the computation of the data since 1976/77
b) The population projections were reconstructed for the years 1960/61-1983/84 using the 1984 Census data and the medium variant population growth rate.

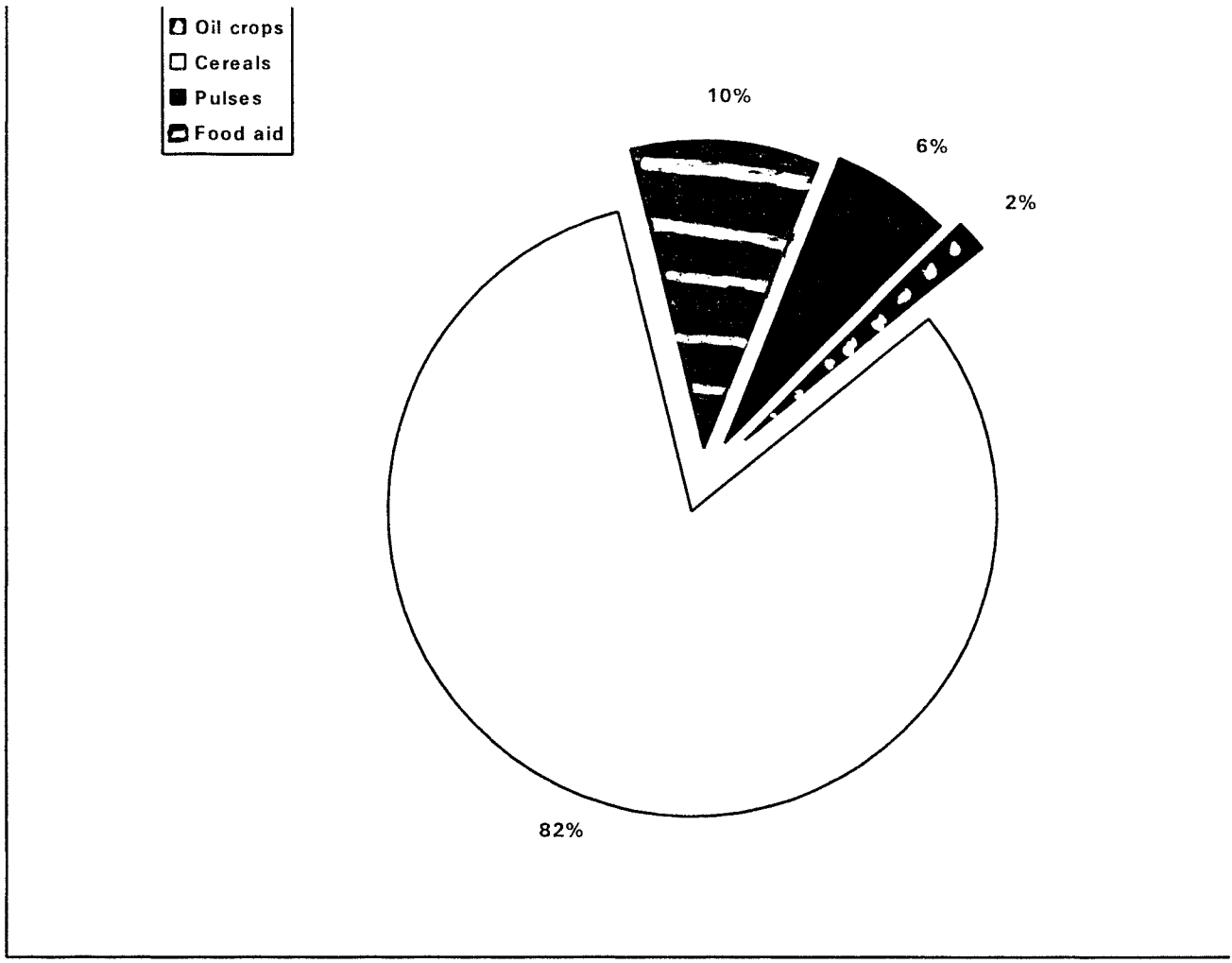

Figure 4. Proportions of domestic grain production and food aid in the total grain supply in Ethiopia (1991/92)

Source: CSA, 1992a and 1992c (Production) RRC, unpublished raw data.

As shown by Figure 4 cereals (tef, maize, wheat, barley, and sorghum) constitute the major part (more than 80%) of the country's food grain supply. The main cereals contribute a large percentage not only to the food supply system, but also to the food consumption side. According to the 1981/82 Rural Household Income, Consumption and Expenditure survey (CSA, 1988) cereals constituted about 90% of the grain consumption and more than 70% of the total

staple food consumption. Total food grains constitute about 80% of the staple food consumption and about 64% of total consumption items (Figure 5). In 1981/82 actual per capita consumption of grains alone and all staple foods (grain plus 'enset' or 'kocho') were estimated at 229 and 283 kg respectively (CSA, 1988). The consumption of kocho alone was about 54 kg per capita in 1981/82. During the same year the per capita consumption of meat, fish and dairy products was estimated to be only about 20 kg. Per capita consumption of fruits and vegetables was estimated at 53 kg. This makes yearly per capita food consumption in Ethiopia far above 300 kg. It is hard to understand these data when compared to the per capita grain production (Figure 3) and given the high prevalence rate of malnutrition.

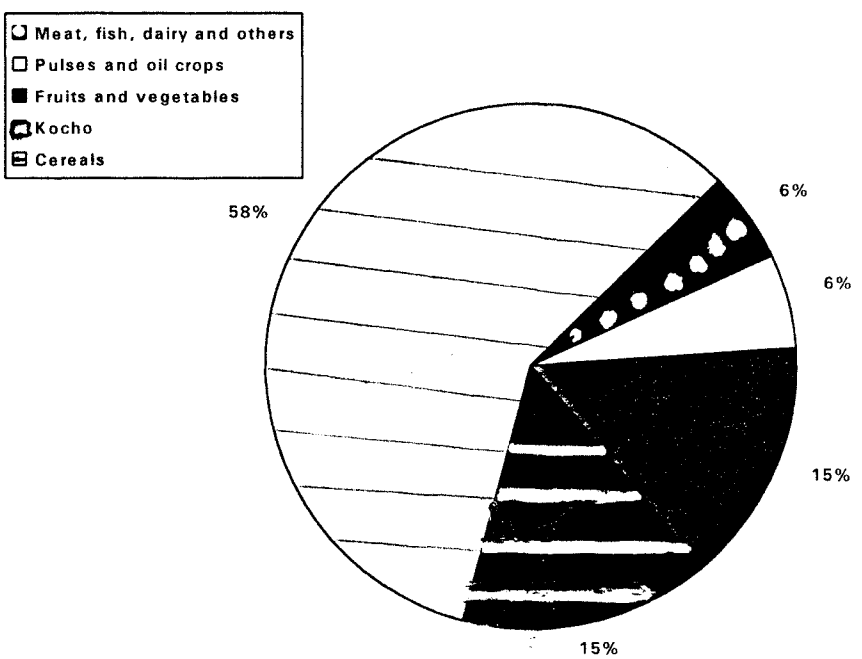

Figure 5. Proportions of staple food consumption in Ethiopia (1981/82)

Source: CSA, 1988 (RHICES: May 1981-April 1982).

The country's food security system is basically dependent upon the level of its grain production, especially of cereal crops. As can be seen from Figures 2 and 3 and Appendix A, the "Great Ethiopian Famine" of 1984/85 exactly matches one of the periods of lowest total and per capita grain production ever recorded over the past 30 years. Pausewang et al. (1990) reported that 1984/85 was a year with the lowest level of production of the last decade. This low production, according to the authors, "together with the armed conflicts, led to regional famines which affected 10 million people, the highest figure ever recorded for a famine in Ethiopia". The Sahel famine of 1974 and the Ethiopian famines of 1978-79 and 1992 also occurred during years of hampered grain production. Under the present conditions of rapid population growth of about 3% annually and the lower very steady growth in production, the per capita domestic food production is expected to continue to follow a downward trend for the next years or even decades. Alemneh (1990) estimated that, in the year 2015, Ethiopia will have to feed a population more than double that in 1992. This in fact will create a greater challenge of food insecurity for the country over the next years.

The Problems of Malnutrition and Undernutrition

The Ethiopian people are obviously undernourished in general given the present high deficit in food consumption. Under the prevailing poor health, sanitation and water conditions, malnutrition in the general population and specifically in infants and children and their mothers is very evident.

An analysis of the results of the 1983 and 1992 National Rural Nutrition Surveys has helped elaborate the nutritional problems. Nationally aggregated anthropometric measurements of children aged 6-59 months were analyzed to

show (i) the extent and nature of malnutrition in Ethiopia as compared to other countries; (ii) the differences in nutritional status of children between 1983 and 1992, between boys and girls and among the four age groups (6-11, 12-23, 24-35, and 36-59 months). Three different nutritional status indicators expressed as percentages of children below the -2 Z score cut-off point were considered for the analysis. Stunting in terms of height-for-age, wasting in terms of weight-for-height, and underweight in terms of weight-for-age were considered to indicate chronic, acute or current, and general malnutrition in children respectively.

