

MINISTRY OF AGRICULTURE NATURAL RESOURCES MANAGEMENT DIRECTORATE



SMALL-SCALE IRRIGATION SITUATION ANALYSIS AND CAPACITY NEEDS ASSESSMENT

(A Tripartite Cooperation Between Germany, Israel and Ethiopia)



Ministry of Agriculture



October 2011 Addis Ababa, Ethiopia





Published by Natural Resources Management Directorate through the support of GIZ, Sustainable Land Management Programme, Ministry of Agriculture, Ethiopia

This publication is supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Government.

Material in this publication may be freely quoted or reprinted with acknowledgment.

Contributors: Yalew Belete, Hussein Kebede, Ermias Birru and Sorssa Natea

Photo credits:

Cover Picture:

Back cover Picture:

Ordering Information

To order copies please contact:

Ministry of Agriculture

Natural Resources Management Directorate

P.o.Box 62347

Addis Ababa

Ethiopia

Tel.: +251-1-6462373

Fax: +251-1-6462366

E-mail: moard-nr@telecom.net.et



TABLE OF CONTENTS

	<u>Pages</u>
ACKNOWLEDGEMENTS.....	I
LIST OF ABBREVIATIONS.....	III
EXECUTIVE SUMMARY	V
1. INTRODUCTION.....	1
2. OBJECTIVES AND EXPECTED OUTPUT.....	2
3. METHODOLOGIES AND APPROACHES	3
4. REVIEW OF RELEVANT POLICIES AND STRATEGIES.....	4
4 RURAL DEVELOPMENT POLICIES AND STRATEGIES.....	4
4.1.2 RURAL LAND ADMINISTRATION AND USE.....	5
4.1.3 WATER SECTOR POLICY AND STRATEGIES.....	5
4.1.4 ENVIRONMENTAL POLICY.....	6
4.1.5 POPULATION POLICY.....	6
4.1.6 COOPERATIVES DEVELOPMENT.....	7
5. STATUS OF IRRIGATION DEVELOPMENT IN ETHIOPIA.....	8
5.1 GENERAL OVERVIEW.....	8
5.2 OVERVIEW OF SSI- CATEGORIES AND FEATURES.....	10
5.3 INSTITUTIONAL ASPECTS AND PARTNERS.....	13
6. SMALL-SCALE IRRIGATION SWOT ANALYSIS.....	15
7. GAPS IDENTIFICATION AND ANALYSIS.....	18
TECHNICAL ASPECTS.....	18
INEFFICIENT ON- FARM WATER AND CROP MANAGEMENT PRACTICES...	20
WEAK RESEARCH AND EXTENSION SERVICES.....	24
WEAK INPUT SUPPLY AND CREDIT SYSTEM.....	24
POOR MARKET STRUCTURE AND INFORMATION SYSTEM.....	25
INSTITUTIONAL /SUPPORT SYSTEM GAPS.....	26
CROSS-CUTTING ISSUES.....	29
8. CONCLUSION AND RECOMMENDATIONS.....	31

ACKNOWLEDGEMENTS

The need for a Small-scale Irrigation Capacity Building Strategy was conceived in a trilateral cooperation agreed upon among the higher officials of the Federal Republic of Germany, the State of Israel and the Federal Democratic Republic of Ethiopia for enhancing capacity of irrigated agriculture in Ethiopia. This is considering the fact that the irrigation sub-sector plays an important role in the national economic development of the country. Therefore, the decision made by the higher officials of the three countries is timely and highly essential; particularly for Ethiopia it has significant importance to build its capacity in the area of irrigation. In this connection, we would like to extend our sincere appreciations to the higher officials of the three countries for this timely and highly important initiative taken up.

The preparation of the report for the small-scale irrigation situation analysis and capacity needs assessment is the result of the concerted efforts of all the three parties involved. We are grateful to GIZ-SLM Programme Coordinating Office of Addis Ababa for the overall support provided to the Joint Mission and then to the Task Force established later to finalize the strategy development. The technical support provided by CINADCO-the Centre for International Cooperation for Agricultural Development in organizing the study tour to Israel was indeed invaluable for which we are quite indebted. Of course, the overall effective coordination and dedicated efforts of the Ethiopian side for the successful completion of the strategy development is highly appreciated and acknowledged. In particular, the task force members; Sorssa Natea, Ermias Birru (GIZ-SLM), Yalew Belete (MoA, AGP), Hussein Kebede (MoA, NRMD) and Awoke Nigatu (MoWE) who worked intensively in revising of the first draft on situation analysis and capacity building needs assessment deserves special appreciation for their courage and concerted efforts in finalizing the report.

We would like to thank the respective Heads and Senior Experts of the Agriculture Bureau of Amhara, Tigray, Oromia, SNNPR and Harari regions for their active participation during the capacity needs assessment and for providing valuable information to the joint mission deployed by the time. We would also thank the Ministry of Water and Energy, Irrigation and Drainage Department and International Water Management Institute (IWMI) for providing to the joint mission with comprehensive information during the briefing sessions held in their respective offices and for supplying supportive materials at the time of capacity needs assessment. We are also grateful to Melkassa Agricultural Research Centre for the fruitful discussions and the overall guidance made to the visit in Agricultural Mechanization Research Unit.

We are also obliged to extend our heartfelt gratitude to the dedicated efforts and timely decisions made by the officials of all the three parties involved for expeditiously supporting the Joint Mission throughout the whole process. In particular, we are particularly grateful to Dr. Andrea Balm, Director of GIZ-SLM Program Coordinating Office of Addis Ababa and Dr. Eckart Bode, Director of Operation of GIZ-SLM, Mr. Zvi Herman, former Head of CINDACO with the Ministry of Agriculture and Rural Development of the State of Israel and H.E Ato Sileshi Getahun, State Minister of the Ministry of Agriculture.

Similarly, we are also grateful to experts of the Joint Mission, which was composed of four Israeli experts, two senior experts from Natural Resources Management Directorate (Hussein Kebede

and Yalew Belete) and two senior experts of former GIZ from Head quarter (Dr. Elizabeth Akker) and from Programme Coordinating Office of Addis Ababa (Yitayew Abebe, former staff) for their efforts and dedication for the successful completion of the capacity needs assessment and precisely identified constraints in the area of Small-Scale Irrigation. This of course, led the team to successfully develop the first draft strategy document. However, first draft strategy was further elaborated



Sileshi Getahun

State Minister, Ministry of Agriculture

LIST OF ABBREVIATIONS

- AfDB African Development Bank
- ARDO Agriculture and Rural Development Offices
- ASSP Agriculture Sector Support Project
- ATVET Agricultural Technical Vocational and Educational Training
- BoA Bureau of Agriculture
- CIDA Canada International Development Agency
- CRS Catholic Relief Society
- CSE Conservation Strategy of Ethiopia
- DA Development Agent
- EIA Environmental Impact Assessment
- EPA Environmental Protection Authority
- ESE Ethiopian Seed Enterprise
- EU European Union
- FAO Food and Agriculture Organization
- FDS Family Drip System
- FHI/E Food for Hungry International /Ethiopia
- FREG Farmer- Research-Extension Group
- FTC Farmers Training Center
- GDP Gross Domestic Product
- GPS Geographic Positioning System
- GIZ-SUN GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) | German International Cooperation – Sustainable Utilization of Natural Resource)
- IFAD International Fund for Agricultural Development
- IPM Integrated Pest Management
- IWMI International Water Management Institute
- IWRM Integrated Water Resource Management
- JICA Japan International Cooperation Agency
- MASHAV Centre for International Cooperation of Israel
- MDG Millennium Development Goals
- MoA Ministry of Agriculture
- MoWE Ministry of Water and Energy

- MoWR Ministry of Water Resource
- NGOs Non- Governmental Organizations
- O&M Operation and Management
- ORDA Organization of Relief and Development for Amhara
- OSHO Oromo Self Help Organization
- PASDEP Program for Accelerated and Sustainable Development for Eradicating Poverty
- PSSIDP Participatory Small-scale Irrigation Development Project
- PRSP Poverty Reduction Strategy Program
- REST Relief Society of Tigray
- RWH Rainwater Harvesting
- SAER Sustainable Agriculture and Environmental rehabilitation
- SDPRP Sustainable Development Program for Reduction of Poverty
- SIDA Swedish International Development Agency
- SLM Sustainable Land Management Project
- SMS Subject Matter Specialist
- SSI Small-Scale Irrigation
- SWC Soil and Water Conservation
- UNDP United Nations Development Programme
- UNICEF United Nations International Children's Emergency Fund
- USAID United States Agency for International Development
- WUA Water Users' Association

EXECUTIVE SUMMARY

Irrigation development in Ethiopia is in its infancy stage and not contributing its share to the growth of the agriculture sector accordingly. But the country has the potential for its development both in terms of vast suitable land and availability of fresh water resources suitable for irrigation purpose. However, currently limited land is being cultivated under irrigated agriculture and therefore, crop production is predominantly based on rainfed agriculture. Irrigated agriculture is being practiced under smallholders, medium and large scale farming. The small-scale irrigation schemes are understood to include traditional and modern communal schemes up to 200 ha (MoWR 2002). However, 'traditional' spate irrigation and even some modern irrigation schemes are also being managed by smallholders as part of small-scale irrigation schemes, whereas the area is quite larger than indicated above. This has been confirmed by some studies carried out by IWMI, which showed that some schemes have the capacity of over 2000 ha that are being managed by smallholders. Traditionally, farmers have built small-scale schemes on their own initiative, but sometimes with some technical and material support from the government and other development actors.

Other forms of small-scale irrigation development through storage works that involve small to medium dams and water harvesting can be undertaken through a variety of ways including capturing runoff from rooftops, capturing runoff from local catchments, capturing seasonal floodwaters from local streams and shallow ground water development. The introduction of low-pressure irrigation systems are cost effective to be adopted by smallholder, particularly in areas with scarcity of water.

However, the fact is that irrigation development, particularly the smallholders has significant importance to raise production and productivity to achieve food self-sufficiency and ensure food security at household level in particular and the country at large. The irrigated agriculture can also play a vital role in supplying sufficient amount and the required quality of raw materials for domestic agro-industries and increase export earnings. Therefore, considering the importance of the irrigation sub-sector in the overall growth of the agriculture sector, the Government of Ethiopia is giving special emphasis to enhance irrigated agriculture. It is with this aim a trilateral cooperation between the three parties involved has been agreed upon and realized the capacity needs assessment and subsequently identified strategic directions.

Therefore, the major production constraints impeding development in the irrigation sub-sector among others are: (i) predominantly primitive nature of the overall existing production systems, (ii) shortage of agricultural inputs and credit systems, (iii) limited access to improved irrigation technologies and inadequate research support, (iv) lack of trained manpower and frequent staff turnover, and (v) unstable institutional set up and inadequate extension services and limited availability of capital. Details are highlighted hereunder.

Technical gaps

The gaps in this area include: planning and identification, design-study and construction and operation and maintenance. It gives highlights amid lack of inventory and resource assessment. The need for design guidelines and manuals is indicated. Existing problems in operation and maintenance and weaknesses in the capacity of WUAs is discussed. The need to rehabilitate schemes that are not operational or malfunctioning is highlighted for additional production with limited cost. Lack of proper diversion and regulating, storage and controlling structures are among the major constraints particularly in the traditional schemes. Lack of drainage is one of the constraints in SSI although it is usually neglected. This will inevitably result in gradual reduction of yield and decline in land quality.

