Efficient Water Use for Agricultural Production (EWUAP) Project

BEST PRACTICES FOR WATER HARVESTING AND IRRIGATION

ETHIOPIA

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Abbreviations and Acronyms

AEZ	Agro Ecological Zone
AMAREW	Amhara Micro-enterprise Development, Agricultural Research, Extension and Watershed Management Project
BBF	Broad Bed and Furrow
BBM	Broad Bed Maker
BOARD	Bureau of Agriculture and Rural Development
BOWME	Bureau of Water, Mines and Energy
BP	Best Practice
CSA	Central Statistics Authority
CMI	Community Managed Irrigation
CT	Conservation Tillage
DA	Development Agent
EARO	Ethiopian Agricultural Research Organization
EHPEA	Ethiopian Horticulture Producer- Exporters Association
EIAR	Ethiopian Institute of Agricultural Research
ERHA	Ethiopian Rain Water Harvesting Association
ESISC	Ethiopian Sugar Industry Support Centre Share Company
ESRDF	Ethiopian Social Rehabilitation Fund
EU	European Union
EWUAP	Efficient Water Use for Agricultural Production
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
GTZ	German Technical cooperation
GW	Ground Water
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
IWMI	International Water Management Institute
LGP	Length of Growing Period
LLPPA	Local Level Participatory Planning Approach
m.a.s.l	Meters above sea level
MERET	Managing Environment Resources to Enable Transition to more Sustainable Livelihoods
MOA	Ministry of Agriculture
MOARD	Ministry of Agriculture and Rural Development
MOWR	Ministry of Water Resources
nd	No Date
NGO	Non Governmental Organization
O&M	Operation and Management
OBARD	Oromia Bureau of Agriculture and Rural Development
OIDA	Oromia Irrigation Development Authority
ONRS	Oromia National Regional State

PC	Planning Committee
pd	Person Day
PPMI	Public/Private Managed Irrigation
REST	Relief Society of Tigray
SG	Sasakawa Global
SS	Sediment Storage
SSI	Small Scale Irrigation
SWC	Soil and Water Conservation
TWRDB	Tigray Water Resource Development Bureau
TOR	Terms of Reference
USAID	United States Agency for International Development
WFP	World Food Program
WH	Water Harvesting
WOCAT	World Overview of Conservation Approaches and Technologies
WUA	Water Users Association

Currency Equivalent

Exchange rates relative to the U.S. Dollar

Year	Rate (Birr)	Year	Rate (Birr)	Year	Rate (Birr)
1990	2.07	1996	6.35	2002	8.13
1991	2.07	1997	6.8	2003	8.31
1992	2.07	1998	7.06	2004	8.31
1993	5.10	1999	8.12	2005	8.45
1994	6.22	2000	8.17	2006	No data
1995	6.29	2001	7.5	2007	8.4
				Nov 20, 2007	9.09

(i) Source of exchange rate for the year 2001 - 2007:
http://en.wikipedia.org/wiki/Table_of_historical_exchange_rates

(ii) Source of exchange rate for year 1990 – 2000: World Bank (Public Expenditure Review)
http://64.233.183.104/search?q=cache:PTPkd_i0HoUJ:www.economics.ox.ac.uk/members/stefan.dercon/Growth%2520and%2520poverty%2520in%2520Ethiopia%2520in%2520the%25201990s.pdf+birr+dollar+exchange+rate+1993+1994+1995+1996+1999&hl=en&ct=clnk&cd=19&lr=lang_en

Glossary of Terms

Bereha	Hot and hyper-arid): General term that refers to the extreme form of Kola, where annual rainfall is less than 200-mm.
Dega	Cool, humid, highlands): Areas from 2500-3000 meters where annual rainfall ranges from 1200 to 2200-mm
E.C.	Ethiopian Calender (Add 8 to convert to Gregorian calendar)
Kebele	Lowest administrative unit below a district
Kola	(Warm, semi-arid lowlands): Areas below 1500 meters with annual rainfall ranges from 200-800 mm.
(Weina Dega	(Temperate, cool sub-humid, highlands): Areas between 1500 to 2500 meters, where annual rainfall ranges from 800-1200-mm
Woreda	District
Wurch	(Cold highlands): Areas above 3000 meters and annual rainfall is above 2200-mm

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1. Introduction and Background

1.1 Introduction

This report is prepared to provide information on the available best practices and sites of excellence in agricultural water use. This paper is a follow up to previous works carried out by the EWUAP project, which includes capacity building, awareness creation and the undertaking of Rapid Baseline Assessment study.

The first sections of the report present brief background information on rain fed and irrigated agriculture and agro ecological zonation of Ethiopia. The criteria for prioritization of BP and sites of excellence are presented in section 5. The major parts of the remaining sections show the long lists of BP and BP sites and the results of the prioritization work. Finally, the paper has presented a brief review of the existing technical guidelines and list of potential institutions for capacity building and twinning.

1.2 Background

1.2.1 Irrigable Area in Ethiopia

The major water user in Ethiopia is the rain fed agricultural system. In 2005, the rain fed cultivated area covered under cereals, oil seeds, pulses and sugar cane in Ethiopia was 7,637,524 ha, 824,430 ha, 1,349,116 ha and 18, 601 ha, respectively (CSA, 2005).

The total irrigated area in Ethiopia in 2004 was 205,842 ha. This is shown in Table 1 disaggregated into traditional CMI and "Modern" CMI (Tadesse, B., et. al. (nd)). Additional information on irrigation area in Oromia and Amhara Regions is attached in Annex 1.

***Table 1**: Actual Irrigated Area by Regions in Ethiopia in 2004*

	Region	Irrigated Area under traditional CMI; ha	Number of Beneficiaries	Irrigated Area under Modern CMI; ha	Number of Beneficiaries	Total	
						Irrigated Area ha	Number of Beneficiaries
1	Oromia	56807	113614	17690	61706	74497	175320
2	Amhara	80710	450910	7410	34140	88120	485050
3	SNNPR	2000	2700	11577	45000	13577	47700
4	Tigray	2607	25692	11270	46350	12607	72042
5	Afar	2440	16640	0	0	2440	16640
6	Somali	8200	16400	1800	7000	10000	23400
7	Gambela	46	373	70	280	116	653
8	Benshangul Gumuz	400	2000	200	170	1696	2170
9	Harari	812	558	125	71	937	629
10	Diredawa	640	1536	1056	3676	1500	5212
11	Addis Ababa	352	8608	0	0	352	8608
	Total	155014	639031	51198	198393	205842	837424

Source: Tadesse, B., et al. (nd); adopted from the regional Bureaux of Agriculture and Irrigation Authorities.

Note: *Traditional schemes are those schemes that were initiated or developed by the farmers with no external input. Modern irrigation schemes are those that were developed with technical and financial input from the Government or NGOs. The size of both types of schemes is often less or equal to 200 ha and are categorized as "small" schemes. Irrigation schemes in the range of 200 – 3000 ha are categorized as medium and those with area greater than 3000 ha are considered as large schemes (MOWR, 2001).*

1.2.2 Agro-Ecological Zones (AEZ) of Ethiopia

(A) Technical Basis Used in Characterizing AEZs

a. Length of Growing Period (LGP)

The growing period analysis was based on water balance, using rainfall, potential evapotranspiration and soil moisture storage capacity. High and low biomass areas occurring during the moisture periods were determined by grouping the single and double growing periods in to seven logical moisture regimes as shown in Table 2. The LGP is defined as "the total number of days per annum with sufficient available moisture for crop growth" (MOA, 2000; MOARD 2005).

Table 2: *LGP Classes Used in the Classification of AEZs*

LGP Days	Universal Terminology
A growing period of below 45 days	Arid
A growing period of 46 - 60 days	Semi-arid
A growing period of 61 - 120 days	Sub-moist
A growing period of 121 - 180 days	Moist
A growing period of 181 - 240 days	Sub-humid
A growing period of 241 - 300 days	Humid
A growing period of >300 days	Per-humid

Source: MOA 2000 and MOARD, 2005

b. Thermal Zone

The thermal zone classes were the second data set required to characterize the AEZs. The thermal zone factor is noted to influence the distribution of the animal population and vegetation communities in a specific zone. The thermal Zone classes are shown in Table 3.

Table 3: *Thermal Zone Classes Used in the Classification of AEZs*

Temperature ^{0}C	Universal Terminology	Elevation (m.a.s.l)
>27.5	Hot	<500
21 – 27.5	Warm	500 – 1600
16 - 20	Tepid	1600 – 2400
11 - 15	Cool	2400 - 3200
7.5 - 10	Cold	3200 – 3800
<7.5	Very Cold	>3800

Source: MOA 2000 and MOARD, 2005

(B) Major Agro ecological Zones

The Ministry of Agriculture and Rural Development has delineated 32 major AEZs based on temperature and moisture regimes classification data (MOARD, 2005). The zones are nomenclatures by terms commonly used to describe the broad temperature, moisture and elevation conditions of an area. The major AEZs are shown in Table 4. Figure 1 shows the most commonly used AEZ classification, which is based on elevation and temperature. In most cases, places at higher elevation receive higher rainfall amount.

(C) Potential for Water Harvesting and Irrigation as a Function of AEZ

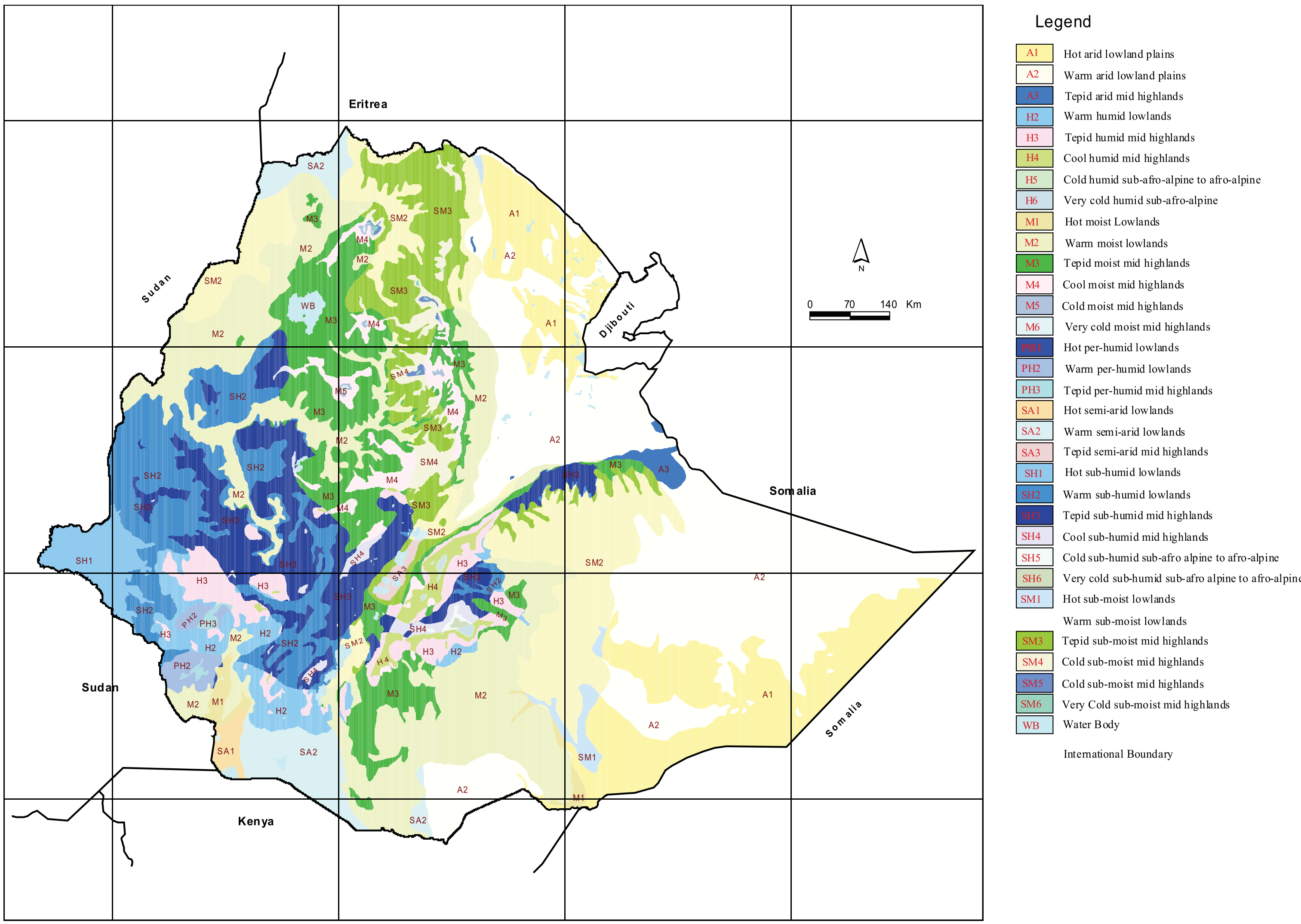
Irrigation and water harvesting are necessary in the low rainfall areas of the three major agro ecological zones that are characterized by low number of growing periods namely;
Arid (LGP = 45 days), Semi-Arid (LGP = 46 – 60 days) and Sub-Moist (LGP = 61- 120 days).

In these three AEZs, rain-fed crops often suffer from moisture deficiency. Thus, supplementary irrigation is the primary necessity of the farmers of the indicated AEZs to obtain at least one good harvest. The “Moist AEZ” has a satisfactory length of growing period (LGP = 121 – 180 days) that would enable farmers get one reliable harvest. With the development of a reliable water supply a second or third crop is possible in the above mentioned four AEZs. The Sub-Humid and Humid AEZs have adequate rain and crops can be grown all year round provided that an appropriate cropping system is established.

Table 4: *Major Agro-ecological Zones and the Area (ha) of the Country under Each Zone*

	Category	Code	Name of the Major Agro-ecological Zone	Area, ha	%, of the Country
1	Arid	A_1	Hot Arid Lowland Plains	12,202,262	10.76
2		A_2	Warm Arid Lowland Plains	22,356,327	19.71
3		A_3	Tepid Arid Lowland Plains	488,137	0.43
		Sub total		35,046,726	30.9
4	Semi-arid	SA_1	Hot Semi-arid Lowlands	444,794	0.39
5		SA_2	Warm Semi-arid Lowlands	3,120,098	2.76
6		SA_3	Tepid Semi-arid Mid Highlands	218,623	0.19
		Sub total		3,783,515	3.34
7	Sub-moist	SM_1	Hot Sub-moist Lowlands	637,273	0.56
8		SM_2	Warm Sub-moist Lowlands	10,894,270	9.6
9		SM_3	Tepid Sub-moist Mid Highlands	5,846,476	5.18
10		SM_4	Cool Sub-moist Mid Highlands	1,314,117	1.17
11		SM_5	Cold Sub-moist Mid Highlands	76,812	.08
12		SM_6	Very Cold Sub-moist mid Highlands	18,018	0.02
		Sub total		18,786,966	16.61
13	Moist	M_1	Hot Moist Lowlands	672,102	0.59
14		M_2	Warm Moist Lowlands	17,147,667	15.12
15		M_3	Tepid Moist Mid Highlands	9,101,092	8.03
16		M_4	Cool Moist Mid Highlands	1,965,932	1.73
17		M_5	Cold Moist Sub-Afro-Alpine to Afro-Alpine	18,823	0.07
18		M_6	Very Cold Moist Sub-Afro-Alpine to Afro-Alpine	15,243	0.01
		Sub total		28,980,959	25.55
19	Sub-humid	SH_1	Hot Sub-humid Lowlands	1,892,953	1.68
20		SH_2	Warm Sub-humid Lowlands	8,046,791	7.09
21		SH_3	Tepid Sub-humid Mid Highlands	7,515,534	6.63
22		SH_4	Cool Sub-humid Mid Highlands	589,026	0.53
23		SH_5	Cold Sub-humid Sub-Afro-Alpine to Afro-Alpine	68,814	0.06
24		SH_6	Very Cold Sub-humid Sub-Afro-Alpine to Afro-Alpine	34,889	0.04
		Sub total		18,148,007	16.03
25	Humid	H_2	Warm Humid Lowlands	2,592,587	2.29
26		H_3	Tepid Humid Mid Highlands	3,065,658	2.7
27		H_4	Cool Humid Mid Highlands	1,069,061	0.94
28		H_5	Cold Humid Sub-Afro-Alpine to Afro-Alpine	62,616	0.06
29		H_6	Very Cold Humid Sub-Afro-Alpine	50,576	0.04
		Sub total		6,840,498	6.03
30	Per-humid	PH_1	Hot Per-humid Lowlands	13,087	0.01
31		PH_2	Warm Per-humid Lowlands	765,363	0.68
32		PH_3	Tepid Per-humid Mid Highlands	152,278	0.13
		Sub total		930,728	0.82
	Water Body			868,040	0.76
	Grand Total			113,385,439	100

Figure 1: *AEZ Classification in Ethiopia*



1.3 Objective of the Study

The specific objectives of the study were to:

- Identify, list, and document best practices in the areas of Water Harvesting, Community-Managed Irrigation, and Public and Private-Managed Irrigation nationally;
- Select few pre-eminent practices from the list of best practices and technically provide a profile or detailed description of the pre-eminent practices;
- identify best practice sites for water harvesting, community managed irrigation, and public and private managed irrigation;
- profile the selected best practice sites with indigenous and/or modern techniques since a selected number of these sites will be targeted for visits by national and/or regional practitioners for the exchange of experiences, and sharing of knowledge and information on the best practices on water harvesting, community managed irrigation and public private irrigation; and
- identify and list national institutions to be considered for twinning activities and then select and recommend few and provide a detailed profile description of these institutions with potential to organize and conduct capacity building activities and implement field level demonstrations or pilot activities in water harvesting and irrigation.

1.4 Approach and Methodology Used

The methodology adopted was first to prepare criteria for prioritization of the best practices in water harvesting, community-managed irrigation schemes and private/public-managed irrigation schemes. The following step was to collect information on BP through review of documents and consultation with resource persons.

All of the institutions consulted did not possess specific documentation on best practices. Thus, it was found necessary to extract from the available documents the practices that were associated with relatively better performance compared to any given control. With this approach, the long lists of best practices and best practice sites were prepared. The describing features of the best practices and best practice sites were collected from the available documentation in the various agencies.

The criteria were then applied to each BP and BP site and scores given using direct matrix ranking technique.

2. Criteria for Prioritization of Best Practices and Best Practice Sites

The criteria for prioritization of the BP and BP sites were built on the indicative criteria developed by EWUAP and are presented in Table 5 and Table 6. The overall emphasis of the criteria is on *sustainability* and *replicability* of the technical, management, economic and social issues involved.

The sustainability of WH and irrigation schemes is often linked to the establishment of effective O&M system, which in turn is linked to profitability of the scheme/technology. To this effect, the presence of an attractive and sustainable market is instrumental.

Replicability of a particular technology is associated with the amount and quickness of the return, cost-effectiveness and simplicity of the technology. Simplicity would imply;

(i) The possibility of disseminating the technology via farmer to farmer way; and
(ii) Easiness of the operation and maintenance of the technology.

Technologies that require high initial investment by farmers as well as high O&M cost are less likely to be replicable. Some technologies could be introduced and replicated through investments by external sources (government or donors). However, as financial support from external sources is limited, the area or population covered would be insignificant compared to the potential. Though not without merit, technologies introduced by way of external assistance could not serve as a dependable entry point for scaling up of best practices. Thus, a technology would be considered as “best” if it has the potential to be adopted and replicated by a large portion of the target farmers or pastoralists who comprise about 85% of the Ethiopian population. Therefore, the most preferred technology would be the one that can be implemented using the family labour independently or combined with that of others in the vicinity.

As indicated above, sustainability and replicability are more linked to socio-economic factors provided that the technology is technically sound. Many studies indicate that only a fraction of the available research findings were successfully adopted by farmers. There are also best indigenous practices that are confined to limited areas (Gete et al., 2006). Despite of the rigorous demonstration activities and the associated convincing results, farmers are often reluctant to adopt new technologies. What one can infer from this is that, the constraint for technology adoption and dissemination is not mainly related to bio-physical factors (such as soil, topography, climate, etc.).[1] The adoption and dissemination aspects are largely influenced by socio-economic factors (Drechsel, P, et. al. 2005).

[1] For a given set of biophysical condition, various technology options can be found locally or imported from any part of the world having similar agro ecological setup.

Farmers often consider the economic importance of a new technology prior to adopting it. For example, irrigators in Ethiopia situated close to big urban markets are noted to grow diversified horticultural crops and earn higher income compared to those in remote areas who grow more of maize, which is not a high value crop (ONRS – OIDA, 2000; IWMI et al., 2004; Mintesinot et al., 2005). Moreover, farmers close to paved roads and/or consolidated all-weather road obtain better price for their produce. Better income implies that the irrigators can afford to undertake regular maintenance of the irrigation infrastructure. Thus, water use efficiency in irrigation farms situated close to big urban markets and near to better roads is higher compared to those in remote areas.

Cognizant of the abovementioned facts, it is considered that socio-economic factors would be the overarching criteria in prioritizing BP and BP sites. Some biophysical criteria are also considered.

Table 5: *Criteria for Prioritizing Best Practices*

	Criteria	Sub-criteria and Weights
1	Low labour demand	A technology that requires low labour input is more likely to be adopted and scaled up quickly. Thus, technologies that require low person day input per unit would be an indicator for replicability. (*Assumption: On average there are 5 working people per family. Each can afford to invest 30 days labour input per year required for adopting BP without adversely affecting their opportunity for additional income from other sources)*; (1 pd = Birr 10.00; 1US $ = Birr 9.09 (Nov 20, 2007)) Scoring: {< (5 people/family x 30 days/year = 150 pd/ha) ➔5; 151 – 180 pd/ha➔ 4; 181 – 450 pd/ha ➔3; 451 – 600 pd/ha ➔ 2; >600 pd/ha ➔1
2	Low initial capital requirement (also measures: availability of spare parts & support service & durability of technology)	Technologies requiring large investment have less probability of replication. Sustainability will also be questionable for lack of maintenance (spare part and support service availability is often a function of the initial cost). Scoring: {Initial cost per family < Birr 500.00 ➔ 5; 501 – 1000 Birr ➔4; 1001 – 1500 Birr ➔ 3; 1501 – 2000 Birr ➔ 2; >2000 Birr ➔1
3	Simple to implement, operate and maintain	Systems and equipment must be simple and within the capacity of the farmers/communities to operate and maintain. Scoring: {If all components (material & labour) are local & dissemination is farmer to farmer ➔5; all components are local & dissemination is through minor demonstration by DA ➔4; Limited input from local market and use of local artisan for implementation/maintenance ➔ 3; Locally available material but construction/installation/maintenance requires the services of a qualified local technician ➔ 2; Components requiring imported item &/or a high level technician for follow up & maintenance ➔ 1}
4	Economic significance (measured as a function of the indicated case that is applicable to the practice)	
4.1	***Case 1***: Crop Yield increment attributed to the technology relative to National Average	Crop yield associated with the technology compared to the national average (or to pre – project situation): {Note: comparison will be made between irrigated crops with or with out technology; and rain fed crops with/without technology} Scoring: {Crop yield with BP > 25% from national average➔5; Yield with BP > 20% from national or Control ➔4; Yield with BP > 15% from national or Control ➔3 Yield with BP > 10% from national or Control ➔2; Yield with BP > 5% from national or Control ➔1; Yield with BP = 0- 5% from national or Control ➔0
4.2	***Case 2***: Multiple use	Uses: (1) irrigation, (2) domestic water supply, (3) livestock water supply, (4) soil and water conservation, (5) groundwater recharge Scoring: {used for 5 purposes ➔5; used for 4 purposes ➔4; used for 3 purposes ➔3; used for 2 purposes ➔2; used for 1 purpose ➔1.

Table 6: *Criteria for Prioritizing Best Practice Sites*

	Criteria	Sub-criteria and Weights
1	The approach and site(s) chosen should have the potential for scaling up both within the country and also perhaps within the Nile basin	*Suitability to all Topography*: Slope class: 0 – 5%; 5+ – 10%; 10+ - 15%; 15+ – 30%; >30%. Scoring:{no limit in topography ➔5; suitable to 4 slope classes ➔4; suitable to 3 ➔3; Suitable to 2 ➔2; suitable to 1➔1
		Suitability to all land uses: Land use class: arable land , grazing land, forest land, marginal area, gullied area, Scoring:{no limit in land use ➔5; suitable to 4 land use class ➔4; suitable to 3 ➔3; Suitable to 2 ➔2; suitable to 1➔1
		*Suitability to all AEZs***:** There are seven major AEZs Scoring:{Suitable to > = 5 AEZ ➔5; suitable to 4 AEZs ➔4; suitable to 3 ➔3; Suitable to 2 ➔2; suitable to 1➔1
2	The best practice should be well adopted and owned by the local community, and show the level and extent of community participation	*Area coverage (within a command area or watershed) compared to the potential:* Large area coverage indicates (i) effective utilization of resources and (ii) adoption of various technologies by a large population of farmers and presence of a wide variety of experience from which to draw lessons. {Scoring: sites with > or = 100% area coverage ➔5 point; 75% – 99% ➔4; 50% – 74% ➔3; 25% – 49% ➔ 2; <25% ➔1
		Effective O&M: is a prerequisite for sustainability of a project. Scoring: {Scoring: Users tend to develop more land using water saved/harvested/diverted ➔ 5; System is adequately maintained by own initiative of users & water loss is negligible ➔ 4; Users maintain scheme but irrigated area is reduced by <10% due to water loss ➔ 3; Users undertake maintenance but irrigated area is reduced by 10 - 20% due to water loss ➔2; Scheme characterized by high loss of water & irrigated area is reduced by > 20% ➔ 1; OR *Strength of the WUA or any form of the Users' Association*: **Excellent WUA {Contribution from the users (in cash & kind) > O&M needs}** ➔5; Very good WUA {Contribution = O&M requirement} ➔ 4; WUA implements the byelaw partially (due to limitations in technical capacity) ➔ 3; WUA has byelaw but can not enforce it fully due to external factors (e.g. legalization problem) ➔2; WUA is present but byelaws are not effective at all➔1; No WUA ➔ 0
3	The sites selected should have delivered proven successful results with respect to agricultural production and have provided income benefits to the local population	Income earned by the farmers is a function of many factors, which can be directly or indirectly linked to the technology. However, as the availability of quantified data is often limited, the surrogate indicator would be the number of the incremental benefits compared to without intervention condition. The following five possible incremental benefits would be checked: (i) increased cropping intensity due to irrigation, (ii) increased production due to enhanced soil moisture or irrigation, (iii) improved livestock productivity due to water and feed availability (iv) new or enhanced apiculture, (v) accrual of assets and facilities such as schooling, health, etc. Scoring: {5 types of benefits ➔5; 4 benefits ➔4; 3 benefits ➔3; 2 benefits ➔ 2; 1 benefit ➔1}
4	The developments should have been undertaken in an environment friendly manner with respect to the local ecosystem	Major environmental concerns are: erosion, salinity, health hazard, sedimentation, reduction of stream flow due to lack of catchment treatment, water pollution, etc. Scoring: {Only positive impact ➔ 5; Adverse environmental impact counterbalanced by positive impact ➔ 4; Adverse environmental impacts are monitored & mitigated ➔3; Management problems leading to adverse impacts are reported but mitigation is delayed ➔1}
5	Developments should have been implemented in a cost effective manner	Schemes requiring large investment have less probability of replication. Sustainability will also be questionable for lack of maintenance. (spare part and support service availability is often a

	that can be used to demonstrate to other interested parties the viability and affordability to rural farmers and communities	function of the initial cost). Scoring: {Initial cost per ha < 1500.00 Birr/ha ➔ 5; 1501 - 1800 Birr/ha ➔4; 1801 - 4500 Birr/ha ➔ 3; 4501 – 6000 Birr/ha ➔ 2; >6000 Birr/ha ➔1 OR *Benefit Cost ratio (BCR)* BCR > 2 ➔ 5; BCR 1.75 – 2 ➔4; BCR 1.5 – 1.75 ➔ 3; BCR 1.25 – 1.5 ➔ 2; BCR 1 – 1.25 ➔1.
6	The experiences of the site should be such that they can be utilized to enhance and understanding of the potential and constraints of water harvesting and/or efficient irrigation management for agricultural production	The presence of a reliable local market (population, road, transport, etc.) is among the driving factors to improve the performance of WH and irrigation schemes in Ethiopia. With more cash income, farmers tend to further diversify crop production, increase cropping intensity and invest more on improving the water use efficiency. Thus, the presence of highest **urban population** within 200 km radius of the scheme would be the **surrogate indicator** for best irrigation management. Scoring: {>400,000 people ➔5; 300,000 – 400,000 ➔4; 200,000 – 300,000 ➔3; 100,000 – 200,000 ➔2; <100,000 = 1

3. Identification and Assessment of Best Practices

3.1 Overview of the Identification Process

The domain of best ***practice*** involves **activities**, **approaches** and **technologies** related to technical, management, economic and social issues in agricultural water use. With this ground, two sources were considered in identifying the technologies that give maximum productivity of water in agriculture.

The first source is linked to development schemes where the technologies are already being practiced by farmers. In this case, the activities/approaches/technologies or sites having better result compared to any given control are identified as a BP candidate and included in the "Long List".