The prevalence of malnutrition in Ethiopian children can be compared with the averages of developing world and sub-Saharan Africa, and with selected East African countries (Table 4). The table shows that the prevalence of all forms of malnutrition is very high in Ethiopian children as compared to the average for the developing world and to the East African countries. The prevalence rates of stunting and underweight in Ethiopian children are approximately 64 and 47% respectively in 1992. The average stunting and underweight rates in the developing world were about 39 and 36% respectively. The average rates in Africa were even less, i. e., 35% stunting and 27% underweight. This clearly shows that the malnutrition problem in Ethiopia is very serious even by developing world standards. According to UNICEF classification, Ethiopia is ranked among the countries with a very high prevalence rate of stunting (more than 50%) as well as high prevalence rates of underweight (41-50%) and wasting (7-12%) (Carlson and Wardlaw, 1990) (Table 5).

It is clearly evident from Tables 4 and 5 that stunting is the most prevalent nutritional problem in Ethiopia, affecting more than half of preschool children. The rate of stunting needs special attention in Ethiopia because:

(1) the prevalence of stunting is higher than the prevalence of wasting and underweight in Ethiopia,

TABLE 4

PREVALENCE OF MALNUTRITION IN ETHIOPIA AS COMPARED TO THE GLOBAL, REGIONAL AND EAST AFRICAN COUNTRIES' RATES

Region/Country		Prevalence of malnutrition (% < -2 Z score)		
		Underweight	Stunting	Wasting
Developing countries[a]		35.7	39.0	8.4
South Asia		45.2	41.3	9.8
Rest of Asia		43.4	46.2	8.3
Americas		13.8	27.7	1.3
Africa		26.6	35.3	10.2
Eastern Africa				
Ethiopia	1983	37.3	59.8	8.1
	1992	46.9	64.0	7.6
Kenya	1982	NA	38.2	4.6
Malawi	1981	23.9	56.2	1.6
Uganda	1988	23.3	44.5	1.9
Tanzania	1988	48.0	NA	NA

Source: Carlson and Wardlaw, 1990; CSA, 1993.

NA = Data not available

[a] = Excluding China

TABLE 5

AFRICAN AND MIDDLE EASTERN COUNTRIES WITH VERY HIGH AND HIGH NATIONAL PREVALENCE RATES OF UNDERWEIGHT, STUNTING AND WASTING

Prevalence type	UNICEF classification	
	Very high	High
	(Over 50%)	(31-50%)
Underweight	Yemen, Arab	Ethiopia, Niger, Madagascar, Mauritania, Tanzania, Burundi, Mali, Iran
	(Over 50%)	(41-50%)
Stunting	Ethiopia, Yemen, Arab, Malawi, Iran	Uganda, Botswana, Sierra Leone, Burundi, Zaire
	(Over 12%)	(7-12%)
Wasting	Mauritius, Nigeria, Iran, Niger, Sudan	Ethiopia, Madagascar, Ivory Coast, Yemen. Dem., Mali, Ghana, Yemen, Arab

Source: Carlson and Wardlaw, 1990; CSA, 1993.

(2) the prevalence rate of stunting is one of the highest in the world, and the highest in Africa. Although, underweight and wasting prevalence rates are also high, Ethiopia is not in the highest risk category defined by UNICEF,

(3) the prevalence of stunting is getting worse and becoming a universal problem for all regions and socioeconomic groups, and

(4) stunting as a malnutrition indicator reflects the problem of chronic food insecurity of the country more than the other two indicators because of the relation a deficit in height-for-age of a child has to results of long-run cumulative experience of slowed growth. Therefore, in the forthcoming discussions more emphasis will be given to the prevalence of stunting.

Changes in Nutritional Status of Children Under 5 From 1983 to 1992

A comparative analysis of the 1983 and 1992 National Rural Nutrition Survey results was used to test changes in the nutritional status of children under 5 between 1983 and 1992. Based on the national averages of the prevalence rates of stunting in children by age group, a chi-square test was performed. Significant difference was found in the nutritional status of children under 5 years of age between 1983 and 1992. There was a deterioration in the nutritional status of children under 5 over this period (Figure 6). The prevalence of stunting (low height-for-age) increased by 4.4% ($p<0.0001$) from 1983 to 1992. The prevalence of underweight significantly increased by over 10% from 1983 to 1992 ($p < 0.0001$). On the other hand there was no significant difference in the prevalence of wasting between the two periods.

Analysis based on the regional averages has also resulted in the same findings which indicated that a country-wide deterioration in nutritional status of children was observed over the same period ($p < 0.0001$). Actually no significant improvement was observed in any of the 11 administrative regions covered by the surveys as will be discussed in the section on regional differences.

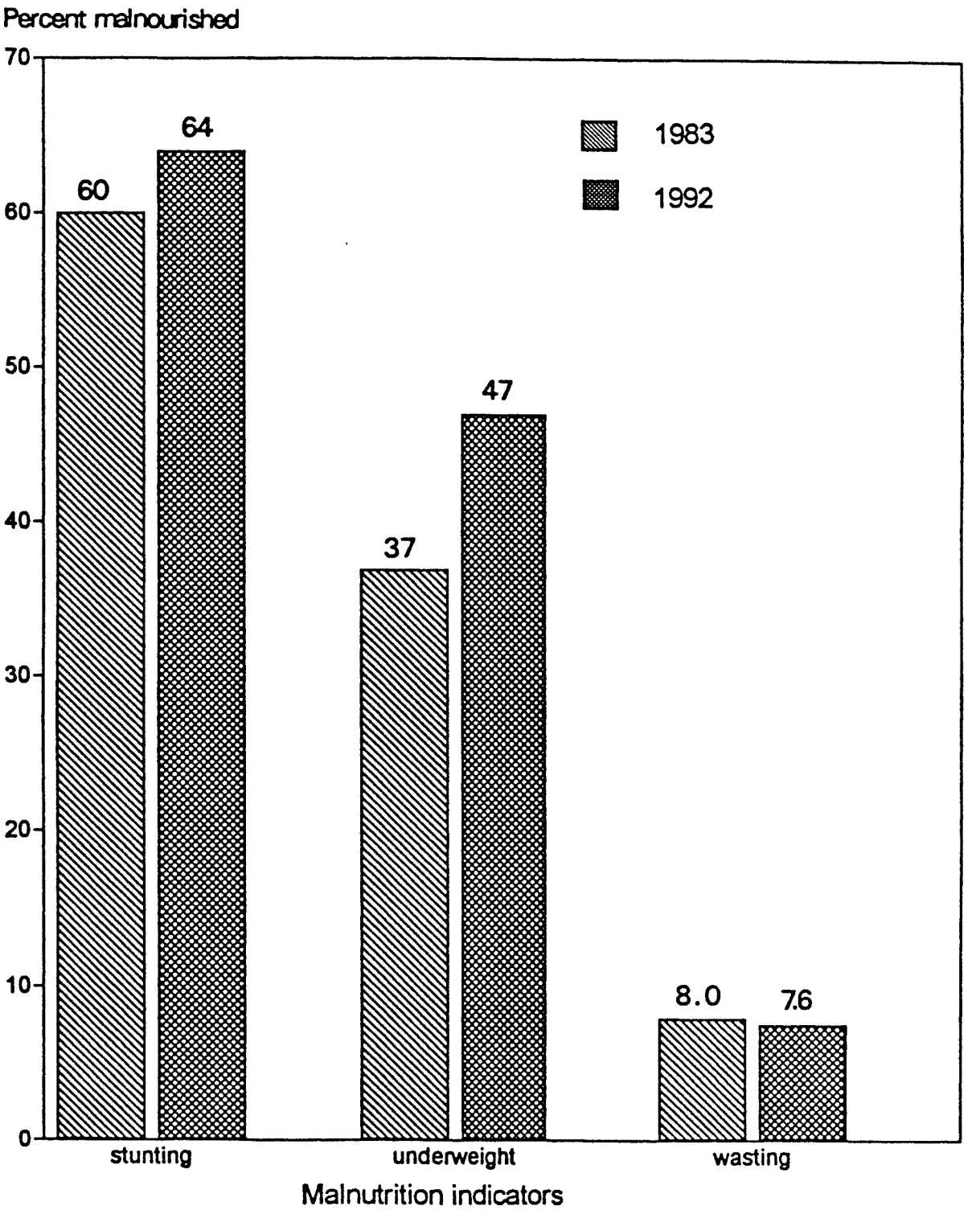

Figure 6. Changes in the prevalence of malnutrition in children under 5 years from 1983 to 1992 in Ethiopia.

Source: CSA, 1992, and 1993 (1983 and 1992 National Rural Nutrition Surveys)

Differences in Nutritional Status of Children
by Gender and Major Age Groups

In 1983 there were no significant gender differences found in the prevalence of stunting and underweight ($p > 0.1$). There was a slightly higher prevalence of wasting in boys than girls ($0.05 < p < 0.1$). On the other hand, in 1992 more boys than girls were classified as malnourished in terms of height-for-age (stunting) ($p < 0.005$). However, no significant gender differences were found in other indicators in 1992 as well. In general a summary analysis of the results of both surveys indicated that a greater prevalence of malnutrition (stunting) was recorded in boys than in girls in Ethiopia ($p < 0.001$) (Figure 7). This is in accordance with the finding of Jus'at (1991) who reported that boys were more malnourished than girls in Indonesia. This could be explained by the fact that he found infection to be more frequent in boys than in girls. The Central Statistical Authority (1993) reported a higher relative risk of caretaking practices for boys than girls by mothers from many ethnic groups. A higher relative risk was defined as a ratio (of stunting in boys and girls) above 1.0 that is significant at p-value of 0.05. Significantly higher relative risk for boys was found in many ethnic groups including, the Amhara, the Oromo, the Guji, and the Hadya.