Agronomic gaps

The major constraints and challenges identified in the area of irrigation water and crop management practices are: Improper crop and varietal selection; improper crop rotation cycle; inappropriate cropping pattern and cropping intensity; inappropriate crop calendar; inadequate availability of small hand tools and farm implements; poor land preparation and leveling; poor soil fertility management; poor irrigation scheduling/crop-water-requirement balance; inappropriate irrigation methods; and inadequate crop pest management practices.

Weak research and extension service

The gaps identified include: poor extension system and services. The main extension team member in Ethiopian extension system is the DA. He/she serves over 600 farmers which is too big for proper delivery of the required service, especially where there is little/no means of transportation. There exist no clearly developed irrigation extension methods under practice currently. The farmers do not know how to build proper furrows or how to properly control water flows in the channels and in their fields. The DAs' extension skill is very variable. In some places there are very skilled and motivated DAs and in others, not so much so. The skill of development agents in general is low in the area of on-farm water and crop management practices and they are not in a position to effectively assist farmers.

Weak input supply and credit gap

Problems of technology generation, manufacturing and multiplication are among the constraints identified. As a result, very often many inputs such as improved seeds, fertilizers, agrochemicals improved farm implements and technologies for water pumping and lifting devices are not available on time and at affordable prices. It is very rare to observe an organized input distribution system or estimation of input requirement, e.g. fertilizers, seeds, spare parts for pumps and irrigation systems, etc. The main inputs for distribution are: micro-irrigation equipment, seeds, seedlings and fertilizers. With reference to credit, though pivotal for irrigated crop production, it is either totally absent or used in only limited number of schemes. The problem is the reluctance of most farmers to use any credit for irrigation. This results in a much slower rate of production boost from an area than is economically desirable from the institutional viewpoint. Overall, the input supply and credit systems are not designed for the irrigation and it is being managed through the existing system established for rainfed farming

Poor market structure and information

The lack of access to market in close proximity has greatly reduced the income that farmers could have gained otherwise. Price information is haphazard, some farmers get it from neighbours or friends visiting the markets and some do not get it at all. The SSI users do not have market structure for their productions. Prices are fixed by traders while farmers have little or no power to bargain on. Storage of farm products and quality control systems are not available that have significantly and negatively affect farmers as a result of high post-harvest losses.

Institutional/support system gaps

The gaps identified in this regard include: lack of clarity in mandates, poor collaboration and networking and poor handing over of irrigation systems. At all levels, there exists low institutional capacity which is critical to enhance development of SSI with respect to development planning, design, implementation, and operation and maintenance including irrigation advisory services. Similarly poor linkages and limited capacities were identified to exist in agricultural research centers and water users' associations. The need to improve the human resources is also highlighted. Limitations in budget to expand SSI are also indicated as one of the main constraints.

1. INTRODUCTION

In recognition of the importance of the agriculture sector, including the irrigation sub-sector in the overall economic development of the country and in realizing the objectives set in the rural development policy and strategy, various donors and development partners have been engaging in the provision of technical and financial support towards improving food security and alleviate poverty. Therefore, in view of the importance and contribution of the irrigated agriculture in the national economic development of the country, the Chancellor of the Federal Republic of Germany (A. Merkel), Prime Minister of the Federal Democratic Republic of Ethiopia (Meles Zenawi) and Prime Minister of the State of Israel (E. Olmer) have agreed and entered into a trilateral cooperation on enhancing irrigated agriculture capacity in Ethiopia. In this trilateral agreement emphasis was given to the technical assistance of Israeli expertise in the area of irrigated agriculture, which is sought to be highly important for Ethiopia. In order to realize the agreed objectives by the leaders a specific tripartite agreement on the development of a small-scale irrigation capacity building strategy was signed in Addis Ababa on 25.07.2008 between the Ministry of Agriculture of the Federal Democratic Republic of Ethiopia (H.E. Ato Ahmed Nasir, the so then State Minister) and the Ministry of Foreign Affairs of the State of Israel acting through MASHAV- the Centre for International Cooperation (Haim Divon, Deputy Director General) and Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ - formerly called GTZ (Ulrich Mohr).

The agreement is mainly focused on conducting of situation analysis and identification of capacity gaps in irrigated agriculture, particularly giving emphasis to small-scale irrigation and develops a capacity building strategy to enhance irrigated agriculture in Ethiopia. This initiative is, therefore, anticipated to be realized under the coordination of the MoA through the Natural Resources Management Directorate and the financial support of the Federal Republic of Germany through GIZ-SLM and the technical backstopping from the State of Israel through MASHAV- the Centre for International Development Cooperation. As part of the implementation of the agreed project activities, the first mission for a study tour to Israel was organized and conducted in September 2008 for the Ethiopian experts for experience sharing. In the study tour participated eight members (four from Amhara, Tigray, Oromia and SNNPR, and two from GIZ – SLM Ethiopia, one participant was from GIZ Headquarter, Germany and one from MoA, Natural Resources Management Department). Almost all the three parties were participated in the second mission to Ethiopia for conducting the needs assessment in order to identify the capacity gaps and strategic issues that could be used to develop a small-scale irrigation capacity building strategy for Ethiopia. This was actually carried out starting from March 4 2009 to end of April 2009.

Therefore, this report is trying to highlight the objectives of the joint assessment mission, methodologies and approaches used in carrying out the capacity building needs assessment in the area of small-scale irrigation, describes review of relevant policies and strategies, status of irrigation development in Ethiopia, gaps identification and analysis, which describes constraints and challenges in the area of small-scale irrigation based on field findings/observations on current situation of small-scale irrigation development.

2. OBJECTIVES AND EXPECTED OUTPUT

2.1 Objectives

- To assess and analyze the existing situation of small-scale irrigation,
- To identify capacity building needs and strategic issues for small-scale irrigation development;

2.2 Expected output

- Identified constraints and opportunities for small-scale irrigation development,
- Identified strategic issues for small-scale irrigation capacity building strategy development;

3. METHODOLOGIES AND APPROACHES

The joint mission reviewed relevant policy and strategy documents, particularly in the area of rural policy and strategy of the country, the water policy and strategy, the water sector development programme, the Plan for Accelerated and Sustainable Development to End Poverty and different studies and assessments carried out by key stakeholders in the area of small-scale irrigation development. Following the document review activities, the mission was able to hold brief meetings with key stakeholders at federal level in order to capture issues and their concerns in the area of irrigation development, particularly giving emphasis to small-scale irrigation. .

Similarly, the joint mission was able to hold brief meetings with mainly regional Bureaux of Agriculture and Bureaux of Water Resources Development in the five regions selected for the capacity building needs assessment (i.e, Amhara, Tigray, Oromia, Harari and SNNPR). In addition to the meetings with regional government officials and non- government institutions, field visits were made in those five regions in order to be familiarized with the overall farming systems and socio- economic set up of the rural areas, particularly giving emphasis to the existing experience in irrigated agriculture. During the field visits, the joint mission was also able to visit small-scale irrigation schemes both traditional and modern small-scale community irrigation schemes, water harvesting structures and SWC activities, nursery sites both for fruit crops and forestry seedling preparations. For data collection, the joint mission used prepared check list and guided with and effectively managed the discussions held with beneficiary farmers and representatives of the woredas visited. Thorough analysis was made to clearly understand the current situation of the respective regions and specific sites visited. Then based on the analysis made the mission was able to identify the capacity building needs and strategic issues that further would be considered for the development of SSI capacity building strategy for Ethiopia.

The findings of the joint mission was presented to the stakeholder workshop and the first draft of the situation analysis and capacity needs assessment was further enriched by the valuable comments obtained at the stakeholder workshop. However, considering the gaps identified in the first draft of the situation analysis and capacity needs assessment a Task Force was again assigned to work on the refinement of the first draft report and prepare detail action plan and resource requirements for the capacity building strategy. Accordingly, the Task Force members were to go through the first draft and thoroughly revised it with some updates and produced this current report on the situation analysis and capacity needs assessment focused on small-scale irrigation development.

4. REVIEW OF RELEVANT POLICIES AND STRATEGIES

4.1 Rural development policies and strategies

As it has been indicated in the rural development policies and strategies, agriculture and rural centered development is taken as a strategy, set to ensure rapid and sustained economic development in the country. Rural development is taken not as an endeavor confined to agricultural development alone but also embraces a number of activities outside agricultural development. The basic principles that govern agricultural development policies and strategies in the country were based on the availability of natural resources, particularly land and human power, even though it is unskilled in most rural areas. The policy direction, thus, places emphasis on the need for coordinated development efforts and agro-ecology-based development approach focusing on labor-intensive technologies than capital-intensive ones. This is given priority in the national economic development plan and poverty alleviation strategy of the country.

The need to articulate a detailed development plan for each agro-ecological zone to exploit the opportunities and conditions favorable for growth and maximize the output in the respective areas is emphatically spelled out in the policy documents. Accelerated and sustainable growth is envisaged to be brought about by utilizing labor- rather than capital-intensive production processes.

The agriculture-led industrialization (ADLI) is aimed at boosting agricultural production and productivity through integrated application of appropriate technologies and improved farming management practices. Therefore, ADLI is seen as a long-term strategy whereby during the first stage of its implementation, agriculture is to play the leading role in the growth of the economy. But the extremely small ratio of urbanization of the country could well raise market outlet as a critical issue owing to inadequacy of the domestic demand thereby making exports a necessity. This again implies that agriculture has to be made internationally competitive for at least those products which have to be directed towards the export markets.

Securing accelerated and sustained development of the agricultural sector through the transformation of the subsistence mode of agriculture to a market-oriented one was envisaged to guarantee the sector's contribution to the national economic development and attainment of the millennium development goals (MDGs) of the country. The strategy has identified key areas of focus including the introduction of high yielding and appropriate technologies supported by agricultural research and extension services; increasing the quantity and quality of marketable agricultural products that can meet the demands of both domestic and international markets as well as providing support to the establishment of appropriate marketing systems; expansion of small- and medium- scale irrigation and water conservation schemes; and ensuring prudent utilization of natural resources.

Following ADLI, a three-year poverty reduction program (SDPRP) was launched covering the period from 2002/03 to 2004/05. This was followed by PASDEP, having poverty eradication as the main development objective of the Government. Hence, the country's development policies and strategies are geared towards this end. The PASDEP represents the second phase of the Poverty Reduction Strategy Program (PRSP) process, which has begun under the Sustainable Development and Poverty Reduction Program (SDPRP).

The PASDEP carries forward important strategic directions pursued under the Sustainable Development and Poverty Reduction Program (SDPRP) related to infrastructure, human development, rural development, food security, and capacity-building. Major focus was laid on growth in the plan period with a particular emphasis on greater commercialization of agriculture

and enhancing private sector development, industry, urban development and a scaling-up of efforts to achieve the Millennium Development Goals (MDGs).

Among quite many considerations, it was also planned to promote and strengthen small-scale irrigation schemes, and improved water use efficiency, including strengthening water harvesting and utilization practices through provision of appropriate technologies. Accordingly, 487,000 hectares of land are planned to be cultivated by the use of irrigation. The extension and training programs will receive particular attention to enhancing farmers' capacities to use water resources efficiently, and help to build the community-level institutional structures necessary for effective irrigation and water resource management. In addition to this, 470,000 water reservoirs/ponds were planned to be constructed for water harvesting and 58,750 hectares of land was planned to be cultivated through irrigation using the water to be harvested at household level in areas of food security. Although the planning period is close to the end, it is not yet known as to how much of the plan was achieved and how effective it was.