The second source of technologies is the findings of research that are either in the process of dissemination or waiting to be disseminated by the extension system. The merits of this source are:

(i) Most of these technologies were developed in response to actual problems in the ground, which is low productivity of land and water;
(ii) The research results, especially crop varieties, are noted to perform well on pilot sites;
(iii) Specific information on each of the technologies is well documented and readily available for scaling-up; and
(iv) Technologies are available for each AEZ.

However, the level of utilization of knowledge and technologies derived by the research system is very low due to gaps in the research and extension systems (Hatibu, N., 2005). By addressing the constraints encountered in the dissemination and adoption of the research results, there is an immediate possibility for increasing the efficient use of water in agriculture. Besides, there is an increasing interest in the scaling-up of research findings by many stakeholders in Ethiopia.

3.2 Identification and Assessment of Best WH Practices

3.2.1 Long List of Best WH Practices

In-situ moisture conservation measures were implemented in Ethiopia extensively as of the 1970s. The implemented measures and impact can be observed in many parts of the country that are prone to moisture deficiency. Ten of such technologies have been identified as BP by WOCAT (2007) and are posted in the web (http://www.fao.org/ag/agl/agll/wocat/).

WH measures that involve storage (ponds and tanks) were implemented extensively during 2003 – 2005 (Table 7) (Tadesse, B., et. al. (nd). As of 2006, the implementation of such WH measures (ponds and WH tanks) has declined to insignificant level (personal communication with officers of the implementing agencies in various regions of the country). The reasons given for this are that: (i) most of the constructed ponds were leaky, (ii) the lining material is expensive and liable to damage and, (iii) the construction cost of the WH tanks is unaffordable by most farmers. Provided that there is financial support, farmers in water deficit areas are interested to construct WH tanks mainly for domestic use, livestock water supply and to some extent irrigating small plots.

The constructed WH measures involve small dugouts (50 - 180 m^3) and concrete and masonry water tanks (60 – 80 m^3). In addition to these are spring development structures and shallow hand-dug wells. All these WH structures are used as source of water for irrigation and domestic water supply. However, a substantial number of the first two types of structures are not functional (Table 7) and the area irrigated using the functional ones is not available.

Among the WH technologies, the plastic lined dugout pond (50 - 180 m^3) has been considered as BP by IWMI and FAO (Drechsel, P et. al. 2005). This is posted in the web[2]. With cheaper lining material, the ponds could be used for supplementary irrigation of high value crops thereby bringing additional income to cash poor families (Landell Mills, 2004).

In 2006, MOARD conducted an evaluation on the performance of the WH measures constructed during 2003 – 2005. The evaluation was carried out in Tigray, Oromia and Amhara regions, which comprise the major part of Ethiopia in the Nile basin. It identified the impact, strength and weaknesses of the WH measures and approaches that include various SWC measures, WH tanks, hand dug wells, etc. (Aklilu, 2006). This evaluation identified *Integrated WH Approach* as an exemplary one that has to be replicated throughout the country.

Other WH technologies, reported to have better performance, are also identified from the reviewed documents. The long list of the identified best WH technologies and approaches is presented in Table 8.

[2] http://www.iwmi.cgiar.org/africa/West/projects/Adoption%20Technology/RainWaterHarvesting/37-Earthen%20pans.htm

Table 7: *Rain Water Harvesting and Other Related Structures Constructed from 2003 – 2005*

Region	Structure Type	Implementation period			Total	Functional	
		2003	2004	2005			
		No.	No.	No.	No.	No.	%
Amhara	Tanks & lined ponds (private)	6627	22059	21516	50202	24856	49.5
	Community Ponds	884	19354	2467	22705	9083	40
	Hand dug well	12444	176374	118389	307207	122883	40
	Spring Development	2428	18642	22060	43130	17252	40
Oromia	Tanks & lined ponds (private)	46105	89989		136094	30200	22.19
	Hand dug well	3470	57569		61039	24415	39.99
Tigray	Ponds (private)	30266	40626		70892	55460	78.23
	Community Ponds		155		155	155	100
	Hand dug well				20000	??	
SNNP	Tanks & lined ponds (private)	4658	74079	4222	82960	12150	14.64
	Community Ponds	1318	7625	18	8961	8961	100
	Hand dug well	3200	54699	1307	59206	59206	100
	Spring Development	218	15734		15952	15952	100

Source: Tadesse, B., et. al. (nd); adopted from the regional Bureaux of Agriculture and Irrigation Authorities

Table 8: *Long list of Best WH Practices*

	Description of Best Practice	Information Source (recommended by)	Location	
			Region	Wereda
	In-situ Measures			
1	Hillside terracing	Lakew, et. al. 2005; WOCAT, 2007[3]	All	All
2	Trash lines	Lakew, et. al. 2005; WOCAT, 2007	SNNP, Amhara	
3	Area closure for rehabilitation	Lakew, et. al. 2005; WOCAT, 2007	All	
4	Multiple cropping	Lakew, et. al. 2005; WOCAT, 2007	SNNP	
5	Level bund with double stone walls	Lakew, et. al. 2005; WOCAT, 2007	All	
6	Ridge and basin	Lakew, et. al. 2005; WOCAT, 2007	SNNP	Konso
7	Konso bench	WOCAT, 2007	SNNP	Konso
8	Stone bund	Lakew, et. al. 2005; WOCAT, 2007	All	
9	SS dam	Lakew, et. al. 2005; WFP. 2004; Drechsel, P et. al. 2005	All	All (in gullied area)
9b	"*Daldal*" (same as SS dam)	Chris Reij & Ann Waters-Bayer (eds.), 2001.	Tigray	Irob
10	Increasing Tillage Depth Using a Modified tool	Feldner K. et al 2004	Amhara	South Gonder
11	Broad Bed and Furrow (BBF) Technology for Vertisol	Tekalign et al, 1993	All	All
12	Conservation Tillage (CT)	SG2000 (eds), 2004 Drechsel, P et. al. 2005	All	It performs well in well-drained soils.
13	Spate Irrigation	Mitku H. et al (nd); Ephraim, A. et al. (nd)	All	Low rainfall
	Storage Measure			
14	Plastic lined dugout (180 m^3 ±)	Landell Mills, 2004; Drechsel, P et. al. 2005, Aklilu, et.al. 2006; ERHA, (nd).	All	Moisture deficit areas
15	Hemispherical masonry tanks	ERHA, (nd)	All	Moisture/water deficit areas
	Integrated Measure			
16	Integrated WH Approach	Aklilu, et.al. 2006	All	All

[3] WOCAT has already identified the first 7 WH technologies as best practice from Ethiopia

3.2.2 Evaluation of the Best WH Practices

(1) Hillside Terracing

Description: Hillside terrace is a structure constructed across slope at regular intervals in marginal lands. It involves levelling a strip of land for conserving water & planting trees. The width of each platform (strip of land) depends on the steepness of the slope. In low rainfall areas, construction of hillside terraces is often considered in combination with micro basins, eyebrow terraces, and trenches.

Strength/Opportunity: Hillside terraces effectively serve as rainwater storage basins and enhance infiltration of rainwater into the ground. With the introduction of appropriate legumes and grasses, hillside terraces could play a significant role in the livestock production sector. This technology combined with others can convert the substantial hilly landscape of the country into productive fodder production farm.

Weakness: Hillside terraces are liable to damage by runoff thus may call for frequent maintenance. Thus, the technology has to be integrated with trenches. As its labour requirement is 250 PD/km, farmers might prefer to invest in activities with quick return. Besides, the hillsides are communal and thus, it needs organized effort to achieve the long term benefits. Organizing the community to implement the technology would be a challenge to the current inefficient extension system.

(2) Trash lines

Description: Trash lines are constructed annually using straw of maize and/or sorghum to retard runoff & promote infiltration of rainwater in cultivated fields. The straw is laid along the contour with additional straw lines perpendicular to the slope to form a rectangular basin.

Strength/Opportunity: The technology is fast to apply, does not require design work, and relatively cheaper than other technologies. It is suitable to moisture deficit areas.

Weakness: The technology performs well only in areas with loam and coarse textured soil and a depth of 50 – 80 cm or deeper. Replication would be challenging in areas where crop residue is required for fuel, feed or construction.

(3) Area closure for rehabilitation

Description: This measure involves enclosing and protecting an area of degraded land from human use and animal interference, to permit natural rehabilitation, enhanced by additional vegetative and structural conservation measures.

Strength/Opportunity: The measure enhances infiltration of rainwater and increase biomass production and recharge of ground water. Benefits of increased access to firewood and other construction materials as well as income generation from the sale of grasses and tree based products.

Weakness: Replication is challenging for two reasons: (i) closures may adversely affect the free grazing culture by reducing and even total loss of the free grazing land, and (ii) Farmers may not have the necessary labour to invest in improvement works required for the rehabilitation;

If the concept and practices of stall-feeding are not conceived, the farmers may let their livestock to graze frequently on the remaining communal lands. This would intensify pressure on the land and could cause land degradation.

(4) Multiple cropping (Intercropping)

Description: Multiple cropping is an agronomic practice of growing two or more crops on the same land simultaneously in a given growing season. It is practised in mainly in Eastern Ethiopia and SNNP.

Strength/Opportunity: The technology enables subsistence farmers with small land holding to produce diversified crop thereby maximizing benefit per unit land and water. It is a risk aversion strategy in case one crop is damaged by pests.

Weakness: Harvesting is difficult since different crops mature at different times.

(5) Level bund with double stone walls

Description: Stone faced level bunds are constructed in areas where stone is available. The stones are meant to reinforce the soil bunds. Construction involves piling stones with a slight side slope on both sides of the bund. The purpose of the bunds is to retain rainwater in moisture deficit areas. For effective result, the bunds should be combined with trenches and tie-ridges.

Strength/Opportunity: The technology is applicable to a wide range of land uses. It has high potential to increase/sustain productivity in moisture stressed areas. It enables to retain rain water 129 – 335m^3/ha compared to without the technology (WFP, 2004). Each household can construct the structure with little or no guidance.

Weakness: Stones need to be available in the farm. Maintenance costs are high. Furthermore, soil bunds require vegetative measures to be stabilized and prevent them from being destroyed at times of heavy rainfall. The cost of construction of soil bunds with double stone walls is expensive (250 PD/km) compared to soil bunds alone (150 PD/km).

(6) Ridge and basin

Description: This measure involves a rectangular shaped soil embankment created by digging up soil and forming a ridge and a basin for harvesting moisture. It is highly applicable to flat (0 – 5% slope) areas with moderately deep soils 50 – 80 cm or deeper.

Strength/Opportunity: The technology started in the Konso area 400 years ago and has become part of the farming system in the area. It can be applied in all land uses but farmers prefer to use it on field for annual crops. It is efficient in enhancing soil moisture thereby improving crop yield (WOCAT, 2007).

Weakness: It is not applicable to areas with shallow soil depth and stony areas. In stony areas it requires the removal of surface stones. Farmers consider the technology as laborious.

(7) Konso bench

Description: The Konso bench is an indigenous land management practice involving 1.5 – 2 m high stone wall along the contour, with land levelling in between two terrace walls to control erosion and promote infiltration of rainwater. It is constructed in hilly landscape with a slope of 16 – 30% and where stone is abundant.

Strength/Opportunity: The technology is of paramount importance to densely populated areas where steep slopes are cultivated for annual crop production. The construction of the wall does not require expert input as many farmers in the country have already the requisite experience. In semi arid areas (with rainfall < 500 mm) the technology retains rain water that is adequate to grow annual crops and also perennial trees.

Weakness: The technology is laborious. It might be considered as an obstruction to farming operations by those farmers who used to plough on a wider area. These factors plus unavailability of sufficient stone in some areas may limit replication of the technology.

(8) Stone bund

Description: Stone bund is a terrace constructed more or less along the contour, combined with artificial waterways and traditional ditches to drain excess water. Construction involves piling large stones on the lower side of the bund and placing smaller stones on the upper side filling the spaces between the larger stones. Whenever stone is scarce, stone faced soil bunds are constructed as an alternative measure. Stone bunds constructed with large and edgy stones and reinforced with soil are effective. The stonewall support prevents soil bunds from breaking. The structure, in comparison to soil bunds, cannot be graded but can still filter sediment and remove excess water.

Strength/Opportunity: Stone bunds take up less land compared to soil bunds. Though stone bunds require high labor costs for construction and upgrading, maintenance cost is generally low.

Weakness: It has high labor demand (250pd/km) compared to soil bund (150pd/km). The stone bunds become a breeding place for rats, which cause serious damage to field crops.

(9) Sediment Storage (SS) Dam

Description: SS dams are a series of check dams (made up of stone-faced earth dams) constructed across a gully or a water course with the purpose of retaining both sediment and rainwater.

In Irob Wereda, Tigray, SS dams (locally called "*Daldal*") are noted to be indigenous practices. The farmers raise and lengthen the walls every year. After many years of O&M, the water course is transformed to step-like terraces that are about 8 m wide and up to 10 m high, with about 20 m spacing between check dams (Chris Reij & Ann Waters-Bayer (eds.), 2001).

Strength/Opportunity: SS dams can control soil erosion and rehabilitate waste gullies and converting them to fertile fields. The seasonal increment in harvested rainwater that could be held within the deposited sediment (i.e. as a function of the SS dams) was estimated to be 2042 m^3/ha as compared to: 1,652 m^3/ha with bench terraces and 129 – 335m^3/ha with soil/stone bunds (WFP, 2004). The additional soil moisture clearly satisfies plant water requirement in the drier areas and limits runoff, soil erosion and downstream flooding.

The enhanced soil moisture and deep soil conditions associated with SS dams offer the opportunity for the production of high value horticultural production and agro forestry. When rainfall becomes below average, the enhanced moisture availability can contribute to crop's resilience to drought and hence better productivity than fields with no structure.

In view of the topography and the high generation of runoff, there is high potential for the replication of the technology in many parts of the country.

Weakness: In areas with highly pervious geologic formation, the benefit could not be easily available to those who construct the SS dam. The design, layout and construction needs expert input. The construction work demands high labour input. These factors could retard the replication rate.

(10) Increasing Tillage Depth Using a Modified tool

Description: The traditional plough does not penetrate deep enough into the soil and consequently a plough pan is prevalent in the highlands. The depth of cultivation that could be achieved with traditional implement is limited to between 12 and 15 centimetres (Feldner K. et al 2004). The plough pan reduces infiltration and aggravates run-off which consequently leads to erosion (WFP, 2004; Feldner K. et al 2004). Thus the productivity of rainwater is low in the highlands.

Strength/Opportunity: The technology increased rainwater infiltration into the deeper layers of clay soils. The improved soil-moisture holding capacity resulted in 25% - 42% increase in wheat yield (Feldner K. et al 2004). The higher yield was obtained from less fertile soils. Reduction of runoff and the associated erosion was also reported.

Weakness: As the improved ploughing tool is manufactured from imported spring steel, the price is higher compared to the traditional implement (Material cost: Birr 70.00; Production cost Birr 50 – 70 per piece (Feldner K. et al 2004)). This would be the only challenge to scale up the technology.

(11) Broad Bed and Furrow (BBF) Technology for Vertisol

Description: Vertisols cover about 12.61 million ha in Ethiopia out of which 7.6 million ha or 63% is found in the highlands (MOARD 2006, Tekalign et al, 1993 adopted from Berhanu Debele[4], 1985). Despite the availability of such a big area, only about 30% of the Vertisol area in the Ethiopian highlands is used to grow low-yielding annual food crops and the remaining is under natural pasture for dry-season grazing (MOARD 2006, Tekalign et al, 1993). The primary production constraint in the Vertisol areas is water logging during the growing season caused by high rainfall and by the high content of swelling clays in these soils. Research works conducted in Ethiopia identified the Broad Bed and Furrow (BBF) technology as the most effective and economically attractive technology (MOARD, 2006, Tekalign et al, 1993).

Strength/Opportunity: Application of the BBF technology in Vertisol areas has enabled to get 50 – 80% increase in wheat yield (Table 9). The increment in production would invite more farmers to adopt the technology.

[4] Berhanu Debele. 1985. The Vertisols of Ethiopia: their properties, classification and management. Fifth Meeting of the Eastern African Sub-Committee for Soil Correlation and Land Evaluation. Wad Medani, Sudan, 5-10 December 1983. World Soil Resources Reports No. 56. FAO (Food and Agriculture Organization), Rome. pp. 31-54.

Table 9: *Effect of BBF Technology on Wheat Yield under Farmers Condition*

Region	Wereda	Number of Participating Farmers	Wheat Yield; Ton/ha		Percent Increase %
			Farmers' Practice	Improved Practice	
Oromia	Becho	152	0.5	2.3	78
	Dendi	163	0.5	2.5	80
	Alemgena	120	0.9	2.4	62
	Ambo	Not Available	0.5	1.5	67
	Alu	60	0.8	2.2	64
	Yayagulele	155	0.5	2.7	81
	Bereh Aleltu	40	0.6	2.9	79
	Akaki	55	0.8	2.7	70
	Chefe Donsa	56	0.8	3.4	76
Amhara	Enewari	323	1.2	3.3	64
	Dejen	20	0.7	1.4	50
	Enemai	30	1.0	3.0	67
	Enebse	35	1.0	3.1	68

Source: MOARD 2006, (Adapted from Sasakawa Global 2000)

Weakness: High runoff and erosion rate are the primary drawbacks associated with the use of BBF (Table 10). Water drained from individual plots can be wasted as runoff and may cause severe erosion unless the issue is addressed systematically at a watershed level. Secondly, the cost of the BBF maker tool and its strength to withstand bending and eventual breakage will limit the replicability.

Table 10*: Effect of BBF on Runoff and Soil Loss from Wheat Cropped Plots at 2.7% Slope at Hidi in 1987*

Treatment	Rainfall (July – Sept) mm	Runoff, mm	Soil Loss, ton/ha
Flat	453	66	3.72
BBF laid at 2.7% gradient	453	124	7.0

Source: (Tekalign et al, 1993)

(12) Conservation Tillage (CT)

Description: In conservation tillage system the soil is either left undisturbed or slightly tilled only to place the seeds. One purpose of tillage is removal of weeds so as to create suitable environment for seed establishment and plant growth; and this addressed by the use of herbicides. Conventional tillage is liable to cause severe soil erosion and loss of rainwater as runoff. With conservation tillage at least 30% of the crop residue is left on the ground and contribute greatly to conservation of soil and rainwater.

Strength/Opportunity: In Oromia, SNNP and Amhara regions, net return from field crops with CT was higher (by 16 – 23%) as compared to conventional tillage. Long term benefits are noted as: control of soil erosion, build up of soil organic matter, soil moisture conservation, better weed control, etc. (SG2000 (eds.), 2004). Farmers appreciate the short term advantages of the technology, which are savings in time and labor requirement during seed bed preparation and weeding (SG2000 (eds.), 2005).

Weakness: Despite of its better profitability than conventional tillage, the adoption of conservation tillage by farmers is slow for the following reasons: (i) farmers do not like to leave the crop residue in the field as they need it for livestock feed, fuel and construction; (ii) buying herbicides is considered as wastage of money when the available labour per household is more than enough to control weed by ploughing and hand weeding (SG2000 (eds.), 2005). Thus, scaling up of conservation tillage would be challenging.

(13) Spate Irrigation

Description: Spate irrigation is practised in the low rainfall areas by diverting runoff water from the watercourses in the proximity to the cultivated land. The farm lands are prepared into a series of benches, which are constructed for uniform water distribution. Within each bench, water is allowed to enter into level furrow thereby avoiding water loss as runoff

Strength/Opportunity: In all of the low rainfall areas, spate irrigation has been practiced as the primary means of growing crops by cash poor farmers. The technology has been replicated by farmers with little external assistance since many decades back (Table 11).

Weakness: The traditional way of diverting runoff and spreading it on the field is associated with some shortcomings. The diversion structure is built by piling riverbed material and reinforced with twigs and stones. This structure is liable to damage by the first major flood event and has to be reconstructed. Moreover, a large amount of water is allowed to flow into the canals, which often ends up in eroding the channel and the fields (Table 11).

Table 11: *Strength and Weakness of Spate Irrigation*

Positive aspects	Negative aspects
Moisture deficit problem is alleviated	Soil nutrients are leached due to excessive flood water
Enough flood water enables farmers to cultivate previously uncultivated land	Uncontrolled excess flood water cause soil erosion and takes away the top fertile soil
Alluvial soil from highlands is deposited and fertility of the soil may increase	There is an increase in the population of annual, biennial, and perennial weeds that their seed is brought by flood water; The top soils of the area may be buried by sand and gravel
Various grasses are grown in the grass strips and around the fields, which are used for livestock feed	Due to lack of drainage system, excess flood water creates water logging and may reduce growth of crops

Source: Mitku H. et al. (nd)

(14) Plastic Lined Small Dugout

Description: During 2003 to 2005 small ponds with a capacity 150 - 180 m^3 were constructed for supplementary irrigation of high value crops and in some cases for domestic and livestock water supply. Effective utilization of these ponds is reported in the following Weredas: Ganta Afe-Shum (Tigray); Bati, Kalu and Minjar (Amhara) and Boset (Oromia) (Aklilu, et. al. 2006).

Strength/Opportunity: Each pond provides water for a supplementary irrigation of 400-1000 m^2

plot. An EU supported evaluation showed that, with the provision of the essential agricultural and marketing extension support, sales from vegetables grown by the indicated pond size enables a household to purchase 30% - 80% of the annual food needs (Landell Mills, 2004). Farmers in Minjar Wereda, Amhara Region, are noted to effectively utilize the pond for domestic and livestock water supply and to some extent for irrigation (Aklilu, et. al. 2006).

As each pond is owned by an individual household, the lengthy procedure of operation and maintenance issue associated with user groups does not exist. The ponds are constructed near the homestead thus, managing of the irrigated plot and the pond could be easy.

Weakness: The technology demands high initial cost (35 – 75 Birr/m^3 of stored water or 4 – 8.6 US $/ m^3 of stored water in 2004) (Landell Mills, 2004). Thus, for the ponds to be viable high value crops need to be grown, which in turn has its own challenge[5] at least in the short term. On the other hand, using the ponds for supplementary irrigation of cereal crops can not be financially attractive due to the smallness of the irrigated plot size. For instance, if a 182 m^3 capacity pond is used to supply water for five supplementary irrigations of wheat planted on a 1000 m^2 plot the production increment could only be 100 kg (TBWRD and REST, 2002). Such increment would be insignificant compared to the effort and cost required to construct a watertight pond.

Moreover, the plastic lining material is liable to damage by rats. It can be easily pierced by gravel or stone during placement or operation (Aklilu, et. al. 2006). When site preparation and quality control are poor, then plastic lining can be punctured. Where sites had been properly compacted and all stones removed, puncturing can not be a problem.

In view of the above points and the unaffordable price of the technology to the farmers, replicability is questionable. In fact, the construction of new ponds has dropped to little or none as of 2006 in most of the Regions of the country.

(15) Hemispherical Masonry Tanks

Description: Hemispherical masonry tank is constructed by excavating a hemispherical shape pond and lining it with masonry. The tank has a storage capacity of 100 cubic meters and is used for domestic use, livestock water supply and irrigation of small plots of horticulture. The source of water is runoff from ground surfaces or roof tops. Lifting is mainly by pedal pump or bucket attached to a rope. The technology is implemented in the Rift Valley system of Ethiopia and other arid and semi-arid parts of the country where other perennial sources of water are unavailable. Integral parts of the tank are the following: the catchment, runoff conveyance channel, silt trap, means of water lifting, and the irrigation system (furrow or small drip kits).

Strength/Opportunity: In areas where there are no other sources of water the tank is used for livestock fattening and production of fruits and vegetables.
Weakness: Compared to a hand dug well, a tank is more expensive as it entails masonry work for

[5] the challenge refers to lack of extension and attractive market for the produce

seepage control and corrugated iron sheet for evaporation control. Thus, farmers can not replicate it unless supported with credit for purchased inputs.

(16) Integrated WH Approach

Description: Integrated WH approach involves the implementation of various WH techniques on hillsides, gullies, grazing & farm land to retain rainwater above and below ground. Water stored in the soil profile can increase biomass production and enhance ground water yield. Tanks and hand dug wells can be used for irrigation, livestock and domestic water supply.

The planning and implementation has to be made on watershed basis. During planning the prevailing problems in the watershed have to be identified and prioritized jointly by the technicians and the community. Then appropriate WH measures based on the topography and land use has to be identified and designed.

Strength/Opportunity: This approach is applicable to all land uses and topography. The community could get quick benefits in terms of increased biomass production and availability of water for various uses. Reduced flooding damage and erosion are also among the quick benefits that can be attributed to the indicated approach. It could thus be easily replicated in view of the quickness of the multiple benefits and the simplicity of each of the SWC measures.

Weakness: Integrated WH approach requires the active participation of the whole community within a watershed. Thus, consensus building and implementation of the plan in accordance with established byelaws would be challenging. Besides, the job requires high commitment from the community leadership and extension workers. In the absence of such precondition, replication would not be easy.

3.3 Identification and Assessment of Best CMI Practices

3.3.1 Long List of Best CMI Practices

CMI Technologies/approaches that are of relevance to cash poor farmers are identified from the reviewed documents and consultations made with resource persons. These are presented in Table 12.

Table 12*: Long list of Best CMI Practices*

	Description of Best Practice	Information Source (recommended by)	Location	
			Region	Wereda
1	Surge Irrigation in Vertisols	Mintesinot, B, et al. 2006	Tigray	Mekelle University
2	Effective Traditional WUA in Wonjela CMI	Adgo, Ethel.	Amhara	Ingebyra
3	Effective Traditional WUA in Gedo CMI	Adgo, Ethel.	Amhara	Waukesha
4	Low pressure gated pipe	Leul K. 1998	Tigray	All
5	Supplementary irrigation as priority use of harvested water	Leul K. 1997	Tigray	All
6	Low cost canal lining material	Fekadu, Y. 1994	All	All
7	New Crop Varieties	Tsedeke A. (ed) 2006	All	All

3.3.2 Evaluation of the Best CMI Practices

(1) Surge Irrigation in Vertisols

Description: Furrow irrigation that uses continuos flow of water throughout the irrigation period entails high loss of water by deep percolation and runoff. Surge irrigation, which involves the application of irrigation water in a series of pulses, is practiced in many parts of the world as a water saving practice.

Strength/Opportunity: Research conducted by Mekelle University in Gum Selassa CMI showed that surge irrigation enabled to increase maize yield from 4.5 to 10.5 ton/ha (164% increment) or net income from $619/ha to $1730/ha (106% increment) or water productivity from 0.71kg grain /m^3 of water to 1.72 kg/m^3 (166% increment) compared with continuous furrow flow system (Tables 13 and 14) (Mintesinot, 2006).

Table 13: *Mean Grain Maize Yield and Water Productivity in Surge irrigation as Compared to that of Continuous Furrow Flow System*

Irrigation Culture	Yield, tons/ha		Standard Deviation	Water Productivity, Kg of grain /m^3 of water	
	1998/1999	1999/2000		1998/1999	1999/2000
Traditional Irrigation	3.8	5.1	0.013	0.53	0.71
Surge irrigation	10.1	11	0.012	1.58	1.72

Source: Mintesinot, B, et al. 2006

Weakness: The additional labor input requirement of the surge irrigation system (US$29/ha as shown in Table 14) could be the minor factor limiting replicability.

Table 14*: Production Cost and Net Income of Surge Irrigation System as Compared to that of Continuous Furrow Flow System*

Cost Component	Traditional Irrigation	Surge Irrigation	Difference
ploughing			
18 pd @US$1.12/ha	20	20	
14 oxen days@US$1.65/ha	23	23	
Cost of Fertilizer US$/ha			
DAP	29	29	
UREA	12	12	
Weeding, watering, Harvesting & threshing; US $/ha	152	181	29
Mean Grain Yield, ton/ha	4.5	10.5	6
Farm Level Price, US$/kg	0.19	0.19	
Net Income, US$/ha	619	1730	1111

Source: Mintesinot, B, et al. 2006

(2) Effective Traditional WUA in Wonjela CMI

Description: Effective traditional WUA is the salient feature of indigenous irrigation schemes. These schemes are known for their relatively better utilization of the available water and enforcement of internal byelaws compared to those schemes constructed with support from the government or NGO. This is attributed to the strength of the indigenous organizational structure.

Wonjela CMI (located in Injibara Wereda, Amhara Region at an altitude of 2393 m.a.s.l), was identified by the Wereda Agriculture Office as "best performing irrigation scheme" in the Wereda. Wonjela irrigation scheme was initiated by few farmers over a century ago using water from a stream called Chakmit. In the 1950s, the irrigable area of the scheme was reduced due to reduction in the flow rate of Chakmit stream. Subsequently, an innovative farmer (called Priest Eyassu) conceived the idea of diverting water from Fetam River so as to irrigate larger area than before. The idea was implemented in the 1970s. Farmers have expanded the traditional irrigation scheme from an insignificant size to 270 ha (with 500 beneficiaries) by constructing more than 7 km long main canal to divert water from Fetam River. They have used flumes carved from woods to cross gullies. They have elected WUA leader and observe strict water delivery (by rotation) and canal maintenance schedule. They use irrigation for early planting of rain fed crops. They also establish crops before the rain ends and irrigate them afterwards (Adgo, et.al.)

Their bye-laws are stated as follows: (i) an absentee from canal maintenance is fined Birr 5.00/day and the money will be used for purchasing refreshments to the participants; (ii) absentees will not get irrigation water unless they effect the penalty payment; (iv) those who are found guilty of water theft will be penalized Birr 50.00 and will miss the next irrigation turn; (iii) Conflicts over water use are resolved by the elected WUA leader. Failure to observe the decision made by the WUA leader would lead to alienation of the offender/defaulter from any social services within the community (Adgo, et.al.).

