ADDIS ABABA UNIVERSITY
RESEARCH AND GRADUATE PROGRAMS OFFICE
REGIONAL AND LOCAL DEVELOPMENT STUDIES

The Role of Irrigation Development in Enhancing Household Food Security: *A Case of Three Small-Scale Irrigation Schemes in Southern Nations, Nationalities and Peoples' Region.*

By
Nigussie Taffesse Henkaro

Addis Ababa

May 2002

ADDIS ABABA UNIVERSITY
RESEARCH AND GRADUATE PROGRAMS OFFICE
REGIONAL AND LOCAL DEVELOPMENT STUDIES

The Role of Irrigation Development in Enhancing Household Food Security: *A Case of Three Small-Scale Irrigation Schemes in Southern Nations, Nationalities and Peoples' Region.*

A Thesis Presented to the School of Graduate Studies, Addis Ababa University, in partial Fulfillment for the Degree of Master of Arts in Regional And Local Development Studies

By
Nigussie Taffesse

APPROVED BY BOARD OF EXAMINERS:	SIGNATURE
1. Tegegn G/ Egziabher (PH D) Chairman, Graduate Committee	
2. Dagnew Eshete (PhD) Advisor	
3. Yared Amare (Ph D) Internal Examiner	
4. Mulat Demeke (Ph D) External Examiner	

ACKNOWLEDGEMENTS

*"**How can I repay the Lord for all his goodness to me?**" Pls.115: 12 NIV*

First and foremost, I would like to thank God for his kindness all the way to the completion of this work. Secondly, I am very thankful and dedicate this report to my organization, Co-SAERSAR for its continuous support and encouragements. Very much thanks to The Netherlands Government, AAU-RLDS and its staffs for their assistances and encouragements during our stay in the campus.

I acknowledge, with great thanks, my dear advisor, Dagnew Eshete (PhD) for his sincere concern to my success and effort made from the time of proposal to finalization of this work. I would like to take this opportunity to express my appreciation and witness that he is dependable consultant with rich experience in development consultancy and research practice.

I am also thankful to my mother Kebebush Soboka for her kind material and prayer support as well during my study. Many thanks to my colleagues Ato Tesfaye Wolde, Ato Anteneh Gulilat, Ato Kasahun Argew and Ato Desalegn Worku for their deep concern to take care of the continuations of my study. My friends Ato Taddesse Fantaye, Abera Abebo, W/ro Worke Matewos and El-Shaddaai Evangelical outreach ministry for their material support and advice during my study.

I would also like to thank Ato Tsegaye Gudisso, Ato Tagesse Sugebo, W/ro Martha Baddi and W/rt Yeshemebt Demissie for their devoting valuable time for editing and typing the manuscript.

Last, but not least, I would like to express my indebtedness to my sisters W/ro Zenebech Taffesse, W/ro Emabet Mekonnen and W/rt Genet G/Michael for their material support and concern for my success and well-being. Thanks are owed to all individuals involved in this research mainly enumerators (Negalign Bobas, Filimon Daka, Tesfaye Anjulo, Lukas Qabule, and Thomas Fancho) and all households and key informants who participated kindly in giving valuable information. Regional Investment Office, DPPB, POBED, and Planning and Programming Service of the COSAERSAR deserve gratitude.

Nigussie Taffesse
May 2002

TABLE OF CONTENTS

List of Tables

List of Figures

Maps

ACRONYMS

AEZ	Agro-ecological Zones
Co-SAERSAR:	Commission for Sustainable Agriculture and Environmental Rehabilitation in Southern Administrative Region
FFS	Federal Food Security Strategy
WFP	World Food Program
FAO	Food and Agriculture Organization of the United Nations
WB	The World Bank
Ha	Hectares
HYV	High Yielding Varieties
ITK	Indigenous Technical Knowledge
USD	United States Dollars
HH	Household
SNNPR	Southern Nations Nationalities and Peoples' Region
PA	Peasant association
FAO	United Nations Food and Agriculture organization
O & M	Operation and Maintenance
MWR/MoWR	Ministry of Water Resources Development
MOA	Ministry of Agriculture
NGO	Non-Government Organizations
SSI	Small-scale Irrigation
MSI	Medium-scale Irrigation
LSI	Large-scale Irrigation
Masl	Meters above sea level
Ml	milliliters
WADU	Wolayita Agricultural Development Unit
AWTI	Arbaminch Water Technology Institute

ABSTRACT

This study examines the use of irrigation development for food security through its impact on food availability, access and diversification. Its main objective being the study of impact of irrigation on household food security, the research focuses on how irrigation is used to change households' decision on food production (e.g. cropping pattern), food supply volume, access to them, and their utilization.

Household survey and fieldwork observation were used to collected data at community, household and individual levels. Data related to area under cultivation, agricultural intensity, household wealth status and cropping pattern related data were collected using structured questionnaire, by using locally recruited and trained enumerators. Study areas' background characteristics, attitudes of government employees and farmers towards irrigation and other related data were accessed from line offices and implementing agencies. The analysis is undertaken using statistical tools such as percentage values and chi-square tests, on top of qualitative analysis.

The findings of this study highlight the positive impact of irrigation as it could bring increased agricultural production and productivity, better access of female members to income, and improved wealth status in the area. Food security situation is enhanced as a result of livestock and its products' increase, agricultural crop diversification, agricultural intensification and enabling more labour engagement in farm activities. Cropping pattern decisions are also changed due to existence of irrigation, resulting in generating more income and access to marketable food.

It is also observed that households with access to irrigation have been able to double their yearly harvest, thereby improving their access to more food. Similarly, irrigators could improve their diet composition due to diversified food sources. Women in the study area have been able to save time from domestic activities and contribute to farm activities in addition to improved access to agricultural products in the long run. Finally, small-scale irrigation development and rehabilitation of non-operational schemes with pertinent, participatory planning and equipped operation and maintenance system is suggested for reducing food insecurity situation of the region.

Chapter One

INTRODUCTION

1.1 Aim and Scope of the Study

This research is aimed at examining the contribution of irrigation in poverty reduction in general, and food security in particular in three Peasant Associations (PAs) of different *woredas* in the Southern Nations, Nationalities and Peoples' Region (SNNPR).

Food insecurity is the most pressing current challenge of the world communities at large and of the study area in particular; and resource potential of most of these food insecure countries is plenty. Therefore, it attracts the attention of development actors to know ultimate impact of irrigation development. It is also crucial to think about the ever-increasing food deficit in the region in relation to the use of existing water resource potential and important to explore whether irrigation is helping in reducing the food insecurity problem or not.

Agriculture: both crop production and livestock husbandry, is the main means of livelihood for the population in the region under consideration. Farming is totally dependent on rain-fed agriculture; and '*meher*', (a season from June to December) is the dominant season of production in most parts of the region. Unfortunately, agricultural production and its productivity in most parts of the region have been severely affected by the recurrent drought and erratic nature of rain. As a result, there is an increasing decline in the food supply status of the people.

However, the scope of this work is narrower than the above discussions and concentrates on the study of relationship between households' food security and irrigation development in

three schemes. Viz. Bissare, Lebu and Weyibo small-scale irrigation (SSI) schemes. The study area covers these three sample irrigation schemes in SNNPR. Its greater part lies in arid and semi-arid climatic zones. It also assesses the impact of irrigation development brought on the life of community and its level of affecting their living conditions and arrives at relevant conclusions and suggestions.

1.2 Justifications of the Study

Irrigation could serve as a viable solution to address the problem of food insecurity by increasing, boosting agricultural production. Based on this premise, in Ethiopia and in other parts of the world, large, medium and small-scale irrigation schemes have been constructed and made available for increasing agricultural production and productivity.

Development researchers have emphasized that irrigation enables to increase income for farmers, create employment opportunities and increase foreign exchange earnings (Desalegn 1999:9). However in many parts of Africa and in Ethiopia, most of the areas intervened by such infrastructure development are still being reported to be suffering from shortages of food supply.

The Southern Africa Development (SADC) report in 1992 (in FAO, 2000) indicates that most new smallholder irrigation schemes in the Southern Africa region could not cover the cost of development and operation, and hence considered uneconomic. It is indicated that they have a negligible impact on the national and household food security. However, contrary to this argument, Food and Agriculture Organization (FAO), (1997c: FAO, 2000) pointed out that many Sub-Sahara African (SSA) countries have realized the critical role of irrigation in food production.

Desalegn (1999:43) also noted that even though all the irrigable land is used for food crop production, the significance of its impact on food security couldn't be very high. However, costs of such projects are huge and must be justified by the value of their return. Thus, it is imperative to examine the importance of irrigation development in the context of the areas chosen.

1.3 Research Objective and Hypothesis

1.3.1 Research Objectives

Based on the research problem and justification stated above, the primary objective of this study is to examine the relevance of irrigation development in addressing the problem of food insecurity in the SNNPR by taking three case study areas, namely: Bissare, Lebu and Weyibo Small-Scale Irrigation (SSI) schemes. The specific objectives of the study include:

- Assessment of irrigation development in enhancing food production and household food security;
- Assessment of the perception of people towards the contribution of irrigation;
- Identification of the ways by which irrigation development affects food security in terms of food availability, access, product diversification and temporal and spatial distribution and
- Investigation of factors affecting the effectiveness of irrigation development.

In order to accomplish the aforementioned study objectives, the following research questions were designed.

- Could irrigation increase land productivity?
- In what ways irrigation enables to increase land productivity?

- Is there any change noticed in food production diversification, production pattern and food supply at household level due to irrigation?
- Is there any noticeable change in the marketable food supply to the near-by markets?
- Do irrigation development activities affect cropping pattern and producers' preference in crop types selection?
- Are there any other factors, which could negatively affect household food security in the study areas? If so, what is the magnitude of the problem?
- Assessing whether there is a significant difference in the level of food production and supply between beneficiaries and non-beneficiaries of the irrigation schemes or not.

1.3.2 Hypothesis

Based on the prevailing theories and knowledge, the hypothesis for this research is that there is a positive relationship between irrigation schemes development and the improvement of household food security. Thus, the effect and trend of irrigation development in enhancing household level food availability, access and utilization/diversification is tested by this study.

1.4 Methodology of the Study

To address the exiting debate and explore supporting evidence regarding the role of irrigation development in enhancing food security, relevant literature of the previous works and research findings, secondary information source, data are used. Moreover, the researcher's practical experience, as a staff member of Commission for Sustainable Agriculture and

Environmental Rehabilitation in Southern Administrative Region (Co-SAERSAR), and his knowledge in these study areas have also been relevant.

Accordingly, the study methodology applied includes both sample survey to collect primary data from study areas, and review of previous research findings and relevant literatures in the area of concern. In order to meet the study objectives, sample survey method is used in the chosen study areas. Therefore, structured and semi-structured questions were used as guide. In the questionnaire designing process, variables used as indicators are defined for this text as follows:

- Wealth status: is used as a measure of a households' income. Its relationship is that the wealthier the households the more access they have to marketable food supply.
- Agricultural intensification: is related to the number of production harvests in a year from a given plot of land.
- Food diversification: is a process of increasing product diversification and dependable family food supply or food security.

1.4.1 Research methodology

It is found to be valuable to apply sample survey method with the aim of increasing the representative-ness, reliability and validity of the study findings; and the need of both qualitative and quantitative data dictated the need for conducting a fieldwork. To this effect, semi-structured interviews questionnaire based discussions were made with key informants and group discussions were held in every selected study area. The key informants contacted include: experts, early warning division head, bureau head, and public relation staff from the regional Disaster Prevention and Preparedness Bureau (DPPB), irrigation engineers,

geologists, plan and program service head, study and design department head, and site managers from CO-SAESAR. Moreover, *Woreda* Administration heads, Agriculture Office staff and irrigation experts were also contacted.

Moreover, pre and post intervention situations were inquired for some relatively new or lately started projects (schemes). Baseline data before intervention have been accessed from implementing agencies. Meteorological information was gathered from relatively near stations, such as *Butajira* and *Hossana*. Secondary data about various characteristic of the region and study area were collected from The Regional Planning and Economic Development Bureau (BOPED).

As a part of the sample survey approach, fieldwork observations and group discussions were conducted with key informants and beneficiaries. During sites visits, the living conditions of sampled households and farms were observed; and appropriate discussion was made. The crops and livestock production activities and their outputs were observed at field site level; and on the fields, canals structures and surrounding market places were also assessed.

1.4.2 Sample Selection Methods and Procedures

To compare the economic and food security status of beneficiaries with non-beneficiaries, three Peasant Associations (PAs) were selected from different zones. Due to the nature of the study, the technique of area sample selection is purposive. With this intention, sample study objects were selected from three PAs of sample *Woredas*. Zones were also purposely selected based on their availability of irrigation schemes; and the same did apply for *Woreda* selection within the sample Zones. Among PAs, which have irrigation scheme(s), three of them were selected according to the pre-established procedure.

1.4.4 Limitations of the Study

This work had a number of limitations in the process of data collection, sample selection and in getting access to the selected sample areas. One of the limitations is the difficulty in getting proper responses from sample respondents concerning income level directly because respondents are not willing to give true information by relating to aids, despite all the efforts made to alleviate the problem.

The other problem, which posed significant pressure on the study, was the existence of the irrigation schemes in inaccessible areas of the region. At the same time selected respondents at Bissare SSI are not living near their irrigated farm lands due to the problem of recurrent drought.

Moreover, the vastness of the region, remoteness of the selected sample study areas from one another, limited time; poor transportation system and fund shortages were some of the limitations during the work.

1.4.5 Organization of the Paper

This paper contains five chapters. The first chapter describes the aim and justifications of the study together with the methodology. The second chapter deals with the provision of contextual and specific study areas background information in relation to the study objectives. The third chapter comprises a review of the relevant literature; and the fourth chapter presents the study findings. The fifth chapter presents the conclusion and suggestions.

By applying the above procedure, a total of 120 households were selected from a population of 2,110 households, 60 households from a total of 522 irrigator households and 60 households from non-beneficiaries. In Bissare SSI of Elo- Erasho PA out of the designed 120 irrigators and 247 non-irrigator households, 20 households each were selected randomly. In Lebu SSI of the Kella PA, out of total 360 households, 20 irrigators and 20 non-irrigators were taken randomly, and similarly, in Weyibo SSI, in Metela Embecho PA, 20 households each from irrigators and non-irrigators were chosen respectively.

1.4.3 Data collection and Analysis

Data from sample households selected from sample frames (i.e., PAs) were collected using pre-designed, structured and semi-structured questionnaire.

Both quantitative and qualitative data collected through sample survey were entered to the computer directly since some of them had been pre-coded, and some were entered after coding. Subsequently, the quantitative survey data have been analysed using Statistical Package for Social Scientists (SPSS). For data analysis, the following analysis instruments are used:

- Percentage values; and
- Chi-square test statistics.

The qualitative data has also been used to explain the relationship between the variables.

The findings of the survey data are discussed together with the qualitative information collected using semi-structured interviews of key informants and from group discussions. In the concluding section, issues were discussed critically on the basis of arguments raised in the review section and during research process. Finally concluding remarks have been presented.

For every selected sample size of irrigation scheme beneficiaries, equivalent sample sizes of non-irrigators (areas that have similar economic, cultural, agro-climatic characteristics but varying only in access to irrigation water) were selected as control units.

Accordingly, two zones were selected from a total of 12 zones of the region, based on their demographic, agro climatic, and economic activities and existence of SSI schemes. Wolayita Zone is selected for its known high population density and hot climate. Gurage Zone is selected from central (moderately hot) part of the region. Similarly, from Wolayita Zone, Damote Woyide and Boloso Sore woredas were selected and Sodo Woreda from Gurage Zone, by considering their peculiar characteristics namely: location, demographic concentration, agricultural practice and related economic activities.

Sample Selection Procedures

Households were selected according to pre-established procedures. The procedures implemented were:

a. Obtaining list of households (sample frame) of both irrigators and non – irrigators from the selected sample PAs;
b. Determining sample size to be surveyed and finding ratio of sample to population;
c. Picking the first sample household randomly, and applying the ratio/ interval systematically;
d. Female-headed households were identified and selected purposely with the aim of promoting gender sensitiveness of the research.
e. Stratifying or clustering study population into income groups based on local wealth indicators and assigning proportion to each group; and

Chapter Two

STUDY AREAS

2.1 Introduction to the Study Areas

As a contextual background, general description of the region in which the study areas are located is introduced in this section. The Southern Nations Nationalities and Peoples Region (SNNPR) is located in the south western part of Ethiopia; bordering with Kenya in the south, Sudan Republic in the south-west, Gambella Regional State in the west and Oromia in the north and east.

The rainfall situation is generally, erratic and low in most parts of the region. The last ten years record shows that, only 24.6% of the region gets annual rainfall of more than 1600 mill metre (BOPED, 2001)

According to the Central Statistics Office (CSA), population size reached 11,064,818 with its growth rate above the country's average. The urban population growth rate is 5.3% per annum whereas that of rural is 3.3%.

As far as culture is concerned, it is so diversified due to existence of various ethnic groups with their own peculiarities such as ethnic diversity. The difference is observed to pose challenges on the development efforts since each and every intervention needs the consideration of cultural backgrounds of the specific recipient area so as to ensure the efficient utilization of the facilities provided.

Lowlanders have generally pastoral culture, and tie their lives with cattle husbandry, while

highlanders are settled farmers, depending on farm production as a major source of their livelihood security. Farming culture and resource conservation practices vary from place to place.

The wide range of agro-ecological conditions permit a variety of farming systems, characterizing the regional agriculture. Cereals are predominantly produced in the region, while root crops like *Enset*, Cassava, Yam, Taro and Sweet potato have a significant role in the economy of the region. Coffee, cotton and spices production are among the major farming activities carried out for cash earning in some parts of the region.

As a result of the existing big agro ecological differences, there are different farming systems which range from traditional to modern practices, but at varying scale of coverage from the use of simple traditional hoe, and draught oxen power to the use of tractors in the region. As stated earlier, there are two farming and hence harvesting seasons in the region, '*Meher*' as a major production season and the other being '*Belg*' (small rainy season).

The region under study is sufficiently enriched with water bodies, which can be used for irrigation on top of their other possible uses. As far as their irrigating potential and hydraulic discharge is concerned, they are said to be huge and adequate enough to serve all the required demands: for hydropower, drinking, transport, and for agricultural. The regional assessment and economic profile indicate that the irrigation potential of the region is so immense. It is also recommended that these potential can be used to cope with the prevailing food shortage problem in the region (SNNPR, 1997); (For details see Appendix)

As regards the specific sample study areas of the region, some specific characteristics of respective sample PAs/woredas where irrigation schemes are located, are described below.

2.2 Specific Study Areas

2.2.1 Bissare Small-Scale Irrigation Scheme

Bissare Small-Scale Irrigation (SSI) is located in Wolayita Zone, Damot Woyde Woreda, about forty kilometres south of Wolayita Sodo town. Bisare is found at about 12 kilometres from the capital of the Woreda called Badessa.

a) Location, Agro-climate and Demographic Characteristics

Damot Weyde woreda is one of the woredas in North Omo Administrative Zone that have frequently been affected by drought in the past and present. The agro–ecology of the Woreda comprises 60% and 40% '*woina dega*' and '*kolla*', respectively, in terms of aerial coverage. The altitudinal variation ranges from 1100-2300 m.a.s.l. According to the Woreda Agricultural Office, the sample Woreda has an arable land of 52,830 ha out of which 47,480 ha is under cultivation while the rest 5,350 ha is potentially cultivable land.

b) Economic Activities

Agriculture: agriculture is the main livelihood source for the people of the Woreda with primitive way of farming practices. Crop production has a paramount importance to the farming community; while other activities like animal husbandry, apiculture, and tree planting are practiced along with crop production. Crop production, however, is confronted with complex problems and crop yields are very low. Being one of the Woredas included in the priority areas, Co-SAERSAR has constructed small-scale irrigation scheme in Elo-Erasho PA, and its name (which is taken from the name of the river) is Bissare.

The beneficiaries of this irrigation scheme are the farming community of Elo-Erasho (previously called Chibsa) peasant association. They have direct and indirect benefits from the

injection of the implemented schemes as a development strategy. The project has the capacity to irrigate a total area of 150 ha. Out of this area, 100 ha enable the farmers get one reliable harvest through irrigation, and on the remaining 50 ha only irrigation has been proposed due to moisture stress. This enabled to make sustainable agricultural production for about 600 family heads at full development.