4.1.2 Rural land administration and use

Rural Land Administration and Use Proclamation of 2005, states the need to conserve and sustainably develop natural resources and establish the necessary data base. As per the proclamation, land is a public property and any peasant farmer or a citizen of 18 years and above who wants to engage in agriculture for a living has the right to hold and use rural land indefinitely. For other users, the duration is to be fixed by relevant laws of the regions. Any holder of rural land shall be given holding certificate that indicates size, land use and cover, fertility level, obligations and rights of the holder. For couples, the holding certificate shall be in the name of both. Irrigable lands may be distributed in order to use land equitably in accordance with the provisions of the proclamation. This can also be done if it is the wish of the peasants or pastoralists and it does not result in further land fragmentation in other areas. A holder of rural land shall be obliged to use and protect his/her land and when the land gets damaged the user shall lose his use rights. It also states where irrigation canals are to be constructed; the holder shall have the obligation to allow the construction of irrigation canals and other infrastructure if they cross his/her land holding.

Irrigated agriculture requires intensive management as compared with rainfed agriculture and the land holding size per household has significant impact on effectively managing the land in a more productive manner. Even though there is no fixed land size at national level the experiences of some of the regions showed that on average 0.5 ha is considered to be appropriate per household. Furthermore, for irrigation infrastructure development there might be some land encroachment, which is being utilized for construction of canals and field distribution channels and sometimes used for reservoirs as well. These may necessitate the land consolidation and redistribution issue, which might require a policy direction how to go about.

4.1.3 Water sector policy and strategies

This was prepared and adopted since 2001. The water sector policy includes the water supply and sanitation, hydropower, irrigation and drainage and cross-cutting issues like water allocation, environment, disasters, and trans-boundary water sources. The overall goal of the national water resources management policy is given so as to enhance and promote all national efforts towards efficient, equitable, and optimum utilization of the available water resources of Ethiopia for significant socio-economic development on a sustainable basis. As per the water allocation and utilization policy directives, basic human and livestock needs as well as environmental reserve have the highest priority. It also gives direction in efficient use of water and the allocation shall not be made on permanent basis, rather it shall be done on an agreed time horizon that fits best with the

socio-economic development plans. It also states that water sales will be the source of finance to administer, operate and maintain large hydraulic structures.

The detailed objective of the irrigation policy states development and enhancement of small-scale irrigated agriculture and grazing lands for food self sufficiency at household level as one of its objectives while the principal objective of the irrigation development strategy is to exploit the agricultural production potential of the country to achieve food self sufficiency at the national level, including export earnings, and to satisfy the demand for raw material by the local industries, but without degrading the fertility and productivity of the land and water resource bases of the country.

The strategies of the irrigation sector cover a wide range of issues across the borders of technical and engineering, financial & economic, institutional, capacity building, and social and environmental aspects. Most of the relevant issues are taken into account in the proposed SSI capacity building strategies. The policies and strategies were followed with short-, medium- and long- term programs covering small-, medium- and large- scale projects.

4.1.4 Environmental policy

The Environmental Policy of Ethiopia, which was extracted from the Conservation Strategy of Ethiopia (CSE), was approved on April 2, 1997 by the Council of Ministers. The Environment Policy of Ethiopia states the overall goal is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs”.

The CSE resulted in the establishment of the Environmental Protection Authority (EPA) as an autonomous government agency responsible for harmonizing environmental protection and economic activities so that both economic and environmental improvements become sustainable. It also gave rise to the Regional Environmental Coordinating Committees that oversee environmental protection in their respective regions, drafted laws on overall environmental regulation, environmental impact assessment (EIA), and pollution control. Procedural and Sectoral Guidelines for EIAs have also been developed. The implementation of these guidelines through the EIA law aimed at the integration of environmental concerns into development planning, thus preempting environmental deterioration, and contributing to improved land and water management for sustainable development and ensure the needs of the present generation without compromising the ability of future generations to meet their own needs to sustain and continue development from generation to generation.

4.1.5 Population policy

Recognizing that population plays a decisive role in national and individual development, especially in terms of sustainable development, the Government of Ethiopia launched a National Population Policy in April 1993. The objective of the Population Policy is to maintain balance between the size of the population and the country's resource base. This clearly indicates the need to match the population growth rate with that of the agriculture sector in order to fulfill the corresponding food requirements. To this end, the strategy focuses on the existing high fertility rates, which resulted in low education status of women and high infant and child mortality rates. On this account, the main contributing factors for the reduction of the population growth rate were taken to be an increase in girls' education, as was also envisaged in the education sector program, as well as an increase in the level of mother and child health care provision including family planning services.

The policy specifically calls for reducing the total fertility rate to 4 and increasing the contraceptive prevalence rate to 44 percent by 2015. Furthermore, it addresses the need to reduce maternal, infant and child morbidity and mortality rates. In line with these objectives, the policy identified four major areas of population activities requiring priority attention. These were: a) improvements in the quality and scope of reproductive health service delivery; b) population research, data collection and dissemination; c) expansion and strengthening of domestic capacity for training in population; and d) expansion of IEC activities and social mobilization.

4.1.6 Cooperatives development

As per the policies set in the rural development, cooperatives play an important role in improving agricultural marketing. They can collect farmers' products and provide warehouse service. It also helps them get inputs with reasonable prices as they can purchase in bulk. Cooperatives play significant role in the expansion of rural micro-finance. Thus establishment and strengthening of cooperatives is taken as one of the priority areas. Through increased availability of loans to cooperatives (up to 14 billion Birr) and by encouraging them to make effective use of this fund, it was envisaged that production and productivity would increase substantially while concurrently agro processing services would develop significantly.

With the aim of strengthening cooperatives, it is planned to increase the share of the market by cooperatives from 70% to 90% by the year 2010. In addition, it is indicated that there is a need to increase their role in agricultural input and output markets from 10% to 60%. Furthermore, the roles of cooperatives' federations in the areas of coffee, saving and credits, milk and milk products, mining, and fruits and vegetables are also given due emphasis.

5. STATUS OF IRRIGATION DEVELOPMENT IN ETHIOPIA

5.1 General overview

Ethiopia has a total area of 1.12 million square kilometres and a total population of 73.7 million (CSA 2007). The country is heavily dependent on rainfed agriculture with about 12 million ha currently under cultivation. This area can be substantially increased if the necessary infrastructure is put in place.

Irrigation is one means by which agricultural production can be increased to meet the growing food demands of the fast growing population of the country. Increasing food demand can be met in one or a combination of three ways: (i) increasing agricultural yield, (ii) increasing the area of arable land, and (iii) increasing cropping intensity by growing two or three crops per year using irrigation. Expansion of the area under cultivation is a limited option. However, increasing yields under both rainfed and irrigated agricultural systems and cropping intensity in irrigated areas through various methods and technologies are the most viable options for achieving food security in the shortest time span. The problems of crop failures, due to dry spells and droughts are common events in the rural settings of Ethiopia.

Agricultural production can be stabilized and increased by providing adequate supply of water through irrigation and retaining of rainwater to increase the soil moisture to be utilized by crop plants using different in-situ moisture conservation techniques to produce surplus that can bridge the gaps during drier years.

Although traditional irrigation has been practiced in the highlands for centuries, particularly for producing subsistence food crops, it was only in the early 1950s that modern irrigation technologies were introduced to Ethiopia by a Dutch company in the Upper Awash Valley with the objective of producing industrial crops such as large-scale sugarcane plantations. It is expected that through an optimal development of water resources, in conjunction with development of land and human resources, a sustainable growth of food production can be achieved to fulfill the food requirements of the country as well as to adequately supply the required agricultural raw materials for the domestic industries and factories and generate increased amounts of export earnings.

Most of the irrigated land is supplied from surface water sources, while ground water use has just been started on pilot basis in East Amhara. Surface irrigation methods dominate throughout. Sprinkler irrigation system is being practiced on about 10,000 ha area for sugarcane production in Fincha State Farm. Similarly, it is being used in some localized areas of eastern Amhara and southern Tigray under smallholders' conditions and on some private farms in the Rift Valley. The technologies were adopted in large private- and government- owned schemes, primarily in the Awash River Basin. Most of the earlier schemes were pump-irrigation projects, but later gravity irrigation schemes were introduced. In all cases, the irrigation method was surface irrigation, predominantly furrow irrigation for cotton and wheat and basin irrigation for commercial fruits such as bananas. Some private farms had installed hydraulic rams on the banks of the Awash River to lift up water. In the mid-1970s, windmills and hand pumps were introduced to lift water from boreholes, mainly to supply water for drinking, domestic purposes and for gardening.

The 12 river basins of the country are estimated to have about 122 billion cubic meters of surface water and 2.6 billion of ground water potential. The potential irrigable land of the country is estimated to be about 3.7 million hectares (and some studies reveal that it can reach up to 4.3

million hectares). There is no consistent and reliable inventory with regard to the SSI schemes developed or potential of SSI in general.

Based on the information available, scanty as it is, only about 10- 12% of the total potential is currently under production using traditional and modern irrigation schemes. However, contribution of irrigation to the national economy is quite limited compared to its potential and also considering that of the rainfed farming.

Poverty eradication and food security are among the priority concerns of the government at the moment. According to some studies the country must double its production by the year 2025 to feed its fast growing population. Thus, irrigation has to play significant role in solving these problems. Currently, there are close to half a million ha of medium and large scale projects, which are under different levels of implementation by the MoWE and respective regions. Similarly, in the area of SSI efforts are being exerted to increase irrigated area through the regular budget of the regions and the federal government and through different donors support development programs (such as ASSP, PASIDP, SLM and others) and NGOs.

Availability of reliable data and information on water resources management consisting of a lack of consolidated strategy, including institutional linkages, on the process of collection, data preparation, storage, analysis and dissemination. Recognizing the gaps in database and information management and in an effort to contribute to the knowledge base of the water sector of the country, some international agencies such as IWMI started to create a database system in the country (Awulachew, 2007).

Despite, the efforts of the government made to expand irrigation, the country has not yet achieved sufficient of its aspirations in the sub-sector to overcome the problems of food insecurity or curb the situation of abject rural poverty. The problems associated with agricultural production in Ethiopia are deep-rooted and complex. Notwithstanding this fact though the following could be cited as the major constraints impeding development in the irrigation sub-sector: (i) predominantly primitive nature of the overall existing production system, (ii) shortage of adequate agricultural inputs and limited improved irrigation technologies, (iii) limited trained human power, (iv) inadequate extension services, and (v) heavy capital requirement. Irrigation development, particularly in the peasant sub-sector has significant importance to raise production and productivity to achieve food self-sufficiency and ensure food security at national level in general and household level in particular. The irrigated agriculture can also play a vital role in supplying sufficient amounts of raw materials at the required quality standards for domestic agro-industries and also increase export earnings. Therefore, considering the importance of the irrigation sub- sector in the overall growth of the agriculture sector, the Government of Ethiopia is giving special emphasis to enhance irrigated-agriculture. Efforts are being made to involve farmers vigorously in various aspects of management of small-scale irrigation systems, starting from the process of planning through to the implementation and management facets of project development, particularly in water distribution, operation and maintenance to ensure sustainability of the performance of the scheme put in place.