Crop yield in the scheme compared with national average is shown in Table 15.

***Table 15:** Crop Yield in Wonjela and Gedo Traditional Irrigation Schemes as Compared to that of National Level*

Crop	Wonjela		Gedo		National
	Crop Yield, ton/ha **	Percent difference compared to National Average	Crop Yield, ton/ha **	Percent difference compared to National Average	Crop Yield, ton/ha
Potato	24	20%	20	0	20 ##
Onion	32		30		
Barley	4.8	296%	2.44	101%	1.21 @@

Source: ** Adgo, ET. el.; ## Tadesse B., Girma, T (nd); @@ CSA, 2006

Strength/Opportunity: The organizational structure of the indigenous irrigation schemes had a vital role in the expansion and sustainability of the irrigation scheme. Members of the WUA observe earnestly their unwritten byelaws and decision of their elected leader. The members fully participate in maintenance activities and have a firm stand against water theft. Such attitude of the members is contrary to those in the Government/NGO initiated schemes. **Thus, the indigenous WUA can offer lessons on how to organize WUA in the CMI schemes built with external support.**

Weakness: In the abovementioned scheme water is delivered on long rotation period (15 – 20 days), due to the limitations in the diverted flow rate and seepage along the canal. A farmer gets 3-hour of irrigation water, regardless of the crop water requirement. Thus, farmers often do not plant onion which has relatively higher water requirement. As a result of the inadequacy of the applied irrigation water crop yield is low (barley 4.8 ton/ha and onion 3.2 ton/ha (Adgo, Ethel.).

(3) Effective Traditional WUA in Gedo CMI

Description: Gedo CMI is located in Ankesha Wereda, Amhara at an altitude of 2410 m.a.s.l. This site as well, was considered as the scheme with best irrigation performance by the Wereda Agriculture Office. Irrigation on 80 ha land was initiated over a century ago by diverting water from three perennial streams, which are all tributaries to Ayehu River. Over the last few years, they have constructed additional structures to irrigate 20 ha more. The structures are simple stone walls with earth used as binding material. The number of beneficiaries at present is 290 households each with 0.2 – 0.5 ha (Adgo, et. el.).

Strength/Opportunity: The three streams which are the irrigation water sources are well protected from siltation and livestock interference by constructing stone fences reinforced by plantations. As of 2000, water is diverted from Ayehu River as the water supply from the three streams was found inadequate.

Supply canals are constructed at very mild slope. Canals are well stabilized and there is no sign of erosion. Gully crossings are constructed using flumes made up of wood and stone walls with earth as binding material.

Farmers plant barley at the end of the rain season (September/October) and harvest it in January/February. Immediately, they plant potato and maize separately or intercropped with each other. These crops are irrigated until the next main rain event, which commences in May. The harvesting period for potato and maize is July and August, respectively. In order to use the residual soil moisture and the late rain occurring towards the end of September for the germination and establishment of the next crop (barley or onion), the farmers finalize the land preparation during the first two weeks of September. Irrigation of these crops commence in November/December depending on the soil moisture. Furrow irrigation is used for potato and while flooding for barley. A combination of furrow and flooding is used for irrigating onion crops. Irrigation frequency is 15 days. The overall O&M is controlled by an elected "water master", who serves the users at no cost. The scheme is divided into blocks, each of which has an elected team leader who are subordinate to the "water master". The unwritten byelaws include the following:

- Absentee from canal maintenance are fined Birr 5.00; (The collected money is used to buy refreshments for those who participated in the maintenance);
- Water will not be delivered to those who failed to pay the penalty;
- Whenever disputes arise, the decision given by the "water master" is final and binding;
- Those who do not respect the decision of the "water master" would be isolated from any social activity within the community.

With such approach the farmers in Gedo utilize effectively both rain and irrigation water for crop production (Adgo, et. el.).

Weakness: Crop yield is low. Farmers get low price for their produce due marketing problems.

(4) Low pressure gated pipe

Description: A study was conducted in 1998 to show the comparative advantage of using imported low pressure gated pipe over traditional canal irrigation system. The study examined the performance of the gated pipe and canal irrigation systems under various ground slopes and different volume of dam embankment (Table 16).

Strength/Opportunity: For a given volume of water, the use of low pressure gated pipe system enables to irrigate at least 75% more land than the unlined canal irrigation system. For an irrigable area of 20 – 100 ha (and considering the most expensive dam embankment volume) the internal rate of return for the pipe irrigation system was 23.88% - 26.02% as compared to 14.1% - 15.98% obtained under the unlined canal system.

The cost breakdown for the low pressure gated pipe system to be installed on a 20 – 100 ha was as follows (Leul K. 1998):
Material cost: 33.1% – 30.2% of the total on farm development cost;
Sea and inland transport, port handling tax, and related costs: 44.8% – 49.7%;
Cost of installation: 22.1% - 20.1%.

Currently, PVC and PE pipes are being manufactured in Ethiopia. Thus, using the pipe system could be financially and environmentally more attractive compared to the unlined canal system.

In most cases, the elevation difference between the water supply inlet and outlet is over 1 meter per 100 meter. This head difference is adequate enough to flash out silt that may enter the pipe system.

Weakness: The use of pipes with silt laden water could be problematic in mild slope areas. In areas with gentle slope, pipes could be clogged with silt and debris.

Table 16: *Investment Cost of Low Pressure Irrigation System as Compared to Unlined Canal System*

Irrigable Area Ha	Investment Cost, Birr				
	##Low Pressure Gated Pipe System		Earthen Canal System**		Difference
	Total Cost	Cost/ha	Total Cost	Cost/ha	
20	168,843	8442.15	202,800	10140	-33,957
50	636,979	12739.58	507,000	10140	129,979
100	1,795,703	17957.03	1,014,000	10140	781,703
Mean		13046.25		10140	

Source: ##Leul K. 1998; **Leul K. 1997

(5) Supplementary irrigation as the priority use of harvested water

Description: A literature-based study was made in 1997 in the semi arid area of Tigray to evaluate the benefits obtained from utilizing the harvested water for either supplementary irrigation alone or for two season irrigation.

Harvested water is subjected to evaporation and seepage losses. Thus, utilizing the harvested water for crop production as early as possible implies minimizing the proportion of water lost by evaporation and seepage. The water saved from loss could be used to supplement irrigation water for additional land (Table 17).

Strength/Opportunity: The water that could have been lost by evaporation and seepage could be used for biomass production. This approach would enable to obtain at least one bumper harvest. A group of farmers can construct. According to findings in India[6], the yield of sorghum and cotton was increased by 49.8% and 85.7%, respectively, due to the use of supplementary irrigation at critical stages of crop growth (Leul K. 1997).

Weakness: Construction of the indicated pond size could be expensive for cash poor farmers.

[6] Indian Society of Agronomy, 1992. Resource Management for Sustained Crop Production. Rajasthan Agricultural University. India

Table 17: *Irrigable Area Using Water Harvested from 1 km2 Catchment*

Computed Data:

Water Harvested from 1km^2 Catchment: 91747 m^3 per rain season
Supplementary irrigation requirement: 4139 m^3/ha
Dry Season Irrigation requirement: 7200 m^3/ha
Seepage loss: assumed as negligible (e.g. by using geo-membrane)

Pond Dimension			Case 1: Supplementary Irrigation Only			Case 2: Two Season Irrigation						Irrigated land Increment by using Case 1	Cost of the Additional Canal System @Birr 10140/ha
						Wet Season: Supplementary			Dry Season Irrigation				
Depth	Bottom Width	Max Surface Area	Evapo ration May - Oct	Water Available for irrigation	Irrigable Area	Evapo ration May - Oct	Water Available for irrigation	Irrigable Area	Evapo ration Nov - Apr	Water Available for irrigation	Irrigable Area		
m	m	Ha	M^3	M^3	ha	M^3	M^3	ha	M^3	M^3	ha	%	Birr
3	175	3.27	31376	60372	14.61	31376	22038	5.3	22444	15890	2.2	94	94,403
6	124	1.84	17648	74099	17.9	17648	27049	6.5	12624	34425	4.8	58	115,596
10	96	1.34	12856	78891	19.1	12856	28798	7	9197	40896	5.7	51	122,694

Source: Leul K. 1997 (Study area: Quiha, Tigray; Semi Arid AEZ. The table takes into consideration rain fall occurring in April/May)

(6) Low Cost Canal Lining Material

Description: Three soil types each mixed with teff and barley straw as a binding material were used as a canal lining material in a research centre at Alemaya University. The dimensions of canal tested in the experiment were as follows: bottom width = 60 cm; depth 52 cm; side slope = 1:1.

Strength/Opportunity: All of the soil – straw mixture canal lining material reduced seepage significantly. Maximum seepage reduction (72%) was attained by the clay loam-teff straw. The lowest seepage reduction (45%) was attained for sandy loam – barley straw mixture.

Weakness: The lining material can be easily removed during canal O&M.

(7) New Crop Varieties

Description: New crop varieties are associated with maximum productivity of land and water. A total of 435 new crop varieties have been released by EIAR between 1970 and 2005 (Table 18). Out of these new crop varieties, more than 250 are currently under production by Ethiopian farmers (Tsedeke, A. (ed.), 2006). That is, as of 2005 more than 185 new crop varieties are available on the shelves of EIAR waiting to be disseminated to the farmer. The potential of the shelved new crop varieties can be observed from one particular demonstration conducted by EIAR in 2005. The aim of the demonstration was to promote new haricot bean variety called "Awash Melka" along with the associated cultural practices. Awash Melka variety is known to be superior in terms of yield and canning quality compared to the traditional ones.

The average yield of the commonly used haricot bean variety in Oromiya, SNNP, Benshangul Gumuz and Amhara Regions for 2004/05 crop season was 1.0, 0.8, 0.8, and 0.7 ton/ha, respectively. On the other hand, 700 farmers who planted Awash Melka variety in demonstration sites obtained on average 2.0 ton/ ha or 120% yield increment (Teshale A. et al. 2006). Thus, new crop varieties offer an opportunity to get highest return per unit volume of rainwater or irrigation water. In order to secure a sustainable market, the new crop varieties have to be produced by a large number of farmers. Thus, community-level planning and implementation is required.

Table 18: *Summary of Released New Crop Varieties in Ethiopia by EIAR*

Crop Type	1970 - 79	1980 - 89	1990 - 99	2000 - 2005	Total
Cereals	15	23	56	101	195
Pulses	11	11	30	42	94
Oil Crops	6	9	8	15	38
Root & Tubers		4	12	26	42
Vegetables			3	14	17
Fruits				6	6
Spices				1	1
Fiber Crops	4	5	4		13
Stimulant		12	5	3	20
Forage Crops	3	5	1		9
Total	39	69	119	208	435

Source: Tsedeke, A. (ed), 2006

Strength/Opportunity: There is a growing demand for various agricultural produce at local and international markets. Thus, the new crop varieties already available in the shelves of EIAR can generate high income to the resource poor farmers. Such increase in income could further enhance the productivity of rain or irrigation water.

Weakness: Promotion of new crop varieties need continuous follow-up by researchers and extension workers. Unforseen events such as low rainfall could lead to poor germination and the farmers could blame wrongly the new crop variety.

A prerequisite for scaling up of the new crop varieties is the presence of a secured market. However, it is often challenging to establish partnership for input supply, production and marketing.

3.4 Identification and Assessment of Best PPMI Practices

3.4.1 Long List of Best PPMI Practices

PPMI practices that are of relevance to cash poor farmers are identified from the reviewed documents and consultations made with resource persons. These are presented in Table 19.

Table 19: *Long list of Best PPMI Practice*

	Description of Best Practice	Information Source (recommended by)	Location	
			Region	Wereda
1	Irrigation Water Management for Cotton on Vertisol	Haider et al 1988	Afar	Melka Werer Research Center
2	Out-grower Contract with Exporter in Dodicha Pumping CMI Scheme	IWMI, et. al. 2004 Mekuria T., 2003	Oromia	Zway
3	Out-grower Contract with Sugar Processing Factory at Wonji-Shewa	Mekuria T., 2003	Oromia	Adaa

3.4.2 Evaluation of the Best PPMI Practices

(1) Irrigation Water Management for Cotton on Vertisol

Description: Research was conducted at Melka Werer research centre (EARO) with the objective of improving water management practice for cotton planted in vertisols. The study recommended the following as an improved water management practice: Optimum furrow length = 200m. For a furrow with a slope of 0.005 – 0.008%, initial flow rate = 3.5 l/sec with cut back flow rate of 1.5 l/sec. For a furrow slope of 0.015%: initial flow rate = 2.13 l/sec with cut back flow rate of 1.61 l/sec) (Haider G., et. al., 1988).

With the above system flow rate, the researchers identified an irrigation schedule that would optimise water use without undermining yield. The recommended irrigation schedule for cotton involves: three irrigations (one of 200 mm at planting, followed by two of 150 mm each at flowering, and boll formation) are adequate to obtain a yield similar to that obtained with the commonly practised nine irrigations with a depth of 75 mm water at two weeks interval.

Strength/Opportunity: Light and frequent irrigation is the practice recommended for water saving. But, according to the indicated research, cotton grown in Vertisol can extract more water from the lower soil depths when irrigated at four week interval than two weeks interval. The abovementioned practice enables to save 40 – 50% of the irrigation water (Haider G., et. al., 1988).

If such water saving practice could have been implemented in time, the salinity problem in the Awash Valley public irrigation schemes near the research centre could have been avoided. The salinity problem in the indicated schemes was developed by excessive irrigation water application and the consequent rise of the water table.

Weakness: The study is very old and was not mentioned in the other reviewed documents. Besides, no additional documents with similar studies were found.

Most of the public irrigation schemes lack systematic working procedure and are subjected to continuous staff turnover (personal communication). Besides, most of them are in the process of privatization due to inefficient performance.

Due to the above factors, replication could not be easy.

(2) Out-grower Contract Arrangement with Exporter in Dodicha Pumping CMI Scheme

Description: The out-grower contract arrangement was made between a private exporter (namely, Ethioflora Horticulture Farm) and a community managed irrigation scheme called Dodicha. The Dodicha CMI implementation started in 2001 with 153 households. The irrigable area is 69 ha and land holding per household varies from 0.25 – 0.5 ha. The water is pumped from Bulbula stream using two diesel pumps. Since 2003, the WUA was making marketing agreement with a trader and exporter (IWMI et. al. 2004, Mekuria T. 2003). The farmers used to sell green bean for $0.12 per kg in the local market. The out-grower contract arrangement enabled them to sell their produce at four times local market prices ([7]). The out-grower arrangement was initiated when the abovementioned private/exporter failed to produce enough beans to meet the demand of customers in Europe.

Strength/Opportunity: According to various studies, the poor performance of irrigation schemes in Ethiopia is linked to the persistent marketing problem for agricultural produce. Farmer – private sector partnership in solving the marketing problem is an exemplary that has to be replicated in other irrigation schemes. On top of marketing, the private company is involved in

[7] http://www.usaid.gov/stories/ethiopia/ss_et_greenbeans.pdf

assisting the farmers in technical issues related to production and quality control. As a result, the farmers grow diversified horticultural crops. Cropping intensity is 200 – 300% and the farmers were planning to increase the irrigable area by another 30 ha in 2004. WUA is legalized and gets credit for input, purchase input from Addis Ababa. Members' income increased tenfold (from Birr 500--600 t0 Birr 5000 – 6000) compared to pre-project; there is an improvement in livelihood of the community (IWMI et. al. 2004)

Weakness: The export and processing industries in Ethiopia are at the infant stage. Thus, the indicated out-grower contractual arrangement might not be replicated adequately to accommodate a large number of farmers in the near future. Besides, export crops such as green bean, are sensitive to quality problems induced by moisture stress and other factors. In light of the abovementioned facts, it would be difficult to replicate the indicated marketing approach in other areas. In the mean time, it would be necessary to upgrade the irrigation management skill of the extension workers and farmers.

(3) Out-grower Contract with Sugar Processing Factory at Wonji-Shewa

Description: A total of 1121 ha irrigable land was established (many decades back) as out-grower farms near the farms of Wonji sugar-factory public enterprise. Water is pumped from Awash River and discharged into reservoirs. Thereafter, water is distributed into the various conveyance networks by gravity. Main canal is lined but, field canals are earthen ditches.

The purposes of the out-grower farms were to improve the living standard of the farmers and increasing the supply of cane to the factory. The sugar cane is planted in phases to ensure continuous supply to the factory. Three elected members control the water distribution throughout the farm.

Strength/Opportunity: The farmers have a secured market and get extension and credit service from the factory. The out-grower farmers are organized into cane producers association, which helps them negotiate for better contractual terms with the factory. The contractual agreement is reviewed by both parties every three years. There is a trend of increasing income of the farmers. Thus, such practice is beneficial to the farmers leading to improved water use efficiency.

Weakness: As yet, the sugar processing plants are found in limited areas with ample amount of water. Thus, the potential to replicate the out-grower arrangement would also be limited in its area coverage. Besides, farmers are advised to grow diversified crops so as not to congest the market and to avoid pest and disease linked to monoculture. But, in the above-mentioned out-grower farms, monoculture involving sugar cane is practised. Sugar cane is high water demanding crop. The farmers feel that they could have earned more from the production of vegetables than sugar cane (Mekuria T., 2003).

4. Identification and Assessment of Best Practice Sites in Agricultural Water Use

4.1 Identification and Assessment of Best Practice WH Sites

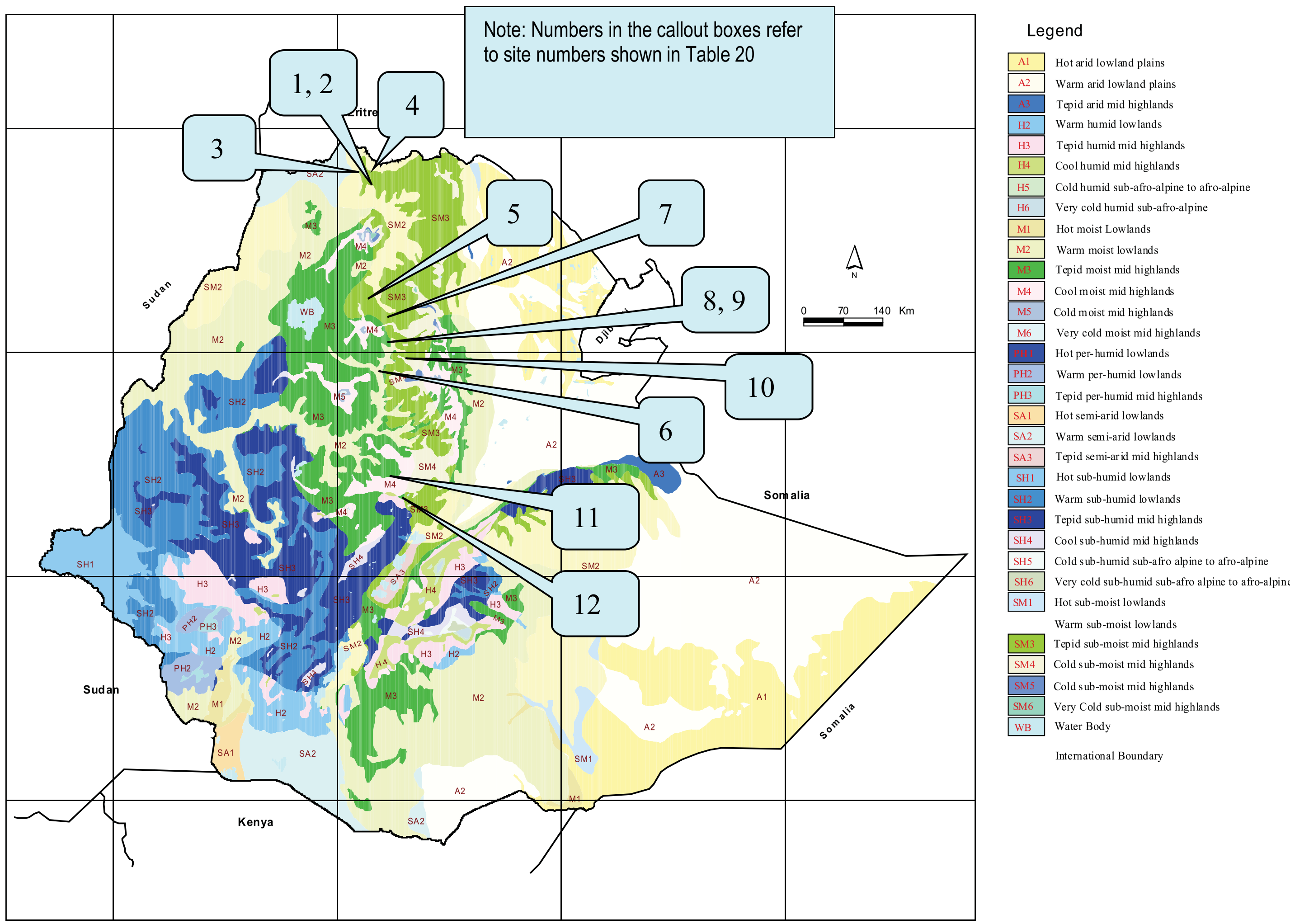
4.1.1 Long List of Best Practice WH Sites

The major source of information for this section was the evaluation made in 2006 by MOARD on the performance of the WH measures constructed during 2003 – 2005 (Aklilu, et.al. 2006). The evaluation team in collaboration with the respective Regional and Wereda BOARD staff, identified 12 WH sites as exemplary and worthy for experience sharing. Other contacted resource persons in MOARD, WFP and the relevant regional offices also concur with the information given in the evaluation report. The long list of the BP WH sites is presented in Table 20 and located in Figure 2.

***Table 20**: Long List of Best Practice WH Sites*

	Description of Best Practice Site	Information Source (recommended by)	Location	
			Region	Wereda
	Integrated Watershed Development Sites			
1	Abreha Atsbeha Integrated Watershed Development	Aklilu, et. al. 2006	Tigray	Kilte Awlaelo
2	Mekuh Integrated Watershed Development	Aklilu, et. al. 2006	Tigray	Kilte Awlaelo
3	Migulat Mekodo Integrated Watershed Development	Aklilu, et. al. 2006	Tigray	Ganta Afeshum
4	Gergera Integrated Watershed Development	Aklilu, et. al. 2006	Tigray	Atsbi Wemberta
5	Ayub Integrated Watershed Development	Aklilu, et. al. 2006	Amhara	Kobo
6	Chekorti Integrated Watershed Development	Aklilu, et. al. 2006	Amhara	Kalu
	Watershed Development Sites			
7	Lenche Dima Watershed Development	Aklilu, et. al. 2006	Amhara	Gubalafto
8	Totit Wajeto Watershed Development	Aklilu, et. al. 2006	Amhara	Ambasel
9	Golbo Watershed Development	Aklilu, et. al. 2006	Amhara	Ambasel
10	Hato Watershed Development	Aklilu, et. al. 2006	Amhara	Bati
	WH Storage Sites			
11	Minjar Plastic Lined Ponds	Aklilu, et. al. 2006	Amhara	Minjar
	In-situ Measures and WH Storage Sites			
12	Boset Wereda WH tanks and moisture conservation	Aklilu, et. al. 2006	Oromia	Boset

Figure 2: *Locations of Best Practice WH Sites*



4.1.2 Characterization of the Best Practice WH Sites

(1) Abreha Atsbeha Integrated Watershed Development

Location: Abreha Atsbeha Watershed is located in Kilte Awlaelo Wereda, Tigray Region.

Topography and Area: The watershed has an area of 7624 ha and encompasses three villages. It has a bowl shape; with the centre being 1047 ha arable land surrounded by hilly and mountainous land scape. The altitude at the plain area is 2060 m above seal level.

Population: There are 992 households in the watershed. The average and maximum land holding per family is 1 ha and 1.5 ha, respectively.

Rainfall Pattern: Major rain season from June – August.

Main Crops: The annual crops grown in the site are the following: wheat, teff, haricot bean, millet, maize, barley, chick pea and others. Irrigated crops are: tomato, pepper, onion, Swiss chard, cabbage and others. Among the fruit trees are: orange, guava, banana, papaya, and mango. Various fodder plants are also grown in the area.

Prominent Water Related Features of Abreha Atsbeha Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems:

- Runoff generated from the hilly and undulating landscape used to inundate the farmlands with flood. Field crops were damaged by the flood and silt deposition;
- Farmlands, grazing lands and hillsides were eroded heavily resulting in big and numerous gullies and removal of a significant layer of the top soil;
- As a larger proportion of the erratic and intensive rainfall was transformed into runoff, field crops used to suffer from moisture deficiency;
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency for a period of 7-month/year.

(b) The Solution

Integrated watershed development approach: Stemming from the abovementioned problems, the watershed community with support from Bureau of Agriculture initiated SWC activities in a scattered way as of late 1990s. After evaluating the inadequacy and ineffectiveness of the scattered effort, the community with support from BOARD decided to adopt integrated watershed development approach in 2002/03.

Participatory Planning: The watershed plan was prepared by the community with technical support from BOARD and WFP. The planing process involved (i) identification and prioritization of the prevailing problems in the watershed; and (ii) identification and design of appropriate SWC measures based on the topography and land use.

Design: Study and design of SWC works was conducted by the technical staff of BOARD. Design considerations and specifications of the typical WH structures similar to those constructed in Abreha Atsbeha watershed are presented in the following section.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by three Development Agents (DAs) assigned in the watershed.

Output: At the hillsides and the undulating terrain of the watershed, hillside terraces, trenches and micro basins were constructed and reinforced with grasses and bushes. Gullies were plugged with check dams and subsequently were reclaimed for cultivation. At the foot of the slopes, trenches were constructed to capture the excess rainwater and allow it to infiltrate. A series of interconnected percolation ponds were constructed along the natural water course. Soil and stone bunds were constructed on the farm land to capture rain water and protect the land from erosion. In general, 70% of the watershed is conserved and rehabilitated, and 80% of the farmers are irrigating using water from springs, river diversion, water tanks, and shallow wells (Aklilu, et. al. 2006).

Impact: The above physical measures improved the productivity of rain fed crops and fodder grass. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased.

As a result of the above integrated WH efforts the following impacts are observed in the watershed:

(i) The advancement of gullies was halted and the gullied area was reclaimed for cultivation. Moisture stored behind the check dams is used for growing fruit trees;

(ii) The farmland is safe from inundation by flood and silt deposition;

(iii) The ground water is adequately recharged and is being used for irrigation, livestock and domestic water supply. Currently, there are 660 shallow hand dug wells;

(iv) The hillsides are covered now with indigenous and introduced grasses, bushes and trees;

(v) The stoppage of free grazing has eliminated the recurrence of contagious livestock disease;

(vi) The income of the community is improved from the sale of various agricultural produce. For example, the annual cash income of one farmer in 2004, 2005 and 2006 was Birr 9,000; 22,000; and 32,000, respectively (Aklilu, et. al. 2006). (Note: Often, f*armers do not count what they consume or what they store as* *income. The income they report is what they obtain from sale of produce).*

(c) Lessons Learned

Four important lessons can be drawn from the abovementioned watershed planning and implementation process, which are: (i) the importance of participatory planning, (ii) the organizational arrangement and role of the community, (iii) highly committed community leadership, and (iv) the importance of joint and earnest efforts by the technical and administration people.

Lesson (1): Participatory Planning: In view of the declining trend in natural resources and livelihood of the community, the demand for solving the water related problems was evident by all stakeholders. At first, the elected community leaders discussed on how to solve the problems with BOARD and identified integrated watershed management as a solution. In 2002/03 the watershed development plan was prepared using the approach known as LLPPA (Local Level Participatory Planning Approach). Members of BOARD and a team called Planning Committee drawn from the community prepared the draft watershed development plan. The draft plan was first discussed with the community leaders and then with the general assembly involving the whole members of the community in the watershed.

Lesson (2): Organizational arrangement and role of the community: There is a Planning Committee (PC) in each of the Kebeles (lowest administrative units) of Tigray. There are also PCs at each village within the Kebele. It was the Kebele level PC in collaboration with the lower level (village) PC who were responsible for the planning activities of the watershed.

In each village, the people are organized into Development Teams comprising of 25 people each. In Abreha Atsbeha watershed, the people are organized into 38 Development Teams. Each Development Team has its own chairperson and secretary and is responsible for carrying out SWC works on the land holdings of the team members including that of aged and disabled neighbours. They are also required to implement their share of SWC works on the communal areas – mainly on the hillsides.

Lesson (3): Highly committed community leadership**:** The elected community leaders played a significant role in mobilizing the community during the preparation of the plan, implementation of the planned activities and maintenance of the established structures. When requested by extension workers, they took the initiatives to adopt/experiment new practices on their own land and served as model farmers.

Lesson (4): Earnest efforts by the technical and administration people: Many months prior to the starting of the watershed planning process, the technical and administration people sensitized the community continuously about the cause, magnitude and solutions of the prevailing rainwater related problems. The joint efforts resulted in an enhanced commitment by the community to bring a change in the status quo by regulating rainwater. During the implementation phase, the requisite technical and material support to the community was closely followed up by the technical and administration people at all levels.

(2) Mekuh Integrated Watershed Development

Location: Mekuh Watershed is located in Kilte Awlaelo Wereda, Tigray Region.