The nutritional status of children by all three indicators was significantly different between the four major age groups of 6-11, 12-23, 24-35 and 36-59 months. The prevalence rate of stunting was very different among the four age groups ($p < 0.0001$). A detailed analysis of the 1992 survey results has shown that the prevalence of stunting and wasting was exceptionally high in the age group of 12-23 months. The nutritional status of children in this age group was worse than other age groups ($p < 0.0001$). The differences between the four age groups in all indicators were more significant in 1992 than in 1983. The

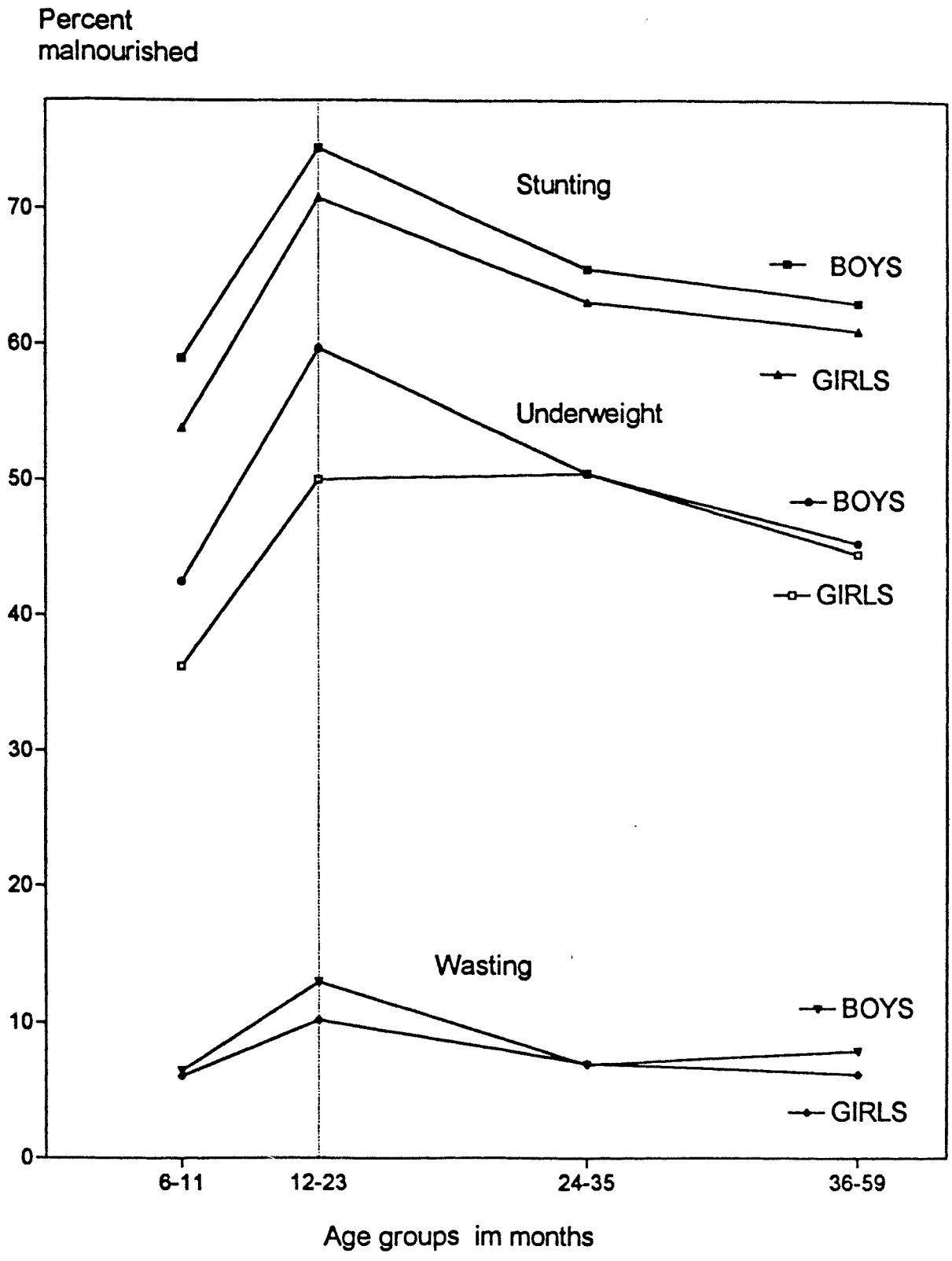

Figure 7. Patterns of the prevalence of malnutrition in children under 5 years by gender and major age groups

Source: CSA, 1993 (1992 National Rural NUtrition Survey).

patterns of malnutrition based on four age groups clearly identified that the 12-23 months age group had the worst prevalence rate of malnutrition for both sexes. The age group 6-11 months old had the lowest prevalence rates in all indicators. After a peak prevalence rate in the age group 12-23 months old, the rate improved in later years (Figure 7).

A study done by Jus'at (1991) identified ages 3-6 and 11-13 months as a cut-off where faltering in growth begins and ends respectively. Therefore, a high prevalence rate of malnutrition is recorded in children starting at about 12 months of age. The author indicated that children aged 6-23 months experienced illness frequently and the gender difference in the prevalence of malnutrition widens between 12-23 months.

Regional Differences in Nutritional Status of Children Under 5

The chi-square test was performed on regional average data for 1983 and 1992, separately, and combined. The prevalence of stunting was found to be significantly different among the regions. As shown in Table 6 the probability for the Likelihood Ratio Chi-square was very significant ($p < 0.0001$) indicating that the prevalence of stunting in children in the four regional zones (North, Central, West and South) was different.

During the 1983 Survey, North zone regions (Gonder, Wollo, and Gojam) had the highest rate of stunting. The North zone was the only part of Ethiopia with a stunting rate above the national average, 60%. Other areas also had high prevalence rates with a minimum of 54.5% for the West zone. For individual administrative regions the prevalence of stunting varied from 50.7% for Bale in

the South to 74% for Gonder in the North (Figure 8). Refer to the map of Ethiopia (Appendix B for the names and locations of regions.

In 1992 the prevalence rate of stunting increased in general, and no zone was found to have a prevalence rate of less than 60%, except the individual regions of Bale and Gamugofa. For the North and South zones there was no significant difference in nutritional status of children between 1983 and 1992.

TABLE 6

DIFFERENCES IN THE PREVALENCE OF STUNTING AMONG REGIONAL ZONES IN ETHIOPIA: 1983 AND 1992.

	Prevalence of stunting				Change from	
ZONES	1983		1992		1983 to 1992	
	%	Sample	%	Sample	%	p-value
CENTRAL	58.8	2556	61.9	5545	3.1	<0.005
NORTH	68.9	2043	68.9	5601	0.0	>0.1
SOUTH	59.3	1883	60.2	4595	0.9	>0.1
WEST	54.5	2277	63.6	3218	9.1	<0.0001
LIKELIHOOD RATIO X^2	⇓		⇓			
Value	99.316		98.732			
df	3		3			
p-value	<0.0001		<0.0001			

Source: CSA, 1992b and 1993 (1983 and 1992 NRNSs).

df = degrees of freedom.

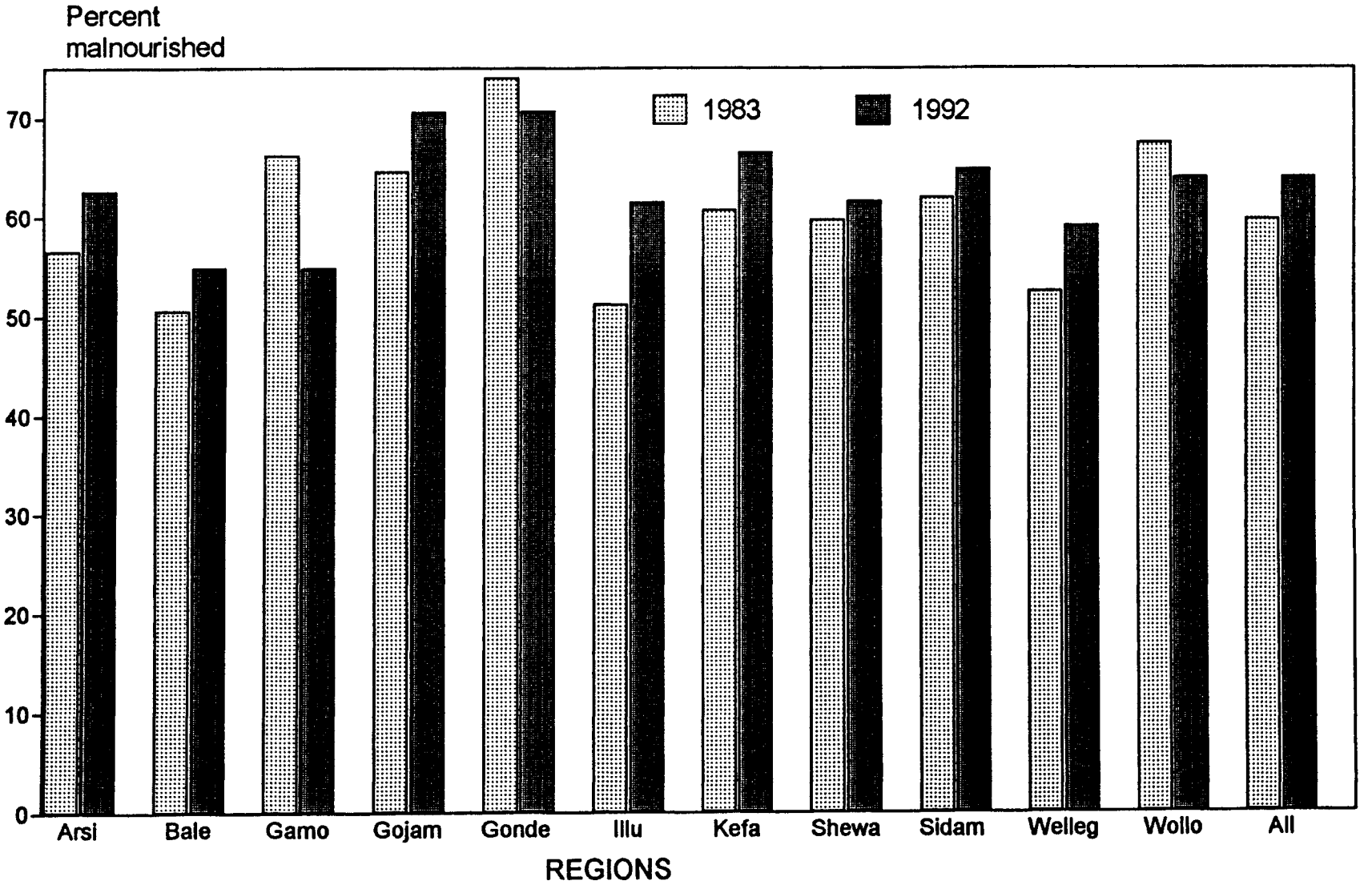

Figure 8. Regional differences and cchanges over time in the prevalence of stunting in Ethiopia (1983 and 1992).