In most cases of the medium- and large-scale commercial farms, cotton and sugarcane are the predominant crops being cultivated under irrigation. However, the crop mix even at commercial farm level is increasing only gradually by including fruit crops such as mango, citrus, avocado, and also vegetable crops such as onion, pepper and tomatoes. However, the major irrigated crops under

small-scale level vary from place to place. But in general the major irrigated crops include: cereals (maize, wheat, barley); pulses (Haricot bean, groundnut); vegetables (onion, tomato, pepper, and leafy vegetables such as cabbage, Swiss chard, cauliflower); root crops (potato and sweet potato); fruit crops (banana, citrus, papaya, mango); and fiber crops (cotton). In general, production of high value crops is not well developed. Farmers prefer to grow crops, which have more values in terms of food security and are less perishable.

5.2 overview Overview of SSI- categories and features

Small-scale irrigation schemes are commonly taken as irrigated areas having an area of about 200 ha. These can be categorized as traditional and improved SSI schemes. Traditional irrigation schemes are usually initiated, built and managed by the community, while modern schemes of various categories discussed below are built taking into account the available technologies and assisted by the government, NGOs and other donors. Some features of the different categories of SSI are described as follows.

(i) Traditional schemes

Farmers have built small-scale schemes on their own initiative, sometimes with government technical and material support. However, the diversion sites of these traditional small-scale irrigation schemes are not built on permanent basis and they are forced to rebuild the structures after every flood season. These schemes are being managed by the beneficiary farmers through their own water users' association' or committees. The farm size for irrigated plots per household is usually in the range of 0.25 ha - 0.5 ha. In some cases, the size is as low as few tens or hundreds of square meters. Water users' associations have long existed to manage traditional schemes. The traditional water users' associations in the form of water committees are generally well organized and are effectively operating by farmers who know each other and are committed to cooperate closely to achieve common goals. A typical association comprises up to 200 users who share a common main canal or its branches. They may be grouped into several teams of 20 to 30 farmers each. Such associations handle construction, water allocation, operation and maintenance functions. Interventions in the area of traditional irrigations is upgrading which usually consists of improving head works, which often get washed away by flood, and lining of main canals.

(ii) Modern diversion schemes

These are usually built on perennial rivers or springs with adequate base flow. The fact that these structures do not have storage on the stream they are not capable of regulating the flow. Some of these schemes were traditional schemes before the interventions to modernize them. The diversion structures help in efficient and sustainable diversion of the flow and stabilizing banks. Rivers with large width and deep alluvial material are costly to be handled by SSI. Thus, intakes on the banks were used instead of complete barrier across the river. Diversion schemes can be provided with night storage facilities to minimize the inconveniences and inefficiencies related to night time irrigation.

(iii) Modern schemes with storage (Micro to medium dams)

In view of the erratic nature of the rainfall, flow regulation is quite important for supplementary irrigation as well as increased intensity of irrigation. To irrigate a sizable area of say 100-200 ha, construction of small- to medium-scale dams is being practiced, particularly in the mid- and

highlands where the population pressure and food insecurity are severe. The construction of dams is being necessitated where there is a need for controlling of seasonal flows and to store more water in areas with inadequate base flows in order to irrigate more land. This option is being practiced to some extent in the mid and highland areas where significant potentials exist for its construction, including availability of appropriate topographic features.

The construction of dams was recognized by the country since the drought of early 1980s and there were some efforts still going on. The major threat in this respect is the heavy silt laden flows that make lifespan of the reservoirs shorter. Relatively high investment costs and low prices of agricultural products in those times were also among the constraints that limit their implementation. In this regard, the need for watershed management is frequently recommended. However, due to heavily degraded lands, the volumes of work and associated costs are high and due to limited attention to its implementation, limits the overall implementation of recommended watershed development activities. Thus, it requires more research in this regard as to how to formulate such works- size and level of degradation of the catchment and size of the reservoir, silt mitigation measures, rate of siltation of dams, etc. Currently, due to these constraints the effort in promotion of such works is limited. Considering this fact, the watershed development approach is taken as a strategy for sustainable management of natural resources. In this regard, irrigation development is being integrated with catchment treatments so as to reduce the sedimentation load and prolong the lifespan of the dam. Similar focus was given to water harvesting structures, including household ponds, spate irrigation and of course, medium and large scale irrigation schemes.

(iv) Pumped schemes

These are schemes with pumping arrangement for lifting water mainly from surface sources where diversion by gravity may not be feasible. As operation & maintenance of these schemes is costly, they are successful mainly in areas with good market access, better service delivery and growing of high value crops. Provision of pumps with credit arrangements is sometimes available. Based on the size of the pump they can be privately owned or communal. Existing market prices of agricultural products are relatively better if market oriented and timely productions are followed. Even though, deep ground water utilization is currently limited, these types of schemes can be classified under this category.

(v) Micro-Irrigation

These are recent introductions in the area of SSI. This micro- irrigation refers to individualized small-scale irrigation technologies for lifting, conveying and applying irrigation water. It therefore, includes treadle and small- power pumps to lift water and a variety of irrigation water application technologies such as smallholder drip systems and micro- sprinklers. These technologies are more affordable to be used by smallholders in their small plots. The use of micro- irrigation systems is highly appreciable under the current efforts of water harvesting activities in the country, where the harvested volume of water is small, and is appropriate to conserve and use the available limited resources- the water, in a more efficient manner.

This is irrigation application method for efficient use of water for crop production, particularly in arid and semi-arid areas where scarcity of water is a critical problem. It can be used with all the above categories of SSI where the water is not turbid.

Water is increasingly becoming a very sensitive and crucial factor for agricultural and industrial uses and home consumption. The increasing demand for water on one hand, and the demand for increased food production on the other coupled with increasing energy costs necessitate

development of low-pressure irrigation systems. There are actually different low-cost drip irrigation systems being used by smallholder farmers in China, India and in many African countries. As compared with other African countries, the introduction of low-pressure drip irrigation systems in Ethiopia is a recent phenomenon. In particular the introduction of this system is associated with the launching of rainwater harvesting activities.

The introduction of low-pressure drip irrigation systems such as bucket, family drip and family nutrition kits are being used in some parts of the country, where water scarcity is a problem. The development of low-head emitters and simple filtration system has reduced much of the initial capital investment and making the low-pressure drip systems more affordable for the smallholder farmers. The use of low-pressure drip system/FDS allows efficient use of the scarcely available water resource.

(vi) Rainwater harvesting (RWH)

Scarcity of water for agriculture is a common phenomenon in tropical countries like Ethiopia particularly in drought-prone areas of the country, where there are frequent crop failures and associated famine is very often unavoidable. In these particular areas crop growing without the support of irrigation facilities is becoming a great challenge to the agriculture sector. Even in areas, which are getting large amounts of rainfall during the rainy season, crops may get short of water during the growing period, due to uneven distribution throughout the growing season. Therefore, water conservation in cultivated fields aims at optimizing the use of on-farm water resources that can be harvested at any time of the season and improving the moisture content of the soil in order to avail water to the growing crops to satisfy the crop-water requirements.

The principles of water harvesting are capturing the runoff, collecting, storing and utilizing the stored water for the intended use. Rainwater harvesting for crop production purpose can be done using different storage structures and the water can be conveyed to the field through different systems. If the water is stored in underground structures, it can be lifted up using different mechanisms including gravity force to direct the water to the crop fields or it can be taken by human labor to water the field manually.

The human endeavor in the development of water sources must be within the capacity of nature to replenish and sustain the system. If this is not the case, costly mistakes of serious consequences could be committed. Applications of innovative technologies and the improvement of indigenous ones should, therefore, include management of the water sources ensuring sustainability and safeguard of the sources against pollution. Water harvesting can be undertaken through a variety of ways including: (i) capturing of runoff from rooftops, (ii) capturing of runoff from local catchments, (iii) capturing of seasonal floodwaters from local streams, (iv) conserving water through watershed management

RWH systems can generally be categorized into two as (i) in-situ water conservation practices, small basins, pits, bunds/ridges; and (ii) runoff-based systems (catchment and/or storage). The storage systems/run off based is usually used in supplemental irrigation. The in-situ systems, which enhance soil infiltration and water holding capacity, have dominated over storage schemes in Ethiopia until recently. Despite the additional costs involved in storage schemes, the recent trend shows that there is a relatively higher degree of adoption. Surface runoff from small catchments and roadside ditches is collected and stored in farm ponds holding an average of about 60m³ of water. This storage is not significant in volume but is sufficient for supplementary irrigation of vegetables. The use of these systems can be extended to crop fields and larger plot sizes through the use of

larger sizes of storages combined with efficient water application methods, such as low-pressure drip irrigation. Hence, rainwater harvesting is a useful means to overcome the recurrent erratic rainfall and dry spell conditions, which often are the major causes of crop failures in Ethiopia.

Spate irrigation which makes use of flush floods from larger catchments can be considered as one form of water harvesting. It can also be categorized under traditional schemes for those built by the community. They are traditionally practiced in Southern Tigray (>400 ha) and in some semi arid areas in Oromia (locally known as Gelcha). Modern spate schemes are also under implementation in some parts of the country. In view of the problems of sedimentation, as has been discussed above, these schemes can be taken as transitional measures until improvements are secured in the catchments for construction of micro dams for regulation of flow. Limited regulation with on-farm storages can partially solve the problem.

(vii) Shallow ground water harvesting

This is commonly used for domestic water supply. However, in areas where shallow ground water resources are available, it is possible to use existing appropriate water lifting technologies like treadle pumps to extend its use for irrigation. These are suitable for individual holding due to availability of affordable technologies. Due to clear water from ground sources compared to surface it can be effective if the method of water application is by drip system. This source of water can be enriched through associated groundwater recharging techniques.

5.3 Institutional aspects and partners

Ministry of Agriculture through its Irrigation & Drainage Department carried out the designs and implementation of the system by its rural infrastructures construction team in the early stages of SSI development in 1980s. In parallel, Water Resources Development Authority was involved in similar activities under small- & medium- scale dams and irrigation projects. Construction for these was carried out by Ethiopian Water Works Construction Authority as a contractor. Towards the late 1980s a third organization, Ethiopian Valleys Development Studies Authority was also involved in similar works. Thus duplication of efforts was quite visible. This used to happen at a site level. During the major droughts, organizations like Ethiopian Roads Authority were mobilized by suspending some of their road projects to build dams. Since the whole thing was centralized, no proper consultation at community level was exercised and only a top-down approach was adopted in the planning of the projects, limited experience in the country has resulted in total failure of the program. Due to poor demand for skilled human power at that time in other sectors, the institutions were relatively better equipped.

Following the process of decentralization of power in the early 1990s, the task was shifted to the regions. Thus the ministries at federal level are expected to engage in support and regulatory issues in areas of SSI. There was significant effort to strengthen the regions through the SAER programs. However, due to possibly the siltation issues discussed above, the effort did not go far enough in areas of storage dams to which the program was much focused.

The institutional stability of SSI remained too shaky since its inception. The attention given is sometimes inversely proportional to the rains and currently it is at the stage of testing different technologies. Thus it appears necessary to have a clear strategy and long-term action plan for making steady efforts in the direction of combating food insecurity from the angle of SSI.