Topography and Area: The watershed has an area of 90 ha and encompasses four villages all of which are in one Kebele (Peasant Association). The total area of the Kebele is 5660 ha; out of this 1136.5 ha is arable land.

Population: There are 1848 households in the Kebele (539 male and 670 female). Out of this 1209 households are involved in the watershed. The average land holding per family is 0.75 ha.

Main Crops: The annual crops grown in the site are the following: wheat, teff, haricot bean, millet, maize, barley, chick pea and others. Irrigated crops are: tomato, pepper, onion, Swiss chard, cabbage and others. Among the fruit trees are: orange, guava, banana, papaya, and mango. Various fodder plants are also grown in the area.

Prominent Water Related Features of Mekuh Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems:

- The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Farm lands at the foot of the hills used to suffer from flooding and silt deposition;
- Farmlands, grazing lands and hillsides were eroded heavily resulting in big and numerous gullies and removal of a significant layer of the top soil;
- Field crops used to suffer from moisture deficiency as a larger proportion of the erratic and intensive rainfall was transformed into runoff;
- Grazing lands were unproductive due to overgrazing-induced land degradation;
- The flow rate of the only perennial stream in the site was very small and could not support agricultural activities other than its service as the church's holy water.
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

(b) The Solution

Integrated watershed development approach: The implementation of SWC works in scattered way was started in the watershed prior to 2002. But, the integrated watershed management plan preparation commenced in 2006 (Aklilu, et. al. 2006).

Participatory Planning: Each village has a planning committee responsible for the overall development plan of the village. Members of the committee are: 3 from public associations; 1 village representative; 1 representative of the church; and 2 influential elders. This committee is responsible for the preparation of the watershed development plan in consultation with the extension workers.

At the early stage, some farmers with large numbers of livestock were against the closure of the degraded areas. After discussion, the proposal was accepted by all members of the community.

Design: Study and design of SWC works was conducted by the technical staff of BOARD and GTZ project.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by three Development Agents (DAs) assigned in the Kebele.

Output: At first, 8.5 ha degraded land was closed, covered with SWC works and then allotted to 34 landless people. After evaluating the impact more land was closed and covered with more SWC works. Gullies were plugged and planted with perennial trees. The flow of the stream was revived and was diverted to supply 23 water tanks used as night storage. All of the additional rehabilitated and developed area was allotted to 42 landless youngsters. In terms of area coverage and implementation of good practices, Mekuh watershed is next to Abreha Atsbeha watershed (Aklilu, et. al. 2006).

Impact: The above physical measures improved the productivity of rain fed crops and fodder grass. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased.

As a result of the above integrated WH efforts the following impacts are observed in the watershed:

(i) The advancement of gullies was halted and the gullied areas were reclaimed for cultivation. Moisture stored behind the check dams is used for growing forage and fruit trees;

(ii) The farmland is safe from inundation by flood and silt deposition;

(iii) The ground water is adequately recharged and is being used for irrigation, livestock and domestic water supply. Currently, at the Kebele level there are: 103 motor pumps used for irrigation, 15 treadle pump, 23 night storage water tanks; 57 productive shallow hand dug wells (out of 112); 39 small plot drip irrigation systems;

(iv) Biogas digesters are planted in 31 sites;

(v) The hillsides are covered now with indigenous and introduced grasses, bushes and trees. As a result, farmers are able to harvest grass for fodder and thatching. Productivity of apiculture is improved and farmers are able to harvest honey three times a year;

(vi) The income of the community is improved from the sale of various agricultural produce. For example, one model farmer is reported to own the following: 1 hand dug well, 1 plastic lined pond, 1 motorized pump, dairy cows, and 40 bee hives.

(c) Lessons Learned

The lessons to be drawn from Mekuh watershed are the same as those from Abreha Atsbeha watershed.

(3) Migulat Mekedo Integrated Watershed Development

Location: Migulat Mekedo Watershed is located in Ganta Afe-Shum Wereda, Tigray Region.

Topography and Area: The watershed has an area of 1595 ha and encompasses two villages all of which are in one Kebele (Peasant Association). The area is hilly and mountainous landscape with slopes greater than 100%.

Rainfall: Rainfall is erratic. Average rainfall is 450 - 600 mm.

Main Crops: The annual crops grown in the site are the following: wheat, teff, haricot bean, millet, maize, barley, chick pea and others. Irrigated crops are: tomato, onion, Swiss chard, cabbage and others. Among the fruit trees are: orange, guava, banana, papaya, and mango. Various fodder plants are also grown in the area.

Prominent Water Related Features of Migulat Mekodo Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation;
- There was severe shortage of water even for domestic use. Rainfall is low and erratic. To overcome moisture stress, farmers are used to divert runoff into their field.
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

(b) The Solution

Integrated watershed development approach: The integrated watershed development plan preparation was initiated in 2002 with the help of the MERET project (Aklilu, et. al. 2006).

Participatory Planning: A planning committee (involving 5 men and 5 female) with technical support from the DA and experts from the Wereda Agriculture Office prepared the watershed plan. The plan was discussed and approved by all community members. In addition to the abovementioned Kebele-level Committee, each village has also a planning committee responsible for the overall planning and implementation within the respective villages.

Design: Study and design of SWC works was conducted by the technical staff of the Wereda Agricultural Office.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by Development Agents (DAs) assigned in the Kebele. The extension work in convincing the community to avoid free grazing was commendable.

Output: Various SWC works that are appropriate for each land feature and land use are implemented in all parts of the watershed. Hillsides were treated with hillside terraces, semicircular terraces, trenches, etc. and plantation of various seedlings. Arable lands were treated with soil bund, stone bunds, cut-off drains etc. Many ponds are constructed in the cultivated field and homesteads. Gullies were plugged with check dams and reinforced with various plantations.
At present, the watershed has a good coverage in terms of physical SWC works. But, there is a big room for biological SWC measures (Aklilu, et. al. 2006).

Impact: As a result of the above physical measures, arable lands are changed into a series of benches and hillsides are rehabilitated. Erosion and runoff from the arable lands and hillsides are reduced. Much of the rainwater is retained in the soil profile and enabled to improve the productivity of rain fed crops and fodder grass. Ground water is adequately recharged resulting in the revival of springs. One new spring has emerged. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased. The income of the community is improved from the sale of various agricultural produce.

(c) Lessons Learned

The lessons to be drawn from Migulat Mekedo watershed is the same as those from Abreha Atsbeha and Mekuh watersheds.

(4) Gergera Integrated Watershed Development

Location: Gergera Watershed is located in Atsbi Wemberta Wereda, Tigray Region.

Topography and Area: The watershed has an area of 1500 ha and encompasses one Kebele (Peasant Association). The area is hilly and mountainous landscape with agricultural fields at the foot of the hills.

Population: 300 households

Rainfall: Rainfall is low and erratic.

Main Crops: The annual crops grown in the site are the following: wheat, teff, haricot bean, millet, maize, barley, chick pea and others. Irrigated crops are: tomato, onion, Swiss chard, cabbage and others. Among the fruit trees are: orange, guava, banana, papaya, and mango. Various fodder plants are also grown in the area.

Prominent Water Related Features of Gergera Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Farm lands at the foot of the hills used to suffer from flooding, silt deposition and gully formation;
- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation. As a result, the people used to take their livestock for grazing to the Afar lowlands (10 – 15 km) during the dry months;
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

(b) The Solution

Integrated watershed development approach: The integrated watershed development plan preparation was initiated in 1997 with the active participation of the community, Wereda administration and extension workers (Aklilu, et. al. 2006).

Participatory Planning: The Wereda administration in collaboration with the extension staff played a significant role in organizing the community, discussing the prevailing problems in the watershed, and planning the activities to be implemented in the watershed.

Design: Study and design of SWC works was conducted by the technical staff of the Wereda Agricultural Office.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by the Wereda administration and Development Agents (DAs) assigned in the Kebele.

Output: Various SWC works that are appropriate for each land feature and land use in all parts of the watershed were implemented. Hillsides were closed and treated with trenches, hillside terraces, etc. and plantation of various seedlings. Arable lands were treated with soil bunds, stone bunds, cut-off drains etc. Gullies were plugged with check dams and reinforced with various plantations.

As of 2001, the entire watershed was almost covered with various physical SWC works. However, there is a still a need for biological SWC measures (Aklilu, et. al. 2006).

Impact: Runoff from the hillsides is no more a threat to the downstream arable fields. Much of the rainwater is retained in the soil profile and enabled to improve the productivity of rain fed crops and fodder grass. Ground water is adequately recharged resulting in the revival of springs. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased. The income of the community is improved from the sale of various agricultural produce (Aklilu, et. al. 2006).

(c) Lessons Learned

The lesson to be drawn from this watershed is the same as those from Abreha Atsbeha and Mekuh watersheds.

(5) Ayub Integrated Watershed Development

Location: Ayub Watershed is located in Kobo Wereda, Amhara Region.

Topography and Area: The watershed has an area of 633 ha and encompasses three villages within one Kebele (Peasant Association).

Population: 265 households
Rainfall: Rainfall is low and erratic.
Main Crops: The annual crops grown in the site are sorghum, teff, and others.

Prominent Water Related Features of Ayub Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- ❖ The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- ❖ Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;

- Grazing lands were unproductive due to overgrazing-induced land degradation.

(b) The Solution

Integrated watershed development approach: The integrated watershed development plan preparation was initiated in 2003 by the Regional BOARD (Aklilu, et. al. 2006).

Participatory Planning: The watershed was among four pilot sites in Amhara Region. There was a limitation in community participation as the plan was prepared by experts from the regional BOARD. Some farmers with large livestock numbers are still against the closure of the degraded grazing lands. There are attempts of breaching the byelaws by letting livestock enter the closed areas. The community has to enforce the byelaws using two guards to control the closed areas against interference by livestock.

Design: Study and design of SWC works was conducted by the technical staff of the Regional BOARD.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by the Development Agents (DAs) assigned in the Kebele with periodic support from the Wereda Agriculture Office.

Output: Hillsides were closed and treated with trenches, hillside terraces, etc. and plantation of various seedlings. Arable lands were treated with soil bunds, stone bunds, cut-off drains etc. Gullies were plugged with check dams and reinforced with various plantations. 28 water tanks, 32 plastic lined ponds are constructed. There are 4 modern hives, dairy development and sheep and goat production (Aklilu, et. al. 2006).

At present, 280 ha out of 633 ha (44%) is conserved. After visiting the watershed development activities in Tigray, the Wereda administration and extension staffs have realized the need for exerting more efforts in the Ayub watershed (Aklilu, et. al. 2006).

Impact: There is an improvement in the vegetative cover of the watershed. The amount of runoff from the hillsides is reduced significantly. Such reduction in runoff has negatively impacted downstream farmers who used to practice spate irrigation. Water stored in tanks and ponds are used for domestic water supply and irrigation of small plots (onion, tomato, papaya, and orange).

(c) Lessons Learned

The planning was not participatory and as a result there was no full sense of community ownership.

(6) Lenche Dima Watershed Development

Location: Lenche Dima Watershed is located in Gubalafto Wereda, Amhara Region.

Topography and Area: The watershed has an area of 1500 ha and consists of rugged, hilly and mountainous landscape.

Population: There are 940 households in the watershed. The average land holding per family is less than 1 ha. The livestock population is beyond the carrying capacity of the area.

Main Crops: The annual crops grown in the site are wheat, teff, chick pea and others. Various fodder plants are also grown in the area.

Prominent Water Related Features of Lenche Dima Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems:

- The hilly and rugged landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Farmlands, grazing lands and hillsides were eroded heavily resulting in big and numerous gullies and removal of a significant layer of the top soil;
- Field crops used to suffer from moisture deficiency as a larger proportion of the erratic and intensive rainfall was transformed into runoff;
- Grazing lands were unproductive due to overgrazing-induced land degradation;
- Livestock must travel for 4 – 6 hours to drink water from Chereti stream; and
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

(b) The Solution

Integrated watershed development approach: The integrated watershed management plan preparation was done in 2003 (Aklilu, et. al. 2006).

Participatory Planning: AMAREW project in collaboration with the Wereda Agricultural Office prepared the initial plan. The watershed development is led by the Kebele administration. The preparation of annual plans, monitoring and evaluation of the implementation is done by a watershed development committee. SWC on Communal areas are implemented by teams each having 30 members (Aklilu, et. al. 2006).

Design: Study and design of SWC works was conducted by AMAREW project and the technical staff of BOARD.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by the Kebele administration and Development Agents (DAs) assigned by the Wereda Agriculture Office.

Output: A certain portion of the degraded hillsides were closed from human and livestock interference and covered with SWC works. Plantation of trees and pigeon pea was carried out on the hillsides. Gullies were plugged with check dams. In 2004, 29 ha of the closed area were distributed to 44 farmers. Additional 175 ha land was closed in 2005. A total of 20 water tanks are constructed, and 4 of them are not functional due to leakage. In addition to domestic and livestock water supply, some of the farmers are using the water in the tank for irrigation of small plots (tomato, pepper, onion, and fruit trees such as papaya, guava, avocado, etc).

The attempt made by the farmers to construct SWC work on their own farms is not satisfactory. Measures to stop free grazing are inadequate. In summary, 204 ha out of 1500 ha (14%) is conserved and most of the watershed is still subjected to free grazing and the subsequent land degradation (Aklilu, et. al. 2006).

Impact: Runoff from the hillsides is reduced and as a result the advancement of gullies is halted. Gullies are rehabilitated and converted into arable land. Farmers are now able to get grass for fodder and thatching - for own use or sale. Pigeon pea has also become an additional source of income for the community. Out of the 29 ha area closed in 2006, 44 farmers were able to get a total of Birr 12,000 from the sale of grass in one season. The water tanks have rectified the domestic and livestock water supply problem.

(c) Lessons Learned

Highly degraded land can regain back its productive function within two years provided that integrated and participatory development approach is followed.

(7) Totit Wajito Watershed Development

Location: Totit Wajito Watershed is located in Ambasel Wereda Wereda, Amhara Region.

Topography and Area: The watershed has an area of 556 ha.
Rainfall: Rainfall is low and erratic.
Main Crops: The annual crops grown in the site are sorghum, teff, and others.

Prominent Water Related Features of Totit Wajito Watershed

(a) Water Related Problem

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation.

(b) The Solution

Integrated Watershed Development: The watershed development task initially focussed on the distribution of degraded land to landless people. The task was initiated in 2003 by the Wereda Agricultural Office (Aklilu, et. al. 2006).

Participatory Planning: First, 6.25 ha closed area was allotted to 25 people to be conserved and developed. After observing the performance of these farmers, more farmers requested for pieces of the degraded area to do the same.

Design: Study and design of SWC works was conducted by the technical staff of the Wereda Agricultural Office.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by the Development Agents (DAs) assigned in the Kebele with periodic support from the Wereda Agriculture Office. For the purpose of implementing WH and SWC works, the people are organized into teams each having 15 – 20 members. But, there is no byelaw to ensure that (1) SWC works of old and disabled neighbours are covered by the teams, and (2) SWC on private holdings are adequately done (Aklilu, et. al. 2006).

Output: Hillsides were closed and treated with trenches, hillside terraces, etc. and plantation of various seedlings. Arable lands were treated with soil bunds, stone bunds, cut-off drains etc. Gullies were plugged with check dams and reinforced with various plantations. Using water from springs, some farmers are irrigating fruit trees, vegetables and forage crops. Nevertheless, substantial part of the watershed is still subjected to severe erosion and needs immediate attention (Aklilu, et. al. 2006).

Impact: The amount of runoff from the hillsides is reduced significantly. There is an improvement in the vegetative cover of the watershed. Farmers are getting income from the sale of grass, wood and honey.

(c)Lessons Learned

Degraded land can regain its productive function by allotting it to individual landless people.

(8) Golbo Watershed Development

Location: Golbo Watershed is located in Ambasel Wereda, Amhara Region.

Topography and Area: The watershed has an area of 800 ha and encompasses one Kebele. About 82% of the Wereda is mountainous landscape with very steep feature. Areas up to 60% slope are cultivated for annual crop production.

Population: There are 1339 households in the Kebele. Maximum land holding per family is 0.5 ha.

Rainfall: Rainfall is low and erratic.

Main Crops: The annual crops grown in the site are sorghum, teff, and others.

Prominent Water Related Features of Golbo Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- In 1997 a land slide caused by runoff from the mountains covered arable lands to a maximum depth of 2 meter.
- The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation.

(b) The Solution

Integrated watershed development approach: The integrated watershed development plan preparation was initiated in 1998 by the Wereda Agricultural office (Aklilu, et. al. 2006).

Participatory Planning: The damage caused by land slide on crops and arable land was the reason for the initiation of the watershed development plan. The community selected 5 men and 5 women as a watershed development planning committee in 1998. The committee along with input from the Wereda Agriculture office prepared the plan.

The implementation and maintenance of SWC measures on own plot is not adequate. There are attempts of breaching the byelaws by letting livestock enter the closed areas. The community has to enforce the byelaws using seven guards to control the closed areas against interference by livestock.

Design: Study and design of SWC works was conducted by the technical staff of the Wereda Agricultural office.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by the Development Agents (DAs) assigned in the Kebele with periodic support from the Wereda Agriculture Office. The actual implementation of the WH and SWC works is done by 27 teams each having 15 – 20 members. But, there is no byelaw to ensure that (1) SWC works of old and disabled neighbours are covered by the teams, and (2) SWC on private holdings are adequately done (Aklilu, et. al. 2006).

Output: 152 ha (out of 800 ha of hillside within the watershed) was closed in 1998 and was covered with various SWC works afterwards. Out of this 22 ha was allotted for 88 farmers in 1999. Biomass production has increased and the farmers are getting wood and grass from the closed areas. Besides, the farmers are harvesting honey from the 149 modern and 61 traditional beehives installed in various parts of the Kebele. A total of 22 plastic lined ponds were constructed but, the functional ones are 13. Pigeon pea is planted along fences and as a reinforcement of farm bunds. Water tanks made up of concrete and masonry are leaky and of little help (Aklilu, et. al. 2006).

Impact: As a result of the SWC works, runoff rate is retarded and subsequently the arable land is now safe from land slide. Income of farmers is improved from the sale of wood, grass, honey and to some extent grain (Aklilu, et. al. 2006).

(c) Lessons Learned

SWC works were found important to control runoff and subsequently prevent land slide in mountainous landscape. Inadequate participation of the community during the planning would lead to some members of the community to breach the byelaw in their favour.

(9) Chekorti Integrated Watershed Development

Location: Chekorti Watershed is located in Kalu Wereda, Amhara Region.
Topography and Area: The watershed has an area of 1017 ha, all of which are in Chorisa Kebele. The area is hilly and mountainous landscape.
Population: 485 households.

Main Crops: The annual crops grown in the site are the following: teff, sorghum, millet, and others. Irrigated crops are: tomato, onion, pepper and others. Among the fruit trees are: mango, avocado, guava, lemon, papaya, and banana. Various fodder plants are also grown in the area.

Prominent Water Related Features of Chekorti Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation;
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

(b) The Solution

Integrated watershed development approach: The integrated watershed development plan preparation was initiated in 1999 with the help of the MERET project (Aklilu, et. al. 2006).

Participatory Planning: A planning committee (involving 5 men and 5 female) with technical support from the DA and experts from the Wereda Agriculture Office prepared the watershed plan. The plan was discussed and approved by all community members. There is a strong sense of ownership of the developed assets.

Design: Study and design of SWC works was conducted by the technical staff of the Wereda Agricultural Office.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by Development Agents (DAs) assigned in the Kebele.

Output: Various SWC works that are appropriate for each land feature and land use in all parts of the watershed were implemented. Hillsides were treated with hillside terraces, semicircular terraces, trenches, etc. and plantation of various seedlings. Arable lands were treated with soil bund, stone bunds, cut-off drains etc. Many plastic lined ponds and concrete/masonry tanks were constructed near to homesteads. Gullies were plugged with check dams and reinforced with various plantations. Spring development and river diversion works for irrigation were also conducted.

Though WH and SWC works are implemented in many parts of the watershed, some farmers are required to spend additional time in correcting poor quality works (Aklilu, et. al. 2006).

Impact: Erosion and runoff from the arable lands and hillsides are reduced. Much of the rainwater is retained in the soil profile and enabled to improve the productivity of rain fed crops and fodder grass. Ground water is adequately recharged resulting in the revival of springs and streams. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased. The income of the community is improved from the sale of various agricultural produce.

(c) Lessons Learned

The community has gained significant benefit from integrated watershed development. The community participation during planning and implementation is commendable.

(10) Hato Watershed Development

Location: Hato Watershed is located in Bati Wereda, Amhara Region.

Topography and Area: The watershed has an area of 370 ha, all of which are in Hato 016 Kebele.

Prominent Water Related Features of Hato Watershed

(a) ***Water Related Problems***

Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation;
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

(b) The Solution

Integrated watershed development approach: The integrated watershed development plan preparation was initiated in the Wereda with the help of the MERET project (Aklilu, et. al. 2006).

Participatory Planning: No data

Design: Study and design of SWC works was conducted by the technical staff of the Wereda Agricultural Office.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by Development Agents (DAs) assigned in the Kebele.

Output: The implementation of various WH and SWC works is progressing with promising results. As yet, some hillsides are treated with hillside terraces, semicircular terraces, trenches, etc. and plantation of various seedlings. Arable lands are treated with soil bund, stone bunds, cut-off drains etc. Many plastic lined ponds and concrete/masonry tanks are constructed near to homesteads. Gullies were plugged with check dams and converted to arable land (Aklilu, et. al. 2006).

Impact: Erosion and runoff from the conserved arable lands and hillsides are reduced. Much of the rainwater is retained in the soil profile and enabled to improve the productivity of rain fed crops and fodder grass. Some farmers are getting benefit from the sale of agricultural produce.

(c) Lessons Learned

Water tanks and sediment storage dams can support production of fruit trees thereby improving the livelihood of farmers in arid and semiarid areas.

SWC works that involve trenches can harvest adequate moisture to sustain production of papaya fruit without any additional irrigation input.

(11) Minjar Plastic Lined Ponds

Location: Minjar Wereda is located in Amhara Region.
(Representative Kebele: Adama)

Topography and Area: Hilly and rugged landscape

Population: 140,000 people in 29 Kebeles.

Prominent Water Related Features of Minjar Wereda

(a) Water Related Problem

Prior to the commencement of the WH program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- There are no springs or streams near the villages and depth to ground water table is over 160 m.
- Women and children spend 3 – 10 hours to fetch water for domestic use;
- Livestock gets water once in 3 days. Round trip to the water source was 12 hours.
- For 6 – 7 months per year source of water supply for domestic and livestock is from unhygienic dugout ponds;
- Runoff from the upland is noted to cause erosion and land slide.

(b) The Solution

Water Harvesting: has been considered as the key solution to the prevailing water problem in the Wereda. Accordingly, the construction of plastic lined ponds was initiated in the Wereda by the Agricultural Office (Aklilu, et. al. 2006).

Participatory Planning: Stemming from the acute water shortage problem, farmers have appreciated the construction of pond. Farmers are replicating the technology on their own. But, the technology is not integrated with other SWC works. Pond owners complain that, the plastic lining materials are damaged during the night by camels. There is no compassion from camel owners.

Design: The initial study and design of the pond was conducted by the technical staff of the Wereda Agricultural Office.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by Development Agents (DAs) assigned in the Kebele.

Output: A total of 2261 plastic lined ponds were constructed during 2003 – 2005, with a plan to construct more in subsequent years.

Impact: The stored water is used for domestic and livestock water supply. Some farmers are using the stored water for production of seedlings, vegetables and fruit trees.

(c) Lessons Learned

Plastic lined ponds are easily replicable and can be effectively utilized for domestic and livestock water supply in water stressed areas like Minjar Wereda. The pond construction need to be integrated with SWC works otherwise its service life could be shortened by sedimentation. The plastic lining material is liable to damage by rats. Thus, there is a need for cost effective and yet resistant to damage.

(12) Boset Wereda WH tanks and moisture conservation

Location: Boset Wereda is located in Oromia Region.
(Representative Kebele: Mareko Oda Lega)

Topography and Area: Hilly and rugged landscape with mild slopes

Main Crops: Irrigated crops are: tomato, onion, pepper, papaya, avocado, mango, orange, and others.

Prominent Water Related Features of Boset Wereda

(a) Water Related Problem

Prior to the commencement of the WH program, the site was characterized by the following water related problems (Aklilu, et. al. 2006):

- ❖ Field crops are subjected to moisture deficiency.
- ❖ The area is subjected to shortages of water supply for both domestic and livestock

(b) The Solution

Water Harvesting Tanks: were considered by the community as the key solution to the prevailing water problem in their area.

Participatory Planning: After observing the performance of one pilot concrete WH tank, the community requested the Agricultural office and an NGO for technical and financial support. Farmers were committed to share the cost.

Design: The Agricultural Office adopted a WH tank design brought from abroad. The design of the plastic lined pond was the same throughout the country.

Implementation: The day to day guidance and monitoring of the implementation of the planned activities was carried out by Development Agents (DAs) assigned in the Kebele.

Output: A total of 277 concrete WH tanks, 800 plastic lined ponds were constructed. The harvested water is used for the production of vegetables and fruits, livestock and apiculture production.

Impact: The income of the farmers have increased from the sale of vegetables, fruit, fattened beef, honey, etc. The average annual income per household is reported to be in the order of Birr 20,000.

(c) Lessons Learned

The harvested water is used to grow seedlings prior to the rainy season and transplanting takes place on the onset of the rain.

The farmers have established WH association with the objective of facilitating market for their produce and purchase of input.

The following measures taken by the farmers to protect the WH tanks from sedimentation are exemplary:

- ❖ The farmers have closed and conserved about 40 ha land upstream of the tanks;

- Check dams are built and reinforced with grass growth;
- The runoff occurring during the first few days of rains is diverted to the farms. After ensuring that the runoff is free of silt, the farmers would divert the runoff to the tanks.

WH tanks increase productivity of livestock, which is attributed to both the availability of drinking water and increased biomass production (crop residue, grass and shrubs) (Dejene. et. al. 2005).

4.2 Identification and Assessment of Best Practice CMI Sites

4.2.1 Long List of Best Practice CMI Sites

Background to the identification Process

Identification of best CMI and PPMI sites has been found highly challenging. Firstly, there is no adequate documentation showing the performance of irrigation schemes and secondly, most of the reviewed documents (*see reference*) are dedicated to portray the drawbacks associated with the irrigation schemes.

In fact, the productivity of most irrigation schemes is low (Table 21) and attempts made to improve their performance were noted as unsatisfactory. For instance, a recently released "Project Completion Report" of IFAD indicated that the performance of the water management component of the project, which was executed during 2000 – 2006 in most parts of the country, was "unsatisfactory". The activities of the indicated subcomponent were meant to increase the productivity of water by improving the knowledge and skill level of the water users and staff in water management and irrigation agronomy (IFAD, 2007). The associated draw backs were (i) the training target was not met and (ii) in many irrigation schemes where the water users were organized into "Water User Cooperatives", dispute among users was common and subsequently more than 50% of the members had left the cooperatives and started the traditional way of WUA (IFAD, 2007).

A preliminary assessment made in 2000 on 97 CMI schemes in Oromia region (covering Eastern, Western, Central and partly Southern part of the country) revealed that market and quality of roads were the major factors that influenced water use efficiency. The irrigation schemes closer to Addis Ababa and to paved roads showed better irrigation performance. Irrigation schemes in East Hararghe were also noted to have good water use efficiency due to their link with the Diredawa, Harar and Djibouti markets (ONRS –OIDA 2000).

In general, the reviewed documents show that in all of the irrigation schemes in the country water productivity is very low. This was explained as:

(i) Inefficient use of water (wastage of water); for instance conveyance losses in unlined canals is estimated in the range of 35 – 40% (IFAD, 2007).

(ii) Water is delivered to individual plots by rotation regardless of crop water requirement;

(iii) Very little extension support in irrigated agriculture; and

(iv) Lack of satisfactory market – a big challenge for commercializing irrigated farming and thereby improving water productivity.

With such premises, some of the reviewed documents identified "better" schemes relative to those covered in the respective reports. The indicators used for identifying the "better" irrigation schemes are direct or indirect measure of water use efficiency. The indirect ones are specified in terms of:

(i) Effectiveness of byelaws;

(ii) High cropping intensity,

(iii) diversified cropping pattern, with higher percentage of horticultural crops;

(iv) Improved income compared to rain fed agriculture; etc.

The CMI schemes that were identified in the reviewed documents as "better" ones are listed in Table 22 and shown in Figure 3.