2.2.2 Lebu Small-Scale Irrigation (SSI) Scheme

a) Geographical Location

Lebu is located in Sodo Woreda, on the Addis Ababa - Butajira road, at a distance of 110km south west of Addis Ababa. Sodo is one of the Woredas of Gurage Zone. Bui is at an elevation of 1960 masl and geographic co-ordinates of 38^{O} 33' E, longitude, 8.19' N latitude.

b) Agro-Ecology

The Woreda is characterized by *Dega* (49%) and *Woina Dega* (51%) climatic conditions. The topography of the Woreda is 40% plain, 7% mountainous, 30% undulating and 23% valley land and its mean annual temperature is 12.5^{O}c and, mean annual rainfall ranges from 800 mm to 1,240 mm, based on the Woreda Agricultural Office and Soil Conservation Research Project (SCRP).

c) Demography

Household size and Farm land Holding

The household family size is relatively large in the case of rural households than the urban ones, which is 5.4 and 4.9 respectively (CO-SAERSAR 1998). The total population of the Woreda is 118,783. Its rural proportion is 111,437 in 20,521 rural households and 7,346 people of the three towns of the Woreda (Buee, Kela and Tia) in a total of 1,506 households according to the 1994 E.C. census projection.

Population Density: The study also examines the special distribution of the population is settled in scattered manner or densely populated per square kilometres. Taking the total population of 118,783 and 542,463 sq. km (54,246.3 ha) of the Woreda, population density equals about 219 persons per sq. km. or 2.2 persons per hectare.

Dependency Ratio: Peoples' dependency ratio in the Woreda shows how many of the active labour is under pressure to feed an additional inactive labor, which is 1.07 for this study area (Co-ASERSAR, 1998)

d) Farming System and Growing Season

As most parts of the region, mixed farming is the most dominant agricultural system in the Woreda. Cattle raising is an important activity of highlanders because of the good grazing land despite the poor quality of the existing forage crop species. This suggests the need to adopt improved grazing land management by introducing appropriate and better performing grass species. And crops are grown mostly during '*Meher*' season therefore crops growing seasons is from April–December. Farming practices are also dependent on the availability of labor, farming equipment and the number of oxen owned by farm households.

e) Economic Activities

The road network of the Woreda is relatively good. There are all-weather and dry-weather roads, which connect the PAs. The selected sample project area also has good access to main road and market centres, only some maintenance and provision of culverts and cross-drainage is necessary.

Agriculture: Of the total cultivable land in the Woreda, annual and perennial crops occupy the major portion. Sodo Woreda has 32,856 ha of agricultural land, of which the dominant

crop species are cereals, 79.2% of the total area. The cereals grown in the area include: maize, sorghum, teff, wheat, barely. Pulses are also dominant crops grown. There are horse beans, field peas, chickpea, lentils and haricot beans. The total cultivated land before the intervention was 30,271.5 ha (Woreda MOA Office: Bu'e)

Soils: According to the information from the Woreda Agricultural Office and field observation, the soil types are characterized with black, red and brownish colour. The textural classification and effective soil depth varied from place to place. In the study area/ Lebu SSI Scheme, the soil type is black. Therefore, appropriate drainage facility need to be arranged in time with the aim of ensuring long- term sustainable use of land.

Off –farm Activities There are no significant off-farm activities in the rural areas of the Woreda except petty trading activity accomplished by women and by some men who are involved mainly in marketing of cereal crops.

f) Moisture and Production

Annual rainfall is in the range of 800 to 1240 mm, indicating that moisture deficiency is not an important cause for crop failure. Crop production using irrigation would be applicable only during dry season when the land is bare. The present irregular rainfall pattern is also a common phenomenon in the Woreda. Measures have been taken by re-sowing the damaged crop to overcome the problem.

2.2.3 Weyibo Small-Scale Irrigation (SSI) Scheme

a) Size, Location and Topography

Weyibo SSI scheme is located in Boloso Sore Woreda 18 kilometres from the capital Areka. Boloso Sore Woreda has a total land area of 32,091 hectare. The Woreda is surrounded by

Kembata and timbaro Zone in the north, Sodo Zuria in the south, Damot Gale in the east and Gena Bosa in the west. The Woreda capital Areka is found at a distance of 200 km from the regional government capital, Awassa (see map xxx). _

b) Farming System

Mixed farming system, which involves crop and animal husbandry, is practiced. The crop production system includes all activities from farmland preparation and ploughing to threshing and harvesting. Most activities are dependent on human labour rather than mechanization, Oxen power are also used for ploughing, land preparation, cultivation, weeding and sometimes for threshing.

c) Water Resource Potential

As it can be seen from the topographic map of scale 1:50,000 (see annexed map) and information obtained from the Woreda offices, the following rivers are flowing through *Boloso Sore* Wereda.

Table 1: The potential rivers in the Woreda with the proposed irrigation structure

No	Name of the River	Type	Proposed Irrigation Structure	Land Resource Potential	Remark
1	Wetere	Seasonal	Reservoir/ dam	>100 ha	The size of potential land resource is traced from the Woreda topographic map
2	Kule	Seasonal	Reservoir	<50 ha	
3	Megera	Perennial	Diversion	>100 ha	

Source: Boloso Sore reconnaissance study Report Co-SAERSAR (1998).

d) Land Resource Potential

Out of the total land area of 32,091 ha in the Woreda, 22,734 ha is arable land. Shrubs, forests, grasses, etc cover the rest. Generally, the Woreda is known for its high population pressure. As a result, land scarcity is observed to be a major production and development constraint throughout the Woreda.

e) Crop Species by Agro-ecological Zones

Boloso Sore Woreda has different agro-ecological zones (AEZ), which is conducive for growing different crop varieties. The three main AEZ of the Woreda are Dega, Weina Dega and Kola zones. The land distribution per family is also different according to the total population and land size by AEZ of the Woreda. Table 2 below illustrates the crop types grown and land distribution in different AEZ of the Woreda.

Table 2: Crop Types under Agro - Ecological Zones

AEZ	Crop species grown	Land holding per family	Remark
Dega	Maize, barley, wheat, teff, pulses, sweet potato, taro	0.5	Zaba, Afamamino Kebeles 10%
W. Dega	Maize, teff, barley, taro, wheat, H.bean, Enset, Coffee, avocado, cassava, S. potato	0.4	The rest 28 kebeles 83 %
Kolla	Maize, teff, ginger, coffee, Enset, Sweet potato, taro, banana, yam, avocado, Haricot bean	>0.5	NA

Source: Woreda Agriculture Office

f) Off-farm Employment

Recurrent food shortage, undesirable cultural practices, extended family formation, scarcity of farmland and other social and economic factors are major constraints negatively affecting development and people's life. To cope with the growing problems some population group try to engage in different marginal economic activities like pottery, metal works (blacksmithing), weaving, petty trading and in few employment on daily basis. Women are mostly involved in petty trading through the credit and saving association that was introduced by Red Barna-Ethiopia.

g) Drought Situation

The Woreda has been recurrently affected by drought since the 1970s. The years 1976/77, 1986/87, 1989 and 1993/94 are considered the worst drought related crises years in history of the Woreda. Although adequate data relating to the magnitude of emergency relief served and the affected people are not available, the 1977 drought related food crises are said to be the most disastrous; and many people were reported to be perished due to the famine. During the 1986/87-drought period about 5,243 affected people were provided with agricultural inputs and modern beehives, etc, with the support of donor agencies.

h) Yields and Productivity

Nearly 22,734 ha is found to be appropriate for crop production both for annual and perennial crops. Maize accounts for ***28*** percent out of all annuals in the Woreda. Major crops grown in the area comprise cereals, pulses, root crops, and spices. Average productivity of maize is estimated to be 10 quintal per ha Due to the problem of land scarcity and low productivity level of the crops, most of the farmers are producing just at minimum level. In order to cope with current land scarcity *intensive agricultural practices* must be given special attention. On the basis of observations, it could be noted that low productivity, population pressure and

occurrence of recurrent drought have played vital role in causing chronic food shortages in the Woreda. On the other hand, from pulses (haricot bean) from root crops: (sweet potatoes), and from perennial crops (Enset) cover relatively large area in terms of farm land size next to the land allocated to cereal crops in the Woreda.

i) Existing Irrigation Practices

The Woreda is lucky and known for its well-developed irrigation system. Currently, there exists one irrigation project known as Weyibo, one of the selected schemes for this study with a recommended irrigation capacity of 150 hectare. Although the scheme was completed in 1977, it has not yet generated significant benefit to the community. This is mainly caused by improper extension package support and management problems. At present very few farmers could use the scheme at a minimum level (i.e. most of the targeted farmers are not yet using the irrigation facility). The already existing demonstration plot could bring very little effect. This suggests the need for concerned government body to exert concerted effort to use this scheme properly. Had the scheme been properly implemented in the past production seasons, it would have demonstrate the expected positive impact of the intervention to be referred as a good model in the region.

Chapter Three

REVIEW OF RELEVANT LITERATURE

3.1 Irrigation Development Concept and Experience

3.1.1 Irrigation Development Concept

Irrigation is the artificial application of water to soil for the purpose of crop production. Irrigation water is supplied to supplement the water available from rainfall and the contribution to soil moisture from ground water (Michael 1997:1). Irrigation is scientifically supported means of artificial mechanism for taking water to fertile land and using it (Teju, 2000: 9). It is a method by which land precipitation may be maintained by supplying water to the intended farmland. In this case, water for agricultural production can be sought from flowing rivers, collection of rainwater by building dams and reservoirs and pumping up from the ground.

Purpose of Irrigation Projects

Similar to any development activities and projects, public investments can be based on expectation of benefits. Expectation may be related to economic, social, equity, or any other policy directed goal. Private investments are primarily for maximization of profit. At macro level, however, any activity must be justified for its net economic benefit to the whole society under consideration. Having this in mind, irrigation projects, whether they are privately or publicly owned can have one or a combination of the following objectives:

a) To increase economic return (financial benefit) to the implementer,

b) For increasing agricultural intensification, and hence enhancing production and productivity;

c) Reduction of cost of production by exploiting economies of scale (which is significant for large-scale irrigation);

d) Production of industrial inputs and increased industrialization;

e) Securing self-sufficiency in food production and maintaining food security;

f) Provide opportunities for optimal allocation and utilization of resources.

g) Employment generation to the rural poor, and making use of available labour resource;

h) Maximization of welfare of the communities;

i) Irrigation projects can be considered as the means for fulfilling specific objectives of food security and as part of the long-term poverty reduction strategy;

j) For bringing unused land areas under cultivation (agricultural expansion) and

k) As a means of attaining import–substitution (e.g., cotton production for textile factories can save significant foreign exchange and promote saving and investment FAO, 2000).

3.1.2 Advantage of Irrigation

Irrigation development historically started, as a response to bad Agro-climate in low rainfall areas and seasons. Modern technology spurs ways for confronting the effect of natural and man-made disasters by using irrigation development structures. Hence, a number of advantages of irrigation are known, some of which are briefly presented below:

a) Irrigation enables to bring uncultivated lands under cultivation. Bhargavea (1980:48) states that irrigation facilitates extending the area of land under cultivation,

b) Irrigation increases agricultural productivity. Mosher (1968: 61) proposed that soil moisture must be supplemented with irrigation water to raise agricultural productivity.

c) The use of irrigation contributes to stabilize fluctuation in food supply. Scientific management of irrigation water provides the best insurance against weather–induced fluctuations in total food production (Michael, 1997:3)

d) Irrigation facilitates agricultural production intensification. FAO (2000: xii) described that irrigation scheme helped to increase agricultural productivity of a given land in Africa such as in Zimbabwe, and this can be explained by the level of input needed and utilized.

e) Irrigation helps to diversify product types. Many research findings (FAO, 2000) attempts to prove that choices of crop types could be facilitated by irrigation and increase food variety and availability.

f) Irrigation can facilitate to provide alternative cropping pattern decision between cash and food items (Sing and Misara, 1960: FOA, 2000: 10).

g) Irrigation provides the chance for increasing income (Meinzen–Dick et al, 1993) It is found that existence of irrigation can increase income by creating more employment since it is labour intensive. Irrigation can create or increase employment opportunities especially, surface irrigation is found to be labour intensive. FOA (1970) reported that farmers in irrigation schemes are far better off economically than laborers in Zimbabwean industries.

h) Irrigation facilitates better use of agricultural land (Pukini, 1984: FAO, 2000:7). Similarly; irrigation contributes to increase in land value since, it provides watering facilities to barren land (Sahas, 1996:12).

i) Irrigation contributes a lot in alleviating famine in disaster prone and food deficit areas. Previous studies for instance, Alvord (1933: FAO, 2001) have proved this fact. FOA (1997b) and Meinzen–Dick et al (1993) reported that 72% of farmers could secure better food production/self sufficiency and ensured source of livelihood income through the use of irrigated land in Zimbabwe.

j) Irrigation schemes enable the growing of high value crops for domestic and export market and ensure exploitation of comparative advantages (FAO, 1997 b). Sahas (1996:11) states that irrigation makes it possible to grow cash crops, which give good returns to the cultivators than the ordinary crops they might have grown in the absence of irrigation. Fruit gardens, sugarcane, potato, tobacco etc are cash crops.

k) The same study (FAO, 1997b) found that irrigation paves the way and induces other infrastructure development in some part of the world.

l) Irrigation in Ethiopia is basically used for mitigating the negative impacts of drought in susceptible to danger areas (Desalegn, 1999:43).

m) Chambers (in Desalegn, 1999:92) also argue that with sound management and careful planning, irrigation use can improve the livelihood of rural poor.

n) It has considerable advantage for domestic activities, such as, bathing and cattle watering (Michael 1997:3, Adugna 2000:3)

o) Irrigation also stimulates the development of commercial mentality of irrigators. Furthermore, there are a number of general and macro economic benefits of irrigation. For example,

> *"Elsewhere in Africa study of irrigation scheme show the following benefits.*
>
> - *Increased income that was translated into increased expenditure, investment, saving and trade.*
> - *Backward and forward linkages: traders were repeatedly coming to purchase irrigation produce (rice) and in turn sell clothes, jewellery, and other consumer items.*
> - *Increased material commodity and household wealth"* (Webb: FAO 2000: 10).

3.1.3 Types of Irrigation and Their Selection

There are different types of irrigation schemes: for instance, traditional and modern. Traditional irrigation schemes were developed in different parts of the world by communities as a response to climatic challenges over time. Since there can be different criteria for dividing such interventions, a number of classification can be drawn. For example, irrigation schemes can be classified on the basis of their structure, into two groups: River diversion and Dam construction. Others distinguish between *intensive* versus *extensive*; yet other divisions can be made as productive versus protective irrigation systems (Rees Ton & Kees Dejong, 1991).

As regards the ways of supplying irrigation water to the farm, the following four types are identified:

- Sprinkling or spray irrigation;
- Drip irrigation;
- Furrow irrigation and
- Flood irrigation.

Modern irrigation systems basically serve the same purpose as thos of traditional systems, except the differences in their technological advancement. Modern irrigation systems are well designed and studied with the aim of securing their sustainability and productivity. Moreover, it can be designed in a way it can serve multiple purposes flexibly according to the prevailing policy, market conditions, consumer tests and other comparative advantages.

Irrigation structures can also be divided into different scales based on their irrigating potential of a given land. As stated in Desalegn (1999) and used in Ethiopia, these are:

a) **Small -scale irrigation (SSI)** schemes conventionally, are those with the discharge that can water up to 200 hectares of land.

b) **Medium-scale irrigation (MSI)** schemes are those that can supply adequate amount of moisture to an area of 200-3000 ha of land.

c) **Large-scale irrigation (LSI)** schemes are those that can secure irrigation water availability to the land size more than 3000 ha

In fact, some countries use other dimensions to categorize irrigation schemes in to different scales: such as the number of beneficiaries (e.g. India) and also, the size of land to be irrigated by each scale can be different according to the condition of the respective countries.

Existence of different types of irrigation dictates the importance of selecting appropriate ones. To this effect, the background information about the intended target area must be incorporated. As a rule of thumb, parameters must be established to measure the viability and feasibility of each type of irrigation scheme. Though it may not be exhaustive, some of the criteria are outlined below:

a) ***Financial:*** the finance requirements for irrigation schemes are said to be very high. Irrigation in some African countries (for example, Kenya) is estimated to cost $ 40,000 per hectare of irrigable land and the amount escalates to US $63,000 (Brown and Nooter, 1995). This therefore, is argued that it creates high pressure on financial resources of a given implementer and needs serious attention before selecting the appropriate type of irrigation.

b) ***Economic***: The returns expected from such irrigation structure should be analysed for justifying appropriate irrigation scale. Not only financial costs but also environmental, psychological, social and opportunity cost should be taken into account. On the other hand, long term and short-term social and economic benefits

required to be measured for all alternative types and base selection decision upon comparative advantage (FAO, 2000).

c) ***Maintainability***: It is an important issue to measure the availability of sufficiently organized maintenance capacity to get a well functioning scheme. Therefore, the complexity and the logistic requirement of maintenance need critical assessment of schemes maintainability.

d) ***Management***: The existence and strength of managing institutions are another important points to be taken into account in the selection process. Water Users Associations (WUA), bylaws, Operation and Management (O&M) systems and other form of institutional structures affect the agricultural performance, economic and financial viability of irrigation projects.

e) ***Ownership:*** It is reported (FAO, 2000) that, privately owned schemes perform better than those publicly owned in Zimbabwe.

f) ***Resource (local)***: the availability and extent of required inputs such as water, land, labour resources, developed infrastructure, etc, should primarily be assessed.

Relevance of irrigation development for specific areas should be considered since, blanket approach of development are leaving floor to local development activities with the aim of increasing efficiency and maintain sustainability. In this line, feasibility of small-scale irrigation schemes for poor countries can be justified from various angles.

Recommended types of irrigation for developing countries, given low-level of technical development, poor financial resource, under-developed market system, poor access to maintenance of them, short-term impacts, and limited government capacity, is **small-scale irrigation** System. Rraiguand Rukuni (1990: FAO, 2000) indicated that small-scale schemes are generally financially viable for third world countries. Makombe and Mainzen -Drck (1993) also shared the same views.

3.1.4 Factors Affecting Irrigation Development Activities

The successes of SSI generally depend on the cooperation of larger range of government institutions and individuals, such as, for instance, the departments of irrigation, extension and rural works, banks and planning bodies. Unsurprisingly, development issues are interrelated and water resource developments by nature have interrelation with many factors. Consequently, irrigation developments are also determined by many factors for their success. As stated by Brown Nooter (1995), the performance of irrigation schemes depends on: cropping pattern, market accessibility, maintenance and spare parts, social and political, and land tenure policies. Some major factors that negatively affect irrigation development, based on previous empirical studies and own observations are:

a) Salinity: in the long term irrigation can increase the salt content of the soil and may cause the land not to be used for cultivation any more

b) Siltation: which is the process of filling canals and reservoirs with soil and sands leached from their respective up streams mostly due to poor catchments management (FAO, 1997b).

c) Depletion of water resource and dependent life systems (i.e., ecological problem of surface and ground water development for marginal water quality areas).

d) Conflicts (e.g., trans-boundary, between upper and down stream users, between management and users, implementers and donors etc) (Desalegn, 1999).

e) Flood and erosion: appropriate surface drainages and effective operation are, therefore, critical for productive and sustainable irrigation in particular since canals are long, and it is difficult to adjust head diversions. Since some are vulnerable to excess water, irrigation-system must be responsive not only to the problems of little rainfall but also to problems of too much rain (WB 129:25).

f) Drainage challenges, renewability issues, seepages, canal lining, theft and vandalism of control structures (Donald Campbell, 1995: 7).

g) Market prices for crops: irrigation projects may exhibit negative net present value (NPV) upon implementation due to change in market prices of goods from what is expected during the time of feasibility studies.

h) Change in interest rate: such huge investments are sensitive to cost of capital fluctuations.

i) Maintenance challenges and quality of design: the quality of design and maintenance system can also determine their sustainability.

j) Pest infestation and input shortages: are also some of the areas of concern due to their significant contribution as a threat.

k) Water born diseases: resulting from an irrigation projects are examples of diseconomies/ external costs imposed by the project to the society (Kanshahu, 2000:195, Sahas, 1996:12). In support of this, FAO (1986, No. 5) indicates that water related diseases and threats to flood plain ecosystem are other high environmental costs.