Lack of clarity in mandates exists among the stakeholders. Ministry of Agriculture at all levels are handling the extension services to community schemes not only small

scale but also that of medium scale categories with its staff largely trained for rainfed agriculture. If the mandates of ADOs are limited to SSI which is less than 200 ha only, community schemes which are above 200 ha will not be attended properly. On the other hand MoWE has started targeting extra large projects which makes it less effective for SSI and its mandate does not extend to extension services to all categories. The definition for SSI needs revision to take into account the situation on the ground. In this regard existing SSI to about 1000 ha (which can include most of community schemes at least) and strengthening AD offices at all levels to take the responsibility of providing extension and expanding all categories of SSI and also enable it to render services to regions that have limited capacity in the medium term need to be looked into.

Partners in the development of SSI

The international community is significantly contributing towards the food security initiative which includes SSI. Among these countries & organizations are World Bank, CIDA, EU, AfDB, US government, Japan, UNDP, UNICEF and others who formed the New Coalition on Food Security in Ethiopia (NCFSE). The coalition has set about 3 billion dollars for the current planning period (5 years) with an objective of increased food availability, increased access to food, improved health, nutrition, water supply and sanitation to the whole nation.

In addition to the above, several other organizations (NGOs and donors) are also involved in financing the study, design and implementation of SSI almost in all regions. Among these are World Vision, Plan International, Menchen fur Menchen, Care Ethiopia, Concern Ethiopia, Water Action, Water Aid Ethiopia, Oxfam, Lutheran World Federation, FHI/E, IFAD, JICA, SIDA, Irish Aid, CRS, GIZ, SOS Sahel, CIDA, and local NGOs like Ethiopian Orthodox church, Ethiopian Evangelical Church, OSHO, ORDA, REST, etc. If all these efforts and commitments remain steady, well coordinated, integrated and targeted significant improvement can be made in the sub sector.

6. SMALL-SCALE IRRIGATION SWOT ANALYSIS

6.1 Strength

- High emphasis and priorities accorded to SSI in the development plan of the country,
- Existence of indigenous knowledge and improved practical skills in irrigation development,
- Increased awareness for the need of setting up appropriate institutions for SSI,
- Government effort to encourage private sector involvement in the study, design and development, including management,
- Establishment of public enterprises for the study, design and development, construction and supervision of construction of irrigation infrastructures,
- Introduction of promising household water harvesting and micro-irrigation technologies.

6.2 Weakness

a) Policy gaps and institutional constraints

- Lack of clear mandates and responsibilities of key stakeholders;
- Institutional instability and high staff turnover,
- Lack of clear water use rights between users;
- Inadequate operation and maintenance skills, including for rehabilitation of schemes, due to lack of participatory process;
- Lack of clear guideline on operation and maintenance issues between government and user communities;
- Inadequate irrigation extension service in irrigated agriculture;
- Poor linkage between research and extension systems;
- Limited affordable and appropriate irrigation technologies and absence of clear institutional arrangement for their multiplication and supply system to the users;
- No timely and inadequate supply of agricultural inputs;
- Absence of legalized WUAs at scheme level, due to lack of legal support to WUAs
- Absence of self-standing water conservancy and irrigated agricultural research institutions;
- No clear guideline on cost recovery mechanisms;
- No standard irrigation facilities and equipments;
- Absence of organized center for maintenance of irrigation equipments and other facilities;
- Inadequate or lack of training to stakeholders at all levels in the area of irrigation technologies and improved crop management practices;
- Lack of clearly articulated policy to fill the gaps through sourcing from private sector;
- Inadequate expertise and skills within the training and higher learning institutions to lead training programs through well-developed curriculum and need-based trainings for key stakeholders;
- Limited experience and knowledge in monitoring and evaluation system

b) Technical constraints and knowledge gaps

- Limited knowledge in modern irrigation water management (irrigation scheduling techniques, water saving irrigation technologies, water measurement techniques, simple water lifting devices, operation and maintenance of irrigation facilities);
- Inadequate knowledge on improved and diversified irrigation agronomic practices;
- Inadequate knowledge base and low level of know-how of technical personnel on irrigation technologies (irrigation pumps, drip irrigation system, fertilizer, post-harvest technologies, market opportunities and constraints, etc);
- Limited basic knowledge and inadequate capacity for database generation and management (climatic, rainfall, runoff, sedimentation data and peak discharge);
- Limited of knowledge on characterization of hydro-geology of an area;
- Scheme based approach rather than area/catchments based approach for the development of SSI Schemes;
- Inadequate baseline data and information on the development of water resources;
- Lack of experience in design, construction and supervision of construction activities of irrigation projects for quality control;
- Low productivity of existing irrigation schemes;
- Limited knowledge of marketing to produce high value crops using irrigation facilities;
- Limited access to credit to initiate business in irrigated agriculture.

c) Socio-economic constraints

- Inadequate community involvement and consultation in scheme planning, construction and implementation of irrigation development;
- Poor economic background of users for irrigation infrastructure development, to access irrigation technologies and agricultural inputs, where the price increment is not affordable to farmers;
- Increasing conflicts between upstream and downstream users for the available resources;
- Open grazing system affects development activities and aggravates land degradation;
- Lack of or low level of awareness of users about irrigated agriculture;
- Increasing evidence of land fragmentation restricted diversification of high value crops;
- Developed dependency syndrome, due to food aids as a result of frequent drought;
- Poor social and physical infrastructures for the development of irrigated agriculture;
- Lack of integration of irrigation infrastructure development and low level of investment with watershed development activities and resource conservation and management
- Diversion structures built by farmers are washed out by floods each season and farmers are forced to reconstruct structure every season.

d) Financial constraints and gaps

- Shortage of survey and construction equipment
- Shortage of adequate budget for study, design and construction
- Lack of financial management capacity of WUAs

6.3 Opportunity

- Strong political will from to senior government leadership;
- Conducive SSI sub-sector policy environment;
- Abundant water resources that can be tapped for irrigation use
- Good marketing opportunity for irrigated crops
- Favourable climate and land suitability,
- Irrigation is getting emphasis in research and higher learning institutions,
- Availability of irrigation technologies, even though limited.

6.4 Threat

- Deep rooted farmers dependency attitude on external support for irrigation construction and maintenance,
- Poor sustainability of irrigated schemes,
- Lack of cross-sectoral coordination and networking.

7. GAPS IDENTIFICATION AND ANALYSIS

Constraints that affect the development of SSI have been assessed thoroughly from the site visits made including interviews with beneficiary farmers, regional and federal levels consultations and review of existing documents. These constraints/gaps were classified into seven categories for better presentation and understanding of the main root causes. The identified constraints are categorized under technical, on-farm water and crop management, Research and Extension, issues related to input and credit systems, marketing and information systems, Institutional and cross-cutting issues, which include environment, gender, social and off-farm activities. However, some of the issues could fit into one or more categories, due to possible overlapping. For the set of identified gaps strategic directions are recommended. The details of gaps identified and the potential strategies formulated are briefly discussed hereunder.

► Technical aspects

(i) Planning and identification of SSI Schemes

The process of planning in SSI should preferably start with understanding of what already exists and by assessment of the potential. There were some efforts by different organizations to make inventory of the existing schemes. However, they are all incomplete and fragmented as different organizations have done the inventory in an isolated manner having little/no information exchange among them. Furthermore, the data collected are by and large incomplete or insufficient to assist the overall planning. Thus projects were mostly recommended to study & design by focusing on drought-prone/food-insecure areas or other criteria. The figures quoted for irrigable areas are usually based on data from the large-scale schemes and then considering some adjustment values for small- and medium- scale ones.

The other factor that makes the potential assessment difficult is the diversity of forms of the small-scale schemes (diversion schemes, storage schemes, traditional schemes, pumped schemes, water harvesting schemes, spate irrigation, family drip systems, etc) as it includes all sorts of possible schemes that lie within the traditional classification of less than 200 ha range. It also includes micro irrigation schemes that are less than a hectare or few tens or hundreds of square meters.

The existence of community schemes as large as 600 ha or more, but still run as small-scale by ARDOs, also makes the need to clarify the scale issues as it becomes out of the range of schemes under its mandate for irrigated agriculture (Small scale i.e <200 ha). A study by IWMI (working paper 124) identified farmer-managed "small-scale irrigation" as large as 2200ha. Although there are limitations, precise estimation of irrigation areas is fundamental for the success of the overall planning. Possibly lack of proper inventory and lack of potential of the country has contributed towards these issues. Availability of workable maps and technologies like introduction of GPS at this stage helps in mapping of what is available and where, creating a national data base and carrying out related analyses very easily.

Refinement of the classification is also necessary as some include terms like micro-schemes for the sizes in the lower range or irrigation at household level. What ever the case strengthening ARDOs at all levels to handle the planning, study, design, implementation and management of SSI is necessary to provide the services for all community schemes at least whose size is quite larger than the conventional 200 ha.

(ii) Study, design and construction

The constraints in this area are mainly lack of appropriate and simple guidelines and manuals to facilitate production of standardized study, design, quality control and O&M. Provision of the necessary equipment (for surveying, plotting, setting gauging stations, etc) and softwares that can improve the expected outputs can help in this regard.

The efforts made in the past in preparing standardized guidelines and manuals (former MoWR) need to be refined and promoted. It also requires evaluation of the impact of such works as to how to go for the next as their utilization seems limited. The lessons learned in water harvesting, family drip system and ground water use need to be consolidated and used in formulating future actions.

Lack of basic knowledge and inadequate capacity for database generation and management (climatic, rainfall, runoff, sedimentation data and peak discharge) exists. The fact that SSI focuses largely on small scale resources, availability of data is more of a problem compared to larger scales. Similarly, lack of knowledge on characterization of hydro-geology of an area and scheme based approach is predominant rather than area/catchments based approach is one of the gaps in the development of SSI Schemes. In addition, laboratory facilities for soil and water analysis are very limited.

Lack of proper consultation of beneficiaries and all stakeholders at each stages of project implementation is the other critical problem which affects operational efficiency and sustainability. Full participation of beneficiaries and all stakeholders in the planning, study, design, construction, and O&M works of SSI schemes needs to be improved and made more effective and real. The objective is to establish a sense of ownership, control by the beneficiaries over their own schemes and the planned interventions (designs) to be responsive to their problems. This can be achieved through a demand-led approach where the consent and participation of beneficiary communities in project conception, preparation, construction, and construction supervision and operation phases is required as the main criteria for project funding.

The other major constraint is limited availability and skill of the staff in study, design and construction which is highlighted under the human resources section 4.6 of this document.

Furthermore, limited availability of field and office equipment, laboratory facilities for soil and water analysis and lack of agro-meteorological stations at schemes level and lack of softwares are also identified as critical limitations in the study, design and irrigation water management.

(iii) Operation and maintenance of SSI schemes

This aspect is the responsibility of the beneficiaries through their WUAs. However, due to limited attention hitherto given to strengthen and legalize them and lack of clear and transparent O & M manual, they have poor records of performance for most of the schemes. Thus conflicts between users and malfunctioning or complete failure of the schemes are commonplace. Agricultural offices at woreda level, which are expected to play a pivotal role in this respect, do not have the necessary staff and commitment in most cases.