Table 21: *Productivity of CMI Schemes Compared to Demonstration Plots on Farmers Field*

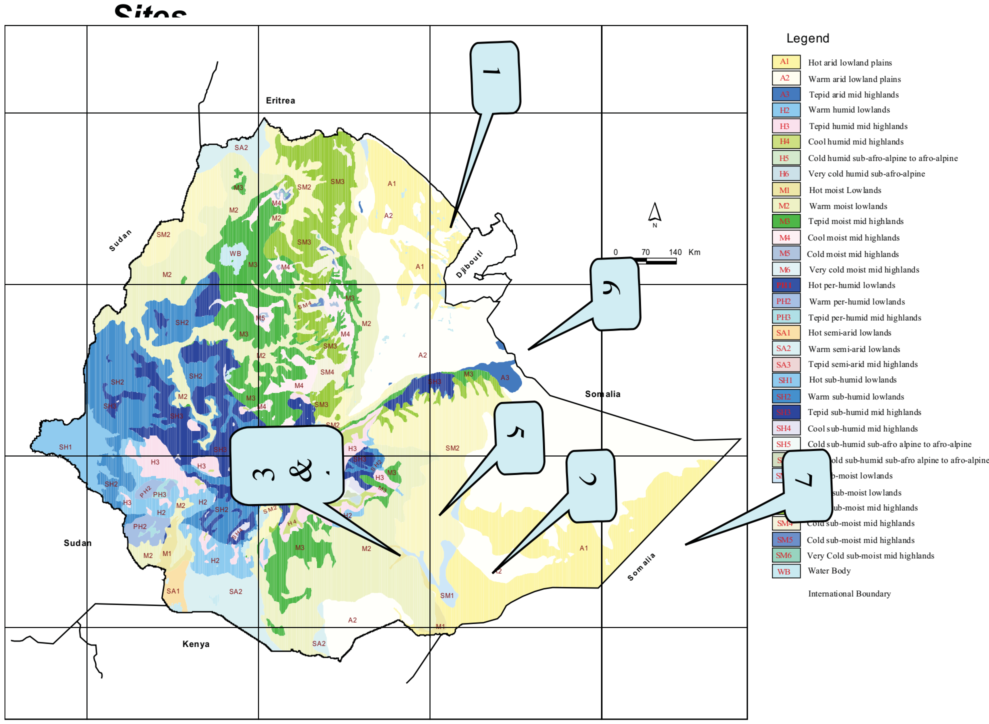
	Crop Type	Average Yield		
		Demonstration Plot	Farmers' Field	
		Ton/ha	Ton/ha	% of the Potential
1	Onion	15.6	9.6	61.54
2	Tomato	28	17.6	62.86
3	Pepper (Green)	29	21	72.41
4	Potato	15	7.5	50
5	Lettuce	12.5	8.1	64.8
6	Cabbage	22	16.5	75
7	Spices	0.5	0.3	60
8	Maize	3	1.4	46.67
9	Carrot	7	4.8	68.57

Source: IFAD, 2007: Adopted from Tigray Bureau of Agriculture

Table 22: *Long List of Best Practice CMI Sites*

	Name of Site	Description of the Significant Parameter	Information Source (recommended by)	Location	
				Region	Wereda
1	Mai Negus	Higher application efficiency, income per cropped area and output per unit water	Mintesinot B et. al. 2005	Tigray	Laelay Maichew
2	Godino	Increased income & living standard of Irrigators	IWMI, et. al. 2004; OIDA, 2000	Oromia	Adaa
3	Chole	Good Irrigation management and Strong WUA	OIDA, 2000	Oromia	Ambo
4	Indris	Good Irrigation management and Strong WUA	OIDA, 2000	Oromia	Ambo
5	Taltale	Expansion of irrigable area	OIDA, 2000	Oromia	Ambo
6	Kobo-Alewuha	Good Irrigation management and Strong WUA	Mekuria T., 2003	Amhara	Kobo
7	Burka Weldiya	Deficit irrigation and effective traditional WUA	IFAD, 2007	Oromia	Jarso

Figure 3: *Locations of Best Practice CMI Sites*



Note: Numbers in the callout box refers to site numbers shown in Table 22

4.2.2 Characterization of the Best Practice CMI Sites

(1) Mai Negus CMI

Location: Mai Negus is located in Laelay Maichew Wereda, Tigray Region.

Topography and Area: The irrigable area is flat land with a slope of 1 – 3%. The command area is 123.9 ha. But, the actual irrigated area fluctuate a function of the rainwater stored in the reservoir (Table 23).

Table 23: *Area under Irrigation in Different Years*

Year	1997/98	1998/99	1999/2000	2000/01	2001/02	2003/04	Average
Area under irrigation, ha	88.1	91.2	101	73.6	109.3	51.2	71
Area under irrigation (%)	71.1	73.6	81.5	59.4	88.2	41.3	57.3

Source: Mintesinot, B. et al. 2004; adopted from Wereda Agricultural Office.

Rainfall: The main rain season is June – August and the mean annual rainfall amount is 662.7 mm.

Main Crops: The annual crops grown in the site are the following: teff, sorghum, millet, and others. Irrigated crops are: maize, onion, pepper, tomato, garlic and others.

Prominent Water Related Features of Mai Negus CMI

(a) ***Water/Irrigation Related Problem***

Prior to the construction of the reservoir dam, fields crops used to suffer from moisture stress due to low and erratic nature of the rainfall (Mintesinot B et. al. 2005).

(b) The Solution

WH reservoir dam: The dam and the irrigation infrastructure were constructed by a government agency in Tigray.

Participatory Planning: Prior to the construction of the dam, the regional government agency and the Administration bodies at Wereda and Kebele level made discussions with the community. The community made partial contribution in labor for the construction of the dam and infrastructure.

Design/Construction: Study, design and construction of the structures was conducted by the technical staff of the regional government agency.

Operation: WUA and the farmers individually are responsible for the irrigation operation. The day to day guidance and monitoring of the irrigation activities is carried out by Development Agents (DAs) assigned in the Kebele.

The following shortcomings were observed by Mintesinot B. et al (2005).

- Poor canal maintenance;
- Irrigated crops infested with weed and disease,
- Irrigated area is below design capacity for two reasons: (i) low water supply in the reservoir, and (ii) water losses during conveyance.

In spite of these, Mai Negus scheme turned out to be a relatively better scheme compared with other two similar schemes in the Region (Mintesinot B et. al. 2005) as shown in Table 24.

Table 24: *Performance of Mai Negus CMI Compared to Other Schemes in the Vicinity*

Indicator	unit	Name of Scheme		
		Mai Negus	Meila	Haiba
Irrigated Area (in 2004)	ha	51.2	70.05	142.6
Proportion of Maize	%	50.39	43.26	51.4
Application Efficiency	%	**85.4**	72.84	64.7
Conveyance Efficiency	%	58.26	**74.8**	53.2
Output per Unit of Water Consumed	US $ / m^3	**0.155**	0.132	0.115
Output per Unit of Water Supplied	US $ / m^3	0.149	**0.156**	0.096
Income Per Cropped Area	US $ /ha	**1682**	1399	1151

Data Source: Mintesinot B et al. 2005

Lessons Learned

Marketing is the primary factor for the better performance of Mai Negus CMI. This scheme is the major supplier of irrigation produce to nearby towns of Axum, Adwa and Shire with no or little competition from other schemes. Besides, a main highway crosses the irrigable area. On the other hand, the produce from Meila and Haiba, which are located in Southern Tigray, are subjected to high competition from other schemes in the vicinity. Besides, they are located about 35 km away from a main road.

(2) Godino CMI

Location: Godino is located in Adaa Wereda, Oromia Region.
Topography and Area: The irrigable area is flat land. The original plan was to irrigate 290 ha. But, in 2004, only 140 ha (48.27%) were irrigated with a declining trend due to reservoir sedimentation.
Population: 270 households benefit from the irrigable area (Dejene. et. al. 2005).
Main Crops: Teff, onion, potato, cabbage, sugar cane, and others.

Irrigation Operation and Management:

The water source is the Wedecha Belbala reservoir dam, which was built in 1980. As the catchment lacks conservation works, the reservoir capacity is being undermined by sedimentation. Besides, lack of canal maintenance and high seepage are noted (OIDA, 2000; IWMI, et. al. 2004; Dejene. et. al. 2005). As a result, the scheme is irrigating only 140 ha out of the designed 290 ha (IWMI, et. al. 2004). The irrigation water application to the field involves wild flooding and was observed as a cause of erosion (Dejene. et. al. 2005).

The scheme has a WUA. The water charge amount in the area is Birr 10.00 per a quarter of a hectare (Dejene. et. al. 2005). The collected money is used for canal repair and maintenance works. Irrigation schedule is by rotation. Farmers who attempt to divert water into their farm outside of their turn are fined Birr 60.00 (Dejene. et. al. 2005).

Due to the lack of credit and extension support, only the relatively resourceful farmers are getting the maximum benefit from the irrigation scheme. Cash poor farmers grow cereals (chick pea, lentils and vetch) while those with cash grow vegetables and harvest 2 – 3 times a year. WUA and the farmers individually are responsible for the irrigation operation (IWMI, et. al. 2004).

Impact: Income and living standard of the irrigators have increased significantly. Two farmers have bought cars for public transport; two farmers bought flour mills; over 70% of the farmers have built better houses; all of the farmers bought oxen for ploughing purpose and some bought dairy cows. The scheme has created employment opportunities for 500 seasonal labourers (IWMI, et. al. 2004).

Lessons Learned

Godino irrigation scheme is very close to big urban centres such as Debrezeit, Adama, Mojo, Addis Ababa and others. Such proximity to such big market has contributed for the high income obtained by the irrigators.

The sustainability of this particular scheme is dependent on the stability of the catchment of the reservoir. Lack of integration and coordination of conservation and development efforts is leading to the loss of the reservoir and the irrigation scheme.

(3) Chole CMI

Location: Chole is located in Ambo Wereda, Oromia Region.

Topography and Area: The irrigable area ranges from flat to slopes greater than 10%. The original designed irrigable area was 100 ha. Currently, 200 ha land is being irrigated.

Irrigation Operation and Management:

The irrigation water source is stream diversion, which was constructed in 1996. OIDA evaluation team identified the scheme as an exemplary one out of 97 schemes. The scheme was designed to irrigate 100 ha, but the hardworking farmers extended the main canal and increased the irrigated area to 200 ha. This increment is considerably high compared to the average irrigated area of the 97 CMI schemes, which was only 57% of the total designed capacity (OIDA, 2000).

The strength of the WUA can be explained by the proper maintenance of canals and equitable redistribution of irrigated lands among members. The significance of the equitable redistribution of irrigated lands was that in the other schemes, farmers with 1- 3 ha irrigable lands were reported to lack the capacity or motivation to irrigate fully.

Impact: Income and living standard of the irrigators have increased significantly.

Lessons Learned: The presence of strong WUA and large market (like Addis Ababa) is instrumental for improved water productivity.

(4) Indris CMI

Location: Indris is located in Ambo Wereda, Oromia Region.

Topography and Area: The irrigable area is undulating with 3 – 10% slope. The original designed irrigable area was 175 ha, but now the actual irrigated area is 382 ha.

Irrigation Operation and Management:

The irrigation water source is a stream diversion, which was constructed in 1993. The scheme was designed to irrigate 175 ha but, the farmers extended the main canal and the actual irrigated area is 382 ha (OIDA, 2000).

The WUA is strong and can mobilize the members to effectively utilize the available land and water.

Impact: Income and living standard of the irrigators have increased significantly.

Lessons Learned: Same as Chole CMI.

(5) Taltale CMI

Location: Taltale is located in Wayu Kebele, Debre Tsige Wereda, Oromia Region.

Topography and Area: The irrigable area is flat land. The irrigable area is 144.9 ha.

Irrigation Operation and Management:

The irrigation water source is a spring. Construction of the infrastructure was completed 1n 1996. The scheme was designed to irrigate 90 ha but, the farmers have extended the main canal and the actual irrigated area is 144.9 ha (62.1% increment). This increment is considerably high compared to the average irrigated area of the 97 CMI schemes evaluated in 2000 by OIDA. The average irrigable area of the 97 schemes was only 57% of the total designed capacity (OIDA, 2000). Despite of the efforts made to increase the irrigable area, the system involves high canal seepage causing waterlogging problem on farm land.

Impact: Income of the irrigators has increased significantly.

Lessons Learned: Same as Chole and Indris.

(6) Kobo – Alewuha CMI

Location: Kobo - Alewuha is located in Kobo Wereda, Amhara Region.

Topography and Area: The irrigable area is flat land. The initially designed/constructed irrigable area was 100 ha. Later on, the canal system was improved, with support from the government, so as to increase the irrigable area to 380 ha.

Irrigation Operation and Management:

The irrigation water source is a diversion from the Alewuha River. The diversion weir was completed in 1996 but, the canal construction was finalized later. In collaboration with the Agricultural office, the WUA has established demonstration plots & nursery to demonstrate how to produce a variety of high value crops. Currently, the farmers are growing high value crops and the cropping intensity is 200% with a possibility of a third harvest. As the farm is located on the Weldiya – Mekelle main road, the farmers receive competitive price at farm gate (Mekuria T., 2003).

The WUA is strong and has effective byelaws through which the duties and responsibilities of each member are defined.

Impact: Income of the irrigators has increased significantly.

(7) Burka Weldiya CMI

Location: Burka Weldiya is located in Jarso Wereda, Oromia Region in the Awash Basin.

Area: The designed irrigated area is 30 ha but, the farmers use the water for 70 ha. Number of beneficiaries is 127 house holds.

Irrigation Operation and Management

The 70 ha irrigable area is divided into four blocks each of which gets water by rotation. Each block has its own elected "water master" who is responsible for water distribution and dispute settlement within the respective block. Some months after the end of the rain, water shortage is a common phenomenon in most of the irrigation schemes in the country. During such period of water shortage, the four water masters in Burka Weldiya scheme jointly decide on how to share the available water among the four blocks – i.e. on 70 ha land. If a dispute over water use arises, the water masters settle it amicably (IFAD, 2007).

Strength: The ability of the WUA to manage water allocation to an expanded area, which is bigger than the designed capacity by 40 ha.

Lesson: Though no additional data was found, the farmers are considered to practice deficit irrigation. The practice of water masters in water allocation and amicable settlement of disputes is considered as helpful.

4.3 Identification and Assessment of Best Practice PPMI Sites

4.3.1 Long List of Best Practice PPMI Sites

The available documents do not have much information on successful results related to public/private irrigation schemes. The largest public irrigation schemes in Ethiopia are those located in the Awash Valley and most of them are associated with salinity or poor water use efficiency (Girma T. Fentaw A. nd). Attempts were made by the government to privatize the irrigation schemes with some success.

Two public irrigation schemes are identified with relatively successful results (Table 25). Their locations are shown in Figure 4. The first scheme, Wonji is identified for its relationship with out grower farmers and having a sugar processing plant. The second scheme, Fincha is identified for its use of sprinkler irrigation on a land with mild slopes and owning a sugar processing plant.

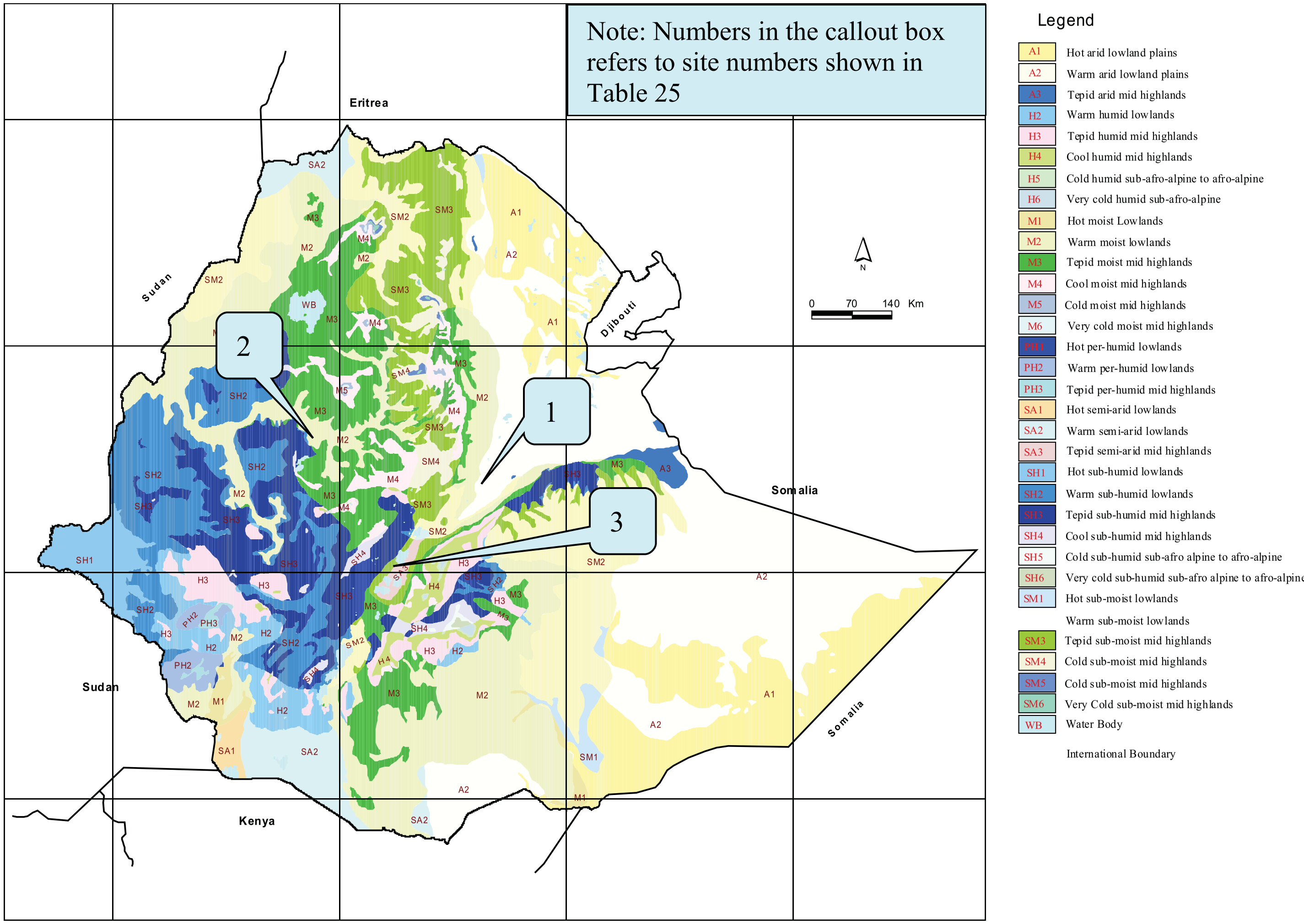
The private irrigation schemes with successful results are those engaged in the floriculture and horticulture production and export business. There are 66 export farms with the following area coverage (EHPEA, nd.):

- 600 ha of green houses,
- 150 hectares of land covered by open field flower,
- 70 ha by cutting,
- 75 ha by herbs and
- 600 ha by vegetables

Table 25: *Long List of Best Practice PPMI Sites*

	Description of Best Practice Site	Information Source (recommended by)	Location	
			Region	Wereda
1	Wonji-Shewa Sugar Factory Public Enterprise	Mekuria T., 2003	Oromia	Ada'a
2	Fincha Sprinkler			
3	Ethio-Flora Private Irrigation Scheme	Mekuria T., 2003	Oromia	Ziway

Figure 4: *Locations of Best Practice PPMI Sites*



4.3.2 Characterization of the Best Practice PPMI Sites

(1) Wonji – Shewa Sugar Factory Public Enterprise

Location: Wonji public irrigation farm is located in the Awash Basin in Adama Wereda, Oromia Region.
Topography and Area: The irrigable area is flat land with an area of 5929 ha. Besides, it also receives sugar cane from an additional 1121 ha cultivated by out-grower farmers.

Irrigation Operation and Management: The sugar cane production farm was established in 1954/55. The sugar production design capacity is 75,000 ton/year and the actual sugar production in 2003/04 was 72,000 ton (or 96% performance). The enterprise is considering of rehabilitation, optimization and expansion of the agriculture and factory with a target of producing 350,000 tons of sugar per year by 2011 (ESISC, nd).

Negative Environmental Effects: The irrigated sugar cane cultivation has been reported as the cause for spreading intestinal schistosomiasis. Both the infection and the host snails were unknown in the area before the starting of the irrigation (Grosse S. 1993 adopted from various sources).

Water wells are affected by high nitrate concentration (up to 30 mg/l) due to excessive application of fertilizers (200 – 600 kg/ha urea) and leakage from septic tanks belonging to the people living in the plantation area (Tenalem, nd. adopted from various sources).

Relevance to Cash-poor Farmers: The enterprise has made contractual agreement with neighbouring farmers as out-grower. It provides extension service on sugar cane production to the out growers.

(2) Fincha Public Enterprise

Fincha sugar plantation (6500 ha) is the only large scale public irrigation scheme located in the Nile basin that is operating successfully (MOWR, 2001; Metaferia Consulting Engineers, et al., 2002). The sugar production design capacity of the enterprise is 85,000 ton/year and the actual sugar production in 2003/04 was 80,000 ton (or 94% performance). Fincha farm has a plan to expand the agriculture and factory to a capacity of producing 270,000 tons of sugar per year by 2011 (ESISC, nd).

(3) Ethio Flora Private Irrigation Scheme

Salient Features of the Farm: The farm uses water pumped from Bulbula River to irrigate 46 ha. The canal system is in good condition and has no seepage problem. Cropping intensity is 200 –

300% and has adopted diversified crops including horticulture for export. The cropping management is excellent. The farm has created employment opportunity for 200 people in off season and 400 people in peak season. However, there are signs of salinity.

Relevance to Cash-poor farmers: Ethio-flora is one of those private irrigation schemes reported to show better performance as far as cash poor farmers are concerned. First the scheme made contractual agreement with neighbouring farmers for the production of green bean. Secondly, it provided extension service to the farmers. Thirdly, it purchased the beans at four times the local market price (USAID 2006).

5. Prioritization of Best Practices and Best Practice Sites

5.1 Selection Process and Result for Best Practices

Using the available data the criteria were applied to each BP. Score summary sheets for best WH practices, best CMI practices, and best PPMI practices are shown in Tables 26, 27, and 28, respectively. The details of the selection process for the indicated three BP categories are presented in Annex 2, 3, and 4, respectively.

5.1.1 Salient Features of the Best WH Practice

As indicated in Table 26, **integrated WH approach** has scored the highest value in the ranking matrix. The salient feature of this practice involves harvesting of rainwater using various techniques and using it for biomass production and water supply for domestic use and livestock.

The techniques included in this approach are a combination of various physical and biological SWC works implemented on all land use types; and to some extent tanks and ponds. The specification of the WH structures implemented in connection with indicated BP is presented in Annex 5.

There are many watersheds in the country that are effectively treated using the indicated BP. The immediate outcome of the indicated approach is minimizing runoff rate and curbing the threat of soil erosion. Secondly, the rainwater retained by the above-mentioned measures is noted to improve crop yield, grass and tree growth, flow rate of springs and yield of wells. The enhanced water resource potential have created an opportunity for the initiation or expanding of small scale irrigation schemes. Moreover, the performance of livestock and apiculture is also improved in many places of the country.

In summary, the selected BP has positively impacted the livelihood of many farmers especially in drought prone parts of the country.

Table 26: *Score Sheet Summary for Best WH Practices*

	Description of Best Practice	Score	Rank
	In-Situ Measure		
1	Hillside terracing	9	
2	Trash lines	13	
3	Area closure for rehabilitation	13	
4	Multiple cropping	13	
5	Level bund with double stone walls	12	
6	Ridge and basin	12	
7	Konso bench	12	
8	Stone bund	12	
9	SS dam	8	
9b	"*Daldal*" (same as SS dam)	8	
10	Increasing Tillage Depth Using a Modified tool	9	
11	Broad Bed and Furrow (BBF) Technology for Vertisol	9	
12	Conservation Tillage (CT)	9	
13	Spate Irrigation	13	
	Storage Measure		
14	Plastic lined dugout (180 m^3 $\pm$)	6	
15	Hemispherical Masonry Tanks	7	
	Integrated Measure		
16	Integrated WH Approach	14	1

5.1.2 Salient Features of the Best CMI Practice

As shown in Table 27, the set of new crop varieties developed by the research system of the country and the traditional WUA in Wonjela CMI scored the highest value. The following secondary criteria were applied to prioritize them further: (i) potential for immediate high return and (ii) probability of successful scaling up. In light of the indicated sub-criteria, the "new crop varieties available with EIAR" is selected as the BP applicable to community managed irrigation or rain fed schemes. Thus, promotion and scaling up of the new crop varieties would enhance the productivity of water.

As of 2005, there were at least 185 new crop varieties available with EIAR (Tsedeke A., ed, 2006). Adopting such new crop varieties would enable farmers get a substantial increase in crop production at no additional cost to the farmer. The only effort required by the extension system is establishing partnership among the stakeholders involved in the input supply, production and marketing.

Details of the prioritization and ranking values are shown in Annex 3.

Table 27: *Score Sheet Summary for Best CMI Practices*

	Description of Best Practice	Score	Rank
1	Surge Irrigation in Vertisols	14	
2	Effective Traditional WUA in Wonjela CMI	15	1
3	Effective Traditional WUA in Gedo CMI	10	
4	Low pressure gated pipe	8	
5	Supplementary irrigation as priority use of harvested water	9	
6	Low cost canal lining material	11	
7	New Crop Varieties	15	1

It is also worth mentioning the attributes of the indigenous WUA. Indigenous WUA are strong in mobilizing the members for construction or maintenance work. But, the productivity of the irrigation water is dependent on external factors such as market and the quality of the extension service.

5.1.3 Salient Features of the Best PPMI Practice

The out-grower farming arrangement established between a private vegetable producer/exporter and cash poor farmers is selected as BP for PPMI (Table 28). Details of the prioritization and ranking values are shown in Annex 4.

After making the contractual agreement, the private irrigator supplied input and extension service to the farmers in the CMI. The farmers are now able to produce green beans that meet the standard of European market. The gross value of their produce is four times greater than the local market price.

Table 28: *Score Sheet Summary for Best PPMI Practices*

	Description of Best Practice	Score	Rank
1	Irrigation Water Management for Cotton on Vertisol	12	
2	Out-grower Contract with Exporter in Dodicha Pumping CMI Scheme	13	1
3	Out-grower Contract with Sugar Processing Factory at Wonji-Shewa	8	

5.2 Selection Process and Result for Best Practice Sites

The criteria developed for prioritizing BP sites were applied to each site. Scores were given based on the available data. Score summary sheets for best WH sites, best CMI sites, and best PPMI sites are shown in Table 29, 30, and 31, respectively. The details of the selection process for the indicated three categories are presented in Annex 6, Annex 7, and Annex 8, respectively.

5.2.1 Salient Features of the Best WH Site

As shown in Table 29, Abreha Atsbeha Watershed has scored the highest value. Thus, it is selected as the best practice WH site. Details of the prioritization and ranking values are shown in Annex 6.

As indicated in Chapter 4.1.2 above, prior to the implementation of the integrated watershed development, the site was characterized by poor agricultural and livestock performance. Erosion and flooding of agricultural field were persistent problems in the site. At present, over 70% of the watershed is treated with various SWC measures. These measures did not only curb the erosion and flooding problems, but also enhanced the soil moisture content in the entire watershed and recharged the ground water. As a result, about 80% of the house holds in the site are able to irrigate small plots each using one or a combination of the following: hand dug wells, tanks, diversion or pumping from streams.

The primary success factor in the site is the commitment and effectiveness of the community leadership. Support from the Wereda administration and Agricultural office was also instrumental for success.

Table 29: *Score Sheet Summary for Best WH Site*

	Description of Best Practice Site	**Score**	**Rank**
	Integrated Watershed Development Sites		
1	Abreha Atsbeha Integrated Watershed Development	24	1
2	Mekuh Integrated Watershed Development	23	
3	Migulat Mekodo Integrated Watershed Development	23	
4	Gergera Integrated Watershed Development	23	
5	Ayub Integrated Watershed Development	19	
6	Chekorti Integrated Watershed Development	21	
	Watershed Development Sites (more of SWC only)		
7	Lenche Dima Watershed Development	17	
8	Totit Wajeto Watershed Development	17	
9	Golbo Watershed Development	17	
10	Hato Watershed Development	17	
	WH Storage Sites		
11	Minjar Plastic Lined Ponds	15	
12	Boset Wereda WH tanks and moisture conservation	19	

Field Verification

The selected best WH site is located in Northern Ethiopia at about 860 km from Addis Ababa (or 4 days drive for roundtrip) (Figure 5). Upon the recommendation of the MERET project coordinator, the nearest site that has adopted "integrated WH approach" successfully was Dabe watershed, which is located in Oromia region, Adama Wereda (Figure 5).

The SWC measures implemented in the watershed include: soil bunds, fanya juu, hillside terraces, check dams and SS dams, etc. The other important feature implemented in the site is the closure of the farm land and hillsides from interference by livestock. {Free grazing system was noted to cause destruction of farm bunds and pulverizing of the soil and making it liable to erosion}. Trees and shrubs and leguminous plants are planted at appropriate locations including gullies, farm edges, along bunds and on the hillsides. Four concrete WH tanks are constructed in the watershed with external support. They are owned and used by individual farmers for domestic use, livestock water supply and irrigation of small plots. The technology is appreciated by the farmers. But, the cost (about Birr 10,000/tank) is not affordable by the farmers at the moment.

From visual observation made on the date of visit (21/11/2007) the biomass area coverage and plant vigour in Dabe watershed was better compared to the other untreated areas in the vicinity
The farmers are satisfied with the increased crop yield. Prior to the intervention, the maximum Teff and wheat yields were 0.8 and 1.0 ton/ha, respectively. After the intervention, the average yield of Teff and wheat has become 1.2 and 1.6 ton/ha, respectively. The increased grass growth and crop residue has enabled the farmers to start fattening of livestock venture. Grass from the hillside is sold annually and shared by the community.

5.2.2 Salient Features of the Best CMI Site

Chole (200 ha) and Indris (382 ha), both of which were identified by OIDA (2000) as exemplary ones, have scored the same high value (Table 30). They scored high value in view of their record of good canal maintenance and expansion of the irrigated area.