The World Bank (Shawki & Maigne, 1990) notes the above and other likely causes of irrigation projects' low development in three categories, namely: external, physical and internal.

3.1.5 Ways of Tapping the Existing Resources

The existence of resources, if not presented in a useable form and utilized, it may be nothing to the owners. To get them in a usable form appropriate ways must be established. Land, water and human power resources must be converted into outputs for consumption and/or input to different production processes. The following are some of the ways used to facilitate the use of resource:

a) Establishing an enabling legal environment;

b) Creating appropriate awareness about the existing potential to pertinent stockholders;

c) Having broad knowledge about short-term and long-term consequences of using and/or not using available resources to the society at large and beneficiaries in particular;

d) Designing pertinent and conducive working policies and strategies proper to a given type of resources.

e) Allowing efficient and productive ownership status by considering the nature of available resources and efficiencies such as community, co-operative (communal), private, or state.

f) Facilitating access to required support that can be financial, technical, manpower, research and development (R & D).

g) Developing sufficient knowledge about the resources carrying capacity and disseminating them to the concerned body and maintaining necessary control over its degradation/depletion such as Environment Protection Policies.

Natural resources like water development have adverse effects in the long run to the environment. Therefore, important impact assessment procedures should be developed and put in place beforehand. Their adherences must also be followed. Contemporary development paradigm dictates the significance of participatory project planning approach to sustainability of development efforts. Similar considerations of the users' or beneficiaries' value of intended intervention and incorporation of Indigenous Technical Knowledge (ITK) are found to be determining factors of project outcomes (Warren, 1991).

Accordingly, irrigation technology could be seen as productive force in the production process. Therefore, irrigation development can be taken as one way of tapping land and water

resources potential to the benefit of the targeted society in particular and economic growth in general.

3.2 Water Resource Potential and Government Strategies

3.2.1 Water Resource Potential

Available information about the development of irrigated area in the world shows that, up until the 1950s, the area irrigated globally expanded and reached 94 million hectares. Between 1950s and 1978, irrigated area expanded much more rapidly than population, averaging 2.8 percent per year as it expanded from 94 million hectares to 206 million hectares. Since 1978, however, growth in irrigated area has slowed down. Going from 206 million hectares in 1978 to 241 million hectares in1991, showing an expansion by 1.2 percent per year (FAO, Production yearbook, various years). It is expected that irrigated area will continue to increase for the indefinite future but is unlikely to increase as rapidly as population growth (Postal, 1993: MoWR, 1999).

At continental level, irrigation potential of the African continent is 20–25 million ha although only small portion is so far under irrigation. However, some scholars argue that more than half of this potential is already in moist or rain-fed areas. As regards its viability, about 75% of all Sub Saharan African (SSA) counties irrigation projects achieved/exceeded economic return though they are not operating at full capacity (Shawki & Maigne, 1990).

On the other hand, common problems related to African irrigation practices are: cost over runs, institutional factors, policy environments, technical quality and related environmental issues. With respect to the types of irrigation, coastal swamps, inland swamps, furrow irrigations and pumping by hand are most frequently used in SSA.

Contrary to the above facts, there are arguments against the impact of irrigation development for Africa. The World Bank (WB) disclosed that irrigation is unlikely to play a significant role in overall development of the region (Shawki, 1990). However, the importance of irrigation is being pronounced to local development rather than, continental level due to the mismatch of potentials and needs (Shawki, 1990: 10).

3.2.2 Government Policies and Strategies to Water Development

Though its impact is found minimal, Ethiopian Government's effort to deal with the utilization of existing water resources is significant. Firstly, large-scale irrigations with mechanization of agricultural activities were sought. Secondly, in 1980s, the importance of small-scale irrigation systems were identified, and resulted in the establishment of Irrigation Development Department (IDD) under the Ministry of Agriculture.

Currently, the sector's development appears to be moving in the right direction and due policy consideration is given. As a result, exclusive government body is institutionalised with regional offices in different regions so as to take care of water resources development including for irrigation development.

In addition to the above facts, the Federal Government has established water resources development policy through its Ministry of Water Resources (MoWR), in which a clear framework of irrigation development as a way of creating conducive environment for the sector's development is stated. Besides, the consideration of irrigation development in National Food Security Strategy as a major component and as a viable option for ensuring food security is also one of the positive efforts made so far.

3.2.3 Water Development Experience in Ethiopia

Concerning the potential and practice of irrigation in Ethiopia, there are different views by different writers. Ethiopia is a rich country in having considerable water resource potential and considered as a water tower of Africa. However, the level of development of the sector is very low despite, the country's considerable endeavours to promote development of the sector. As a means of dealing the problem Ethiopian Government has formulated policies, strategies and programs for water resources development.

Even though there are a number of components of water resource development, irrigation is presently one of the priorities of the Ethiopian Government as can be seen from the resources budgeted for irrigation development. The overall national potential for small, medium and large-scale irrigation is between 1.8 and 3.4 million hectares. To date, there are about 190,000 hectares brought under irrigation in the country and there are plans to double this area (MoWR 1998).

The government's strategy emphasizes the importance of enhancing small farm productivity and irrigation as key factors of success in increasing the overall agricultural productivity and crop diversification. Further proof of the importance attached to irrigation is the USD75 million for small-scale irrigation program component in the Ethiopian Social Rehabilitation and Development Project (ESRDP) approved in March 1996. In this frame, small–scale irrigation (SSI) is expected to provide facilities for some 87,850 households on altogether 18,700 hectares of land.

In Ethiopia, Modern irrigation schemes construction began in the second half of the 1950s (Desalegn 1999:5). They were at large scale and managed by parastatals. As to irrigation potential of the country, there are different estimates despite the availability of a relatively

more recent and accepted figure, 2.7 million hectare (Desalegn 1999, Water and development, 2000)

The irrigation development trend in Ethiopia seems very low even when compared with other African countries (Desalegn, 1999: 10). Irrigated land accounts less than 2% of cropped land. The objective of irrigation development is changing from time to time. At the beginning irrigation water was mainly used for developing cash crops like sugar cane, cotton, sesame fruit and vegetables at large scale; latter food security became an area of focus (target) for irrigation schemes development; similarly, since the mid-1980s the Ethiopian Government have been giving due attention about the desirability of small–scale irrigation development schemes (MOA, 1986; Tahal 1988: Desalegn, 1999); even though their impact so far is limited due to a number of factors (Desalegne 1999, Faud, 2001). Irrigation practices in the country up until the end of 1990s is shown in Table 3 below:

Table 3: Irrigation experience in the Ethiopia

Scheme	**Area irrigated (hectares)**	**Remarks**
Large & medium	89,000	As of mid 1980s
Small scale	10,000	Includes micro dams & pumps
Traditional	69,000	Based on incomplete data
Total	**168,000**	

Source: MOA 1986,1992,1993 (in Desalegn 1999)

3.2.4 Irrigation Development Experience and Potential in SNNPR

SNNPR is gifted with big rivers, lakes, springs and high ground water potentials that are sufficient in quantity and best in quality having the capacity of bringing more than 648,832 ha of land under irrigation. However, out of the regions total irrigation potential, only 18,140 ha of land (2.7%) is brought under irrigation by traditional practices, private investors, NGOs and the Government. Their respective proportion being: Government 6,670 ha, NGOs 6,958 ha, private 500 ha, and traditional means 4,012 ha (ADF, 1998), which is found to be insignificant.

At present, the Government is making a good effort to promote small-scale irrigation project constructions that are basically demand driven, and also calls for loans and aid for the successful attainment and support of the Co-SARERSAR.

3.3 Food Security/Insecurity

3.3.1 Concepts and Definitions

In 1979 WFP's report tried to conceptualise food security, equating it with "an assurance of supplies and a balanced supply-demand situation of staple foods in the international market". The World Bank (1986) gives the most conventional definition of food security. According to the World Bank, food security is defined as "access by all people at all times to enough food for an active and healthy life". According to the United Nations (1990 as cited in Dagnew, 2000:2), household food security is defined as "**the ability of a household members to assure themselves sustained access to a sufficient quantity and quality of food to live active, healthy lives**".

There was also widespread thinking that; a country is food secure if there is an increase in national food production. If the result of food balance sheet exercise of a given country shows surplus or no deficit in food, people conclude that there is food security. While this is true at national level, it has become evident that not all households have access to the available food in a country. Only those people or households who have the purchasing power can access to the marketable surplus.

There are three aspects of food security. These (the three pillars of food security) are availability of food (enough food), access to food (entitlement) and utilization (consumption) of food. Each of these aspects have their own components. Food can be available either through domestic production or commercial import or transfer/relief/gift. Access is influenced by the distribution/supply capacity, the purchasing power, and ownership of assets or exchange. The factors like individual needs, culture and tradition and / or diseases affect utilization of food.

3.3.2 **Types of Food Insecurity**

Food insecurity is some times classified based on their persistence to a given area in a certain duration and with negative or positive socio economic effects of differing magnitudes; and the two types of food insecurity are: ***transitory and chronic***. These are also explained as follow:

- Transitory food insecurity: temporary, short term, serious food shortages and/or famine
- Chronic food insecurity: permanent, long term/regular food shortages.

3.3.3 Food Security Situation

Levels of food security/insecurity can be assessed at different geographical areas of interest, which address food security problems from global, national, regional and household levels and even intra-household situations. This section is intended to highlight some aspects of food security/insecurity in these different scopes.

a) Global Food Security Situation

Global Food Security refers to availability of food that meets the food demand of all people at macro computation. Total food stock may be equal to total world population food needs. Which is actually becoming a threat for world population to secure sustainable food supply due to increasing gap between population growth rate and productivity increase in food production system. Due to poor population growth control capacity of developing countries and the Third world's economic growth, the demand for food consumption is annually rising. To worsen the case, productive capacity of producers and means of productions are declining at least due to reducing land-holding size, short fallow periods, degradation etc (WB, 1996:8).

The world agricultural growth rate has been slowing down in the last three decades (Mitchell and Donald, 1995). These developments have been interpreted by many (for example, Brown, 1994) as a turn for the worse and have given rise to expressions of concern about the capability of world agricultural production to keep up with the growth of world population.

It is reported that food demand is in balance with its supply currently and the trend implies that, given technological and other related advancements, this balance can be maintained until 2025. (Nikos Alexandaros, 1995: Mithell and Donald, 1995).

Leslie E. and Svendsen M. (1992: 1) examined food demand and supply prospects up to 2010; and explored that world food supply in 2010 would probably meet global food demand. However, the WB (1996:9) assesses African, particularly of SSA countries' future and concludes that one of the risks that inhabitants may suffer is lack of sufficient food to support all their requirements. Therefore, for Africa, due to recurrent drought, erratic and low level of rainfall, irrigated agriculture is opted so as to make use of available water resource potential (FAO: WB, 1996).

b) National, Regional, Household Food Security Situations

Ethiopia has the third highest population in Africa, a majority of which live in rural areas. Only 16% of the total population is urban. The overall demographic and health situation is one of the worst in the world due to poverty, famine, war and lack of infrastructure. According to UNICEF, in Ethiopia, the under 5-mortality rate is 177 per 1000 live births, the total adult literacy rate is 36%, and primary school enrolment is about 27%. According to the 1992 National Nutritional Survey, 64% of children aged between 6 and 59 months showed stunted growth (MoWR, 1999)

Ethiopia's population growth rate 2.9% is among the highest in the world and the current population is expected to double within the next 23 years. Indeed, the total fertility rate is 7.0 and the national contraceptive prevalence rate 4% (UNICEF, State of the World's children 1998: MoWR 1999).

The agricultural sector is the most important sector in the Ethiopian economy. It produces above 55% of the Gross Domestic Product (GDP) at factor cost, employs 85% of the labour force, generates 60% of the commodity export earnings and provides raw materials for 70% of agriculture –based large and medium enterprises.

The National Nutritional survey in1992 (MoWR, 1999:19) showed that the situation had worsened. Food already being scarce, poverty exacerbates the situation by limiting the people's access to whatever food is available. The World Bank 1998 social sector study indicates that about 52% of the population consumes less than 1,770 calories per day, showing that there is already a gap between the demand (i.e. purchasing power in poverty stricken circumstances and human requirements). Despite surplus grain production in certain parts of the country, severe structural food deficit in others, analysis shows that markets between these areas are not developed (MoWR, 1999).

Generally, about 52% of the country's population is reported to be food insecure (FFS Strategy 1996). As also indicated by Dagnew (2000:5) domestic production performance observed between the late 1980s and early 1990s could only meet some 70-85% of the minimum level of food consumption requirement equivalent to 600 gram/person/day.

To achieve food security in Ethiopia AFD Program (MoWR, 1999:20) recommends:

I) Enough food must be available with in the country from national production and commercial imports and /or food aid in kind;

II) Markets must be more efficient to ensure that it is available where the people need it and

III) People must be able to produce or purchase the food necessary to meet their basic requirements.

Regional Food Security Situation

According to the Bureau of Planning and Economic Development of SNNPR (BOPED) regional profile, proportion of food insecure population of the region is greater than that of the country. Some 56.5% of the regions population is food insecure, and regional average per

capita food consumption is 1800.36 kcal/day whereas national consumption average is 1954 kcal, both falling far below the WHO's standard of 2220 kcal/day for adults, the country per capita income is also 1,087 Birr (134 USD) whereas the regional (SNNPR) one is 945.48 Birr (116.6 USD).

As far as population density is concerned, annual growth rate is 3.3% greater than that of the country. However, food production in the region was not growing at comparable rate. It was even declining sometimes. Table 4 below shows the food production trend in SNNPR.

Table 4: Food production 1994-1998

Year	Crop Production (Wheat equivalent)
1994	17,844.4 (Quintals)
1995	18,655.20 " "
1996	18,083.8 " "

Source: BOPED, 2000

Table 4 shows that, total food production declined in year 1996 compared to 1995 by about its increase in earlier production period.

As the regional DPPB 2001 assessment, most of the woredas of the region are in need of food supplies to fill their deficit (See Annex 6b). Similarly,, more than half of total area (i.e., 8.6 and 48.9%) (BOPED) are categorized as '*Harur*' and '*Kola*' agro ecologically. As a result, only 36.9% of the region is considered cultivable by rain-fed agriculture, but only 23.5% cultivated. Rainfall is insufficient in most places of the region, only 24.6% of the region receives annual rainfall more than 1600 mm. Besides, 89% of regional population are engaged in agriculture with 1.7% unemployment level (BoPED, 2001).

As regards to the level of agricultural populations' poverty, less than 30% have two or more oxen for farm work, more than three-fourth of the residents in most Kebeles of the region are categorized as 'poor' in their standard and ranking (survey February- March 2002).

3.3.4 Factors Negatively Affecting Food Security at Different Levels

As discussed in the introductory part of this chapter, food insecurity is of many types, and each of these types can be caused as a response to different factors. They also can have different effects with varying extent and duration.

These factors can be seen from other dimension of food insecurity such as global, national, regional, and household. For example, household food insecurity may be addressed by increasing purchasing power of that household and facilitating easy access to marketable surpluses, given local food availability.

Generally, as the World Bank (Leslie E. and Svendsen M., 1992) study shows that increasing scarcity of water and land resources, and environment degradation: including erosion, pollution, and loss of biodiversity, might constrain the expansion of food production in developed and developing countries. Further more, climatic changes, including global warming, might adversely affect the prospects of production growth. Such food shortage also resulted due to increasing population size, natural environment degradation, worsening poverty, and inequitable distribution of resources and poor agricultural performance among others. The poor performance of the Ethiopian agricultural sector can be explained by:

(i) Inadequate research and extension support;

(ii) The "primitive" farm technology, except for the extremely limited introduction of modern inputs such as fertilizer and seeds of improved varieties;

(iii) Recurrent droughts;

(iv) The limited area under irrigation about 2% of the total area (Adugna, 2000: MoWR, 2000: 3), despite significant potential (MoWR, 2000) and dominance of rain-fed agriculture (Dagnew, 2000: 6); and

(v) The decline in soil fertility due to overgrazing reduced fallow and very rapid deforestation (from 16% of the total land area in the early 1950s to only 2.7% in 1989), and resulting soil erosion.

In general the agricultural sector in SNNPR is still characterised by many problems that include erratic and low level of rainfall, drought, backward agricultural practices, inadequate input supply and credit, the absence of strong and developed infrastructure, and in some zones, over population which has resulted in fragmented holding of the farm land.

Even acquired food itself is unevenly distributed and hence intensified food insecurity at local and household levels, even more specifically, there is prevailing differences among individuals with in a household, which can raise issue of intra-household food insecurity situation.

3.3.5 Government Food Security Strategy and Program

Confronting the prevailing food security problem and its worsening trend is becoming the most pressing challenge to the world societies in general and humanitarian development oriented actors in particular. In this line, several studies have been conducted and a number of strategies were recommended, implemented and practiced. However, what has been done so far could bring very limited change in solving the overall problem. Even the application of these findings could bring no change or even worsen the case in some instances.

Even though their positive effects are dependent on the situation or background specificities of the intervention areas, components of the Federal Food Security Strategy needs to be maintained. Some of the components are:

1. Economic growth and employment
2. Additional entitlement/Access and targeted program such as: supplementary employment/income scheme, targeted programs, nutrition and health interventions
3. Emergency capabilities to be maintained and strengthened

Taking the opportunity provided by established policies and strategies, the following activities were undertaken by different government institutions in Ethiopia:

- Agricultural mechanization: development of large-scale irrigation schemes and commercialisation of farm during Haile Sillassie regime.
- Food / Grain Market regulation
- Cooperative formation and large scale /mass production: Integrated Rural Development Programs, PADET, PADEP, IDD (irrigation development department) and the like of the 'Derge';
- Agricultural intensification and Agricultural expansion: like resettlement programmes
- Diversification of income and food sources: Rural/Agricultural Extension Services/Packages, Agriculture Led Development Industrialization Strategy (ADLI);

3.4 The Relevance of Irrigation in Enhancing Food Security

In this part, the emphasis is on assessing the relevance and impact of small-scale irrigation on food security of developing countries.

3.4.1 Relevance of Irrigation in Enhancing Food Security

- Increase in agricultural productivity increases income of the people engaged in it and thereby purchasing power; thus, it secures access to marketable food items (Fuad, 2001:53).
- Irrigation also enables producers to select high calorie crops for their production using continuous flow of water. The availability of such facilities affect cropping pattern and related cropping decisions.
- The contribution of irrigation to food security is stated by Bhargavea (1980:48) that irrigation facilitates extending the area of land under cultivation and Mosher (1968: 61) proposed that soil moisture must be supplemented with irrigation water to raise agricultural productivity.

Moreover, the task to feed an ever-increasing population while preserving the sustainability of the natural resource base will require investment that allow resources to be used more intensively by ensuring their sustainability for future generations (WB, 1996:V).

In sum, irrigation's contribution to food security can be seen from different dimensions:

a) ***Availability*** can be increased by agricultural intensification, expansion and diversification; b) **Access** can be maintained by increasing income of the rural poor and increasing purchasing power to procure from market. It is possible since irrigation creates job opportunity; and

c) ***Utilization/food distribution*** can be affected by the existence of irrigation since it enable to produce various food items at different seasons like dry season irrigated agricultural production is viable by using irrigation.

a) **Relevance of Irrigation in Product Diversification**

Irrigation can help producers to grow different crops, which in turn can increase varieties in households' food preparation. Moreover, product diversification reduces risk against a number of calamities such as flood, drought, and crop failure.

Diversification can be sought as a strategy for coping with food insecurity problem. By the fact that diversification itself can have several dimensions such as: i) diversifying income sources, ii) diversifying food sources, and iii) diversifying nutritional mix (composition of meals). Therefore, ways can be widened in exploiting any of these options: diversification of sources of income, food sources, and food types. Irrigation helps to diversify product types. Many research findings (FAO, 2000) attempts to prove that choices of crop types could be facilitated by irrigation and increase food variety and availability.