The problem is even worse in modern schemes that were constructed with limited consultation with the beneficiaries and those constructed in areas having relatively better rainfall amount. All these situations have inevitably resulted in poor water management in the form of under irrigation, loss of water by seepage (mainly on the conveyance which is usually unlined) overflowing of the canals, etc. Similarly in areas with more water resource potentials than the land available, over irrigation takes place which again has a damaging effect on the land.

In most cases, the field is not prepared well for basin or furrow irrigation and thus flood irrigation is commonly used. The length of furrows or basins is not related to the type of the soil, or the rate of the flow, so the water distribution is not as it should be. Similarly, watering time is longer than necessary so the water depth becomes much below the root zone and hence plants get water-stressed.

Rehabilitation of schemes that are not operational or are malfunctioning is important for additional production with limited cost. Lack of drainage is one the constraints in SSI although it is usually

neglected. This results in gradual reduction of yield and land salinization.

Lack of proper diversion, regulation, storage and controlling structures are among the major constraints prevailing particularly in the traditional schemes. Thus they are inefficient in their water use. They are also maintenance-intensive. This includes the headwork that often gets washed away during floods and inadequate cross drainage structures. The other feature of some of these schemes is their location which is often on steeper land slopes with limited or no levelling and inappropriate application methods which certainly entail erosion hazard. Hence, upgrading of these schemes to alleviate these problems, which is on progress, need to be strengthened.

The recent introduction of household level rain water harvesting (RWH) and family drip system (FDS) will be instrumental in promoting irrigation for food security. Due to massive efforts being exerted all at a time with no past experience and poor extension approach, it was encountered with many impediments in RWH at times making it unsuccessful in some areas. Among the problems are inappropriate site selection, water loss, rodent attack on the plastic sheets, cracking of masonry storages, etc. Provided the constraints were analysed and the necessary measures taken, RWH will have a significant contribution at household level.

In areas where FDS were tried, the system is recent and no comprehensive evaluation was carried out so far. However, some of the drawbacks observed during the site visits include some facts that the intervals of irrigation are not kept according to the crops' water requirements, clogging of laterals, as well rodent attack.

Upgrading the skills of DAs, farmers, strengthening of WUA are among the gaps identified and discussed in more detail under institutional and other sections.

► Inefficient on-farm water and crop management practices

The major constraints and challenges identified in the area of irrigation water and crop management practices are: improper crop and varietal selection; improper crop rotation cycle; inappropriate cropping pattern and cropping intensity; inappropriate crop calendar; inadequate small hand tools and farm implements; poor land preparation and land leveling; poor soil fertility management; poor irrigation scheduling/crop water requirement; inappropriate irrigation methods; and inadequate crop pest management practices;

The findings of the assessment of each of the agronomic constraints identified in the small-scale irrigation development schemes in Ethiopia are discussed hereunder in more details.

(i) Crop management

The crops and varieties recommended during the planning phase are not implemented accordingly at scheme level. Farmers usually prefer to produce field crops that have more importance to food security rather than producing high-value crops with greater demand in the local and international markets. In general shortage of improved varieties of irrigated crops is crucial in Ethiopia, due to less emphasis given to varietal development under irrigated condition, particularly, the availability of improved quality seeds. Variety adaptation and suitability studies are also limited. Similarly, mother trees of fruit crops such as mango, avocado and the like are not characterized properly and the records are not well maintained. Overall, the seed supply system for irrigated crops is almost lacking. As a result, farmers are forced to use either local varieties or imported seeds of vegetable crops, without having adequate information on their adaptability and yield potentials. Even sometimes old varieties of some vegetable crops are still being used without having been properly maintained and thus tax the farmer with substantial reduction of yield.

Furthermore, some crops are being grown in areas where the agro-climatic conditions are not suitable for revealing their full yield potential such as potatoes and cabbages. These crops are growing and giving better yields in the mid- and high- altitude areas. In the lowlands, on the other hand, formation of marketable tuber sizes is not satisfactory and in areas with higher temperatures, quality heads of cabbage are not developed. Even crops can be attacked by diseases or insect pests.

Storage facilities for improved varieties are not appropriate and the technical know-how is lacking for proper management. This, of course, negatively affects the seed quality and the germination capacity. Strong regulatory mechanism for transporting planting materials of root crops like potato and sweet potato is generally lacking. This may lead to spreading of diseases from place to place, particularly viral diseases.

Farmers are not following appropriate crop rotation systems that could have been established locally based on their long years of experience and considering the nature and mix of the available crop types that have adapted to specific localities. This is primarily, due to inadequate technical know-how and limited practical skills but sometimes conditions may force them not to follow such systems of crop rotation. Such factors as unavailability of seed, preferences of farmers for selected crops and market demands may force farmers to concentrate on limited crop types and varieties.

In most cases, farmers are not well aware of the magnitude of soil-borne diseases and insect pest problems that could be aggravated further by growing similar crops in the same field year after year. But the fact is that crop pest development is crucial and related crop yield losses are significant in areas where crop rotation system is not practiced. This is clearly observed in the field as crops are attacked by diseases and proper protection measures are not undertaken, due to limited access to the required chemicals by the farmers. In addition, the advantage of crop rotation as a soil fertility improvement option is not well appreciated by the farmers.

Farmers usually consider the importance of irrigation when there is drought and related crop failures. But in areas with sufficient amount of rainfall and an even distribution throughout the crop growing period, farmers usually grow one crop under rainfed condition and the second crop under irrigation in areas where irrigation infrastructures are in place. In most places, twice cropping is done on the same field, one each during the rain and off seasons using irrigation.

Furthermore, there are actually different factors that govern the cropping pattern and cropping intensity. But most farmers prefer to grow those crops, which have greater importance for food security rather than growing crops with greater market demand and better prices. In addition, the irrigated plots owned by individual farmers are small and fragmented, which in turn limits the possibility of maintaining appropriate cropping pattern.

The concept of crop planning is not well developed among farmers. Farmers are not also well aware of the importance of growing early-maturing crop varieties during the main rainy season in order to free the land for the next crop to be cultivated with supplemental irrigation. Long maturing crop varieties prolong the harvesting period. This affects the land preparation and timely planting of the next crop under irrigation which, therefore, precludes the possibility of growing two or three crops in a season.

Farmers are not taking special consideration on the importance of cropping calendar from the perspectives of getting better market prices and escaping frost and pest problems. Farmers usually lack technical know-how to establish their own crop calendar. This will again force them to face labor shortage at times of peak operations like weeding or harvesting and of course, necessitate additional costs to be incurred either directly by hiring labor or indirectly through losses of products.

Since the appropriate crop calendar is not followed, crops will mature and become ready for harvest almost at the same time. Similar, produce again will reach the market within the same period of time and the market will be saturated. This of course, will result in reduced market prices, which is not the desired outcome for irrigated agriculture.

(ii) Irrigation water management

Monitoring of the soil moisture status and the crop water needs at different growth stages is not getting sufficient attention. In most cases, farmers are irrigating their fields with prolonged intervals not appropriate for most vegetable crops, since it entails negative consequences on crop yields. As it has been observed from the field, on-farm irrigation water management is generally poor, due to absence of flow measurement structures. Factors such as crop types, soil characteristics, irrigation methods, crop development stages and their specific crop water needs, water availability, and others, which are essential for proper determination of irrigation scheduling, are not considered seriously. However, these are very crucial factors in determining how much water and when it should be applied to a given crop.

Field observations revealed that irrigated fields are either over- or under irrigated. In both cases, negative results are inevitable. When the field is over-irrigated crop roots are not properly functioning and are not able to take up adequate amount of nutrients from the soil. As a result of over-irrigation, soil nutrients, particularly nitrogen will leach down beyond the active rooting depth of plants and thus results in a significant amount of nutrient loss and yield reduction. Over-irrigation causes water logging and a significant loss of the available resource which could be used even to irrigate extra field and thus could result in the net increase of the irrigated area.

In areas, where there is adequate irrigation water available, farmers are tending to over-irrigate their fields without clearly understanding the associated risks and damages to the land. As a result of over-irrigation salinity is becoming the potential problem, which deteriorates the land quality and significantly reduces crop yields. Salinity is becoming the potential problem, particularly, in the lowlands where there is shortage of rainfall for maintaining natural leaching.

The most widely used irrigation methods in Ethiopia are grouped under surface irrigation methods such as wild flood, controlled flood, furrows and to a limited extent low-cost gravity fed and pressurized irrigation systems. However, the most pressing challenge is the poor water management practice, which is very common in most irrigation schemes, The major causes for such poor practices include: poor land preparation and leveling, improperly designed main and field canals, absence of water level measuring devices, poor maintenance of main and field channels, and limited know-how and inadequate practical skills of farmers on crop water needs, soil types and climatic conditions which are instrumental in choosing the more appropriate irrigation methods.

Farmers are not paying attention to the water losses through seepage, deep percolation and evaporation. Environmental degradation is also crucial, due to water logging and salinity problems resulting from selection of inefficient irrigation methods. Even sometimes, soil erosion is a potential hazard in some irrigated fields, due to poor land leveling and lack of maintenance of furrows strictly across the contour. Cropping rows and planting methods sometimes affect proper layout of the selected irrigation methods. Farmers are not sometimes maintaining the recommended inter-row spacing and planting methods considering the crop characteristics and the irrigation methods to be used for proper water application.

(iii) Small farm tools and implements

In most cases, proper planning is not carried out for launching irrigated agriculture. Identification of appropriate tools is not getting sufficient attention during planning. Similarly, the required quantity of tools, considering the field size and the required labor force, is not timely acquired. Of course, this affects significantly the performance of each agricultural operation. Usually, farmers are not using appropriate tools in order to ease their work load and finish the operation quickly.

Basic hand tools required for gardening and improved farm implements are not easily available at the local markets. Proper maintenance and handling of tools and farm implements is generally

lacking. Tools are not properly cleaned and greased after each operation and this affects their efficiency and lifespan. In nursery sites proper storages for tools are also lacking. Improved farm implements are not widely used, even though some research outputs still exist. This is, due to lack of proper demonstration of the use of these improved farm implements for different operations, limited capacity of technology multiplication and lack of private sector involvement in technology multiplication and distribution.

(iv) Land preparation

In principle land preparation is the main operation undertaken in the main field. However, the fact is that irrigated fields are not well prepared and leveled and row based production is not practiced which reduces the possibility of proper weed control over the planted area. As a result, the water distribution system is significantly affected and also heavy loss of irrigation water occurs.

In addition, poor plant population is observed in irrigated fields, due to poor seed germination, particularly for small-sized crop seeds. This significantly affects crop yields. The level of weed infestation is high in poorly prepared land and even field sanitation is crucial. The weeds and sanitation problem will increase the loss of irrigation water. Additional labor is required for weed control and field sanitation activities. In some cases, land preparation is not properly done following the contour, which consequently aggravates soil erosion. In addition, proper farm implements are not being used for land preparation, either due to inaccessibility or price limitation.

(v) Poor soil fertility management

Irrigation increases cropping intensity and increased removal of nutrients from the soil. If nutrients are removed more rapidly than they are replaced, the system is not stable, the soil resource base degrades and crop yields are reduced. In this regard, in most of the SSI schemes across the country, irrigation water is taken as the only input in addition to seeds and seedling materials. The application of fertilizers both of organic and inorganic sources is not getting sufficient attention. However, in some parts of the country farmers are using both fertilizer and organic material such as compost, (which in most cases are not well prepared), manure and crop rotation, although with reduced amount, in order to improve the supply of nutrients to the growing crops. In most cases, under irrigation condition, farmers are not using the right amount of fertilizers or not at all, due to unavailability of the required type and amount of fertilizers and the escalating prices which lead to some compromises on its proper application. But the fact is that irrigated agriculture is more responsive to fertilizer use.