Source: CSA, 1992 and 1993 (National Rural Nutrition Surveys).

On the other hand, the Central and West zones experienced a great deterioration in nutritional status of children from 1983 to 1992 (with $p < 0.0005$ and $p < 0.0001$, respectively).

The armed conflicts and civil unrest, among other factors, seemed to be contributing to the nutritional problems in the North in 1983 and to the deterioration in 1992 in the Central and West zones. In 1983 all regions but the North were relatively peaceful with no armed conflicts. During the 1992 survey the conditions were completely reversed; only the North was relatively without civil unrest. As indicated earlier, Pausewang et al. (1990) showed an impact the armed conflicts had on regional famines in the North.

Differences in Nutritional Status of Children by Agricultural System and Socioeconomic Groups

The community agricultural types and average household farm sizes, as socioeconomic grouping factors, were analyzed to help explain differences in nutritional status of children across and within the agricultural systems. The grouping was based on CSA classification (CSA, 1993). The community agricultural types included: cattle raising, cereals growing, cereals plus cash crops farming, cereals plus roots growing, coffee growing, roots growing, and others. These agricultural systems are subdivided according to the average cultivated area holding (farm size).

A significant difference in the prevalence of stunting among the seven agricultural activities ($p < 0.0001$) was identified by the chi-square test. Table 7 summarizes the differences in the average prevalence rate of stunting among the various agricultural systems. The table is organized in decreasing order of

the prevalence rate of stunting to indicate a pair-wise comparison between any two consecutive variables (agricultural systems).

TABLE 7

DIFFERENCES IN THE PREVALENCE OF STUNTING AMONG AGRICULTURAL SYSTEMS IN ETHIOPIA

AGRICULTURAL	Prevalence of stunting		Pair-wise comparison*	
SYSTEM	%	Sample	p-value	x^2-value
COFFEE	76.6	401	-	-
ROOTS	66.7	778	<0.0001	12.543
CEREALS	64.7	15165	>0.1	1.362
OTHERS	63.4	1544	>0.1	0.971
CEREALS PLUS ROOTS	60.1	1701	<0.05	3.787
CEREALS PLUS CASH CROPS	58.4	392	>0.5	0.366
CATTLE	47.8	245	<0.01	6.905
LIKELIHOOD RATIO X^2	⇓			
Value	77.973	*=> In the pair-wise comparison each agricultural system was compared to the one immediately below it.		
df	6			
p-value	<0.0001			

Source: CSA, 1993 (1992 NRNS).

df = degrees of freedom.

The prevalence of stunting in children under 5 for coffee growing households is the highest figure (76.6%) recorded. There is a very great difference in the rate of prevalence of stunting between coffee and cattle community agricultural types. The prevalence rate of stunting in the coffee growers is higher than any of the other systems ($p < 0.0001$). The prevalence rate of stunting obtained for the cattle raising communities is lower than any of the other systems (with $p < 0.01$ when compared to cereals plus cash crops growers, the next lowest rate). There were no significant differences between cereals and roots ($p > 0.1$) and between cereals plus cash crops and cereals plus roots ($p > 0.5$) agricultural types.

A logistic regression analysis was performed to assess any change or difference in the nutritional status of children with different farm sizes or socio economic grouping for each agricultural system. Each agricultural system was divided into three or four groups based on equally spaced average farm sizes in hectares. For instance, for cereals growing system, the average farm sizes vary from less than a quarter of a hectare to greater than 1.5 hectares. For the logistic regression analysis, cereals, and cereals plus roots were classified using midpoints 0.25, 0.75, 1.25, and 1.75 hectares. For the roots, cereals plus roots, roots plus cattle, and coffee systems, the midpoints 0.25, 0.50, and 0.75 hectares were specified. The farm size (X) in each agricultural system is the independent variable. The sample size and the sample proportion of children below -2 Z score height-for-weight for each farm size provide the data for estimating the logistic regression model.

For a given agricultural/farming system a logistic regression function:

$$\ln (P/\{1-P\}) = B_0+B_1X;$$

was determined using PROC LOGISTIC of the PC SAS® software.

where, X = farm size

P = probability of malnutrition

B_0 = intercept, and

B_1 = slope for farm size

The results of the logistic regression analysis are given in Table 8. According to the logistic regression analysis there is very significant negative association between the average size of cultivated land and the prevalence of stunting for cereals and cereal-root combination farming systems ($p < 0.0001$). In the cereal-cattle, and root agricultural systems a negative association, although not significant, was found between the farm size and prevalence of stunting ($p > 0.1$). On the other hand, in the coffee and roots-cattle systems, a positive, but not significant, association was found between the cultivated land holding and prevalence of stunting ($p > 0.1$). A lack of negative association in the coffee growing system is because, among other factors which may not be explained by these data, coffee being a cash crop commonly grown on small farm sizes may not have a significant positive impact on nutritional status of children. For the root-cattle system which combines intensive roots farming and cattle raising, a lack of negative association between farm sizes and the prevalence of stunting in children was not expected.

Logistic regression functions can be fitted for the various agricultural systems using the results in Table 8. For the cereal system, for instance, the estimated logistic regression function would be:

$$\ln (P/\{1-P\}) = 0.7911 - 0.1701X.$$

TABLE 8

RESULTS OF THE LOGISTIC REGRESSION ANALYSIS FOR VARIOUS AGRICULTURAL SYSTEMS IN ETHIOPIA BASED ON FARM SIZES

AGRICULTURAL SYSTEM	Intercept (B_0)	Coefficient (B_1)	p-value	Sample size	farm[a] size (ha)	Standard deviation
CEREALS	0.7911	-0.1701	<0.0001	12276	1.13	0.55
CEREALS AND CATTLE	0.6471	-0.0711	>0.1	2823	1.12	0.55
CEREALS AND ROOTS	1.3305	-1.155	<0.001	1400	0.61	0.18
COFFEE	0.4674	0.7239	>0.1	493	0.57	0.20
ROOTS	0.6973	-0.3648	>0.1	527	0.55	0.19
ROOTS AND CATTLE	0.1647	0.6402	>0.1	248	0.43	0.19

Source: CSA, 1993 (1992 NRNS).

Note: [a] = Average farm size in hectare (ha).

In this logistic regression model the coefficient $^{B}1$ is negative ($^{B}1 = -0.1701$). This indicates a negative relationship between the probability of malnutrition and a farm size. As farm size of a household increases the probability of child malnutrition decreases.

If $\ln (P/\{1-P\}) = B_0+B_1X \Rightarrow P = 1/\{1+E^{(-B_0-B_1X)}\}$;

Then, $\ln (P/\{1-P\}) = 0.7911 - 0.1701X \Rightarrow P = 1/\{1+E^{(-0.7911+0.1701X)}\}$.

Therefore, if cultivated land increases for the cereals agricultural system by 1 hectare from 0.25 to 1.25 , the following result may be obtained.

$$\ln (P/\{1-P\}) = 0.7911 - 0.1701(0.25) = 0.7486$$

$$P = 1/\{1+E^{(-0.7911+0.1701[0.25])}\} = 0.68, \text{ and}$$

$$\ln (P/\{1-P\}) = 0.7911 - 0.1701(1.25) = 0.5785$$

$$P = 1/\{1+E^{(-0.7911+0.1701[1.25])}\} = 0.64.$$

This means that, on the average, the estimated chance for a child to be malnourished is about 68 and 64% for households with 0.25 and 1.25 hectares of cultivated land respectively. Therefore, the probability of stunting in children under 5 would decrease from 0.68 to 0.64 as a result of an increase in one hectare of cultivated land in the cereals growing system. In other words, on average, there is an estimated 68% chance that a child living in a household with a farm of 0.25 hectare may be malnourished (stunted). The chance for a child to be malnourished would decrease to 64% if the household's cultivated land increases to 1.25 hectare. Melkie et al. (1993) also found (in Gonder region, Northern Ethiopia) that the nutritional status of preschool children of cooperative farmers with mean land size of 3.63 hectares was significantly better than the nutritional status of non-cooperative farmers with mean land size of 1.41 hectares.