As a way of increasing sources of income, employment generation schemes, petty trade by providing appropriate credit and market facilities, and policy issues (macro economic environments) can be considered. Rural industrialization, increasing prices of agricultural products and export trade on top of import substitution are some of the ways by which rural and local income may be raised.

By the same token, supply diversification can be attained by establishing fair marketing systems, appropriate rules and laws, stable and secured economic activities, equitable and fair growth rate, information dissemination and related marketing issues. It can also be maximized by providing adequate storage, transport and distribution facilities of food items.

On the other hand, calorie requirement can be maintained by changing feeding pattern. Some food items are nutritionally richer than others; and hence, by different mix of them the

WHO's threshold may be reached. Such composition changes are basically resulted from various causes like changes in consumers tests, market prices of food items, agricultural technology, agro-climate and their coping mechanisms.

The contribution of irrigation to livestock production and livestock feed products is also worth considering. Literatures considering their importance in enabling production of animal forage in moisture-stress areas. Development of irrigation scheme in lowland areas is being encouraged for their capacity to create settlement option for nomads: who moves from place to place in search of water and feed for their livestock (WB, 1996).

b) Relevance of Irrigation in Enhancing Crop Production and Productivity

Expansion and intensifications are systems by which irrigation enhances agricultural production. This is because, such interventions can increase number of harvesting times (multi-harvest) with in a year; and enable the use of unused farmlands. Irrigation facilitates agricultural production intensification. FAO (2000: xii) described that irrigation scheme helped to increase agricultural productivity of a given land in Africa such as in Zimbabwe, and this can be explained by the level of input needed and utilized.

Besides, the contribution of irrigation to increase soil fertility by enabling crop rotation is popular. Irrigation brining more uncultivated land in to cultivation can provide fallow period for farmlands thereby an increased productivity.

c) Relevance of Irrigation in Enhancing Employment and Income

The role of irrigation in increasing job opportunities and income has been studied, and found significant (FAO, 2000). Irrigation, especially surface irrigation systems are labour intensive and requires engagement of more labour than rain-fed agriculture keeping other things

unchanged. Therefore, irrigation can increase employment opportunity and income. This in-turn enables to get access to food by improving purchasing power of individuals. Irrigation provides the chance for increasing income (Meinzen–Dick et al, 1993) It is found that existence of irrigation can increase income by creating more employment since it is labour intensive. Irrigation can create or increase employment opportunities especially, surface irrigation is found to be labour intensive. FOA (1970) reported that farmers in irrigation schemes are far better off economically than laborers in Zimbabwean industries.

d) **Relevance of Irrigation in Enhancing Household Food Security**

Research findings state that, water resources development contributes to short-term and long-term alleviation of social problems like food insecurity. As to their relation, irrigation schemes development affect agricultural productivity, which results in increased supply of products. Increased supply of food in turn increases food availability level whether at household and/or market levels. The critical importance of water for food security in general, and crop production in particular, is stated by Brown and Kane (1994:10) as productivity of crops are also endangered by competing uses of water resource.

Irrigation contributes a lot in alleviating famine in disaster prone and food deficit areas. Previous studies for instance, Alvord (1933: FAO, 2001) have proved this fact. FOA (1997b) and Meinzen–Dick et al (1993) reported that 72% of farmers could secure better food production/self sufficiency and ensured source of livelihood income through the use of irrigated land in Zimbabwe.

Chapter Four

STUDY FINDINGS AND DISCUSSION

4.1 Introduction

Regional Food security strategy (SNNPR, 1997) considers the relevance of small–scale irrigation in reducing the prevailing challenge of food insecurity. The reduction is possible through diversion of perennial rivers, dam constructions and provision of adequate sustainable irrigation water to the vast potential irrigable land, during the dry and insufficient wet seasons. Therefore, irrigation development in the region is being undertaken to attain this objective.

General characteristics of the study area are presented below briefly. In this table demographic, land holding and family size characteristics are also tabulated

Table 5: General Characteristics of the study area

No	Irrigation scheme	Name of Peasant Associations (PA)	Number of irrigators	Average family size	Average land holding size (ha)	No of households			Age of scheme (in years)
						Female headed HH	Male headed HH	Total	
1	Bissare	Elo- Erasho	120	6.7	1.25	49	318	367	3 years
2	Lebu	Kela	180*	5.9	1.25	-	-	360	5years
3	Weyibo	Metela Embecho	222	8.25	0.75	189	1194	1383	17 years

* 60 out of 180 users of irrigation were not included in the design.
Source: Records of respective PAs, and Survey conducted in February 2002

This background information about the study areas can help readers to look in to food security status of the respective areas from a wider scope. This is because household food security

condition should be seen in relation to the number of people to which a given household is feeding. Similarly, land holding size helps to judge whether a certain household is food secure/insecure, since the amount of land under a household can affect production level and food/income by large.

For instance, as could be realized from Table 5, Weyibo scheme is in an area where the population density is so high: where average family size in the area is 8-9 persons/household and there exist comparably low land holding size of 0.75 hectares per household on average.

Before proceeding to the description of the study findings some concepts used to explain relationships are discussed in view of conceptualizing for this research as follows:

Asset holding is determined and used in this paper as an indicator of ones ability to access to available/marketable food. These assets are used as an its indicator based on locally accepted standards. These assets are Iron roofed houses, one or more oxen for agricultural activities, ownning cattle more than two for milk production for a given household. For this paper a given household is considered as relatively rich if they have any two of the above assets. The assumption is that income from any source is invested in the above assets.

Diversification is shown as a practice of producing any one or more of vegetables, root crops and perennials in addition to cereals on more than half of their land at least once a year.

Sufficient and surplus production of items is considered as a measure of food self-sufficiency and are indicated by production of sufficient or more for annual household requirement.

Agricultural intensification (multiple cropping) is considered for its direct relation to food supply/availability due to its contribution for increasing volume. It is assessed by the number of harvest in a year from a given farm plot.

Engagement in farm activities is measured by the percentage of family members engaged on own farm activities for more than three-fourth of the year's time. Income from this engagement is considered as it has positive relation with food access and hence food security on top of its effect on volume of out put.

4.2 Irrigation, and Household food supply

Agricultural production is a measure of volume of outputs of a given household, and productivity deals with the level of production using a given volume of inputs. In this work, they are measured by assessing the time/portion of a year by which a household can afford to consume from ones own production. To describe them site by site, let's have a look in Table 6 below.

Table 6: **Proportion of sample self-sufficient households and who pursue multiple harvests/cropping (Agricultural intensification)**

Irrigation Schemes	Access to Irrigation	Sample size	Sufficient & surplus producers (%)	Intensification (multiple Cropping)
Bissare	Irrigators	20	50	50
	Non-irrigators	20	45	-
Lebu	Irrigators	20	30	95
	Non-irrigators	20	20	-
Weyibo	Irrigators	20	20	90
	Non-irrigators	20	-	35
Total	Irrigators	60	33.3	78.33
	Non-irrigators	60	21.7	11.66

Source: Survey February-March 2002

a) Bissare Small-Scale Irrigation Scheme

In Bissare 50% of the irrigators are able to produce enough food for their annual consumption; while that of non-irrigators has found to be 45%. In the same token, on average 50% of irrigators harvest double/triple whereas all non-irrigators harvest only once in a year. Therefore, its implication is that the contribution of irrigation at Bissare SSI scheme, for increasing food production volume by intensification is significant. Therefore, development of such infrastructure seems a good imperative.

In broader sense, food availability is increased by agricultural/farm land expansion since people are cultivating new bare lands, which had been left unused for long period of time due to the prevailing moisture stress. Ultimately farmers are resettling back on their irrigable land, which they left because of recurrent drought and related crop failures.

It implies that the effect of irrigation in determining population settlement pattern, consequent environmental protection and sustainability is worth mentioning.

As regards to productivity, by the provision of sufficient and reliable water requirement to plants, irrigation helps in increasing the output of a given plot in addition to its effect in reducing crop failure rate. According to the observation, some 90% of respondents did not encounter crop failure since last two years, whereas all non-irrigators face at least partial loss. One of the ex-committee members of WUA Ato Tesfaye, explained the impact that irrigation has in productivity as follows:

"One row of sweet potato is sold for the amount of cash equal to the amount, which can be earned, by selling three rows of it with out project (availability of irrigation scheme)."

b) Lebu Small-Scale Irrigation Scheme

In this scheme, about 30% of the irrigators are able to produce enough food crops for their yearly household consumption; but the proportion for non-irrigators is only 20%. In the same token, 95% of irrigators harvest more than once and all non-irrigators only once in a year on average. Therefore, this implies the contribution of irrigation at Kela PA, to increase food production volume by intensification as being significant. As the result, the irrigation development could be viable in this area.

c) Weyibo Small-Scale Irrigation Scheme

In this project, some 20% of the irrigators managed to produce enough food for their annual consumption, while the statistics for non-irrigators is **nil** i.e. none of the non-irrigator families could produce sufficient for consumption. Similarly, 90% of irrigators are getting multiple-harvest while only 35% of the sample observations of non-irrigators can do so in a year on average. This implies that the contribution of irrigation for this particular intervention, to increase food production volume by intensification as being significant. Therefore, with irrigation objective of ensuring self-sufficiency in food production can be attained.

Local production of food obviously increases food availability. But availability alone cannot guarantee food security, since it is a necessary but insufficient condition to food security. The survey result of the whole study areas in relation to the impact of intervention in food supply is positive since the value reads, some 33.3 % of irrigators were able to produce enough for household consumption or surplus; whereas, only about 21.7 % of non-irrigators managed to be self-sufficient in food production. This difference is significant at 10 %. (X^2=3.37) As indicated in the limitation part, reliability of the information provided was qualitatively crosschecked based on observations and interviews made.

Table 7: Comparison of agricultural diversification and intensification of sample households before and after establishment of irrigation schemes.

Site	Before Versus After Construction of irrigation schemes	Sample size	Diversification	Household food source diversification	Food self sufficiency	Agricultural intensification (multiple cropping	Number of HH who get meal 3 or more times /day (Food Security)
Bissare	Before	20	5	8	0	0	4
	After	20	18	15	7	16	18
Lebu	Before	20	0	0	0	0	18
	After	20	19	2	1	19	18
Weyibo	Before	20	19	18	1	1	17
	After	20	19	19	1	19	15
Total	Before	60	24	26	1	1	39
	After	60	56	36	9	54	37
	X^2 Value		5.594 *		2.356	2.492	3.6753**

Note: * significant at 2.5 % probability level
** Significant at 10 % probability level

Source: Own Survey, February-March, 2002

Similarly, the analysis of irrigators situation before and after intervention confirms that 15% of irrigators as being food self-sufficient after intervention, but out of it only 1.7% households were self-sufficient before intervention for the whole survey areas.

As it has been shown in Table 7 about additional 13.3% (15% less 1.7%) of respondents could diversify food sources, (i.e. they could increase variety to their meal/diet) on top of possibility of diversifying their income sources. Similarly, relative to the status before intervention, food

self-sufficiency (i.e., having at least three meals a day) is attained by additional 20% of respondents, since it is significant at 10% ($X^2 = 3.675$). As could be seen from the same table, 43.3% of irrigators produce cereals and vegetables such as: maize, sweet potato, onion, and ginger on their farm plots. Whereas only 16.7% of non–irrigator respondents could diversify the production. From cropping pattern point of view, 40% of respondents were producing various crops on top of cereals before intervention, but after intervention, 93.3% of irrigators manage to practise multiple cropping, which is significant at 2.5% significance level ($X^2 = 5.594$). By implication, agricultural diversification can be maintained by availability of irrigation. This is one of the very for-arguments of irrigation and risk diversification against drought and other failures.

Livestock and Irrigation

One of the farmers at Elo-Erasho said,

> Due to the existence of these schemes, we could have these all [stored maize, sweet potato, sugarcane, fruits livestock]. And we had nothing to feed our livestock when all the trees shade their leaves in the dry seasons; all of our holdings were dying every year, from a disease called " Gandi". But as you can see now [pointing to the irrigated land and the crowd of cattle in front of the discussion group] our cattle are well in February even. We are feeding them leaves of sweet potato: which is our main food second to maize in our household consumption.

The improvements made in the livestock productivity have a recognizable impact in household food availability. In most of the study areas milk and milk products are major sources of food diversification (varieties). Moreover, they are mostly under the control of females who are actually more responsible for food preparation.

This shows that the contribution of irrigation in improving food security is in two dimensions: viz. increased volume of production of milk and milk products and improved access to and control over these items by women.

Household survey also confirms that more than 78.3% of the respondents as accepting the increasing impact of irrigation to livestock, milk and related products' productivity. Even many of the non-irrigators could witness its validity for livestock growth as well. Since the regions agriculture (main economic activity) is characterized by the mixed–farming of crop and livestock husbandry, the perceived change in productivity of livestock can have a significant effect on the living standard of the community at large, and household food security status of the targeted people, in particular.

Agricultural Intensification and Expansion

Though it is argued against for its less sustainability in arid and semi-arid areas where topsoil is shallow and moisture content is exhaustibly low (Fuad, 2001), agricultural intensification has been considered as a strategy for increasing agricultural productivity/production. Even though, a great deal of African irrigation potential is supplementary to rain-fed agriculture, irrigation developments' contribution in densely populated high lands and relatively low rainy areas is very important.

Analysis of the fieldwork shows that, 76.7% of irrigators harvest at least twice a year, whereas only 13% of non-irrigators could harvest twice by '*meher*' and '*belg* ' rainy seasons. In fact, double /triple cropping of irrigators is not only by using irrigation but also by both rain-fed agriculture and supplementary irrigation. Therefore, irrigation is now found to contribute a lot in intensifying agricultural production over limited land holdings.

Such double and triple harvest of crops facilitated the provision of animal feed from harvest strews and by–products such as leaves of vegetables throughout the year.

Farm expansion is the process of bringing previously uncultivable land in to cultivation. Which is the observed fact at Bissare SSI, as it can be perceived from the quotation of one of the participants of group focus discussion below.

Though the contribution of irrigation based on survey varies, most of the respondents reacted that, in most of the study areas irrigation enables to double/triple harvesting. However, for one of the projects, i.e. Bissare, irrigation could bring the previously uncultivable land into cultivation. Currently cultivable farm at Bissare was not under cultivation for long past. By way of confirming the fact, during group discussion, irrigators stated:

> "*Though these land has been ours for long, we could not use it due to the recurrent drought in the area and the subsequent crop failures. Hence, we were forced to evacuate/migrate to the upper part of the PA (kebele), since our children and cattle could not tolerate the situation. But now thanks to our government it becomes possible for us to use our land resource, it has been three years since we came here and had attractive harvests. We are not in a position to look for food aid any more but we can help others.*"

Basically distribution is one of the three dimensions of food security. One of the probable reasons for a prevalent price decline of agricultural products is the problem of effective distribution. Distribution refers not only the spatial consideration but also distribution of items on temporal basis. Moreover, the concept of distribution can have relation with storage. To clarify the above assertion, for instance irrigable land enables producers to harvest when rain-fed (main season harvest) production is finished.

4.3 Irrigation, and Asset Holding and Engagement in Farm Activities

For the study areas, information collected concerning income was about the wealth ownership status; and wealth status is analysed by using asset holdings as per local indicators. Since the assumption asserts that one who has more asset has better access, assuming other things remain constant.

According to the research findings, the following figures are exhibited for all groups of respondents from the three selected schemes.

Table 8: Proportion of better offs (relatively riches) between irrigator and non-irrigator households and agricultural activities engagement

Schemes	Access to irrigation	Wealth Status (Asset holdings)	Household engagement in farm activities (percentage)
Bissare	Irrigators N=20	45	85
	Non-irrigators N=20	20	50
Lebu	Irrigators N=20	70	95
	Non-irrigators N=20	50	85
Weyibo	Irrigators N=20	55	85
	Non-irrigators N=20	45	65
Total	Irrigators N=60	45	88
	Non-irrigators N=60	40	66

Source: Own Survey, 2002 N= Sample size

a) Bissare Small-Scale Irrigation Scheme

Based on the percentage analysis of the above table, 45 % of the irrigators own at least two or more of the iron roofed houses, oxen and cattle, whereas on average 20% of the non-irrigators own these assets. Similarly, 85 % of irrigators' families involve in farm activities, while only 50% non-irrigators use all their labour-hours on duty. Therefore its interpretation is that irrigation development is a viable option. The difference between the values for both groups is significant at 2.5% probability level ($X^2 = 5.594$)

On the other hand, during construction, market for charcoal was intensified since; vehicles moving to site were means of transporting charcoal to urban areas. Therefore environmental conservation and farmers' choice between cultivating their farm plots and making charcoal may be affected and hence, the sustainability/usability of the project and environment might be determined. A person in Ello Erasho said:

> "Toso Geletao! This [irrigation] is a blessing from Lord and government for us; it would have been impossible for us and you to be here at this time. [February! the driest month] with out the existence of irrigation. We are privileged to enjoy looking green leaves for our eyes, to shade drink/water our cattle. Had there been no irrigation here, we were simply sit under the trees. To work on our farm plots no precipitation, to rear livestock no grass due to drought. But, now we [all family members] are busy distributing water on our fields, in the morning and evening, protecting our farms from cattle and wild animals around.

b) Lebu Small-Scale Irrigation Scheme

Based on the percentage analysis of the data in Table 7, some 55 % of irrigators own two or more of iron roofed houses, oxen and cattle whereas, on average 45% of the non-irrigators have these assets. Similarly, 95 % of irrigators' families involve in farm activities, while 85% of non-irrigators use all their available time of their family on duty.

c) Weyibo Small-Scale Irrigation Scheme

According to the analysis of the same Table above, 70 % irrigators own a combination of any two of iron roofed houses, oxen and cattle whereas, 50% non-irrigators have these assets. On the contrary, only five respondents among the 20 irrigators disclosed that they have nothing, while ten of non-irrigator households do not have any of these assets. Similarly, 85 % of irrigator household families involve in farm activities, perhaps 65% of non-irrigators households' members engage in farm activities.

To generalize the study findings, irrigation, if developed and implemented at full scale could have a significant positive impact on wealth status of beneficiaries. As explained above wealth indicates income position, and the effect of income in creating purchasing power and access to food is considerable. Then access to food security can ultimately be secured.

Cumulatively, at the three sites irrigators outweigh wealth rank in the study areas. At the same time most of the iron roofed houses were newly constructed for all sites and particularly for Lebu (Kella PA) which indicates that irrigation enabled beneficiaries to benefit from it and became wealthier than non –irrigators. Income appropriated from non-farm activities such as petty trade were observed as being raised by non-irrigators.

A person from upland explained the fact as follows:

> I come to this market place every week having twenty birr. I buy potatoes and "*Godare*" from farmers in total and allocate and resale it on retail basis for birr 1.and 0.50, as you can see [gazing at his fragmented items for sale]. This is usual way of copping household food deficit, since, at least, I can take the left-over to home after recovering my purchase cost".

Likewise, the contribution of irrigation in job creation is paramount, since it could create sufficient job for all family members and hired labourers. As a person witnessed "in the study area it was only in April that farmers usually work on their farms with rain and remain idle during the rest of the year". Others witnessed that the development/construction of the irrigation scheme could provide local people with job as labourers. To get extra income, a need doesn't arise to go distant places to seek for employment. Therefore, the availability of irrigation could reduce temporary migration and contributes in creating job locally and labour resource use. Study affirms that 88% of irrigating households are totally busy in farm activities, whereas 66% of non-irrigators can use their time in agricultural works.

4.4 Irrigation and Household Food Security

4.4.1 Availability/food supply

a) Availability of food item in *Bissare* SSI scheme has improved at household levels and nearby markets (table 7). This availability is acquired both in quantity and variety. Bissare SSI scheme's irrigators could diversify their production from producing only cereals (Maize) to production of Maize and Sweet Potato mostly. By planting Sweet Potato, as observed and surveyed, they could diversify source of food items to cereals, vegetables and improved livestock products: such as milk.

Milk products' improvement has resulted from the possibility of getting more animal feed. The animal feed that helped them is mainly leaves of sweet potato and maize by-products (straw) during dry season the period when non-irrigators could get nothing in the area for their animals. In fact no attention is given for preventing cow diseases to bring sustainable/dependable change.