It is common that farmers are using only DAP and Urea to supply nitrogen and phosphorus nutrients and the availability of other micro and macro-nutrients out of the additional 14 elements is limited. In this case, the nutrient requirements of crops are not satisfied and thus result in low crop yields. Unless other wise proper methods and time of application are maintained, nutrient losses may occur in irrigated condition, particularly nitrogen through leaching beyond the active rooting zone of the crop, from where it won't be available anymore to the plant.

The overall crop management practices are based on maximum exploitation of the available nutrients without returning to the soil matching amounts of nutrients removed in the form of crop residues. Due to limited availability of alternative household energy sources, crop residues are being widely used for fuel instead of for maintaining soil fertility. The content of organic matter in most Ethiopian soils is generally low which in turn affects the stability of the soil by making it more susceptible to erosion. In addition, due to the increased prices of artificial fertilizers, adequate input supply is lacking especially with irrigated crops. The existing input supply system in most parts of the country is established for rainfed crop production. Furthermore, research recommendations on soil fertility management including fertilizer rates for irrigated crops are inadequate. Proper crop rotation cycles that are aimed at improving soil fertility are not given due attention.

(vi) Crop pest management practices

Irrigated crops are attacked by different insect pests and diseases. However, the disease infestation level is relatively low during the dry season under irrigation condition. But soil-borne diseases are easily transmitted from infested fields to others via the irrigation water. As it has been explained earlier, crop rotation is not well practiced due to different reasons; neither are taken appropriate crop protection measures generally resulting in heavy crop yield losses from diseases and insect pests in irrigated fields. Insect pests like cutworms, stalk borer, bollworms, aphids, termites, onion thrips, spider mites, etc. are common. Similarly, diseases like powdery mildew, root rots, nematodes, bacterial wilt, etc. are common under irrigation conditions.

► Weak research and extension services

The extension system of delivering services is very weak. The primary team member in Ethiopian extension service is the DA. He/she serves over 600 farmers which is too big for proper discharge of the DA's responsibility, especially in the absence of any means of transportation. There exist no clearly developed irrigation extension methods under practice currently. The farmers do not know how to build proper furrows or control water flows in the channels and in the fields. No clear policy was put in place with regard to introduction of more sophisticated irrigation methods. The extension skills of DAs are very variable such that in some places there are very skilled and motivated DAs and in other places rather not so much.

The research system commonly follows on-station research approach with little or no involvement of the extension works and most importantly the farmers. Hence, the research agenda or topics are by and large selected based on the researchers' interest without reflecting the farmers' true problems or needs. There is currently emerging on-farm research approach which needs to be further expanded. Most research works are in rainfed agriculture and there is currently no significant research work in irrigated agriculture.

A major gap observed include: the lack of seed sources for high-value and improved crop varieties. This has forced farmers to use very low productive seeds. There is a dire need for research institutions to work on high-value and improved variety seed testing and verification works.

A general limitation is that the collaborative working relations between the research and extension workers are very low. Very little research works in irrigation agronomy were noticed in research institutes beside those of IWMI. On farm research activity was not found at all, nor development of technology dissemination mechanisms.

► Weak input supply and credit system

(i) Inadequate input supply system

Generally, there is a problem of technology generation, manufacturing and multiplication. As a result, very often many input products are not available. It is very rare to observe an organized input distribution system or estimation of input requirement, e.g. fertilizers, seeds, spare parts for pumps and irrigation systems etc. Farmers usually buy only what is available. Estimation of inputs should be worked out but as long as the extension service is not involved, it is usually missing. The main inputs for distribution are: micro-irrigation equipment, seeds, seedlings and fertilizers. There is no organized market for inputs and no competition between suppliers. The farmer has no options to negotiate prices and types of inputs she/he needs. Estimation should have been done based only on soil tests; otherwise it is just a simple guess. Proper supply of technical services is not available to the farmers. Often they have to travel long distances to major cities for repairing of water pumps or for spare parts.

In addition, input supply problem occurs due to inaccessibility of the rural areas and/or in some cases lack of credit facilities for the beneficiaries. Related to the production of high value horticultural crops, both input and output side of marketing is considerably important. In the light of various market constraints, inaccessibility and small size of market is the very important limiting factor for irrigation systems. The acquisition of inputs from local market could not meet the demand of farmers. Therefore, farmers whether irrigation or rainfed cultivators, rely on outside dealers for most of the inputs. For instance, in spite of high prices, most of the time fertilizers are not available or the supply is untimely. All farmers that use fertilizer as an input for the production of high value horticultural crops and low value food grain crops do not apply the recommended rate. Therefore, the amount of production depends on the amount of fertilizer used provided that all other factors remained same.

Those farmers who are selected to be embraced by the rainfed package program will be provided the privileges such as credit service and technical assistance with close farm supervision. However, irrigation farmers are not yet considered into the package program by the regional governments. Hence, fertilizing irrigated plots is not a common practice in most irrigation schemes. Moreover, in schemes where fertilizers are being used, the application rates are much below recommendations. Hence, almost all irrigating farmers do not yet exploit the synergetic effect of fertilizers and water. The case is almost the same in relation with the utilization of improved crop varieties and seeds,

(ii) Inadequate credit supply arrangements

With reference to credit, although it is pivotal to irrigated crop development, it is either totally absent, or is used in only limited number of schemes. The problem is the reluctance of most cultivators to use any credit for irrigation, resulting in a much slower rate of buildup of production from an area than is economically desirable from the institutional viewpoint. Their reluctance to borrow is understandable, as the amount of money involved, judged by a small farmer accustomed to subsistence level rainfed agriculture seems to be very large. From the institutional side as well the attempts to supply credit for irrigation cropping seems halfhearted especially when compared to the concerted efforts observed for the rainfed agriculture.

Clear credit supply arrangements and policy were not observed. The small holder cannot get any loans, even if available, as he has nothing to put as mortgage. Women-headed households are less favored getting access to credit through group collateral.

► Poor market structure and information system

The lack of access to market in close proximity has greatly reduced the income that farmers could have gained otherwise. Price information is haphazard, some farmers get it from neighbours or friends visiting the markets and some do not get it at all. The SSI users do not have market structure for their productions. The traders come to the farm and offer prices that farmers cannot negotiate on. Storage of farm products and quality control systems are not available and this does significantly affect farmers as a result of high post harvest losses. There are some indications for initial farmer cooperatives organizations in regard with development of marketing systems.

Post-harvest handling of farm products is very limited and no facilities involved were observed. Facilities for adding values to the products, e.g. sorting, packing, storing and transport means are not available. There are no new cost efficient technologies in post harvest and storage that add value to vegetables and fruits. Processing of products at domestic level does not exist, thus the farmers have no outlet for surpluses. Therefore, establishing of "collection centres" at close proximity might be important with some adding value features like sorting, storing, packaging and marketing of farm products, transport facilities, inputs and credit supply, farm tools rental services, spare parts, technical services and for information and training purposes involving the private sector.

Production is mainly for the local consumption and only some surpluses are marketed. The situation at some locations is different that where stable farming systems are used and the irrigation systems are developed, there is some commercial production for the markets at a very low level and prices. The small scale farmer has no information about the market prices and quantities. If they are located at some distance away from the market centers, they even don't have cellular connection. All farmers in the region are producing nearly the same products at the same time. At the harvesting time, all farmers together are finding themselves in the same market and in the hands of traders or even worse in the hands of middlemen.

Transportation to the markets is done on the back of humans or animals usually donkeys. The transportation from the market places is done by open trucks, no matter how far the distance or the temperature might be may be for several days. By the time of arrival at the main markets, the products are in terminating conditions with only few hours of shelf-life remaining and should be sold on the spot. There are some wholesale markets in the big cities like Addis and bigger towns, but there are no facilities for prolonging the shelf-lives of the product.

► **Institutional /support system gaps**

(i) Institutional arrangements: Lack of clarity in mandates.

At federal level responsibilities with respect to development planning, design, implementation, and operation and maintenance including irrigation advisory services related to the small-scale irrigation and water harvesting schemes fall within the mandate of the MoA. However, the Ministry is poorly staffed at the moment. At regional level these mandates are not clear between the Bureaus of Agriculture and that of Water Resources which creates gaps in ownership of some activities. This in turn results in lack of accountability where each thinks that the other should have done. It is not always clear which institution is responsible for the maintenance and rehabilitation of water schemes. In addition, the roles and responsibilities of BoWE and BoA for some irrigation advisory services such as portable pumps installation and maintenance lack clarity.

(ii) Poor collaboration and networking

This is very weak and often does not exist. The poor institutional linkage and coordination is manifested at different stages of scheme development. At design stage, for instance, the BoA and BoWE should collaborate and work together in areas of watershed management and O&M including extension services for irrigated agriculture. Working in this area requires concerted efforts of all stakeholders as it is one of the major constraints in the development and sustainability of the schemes. There is also no feedback system to refine the future based on the performance of the present through collection and exchange of information. This aspect is a problem not only across different institutions but it is also a constraint within institutions.

(iii) Inadequate skilled manpower and inefficient human resource management

One of the critical problems that affect the sustainability and efficiency of the existing schemes and/or the overall development of irrigated agriculture is lack of appropriate skilled manpower in the field of irrigation development. Planning and implementation of irrigation projects require the involvement and coordinated efforts of multi-disciplinary professionals of engineering, geotechnical, watershed, agronomy, socioeconomics and

environment. The majority of the professionals and technical staff, who have been implementing irrigation projects, are relatively inexperienced and they too are in limited supply.

Faulty design outputs based on inadequate data and knowledge; poor construction quality technology choices; inadequate knowledge on improved and diversified irrigation agronomic practices, inadequate advisory services on the installation and O&M of micro irrigation equipment, and inefficient irrigation water management are some of the problems associated with shortage of skilled human power. Thus it is necessary to produce qualified and targeted human power so that the various tasks from planning to implementation could be properly accomplished.

The other constraint that affects the efficiency and sustainability of the existing schemes is lack of appropriate irrigation advisory/extension/ service. Irrigation advisory/extension service is constrained by shortage of appropriate human power and absence of irrigation advisory/extension service packages. There is a significant number of professionals with relatively good knowledge levels in design compared to irrigation advisory/extension services. The rainfed system is relatively better equipped with the necessary manpower. In fact irrigation is handled by these staff at the moment in most areas. Thus, capacity building is necessary for better performance of the schemes. This can be effectively carried out by upgrading the skill of the DAs for the rainfed or by training of new ones. The existing capacity is low at all levels. This is mainly due to increased demand in the market particularly the private sector. Thus high turnover of professionals is one of the major constraints in this regard. Increased involvement of the private sector is one aspect that can assist the stakeholders in this area. Farmers lack proper knowledge on irrigation water management resulting in wastage of water and intensification of salinity and water logging problems.

At the moment, capacity is low at all levels. This is mainly due to increased demand in the market particularly the private sector. Thus, high turnover of professionals is one of the major constraints in this regard. Increased involvement of private sector is one aspect that can assist the stakeholders in this area.