Differences in Nutritional Status of Children
by Mother's Ethnic Background

Analyzing differences in the prevalence of stunting in children by mother's ethnic background is considered important, because, the cultural differences in child caretaking and feeding practices among the various ethnic groups in Ethiopia are anticipated to have correlation with the prevalence of stunting in children. The chi-square test was used to identify the overall and pair-wise differences in nutritional status of children among nineteen ethnic groups. Differences in nutritional status of children were found by mother's ethnic background ($p < 0.0001$). The Borena ethnic group had 41.1% prevalence of stunting which was the lowest percentage recorded for any ethnic group (Table 9). This prevalence rate is significantly better than the prevalence rate in any ethnic group ($p < 0.05$, when compared to Ari/Ara, an ethnic group with the second lowest record). This result was in line with the findings from the agricultural system analysis in which cattle raising communities were relatively the best of all systems for nutritional status of children. The Borena is a sub-group of the Oromo ethnic group, and yet had lower prevalence rate of malnutrition. This lower prevalence rate was expected, because, the Borenans are predominantly cattle raising people, who depend mainly on animal protein sources.

Data for the remaining ethnic groups were analyzed pair-wise (Table 9), but discussion is provided only for selected reference ethnic groups. For instance, Ari/Ara can be used as a reference, because this ethnic group had relatively lower prevalence of stunting, only behind Borena. The only two ethnic groups which are not different from Ari/Ara are Konso and Gimira. If Kembata, with the highest prevalence of stunting, is taken as a reference, all ethnic groups

TABLE 9

DIFFERENCES IN THE PREVALENCE OF STUNTING IN CHILDREN BY MOTHER'S ETHNIC BACKGROUND IN ETHIOPIA[a].

Mother's ethnic background	% stunted	Sample size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Kembata	73.0	318																			
2. Hadya	72.3	530																			
3. Kimant	71.8	195																			
4. Sidamo	69.5	750																			
5. Agew	67.6	253																			
6. Amhara	67.0	5846																			
7. Gedeo	66.5	501																			
8. Tigraway	65.8	1475																			
9. Welaita	64.6	311																			
10. Kefa	64.6	299																			
11. Others	63.1	1076																			
12. Oromo	60.9	5988																			
13. Guji	60.9	327																			
14. Gurage	60.0	723																			
15. Gamo	58.6	493																			
16. Gimira	56.8	329																			
17. Konso	54.6	174																			
18. Ari/Ara	51.1	427																			
19. Borena	41.1	190																			

Likelihood Ratio $X^2 = 192.517$ $P < 0.0001$

Source: CSA, 1993 (1992 NRNS)

Note: [a] = The ethnic groups joined by solid lines are not significantly different from each other (at 0.05 p-value) in the prevalence of stunting in children.

except the Hadya, Kimant, Sidamo and Agew had a lower prevalence rate than Kembata. No significant difference in the prevalence rate of stunting was found among these five ethnic groups (Kembata, Hadya, Kimant, Sidamo, and Agew). Two of these ethnic groups concentrate in the North (Kimant and Agew) while the other three concentrate in the South (Kembata, Hadya and Sidamo). The high prevalence of stunting among the Kimant and the Agew supports the previous findings from the analysis of zones, in which the North zone was identified as a seriously malnourished part of the country. However, the Kembata, Hadya and Sidamo ethnic groups did not show similar results as that of the analysis of zones. It is very likely that the high prevalence of stunting in these groups can be concealed within the Southern zone prevalence average rate, because Kembata and Hadya occupy one of the most densely populated areas in Ethiopia.

It is also important to take the Oromo as a reference ethnic group because the Oromo is the major ethnic group in Ethiopia. Only two ethnic groups, namely Borena and Ari/Ara (both in the Southern regions) had lower prevalence of stunting than the Oromo. On the other hand, the Oromo had lower prevalence of stunting than the Kembata, Hadya, Kimant, Sidamo, Agew, Amhara, Gedeo and Tigraway. No significant difference was found between the Oromo and the remaining ethnic groups.

CHAPTER V

DETERMINANTS OF NUTRITIONAL STATUS OF CHILDREN UNDER FIVE YEARS OF AGE IN ETHIOPIA

Relationships Between the Nutritional Status of Children and Selected Associated Factors

The three nutritional status indicators, i.e., the prevalences of stunting, wasting and underweight are the main dependent variables used for the analysis in this study. The prevalences of stunting, wasting and underweight described as average percentages of children less than -2 Z Scores of the NCHS/WHO standards (WHO, 1983) for each region were used and transformed to degrees by arcsin-square root transformation (Steel and Torrie, 1980).

These nutritional status indicators were analyzed for significant relationships to the independent variables using correlation analysis. The variables with high Pearson correlation coefficients ($r > 0.4$) or p-values less than 0.1 were selected for regression analysis. As indicated in Table 10, total under five population is very significantly associated with the prevalence of stunting of children in general and with that of the older groups (24-59 months old) in particular.

The prevalence of stunting was not found to be associated with the overall prevalence of illness. The prevalence of illness is the total

TABLE 10

PEARSON CORRELATION COEFFICIENTS FOR PREVALENCE OF STUNTING AND SELECTED INDEPENDENT VARIABLES

Independent variables of interest	Prevalence of stunting by age groups of children					
	6-59 months		6-23 months		24-59 months	
	R value	P value	R value	P value	R value	P value
Total under 5 population	0.49	<0.05	0.19	>0.1	0.53	<0.01
% of children reported ill	0.27	>0.1	0.03	>0.5	0.36	<0.1
% of children with diarrhea (incidence)	0.02	>0.5	0.05	>0.5	0.06	>0.5
% of children with vomiting (incidence)	0.38	<0.1	0.15	>0.5	0.41	<0.1
% of children with malaria (prevalence)	0.31	>0.1	0.19	>0.1	0.32	>0.1
% of household with pipe/protected water	-0.52	<0.05	-0.45	<0.05	-0.45	<0.05
% of infants immunized (DPT)	-0.39	<0.05	-0.41	<0.05	-0.29	>0.1
% attending at under 5 clinics	-0.44	<0.05	-0.59	<0.005	-0.26	>0.1
Exclusive breast feeding up to month 8	0.61	<0.005	0.70	<0.005	0.46	<0.05
88_92 average per capita production	0.05	>0.5	0.13	>0.5	-0.03	>0.5
Number of nurses	0.19	>0.1	-0.09	>0.5	0.28	>0.1
Number of health centers	0.48	<0.01	0.34	>0.1	0.44	<0.05
Population per health personnel	0.47	<0.05	0.58	<0.01	0.29	>0.1
Population per health facility	0.60	<0.005	0.45	<0.05	0.53	<0.05

percentage of children with one or more incidences of diarrhea, vomiting, fever, and other illness during 14 days before the survey.

On the other hand, the prevalence of wasting in children was positively associated ($r = 0.44$, $p < 0.05$) with the overall prevalence of illness, including diarrhea, vomiting, fever, and others (data not shown). The association was significantly stronger among younger children of age 6-23 months ($r = 0.44$, $p < 0.05$) than among older children of age 24-59 months ($r = 0.32$, $p > 0.1$). This is because wasting, as an indicator of current acute malnutrition resulting from failure to gain weight or actual weight loss, is very sensitive to the prevalence or incidence of diseases (Carlson and Wardlaw, 1990). There was high correlation between diarrhea and the prevalence of wasting ($r = 0.55$, $p < 0.01$) in children in general. The effect of diarrhea, however, is more closely related to the prevalence of wasting among older children ($r = 0.62$, $p < 0.005$) than among younger children ($r = 0.22$, $p > 0.1$).

Stunting was positively correlated with the distribution of health facilities and the number of health personnel. Reasons for this result might be: (i) a high positive correlation exists between population and the number of health facilities and health personnel, and (ii), population is also highly positively correlated with the prevalence of stunting. In other words, regions with a large population, especially with a large number of children under five years have relatively more health facilities but also have a high prevalence of stunting. As a result these three variables, namely population, prevalence of stunting and health facilities and health personnel were correlated in the same direction. Therefore, the ratios of population to health facilities and health personnel are considered. Population per health facility and per health personnel were positively correlated with the prevalence of stunting ($r = 0.60$ and 0.47, $p < 0.005$ & 0.05 respectively). Percent of children attending under 5 clinics and regional per capita out-

patient visits had negative significant association with the prevalence of stunting ($r = .44$, $p < 0.05$).

The availability of protected drinking water (pipe water) and the lack of pipe water are equally strongly correlated with the stunting conditions, but in different directions, negative and positive associations respectively. An interesting point to be noted is that the duration of exclusive breast feeding (a child care factor) is the only factor that was found to be strongly positively associated with both the prevalence of stunting and the prevalence of wasting.

According to this correlation analysis, association between the prevalences of stunting and wasting was weaker ($r = 0.43$, $p < 0.05$) than the associations between stunting and underweight ($r = 0.82$, $p < 0.0001$) and between underweight and wasting ($r = 0.73$, $p < 0.0001$). This is because underweight is a general malnutrition indicator which can be considered as a summary measure. Therefore, certain variables such as the population parameter and the incidence of illness which were associated with only stunting and wasting respectively were both associated with the prevalence of underweight. In addition, incidences of vomiting and other illness and cases of malaria were also identified as important factors having association with underweight. These variables were not found to be associated to either stunting or wasting.

Determinants of Nutritional Status of Children Under 5 Years of Age

As indicated previously, the findings of this study do not determine any causal relationships. However, it is the aim of the study to identify the existing associations between nutritional status of children and health and socio-economic factors. Summary of the correlation analysis (Table 10) and simple

linear regression and multiple linear regression analyses were used to show the associations between the prevalence of malnutrition and selected health and socioeconomic factors.