However due to poor market consciousness, weak transport and market facilities people in the scheme are mainly engaged in the production of food items.

b) At ***Lebu*** SSI, irrigators are mostly producing onions by using irrigation water and staple food items using rain. Though some, mostly, young irrigators try to produce three times a year, double cropping is common in the scheme, considering soil type and it's drainage requirement. Due to the availability of relatively more developed transportation system and market access, cash crops: potatoes and onions are comparatively favoured. Some of the respondents are business-minded and justify their cropping decision/choice towards cash crops by stating cheap market prices of food items and the possibility of using income for food purchase (table 7).

However, users prominently complain the implementer's weakness to follow-up and the absence of a concerned body for research and development to find adaptable crop species. As observed during the fieldwork, certain disease called "wag" infects onion products on some farms.

Photo: Nigussie

Fig. 1: Onion harvesting by the involvement of all family members at Lebu SSI scheme

The Woreda Government office could not deal with the issue regardless of frequent request of the users. This and the fluctuating price of the agricultural products had created problem and endangered the sustainability of the scheme's operation.

c) ***Weyibo*** SSI is known for its small average land holding size (table 5) and agricultural intensification; and irrigation is found to increase the volume of production. Even though the effect of irrigation on diversification is minimal, doubling and sometimes tripling harvest help irrigators to improve their food security situation.

4.4.2 Access and Utilization

Access to food for this work is defined as ability of a household to marketable and produced food. Which is also shown by the right of a household member to use available resources. The level of access is assumed to be affected by availability of cash income Then the impact of irrigation in income level is shown by the percentage of households who shift their usually grown crops to cash crops (i.e., diversification). Utilization is considered as ability of a household to get more types of food and increased number of meal per day. The finding in this respect is shown as follows site-by-site.

a) ***Bissare*** **Small-Scale Irrigation Scheme**: As discussed in chapter three, one dimension of food security is access. The right of individuals to get access to available food is related to different factors like: legal (exclusion of non-owners' use), cultural (gender/age related rights) and position within the family. Accordingly, in the study area access of female family members to the available food items has been improved. Previously, women in the family had limited access to cereal products, since such crops are sold and used for payments of non-consumptive expenditures like taxes. But with the diversification of crops and improvement of livestock products, women, who are culturally responsible for domestic food

preparation, secure access to sweet potatoes, milk and milk products. In this particular area as most parts of the region, more than 92% of responding households' ladies have the right over milk and homestead/garden products. Moreover income (wealth status) of irrigators is improved (table 8), access to food is improved as well after intervention.

Table 8b Shift of households from cereal (food crops) production to cash crops production

	Before establishment of irrigation	**After establishment of irrigation**	**Sample size**
Cash crop producers (absolute)	24	56	60
Cash crop producers (percentage)	40	90	
Chi-square Value	**5.5112**		

Source: Computed from own Survey February-March 2002

According to table 8b, there is significant shift of households from food items production to production for cash, which reads 90% after intervention from its earlier 40%. Which is significant chage at 2.5% siginificance level ($X^2 = 5.5112$). That implies, had there been appropriate education and awareness creation about all possible production processes and related advantages, users could have diversified their products better than the existing level. Therefore, more has to be done to exploit the existing resource to their maximum.

Concerning their purchasing power, those responsible for food preparation [ladies] could maintain their right to take what is relatively more expensive in the seasonal market and use the income to procure food or other consumer goods. The existence of Bissare SSI enables

these households to get income through-out the year, because they are privileged enough to harvest Beat-roots, Sweet Potatoes and Sugarcane when they are less in the market due to the seasonal harvest of non irrigators. Moreover, this supply during non-harvesting times helped irrigators to claim better prices for their products, on top of enabling to get food at different seasons of the year, i.e., temporal distribution.

b) ***Lebu* Small-Scale Irrigation Scheme**: in Lebu SSI scheme, similar to that of Bissare, access to food has been found improved. As one lady said, " Since we are supposed to pay all our expenses like taxes, from our main 'meher' harvest, all items produced during the dry-season are freely accessed by us. I can consider this as extra because even government do not demand any tax from this and therefore it is not taxable." Moreover, irrigation enables school children and women to take some crops from homestead garden whenever they need and leave for market centres and schools.

In addition, one of the beneficiaries said that they managed to buy what they need from market by selling their Onions at good price. They found that it was better to use their land for the production of Onions, and sale at better prices. With the improved income they can procure 'Teff' from market given existing cheap cereals prices.

In addition to this, at Lebu SSI, some people who came from places, where there are no irrigation facilities, could get daily wage work during the free seasons. By earning income they can purchase food items. As also one can see from table 7 more crop diversification is exhibited in the study area, i.e., 75 % for irrigators and 40 % for non-irrigators.

c) *Weyibo* **Small-Scale Irrigation Scheme**: It is also observed that irrigation could enable people of the village to get more income and improve their purchasing power. Given

relatively small land holding size (as shown in Table 5, average land holding size in this PA is 0.75 ha), and large family size (8.25 persons/household), irrigators in the PA managed to intensify production and get products in non-harvesting seasons and make more money to maintain easy access to marketable food. People in this area can make enough money by taking advantage of the available transport facilities and market of the adjacent Kambata and Timbaro zone, to increase their purchasing power. This in turn contributes in increasing demand side of the food balance sheet and stabilizing market prices at macro level.

According to the study findings (qualitative), most of the respondents/participants during group discussion favour irrigations' positive contribution to food access. Given cultural responsibility of ladies (females) to food preparation for family. Since, these irrigation schemes facilitate the production of sweat potatoes, sugarcane, onions and beat roots, the right to use for household consumption and to raise cash for purchase complements of food items are improved.

Literatures emphasize the positive effect irrigation has on employment creation from its inception to implementation. Local and other people, who are skilled or unskilled, whoever involved in the process, can generate income and change their living condition.

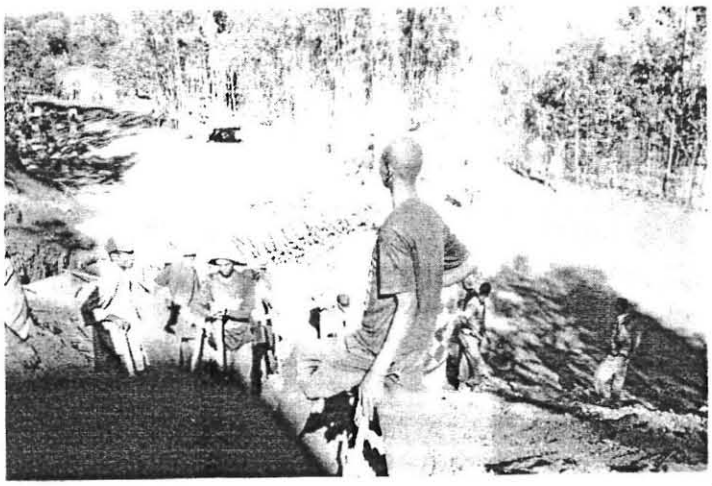


Photo: by Nigussie T.

Fig. 2: People are making money by working as a wage laborers in Beloso Sore

According to study areas' description, it is a common practice of the population to engage in non-farm activities to complement/supplement their livelihood income. During data collection, it was observed that several household heads and their able bodied children migrate to distant areas in search of job. It is common to temporarily migrate to Awash valley in their non-agricultural times to earn income to fulfil their demands (mostly non-consumptive needs) like, marriage and house construction, clothing's and school expenses. However, this study confirms that irrigation made 90% of the sample households to engage in farm activities, the proportion being only 66.6% for non–irrigators.

Based on the survey conducted and observation made, the contribution of irrigation to household food security is found positive. Concerning availability, irrigators could harvest more volume than non-irrigators. Comparing irrigator and non-irrigator households, food consumption out of one's own production shows that some 33.3% of irrigators in the three sample areas produce equal to or greater than their family annual consumption whereas only about 21.7% of non-irrigators managed to produce sufficient food for their yearly consumption. The siginificance test shows chi-square test value of 3.37 . Comparing the pre and post intervention situations, only 1.6 % of irrigators were self–sufficient food producers before intervention, which is lower proportion than that of 15% after intervention situation.

As confirmed by MoWR (1999), the impact of irrigation at farm level is to improve productivity of either food or cash crops. In this aspect the study area exhibits changes of cropping pattern from production of food crops to production of other crops for earning cash income. For instance, Lebu SSI scheme beneficiaries started to use their land for Onion and Tomato production in dry seasons, with very few of them assigning small plot of land for

Maize production and Sugarcane, which can be clearly seen in table 9, diversification practice increased after intervention. The difference of diversification after intervention is found to be significant at 10% level of significance (X^2=3.28).

By increasing income, access to marketable food has been improved, since access is one of the dimensions of food security to the contrary to Fuad's conclusion. Fuad (2001:29) states that, irrigations helping to raise cash income but because it is controlled by males and less by female who are responsible for food preparation, its impact on food access is insignificant.

Group discussion with female affirms that access to marketable products as being improved, since, females who used to stay around homestead take care of garden, it is better for them to take whatever the market needs for sale and use the income to buy household consumables.

In general, based on the chi-square test, the contribution of irrigation to household food security is observed to be statistically significant (see table 9) in food self-sufficiency, farm activities engagement and hence income and food diversification by affecting access, availability and utilization pattern.

However, as indicated in chapter two, the existence of irrigation for a long time could hardly bring significant changes in attitudes of people of the study area. It indicates that establishment of structures are creating little effect, unless it is supported by required follow-up and building of technical skill about operation and its importance. Taking the opportunities of the existing free-market economy individuals could decide on how to use their farmland.

By way of concretising the finding remarks it is presented in a nut shell as follows:

As could be perceived from table 7 most of crops are firstly designed to cover household consumption even though some of the respondents, particularly irrigators, chose for both sales and consumption. However, the contribution of existing irrigation schemes, could affect their

existing habit of growing only cereals than other types of crops. Irrigators in Lebu grow vegetables like Onions due to the existence of irrigation facilities. It would have been impossible for them to do this without this canal water. By so doing, irrigators use rainy season for production of food crops like 'Teff' and the dry season for the production of crops for market and get income. Regarding the question raised during the group discussion about the use of irrigation for Maize cultivation instead of Onion, the response of Ato Tesfaye, secretary of WUA, was

> *" It is by far better to produce onion for market and use the income to procure food items from market, since they are currently very cheap and could use the rest of money for purchase of other items."*

The contribution of irrigation is also perceived in another dimension, that is distribution. According to the responses of some of the respondents, the availability of harvest during non-harvest and expensive times, irrigation enables them to get their products distributed over different times/seasons of the year.

Irrigation allows harvesting crops in dry-seasons, when some crops disappear from market and hence, enables to earn better price and increase income. By distributing the harvesting time both household nutritional balance and better income can be attained, and hence, two dimensions of food security: availability and access are secured.

Moreover, given the ever-decreasing land size, irrigations' effect on intensification of agriculture is considered. With the existence of irrigation water, dry season production is made possible. Besides, the shift to grow horticultural crops such as Sweet potatoes, Beat roots, and Onion rather than cereal crops has implication for maximizing carrying capacity of the farmland. It has been proven that non-cereals on the same sized plots, can yield more income than cereals.

Table 9 Summary of the findings

		Results			
Reference	**Variables**	**Irrigators**	**Non-irrigators**	**X^2 -Value /sign. Level**	**Contribution**
Table 8	Income: better off	56.7%	38.7%	0.06391	Access
Table 6	Self-sufficiency	33.3%	21.7%	3.37	Availability
Table 6	Production: Agri. Intensification	78.33%	11.66%	3.29	Distribution Availability
Table 8	Agricultural Engagement	88%	66%	5.51	Access Availability
		Before intervention	After intervention		
Table 7	Multi-cropping/ diversification	40%	93.3%	3.28	

* Critical value for df = 1 and sig. Level 10 % = 2.706 (taken from Fisher &Yates statistical tables for biological, agricultural and medical research, 1974)

Note: Chi-square result show significant variations in income level (wealth status), agricultural intensification, farm engagement and diversification for the study areas, since their value is greater than the critical value of 2.706.

Other Benefits of Irrigation Observed in the Study Areas

Grasses in the banks of canals for 'cattle/calves is used by households in dry seasons, otherwise it is impossible to find such soft grasses especially in hot zones and in places where there exist no 'Enset' cultivation.

Some ladies were observed using the canal water for cloth washing at their gate along with undertaking domestic activities. Some are fetching water for home use and floor plastering without going to distant rivers or otherwise. Additionally, communication and transport facilities are being attracted due to the existence of such schemes. For example, in two of the three schemes, merchants come with their 'ISUZU" vehicles to carry Onion and Sweet

potatoes Ginger, directly from farm plots (fields). These vehicles (mini-truck) are being used as means of transport to nearby markets and service centres like health stations, which in turn contributes to improve living standards of rural communities.

Furthermore, the availability of irrigation system could attract infrastructure development and investment. In Damote Woyide Woreda, demonstration plot is established to teach users about the use of irrigation water. In Lebu, a NGO called Self-Help had constructed store and had established system of marketing for their products in addition to the provision of credit. Onion is easily damaged if not stored carefully and all producers harvest it nearly at the time when no change in market demand.

As Economics explains price can be determined by supply and demand, the effect of such harvest is adverse and leads to price reduction. The financial feasibility of those products in turn, may be in question. Expecting such an adverse effect of irrigation development and the irrigators' performance, NGO called Self-Help is working with WUA of Lebu. This NGO had constructed standard warehouse for Tomatoes and Onions storage, where products could be purchased and kept until favourable market might be found. Rural credit is also provided by the same organization for the purchase of inputs.

4.5 Effects of Irrigation on Womens Roles

a) Bissare *Small-Scale Irrigation Scheme*

Women at this site are observed working on the farms. Previously due to the remoteness of the farms from their home places, involvement of women in farm activities was very limited. As indicated in chapter three, currently farming activities with irrigation, especially surface irrigation, is labour intensive. At the same time, these canals enable to cultivate near-by homesteads continuously and facilitated the use of female labour in production activities. Since labour itself is a resource, which is to be utilized efficiently with the aim of increasing cumulative production, the contribution of irrigation in this respect is considerable. Even though women have a lot of socially assigned domestic roles to play, irrigation has helped them in reducing domestic workload. As one can see from table 8 in 88 % of responding households, all family members including female are involved in agricultural activities, its non irrigators counterpart is only 66%.

In sum, as stated by Adugna (2000:5), some of the uses of irrigation on top of its agricultural production are: washing, drinking water for animal and supplying water for domestic purposes. Accordingly, Women at Bissare SSI scheme could save time for farm activities, by not spending time to get water for cattle from distance areas for their cattle. And about 95% of group discussion participants favour irrigation for its contribution in releasing females' time for farm activities

b) Lebu Small-Scale Irrigation Scheme

As observed in the area, in this scheme whole family members participate in farm activities related to irrigation. Due to the shortage of water and the scheduling problem when men go to divert water from secondary canals that are located at a distance, other family members

should distribute water to the plants in their farms. As one irrigator replied as to the reason why he did not irrigate all his irrigable land, he said,

"I am so weak and old that I can not compete with other young people. By the time I arrive at my plot from the point of diversion, others may divert it to their line unless my wife helped me". He also added, " given the absence of any helper how could I protect my sugarcane from thieves?"

The implication here is that irrigation helps to make household members busy on working on farms and to exploit available labour resource in the area under study including female labour.

c) Weyibo Small-Scale Irrigation Scheme

In Weyibo, access to food is relatively more accessible to female members since perennial crop production is accustomed in the village and is possible for reaping easily whenever need arises, relative to those without irrigation facilities.

A lady at Metela village stated, " *Due to the existence of the irrigation facility we could get food items from our home stead garden through out the year, otherwise we expect to get some only during 'mehar' harvest before putting yield in to store or 'Keffo'."*

4.6 Major Factors Affecting Irrigation Practices at Household level

Number of factors can determine irrigation practices in all sample schemes. However, some of the factors are local and culture specific.

a) ***Bissare***: the mostly responded problems by users and potential users were:

- Lack of knowledge about the existing situation such as comparative advantage, market information etc;

- Its location in the lowland where sparse population is settled; wild animals attack crop and difficulty of controlling own farm;
- Poor water scheduling/distribution and failure to get sufficient water at lower streams according to design, occur mostly due to the extravagant use of upper stream irrigators. Some farmers use water for their farm regardless of crop water requirement of each crop type (CROPWAT);
- The traditional belief, that some people on the command area are satisfied with single harvest, in a year; and does not support the idea of multiple harvest by in fear of losses of fertility in the long-run. However, design could not consider this fact and neglect Indigenous Technical Knowledge of the targeted beneficiaries and undertook non-participatory planning. Hence sustainability of the schemes performance might be in question, if appropriate training is not provided to them;
- Lack of input, mainly of labour and oxen, especially in case of female-headed households. These female-headed households are reluctant to take loans and use their plots in fear of crop loss and failure to repay the loan because they are forced to give/rent that farm plot for a lender until all debt is paid/recovered from the yield.
- Level of awareness by itself could pose difficulty in irrigation development, since most of the irrigators are reluctant and ignorant of other uses of such intervention. If they manage to produce what is enough for them, they are less interested in surplus production. Therefore, they want to fallow their plots having the aim of protecting their land productivity. On the contrary, the WUA guideline does not allow farmers to leave irrigable lands idle without cultivation.

Therefore, to maximize benefits from available resources, taking in to account both sustainability issue of the natural resource base and ITK of local users, appropriate action should be designed.

b) ***Lebu***: frequently expressed causes for inefficient use of the irrigation facility are:

- Weak WUA committee; that they fail to effectively administer water distribution schedule;
- Poor legal power to protect the benefit of users and left unauthorized users of the scheme in the upper stream unaffected. Due to poor exclusion of unauthorized use of irrigation, reduced designed volume of water for down stream users;
- Input limitedness and poor/risky credit system. Irrigators were managed to get some loan from an NGO called Self-Help but due to price reduction of agricultural products and similarity of items produced, most irrigators could not pay back their loans;
- Poor maintenance, the non-existence of legal body to resolve such problems, and the undefined line of communication between implementers, users, and government;
- Conflict of interest of the users: they know the importance of cleaning canals at their land holdings but they want to use the banks of canals for growing grasses for their cattle;
- Lack of or weak farmers training. Training at the beginning helped very little, since the training is for very short time before practicing it. It would have been better, if they had been trained after using the system based on their demand;

c) ***Weyibo***: Similarly irrigators (both actual and potential) at this scheme were not using these facilities for more than ten years at full capacity. Their rationales for this based on survey are:

- Poor maintenance and the need for rehabilitation;

- Ignorance of the systems operation due to lack of appropriate and demand-driven training for the users;
- The area's being at climatically moderate zones and rainfall sufficiency in normal years might reduce interest of using the system; and
- Availability of neither strong organization and management system nor clearly defined responsible entity, to deal with the effectiveness of such infrastructure;

4.7 Constraints in Developing Irrigation Projects

In general, as discussed in the literature part, the successes of such interventions are determined by several factors, which are interrelated to one another. In general, their successes are determined by actions taken from the time of project inception to its implementation. The level of participation during planning can mostly determine the sustainability of such projects. Evaluation of the ***Hare*** irrigation project (AWIT) indicates that the failure of such a huge project accounts to the non- participatory planning. Similarly ' ***Sesiga***' irrigation in Gofa Zone could hardly be put in to operation since, the main canal affects the usually used road to markets. Before investing any capital for irrigation development/construction, there must be detailed discussion with pertinent stakeholders.

Manageability and maintainability of irrigation schemes have a significant effect on their success. Absence of clear line for information transmission and formally concerned body to deal with maintenance issues had posed to its limit on the use of the schemes. For example, in 'Weyibo ' several years were passed without using the irrigation facility due to the failure of cleaning canals. To solve the problem, there exists neither mandated and equiped body nor technically competent users.