Indris scheme was selected as BP CMI site for two reasons: (i) It has larger area thus, it can offer wider opportunity to draw lessons from; and (ii) The performance of Indris scheme was instrumental in influencing the construction of additional irrigation schemes in the vicinity including Chole.

Details of the prioritization and ranking values are shown in Annex 7.

Table 30: *Score Sheet Summary for Best CMI Site*

	Name of Site	Description of the Significant Parameter	Score	Rank
1	Mai Negus	Higher application efficiency, income per cropped area and output per unit water	20	
2	Godino	Increased income & living standard of Irrigators	21	
3	Chole	Good Irrigation management	27	1
4	Indris	Good Irrigation management	27	1
5	Taltale	Good Irrigation management	19	
6	Kobo-Alewuha	Good Irrigation management and Strong WUA	26	
7	Burka Weldiya	Deficit irrigation and Strong traditional WUA	19	

Note: “Good irrigation management” indicates good performance by individual farmers irrespective of the WUA.

Field Verification

A field visit was made to the top two best CMI schemes, Indris and Chole, which are located in Oromia Region, Ambo Wereda at the headwaters of the Nile basin (Figure 5). Their cropping pattern and water management is the same. The canals are equally well maintained and there was no sign of seepage problem. Additional observations on Indris CMI are presented as follows:

The performance of Indris influenced expansion and replication of irrigation: Indris scheme was constructed in 1993 and started operation on 175 ha. The initial performance of the scheme attracted additional farmers within the command area and expanded the irrigated area to 382 ha by extending the main canal and branch canals. At a later stage, another 150 ha wide Birbirsa irrigation scheme was constructed upstream of Indris scheme. Chole irrigation scheme was constructed in 1997.

High value dominant cropping Pattern: The cropping pattern in Indris CMI in 2006/07 was: tomato 202 ha; onion 53 ha; potato 32 ha; cabbage 44 ha; (or over 86% of vegetable crops). The farmers do have the experience of growing tomato during the challenging season (October – December) and sell it at highest price.

5.2.3 Salient Features of the Best PPMI Site

Private Schemes: There are 66 private export farms engaged in the production of horticultural crops and flowers for export. These schemes use state of the art technology for application of water. These farms have created employment opportunities for more than 30,000 people and generated over US$60 million in 2006/07.

There are also other small private irrigation schemes, owned by cash poor individual farmers, all over the country. The management and productivity of such schemes is not far from that of CMI schemes.

Public Schemes: The public irrigation schemes are noted for their inefficient use of water and consequently poor productivity. Most of them are in the process of privatization.

Information pertaining to PPMI was not available. Limited information was found on one private scheme (namely, Ethio-Flora Private Irrigation Scheme) and two public irrigation schemes namely (i) Wonji-Shewa Sugar Factory Public Enterprise and (ii) Fincha Sugar Factory Public Enterprise The available literature

As shown in Table 31, Fincha Public-managed irrigation scheme and Ethio-Flora private-managed irrigation schemes scored high value. Another sub criterion, namely “relevance to cash poor farmers” was considered to prioritize the two types of scheme. Accordingly, Ethio-Flora private-managed irrigation scheme is considered as the centre of excellence for PPMI (Figure 4).

The abovementioned private scheme has established a contractual agreement with the adjacent CMI for the production of green beans on out-grower basis. It supplies input and provides extension support to the CMI.

Details of the prioritization and ranking values are shown in Annex 8.

Table 31: *Score Sheet Summary for Best PPMI Site*

	Best Practice Site	Score	Rank
1	Wonji-Shewa Sugar Factory Public Enterprise	17	
2	Fincha Sprinkler	25	1
3	Ethio-Flora Private Irrigation Scheme	25	1

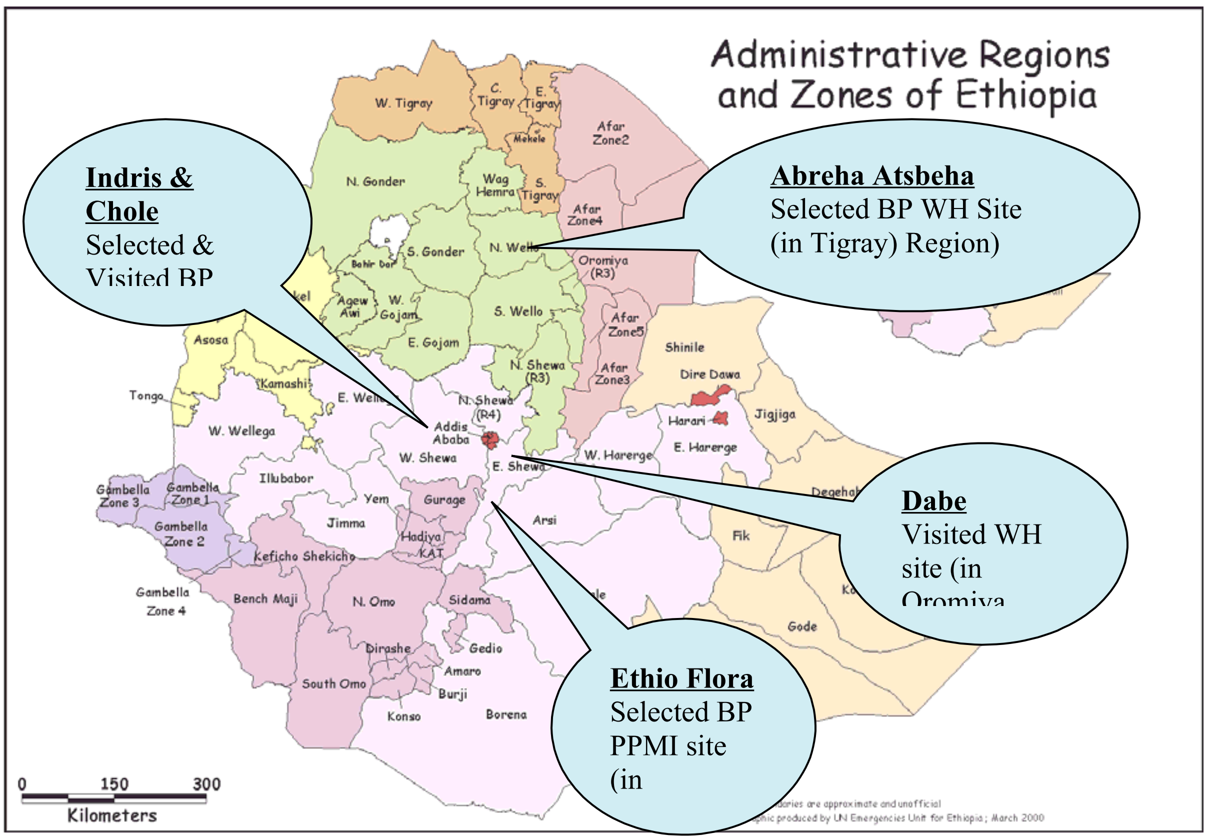


Figure 5: *Map of Ethiopia Showing the Selected BP Sites*

6. Review of Existing WH and Irrigation Guidelines

The various guidelines in water harvesting and irrigation being used by the implementation agencies are specified below. The gaps in the guidelines are also indicated.

Guideline 1: Lakew D. Carucci, V. Asrat W., and Yitayew Abebe (eds.). 2005 Community Based Participatory Watershed Development: A Guideline. MOARD. Addis Ababa, Ethiopia

This guideline is the most recent one prepared by the Ministry of Agriculture and Rural Development in collaboration with major stakeholders, namely AMAREW, GTZ, ILRI, WFP and USAID. It gives information on how to plan, design and implement community watershed development activities. It also provides consolidated technical information on various WH measures. The guideline was translated into three local languages, namely Amharic, Oromiffa and Tigrigna.

Gap: In many parts of Ethiopia, the structural soil and water conservation measures such as terraces, bunds and micro basins, etc. are properly designed, laid out and constructed (WFP, 2004). On the other hand, there appears to be a gap in the identification and promotion of suitable and high value plants/crops. There is a strong demand for the introduction of improved forages (legume/grasses) that could grow using the soil moisture retained by the extensive WH structures built on the hillsides and marginal areas.

Guideline 2: Volli Carucci. 2000. Guidelines on Water Harvesting and Soil Conservation for Moisture Deficit Areas in Ethiopia: The Productive Use of Water and Soil: Manual for Trainers. WFP. Addis Ababa, Ethiopia

This guideline contains detail and comprehensive information on theoretical and practical aspects of various SWC and WH technologies. The specification of various structures, the layout and construction procedures are addressed adequately. Illustrative sketches and pictures of various structures are also included. The guideline covers the following major topics:

Part 1: Arid and Semi-arid Regions Profile: The Specific Case of Ethiopia;
Part 2: The Erosion Process;
Part 3: Technical Elements for the Design and Implementation of Soil and Water Conservation Measures;
Part 4: Planning and Implementation Aspects Related to Soil and Water Conservation in Moisture Deficit Areas;
Part 5: Water Harvesting and Soil Conservation Measures;

From the review of the guideline and discussion made with relevant resource persons, this guideline is complete as far as SWC is concerned.
Guideline 3: Continental Consults P.L.C, Consulting Engineering Services (India) Pvt. Ltd.

1997. Small Scale Irrigation Project (Gravity) Technical Handbook. ESRDF.

The guideline was prepared by ESRDF (now dissolved) in 1997. ESRDF used to appraise and monitor the study, design, implementation, as well as, maintenance of SSI projects before and after financing. The guideline is being used by the relevant institutions throughout the country.

The objective of the guideline is to provide technical procedures for formulating, study, design and implementation of ESRDF sponsored small scale irrigation projects.
The guidelines have the following ten components:

Component I: Guidelines on SSI Project Formulation
Component II: Guidelines on SSI Project Screening
Component III: Guidelines on SSI Project Watershed Management
Component IV: Guidelines on SSI Project Headwork and Irrigation System Design
Component V: Guidelines on SSI Project Standard Tender Dossier and Contract Document Preparation
Component VI: Guidelines on Construction of SSI Project
Component VII: Manual on Construction Supervision of SSI Project
Component VIII: Manual on Operation and Maintenance of SSI Project
Component IX: Guidelines on SSI Project for Institutionalizing WUA
Component X: Outline on SSI Project for Applied Research

Gap: Examining the contents of the guideline reveals that all aspects of irrigation project formulation, study, design, construction and operation and maintenance are covered in detail. Thus, no gap is identified in these guidelines.

Guideline 4: Continental Consultants and Concert Engineering and Consulting Enterprise, 2002. Guideline, Manual and Standard Design of Small and Medium-Scale Irrigation Projects in Ethiopia. Federal Ministry of Water Resources of Ethiopia.

This guideline has ten components covering all the requisite disciplines. The components focus mainly on the identification, study, design and construction, of small and medium scale irrigation schemes. Among these is a guideline titled "irrigation Agronomy", which shows the methods and techniques to be used by an agronomist in the study of irrigation schemes.

Gap: The content of this guideline is not as comprehensive as the one prepared by ESRDF indicated above. Subsequently, most of the Regional offices involved in irrigation development are using the ESRDF guideline, new guidelines of their own and text books.

EIAR Guidelines and Leaflets: Crop specific guidelines and leaflets prepared in Amharic are distributed to each Wereda Agricultural office by EIAR. The irrigation water management aspect needs further elaboration.

Ministry of Agriculture and Rural Development Handouts on Design and Construction of WH Tanks: The handout presents copies of technical specifications and sketches of various WH tanks, which were adopted from Kenya and China.

Gaps: The handout fails to illustrate other affordable options of WH structures that can be constructed using local material and skill.

7. Potential Institutions for Capacity Building and Twinning Activities

The resource persons consulted have identified the potential institutions for capacity building as shown in Table 32. Detail information of each of these institutions is shown in Annex 10.

Table 32: *Potential Institutions for Capacity Building and Twining*

	Institution Name	Expertise in relation to the needs of EWUAP	Address
1	Ethiopian Institute of Agricultural Research (EIAR)	Irrigation; horticulture development	Email: iar@ethionet.et
2	Addis Ababa University, Faculty of Technology	In-service training courses in hydrology	Email: bayou@ceng.aau.edu.et
3	Haramaya/Alemaya University	WH, Irrigation: provides in-service training upon request; conducts research in different fields of agriculture;	http://www.alemayu.edu.et College of Agriculture email: coaau@ethionet.et
4	Arbaminch University	Irrigation: provides in-service training upon request; conducts research in irrigation;	Email: awti@ethionet.et
5	Debub University	Training in plant production and dry land farming	Email: aca.ppdf@ethionet.et
6	Jimma University	Irrigation; horticulture development	
7	Mekelle University	Training in: dry land agriculture, irrigation	Email: muofficial@mu.edu.et Tel: 251-0344-40-7500
8	(International Water Management Institute) IWMI	Irrigation water management best practices identification	Tel: 2511646 3125
9	SASAKAWA Global – 2000 Ethiopia;	WH; conservation tillage; vertisol management	Email: sgeth@ethionet.et Tel:251 115528511
10	Ethiopian Horticulture Producer – Exporters Association	Efficient water use in the production of vegetables, herbs and fruits; out grower arrangement for cash poor farmers	Email: ehpea@ethionet.et Tel: 251 11 6636750 www.ehpea.org.et
11	MERET Project	Water harvesting, Integrated watershed development,	Email: ffwp@ethionet.et Tel: 251 11 552 53 21
12	ERHA	Promotion of WH measures	erha@ethionet.com Tel: 251 0116638513/14

8. Conclusion

WH Practices

Best practices in the area of in-situ water harvesting technologies are abundant mainly in the moisture deficit areas of the country. There are various options of WH technologies for each land use and land form. For effective results, all measures need to be implemented in an integrated manner following the watershed approach. A manageable watershed size is 200 – 500 ha or the size of one village (*kebele*). The key ingredient for success in watershed management is the commitment and the effectiveness of the community leadership. In this regard, Abreha Atsbeha watershed could offer excellent lesson.

The other types of WH technologies such as ponds and tanks are noted to have some limitations. A substantial number of the structures constructed during 2003 – 2005 throughout the country are not functional due to technical deficiencies. Though the structures are appreciated in water deficit areas (for domestic use and livestock water supply), the unit cost of such structures is beyond the capacity of many farmers. Thus, there is a need for technically sound and low cost pond/tank construction technologies. Table 33 shows a summary of the key lessons from the best WH sites.

CMI Irrigation Practices

With the exception of the export-oriented private irrigation scheme, the water productivity of all of the other irrigation schemes is not attractive. In many schemes, the canal routes consist of pervious geologic formation and thus a substantial volume of the irrigation water is lost during conveyance. In Indris irrigation scheme (the BP CMI site), there was no water loss in the conveyance system due to the thick clay layer along the canal route. But, there was a problem with the crop management. For example, tomato row spacing was less than 40 cm in many plots instead of the recommended 120 – 150 cm. Under such smaller row spacing, the tomato leaves make contact with the irrigation water, which subsequently leads to blight disease. Table 34 shows a summary of the key lessons from the best CMI sites.

PPMI Practices

Most of the successful private irrigation schemes are those engaged in the production of floriculture and horticulture for export. These schemes could play a significant role in upgrading the performance of the CMI by sharing knowledge and using them as out-growers.

9. Recommendation

The sustainability of many irrigation schemes is threatened by either sedimentation of reservoirs or reduction in stream flow. Close observation in the catchment areas of these sources of the water reveals that, the problem is attributed to the persistent land degradation. Thus, immediate measures are required to treat and rehabilitate the catchment areas.

The productivity of water is persistently low due to lack of adequate extension support in irrigation agronomy, crop protection, water management, and marketing. Thus, the extension system should be well planned and executed.

Monitoring and evaluation system should be designed so as to measure the performance of (i) irrigation agronomy, (ii) crop protection, (iii) water management, and (iv) marketing.

Table 33: *Summary of the Lessons Associated with the BP WH Sites*

Region	Site	Key Lessons
Tigray	Abreha Atsbeha	(i) Participatory planning should be practiced, (ii) There has to be effective organizational arrangement with defined role of the community, (iii) there has to be highly committed community leadership, and (iv) there has to be joint and earnest efforts by the technical and administration people.
	Mekuh	
	Migulat Mekodo	
	Gergera	
Amhara	Ayub	Participatory planning is essential for establishing sense of community ownership and sustainability of development interventions.
	Chekorti	Integrated watershed development can bring significant benefit to community. To this effect, community participation during planning and implementation is instrumental.
	Lenche Dima	Highly degraded land can regain back its productive function within two years provided that integrated and participatory development approach is followed
	Totit Wajeto	Degraded land can regain its productive function by allotting it to individual landless people
	Golbo	SWC works were found important to control runoff and subsequently prevent land slide in mountainous landscape. Inadequate participation of the community during the planning would lead to some members of the community to breach the byelaw in their favor.
	Hato	Water tanks and sediment storage dams can support production of fruit trees thereby improving the livelihood of farmers in arid and semiarid areas. SWC works that involve trenches can harvest adequate moisture to sustain production of papaya fruit without any additional irrigation input
	Minjar	Plastic lined ponds are easily replicable and can be effectively utilized for domestic and livestock water supply in water stressed areas. The pond construction need to be integrated with SWC works otherwise its service life could be shortened by sedimentation. The plastic lining material is liable to damage by rats. Thus, there is a need for cost effective and yet resistant to damage. Sharp objects such as gravel should also be removed.
Oromia	Boset	Water stored in tanks can be used to grow seedlings prior to the rainy season so as to transplant them on the onset of the rain

Table 34: *Summary of the Lessons Associated with the BP CMI Sites*

Region	Site	Key Lessons
Tigray	Mai Negus (Compared to two scheme in the vicinity)	Relatively better marketing access is the primary factor for the production more of horticultural crops in Mai Negus. This scheme is the major supplier of irrigation produce to nearby towns of Axum, Adwa and Shire with no or little competition from other schemes. Besides, a main highway crosses the irrigable area.
Oromia	Godino	Godino is very close to big urban centres such as Debrezeit, Adama, Mojo, Addis Ababa and others. Such proximity to such big market has contributed for the high income obtained by the irrigators. Lack of integration and coordination of catchment conservation and the irrigation is leading to the loss of the water reservoir and consequently abandonment of irrigation scheme
	Chole	The presence of strong WUA and large market (like Addis Ababa) is instrumental for improved water productivity
	Indris	
	Taltale	
	Burka Weldiya	The farmers practice deficit irrigation (i.e. the scheme was designed for 30 ha but, is irrigating 70 ha.) The role of water masters in water allocation and amicable settlement of disputes is considered as helpful.
Amhara	Kobo – Alewuha	As the farm is located on the Weldiya – Mekelle main road, the farmers receive competitive price at farm gate. Thus, the farmers are growing more of horticulture crops and the cropping intensity is 200% with a possibility of a third harvest.

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Annex 1: Additional Information on Irrigable Area in the Country

Table 1 – 1: Modern Irrigation Schemes in Oromia Region

Source: MOWR, 2005: Adopted from OIDA

S/N	Name of Scheme	Water Source	Abstraction Method	Woreda	Gross Irrigable Area ha	No of Beneficiaries FH	Status (%)
A. East Hararghe							
1	Arara 01&02	Spring	Spring Protection	Kersa	65	376	115% Irrigating as of 1992 EC
2	Babi Ali	"	"	Deder	46	130	130% " "
3	Hara Daneba	"	"	Bedeno	102	376	100% " "
4	Chulul	"	"	Grawa	75	275	86% " "
5	Erer Meda Telila	"	"	Goro Gutu	100	600	100% " "
6	Gelan Sedi	"	"	Deder	100	360	100% " "
7	Burka Bribrisa	"	"	Grawa	100	100	NA
8	Jerjertu	River	Diversion	MeelkaBelo	60	119	60% " "
9	Melba	Spring	Spring Prote	Grawa	40	170	150% " "
10	Mudena Selo	"	"	"	51	120	86% " "
11	Ramis	River	Diverion	Meta	60	273	85% " "
12	Seid Ali	Spring	Spring Prote	Deder	46	160	150% " "
13	Water-01	"	"	Kersa	60	130	151% " "
14	Water-o2	"	"	Kersa	71	150	85% " "
15	Water-03	River	Diversion	Kersa	40	260	100% "
16	Harewo	Spring	Spring Prote	Meta	40	130	37% " "
17	Burka Woldeya	"	"	Jerso	30	127	100% " "
18	Nedhi Gelan Sed	"	"	Deder	75	375	100% " "
19	Burka Daneba	"	"	Grawa	76	215	100% " "
20	Seketa	River	Diversion	Boke	128	309	On going
21	Mumicha	"	"	Deder	60	596	100% New Scheme
22	Modjo Ansha	Spring	Spring Prote	Grawa	80	370	On going
23	Erer Goda	"	"	Goro Gutu	103	466	100% New Scheme
Subtotal					**1608**	**6187**	
B. West Hararge							
24	Aminur Dechao	Spring	Spring Prote	Tulo	40	80	43% irrigating as of 1992 EC
25	Chafe Gurati	River	Diversion	"	60	220	58% " "
26	Hirna	"	"	"	70	240	63% " "
27	Omicho	"	"	Chirio	375	600	56% " "
28	Kase Hija	"	"	"	187	750	74% " "
29	Midhegdu	"	"	Kuni	135	250	45% " "
30	Hima Midhaegdu	Spring	Spring Prote	Tulo	20	90	100% New Scheme
31	Midhegdu Burka	"	"	Badessa	60	160	100% " "
Subtotal					**1047**	**2390**	
C. East College							
32	Gibelemu 01&02	River	Diversion	Bila Seyo	113	370	68% irrigation as of 1992 E.C
33	Waja	"	"	Limu	20	200	99% " "
34	Abono-02	"	"	Leka Dulecha	80	248	83% " "
35	Dhengego 01	"	"	Jima Rare	30	200	70% " "

36	Dhengeg02	"	"	Jima Rare	20	120	0% " "
37	Jato - 01	"	"	Guto Wayu	54	200	85% " "
38	Jato - 02	"	"	Guto Wayu	60	207	0% " "
39	Gambeia Tare	"	"	Bila Seyo	150	235	39% " "
40	Negeso	"	"	Jima Arjo	30	128	100% " "
41	Jare	"	"	Bila Seyo	40	112	100% New Scheme
42	Tate	"	"	Guto Wayu	20	248	25% irrigating as of 1992 EC
43	Chirecha	"	"	L/Delecha	50	100	100% New Scheme
44	Indris	"	"	Sibu Sire	40	93	100% " "
45	Baseka	"	"	Guto Wayu	60	281	100% " "
46	Gabar	"	"	Jima Horo	40	63	100% " "
47	Wachu	"	"	Guto Wayu	60	275	100% " "
Subtotal					**867**	**3080**	
D.I/A/Bora							
48	Koba Guda	River	Diversion	Gachi Bore	60	300	0 % irrigating as of 1992 EC
49	Loko	"	"	Bedele	72	240	100 % New Scheme
Subtotal					**132**	**540**	
E. West Wollega							
50	Degaro	"	"	Nejo	120	296	23% irrigating as of 1992 EC
51	Gii	"	"	Gimbi	60	228	13% " "
52	Borta	"	"	Sayo	40	150	17% " "
53	Kujur	"	"	Nejo	57	110	100% New Scheme
54	Sokoru	"	"	Manasibu	30	265	83% irrigating as of 1992 EC
55	Bondo	"	"	Sayo	50	250	16% " "
56	Melka Alai	"	"	Manasibu	38	83	100% New Scheme
57	Kella	"	"	Nejo	47	83	100% " "
58	Sichir	"	"	Gawo Dale	48	90	100% " "
Subtotal					**490**	**1555**	
F. Jimma							
59	NedaGuda	"	"	Omo Neda	120	480	26% irrigating as of 1992 EC
60	Kawa	"	"	Dedo	120	270	45% " "
61	Abono	"	"	Seka Chekorsa	160	800	83% " "
62	Waro	"	"	Dedo	100	300	14% " "
63	Birbirsa	"	"	Keras	70	308	7% " "
64	Chilalo	"	"	Seka Chekorsa	73	150	100% New Scheme
65	Kersa	"	"	Kersa	70	150	100% " "
Subtotal					**713**	**2458**	
G. Arsi							
66	Kawa	Spring	Spring Prote	Gedeb Asasa	200	500	10% irrigating as of 1992 EC
67	Meti Metena	River	Diversion	Munessa	40	180	76% " "
68	Sedi Sedi	Spring	Spring Prote	"	60	221	83% " "
69	Arata Chufa	River	Diversion	Zeway Dugda	100	317	100% " "
70	Sheled-01	Spring	Spring Prote	Tiyo	50	200	94% " "
71	Sheled-02	"	"	"	25	100	0% " "
72	Bosha-01	"	"	"	100	233	80% " "
73	Bosha-02	"	"	"	60	220	58% " "
74	Shoba	River	Diversion	Munessa	100	440	60% " "

75	Homba	"	"	Merti	100	300	10% " "
76	Gedemso-01	"	"	Munessa	80	250	72% " "
77	Gedemso-02	"	"	"	90	320	11% " "
78	Lafa	"	"	"	80	260	79% " "
79	Dilalle Simbiro	"	"	"	60	162	67% " "
80	Degaga Simbiro	"	"	"	40	270	50% " "
81	Sole Bekeksa	"	"	Tena	100	300	40% " "
82	Ketar-1	"	"	Tiyo	100	400	100% " "
83	Ketar-2	"	"	Tiyo	200	200	100% " "
84	Ketar-3	"	"	Tiyo	90	360	100% " "
85	Hasen Usman	"	"	Tena	230	367	122% " "
86	Dodicha	Lake	Pump	Zweay Dugda	69	153	100% " "
87	Qobo Melmele	River	Pump	Dodota Sire	60	128	80% Completed but pump ins. Remain
88	Sedicho	River	Pump	Zeway Dugda	75	152	80% " "
89	Unshite	River	Pump	Zeway Dugda	65	149	80% " "
Subtotal					**2174**	**6182**	
H. North Shewa							
90	Taltale	Spring	Spring Prote	Y/G/D/Liban o	90	.	161%irrigating as of 1992 EC
91	Lemi	River	Diversion	"	30	682	187% " "
92	Abayi	Spring	Spring Prote	Kimbibit	26	100	100% New Scheme
93	Trima	"	"	Kuyu	53	255	100% " "
Subtotal					199	782	
I. West Shewa							
94	Indris	River	Diversion	Ambo	175	300	217% irrigating as of 1992 EC
95	Leku	"	"	Beko Tibe	50	100	12% " "
96	Walga	"	"	Wanchi	150	637	344% " "
97	Walshemo	"	"	Chelia	50	NA	Insignificant
98	Robi	"	"	Meta Robi	120	349	103% irrigating as of 1992 EC
99	Chole	"	"	Ambo	100	304	200% " "
100	Ijajji	"	"	Beko Tibe	48	160	100% New Scheme
101	Kulit	"	"	Ammaya	200	234	100% " "
102	Abuko	"	"	Beko Tibe	80	92	100% " "
103	Alenga	"	"	Chelia	60	150	100% " "
104	Omicho	"	"	Ada'a Berga	40	190	100% " "
Subtotal					**1073**	**2516**	
J. East Shewa							
105	Lugo	"	"	Fentale	57	100	93% irrigating as of 1992 EC
106	Godino	River	Dam	Ada'a	219	646	84% " "
107	Belbela	"	"	"	100	NA	42% " "
108	Fulitino	"	"	"	85	170	39% " "
109	Meki-Zeway	Lake	Pump	Dugda Bora	1500	1200	21% " "
110	Laftu	River	Diversion	Shashaman e	30	120	8% " "
111	Keraro Arsi	"	"	A/Nagalle	42	160	90% " "
112	Sogido Bandira-0	"	"	Fentale	140	223	79% " "
113	Tiliku Dedeba	"	"	A/Nagalle	50	200	51% " "
114	Goha Worki	"	Dam	Ada'a	150	308	100% New Scheme
115	Wayo Siriti	Lake	Pump	Dugda Bora	17	34	100% " "
116	Tepo	"	"	"	10	NA	Reahab. Self-help Intern.