From the correlation analysis, six independent variables, that the researcher assumed were important which had significant positive or negative correlation coefficients with the prevalence of stunting ($r > 0.4$ or $p < 0.1$) were selected. The under 5 population, incidence of vomiting, exclusive breast feeding up to month 8, and the ratio of total population to the number of health personnel had significant positive associations, while percent immunization status and availability of pipe water had significant negative associations with the prevalence of stunting. These variables were also tested for any multicolinearity effect in order to fit a multiple regression equation.

Two other variables of interest, five year average per capita grain production and endemic cases of malaria, were included in the first step of the multiple regression analysis. Production per capita was not correlated with the prevalence of stunting in children ($r = 0.045$, $p > 0.5$) in general and with the specific age groups ($r = 0.13$, $p > 0.5$ for 6-23 months and $r = -0.028$, $p > 0.5$ for 24-59 months). The prevalence of malaria had a positive association with the prevalence of stunting ($r = 0.31$), but it was not significant ($p > 0.1$).

Based on the linear regression analysis, prolonged exclusive breastfeeding up to the end of month eight was found to have a high goodness of fit (R^2) of 0.38. On the other hand, after removing the major (statistically significant at $p<0.05$) multicolinearity effects and by fitting a multiple regression analysis the following findings were obtained (Table 11).

An eight variable regression model run on the prevalence of stunting (based on the transformed data from the original percentages using arcsin

square root transformation) predicted 85% ($p<0.01$) of the variability. (See Appendix C for the alternative model, based on the original percentage data). The population parameter and exclusive breast-feeding up to the 8th month of the child's age remained significant ($p<0.05$) determinants in the full eight variable model. All other variables were not statistically significant in the eight variable model.

TABLE 11

SUMMARY OF THE RESULTS OF THE MULTIPLE REGRESSION ANALYSIS: DEPENDENT VARIABLE STUNTING

INDEPENDENT VARIABLES	B-values	F-values	p-values
INTERCEPT	0.685	211.02	<0.0001
PER CAPITA GRAIN PRODUCTION (1988-92 AVERAGE)	0.011	0.68	>0.1
INCIDENCE OF VOMITING	0.018	1.64	>0.1
IMMUNIZATION STATUS (DPT)	0.00037	0.25	>0.5
AVAILABILITY OF PIPE WATER	-0.0014	0.69	>0.1
UNDER 5 POPULATION	0.00026	7.05	<0.05
EXCLUSIVE BREAST FEEDING UP TO THE END OF 8th MONTH)	0.00205	5.98	<0.05
POPULATION PER HEALTH PERSONNEL	0.0016	0.19	>0.5
PREVALENCE OF MALARIA	0.00061	1.82	>0.1

$R^2 = 0.85$ Regression F-ratio = 6.39 => $p<0.05$

The full model for the prevalence of stunting with eight independent variables as determined using backward elimination stepwise regression procedure of the SAS® system is stated as follows:

Stunting = 0.685 + 0.011prodnpercap + 0.018vomiting*
+ 0.00037immuneu1- 0.0014pipewater + 0.00026u5pop**
+ 0.00205excbfmonth8** + 0.0016pop/healthpers
+ 0.00061malaria.

R^2=0.85. Regression F-ratio=6.39**

* = 0.1<p<0.05 ** = 0.05<p<0.001.

Where; Stunting - prevalence of stunting (transformed values of % of children below -2 Z score height-for-age);

Prodnpercap - 5 year average per capita grain production in quintals (1988-92);

Vomiting - incidence of vomiting (% with at least 1 incidence);

Immuneu1 - % of infants fully immunized (DPT);

Pipewater - % of households with (safe) pipewater;

U5pop - total number of children under 5 years old;

Excbfmonth8 - % exclusively breast-fed up to the end of month 8 of a child's age;

Pop/healthpers - Ratio of total population to the number of health personnel

Malaria - prevalence of malaria (% of children with cases).

A backward elimination stepwise regression procedure was preferred, because this procedure allows all the variables to be considered in the model at the beginning. Based on maximum R-square value and/or least-sum-squares, statistically insignificant variables were removed from the model one by one. At the partial significance level of 0.1 only three variables (U5pop, Excbfmonth8, and vomiting) remained in the final model after the fifth step of backward elimination. The model with all variables significant (in the model at the 0.1 level) is as follows:

Stunting = 0.6876 + 0.0245vomiting** + 0.000327u5pop***
+0.00262excbfmonth8***

R^2=0.81 Regression F-ratio=20.06*** *** = p<0.0001

The three variable model has almost equivalent predicting power of stunting as the eight variable model, with a larger F-ratio than the latter. The goodness of fit (R^2) of 81% explained stunting well with a great improvement in the F-ratio from 6.39 to 20.06. This indicates that the three variables explained 81% of the variability in the prevalence of stunting with a 99.99% chance of explaining this amount all the time. Although the findings from the present regional aggregated data indicate only three statistically significant variables as major predictors of the prevalence of stunting in children under 5 in Ethiopia, certain variables still need special attention here.

If the stepwise backward elimination regression model discussed above is examined, it will be noted that the three variables, namely population per health personnel, infant immunization status, and grain production per capita were removed respectively in the first , second and third steps with not much effect on

the R^2 value. Two other variables, availability of pipe water and prevalence of malaria, were removed from the model in the fourth and fifth steps respectively.

According to the present data, pipe water availability and infant immunization status were removed from the models because these variables cover a very small percent of the population. The researcher assumes that there are no inherent problems in these variables as predicting variables in explaining stunting in children except that the variables do not apply to the majority of the data. Had there been a sufficient proportion of the population with access to safe drinking water (pipe water) and a sufficient proportion of infants receiving immunizations, these variables might have explained stunting better than they did in this model. The case with the ratio of population to the number of health personnel may be similar. That is to say the ratio is very large to establish a significant relationship with the prevalence of stunting in children under 5 years of age. The present health care coverage in Ethiopia (about 7,000 people per health personnel in general and more than 20,000 people per physician) may not show a statistically significantly recognizable effect on the nutritional status of children based on the analysis of the national and regional aggregated data.

The other two variables which were not statistically significant in the model (per capita grain production and prevalence of malaria) have different problems. The problem with the average per capita grain production may arise from aggregation. The per capita grain production which is based on regional aggregation of production may obscure the differences between households with low and high per capita grain production. In addition, per capita grain production may not accurately reflect consumption in general and childhood food consumption in particular. As shown in Figures 2 and 3, reduced total and per capita grain production exactly parallels the periods of famines, undernutrition and/or malnutrition in Ethiopia.

The case for the prevalence of malaria is different. The cases of malaria can vary from one region or area to another simply based on the altitude. An analysis based on different altitude groups would have been better, but this is more than the scope of the present study.

As indicated in the stepwise regression analysis, the size of the under 5 population and the duration of exclusive breast feeding are the two most significantly related variables to stunting. On the average exclusive breast feeding begins to become an important detrimental factor by the end of the fourth month. The contribution of prolonged exclusive breast feeding to the prevalence of stunting becomes very important when the duration is extended to month 8 ($p < 0.0001$). The prolonged exclusive breast feeding indicates that food supplementation is introduced very late in most parts of the country. Therefore, the important issue is to identify the appropriate time for the introduction of weaning foods. From the above discussion the fourth month of a child's age may be proposed as an appropriate time for the introduction of solid foods and these foods should not be delayed up to the age of month eight in Ethiopia.

The other important factors highly associated with the prevalence of stunting, in addition to the population parameter and prolonged exclusive breast feeding, are prevalence of illness, especially of vomiting with or without diarrhea; cases of malaria; number of health personnel, especially the number of nurses. These factors are strictly related to the provision of health care including the availability of potable water, community sanitation and health education, or the lack thereof. A lack of support for rural infrastructure as well as a lack of appropriate policies on these issues generally worsen the situation.

CHAPTER VI

SUMMARY AND POLICY IMPLICATIONS

It was clearly indicated in the analysis of this study that the present nutrition situation in Ethiopia is worse than a decade ago. This very poor nutrition condition of the country is highly associated with the lack of appropriate child care and feeding practices, with the population pressure, with poor health, sanitation, and water conditions, and with poor performance of domestic production.

The nutritional status indicators as well as the associated health and socioeconomic factors were found to be significantly different among the regions of the country and across the various agricultural systems and socioeconomic groups. Moreover, these factors were significantly different by gender and by major age groups of the children.

The poor nutrition, health and economic situation of the country are generally expected to continue to deteriorate under the present rates of population and production growth and other prevailing conditions. To reverse the situation, the government of Ethiopia in general and the policy makers in particular should take immediate action to design and develop short-term and long-run polices and programs. Although, it is very difficult to forward policy conclusions from this study, nor is it appropriate, the following issues can be considered for the development of short-term and long-run food and nutrition programs and polices as depicted in the following schematic model (Figure 9).