As it is also frequent experience of many African countries' similar interventions, in the study areas, there are several factors, which affect the use of established schemes. These factors can be categorised as practical /technical, attitudinal and policy related. Similarly, many of our schemes are not operating at targeted manner and designed capacity. On the basis of the survey findings some factors affecting the practicality of the irrigation schemes are the following:

1. Most irrigators are complaining for poor irrigation quality that resulted in crop failure;
2. Water volume decrease is also considered as a factor. During dry –season they do not get the expected amount of water. This has indicative implication of the poor design and the non-existence or weak rule of law; for example, in 'Lebu ' SSI scheme.
3. Pertinent education and training about the use of irrigation water together with its long–term consequences have great importance in smoothening the operation of schemes under operation. Farmers (irrigator) are not sufficiently aware about the water requirement of different types of crops; and hence, frequent conflict arises among them (e.g., Lebu).
4. Non-existence of a well-organized operation and maintenance system and WUA is also one of the major constraints. Poorly mandated WUA committee could not mobilize users for even minor maintenances in 'Weyibo and Lebu' irrigation schemes.

Chapter Five

CONCLUSIONS AND POLICY SUGGESTION

5.1 Conclusions

In this chapter, the whole work of this research is summarized and presented briefly. With the aim of pin pointing attributes of the study areas, such as food security situation, irrigation development status, efforts made in the sector development, strategies implemented and results achieved. Moreover, success factors and challenges posed the successes of interventions are assessed. In the last section critical discussions of findings, and practical and educational suggestions are presented.

The study areas: Damot Wayide, Boloso Sore, and Sodo Woredas, are areas where there exist both types of food insecurity: Chronic and transitory, resulted from recurrent drought, high population density, fragmented land holding size, and irregular/ erratic nature of rainfall. They are places where relief and food aids were distributed several times (see Appendices) and registered as priority targets for interventions and government attention.

Irrigation potential of the areas under study is attractive as the quality and quantity even though, accessibility to develop/construct them is a great challenge. In addition, Ethiopian Governments' programs and policy strategies focus on irrigation development for the improvement of economic growth in general, and poverty reduction and food security, in particular, are good indications for the attention given to the sector's development. To address the issue, policy options are provided and implemented by emphasizing the necessity of irrigation development. For example, both the Federal Food Security Strategy and Water

Resource Development Policy considered irrigation development as a basic component of the framework.

With the intention of realizing of the above targets, resource potentials and viability of their development are assessed and found feasible. Perennial rivers and their adjacent command lands in these three Woredas are viable for the sector's development to complement and supplement usual low and unreliable rain-fed agriculture in some of the study areas. In the region, irrigated agricultural practices were started as a mechanism against the risk of crop failures due to recurrent moisture stresses. However some modern irrigation development activities were found non-operational in the study areas for a long time. The reasons for their failure were top-down imposition of development plans, disregarding indigenous technical knowledge of the targeted communities, blanket planning approach, non-participatory decision, low local resource consciousness, poor awareness creation and problem of land tenure arrangements, among others.

According to study findings, it can be concluded that irrigation development could bring positive social benefits on top of its economic benefits in the study areas. Therefore, the contribution of rural infrastructure like irrigation schemes construction to overall economic development, poverty reduction, infrastructure development attraction, employment creation, food security, skill/mental growth, means for transfer of technologies and gender considerations are perceivable.

Irrigation development contributes to agriculture production and productivity improvement. This increase in agricultural production is due to agricultural expansion and intensification. Moreover availability of food is improved by product diversification. Irrigations development enables to bring uncultivated land under cultivation and enable multiple cropping with in a

year time (agricultural intensification).

Besides, irrigation made possible to diversify agricultural production by creating favourable condition to many of non drought-resistant crops production. By irrigation, irrigators could produce more crops like Sweet Potatoes, Onions, Vegetables and Perennial crops than non-irrigators.

Similarly livestock feed is improved and hence, food availability is maintained by production of milk and milk products due to available crop by-products like leaves of Sweet Potatoes, Corncob and stems, and their uses as animal feed.

Operational schemes in the region are mostly those constructed/ upgraded in the areas where traditional irrigation schemes are being used which indicates that prior adaptation and awareness about the use of the system determines sustainability of operation.

However, these schemes are found operating at less than their designed capacity due to several constraints. To mention some:

1. Some of the schemes are not virtually desired by beneficiaries, (eg. Weyibo, Soke) it is found that due to lack of awareness about its use.
2. Less number of beneficiaries than indicated in project document, which was calculated based on a 0.25 ha per household, are practicing (e.g., Weyibo, Bissare).
3. Beneficiaries are not readily flexible to adopt new technologies and hesitant to agricultural intensification; i.e., by giving reason that double and triple cropping may decline long-term land productivity (Bissare).
4. Some (irrigation schemes) are being used in a way different from proposed in their study documents and hence less efficient. For example, Kankara and Betto are modern

small-scale irrigations but used in a traditionally adapted and inefficient manner resulting in low productivity. This is excused for not giving appropriate training about operations management and maintenance of irrigation schemes.

5. Goyimo SSI scheme leads to deforestation of reserved natural forest. Because concerned owner individuals, to expand their agricultural plot, clear jungles. Agricultural expansion due to availability of water, leads to disturbance of ecological balance and source of firewood.

In sum, most commonly identified problems accounting for low performance of irrigation development are land tenure, poor site selection, input and supplies shortages, marketing, non-participatory planning practices, environmental concerns, and lack of training.

In this work, therefore, the objective of investigating the impact of irrigation in household food security status and their ways of contribution are dealt, and were found that irrigation development can have positive cause and effect relationship with household food security in the region. Factors those may retard the effectiveness and sustainability of such projects were also identified.

5.2 Policy Suggestions

In order to bring a beneficial impact on rural living condition, policies ought to target at facilitating the increase in agricultural production and productivity; and ensuring their sustainable usage and performance status.

Regional Food Security Strategy (1997), under the framework of Federal Food Security Strategy (1996) also states that, as the level of food security is directly or indirectly linked

to many aspects of an economy, programs drafted to address such issues ought to be integrated and comprehensive rather than sectoral/fragmented.

It is a known fact that, agriculture occupies central place for the realization of food security. Though agricultural activities are dependent on the availability of arable land, land fertility, and its size, and the quality of labour engaged, its output is also determined by the timeliness and adequate distribution of rainfall received. However the predominance of dry and semi-arid agro ecological climatic zones in the region is the natural factor that has been exposing the people in the areas to recurrent food shortages. According to DPPB's (2001) situation assessment, 1,408,000 people who are about 13.67% out of 10,297,108 have already been affected by the recurrent food shortage (see appendices).

As long as of utilization of water and land resources are possible, overcoming the problem of food insufficiency in conditions where not only frequent occurrence of drought but also the erratic nature of rainfall, is a promising effort (WB June 1996:46-48,90). On the same trend, the appraisal of the region's irrigation potential (annex 4) indicates that utilizing available potential can solve the problem of food insecurity of its population if appropriate designing, beneficiary involvement, continuous follow–up and monitoring with pertinent extension services are incorporated. Irrigating 42,825 ha of land in the region will secure 828,900 peoples' food requirement (appendix).

Therefore, coordinated effort of all development actors must be designed in such a way that each part may play respective role efficiently at a minimum slack time and resource use. For instance, if irrigation development is synchronized with the development of rural infrastructure like rural road, afforestation and water shade catchments' management, it becomes possible to secure its sustainability and reduce costs that would have been expended for more schemes development.

According to observation, most of the constraints are resulted from lagging technical skill, lack of awareness about the benefits and short and long-term effects. Therefore, pertinent and timely training should be given to users as well as implementers and rural extension agents.

Since, policy dictates consideration of social strategy on top of economic growth; and social environmental contribution of irrigation in the region is feasible, irrigation development is imperative to pursue. Policy change and improvement of institutional performance by governments are also essential for many of the opportunities indicated above to be realized. This research arrived at a conclusion of favouring irrigation development especially SSI in lowlands, and densely populated parts of the region with due attention to complementary and related sectors' such as rural road, extension, credit, market development and the like.

It is also found that their contribution in addressing the problem of food insecurity is noticeable, because irrigation could positively affect food availability, access, utilization and distribution, even at the existing level of operation, providing some preconditions. To get these goal addressed, effective exercise is needed in bringing the following conditions:

- Regard willingness by the intended beneficiaries to allocate land as well as their financial participation, as pre-conditions for any government involvement in development.
- Allow SSI to find its own place among the various activities from which rural people make their living.
- Allow the irrigators to determine their own cropping patterns on the basis of local comparative advantages, and facilitate marketing conditions that can alleviate

structural food deficit.

- Attention should be made for improvement of traditional schemes and rehabilitation of old schemes so as to increase national and hence, household food supply, on top of constructing new structures.

As noted above, water development policy should adopt a pluralist approach and promote large and small-scale water resource projects. But given our own past experience and the investment resources at the country's disposal, policy should place especial emphasis on the development of small-scale (SS) projects.

What is required, in other words, is a new water consciousness, which recognizes that sustainable water schemes should be based on local resource usage, and that water users should have sufficient knowledge and respect for the resource, which is so vital for their livelihoods.

REFERENCES

Adam, W.M. (1992). Wasting the Rain: Rivers, People, and Planning in Africa. East Scan Publication Ltd. London.

Adugna Jabesa (2000). Irrigation Development (in Ameharic): *Water for 21st century*. MWR, Water and Development, Vol. 4, No. 14, May 2000, Addis Ababa

Bargahvas (Dr.) B.S. (1980). Minor Irrigation Development Administration (A study in an Indian State), Ashish Publishing House, New Delhi, India.

Best J.W.James V.Kahn, (1999). Research in Education: 7ed. Prentic Hall of India Plc. New Delhi-110001.

BOPED (1998). Socio Economic Profile SNNPRS. Awassa

Brown E.P. & R. Nooter (1995). Successful Small-Scale Irrigation in the Sahel. World Bank Technical Paper No. 171, Washington D.C.

CO-SAERSAR, (2001). Regional irrigation Potential Assessment, Awassa (unpublished).

CO-SAERSAR (1997). Feasibility study Boloso Sore, Awassa (unpublished)

CO-SAERSAR (1998). Feasibility study Damot Woyede, Awassa (unpublished)

CO-SAERSAR (1997). Reconnaissance Survey Boloso Sore Awassa (unpublished)

Dagnew Eshete (2001). Differential impact Assessment of Disasters and Coping Strategies: A research methodology Experienced in Ethiopia. Berhanena Selam Printing Press, Addis Ababa, Ethiopia.

Dagnew Eshete (2000). The Role and Contributions of Non Government Organizations (NGOs) in Food Security in Ethiopia

Dagnew Eshete (1995). Indigenous Coping Mechanisms in Times of Disaster: A Case Study of Wolaita Awraja in Southern Ethiopia. Addis Ababa, Ethiopia.

Dagnew Eshete (1994). Food Security, Household Coping Strategies with Food Shortage and Food Security Planning Approaches. Addis Ababa, Ethiopia.

Desalegne Rhameto (1999). Water Resources Development in Ethiopia: Issues of Sustain Abilities and Participation, Forum for Social Studies, Addis Ababa Ethiopia.

Donald Campbell (1995). Design and Operation of Smallholder Irrigation south Asia. (W.B Technical Paper No. 256), Irrigation and Drainage series Washington D.C.

DPPB (1997). Regional Food Security Strategy Awassa (unpublished)

DPPB (2001). Regional Food Security Situation Assessment Findings. Awassa, (unpublished).

EVDSA, (1996). National Irrigation Policy Paper Addis Ababa, Ethiopia.

FAO (2000). Socio –Economic Impact of Smallholder Irrigation Development in Zimbabwe: Case studies of ten irrigation scheme. Harare, Zimbabwe

Fasil G/Kiros, (1993). The Subsistence Crisis in Africa: The Case of Ethiopia. OSSREA ICLPE Science Press, Nairobi, Kenya.

Fuad Adam (2001). Small-scale Irrigation and Household Food Security: A Case Study from Central Ethiopia. Forum for Social Studies, Addis Ababa.

FDRE, (1996). Ethiopian Food Security Strategy. Addis Ababa, Ethiopia.

Getachew Alemu(2000). Rain Water Harvesting in Ethiopia: an Overview: *Water and Development* V.4, No. 15 September 2000, Addis Ababa.

Getachew Diriba, (1995). Famine and Food Security in Rural Ethiopia. Economy at the Cross Road. CARE International in Ethiopia, Addis Ababa, Ethiopia.

GOE. (2000). Ethiopian Interim Poverty Reduction Strategy Paper (2000/01-2002/03). Addis Ababa, Ethiopia.

Kidare Georgis (1999). Agronomic techniques for higher & sustainable crop production in the dry land areas of Ethiopia food security perspective. *Proceedings of the first National Workshop of NOVIB partners forum on sustainable land* use (ed.) Taye Assefa.

Leslie E. and Svendsen M. (1992). Working Papers on irrigation Performance 1: A Framework for Assessing Irrigation Performance. IFPRI.

Michael A.M. (1978). Irrigation Theory and practice. Vikas Publishing House pltd Newdelhi, India.

Mitchell B. and Donald O. MarlinalaD. (1995). Global and Regional food supply prospect: *population and food in the early 21^{C}, meeting future food demand of an increasing population.* (ed.) Nurul Islam. 1995.

Mosher A.T. (?). Getting Agriculture Moving

Mulat Demeke (1999). Rural Development and Poverty. Department of Economics, FBE, AAU (unpublished).

MWR. (?). Ethiopian Water Resources Management Policy, FDRE, Addis ababa, Ethiopia.

MWR (1999) AFD Programme for Irrigation Development Project in Amhara, Orormia and Southern Regions, Finalization of Feasibility study.

Rees Ton & Kees Dejong, (1991). Irrigation Technology and Social Change: An analysis of the Social Variable of Technology: *Journal of Developing Areas*, Vol.25, No. 2 January 1991. Ed. Ill ions University, 900 West Adams street. U.S.A

Shawki Barghouti And Guy Le Moigne (1990). Irrigation in Sub-Saharan Africa: The Development of Public and Private Systems, W.B Technical Paper No. 123, Washington D.C.

SNNPRS (2000). Basic Informations of SNNPRG: facts and figures

Tesfaye M. Zegeye and Debebe Habtewold (1995). Food Security in Ethiopia: A Situation Analysis: A Paper Presented on the Inagural and First Annual Conference of Agricultural Economic Society Series No. 2, CSA, Addis Ababa.

Teju Asaminew (2000). Problems Due to Improper Irrigation use. *Water for 21st century.* MWR, Water and Development, Vol. 4, No. 14, May 2000, Addis Ababa.

Warren D.M. (1991). Using ITK in Agriculture. World Bank Discussion Paper No. 127. The WB. Washington D.C., USA.

World Bank, (1992). World Development Report: Development and the Environment. Oxford University Press, New York.

World Bank June (1996). Case Studies in War-to-Peace transition. World Bank Technical Paper No. 331 Washington D.C.

World Bank (1995). Future supplies of Land and Water for World Agriculture. World Bank Technical Paper No. 184, Washington D.C.

World Bank November (1996). Global Food Supply Prospects: A Background Paper Prepared for the World Food Summit Rome. World Bank Technical Paper No. 353, Washington D.C.

World Bank (2001). Private Infrastructure in East Asia: Lessons learned in the Aftermath of the Crisis. World Bank, Technical Paper No. 501, Washington D.C.

Annex

Survey Questionnaire for Assessing The Role Of Irrigation In Addressing The Problem Of Food Insecurity In The SNNPRS.

Name of enumerator.....

Date .....

Name of the Respondent .....

A. General Information

1. Zone .....
2. Woreda .....
3. Agro-ecological Zone .....
4. Name of Kebele Administration .....

B. Questions For Farm Households Of Both Irrigator & Non-Irrigators With Specific Reference To Major Food And Cash Crops.

1 . House Hold Demographic And Socioeconomic Characteristics

1.1 Age .....

1.2 Sex 1 = Male, 2 = Female.....

1.3 Household Size 1 = Less than 3, 2 = 3-4, 3 = 5-7, 4 = 8-10,4=greater than 10].....

1.4 Position of interviewee in the Household 1=Head,2=Spouse of the head

1.4.1 3= Household member.....

1.5 Size of landholding in hectare(in any local unit) [1= Less than 0.5, ,2 =0.5-1, 3= 1-1.5,4=1.5-2, 5 = 2.0-3.0, 6 = More than 3 ha.. .....

1.6 Level of Education 1=Illiterate, 2 = Read only, 3=Read and Write, 4=Elementary School, 4=Junior Secondary School. 5=High School, 6 = other .....

1.7 Wealth Ranking according to the local community standards [1=Rich,2=Medium, 3=poor,4=Very poor] .....

1.8 Would you mind to tell me indicators for your wealth ranking 1= Oxen & corrugated iron roofed house, 2= Watch Radio & blanket 3= Mule donkey..4= other (specify)

1.9 Socio-Political Status within the Community? [1=Leadership member of the Kebele Administration,2=Farmers Cadre, 3= Community elder,4=Representative or Leader of Religious Setup, 5=Other(Specify)

2. The following questions are about the household Participation in the (Use of irrigation Projects)

Do you participate in irrigation based farming

2.1 For how many crop production seasons have you participated in irrigation, based production 1 = 9 – 10, 2= 7- 8, 3 = 5 –6, 4 = less than 5, 5 = not used .....

2.2 How was your agricultural production harvest for the last three years on average? 1= excess of annual household consumption, 2 = sufficient for consumption 3 = sufficient for only 6 months, 3 = sufficient for about 9 months, 4 = sufficient for less than 4 months, 5=for 3 months, 6 = less than two months

2.3 Which of the food grain crops have you adopted through the use of irrigation schemes? [1 = Wheat, Maize & Teff, 2 = Wheat & Maize 3 = Wheat & Teff, 4 = Maize & Teff, 5 = only Wheat] 6 = horticultural 7= Livestock 8 = other cash crops (specify).....

2.4 Why do you choose them ? 1= climatic & due to irrigation, 2 = economic advantage(better marketability, 3 = household food demand, 4 = other (specify) .....

2.5 Who are the main workers in your farm usually? 1 = only male family members, 2 = all family members, 3 = family and relatives, 4 = family and hired labor, 5 = others (specify)....

2.6 Do you send your children(young family members to school)? 1=yes, 2 = no, 3 = not all

2.7 If no and not all, why? 1= school distance, 2 = absence of food, 3 = lack of educational materials and money for tuition, 4 = thought as unnecessary, 5 = Other(specify).....

2.8. Which of the following inputs have you used for your seasonal production 1 = Fertilizers. Improved Varieties, Herbicides and pesticide, Improved Farm Implements, post harvest Technologies & Extension services by Development Agents, 2 = Fertilizers, Improved Varieties, Herbicides and pesticides, Improved Farm Implements & Post harvest Technologies, 3 = Fertilizers, Improved Varieties, Herbicides and Pesticides, Improved

Farm Implements, 4 = Fertilizers, Improved Varieties, Herbicides and pesticides. 5 = Only Fertilizers & Improved Varieties].....

2.12 Would you describe the inputs you used in quantity?

Item	Quantity(in local unit)
Improved seed	
Fertilizer	
Herbicide	
Pesticide	
Other (if any)	

3. The Following Questions Are About The Household Achievements In Benefiting From The Schemes.

The Table below presents area of land on which production activities have been undertaken, and amount of production obtained since and before the establishment of the schemes, if any.

Years	Area in Hectares	Other cash Crops	Harvest Obtained in Quantities				
			Cereals	Vegetables	Fruits	Total	Average Per Capita
Before schemes dev.							
When scheme started							
At full dev.t (3 yrs. after completion							
Last harvest season							
Total							

1 How do you estimate the increase in the yield of **cereals** through the adoption of irrigation schemes as compared to the harvest through traditional rain fed farming?

1 = It is tripled , 2 = It is doubled, 3 = It is 1 & half times greater, 4 = no difference

.....