							Scheme
117	Kanteki Mika'el	"	"	"	6	24	All are functional 100% and implemented by JICA
118	Taticha Elan	"	"	"	3	12	
119	Bade Gosa	"	"	"	5	19	
120	Odaa Chisa	"	"	"	5	21	
121	Odaa Bilbilaa	"	"	"	4	18	
122	Taticha Golbaa	"	"	"	3	12	
123	Shubi	"	"	"	6	17	
124	Sombo Genet	"	"	"	6	23	
125	Sombo Aletu	"	"	"	5	20	
126	Sara Weyiba	River	Diversion	Fentale	280	481	Not yet completed
Subtotal					**2723**	**3808**	
K.Borena							
127	Abeba Chabme	River	Diversion	Adola	60	45	0% irrigating as of 1992 EC
128	Melka Hida	"	"	Galana Abayi	70	138	100% New Scheme
129	Hila	"	"	Adola	40	100	100% " "
130	Afaleta	"	"	Bule Hora	102	166	Not yet completed
Subtotal					**272**	**449**	
L. Bale							
131	Chiri	"	"	Mena Angatu	50	144	100% irrigating as of 1992 EC
132	Ukuma	"	"	Dodola	100	420	0% " "
133	Shaya	"	"	Sinana Dinsho	230	271	0% " "
134	Shanaka	"	"	Agarfa	420	2039	100% " "
135	Hora Boka	"	"	Sinana Dinsho	32	183	3% " "
136	Oda Roba	"	"	Ginir	70	150	100% " "
137	Melka Buta	"	"	Goro	85	340	0% " "
138	Haya Oda	"	"	Mana Angata	100	370	96% " "
139	Dinik	"	"	Ginir	200	137	84% " "
140	Gomogoma	"	"	Mana Ange	71	213	72% " "
141	Arda Tare	"	"	Ginir	120	368	100% " "
142	Ambentu	"	"	Agarfa	200	523	100% New Scheme
143	Hambela	"	"	Barbare	200	400	100% " "
144	Dayu	"	"	Mana Angata	124	210	100% " "
145	Gebe	"	"	Barbare	200	400	100% " "
146	Dugda Adu	"	"	Barbare	400	662	Only Phase-I Completed

Common problems observed on those schemes, which fail to function properly are:

1. Mismanagement and/or poor operation and maintenance
2. Lack of interest due to market problem and inaccessibility
3. Flooding of head works due to absence of catchment treatment
4. Silt up of canals due to lack of canal clearance
5. Cattle interference on protected spring eye
6. Canal breaching
7. Excessive canal and other structure seepage
8. Land slide along canal routes, especially on canals running on the waist of ridges
9. Water logging of command area due to leakage and/or seepage of canals
10. Canal overtopping due to silt up of canals

11. Flooding of head works due to under estimation of flood magnitude
12. Existence of dependence syndrome /Waiting for the Government
13. Poor extension service
14. Lack of credit service
15. Irrigation land holding beyond labor supply of a family (> 2 ha)
16. Weak water users association

Table 1-2: Irrigated Area in Amhara Region until April 2005, ha

Zone	Modern Scheme	Indigenous Scheme	River Basin
West Gojam	16635	29474	Nile
East Gojam	8825	7738	Nile
Awi	23212	24705	Nile
North Gonder	11693	6945	Nile
South Gonder	9643	15421	Nile
North Wello	3286	7959	Nile/Awash/Denakil
South Wello	13187	14978	Nile/Awash
North Shewa	6129	15973	Nile/Awash
Oromia	2001	5126	Awash
Wag	118	754	Nile/Denakil
Sub Total	**94729**	**129073**	
Total = 223802			

Source: MOWR, 2005; (Adopted from Amhara Bureau of Agriculture and Rural Development)

Annex 2: Matrix for prioritizing Best WH Practices

5 = Excellent; 4 = Very good; 3 = good; 2 = fair; 1= little relevance; 0 = no relevance

	Technology	Indicators, Description of the Intervention & score				Total Score
		Low labour demand	Low initial capital requirement	Simple to implement, operate and maintain	**Case 1:** Crop Yield Increment attributed to the technology relative to National Average **Case2:** Multiple Use	
1	Hillside terracing	250 pd/km; {20 lines x 100m/ha} =2000 m/ha ➔500 pd/ha	Same as column on the left	all components are local & dissemination is through minor demonstration by DA	used for 3 purposes Irrigation, SWC, Ground water recharge	9
		Score= 2		4	3	
2	Trash lines	30 pd/km;{6 lines x 100m/ha} =600m/ha ➔18 pd/ha		all components (material & labour) are local & dissemination is farmer to farmer	used for 3 purposes Irrigation, SWC, Ground water recharge	13
		Score= 5		5	3	
3	Area closure for rehabilitation	4 PD/Ha/year		all components (material & labour) are local & dissemination is farmer to farmer	used for 3 purposes Irrigation, SWC, Ground water recharge	13
		Score=5		5	3	
4	Multiple cropping	No additional cost		all components (material & labour) are local & dissemination is farmer to farmer	used for 2 purposes Irrigation, SWC	13
		Score=		5	2	
5	Level bund with double stone walls	250 pd/km; {6 lines x 100m/ha} =600m/ha ➔150 pd/ha		all components are local & dissemination is through minor demonstration by DA	used for 3 purposes Irrigation, SWC, Ground water recharge	12
		Score= 5		4	3	
6	Ridge and basin	1PD/5 Basins; {400 basins/ha ➔ 80 pd/ha}		all components are local & dissemination is through minor demonstration by DA	used for 3purposes Irrigation, SWC, Ground water recharge	12
		Score= 5		4	3	
7	Konso bench	500 PD/km; {10 lines x 100 m/ha} =1000m/ha ➔500 pd/ha		all components are local & dissemination is through minor demonstration by DA	used for 3 purposes Irrigation, SWC, Ground water recharge	12
		Score= 2		4	3	
8	Stone bund	250 pd/km{6 lines x 100m/ha} =600m/ha ➔150 pd/ha		all components are local & dissemination is through minor demonstration by DA	used for 3 purposes Irrigation, SWC, Ground water recharge	12
		Score= 5		4	3	

9	Plastic lined dugout (180 m^3 ±)	0.5 m^3/PD + Birr 1200 for plastic = 5200 Birr per unit		Components requiring imported item &/or a high level technician for follow up & maintenance	used for 3 purposes Irrigation, SWC, Ground water recharge	6
		Score= 2		1	3	
10	SS dam	0.5 m^3/PD{45 m^3/100 m^2 ➔ 9000 pd/ha		all components are local & dissemination is through minor demonstration by DA	used for 3 purposes Irrigation, SWC, Ground water recharge	8
		Score= 1		4	3	
11	Integrated WH **Approach**	No additional cost		all components are local & dissemination is through minor demonstration by DA	used for 5 purposes Irrigation, SWC, Ground water recharge, domestic & Livestock water supply	14
		Score= 5		4	5	
12	Increasing Tillage Depth Using a Modified tool	Additional cost of new tool compared to traditional about Birr 100.00		Components requiring imported item &/or a high level technician for follow up & maintenance	used for 3 purposes Irrigation, SWC, Ground water recharge	9
		Score= 5		1	3	
13	Broad Bed and Furrow (BBF) Technology for Vertisol	Additional cost of new tool = Birr 200 - 500		Limited input from local market and use of local artisan for implementation/maintenance	used for 1 purposes Drainage	9
		Score = 5		3	1	
14	Conservation Tillage (CT)	No additional cost		Components requiring imported item &/or a high level technician for follow up & maintenance	used for 3 purposes Irrigation, SWC, Ground water recharge	9
		Score= 5		1	3	
15	Spate Irrigation	No additional cost		all components (material & labour) are local & dissemination is farmer to farmer	used for 3 purposes Irrigation, SWC, Ground water recharge	13
		Score= 5		5	3	
16	Hemispherical Masonry Tanks	Cost > Birr 10,000		Limited input from local market and use of local artisan for implementation/maintenance	used for 3 purposes: Irrigation, Domestic use, Livestock,	7
		Score= 1		3	3	

Annex 3: Matrix for prioritizing Best CMI Practices

5 = Excellent; 4 = Very good; 3 = good; 2 = fair; 1= little relevance; 0 = no relevance

	Technology	Indicators, Description of the Intervention & score				Total Score
		Low labour demand	Low initial capital requirement	Simple to implement, operate and maintain	**Case 1:** Crop Yield Increment attributed to the technology relative to National Average **Case2:** Multiple Use	
1	Surge Irrigation in Vertisols	Same as the data in the right side column	Additional labour cost US $29 or Birr 261/ha; or Birr 65/family holding	Limited input from local market and use of local artisan for implementation/maintenance	maize yield increased from 4.5 to 10.5 ton/ha (164% increment	14
		Score=	5	4	5	
2	Effective Traditional WUA in Wonjela CMI		No additional cost	all components (material & labour) are local & dissemination is farmer to farmer	Potato yield is 20% higher than national average under CMI	15
		Score=	5	5	5	
3	Effective Traditional WUA in Gedo CMI		No additional cost	all components (material & labour) are local & dissemination is farmer to farmer	Potato yield is same as national average under CMI	10
		Score=	5	5	0	
4	Low pressure gated pipe		Cost = Birr 13,046/ha or Birr 2,906/ha more than that of earth canal system; or Birr 726/family holding	Locally available material but construction/installation/maintenance requires the services of a qualified local technician	low pressure gated pipe system enables to irrigate at least 75% more land than the unlined canal irrigation system	8
		Score=	1	2	5	
5	Supplementary irrigation as priority use of harvested water		Cost of additional canals = @ Birr 10140/ha; or Birr2535/family holding	Limited input from local market and use of local artisan for implementation/maintenance	the yield of sorghum and cotton was increase by 49.8% and 85.7% , respectively, due to the use of supplementary irrigation at critical stage of crop growth	9
		Score=	1	3	5	
6	Low Cost Canal Lining Material		Minor labour and material input per family	all components are local & dissemination is through minor demonstration by DA; But would require frequent maintenance	Maximum seepage reduction (72%) was attained by the clay loam-teff straw mixture	11
		Score=	5	1	5	
7	New Crop Varieties		No additional cost	all components (material & labour) are local & dissemination is farmer to farmer	Haricot bean yield increment = 120% compared to commonly used varieties	
		Score=	5	5	5	15

Annex 4: Matrix for prioritizing Best PPMI Practices

5 = Excellent; 4 = Very good; 3 = good; 2 = fair; 1= little relevance; 0 = no relevance

	Technology	Indicators, Description of the Intervention & score				Total Score
		Low labour demand	Low initial capital requirement	Simple to implement, operate and maintain	**Case 1:** Crop Yield Increment attributed to the technology relative to National Average **Case2:** Multiple Use	
1	Irrigation Water Management for Cotton on Vertisol	No additional cost	Same as column on the left	Measurement of soil moisture and flow in furrows requires the services of a qualified local technician	The practice enables to save 40 – 50% of the irrigation water	12
		Score= 5		2	5	
2	Out-grower Contract with Exporter in Dodicha Pumping CMI Scheme	No additional cost		Limited input from an exporter for implementation	The out-grower contract arrangement enabled the farmers to sell their produce at four times local market prices	13
		Score= 5		3	5	
3	Out-grower Contract with Sugar Processing Factory at Wonji-Shewa	No additional cost		Limited input from a processing factory for implementation	The farmers feel that they could earn more from the production of vegetables than sugar cane.	8
		Score = 5		3	0	

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Annex 5: Guideline for the Practices Used in the Selected Best WH Site

(1) Contour Soil Bunds (Level Soil Bunds)

The objective of contour bunds is to mitigate erosion and retain runoff and subsequently to improve agricultural productivity. The trenches on the upstream side of the bunds are intended to retain all of the incoming runoff. Thus, contour bunds are not provided with an overflow section. Contour bunds are suitable in semi arid and arid areas. They can also be used in medium rainfall areas with well drained soils. They can be implemented on cultivated lands with a slope range of 3 – 15%; on grazing land with a slope 3 – 5% and with wider intervals. In high rainfall areas the bund has to be constructed with gradient.

Specification for Contour Soil Bunds:
Minimum Height = 60 cm;
Base Width in stable soils = 1 – 1.2meter; side slope = (1 Horizontal: 2 Vertical)
Base Width in unstable soils = 1.2 – 1.5meter; side slope = (1 Horizontal: 1 Vertical)
Top Width = 30 cm in stable soils; and 50 cm in unstable soils.
Trench: 50 – 60 cm depth and bottom width; trapezoidal shape.
Ties: Placed at an interval of 3 – 6 meter along the channel.
Vertical interval (VI): 1 – 1.5 meter on a slope of 3 – 8%;
1 – 2 meter on a slope of 8 – 15%
Longitudinal length of bund: 30 – 60 meter and have to be staggered to allow a space for animal crossing.
Work norm: 150 person days per Km length. This would include layout of the contour line, clearing of plants/grasses, trench excavation, constructing the embankment by compaction.

(2) Stone Bunds

Stone bunds are constructed in cultivated areas and hillsides where stone is abundant. The bunds can be constructed with or without soil blanket on the upstream side.

Specification for Stone Bunds:
Height: 60 – 70 cm up to 100cm measured from down stream.
Total base width: (Height/2 + 30 cm)
Top width: 30 cm
Foundation for key: 30 cm depth; 30 cm width
Side slope (downstream): 1 Horizontal: 3 Vertical)
Side slope (upstream): 1 Horizontal: 4 Vertical)
Bunds need to be staggered to allow access for animals
Maximum longitudinal length = 80 meter.
Work norm: 250 person days per Km length.

This would include: collection of stones, foundation excavation and stone placement.
Vertical interval (see Table 4-1)

Table 4-1:Vertical interval (VI) of Stone Bunds

Ground Slope, %	Bund Height, m	VI m	Horizontal Spacing, m
5	0.5	1.0	20
10	0.5	1.5	15
15	0.75	2.2	12
20	0.75	2.4	10
25	1.0	2.5	8
30	1.0	2.6	8
35	1.0	2.8	6

(3) Hillside Terrace

Hillside terraces are structures constructed along the contour with remarkable result in controlling runoff and erosion. As a result, they have significant contribution to ground water recharge and hence the revival of springs and restoration of stream flow. In semiarid and arid areas, they are constructed for harvesting rainwater and growing of trees and grasses. Hillside terraces can also be constructed in medium rainfall areas with deep and well drained soils.

Specification for Hillside Terrace

Vertical interval: 2 – 3 meters;
Height of stone raiser: 0.5 – 0.75 meters;
Width of terrace: 1.5 – 2 meters (for planting fodder, trees, etc);
Foundation: 0.3 meter depth X 0.3 meter width;
Stone wall side slopes: 1 Horizontal: 3 vertical;
Reinforce the walls with sisal, aloe, and other drought resistant and economically important plants;
Trench is an integral part of hillside terrace as it can protect the terrace from being overtopped by runoff. Trench can also substitute hillside terrace in areas where stone is not available.

(4) Trench

In hillsides and mild slope lands, trenches for WH purpose can be constructed behind hillside terraces or bunds. The vertical interval of trenches in hillsides could be same as that of the hillside terraces (i.e. 2 – 3 meters). The trench needs to be tied at a spacing of 2 – 3 meters with an earth block having the following dimension: (Width = same as trench; Length = 0.6 meter; Height = half of the trench depth).

In plain areas where the soil is highly permeable, trenches can be constructed at a horizontal spacing of 10 – 30 m depending on the amount of the anticipated runoff. Successive trenches should be staggered or the trenches need to have a wide shallow cross section to allow easy

crossing by human and livestock.
In low rainfall areas the trench has to be constructed along the contour and should be tied at a spacing of 5 – 10 meter. In high rainfall areas, the longitudinal slope of the trench should be about 0.5%.

(5) Micro-basin

There are many versions of a micro basin, the dominant of which are circular, rectangular and semicircular. Micro basins are applicable in steep (up to 50% slope) and degraded hillsides and are used mainly for tree planting. They are constructed integrated with other measures such as hillside terraces, bunds, trenches, etc. They are constructed along the contour and in staggered way. The design involves stone faced or sodded bunds with a radius of 1 – 1.5 meters. The stone riser should have 0.2 m foundation and 0.2 – 0.4 m wall height above the ground. Plantation pit is excavated inside the micro basin with a diameter of 0.4 m and depth of 0.5 m.

(6) Semicircular (Half moon) Terraces

Semicircular terraces are applicable to moisture deficit areas with rainfall below 500 mm for cultivation of food and/or forage crops. They have to be constructed along the contour and in staggered way in areas with a slope of less than 5%. The design involves stone faced bunds with a radius of 1 – 3 meters. Larger diameter is suitable for cultivation of field crops, while the smaller one can be used for growing trees/bushes. The bund height is 0.50 – 0.75 meter with decreasing height towards the upstream ends.

(7) Percolation Pond

Percolation pond is created by excavating soils in an area which is generally flat or in a depression or low point within a broad drainage way. It can be constructed in the original watercourse or outside of the main channel (off-stream). Indeed, it can be located at any place with pervious formation and ensuring that it has adequate catchment or is connected to a cut-off drain.
Percolation ponds must have permeable soils beneath the pond bed to allow faster percolation of rain water. Silt or clay has to be removed from the pond bed both during construction and seasonal maintenance program.

The size of the percolation pond is governed by the size of the available land for construction and the resources required for the construction. The larger the pond size the larger the amount of rainwater allowed for recharging the ground water.

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Annex 6: Matrix for prioritizing Best WH Sites

5 = Excellent; 4 = Very good; 3 = good; 2 = fair; 1= little relevance; 0 = no relevance

	Site	**Indicators, Description of the Intervention & score**							**Total** Score
		Potential for Scaling up		Well Adopted and Owned by the Local community		Delivered Proven Successful Results (Multiple Benefits)	Cost effective	Environment Friendly	
		Suitability to all Topography	Suitability to all land uses	Area coverage compared to the potential	**Case 1:** Effective O&M System **Case 2:** Strong WUA	Irrigation; domestic water supply; livestock water supply; SWC; GW recharge; apiculture	**Case 1:** Initial Cost **Case 2:** Benefit/Cost Ratio	Impacts (+) Positive (-) Negative	
1	Abreha Atsbeha Integrated Watershed Development	Suitable to all Topography	Suitable to all land uses	70% area and 80% population coverage	In addition to the community level association, the people are organized into teams each with 25 people. Each team covers SWC works on the land holdings of the team members including that of aged and disabled neighbours.	> 5 types of benefits	No data	(+); Land rehabilitated; flood damage reduced, GW recharged @ 1 – 15m depth); Livestock disease mitigated from stoppage of free grazing	
		Score= 5	5	4	5	5		5	24
2	Mekuh Integrated Watershed Development	Suitable to all Topography	Suitable to all land uses	"Second best coverage next to Abreha Atsbeha"	Same as above	>5 types of benefits	No data	(+) Same as above	
		Score= 5	5	3	5	5		5	23
3	Migulat Mekodo Integrated Watershed Development	Suitable to all Topography	Suitable to all land uses	Physical SWC is in good progress; Biological SWC implemented on little area	Same as above	> 5 types of benefits	No data	(+) Same as above	
		Score= 5	5	3	5	5		5	23
4	Gergera Integrated Watershed Development	Suitable to all Topography	Suitable to all land uses	Physical SWC completed in 2001. Biological SWC is still going on.	Same as above	> 5 types of benefits	No data	(+) Same as above	
		Score= 5	5	3	5	5		5	23

5	Ayub Integrated Watershed Development	Suitable to all Topography	Suitable to all land uses	280 ha out of 633 ha (44%) conserved; the Wereda administration and extension staff have realized the need for more efforts	The Users' Association has employed guards to protect the closed areas from interference by livestock. There were cases of breaching the byelaw.	5 types of benefits	No data	(-) runoff reduction for down stream users of spate irrigation (+) Land rehabilitation	
		Score= 5	5	2	3	5		4	19
6	Lenche Dima Watershed Development	Suitable to all Topography	Suitable to all land uses	204 ha out of 1500 ha (14%) is conserved; Most of the watershed is subjected to free grazing and the subsequent land degradation	The watershed development is led by the Kebele administration. SWC on communal areas are implemented by teams each having 30 members. SWC on private holdings is not adequate. Measures to stop free grazing are inadequate.	5 types of benefits	No data	(+) Land rehabilitation	
		Score= 5	5	1	1	5		5	17
7	Totit Wajeto Watershed Development	Suitable to all Topography	Suitable to all land uses	"Substantial part of the watershed is still subjected to severe erosion"	SWC are implemented by teams each having 15 – 20 members. But, there is no byelaw to ensure that (1) SWC works of old and disabled neighbours are covered by the teams, and (2) SWC on private holdings are adequately done.	5 types of benefits	No data	(+) Land rehabilitation; Stoppage of land slide	
		Score= 5	5	1	1	5		5	17
8	Golbo Watershed Development	Suitable to all Topography	Suitable to all land uses	152 ha out of 800 ha (19%) is fully conserved	Same as Totit Wajeto	5 types of benefits	No data	(+) Land rehabilitation; Stoppage of land slide	
		Score= 5	5	1	1	5		5	17

9	Chekorti Integrated Watershed Development	Suitable to all Topography	Suitable to all land uses	WH and SWC works are implemented in many parts of the watershed. More work is required.	The users observe the byelaws. They have a system to establish & utilize communal assets (grass, wood, mills, school, etc). But, some people tend to perform substandard works and are reluctant to correct the poor quality works.	5 types of benefits	No data	(+) Land rehabilitation; GW recharge	
		Score= 5	5	3	3	5		5	21
10	Hato Watershed Development	Suitable to all Topography	Suitable to all land uses	The implementation of various WH and SWC works is progressing with promising results.	Efforts made by individual farmers are more eminent. No data on farmers' association.	5 types of benefits	No data	(+) Land rehabilitation; GW recharge	
		Score= 5	5	1	1	5		5	17
11	Minjar Plastic Lined Ponds	Suitable to all Topography	Suitable to all land uses	Ratio of plastic lined ponds to population = 2261: 140,000	Efforts made by individual farmers are more eminent. No data on farmers' association.	3 types of benefits	0.5 m^3/PD + Birr 1200 for plastic = 5200 Birr	(+) Reduced burden on women and children	
		Score= 5	5	1	1	3		5	15
12	Boset Wereda WH tanks and moisture conservation	Suitable to all Topography	Suitable to all land uses	277 concrete WH tanks, 800 plastic lined ponds were constructed → low compared with the demand	WUA focuses on marketing aspects. Besides, the WUA has treated the catchment effectively.	4 types of benefits		(+) Reduced burden on women and children	
		Score= 5	5	1	4	4		5	19

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Annex 7: Matrix for prioritizing Best CMI Sites

5 = Excellent; 4 = Very good; 3 = good; 2 = fair; 1= little relevance; 0 = no relevance

	Site	**Indicators, Description of the Intervention & score**							Total Score
		Potential for Scaling up		Well Adopted and Owned by the Local community		Delivered Proven Successful Results (Multiple Benefits	Cost effective	Environment Friendly	
		Suitability to all Topography	Suitability to all land uses	Area coverage compared to the potential	**Case 1:** Effective O&M System **Case 2:** Strong WUA	Irrigation; domestic water supply; livestock water supply; SWC; GW recharge; apiculture	**Case 1:** Initial Cost **Case 2:** Benefit/Cost Ratio	Impacts (+) Positive (-) Negative	
1	Mai Negus	Suitable to all Topography	Suitable to all land uses	57.3% is irrigated; It is a function of harvested water. Rain shortage.	Poor canal maintenance; Irrigated crops infested with weed and disease; High water losses during conveyance	Irrigation, Livestock water supply; feed;	No data	(+) Livelihood improvement.	20
		Score= 5	5	1	1	3		5	
2	Godino	Suitable to all Topography	Suitable to all land uses	48.27% is irrigated; But, is a function of harvested water. Sedimentation problem	Water charge = Birr 10.00 per 0.25 ha; Penalty = Birr 60.00; It is used for canal maintenance.	Irrigation; feed;	No data	(+) Livelihood improvement; (-)irrigation water causing erosion;	21
		Score= 5	5	1	4	2		4	
3	Chole	Suitable to all Topography	Suitable to all land uses	Designed area = 100 ha, Actual = 200 ha; 100% increment	Canals properly maintained; Irrigable land is redistributed equitably among members.	Irrigation; feed;	No data	(+) Livelihood improvement.	27
		Score= 5	5	5	5	2		5	

4	Indris	Suitable to all Topography	Suitable to all land uses	Designed area = 175 ha, Actual > 175 ha; ---% increment	Canals properly maintained; available land and water are effectively utilized.	Irrigation; feed;	No data	(+) Livelihood improvement.	27
		Score= 5	5	5	5	2		5	
5	Taltale	Suitable to all Topography	Suitable to all land uses	Designed area = 90 ha, Actual = 144 ha; 62% increment	WUA not strong. High water loss	Irrigation; feed;	No data	(-) waterlogging problem on farm land due to high canal seepage	19
		Score= 5	5	5	1	2		1	
6	Kobo-Alewuha	Suitable to all Topography	Suitable to all land uses	Initial irrigable area = 100 ha; Now = 380 ha.	WUA is strong. duties and responsibilities of each member are defined	Irrigation; feed;	No data	(+) Improvement in livelihood	26
		Score= 5	5	5	4	2		5	
	Burka Weldiya			Design area = 30 ha, irrigated area = 70 ha = (133%)	WUA not strong. High water loss	Irrigation; feed;	Birr 9354/ha	(-) Water Shortage	19
		Score= 5	5	5	1	2		1	

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Annex 8: Matrix for prioritizing Best PPMI Sites

5 = Excellent; 4 = Very good; 3 = good; 2 = fair; 1= little relevance; 0 = no relevance

	Site	**Indicators, Description of the Intervention & score**							**Total Score**
		Potential for Scaling up		Well Adopted and Owned by the Local community		Delivered Proven Successful Results	Cost effective	Environment Friendly	
		Suitability to all Topography	Suitability to all land uses	Area coverage compared to the potential	**Case 1:** Effective O&M System **Case 2:** Strong WUA		**Case 1:** Initial Cost **Case 2:** Benefit/Cost Ratio		
1	Wonji-Shewa Sugar Factory Public Enterprise	Suitable to mild slope	Sugar cane cultivation only	Fully irrigated; & works with out growers	Established in 1954 & considering of expansion	Sugar production design capacity = 75,000 ton/year; actual sugar production in 2003/04 = 72,000 ton (or 96% performance)	No data	(-) Spreading of intestinal schistosomiasis; (-) GW pollution. (+) high income generation	17
		Score= 1	1	5	5	4		1	
2	Fincha Sprinkler	Suitable to any topography	High value crop production land only	Fully irrigated	Considering of expansion	sugar production design capacity = 85,000 ton/year; actual sugar production in 2003/04 = 80,000 ton (or 94% performance)	No data	(+) Income generation	25
		Score= 5	1	5	5	4		5	
3	Ethio-Flora Private Irrigation Scheme	Suitable to any topography	High value crop production land only	46 ha fully irrigated; works with out -growers	Cropping intensity = 200 – 300%	Exports vegetables from won farm and out-grower farms	No data	(-) Salinity developed (+) high income generation	25
		Score= 5	1	5	5	5		4	

Annex 9: List of Persons Contacted

Mr. Dejene Abesha; Department Head, (WH, SSI, and Rural Infrastructure Development and Promotion Department; MOARD)
Mr. Habtu Bezabih; WH expert; MOARD
Mr. Asegid Ayalew; Irrigation Expert; MOARD
Mr. Bisrat Retu, Director SG – 2000.
Dr. Tesfaye Tessema, Expert SG – 2000.
Mr. Yohannes Geleta, Irrigation Design Expert. OIDA
Mr. Birhanu Hirpo, Head Planning and Programming Department, OIDA
Mr. Grma Lemma; Expert, Irrigated Agriculture Team, OIDA
Mr. Tsegaye Abebe, Chairman, Ethiopian Horticulture Producer – Exporters Association.
Mr. Uffo Gidebo, Expert, Irrigation and Drainage Department, MOWR,
Mr. Kifle Alemayehu, Team Leader, Water Utilization, Control and Structures Safety Follow-up, MOWR
Mr. Betru Nedassa; Coordinator, MERET project MOARD
Mr. Arega Yirga; Senior Program Assistant, World Food Program
Mr. Tariku Alemu; Senior Program Assistant, World Food Program
Mr. Kefyalew Gebreyes; Team Leader, Horticulture Development, Oromia Bureau of Agriculture and Rural Development
Mr. Andinet Degefa; Expert, Horticulture Development, Oromia Bureau of Agriculture and Rural Development
Dr. Fantahun, Director, Soil and Water Research, EIAR.
Mr. Dagnachew Deressa, Head, West Shoa Zone OIDA
Mr. Degu Terresa, Expert, Toke Kutaye District OIDA
Mr. Israel Dibaba, Team Leadre, Adama Wereda Natural Resource Development Team, Agriculture and rural development
Mr. Wondu Fisseha, Project Officer, ERHA

Annex 10: Brief Features of the Potential Institutions Identified for Capacity Building and Twining

A. Ethiopian Institute of Agricultural Research (EIAR)

A.1 Research work/ Projects Undertaken

EIAR, through the research centres located in various parts of the country, has released a total of 435 new crop varieties between 1970 and 2005 as shown in Table 18 of section 3.3.2.

A.2 Strength

EIAR is mandated to coordinate research activities of agricultural research centres or higher learning institutes and other related establishments which undertake agricultural research on contractual basis. Thus, it could have a collection of research outputs produced by the various researchers in the country. As of 1998, EIAR has adopted a participatory, client-oriented, agro-ecological based research strategy.

A.3 Weakness

Until recently, the research was mainly commodity-based; involving cereals, maize, coffee etc., and inadequate attention was given to livestock, natural resource management, and research extension linkages. The research centres have limited research output in the areas related to agricultural water use. Such limitation is attributed to lack of capacity and experience on the use of water in agriculture.[8]

A.4 Opportunities for Cooperation under EWUAP

EIAR can be involved in the identification and/or undertaking of adaptive trials of best practices.

B. Addis Ababa University Faculty of Technology

B.1 Research work/ Projects Undertaken

Research projects currently underway, include the following.

- Multi-purpose water resources development project;
- Management in Ethiopian construction industry;
- Biogas manufacturing, and
- Defluorization of Awash River.