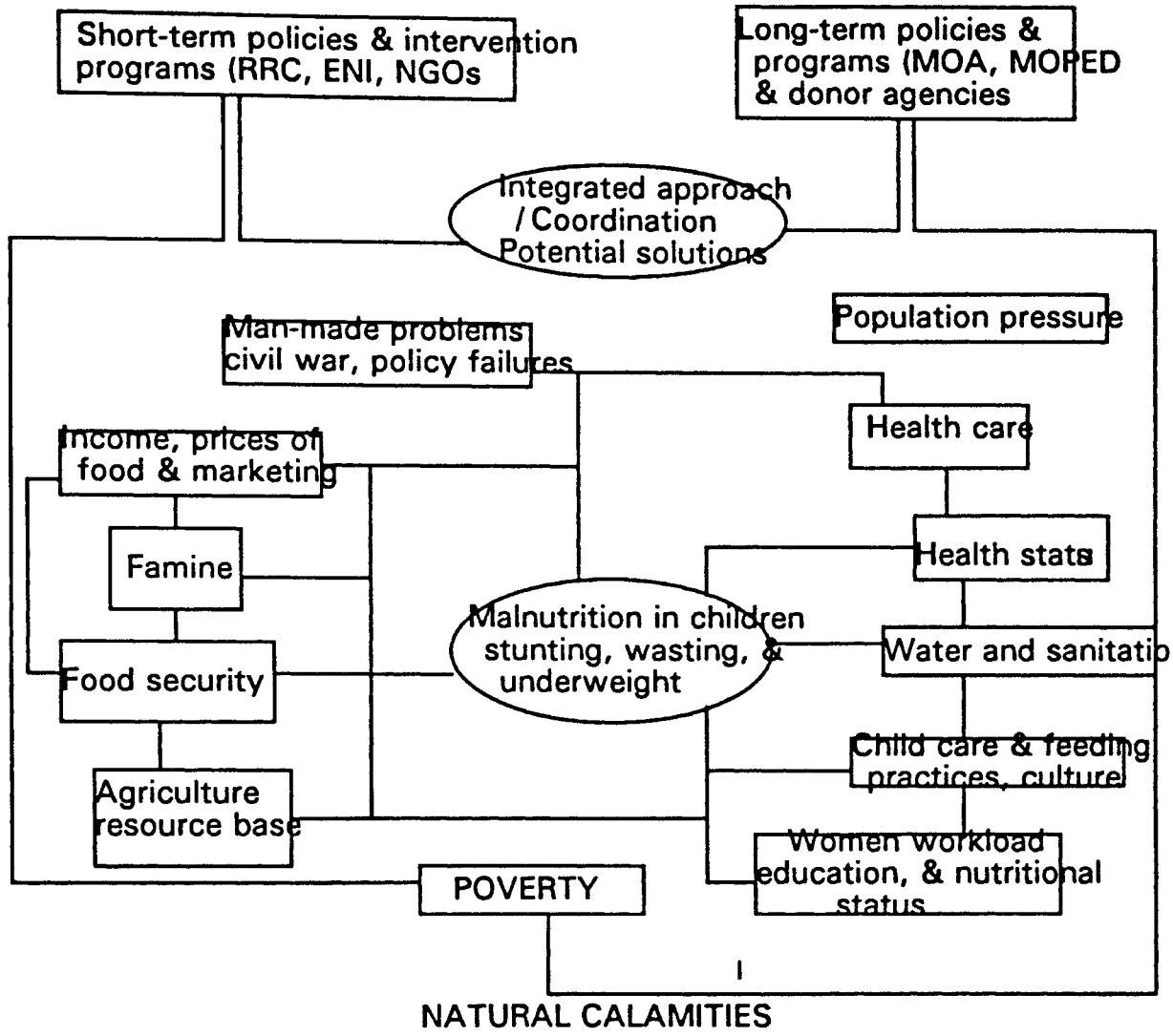

Figure 9. Schematic presentation of the relationships of various independent variables to the prevalence of malnutrition in children, indicating possible interactions and policy issues.

The problems of food insecurity, poor health status and the prevalence of malnutrition are very closely associated in affecting the general well-being of children in Ethiopia. Malnutrition in children as a core dependent factor, as

shown in Figure 9, can be caused by a number of underlying and immediate factors including poor health status and related factors such as infectious diseases, poor water and sanitation, food insecurity, improper child care and feeding practices, lack of appropriate policies and coordination among the responsible institutions, and, needless to mention, the population pressure.

Implications for Food and Nutrition Policy and Planning

The underlying factors and immediate causes of malnutrition including food insecurity and poor health status are not without solutions. The problem in the past was that policy makers, program designers and project implementers tried to solve the problems of malnutrition and food insecurity separately. In Ethiopia the MOA, the MOPED and international donor agencies were concerned about food self-sufficiency as the basic strategy, without direct concern to how the nutritional well-being of the population could be attained. On the other hand, the ENI, the RRC, and international food aid providers concentrated on solving malnutrition and providing relief, while the MOH was primarily dealing with long-tem and short-term health issues. Despite these efforts, as indicated in this study, the food security situation is becoming worse and the malnutrition problem is becoming more serious.

This study suggests coordination between these two groups of institutions, specifically coordination in their policy planning, project analysis and development options, so that efforts can be integrated to alleviate the problems of malnutrition and food security at the same time. The nutritional objectives must be explicitly included in this integrated approach.

There may be at least two important conditions for the explicit consideration of nutritional goals in national policies and in agricultural and rural develop-

ment planning and project analysis. The first of these is the need to have a system by which the causes, extent and nature of the nutritional problems can be identified. A system is needed to link the information on the nutritional problems to the policy makers and planners. This gap can be filled by a system of surveillance of the nutritional status of the population. The 'Nutritional Surveillance System' (first recommended by the 1974 World Food Conference) can provide the information needed for policies and programs that would lead to nutritional improvements, by monitoring the food and nutrition conditions of the population, especially of those at risk (Mason et al., 1984).

This particular system, the Nutrition Surveillance System, was not appropriately defined under any institution in Ethiopia. There must be a 'National Nutrition Surveillance Unit', the responsibility of which is to organize and coordinate concerned institutions to alleviate the food and nutrition problems of the country within the frame work of the integrated approach. Under the integrated approach, increased domestic staple food production, together with appropriate agricultural input prices as well as product price policies should be considered. As indicated in the NFNS, increased production, to attain the level of food self-sufficiency, must be given another chance within the integrated framework. Input price subsidies and production incentives are the best options to increase food production in Ethiopia. To insure that the increased production is in the interest of the poor, the needy ones, infrastructure development, marketing and distribution facilities should be planned for right at the beginning.

The second condition is the inclusion of evaluation and impact analysis as an integral part of the policies, planning processes and projects. Without an impact analysis, it is difficult to identify the net economic and nutritional changes attributable to the proposed and implemented policies and projects.

Once we have identified base-line information and projected future trends and policy decisions, and once we have feedback and analysis of results, any set of policies, projects and their relation to each other and to nutrition can be considered. One area of explicitly considering nutritional objectives in national and sectoral policies is changing and/or modifying those policies which are directly and indirectly related to nutrition so that they can address the problems of food security, purchasing power, and nutritional status of the vulnerable groups of the society. In addition, these policies should be integrated with each other and with nutrition, health and human development policies. For instance, agricultural policies and programs that resulted in agricultural production and hence income, should consider the distribution effect of the real income generated as a result of these policies and programs.

The agricultural policies and rural development programs can be modified to influence nutritional status through their impact on food availability. Policies also can be modified for positive influence on ability of households to acquire food; household food acquisition behavior; and food distribution and utilization within the household. In general we need to identify the nutritional problems, the population groups at risk and then target nutrition services and nutrition related agricultural policies and rural development projects by region, population group, income levels and season of the year.

The findings of this study can provide preliminary information in this regard. For instance, the prevalence rate of stunting in Ethiopian preschool children, particularly in the Northern regions, in children aged 12-23 months old, and in coffee growing areas was identified as one of the worst rates in the world. This can make policy makers aware of the extent and nature of the malnutrition problem and alert them for priority setting.

The main nutritional problem of the country is chronic malnutrition, however, because of the scarcity of resources, both human and capital, it is necessary to set priority actions. A major emphasis can be given to regional considerations. For instance, the four relatively nutritionally deprived regions (Gonder, Gojam, Tigray and Wollo) must be considered for priority actions. These regions have many things in common. The most important contributing factors to the high prevalence of malnutrition in these regions appeared to be prolonged exclusive breast feeding and high prevalence of diarrhea and vomiting.

Low per capita production is a common factor for Tigray and Wollo. There are underlying causes for the very serious problems in these regions. Extreme land degradation (soil erosion and deforestation over several centuries especially in the case of Tigray and Wollo) and the resultant lack of rain and the frequent droughts are the most important factors.

Giving priority to the provision of agricultural inputs and credits, increasing the number of health professionals and their budget along with appropriate health and nutrition education should be considered for short-term actions. Developing a non-traditional intermediate technology oriented farming system should be a long-run goal, if the nutrition, health, and economic status of these northern regions has to improve. This is because the Tigray-Wollo sub-region can no longer depend on and wait for seasonal rainfall.

Another issue of interest is the difference in nutritional status between the younger (6-23 months) and older (24-59 months) age groups. The problem of weaning must be considered for both short-term and long-run policy development. Nutrition and health education programs should incorporate immediate actions towards the appropriate supplementation starting at 3-6 months of a child's age. At the same time, long-term actions and programs must include the

necessary consideration for the development of appropriate weaning foods based on locally available products.

These activities must be coordinated under one centrally and yet freely operating organization, a 'National Nutrition Surveillance Unit', which may include professionals and experts from those institutions that deal directly or indirectly with nutritional health of the population. These institutions may include the Ethiopian Nutrition Institute, the Central Statistical Authority, the Relief and Rehabilitation Commission, the Food and Nutrition Unit of the Ministry of Planning and Economic Development, the Ministry of Agriculture and the Ministry of Health.