2. How do you estimate the increase in the yield of **Vegetable** through the adoption of improved packages as compared to the harvest through the traditional farming?
[1 = It is tripled, 2 = It is doubled, = It is 1 & half times greater, 4 = It has no difference]
..... ☐

3. How Do you estimate the increase in the yield of **fruits & perennial crops** during the years when compared to the harvest through the traditional farming?
[1 = It is **tripled or more**, 1 = It is **doubled**, 3 = It is **half times** greater, 4 = It has **no difference**, 5 = decrease ..... ☐

4. Referring to the above Table, how do you estimate the average total increase in the yield of all the three crops together during the years of intervention when compared to the harvest through traditional farming? [1 = It is **tripled or more**, 1 = It is **doubled**, 3 = It is **half times** greater, 4 = It has **no difference**] ☐

5. Referring to the above Table, how do you estimate the average total increase in per capita production of all the three crops during the years of intervention when compared to the harvest through the traditional farming?
[1 = It is tripled, 2 = It is doubled, 3 = It is 1 & half times grater, 4 = It has no difference, 5 = It is diminishing] ..... ☐

6. how do you estimate the average total yield of live stock & their products during the years when compared to the harvest through traditional farming? [1 = It is **tripled or more**, 1 = It is **doubled**, 3 = It is **half times** greater, 4 = It has **no difference**] ?? ☐

D. The Following Question Are About The Household Problems In Using Irrigation Schemes

1. Who are the owners of Irrigation schemes? [1 = The Government, 2 = Private Companies, 3 = Service Cooperative, 4= Individual Farmers (you), 5 = Other Community Based Organizations (Specify) ..... ☐

2. Have you ever faced problems associated with the use of irrigation.
[1 = Yes , 2 = No] ..... ☐

3. If the answer to the above question is 'Yes', what are the major problems? please tick the problem

[1 = Shortage of Water 2 = down stream conflict 3= the timing of irrigation water flow 4 = Lower quality. 5 = Delaying of system. 6=Water use administration Problem, 7 = lack of maintenance 8=Land size reduction 9 Problems = 1, 2, 3 & 4 **10** = The problems indicated in choice # 1, 2, & 3, **11** = The problems indicated in choice # 1 & 2, 12 = Other administrative Disincentives in the process of supply (Specify)……

13 = training or lack of usage/ operation skill.

4. If you are purchasing improved inputs on credit, where do you get the loan?

[1 = From the Government , 2 = From Private firm, 3 = From Local Users,

4= Others (Specify)…… ☐

5. What are the main sources of your annual earnings (cash income) currently.

Source of income	Amount in Birr
Cash crop sales	
Food crop surplus sales	
Livestock (assets) sales	
Remittance	
Non-farm activities out of the village	
Other(specify)	

6. Have you ever faced problems associated with credit repayment?

[1 = Yes, 2 = No …… ☐

7. If the answer to the Question # 6 is 'Yes', what are the major problems?

[**1** = Crop failure, **2** = unaffordability , **3** = Low prices for agricultural products, **4** = Repayment scheduled at leaner seasons, **5** = All of the above choices indicate the problem, **6** = The problems indicated in Choice # 1, 2, & 3. 7 = The problems indicated in choice # 2, 3, & 4, **8** = The problems indicated in choice # 2 & 3, 8 = Other administrative disincentives in credit collection (specify) …..] … ☐

8. Have you faced any problem of crop failure when using irrigation? [1 = Yes 2 = No]

…… ☐

9. If the answer to the Question # 8 is Yes, which of the following are the major causes ? [1 = water shortage 2= production decline 3= siltation , 4 = Crop diseases, 5 = poor irrigation maintenance 6. over flooding of the farm & consequent erosion 7 = All of the above choices indicate the causes. 8 = The problems indicated in choices # 1, 2, 3, & 4, 9= The problems indicated in choices # 1, 3,4, 6 & 7, 10 = The problems indicated in choices # 1, 2, & 11 = Others (Specify) ..... ☐

10. If the answer to the Question # 8 is 'Yes', how many times have you faced a total loss of the harvest? [1 = More than 5 times, 2 = times, 3 = 4 times, 4 = 3 times, 5 = 2 times, 6 = 1 times] ..... ☐

11. Based on the answer for Question # 6, how many times have you faced a partial loss of the harvest? [1 = More than 5 times, 2 = 5 times, 3 = t times, 4 = 3 times, 5 = 2 times, 6 =1 times]..... ☐

12. What are the local of prices for your agricultural products at local markets during harvest seasons? [1=Very cheap. 2 = Cheap, 3 = Competitive,4=Expensive ☐

13. What is the condition of prices for your agricultural products at local markets during the non-harvesting seasons? [1 = Very cheap, 2 = Cheap, 3 = Competitive, 4 = Expensiv ☐

14. What options are available to you to get food items in case of crop failure 1 = Food aid: Food for work & relief , 2 = Market, 3 = Support from relatives. 4 = stock..... ☐

15. What options are available to get cash income in case of crop failure/ low production? 1 wage in locality, 2, wage work in urban areas, 3 remittances 4 Assets sales, 5 other.. ☐

16. What options do you have for the credit repayment when there is a danger of crop failure and/ or marketing problems? [1 = Selling of livestock , 2 = Selling of household assets 3 = Renting out of land, 4 = Borrowing from friends and relatives , 4b. Subsidy or help from relatives 5 = All of the above choices indicate the means, 6 = The means indicated in choices # 1, 2 & 3, 7 = the means indicated in choices # 1, 2 & 4, 8 = The means indicated in choices # 1 & 4, 9 = The means indicated in choices # 1, 10 = Other means (Specify)..... ☐

E. The Following Questions are About Household Food security Conditions For irrigators With Particular Reference to the Food Availability Since the intervention in the area.

1. Per-Intervention Situation

1.1 How do you estimate the per-intervention average pre capita food grain production of your house by comparing the condition after the use of irrigation schemes [1 = it was lower, 2 = It was higher, 3 = It had no difference ..... ☐

1.2 What proportion of the food grains consumed in your household has come from own production? 1 = Full, 2 More than half. 3 = Quarter to half, 4 = Quarter, 5 = Less than quarter, 6 = No own production] ..... ☐

1.3 Can you mention your usual meal composition. 1= Cereals, 2 = livestock product & by-products 3 = vegetables fruits 4 = other (specify) ☐

1.4 Who gets better/more food among your family ?
1, Head, 2 Spouse 3 Children 4, Gusts 5. The same 6, other(specify) ☐

1.5 Which of the following daily dietary times (meal frequency) were experienced in this household? 1 = More than 3 times, 2 = 3 times, 3 times, 3 = 2 times, 5 = Less than 1 times ..... ☐

2. Post - Intervention Situation

2.1. How do you estimate the post intervention average per capita food grain production of your household comparing with the condition before the use of irrigation system. [1 = Increasing, 2 = Decreasing, 3 = No difference ..... ☐

2.2 If the answer to the Question # 38 is increasing which of the followings are the main causes? 1 = intensification, 2 expansion 3 diversification 4 = No return from the system 5 = change in cropping pattern between cash & food crops ..... ☐

2.3 What proportion of the food grains consumed in this household has come from own production since the start of irrigation, programs 1 = Full, 2 = More than half, 3 = Quarter 4 = Less than quarter, 5 = No own production ..... ☐

2.4. Which of the following daily dietary times were experienced in your household since the practice of irrigation system 1 = More than 3 times, 2 = 3 times 3 = 2 times, 4 = 1 times, 5 = less than 1 time

2.5. Can you mention your usual meal composition. [1= Cereals, 2 = livestock 3 = vegetables fruits 4 = other (specify)

2.6. Can you tell us the impact of the irrigation scheme on livestock production in relation to disease occurrences, grazing land & animal feed availability?

1= better, 2 = worse 3 = no significant impact

2.7. Advantages of irrigation are:[1 = to expand farm size, 2 = to intensify production, 3= to diversify crop between cash and food crops, 4 = to fill rain fall gap 5 = to get more food for livestock, 6 = all, 7 = to get more income 8 = 1,2,3,4 & 7

2.8. Do you irrigate all of your irrigable land? [1 = yes, 2 = no]

2.9. If not, why? [1= low productivity, 2 = getting sufficient produce by rain fed agriculture, 3 = poor quality of irrigation, 4 = poor maintenance, 5 = Other (specify) .....

2.10. If 'YES' Did it increase your dement for inputs? 1, Yes 2, No

2.11 did it affect labour requirement for your farm activities? 1, yes 2, No

2.11 did it brought any change on your labour division?

2.12. Do you notice any problem compared to traditional rain fed agriculture?

2.13. If 'yes' could you list them in the order of priority? 1 ....., 2..... 3 4

2.14. Did you perceive any change in your land holding size? 1, increase, 2, decrease 3 no effect

2.15.What institutional support you need in relation to the scheme? 1 O& M, 2, rules and regulations 3, maintenance, 4, other (specify) .....

2.16. In your opinion, how the performance of irrigation is judged? 1, benefiting 2, harmful 3, cost = benefit

2.17.Can you explain about the impact of irrigation on Forests and land utilization? 1, decrease deforestation problem, 2, no change in the trend 3, worsen

Signature of the enumerator .....

Checklist for discussion with key informants

1. How many households have plots on the scheme
2. Can we access the list of irrigators
3. What types of maintenance activities have to be performed on the scheme?
4. How often
5. by whom
6. What are the major problems encountered by farmers in the schemes?
7. Do farmers in the schemes have access to dry-farm land plots?
8. What types of records are maintained in/about the schemes?
9. Can we get information about:
    a. Area under different crops re4cently on the scheme?
    b. Yield?
    c. Level of input use?
    d. Sales record?
    e. Wealth change?
10. In your opinion, what is the impact of the scheme to the villagers in general?
11. If it is positive in what ways?
12. In negative what are the reasons for dissatisfaction?
13. Who is the responsible authority for the running the schemes?
14. Which institution (s) is (are) involved in the process & system in one or other way?
15. What roles are played by each of them?
16. Is there any association like WUA? What are their activities?
17. Is there any effect on cropping pattern/season?
18. In your opinion, do irrigation serve the purpose of ensuring food availability/income growth/ marketability?
19. Is there any problem of land holding size? How can you perceive this problem in this line?

For DPPC

1. What criteria are used for allocating drought relief food?
2. Who determines these criteria?
3. How many types of drought relief are there?

APPEDICES

V Total People Affected and Distributed Food Aid (quintals) From 1996-2000 SNNPR

№	Zone	Woreda	1996		1997		1998		1999		2000	
			Assisted Pop.	Food Aid Distribute	Assisted Pop.	Food Aid Distribute	Assisted Pop.	Food Aid Distribute	Assisted Pop.	Food Aid Distribute	Assisted Pop.	Food Aid Distribute
1	North Omo	Boloso Sore	40,000	33,750	26, 000	15,600	28,536	10,700.9	40,000	10,588	40,000	34,200
		Damot Gale	15, 000	12,380	19, 000	11,400	-	14,907.45	35,400	9,370	21,900	18,720
		Damot Woide	10, 000	9,000	15, 000	9,000	18,563	9,281.68	25,000	9,926	40,300	47,790
		Sodo Zuria	-	-	15, 000	9,000	2,066	516.6	6,000	1,588	12,700	9,530
		Kindo Koyisha	20, 000	18,000	19, 000	11,400	15,679	5,879.45	38,121	15,132	42,700	36,510
		Loma Bosa	-	-	-	-	4,00	1,499.54	-	-	-	-
		Goffa Zuria	10, 000	6,750	-	-	1,333	333.3	16,000	25,411	32,600	24,450
		Kucha	6, 000	6,750	12, 000	7,200	8,290	3,110.12	20,420	32,418	20,400	24,420
		Offa	30, 000	24,750	12, 000	7,200	7,560	2,837.45	6,000	1,588	21,300	15,980
		Humbo	15, 000	12,380	11, 000	6,000	6,000	2,266.3	32,000	12,684	68,000	80,970
		Boreda Abaya	-	-	10, 000	4,500	6,456	1,614	15,000	3,975	31,400	40,190
		Dita Daramalo	-	-	-	-	5,900	2,219	12,000	3,264	15,300	11,480
		Zala Ubamale	5, 000	3,380	8,000	4,800	8,350	3,131.29	16,096	6,389	44,000	56,090
		Kamba	5, 000	3,380	4,700	2,820	12,700	4,764.1	15,600	6,194	25,000	34,200
		Bonke	-	-	-	-	-	-	-	-	12,000	14,400
		Arbaminch	-	-	2,700	2,430	3,580	1,791.42	-	-	6,200	8,480
		Chencha	-	-	-	-	-	-	3,045	-	-	-
2	KAT	Alaba	-	-	-	-	-	-	15,000	5,956	23,300	10,490
		Kedida Gamela	-	-	5, 000	3,000	1,180	148.6	9,970	2,640	10,200	7,650
		Omo Sheleko	20, 000	18,000	4, 000	2,400	2,884	721	34,985	13,891	16,700	16,280
		Kacha Biraa	-		5, 000	3,00	980	245.5	17,613	4,662	4,500	2,030
		Angacha	-		-	-	312	39	6,322	2,511	4,100	1,850

№	Zone	Woreda	1996		1997		1998		1999		2000	
			Assisted Pop.	Food Aid Distribute	Assisted PoP	Food Aid Distribute	Assisted Pop.	Food Aid Distribute	Assisted Pop.	Food Aid Distribute	Assisted Pop.	Food Aid Distribute
3	Guraghe	Mcsk/Marako	-	-	-	-	-	-	-	-	9,100	5,460
		Lanforo	8,600	9,030	-	-	-	-	-	-	3,100	1,400
		Silti	-	-	-	-	-	-	-	-	3,000	1,350
		Dalocha	6,600	6,930	-	-	8,200	3,067	-	-	3,800	1,710
		Goro	6,500	6,830	-	-	-	-	-	-	600	270
4	Hadiya	Lemo	-	-	20,000	12,000	12,000	4,231.3	56,239	44,656	32,600	17,420
		Baclawacho	25,000	24,750	2,300	1,370	3,800	1,426	10,800	2,866	-	-
		Soro	-	-	20,000	15,000	5,300	1,988	3,231	1,283	-	-
		Misha	-	-	-	-	-	-	3,340	1,326.5	-	-
5	S/Omo	Hamer Bena	-	-	-	-	13,104	4,914.06	24,217	9,614	37,400	38,370
		Kuraze	-	-	-	-	8,066	2,016.4	19,093	7,579	39,440	40,470
		Bako Gazar	-	-	-	-	-	0.70	-	-	15,400	18,400
		Selamago	-	-	-	-	-	-	-	-	-	-
6	Burji	Burji	8,000	8,550	-	-	-	16.5	16,304	25,773.6	28,500	29,240
7	Konso	Konso	94,100	84,690	28,400	15,380	22,599	11,299.67	57,352	87,984	157,000	161,080
8	Derashe	Derashe	-	-	-	-	1,150	288	17,152	7,187.4	30,200	30,990
9	Amaro	Amaro	8,000	10,800	-	-	5,750	2,156.27	484	2,762	-	-

III **List of Implemented & on going projects/up-to-the end of 1993 E.C. in SNNPR**

№	Name of the project	Location			Development Area	Benefit. Household	Construct		Sponsor	Project Cost (Birr)	Remark
		Zone	Woreda	Kebele			Started (E.C.)	Comp. (E.C.)			
1	Bilate	Welaita	Weyde	Bilate	1200	2200	-	1964	Gov.	537,928.35	Cost for rehabili.
2	Kette	KAT	O. Sheleko	-	60	240	-	1976	ADF	5,978.30	Cost for rehabili.
3	Lasho	Wolaita	Humbo	Abela	80	320	-	1977	Gov.	UNKNOWN	
4	Lentalla	Hadiya	Gimbicho	-	60	240	-	1978	ADF	UNKNOWN	
5	Wamole	Sidama	Shebedino	-	120	480	-	1978	ENI & GOV	UNKNOWN	
6	Kedoboga	Sidama	Awassa Z.	-	230	460	1981	1988	ENI & GOV	749,751	Not fully completed
7	Gewada	Konso	Konos	Gewada	100	400	1982	1985	ADB	23,303.74	Cost for rehabi. only
8	Shafite	Gamo Gofa	Gofa Z.	Shefite	150	600	-	1986	FAO	UNKNOWN	
9	Woyto	Konso	Konso	Weyto	250	650	1982	1987	FAO	43,271.00	Cost for rehabi. only
10	Ella	Wolaita	Humbo	-	80	320	1986	1987	IFAD	UNKNOWN	
11	Ameka	Hadiya	Konteb	Ameka	153	612	1987	1988	GOV	829,357.00	
12	Gidabo	Sidama	Dale	-	220	880	-	1987	LWF	UNKNOWN	
13	Weybo	Wolaita	Boloso	Hembecho	150	600	1986	1988	IFAD	UNKNOWN	
14	Wondo Wosha	Sidama	Awassa Z.	-	200	400	-	1989	LWF	UNKNOWN	
15	Sezga	Gamo Gofa	Gofa Z.	Sezga	60	240	1987	1988	GOV & IFAD	330,477.00	
16	Ebella	KAT	Kedida G.	-	120	200	1989	1989	GOV	425,785.90	
17	Dobi	Guragie	M.Mareko	Dobi	40	160	1988	1989	GOV	540,533.00	
18	Kankara	Gamo Gofa	Ubamale	Kencho	112	180	1988	1989	GOV	805,866.00	
19	Lebu	Gurage	Sodo	Kela	100	160	1989	1989	ESRDF	1,198,444.00	
20	Betto	Gamo gofa	Ubamale	Bala	100	150	1989	1990	ESRDF	1,364,076.00	

№	Name of the project	Location			Development Area	Benefit. Household	Construction		Sponsor	Project Cost (Birr)	Remark
		Zone	Woreda	Kebele			Started (E.C.)	Comp. (E.C.)			
21	Meshkere	Gamo Gofa	Gofa Z.	Karza	80	160	-	1990	FAO	UNKNOWN	
22	Argoba	Derashe	Derashe	Argoba	150	600	1982	1987	ADB	24,206.84	Cost for rehabi. only
23	Harre	Gamo Gofa	A/M.Zuria	Chano	1,000	2,000	1985	1987	China	$40x10^6$	For remaining works 593,908 in 1990 Allocated
24	Gatto	Derashe	Derashe	-	200	800	-	1982	LWF	Unknown	
25	Lomate	Gamo Gofa	Ubamale	Bato	400	1,600	-	1981	LWF	Unknown	
26	Masta	Gamo Gofa	Ditadaramalo	-	450	1,800	-	1984	LWF	Unknown	
27	Zagie	Gamo Gofa	Ditadaramalo	-	450	1,800	-	1982	UNICEF	Unknown	
28	Wajifo	Gamo Gofa	Satusa	M.Abaya	300	1,22	-	1989	World visi	Unknown	
29	Soke	Wolaita	Boloso	-	90	320	1990	1990	Gov	710,000.00	
30	Lamo	Kat	Omo Sheleko	-	120	400	1990	1991	Gov	1,238,250.00	
31	Lefi	Wolaita	K.Koisha	-	75	300	1990	1995	Gov	1,908,854.00	Not yet completed
32	Hombancho	Hadiya	Soro	-	80	320	1991	1992	ESRDF	890,000.00	
33	Osone	Gamo Gofa	D.Daramalo	-	100	200	1991	1993	ESRDF	1,260,000.00	
34	Segen Gete	Konso	Konso	-	200	800	1991	1992	ESRDF	1,900,000.00	Finishing works remain
35	Gonjo	Hadiya	Soro	-	100	400	1991	1992	ESRDF	1,200,000.00	
36	Bisare	Wolaita	D.Woyde	-	164	600	1991	1992	ESRDF	1,460,000.00	
37	Duano	Amaro	Awaro	-	100	400	1991	1992	ESRDF	1,240,000.00	
38	Weldiya	Gurage	Sodo	-	80	320	1992	1992	ESRDF	840,000.00	
39	Goymo	Gamo Gofa	Kemba	-	55	220	1992	1992	ESRDF	500,000.00	
40	Sille	Gamo Gofa	A.Zuria	-	310	570	1992	1992	LWF	Unknown	

№	Name of the project	Location			Development Area	Benefit. Household	Construct		Sponsor	Project Cost (Birr)	Remark
		Zone	Woreda	Kebele			Started (E.C.)	Comp. (E.C.)			
41	Goha	Gamo Gofa	D.Daramalo	-	200	595	1992	1992	LWF	Unknown	
42	Erbore	South Omo	Hamer Bena	-	100	400	1991	1993	Gov	1,296,922.00	On going project
43	Bedessa	Wolaita	D.Woyde	-	100	400	1993	1993	ESRDF	733,300.00	On going project
44	Kako	South Omo	Bakg Gazer	-	120	600	1993	1993	ESRDF	1,194,600.00	On going project
45	Zenti	Gamo Gofa	Gofa	-	120	600	1993	1994	ESRDF	1,313,000.00	On going project
46	Menissa	Wolaita	Offa	-	200	800	1993		ESRDF	1,739,000.00	On going project
47	Ablle		Kindo K.	-	100	400	1993		ESRDF	627,500.00	Not started due to budget constraint in ESRDF
48	Lasho		Humbo	-	100	400	1993		ESRDF	2,000,000.00	On going project
49	Dobena	Gurge	M.Mareko	-	150	600	1993		IFAD	1,417,350.00	On going project
50	Maze	Gamo Gofa	Kemba	-	200	800	1993		IFAD	1,548,100.00	On going project
51	Megera	Wolaita	Boloso Sore	-	60	240	1993		AFD	1,800,000.00	On going project
Total					**9,539**	**30,137.00**				**72,975,133.74**	

Note:

- Some of the projects are without their original construction cost & the cost indicated refers only rehabilitation cost please, see the remark.
- It is supposed that all those projects undergoing 1993 will be completed the same year.
- The Double Counting of Lasho project is due to the activities done during construction & now a major rehabilitation after 16 years.