In summary, knowledge and skill development gaps are noticed in disciplines such as hydrology, hydrogeology, geology, hydraulic and structural design, improved agronomic practices, soil and water management, irrigation water application techniques, construction management and quality control, etc. The current state of expansion of higher learning institutions opens up the opportunity to alleviate the situation shortly if they provide targeted trainings.

The expansion of higher learning institutions is the major area of opportunity expected to alleviate the situation in the short term if they provide targeted trainings.

(iv) Unclear handing over procedures of irrigation schemes

Transfer of schemes to farmers, upon completion of construction, does not include assessment of the capacity of the farmers. Therefore, the need to make closer follow up and assistance is not properly addressed even at early stages. Thus schemes can fail soon after commissioning. Normally

maintenance problems are increasingly high until the whole system stabilizes. The beneficiaries should be part of the whole process from the very beginning and equally true is that the transfer of schemes should be done after properly building the capacity of the users in order to ensure sustainable performance of the system. Currently, for instance, farmers are accustomed to free maintenance service given by the government even for works which can be done by themselves. Preparation of comprehensive operation and maintenance manual indicating who should do what, how and when is a prerequisite. Complete transfer of schemes should take place only after the system is closely monitored and evaluated for a certain period of transition. In some of the schemes nature of the structure may demand regular inspection even after handing over. It is also necessary to have regular bottom-up reporting mechanisms for taking timely actions.

(v) Limited role of Water Users' Associations

The main function of water users' associations is to fairly and equitably distribute the water resource among the members and mobilize them for the maintenance works. Traditional water management organizations, which exist in almost all of the traditional irrigation schemes, are not usually given attention. WUAs have no legal status on their formation and operation and thus have to be transformed into irrigation cooperatives as the latter have legal backing. However, the establishment of irrigation cooperatives needs to be thoroughly evaluated as the cooperatives are mainly focused on input and output marketing rather than water distribution and management issues. Besides, irrigation cooperatives are established by voluntary members only, but for WUA membership is a mandatory.

Often there are no facilities in close proximity to WUAs for value addition such as necessary for sorting, storing, packaging and marketing of farm products, transport facilities, inputs and credit supply, farm tools rental services, spare parts, technical services and for information and training purposes. The private sector should be encouraged to open up centres that can provide such services.

(vi) Limited irrigation technologies and weak extension systems

The Ethiopian Agricultural Research Institute at federal level and the regional agricultural research institutes are mandated to carry out agricultural water management research activities. However, it is often overshadowed by their overall mandate which is focused on rain fed crop production. Only few research centers are mandated and capacitated to carry out research on soil and water management, rain water harvesting, small holders' irrigation equipment, irrigation agronomy, etc. The majority of the research centers are poorly staffed and equipped with the necessary office, laboratory and field research equipment. Therefore, technology generation in the field of agricultural water management and irrigated agriculture is very low. As a result, yields per unit area are not much better compared to yields obtained from rainfed farms.

There are only limited institutions, government or private that are responsible for the manufacturing and multiplication of generated technologies from the research centers. Multiplication of horticultural and other crop varieties of seed for transfer to end-users in the country as a whole is the major gap noticed. This reality obliges farmers to depend entirely on low yielding local crop varieties, which are susceptible to pests and diseases.

The other constraint that affects the efficiency and sustainability of the existing schemes is lack of appropriate irrigation advisory/extension/ service. As it has been discussed earlier

irrigation advisory/extension service is constrained by shortage of skilled manpower and limited availability of technological packages suitable for different agro-ecologies and farming systems. As a result of lack of proper knowledge of farmers on irrigation water management leads to wastage of water and intensification of salinity and water logging problems.

(vii) Limited involvement of the private sector

Despite the fact that the involvement of the private sector in the overall small-scale irrigation development activities is essential, their involvement is actually limited. However, the involvement of the private sector specifically in the area of study, design, implementation/construction activities, operation and maintenance, in multiplication and provision of inputs and irrigation technologies as well technical services is vital.

► Lack of adequate financial resources

The major stakeholders lack sufficient and steady financial support to plan and implement the schemes and build their capacity in general. Thus, mainline institutions responsible for the developing SSI facilities often lack stability and their capacity building efforts become ineffective as they are frequently obliged to scale down their staffing due to financial constraints. As it is generally known that irrigation requires heavy investment and yet the financial support of donors and even the allocation of appropriate budget from the government side is inadequate so far. The critical areas that lack financial resources are: the need of heavy machineries and equipment, field and office equipment required for the study, design and supervision of construction activities, costs related to operation & maintenance activities.

In addition, cost recovery mechanisms in areas of operation and maintenance are not introduced in a more coordinated manner, even though it has been supported by the water sector policy.

► Cross-cutting issues

(i) Social aspects and gender

Success of a scheme depends on inclusion of considerations of social and environmental issues. Past experiences have also shown that failure or malfunctioning of some of the SSI schemes is related to poor consultation with the beneficiaries. This is because the planning and implementation approach was top-down and hence not demand-driven.

The concept of integrated irrigation water use is not well addressed right from the planning and implementation periods. As a result, the societies living adjacent to the irrigation schemes are forced to fetch drinking water inappropriately or fetching water from distant areas. In addition, due to inadequate facilities set for livestock drinking water, main irrigation canals are being damaged by open livestock interference.

Involvement of women in small-scale irrigation schemes is one of the areas where gender equality can be assured. However, gender parameters are not well captured in the development of irrigation projects. As a result the role of women in decision making processes at all stages of schemes development is generally lacking. In addition, the

participation and consultation of WUAs right from planning through implementation are also limited.

(ii) Environmental issues

Land degradation is one of the main environmental issues, which is eroding the very basic sustenance on which the population depended for centuries. This further result in loss of top soil and subsequently resulted in declining of soil fertility that supports the existence of vegetation cover and sustain crop production. Due to topographic variations and torrential nature of rainfall flooding is a potential problem in the lowlands and resulted in deposition of silt and gravel, which reduces the suitability of the area for agriculture. Sometimes, as a result of deforestation for agricultural production purpose brings ecological imbalance, which further aggravates the climatic change. This further contributes to the expansion of desertification.

As a result of poor irrigation water management practices salinity and water logging problems can be potential environmental constraints, which impede irrigation development. Poor drainage facilities further aggravates the magnitude of water logging and salinity hazard. Furthermore, water related health hazards, such as malaria, schistosomiasis, water borne disease and the like are potential constraints in irrigated agriculture. These primary health risks associated with small-scale irrigation projects are related to water and vector borne diseases.

Therefore, these are the areas that need close monitoring to mitigate ill effects on human health and reduce environmental degradation.

(iii) Alternative energy sources

The high population pressure in the highlands entails high demand for energy, of which the main source is wood especially in rural areas. Thus, unless alternative energy sources are made available, the extent of deforestation is being aggravated. This leads further to climate change. Promotion of alternative energy sources such as energy-saving stoves, utilization of biogas, wind energy and solar radiation cooking devices is not strengthened.

In line with these constraints highlighted it will be vital to promote the use of alternative energy sources as described above including rural electrification.

(iv) Off-farm activity

Since agriculture is the main stay of employment, the present trend of rapid population growth resulted in continued fragmentation of the land resource, which in some cases has already reached a level where it is no more manageable. This situation will be more pronounced in SSI as the land resource is much smaller than under the rainfed conditions.

Off-farm activities such as agro- processing, micro- enterprises, beekeeping, mushroom production, sericulture, vermi-compost preparation for sale and self consumption are not getting sufficient attention in rural development. However, these are the areas that can create additional job opportunities and potentially used for income generation for improving rural livelihoods.

8. CONCLUSION AND RECOMMENDATIONS

Agriculture still remains to be the leading sector in the national economy of Ethiopia. The country is endowed with a wide range of natural resources such as land, irrigation potential and agro-ecological diversities favorable for the growing of various crops. However, these natural resource bases are not getting sufficient attention for the wise use and sustainable utilization in order to bring a sound change and sustainable development in the overall economic development of the country.

Despite, the huge potential that the country has in terms of water availability and land, which are in most cases suitable for irrigation development, irrigation development is in its infancy stage and the country is not benefiting from the sub-sector accordingly. The major production constraints that impede the development of the sub-sector among others are predominantly primitive nature of the overall existing production system, shortage of agricultural inputs and low level of users participation in the development and management of irrigated agriculture, limited trained manpower and inadequate extension services.

However, the fact is that the importance of irrigation development, particularly at smallholders' level need prime consideration to raise production and achieve food self-sufficiency and ensure food security at household in particular and national levels at large. The irrigated agriculture can also play a vital role in supplying with sufficient amount and the required quality of raw materials for domestic agro- industries and increase export earnings. Unfortunately, there are a large number of small-scale irrigation schemes that have been developed in different parts of the country by the Government and through the support of different funding agencies. However, due to different environmental and management factors most of these schemes are not being exploited fully and irrigation, in general is not contributing its share accordingly to the overall economic development of the country. Hence, considering the limitations the government is giving emphasis to the irrigation sub-sector in order to enhance the capacity and increase its contribution in the overall economic development of the country. But this needs to be strengthening further and enhance irrigated agriculture, particularly giving emphasis to small-scale irrigation development to increase production and productivity and improve food security and reduce poverty. This basically based on the fact that small-scale irrigation has a comparative advantage as compared with medium and large irrigation schemes, where SSI has lower investment cost, easier to construct and maintain, end users can be actively involved and have more control over the water resources, requires less management capacity, has less environmental impact and can be more fairly distributed to benefit more users.

In conclusion the situation analysis and capacity needs assessment has been successfully conducted and identified constraints being encountered in the area of small-scale irrigation development. Furthermore, strategic issues are identified that could service as basis for the formulation of the small-scale irrigation capacity building strategy that will serve as long-standing framework and be used as a road map to enhance irrigated agriculture. In the formulation of the capacity building strategy it will be highly important to focus and properly identify the key action steps that need to be captured in order to meet the set goals in line with the strategic directions.

Furthermore, in the course of the strategy development it might be important to synchronize the strategy focus with other ongoing initiatives being captured in the long-term development plan of the country.

References:

- Rural development policies, strategies and instruments, *Nov 2001*
- PASDEP- Plan for accelerated and sustained development to eradicate poverty (for the planning period *2006-2010*)
- Conservation Strategy of Ethiopia- Environmental policy
- Water Resources Management and Irrigation & drainage policy and strategy
- Population policy
- Tropical Africa Agriculture and Rural Development, Agmon, R. (*1999*).
- Implementing IWRM in a catchment: Lessons from Ethiopia, Jembere, K. (*2009*).
- Opportunities and Challenges for Developing High Value Agricultural Export in Ethiopia- The World Bank (*2004*).
- CTA working document 8031- on Small-scale irrigation for food security in sub Saharan Africa by Mekuria Tafese, Jan-*2003*
- Experience and opportunities for promotion of small scale /Micro irrigation and rainwater harvesting-IWMI- Working paper 98
- Water resources development in Ethiopia- Issues of sustainability and participation (Desalegn Rahmato -A.A June *1999*).
- 12. Water Resources and Irrigation development in Ethiopia- IWMI- working paper 123 -*2007*
- 13. Irrigation Practices in Ethiopia (working paper 124): Characteristics of selected Schemes (Michel M.Girma and Seleshi B.Awulachew).