In general, for any success to be seen in Ethiopia, the government, regardless of its form or power source, military or elected, should be able to keep peace and stability. The issue of peace and stability is very important at the national as well as at the household level. Policy makers need an appropriate political environment to immediately and honestly design policies and programs. The peasants, the main source of food for consumption in Ethiopia, as household or as communities need peace and stability to cultivate, harvest and sustain production.

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APPENDIX A

PRODUCTION OF MAIN GRAINS IN ETHIOPIA '000 TONS
(1960/61 - 1991/92)

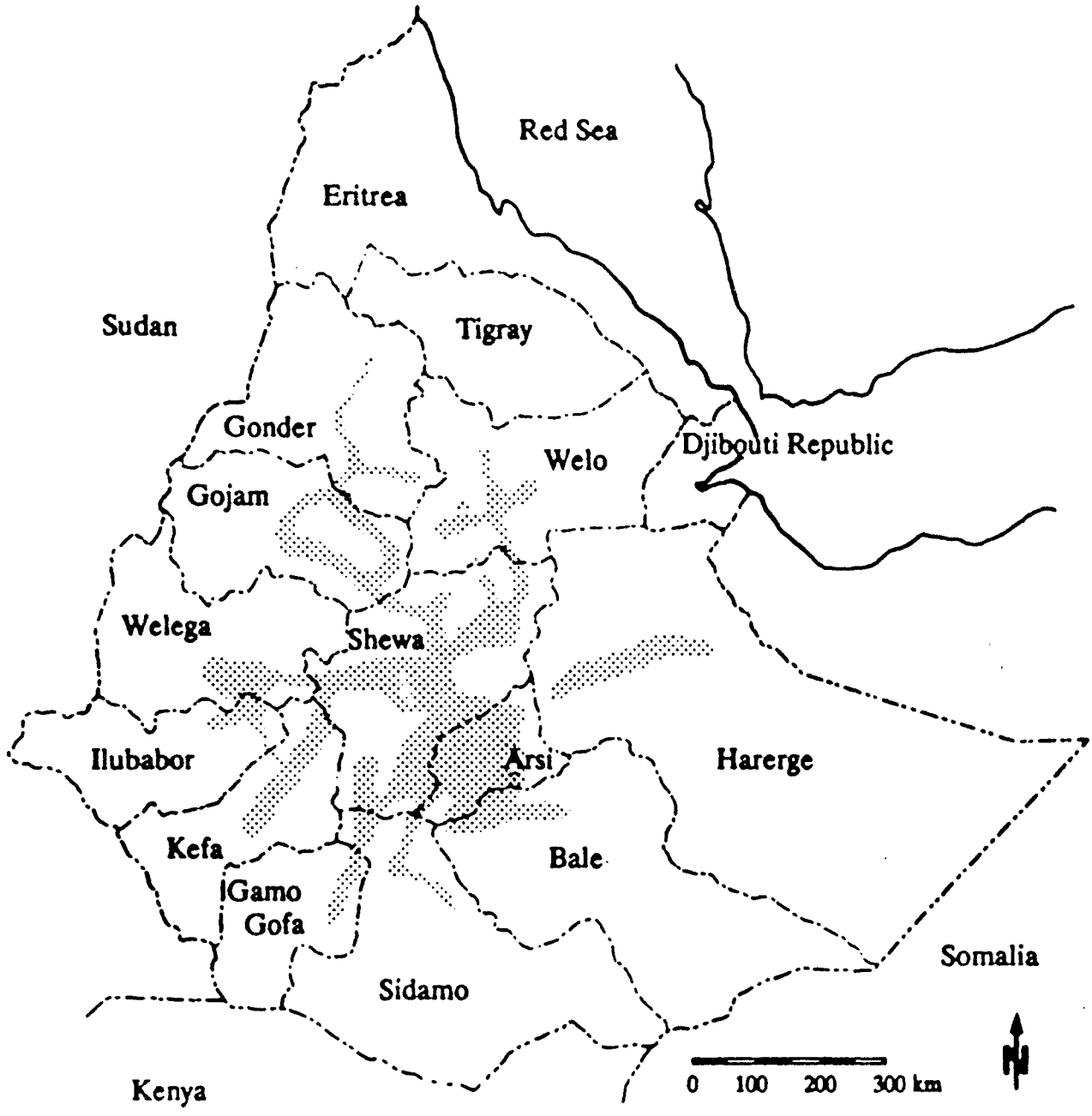
YEAR	TOTAL PRODUCTION	CEREALS	PULSES	OIL CROPS
1960/61	5381.00	4530.00	520.00	331.00
1961/62	5470.20	4607.00	527.20	336.00
1962/63	5568.50	4694.00	535.20	339.30
1963/64	5889.30	4979.10	548.70	361.50
1964/65	5914.20	5002.90	554.70	356.60
1965/66	6077.50	5136.30	568.50	372.70
1966/67	6285.10	5320.10	580.60	384.40
1967/68	6491.60	5486.80	593.60	411.20
1968/69	6651.20	5608.00	609.40	433.80
1969/70	6838.50	5751.90	628.30	458.30
1970/71	6873.90	5736.80	650.70	486.40
1971/72	7088.00	5895.10	676.60	516.30
1972/73	5168.90	4363.00	579.10	226.80
1973/74	5167.60	4337.30	593.10	237.20
1974/75	5177.90	4419.50	618.10	140.30
1975/76	6561.40	5857.80	555.90	147.70
1976/77	4842.72	4184.49	615.35	42.88
1977/78	4534.12	3975.09	508.25	50.78
1978/79	5103.62	3905.19	1152.45	45.98
1979/80	7304.80	6221.24	997.56	86.00
1980/81	6369.74	5435.11	835.69	98.94
1981/82	6105.44	5218.19	807.98	79.27
1981/83	7614.59	6542.97	953.06	118.56
1983/84	6145.82	5351.51	698.91	95.41
1984/85	4664.52	4064.54	499.59	100.39
1985/86	5212.88	4644.68	469.89	98.31
1986/87	6493.26	5837.37	568.58	87.31
1987/88	7001.34	6337.91	579.74	83.69
1988/89	6607.37	5934.51	591.54	81.32
1989/90	7126.94	6352.05	674.77	100.11
1990/91	7972.55	6601.74	1039.96	330.86
1991/92	6269.71	5476.19	674.06	119.46

Source: CSA, 1987: Time series data; CSA, 1990, 1992: Sample Survey; CSA, 1992: Production Forcast

Note: Production of Eritrea was not included starting 1976/77 in the above data.

APPENDIX B

MAP OF ETHIOPIA INDICATING THE ADMINISTRATIVE REGIONS



Source: Pausewang, S., Fantu C., Stefan B., and Eshetu C. (1990)

APPENDIX C

AN ALTERNATIVE MODEL FOR THE REGRESSION ANALYSIS

The following model is based on the Original data, percentages, which are not transformed using arcsin square root transformation, as in chapter five of this study. An eight variable regression model (per capita grain production, incidence of vomiting, immunization status, availability of pipe water, number of children under 5, duration of exclusive breast feeding, population per health personnel, and prevalence of malaria) run on the prevalence of stunting predicted 85.8% ($p<0.005$) of the variability. The population parameter and exclusive breast-feeding up to the 8^{th} month of the child's age are the significant ($p<0.05$) determinants in this eight variable model. All other variables were not statistically significant in the model.

Stunting = 40.3 + 1.061prodnpercap + 1.8vomiting + 0.037immuneu1
- 0.134pipewater + 0.0253u5pop** + 0.194excbfmonth8**
+ 0.156pop/healthpers + 0.059malaria*.

Where; Stunting - prevalence of stunting (% of children below -2 Z score height-for-age);

Prodnpercap - 5 year average per capita grain production in 000 quintals (1988-92);

Vomiting - incidence of vomiting (% with at least 1 incidence);

Immuneu1 - % of infants fully immunized (DPT);

Pipewater - % of households with (safe) pipewater;

U5pop - total population of under 5 years old;

Excbfmonth8 - Exclusive breast-feeding up to end of month 8;

Pop/healthpers - Ratio of total number of population to the number of health personnel

Malaria - prevalence of malaria % of children with cases.

R^2=0.858. Regression F-ratio=6.8**

* = 0.1<p<0.05 ** = 0.05<p<0.001.

A backward elimination stepwise regression procedure was performed, because this procedure allows all the variables to be considered in the model at the beginning. Based on maximum R-square value and/or least-sum-squares, statistically insignificant variables were removed from the model one by one. At the partial significance level of 0.1 only three variables (U5pop, Excbfmonth8, and vomiting) remained in the final model after the fifth step of backward elimination.

Stunting = 40.59+2.41vomiting**+0.0319u5pop***+0.253excbfmonth8***

R^2=0.82 Regression F-ratio=21.21*** *** = p<0.0001

The final three variable model has almost equivalent predicting power of stunting as the full eight variable model, with a larger F-ratio than the latter. The goodness of fit (R^2) of 82% explained stunting well with a great improvement in the F-ration from 6.8 to 21.21. This indicates that the three variables explained 82% of the variability in the prevalence of stunting with a 99.99% chance of explaining this amount all the time. Although the findings from the present aggregated data indicate only three statistically significant variables as major predictors of the prevalence of stunting in children under 5 in Ethiopia, other variables are also considered important.

If the stepwise backward elimination regression model discussed above is examined, it will be noted that the three variables, namely pop/healthpers, infant immunization status, and average per capita production were removed respectively in the first , second and third steps. The other two variables (availability of pipe water and cases of malaria) were removed in the fourth and fifth steps respectively. The order in which these variables removed from the model is the same in the model which uses arcsin square root transformation.

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