Source: *CO-SAERSAR Regional Irrigation Potential Assessment(2000).*

II The Food Insecure Drought Prone Woredas of SNNPR

№	Zone/Sp. Woreda	Total Woredas	Affected Woredas	Names of the Woredas	Affected Population
1	South Omo	6	4	Kuraz, Hamer, Benna-Tsemay, Selamago.	95,000
2	Konso	47 Kebeles	1	Konso all Kebeles	167,000
3	Derashe	27 Kebeles	1		42,000
4	Gamo Gofa	13	11	Bonke, Chencha, Arbaminch-zuria, Kemba, Zala, Dita, Boreda-Abaya, Daramalo, Ubamala, Gofa zuria, Kucha	277,000
5	Wolayta	7	7	Humbo, Kindokoysha, Boloso sore, Damot gale, Damot woyde, Ofa, Sodo-zuria	425,000
6	Dawro	5	2	Gena Busa, Lome	15,000
7	Konta	-	1		-
8	Basketo	32 Kebeles	1		-
9	Burji	21 Kebeles	1	18 Kebeles	28,000
10	Gedeo	4	3	Wonago, Keehore, Yirgachefe	5,000
11	Sidama	10	7	Shebedino, Dale, Bensa, Aletta-Wondo, Dara, Awasa-zuria, Aroresa	103,000
12	Kembata and Tambaro	4	4	Omosheleko, Kachabia, Kadida-Gamela Angacha	72,000
13	Alaba	-	1		23,000
14	Yem	37 Kebeles	1		-
15	Hadiya	7	4	Lemo, Bada Wacho, Soro, Misha	98,000
16	Gurage	10	4	Cheha, Soddo, Goro, Meskanina Marako	48,000
17	Silte	6	4	Lanforo, Silti, Dalocha	
18	Bench Maji	8	3	Surma, Dizi, Meinet	-
19	Amaro	31 Kebeles	1		10,000
Total		**87**	**60**		**1,408,000**

Source: *Regional DPPO, Food Security Situation Assessment Findings (2001)*

IV Major Rivers in SNNPR

River	Origion Area	Zones (Region) Crossed Bordered by the River	Destination	Tributaries in the Region
Omo	West Shewa	Oromiya, Guraghe, KAT, Kaffa-Shaka, North Omo, B. Maji, South Omo	S. Omo, Lake Rudolf	Gojeb, Shaima-Dalcha, Denchio, Shalka, Guma, Zigna Mansa, Muwi, Mago, Irgene, Mishkere Deme, Kulecho, Giyo
Gojeb	Kaffa-Shaka	Oromiya, Kaffa-Shaka, N. Omo	R. Omo Jimma, KAT	
Mago	North of S. Omo	South Omo	N. Omo border	
Segen	Oromiya/Konso	Oromiya, Konso, South Omo	R. Omo	Neri, Sela/Berso Maki
Weito	S. Omo. N. Omo	S. Omo, N. Omo	Chew Bahir	Weito, Haro, Gayo, Turkut
Akobo	Bench-Maji	Sudan-Ethio Border	Segen River	Afa, Lemeto, Merka
Dima	Bench-Maji	Maji, Bench	R.Baro (Sobat)	Dima Gilo, Gejet, Akula
Muwi	Bench-Maji	Bench-Maji	Akobo River	
Kibish	Bench-Maji	Bench-Maji	Omo River	
Gidabo	Sidama	Sidama	Lake Abaya	Gorombo, Meged, Gombora, Kereb
Geiana	Gedeo	Gedeo, Amaro	Lake Abaya	
Walga	Guraghe	Guraghe	Ghibe	
Malga	Oromiya	Guraghe	Ghibe	Kerabit, Aredi, Wegera
Meki	Guraghe	Guraghe	Lake Ziway	Bisare, Woyra
Bilate	KAT. N. Omo	N. Omo	Lake Abaya	
Gejet	Bench-Maji	Bench-Maji	Gilo	Furfura
Beko	Kaffa-Shaka	Bench-Maji	Gilo	
Dijo	Guraghe	Guraghe	Lake Shala	
Genale	Sidama	Sidama, Oromiya	Juba River	Goromot, Gange, Gelana, Morcda, Bunora

Source: BOPED Socio-Economic Profile 1996.

VIa Population affected by food shortage 1993-1996

Zone/Sp. Woreda	Estimated Popu. 93/96	Estimated Aff. 93/96	% Aff. Pop.
Region	10.520	1.149	10.9
Guraghe	1.549	0.035	2.2
Hadiya	10.044	0.089	8.5
North Omo	2.591	0.588	22.7
South Omo	0.326	0.059	18.0
Kaffa-Shaka	0.721	0.005	0.7
Bench Maji	0.324	0.021	6.6
KAT	0.730	0.114	15.7
Sidama	2.033	0.040	2.0
Gedeo	0.561	0.045	8.0
Amaro	0.098	0.019	19.7
Burji	0.039	0.009	24.5
Konso	0.157	0.050	31.6
Derashe	0.089	0.074	82.8

VI a Drought Affected Population and Distribution of Aid (1993-1996)

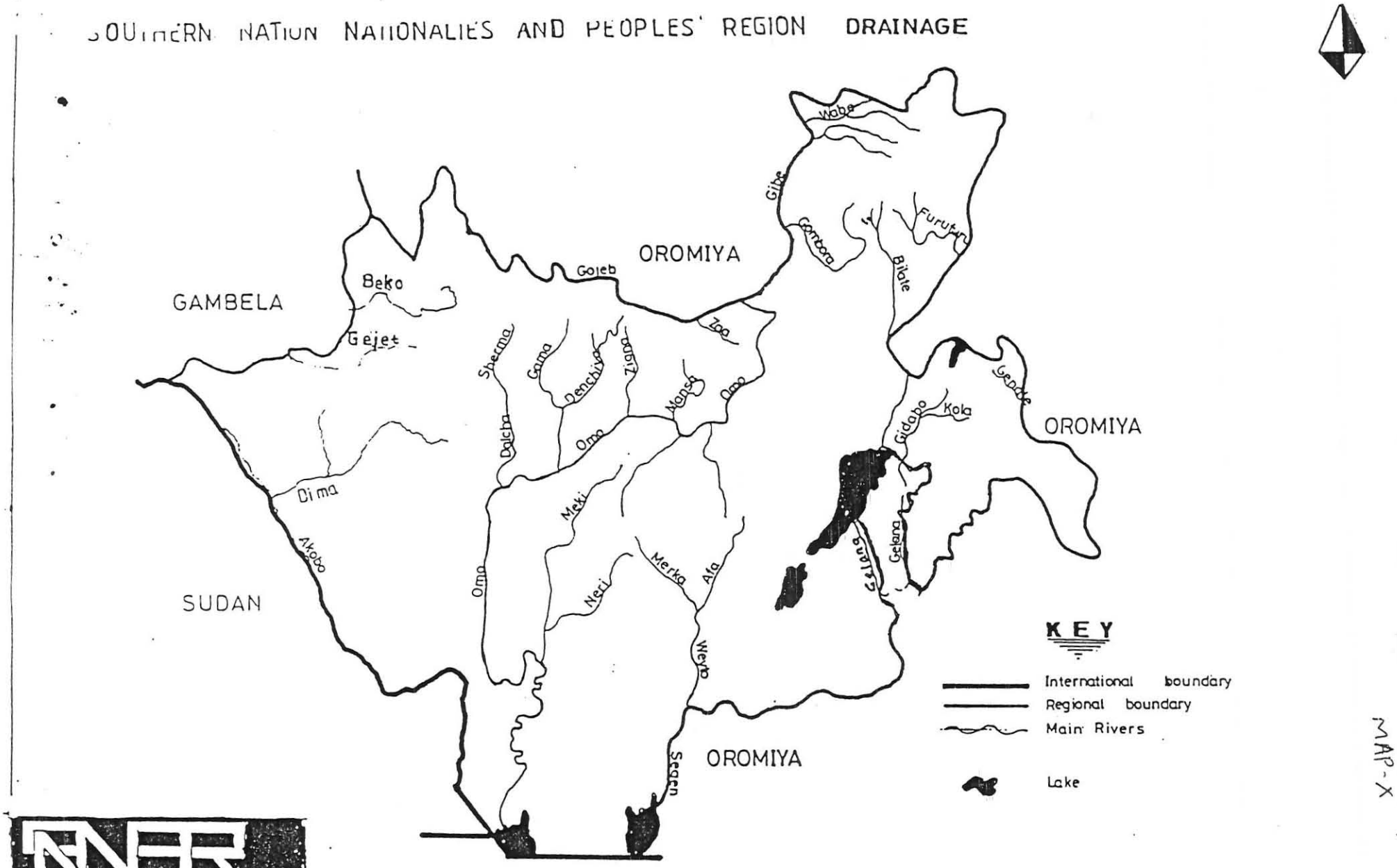
Year	Drought Affected Population	Aid Distributed In Qt.
1993	0.515	0.147
1994	2.898	0.365
1995	0.965	0.220
1996	0.143	0.060

VII Annual Amount of Rainfall Recorded in Some Stations in SNNPR /1986-1995/

№	Zone	Meteorological Stations	Annual Amount of Rainfall in mm.									
			1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	Sidama	Awassa	1194	891.9	1073.5	1016	756	871.9	963.6	928.4	862.2	1003.9
		Wondotika	1049	980.9	898.4	1057	731.2	-	-	-	-	-
2	Narth Omo	W.Sodo	307	1225	1221.7	1276	1269	1112.3	1316.9	1443.8	1260.2	1254.6
		Bodity	1259	1296	1478.2	1107	1218	1213	1577.3	1310.1	1192.9	1079
		Kemba	1233	1691	801	1132	22.7	1005.3	1342.8	1336.4	1618.2	1725.8
3	South Omo	Keyafer	369.1	780.6	903	1107	633.2	904.2	923.8	830.6	729.8	1581.2
4	Kaffa-Shaka	Bonga	1548	1680	1704.1	1490	1800	1727.6	1784.2	1772.6	1428.7	1472.9
		Yeki	1392	1333	1600.7	1205	144.8	2069.2	1918.3	1018.6	2137.9	1592.2
		Tepi	1223	1338	1669.3	1543	1909	1487.8	1574.8	1382.4	1633	834.6
		Wush Wush	1570	1304	1789	1769	1904	1834.4	1777.4	2147.2	1923.6	3264.6
		Gojeb	114.9	105.8	108.6	128.2	136.1	-	-	1740.5	285.6	-
5	Guraghe	Endiber	1371	416	-	1253	1229	1059.1	333.3	1248.5	164.4	1295.5
		Butajira	1061	1187	1118.4	1288	1727	533.4	-	608.8	1090.2	1151.9
		Wulbareg	1422	1368	1058.1	996.4	1019	1413.5	1526.9	1376.4	-	133.2
6	Bench Maji	Mizan Tefei	1821	3720	1959.9	2058	4049	2608.2	3750.3	-	-	-

Sources: Minstry of Water Resources AFD Program for Irrigation Development (1999)

SOUTHERN NATION NATIONALITIES AND PEOPLES' REGION DRAINAGE



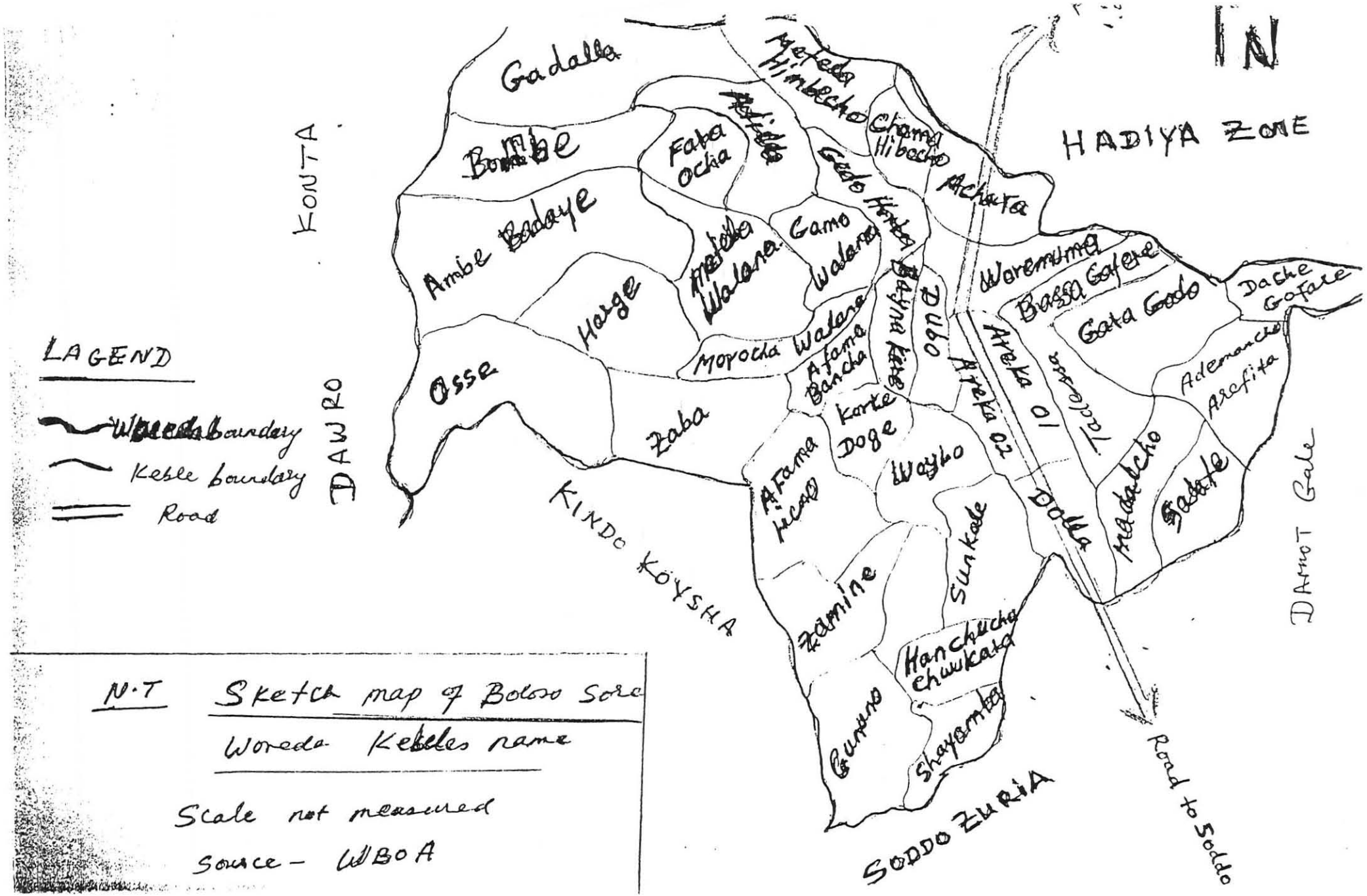
MAP-X

ENAR

PLANNING AND ECONOMIC DEVT
BUREAU
PHYSICAL PLANNING DEPT

Date Jan 1996
Scale 1:3 000 000

CAUTION – The delineation of boundaries on this map must not be considered Authoritative

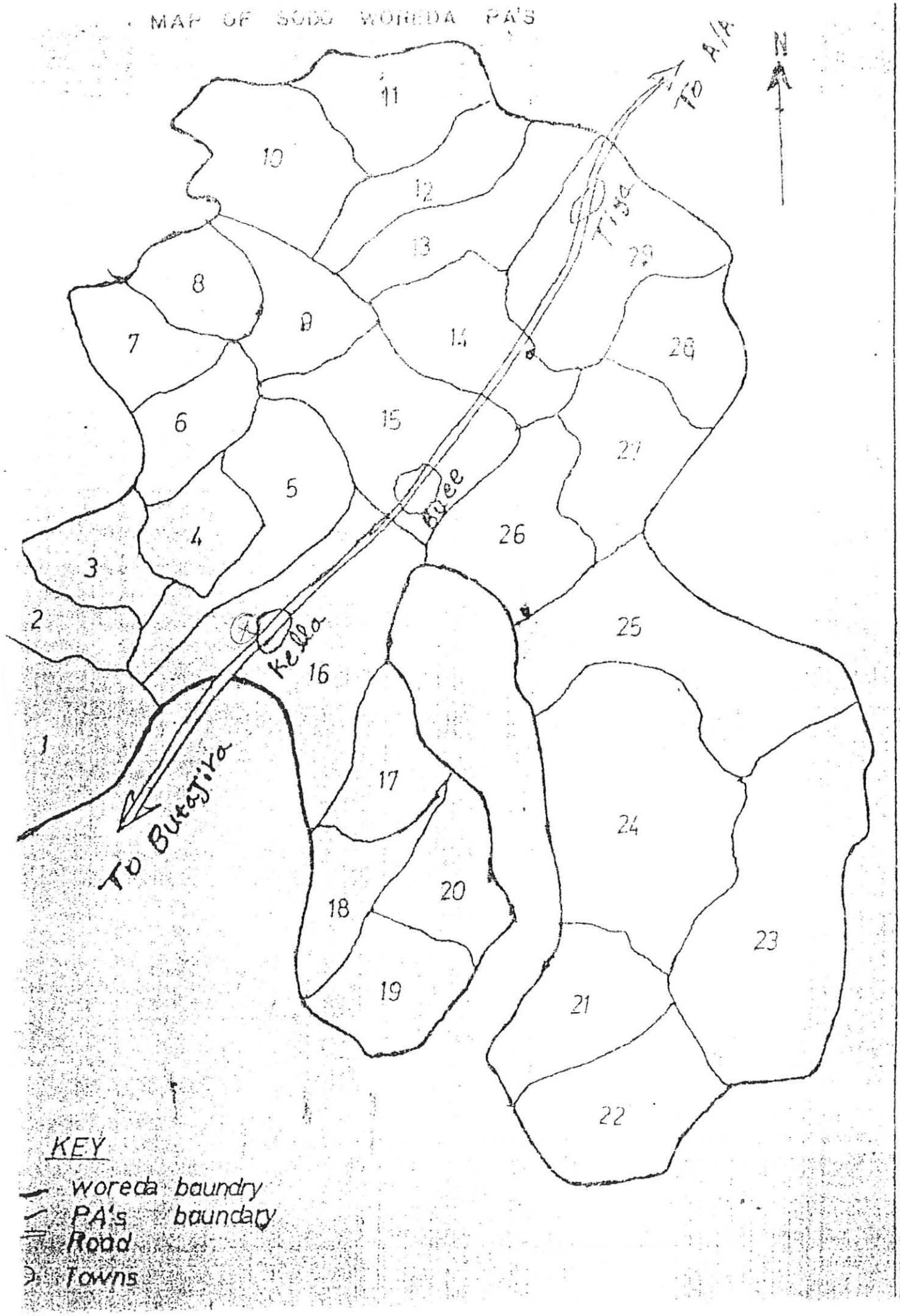


N.T Sketch map of Bolosso Sore

Woreda Kebeles name

Scale not measured

Source - WBOA


MAP OF SOD WOREDA PA'S
N
TO AIR
11
10
12
13
9
8
7
6
5
4
3
2
1
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
Kella
To Butajira
KEY
Woreda baundry
PA's baundary
Road
Towns

Declaration

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

Name: Nigussie Taffesse Henkaro

Signature: 

Date: May 20, 2002

Place: Addis Ababa