[8] Hatibu, N. (ed) 2005. Scaling-Up and Uptake Promotion of Soil and Water Management Research Outputs in East and Central Africa: Constraints and Barriers. SWMnet Discussion Paper 4. ICRISAT. Nairobi, Kenya

B.2 Strength

The university offers undergraduate courses in civil engineering and post graduate (MSc.) courses in Construction Technology and Management, Hydraulics, Structures, and Geotechniques. The current staff profile of the two departments giving the above mentioned courses is summarized below:

(i) Construction Technology and Management Department: 3 (Ph.D); 8 (M.Sc.); and 5 (B.Sc.)
(ii) Civil Engineering Department: 17 (Ph.D); 10 (M.Sc.); and 4(B.Sc.)

B.3 Weakness

The involvement of the university would be limited only to the engineering aspects of water. Thus, there would be a need for involving expertise from other sources to address the agricultural aspect.

B.4 Opportunities for Cooperation under EWUAP

The university can give short courses as per specification to be prepared by EWUAP.

C. Haramaya/Alamaya University

C.1 Research work/ Projects Undertaken

At present, the University's research and extension activities operate under the umbrella of the Ethiopian Institute of Agricultural Research (EIAR). The current research programs of the university include:

- Socio-Economic Research Program,
- Agricultural Mechanization Research Program,
- Food Sciences and Post Harvest Technology Research Program
- Dry-land Agriculture and Agro meteorology Research Program,
- Highland and Lowland Pulses Improvement Program,
- Soil and Water Conservation Program,
- Fruits and Vegetable Improvement Program,
- Oil Crops Improvement Program,
- Wheat Improvement Program,
- Maize Improvement Program,
- Sorghum Improvement Program,
- Root and Tuber Crops Improvement Program,
- Forestry Improvement Program,
- Beef Cattle Improvement Program,
- Camel Improvement Program,

- Small Ruminants Improvement Program,
- Poultry Improvement Program,
- Dairy Cattle Improvement Program,
- Animal Health Improvement Program,
- Feeds and Nutrition Research Program, and
- Fisheries and other Aquatic Lives Research Program.

Previous research works are also related to the above programs.

C.2 Strength

The university has a department called "Soil and Water Management and Engineering", which addresses the engineering and management aspect of soil and water in integrated manner. The content of the undergraduate training program was designed in such a way that students are able to:

(1) Do feasibility studies, plan, design, construct and manage small and large-scale irrigation projects including the following components:
   - ❖ Water collection (hydrological studies) ;
   - ❖ Water storage (dam design and construction);
   - ❖ Water diversion from rivers;
   - ❖ Water conveyance from the source to the farm (design of canal and associated structures);
   - ❖ Design of on farm-water distribution (gravity and pressurized methods);
   - ❖ Planning of an irrigation schedule for multiple crop-farming;
   - ❖ Safe disposal or drainage of excess irrigation and rain water.

(2) Contribute in the planning, design and implementation of water harvesting at farm level;
(3) Study extent of soil erosion, determine factors responsible and recommend appropriate measures;
(4) Plan, design and implement engineering and biological measures of soil conservation at farm and watershed level;
(5) Design and manage rural water supply and sanitation projects.

In addition to the above, the university has also opened a new graduate program in Soil and Water Engineering.

C.3 Weakness

According to senior officers in MOARD, MOARD, BOARD and BOWME, new graduates from all universities/colleges lack the skill for practical work. Often, the gap is rectified through in-service training.

C.4 Opportunities for Cooperation under EWUAP

The university can be involved in (i) providing tailor made courses in all aspects related to agricultural water use, and (ii) conducting research in topics to be specified by stakeholders.

D. Arbaminch University, Water Technology Institute

D.1 Research work/ Projects Undertaken

The research outputs of the Water Technology Institute of Arbaminch University are the following:

(i) Completed PhD Research

- Investigation of water resources aimed at multi-objective development with respect to limited data situation: the case of Lake Abaya Chamo basin, Ethiopia
- Water quality monitoring in the Lake Abaya Chamo basin.
- Modelling of sediment transport and morphological process in rivers
- Integrating GIS with hydrological and sedimentological models for storm water management planning;
- Meteorological forcing on sediment deposition in Abaya lake, Ethiopia

(ii) Completed MSc Thesis

Ground water potential investigation in Abaya catchment

- Optimal small scale hydropower sites in Blue Nile/Abay/River basin;
- Analysis of regional drought-a case of Benishangul Gumuz;
- Analysis of severity-duration-frequency (SDF) of drought using GIS- a case study of Abaya Chamo basin;
- Development of a model for optimization of water supply system- cost and supply problems with a case study for Hossiana town;
- Hydropower development potential and optimum option in Ghiba River basin;
- Evaluation of field water application performance of Sprinkler Irrigation system at Fincha Sugar state;
- Performance evaluation and sensitivity analysis of fixed and cutback flows for furrow irrigation at Metehara Sugar factory;
- Regional flood frequency analysis in Blue Nile basin;
- GIS based Irrigation suitability Analysis;
- Analysis of severity-duration-frequency (SDF) of drought using GIS- a case study of Abaya Chamo basin;
- Reservoir operation planning for Melka Wakena Hydropower scheme;
- Analysis of regional drought-a case of Benishangul Gumuz;
- Hydropower development potential and optimum option in Ghiba River basin;

- Evaluation of field water application performance of Sprinkler Irrigation system at Fincha Sugar state;
- Performance evaluation and sensitivity analysis of fixed and cutback flows for furrow irrigation at Metehara Sugar factory;
- Development of a model for optimization of water supply system- cost and supply problems with a case study for Hossiana town.

(iii) Ongoing PhD Researches

"Hydrological Drought Analysis: Occurrence, Severity, risks"-Adane A.
"Decision support tools for the Blue Nile river basin"-Alemayehu H.
"Integrated watershed management: its impact on small scale Irrigation water utilization"-Kassa T.
"Investment maintenance risk optimisation for hydraulic structures using probabilistic structure and maintenance modelling"

D.2 Strength

The Water Technology Institute of Arbaminch University has four main departments, namely: Hydraulics Engineering, Irrigation Engineering, Meteorology, and Water & Environmental Engineering departments. There are 6 PhD, 14 M.Sc. and 8 B.Sc. level staff. The Irrigation and Hydraulic Engineering departments give courses at three levels: Advanced Diploma, B.SC and M.SC.

D.3 Weakness

According to senior officers in MOARD, MOARD, BOARD and BOWME, new graduates from all universities/colleges lack the skill for practical work. Often, the gap is rectified through in-service training.

D.4 Opportunities for Cooperation under EWUAP

The Water Technology Institute of Arbaminch University can give short courses as per specification to be prepared by EWUAP.

E. Debub University, Awassa Agricultural College

E.1 Research work/ Projects Undertaken

Current and previous research works of the university are shown below. Year of commencement and completion of the research are shown in bracket:

- Maize improvement for low rain fall areas by s1selection method (1990 - 2003);
- Drought tolerant/resistant maize variety development for low and medium altitudes of

Ethiopia (?-- 2004);

- Developing stable and responsive maize varieties for moisture (2001 – 2006);
- Collection and characterization of Ethiopian adapted maize germ plasm from some pocket areas of southern Ethiopia (2001 – 2005);
- Improving indigenous crops to ensure food security of Plectranthus Edulis (2002 - ?);
- Growth, development and characterization of Enset and land-races (2001 – 2005);
- Effect of irrigation on onion seed yield and seed components (2002 – 2003);
- Low input sustainable agriculture on rift valley soils (1998 – 2003);
- Integrated nutrient management to attain sustainable productivity (2002 – 2006);
- Diversity in home garden agro forestry system in southern Ethiopia (1998 – 2001);
- Comparative age and growth study of commercially important fish species (1996 – 2005);
- Resource use and life history of commercial fish in lake Awassa (2002 – 2006);

E.2 Strength

There are two departments of relevance to EWUAP, which are (a) Agricultural Engineering and Mechanization and (b) Cooperatives. The former has B.Sc. degree programme in Agricultural Engineering and Mechanization that focuses, among other things, on (i) identification, design and implementation of soil & water conservation projects, and (ii) identification, design and implementation of small and large-scale irrigation projects.

The cooperative department focuses on concepts, theories, principles and philosophy of cooperation, co-operatives and cooperative organization, management, auditing and accounting.
It also aims at enhancing students' ability and capacity to organize cooperatives, prepare organizational plans, manage cooperatives, audit co-operative resources, offer training and conduct cooperative research and consultancy.

E.3 Weakness

According to senior officers in MOARD, MOARD, BOARD and BOWME, new graduates from all universities/colleges lack the skill for practical work. Often, the gap is rectified through in-service training.

E.4 Opportunities for Cooperation under EWUAP

Awassa College of Agriculture of Debub University can give short courses in the establishment and strengthening of WUA.

F. Jimma University, College of Agriculture

F.1 Research work/ Projects Undertaken

The College of Agriculture of Jimma University is carrying out research activities that encompass socio-economics, post harvest technology, animal health, high-land pulses, root and tuber crops, vegetables and flowers, fruit crops, spices and medicinal plants, plant protection, dairy cattle, forage and pasture and bee keeping. Besides, the following research projects are being implemented by the university in collaboration with donor agencies:

- Enhancement of Drought Resistance in Sorghum under Ethiopian Conditions (in collaboration with USAID)
- Studies on current management practices of multipurpose trees and indigenous knowledge on the role of trees in Kafa Zone (in collaboration with FAO)
- Sustainable soil and water conservation in Kafa Zone (in collaboration with FAO)

F.2 Strength

The different departments under the school offer wide variety of training programs both at undergraduate and graduate levels. The M.Sc training programs currently being run are horticulture, animal Science, and plant pathology. Efforts are being made to further expand the dimension of the M.Sc level training. The academic staffs have diverse training background including horticulture, crop science, animal science, natural resource management, agricultural engineering, and agricultural economics and extension. Apart from teaching, the academic staffs are engaged in research.

F.3 Weakness

According to senior officers in MOARD, MOARD, BOARD and BOWME, new graduates from all universities/colleges lack the skill for practical work. Often, the gap is rectified through in-service training.

F.4 Opportunities for Cooperation under EWUAP

The university can give short courses as per specification prepared by EWUAP.

G. Mekelle University, Faculty of Dry Land Agriculture and Natural Resources Management

G.1 Research work/ Projects Undertaken

The university has undertaken a number of research projects in irrigation, natural resource management, cooperatives, etc.

G.2 Strength

The abovementioned faculty of Mekelle University gives a degree level training in land resources management and environmental sciences. Through this program, many courses are offered in areas of water. In addition, short-term trainings are organized for stakeholders in areas of water harvesting, irrigation management and soil and water conservation. Apart from this, the university staffs are also involved in multi-disciplinary research in areas of water productivity, socio-economics, and health aspects.

G.3 Weakness

According to senior officers in MOARD, MOARD, BOARD and BOWME, new graduates from all universities/colleges lack the skill for practical work. Often, the gap is rectified through in-service training

G.4 Opportunities for Cooperation under EWUAP

The university can give short courses as per specification to be prepared by EWUAP.

H. IWMI

H.1 Research work/ Projects Undertaken

IWMI was running a project titled "**Irrigation Impact on Poverty and Environment**" during 2004 – 2007. The expected outputs were the following:

(a) Knowledge base on performance of irrigated agriculture;
(b) Assessment of contribution of irrigated agriculture to the national economy;
(c) Analyses of efficiency, linkages, and coordination of support services for irrigated agriculture;
(d) Analysis of institutional frameworks relevant to irrigation sector;
(e) Guidelines for EIA of irrigation schemes in Ethiopia;
(f) Assessment of the effectiveness and efficiency of water control and management systems;
(g) Database detailing important characteristics and performance of the selected irrigation schemes;
(h) Analysis of the impacts of the selected irrigation schemes on poverty, environment, health and household food security;
(i) Recommendations for improved efficiency of the selected irrigation schemes developed jointly with appropriate stakeholders;
(j) Comprehensive irrigation impact assessment framework and guidelines;
(k) Knowledge base on impacts of irrigation development in Ethiopia;
(l) Reports, refereed journal articles, policy briefs, guidelines and strategic options for future interventions (investments, management, etc.);

(m) Capacity building to undertake interdisciplinary problem oriented research Ph.D. and M.Sc Students;

(n) Dissemination of results through published reports, articles, brochures, guidelines, workshops, training and conferences.

As yet, IWMI has supported the following research projects run by Ph.D. and M.Sc Students

(A) PhD Proposals

- The Socio-economic Impact of small-scale Irrigation in Tigray, G/Hawaria G/Egziabher, Ethiopia Mekelle University Admitted to Oslo University
- "Environmental Impact Assessment of Irrigation Projects in Ethiopia", Dominique Ruffies, BOKU Student Admitted to BOKU

(B) Completed MSc Thesis

1. "Analysis of Irrigation Systems Using Comparative Performance Indicators: A Case Study of Two Large-Scale Estate Farms In The Upper Awash", by Abdu Beshir, MoWR-AMU
2. "Environmental And Socio-Economic Impact Of Irrigation Development: Case Study At Amibara Irrigation development project", by Moltot Zewde, EARO-AMU
3. "Dimensions and Determinants of Rural Poverty in North Shewa, Baso ena Werena District" (study the dimensions and determinants of rural poverty in relation to various factors such as access to services, water/irrigation, household characteristics, vulnerability etc), by Solomon Medhane, AU
4. "Assessment of the Socio-Economic And Environmental Impacts of Irrigation In Fincha Valley", by Dereje Chimdessa, AAU
5. "Performance of Dairy Production in Irrigated Areas: Contribution to food self sufficiency and alleviation", by Endalemaw Bayou , AAU
6. "Technical Efficiency of Irrigated Agriculture: A Comparative Study among Irrigation Schemes and with Non-irrigated Farms in the Awash and Rift Valleys ", by Dawit Kelemework, AAU
7. "Assessment of Design Practices and Performance of Small Scale Irrigation Structures in Southern Region" (With special emphasis on failed structures), by Robel lambisso, AMU
8. "Community Based Irrigation Impact Assessment on Health and Environment at Ziway and Holota", by Gizaw Ebissa , AAU
9. "Institutions, Management Practices And Challenges: The Case Of Gibe Lemu And Gambella Terre Small-Scale Irrigation Schemes, Western Oromia, Ethiopia", by Shimeles Dejene, AAU
10. "The Institutional Perspectives for The Development of Community Based Irrigation in the Ethiopian Nile Basin", by Dieuwe De La Parra, University of Toulouse, France
11. "Environmental Impact Analysis of Irrigation Scheme in Ethiopia: Focus on IDRIS and Wonji Watershed", by Katharina Wallner, BOKU
12. "Typology of Irrigation in Ethiopia", by Alexandar Werfreing, BOKU

13. "Geographic Information Systems and remote sensing integrated environmental impact assessment of irrigation in Fincha Valley", by Ahmed Amdihun, AAU
14. "Evaluation of failures and design practices of river diversion structures for irrigation" (case of Oromia Regional State), by Girma Asfaw, AMU

H.2 Strength

IWMI has a wealth of regional and international research experience in irrigation water management.

H.3 Weakness

Many professionals in the line Ministries and Bureaux are not aware of any research output by IWMI or the other institutions. There is a gap in transforming research results into action.

H.4 Opportunities for Cooperation under EWUAP

IWMI can be involved in the identification and promotion of best practices.

I. SASAKAWA Global – 2000 Ethiopia Project (SG 2000)

I.1 Research work/ Projects Undertaken

SG 2000 is a science-based agricultural intensification program that uses proactive field demonstrations. It is based on the Green Revolution model used in the 1960s/70s in South Asia. It uses demonstration plots typically ranging from 0.25 to 0.50 hectares, unlike the previous Small Plot Adoption Trial of 50-100 square meters.

I.2 Strength

SG 2000 core staff works very closely with the agricultural sector and provides advice to policy makers on issues of national interest and where the government should focus to re-energize the agricultural sector.

I.3 Weakness

SG 2000 is a program with a life span dependent on the interest of the financers.

I.4 Opportunities for Cooperation under EWUAP

SG 2000 has a built a good reputation in the promotion of new agricultural technologies and building the capacity of MOARD extension staff. Thus, it could serve as a partner to EWUAP in the promotion of best practices using existing channels.

J. Ethiopian Horticulture Producer – Exporters Association

J.1 Research work/ Projects Undertaken

Members of the association are engaged in the production and export of vegetables, fruit and flower. The task of the association is to facilitate horticulture export for its members.

J.2 Strength

The association provides technical information for those who would like to be engaged in the production of floriculture and horticulture for export. It has 77 members. One of its members has established an out grower contractual agreement with small scale farmers.

J.3 Weakness

The association has only limited administrative staff. The members of the association are private business enterprises and may not have spare time to be engaged in capacity building activities.

J.4 Opportunities for Cooperation under EWUAP

The association could share experience in solving the prevailing production and marketing problems of CMI schemes.

K. MERET Project (WFP – MOARD joint project)

K.1 Research work/ Projects Undertaken

MERET has supported soil and water conservation measures and area closures in 600 micro-watersheds situated in 74 moisture deficit Weredas. The project also supports activities aiming at diversification of income opportunities at farm level.

K.2 Strength

MERET is joint project of MOARD and WFP. The activities of MERET project are streamlined with that of MOARD and BOARD. The main thrust of the project at the grass root level is community participation. During the last few years, it has enabled farmers to grow fruit trees as an integral part of water harvesting scheme.

K.3 Weakness

The project uses food assistance as the major catalyst in the implementation of soil and water conservation activities.

K.4 Opportunities for Cooperation under EWUAP

MERET project can facilitate study tours within the country for national and regional trainees in the area of (i) watershed development, (ii) participatory planning and implementation approach and (iii) the production of fruit trees as an integral part of water harvesting schemes.

L. Ethiopian Rainwater Harvesting Association (ERHA)

L.1 Research work/ Projects Undertaken

ERHA has carried out the following case studies:

- Berhanu F., Ephraim A., and Seid Ali, 2002. Traditional RWH systems for food production: The case of Kobo Woreda, Northern Ethiopia.;
- Befekadu Kassahun. 2004. Spate irrigation another form of runoff harvesting: the practice and challenges in Konso area, Southern Ethiopia.
- Ephraim A. and Sorasa Natea 2004. The Gods of Siyoo witnessed streams: a participatory assessment of RWH systems providing domestic water supply: Case studies from the rift valley area, Central Ethiopia.
- ERHA. 2004. Potentials of RWH to improve water supply and sanitation: The case of Welenchiti area in Oromia Regional State, Ethiopia.

L.2 Strength

ERHA has about 160 individual members in Ethiopia. It has been participating in Southern and Eastern African Rainwater Network and the Greater Horn of Africa Rainwater Partnership. It dispatches useful information on RWH and related issues by participating in various workshops and forums.

L.3 Weakness

ERHA has only 4 fulltime and one part time staff to carry out its day to day organizational functions.

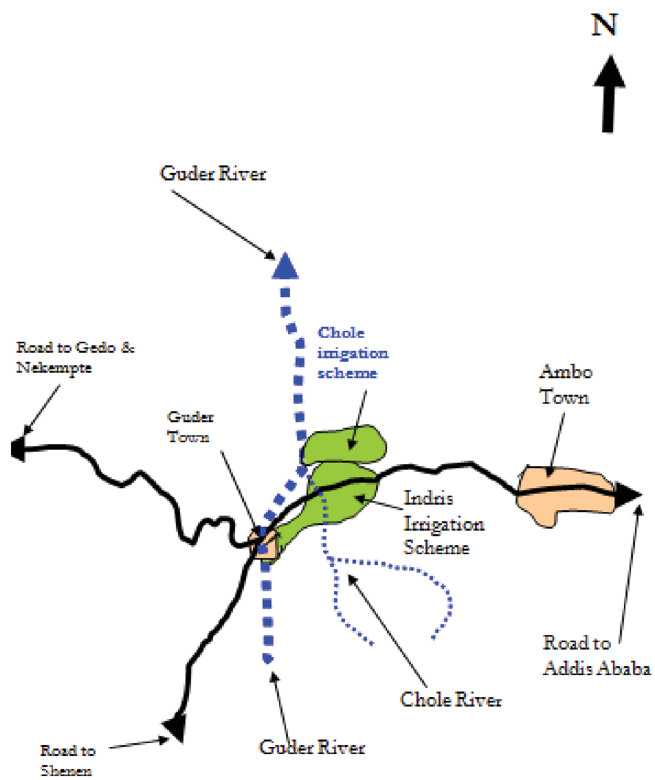
L.4 Opportunities for Cooperation under EWUAP

ERHA could play a role in the identification and dissemination of best practices using the services of its members.

Appendix

Chole

Date of Visit 20/11/2007	Category: Community Irrigation
Name of Site: Chole	Either water Harvesting; Community Irrigation or Private Public Irrigation
	Sketch Map of Site
Geographic location of practice: Oromia Region, Ambo Wereda	(see sketch map below)
(GPS) Coordinates: 9^o 01' N 37^o 46' E	



Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc Name of Villages: Agafile and Guder Town	No. of Beneficiary Households: Total: 300
Characteristics of the area: The area is endowed with land and water resource.	
Climate (AEZ) + Description: (Sets the climatic context - Arid; semi-arid; humid tropics; Mediterranean - Influences the types of crops that can be grown). Tepid moist mid highlands	
Average annual rainfall (mm) 1059	
Months of Short Rains:	March - May
Months of Main Rains:	June - August
Mean annual ref. crop Evapotranspiration (mm): 1460	
Predominant soil type:	Clay
Topography:	plain - mild slope and undulating
Slope:	0 - 10%
Erosion:	High in steep slopes and near valley bottom
Period of year during which used: All year round	
Period of year during which benefits utilised: All year round	
Water Source: Perrenial river with reliable flow rate	

Irrigated area: (ha) 200

Method of water abstraction: (Pumped; gravity; artesian - Influences the pattern of supply and cost of irrigation water).
Gravity (diversion weir with control gate)

Water delivery infrastructure: (Open channel; pipelines; lined; unlined - Influences the potential level of performance.)
Unlined canal (main, secondary, and field canals); with no gates, and water measuring structures

Type of water distribution: (Demand; arranged on-demand; arranged; supply orientated - Influences the potential level of performance.)
Rotation: once in 7 days for few hours

Predominant on-farm irrigation practice: (Surface: furrow, level basin, border, flood, ridge-in-basin; Overhead: rain-gun, lateral move, centre pivot; drip/trickle - Influences the potential level of performance). Furrow (5 - 30 meter length) and uncontrolled flooding of fragmented plots (50 - 1000 square meter plots)

Major crops (with percentages of total irrigated area): (Sets the agricultural context. Separates out rice and non-rice schemes, monoculture from mixed cropping schemes). The dominant irrigated crops are tomato, onion, potato and cabbage. Data on cropping pattern was not available.

Average farm size: (Important for comparison between schemes, whether they are large estates or smallholder schemes).
Maximum 1.5 ha/household; minimum 1000 square meter/household; average 0.4 ha/household

Type of management: (Government agency; private company; joint government agency/farmer; farmer-managed - Influences the potential level of performance).
Farmer Managed

Technical Description: (Please describe in about 250 words the background of the irrigation development, how it is used, how it achieves its objectives and its main purpose - For local markets; home consumption; regional or national markets; export. The irrigation water source is stream diversion, which was constructed in 1996. Regional irrigation office (OIDA) evaluation team identified the scheme as an exemplary one out of 97 schemes. The scheme was designed to irrigate 100 ha, but the hardworking farmers extended the main canal and increased the irrigated area to 200 ha. This increment is considerably high compared to the average irrigated area of the 97 CMI schemes, which was only 57% of the total designed capacity.

The strength of the WUA can be explained by the proper maintenance of canals and equitable redistribution of irrigated lands among members. The significance of the equitable redistribution of irrigated lands was that in the other schemes, farmers with 1- 3 ha irrigable lands were reported to lack the capacity or motivation to irrigate fully.

The canal route is clay and thus the conveyance system is water tight.The canals are properly maintained. The produce from the scheme is sold in the Addis Ababa market.

Technical Details: Socioeconomically Studies: conducted using FAO and the implementing agencicy's (OIDA) own guidline. The data/reports used before implementation was: census data, secondary data from the district Agricultural Office, and primary data from the farmers.
Soils Study: Conducted using OIDA guidline. The data used were: soil test result.

Agronomy Study: Conducted using FAO and OIDA guideline. The data/report used were: soil study report, meteorological data, secondary information from the district Agricultural Ofice, and primary data from the farmers.

Geological study: Conducted using ESRDF and OIDA guideline. Data used were: results of test pit excavated at the weir foundation and abutment, canal route, & prospective quarry site.

Watershed Management Study: conducted using OIDA Guideline. Data source: field observation
Hydrological Study: Conducted using ESRDF, OIDA and Ministry of Agriculture guidelines. Data/reports used were: river gauge data, metrological data, land use data and maximum flood level mark on the river abutment. The major calculations made were: unit hydrograph, maximum flood, base flow and flood duration.

Environmental Impact Assessment: Conducted using OIDA guideline. Data source: the various study reports and field observation.
Engineering Design: was a conducted using ESRDF, OIDA and Ministry of Agriculture guideline. The reports/data used were: hydrological study report, agronomy study report, geological study report and surveying output. The major calculatios were focussed on determination of: weir size, weir stability and canal and canal structures dimensions.

Financial Analysis: was conducted using ESRDF guideline. Data source: agronomy report, engineering estimates, primary data from local market.

Useful in: Describe the types of area where it can be used, the	Limitations: Describe the conditions or situations where it does not

conditions where it produces good results, Sites of applications, etc. The site is close to Addis Ababa and other big urban areas. Traders purchase the produce at farm gate. Market was the factor for attaining good results in this site. Thus, the experience from this site is useful in areas where the farmers are able to get attractive price for their produce.	perform well and conditions that will restrict its wider application Farmers in remote areas do not use the irrigation water and land efficiently for lack of market.
Geographical extent of use: The area of the study country where it is found and the sort of areas where it could be used within the Nile Basin The intervention is practiced throughout the country.	Effectiveness: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do. Income and living standard of the irrigators have increased significantly
Other Sites where used: There are many other CMI schemes with similar performance.	
Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding, the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) ....The cost of construction of the scheme in 1997 was Birr 475,150 (or US $ 69,875; in 1997, 1 US $ = Birr 6.8). The cost was covered by the goverment.	**Operation and Maintenance arrangements**: (Who manages, operates and maintains the works, how this is funded, conrtibutions levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) The users organize them selves to undertake canal mainatenance, which includes up to three days (3-4 hours/day) of removal of debris, sediment deposit and weed from the canals. There is no external assistance for the O&M of the scheme.
Benefits: (Estimate the returns achieved from the site if involves irrigation or costs saved in getting water if water for humans or livestock No dat. But, in neighboring Indris CMI crop yields (ton/ha) during 2006/07, were as follows: Onion = 30 - 40; tomato = 17 - 20; potato = 12 = 13; cabbage = 13 - 14; green pepper = 3.2	**Water User Association or User Group**: (Provide details of the type of organisation, how it works and elects members, number of members and all other pertinent details). The scheme has WUA. It was established after the scheme was constructed. The WUA is responsible for the allocation of water and O&M of the canals. (No additional data was available).
Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users? How and why are they involved in the practice? Actual level of beneficiary involvement under operation: The scheme was initiated and constructed by the Ministry of Agriculture. Government office (OIDA) is responsible for extension related to irrigation and major maintenance work, if any; Holeta Agricultural Research center identifies appropirate crop varieties, provides training in agronomy and plant protection to farmers and extension staff; local traders are instrumental in establishing market link in Addis Ababa. **Who are the main beneficiaries**	**Enabling Environment**: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The scheme was initiated by the government. The implementing agency had manuals to guide the design and construction of irrigation schemes. **beneficiary involvement** **demand based interventions**
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The extension staff and the farmers were given training in horticultural crop production techniques by Holeta Agricultural Research Center and bureau of agriculture in many occasions since the scheme became operational.	**Extension support:** The Bureau of Agriculture through the Wereda office provides extention support mainly in agronomical aspects. The current extension support in water management is noted to be inadequate.

<table>
<tr><td></td><td></td></tr>
<tr><td>Environment benefits:
The irrigation scheme is not linked with the upstream catchment protection works.

Sustainability economic aspects
cultural
environmental aspects
technical</td><td>Social/Cultural acceptability:
The irrigation scheme has brought a significant change in the livelihood of the irrigators. The scheme has opened job opporunity for many landless youngsters.</td></tr>
<tr><td>Advantages:

• Traders purchase vegetables at the farm gate;
• Holeta Agricultural Research Center has been instrumental in availing seeds of improved horitcultural crop varieties and the associated management practices to the irrigators;
• (iii) Irrigators have experience in growing tomato during the rainy season (off-season) and sell it at high price; (iv) there is no conveyance loss as the canal route is clay; and (v) water disribution among the users is handled effectively by the WUA.</td><td>Disadvantages:
• Shortage of water due to expansion of the irrigable area within the command area;
• (ii) There are no water measurement structures.</td></tr>
<tr><td rowspan="8">Scaling Up: (Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;)
The presence of good roads and market were the key factors for success in this scheme. Thus, provided that all other technical issues are addresed, access and market are the vital factors that would determine scaling up.</td><td>What is potential for applying all/parts of initiative elsewhere?</td></tr>
<tr><td>(Score from 1 to 10 on list below with 10 being highly applicable)</td></tr>
<tr><td>I [ ] Transfer of practice to another group/culture/land-use system, etc.</td></tr>
<tr><td>II [ ] Easy to transfer the practice, but with minor adaptations for local conditions</td></tr>
<tr><td>III [10] Transfer possible, but significant modifications/prerequisites to consider.</td></tr>
<tr><td>IV [ ] Difficult to transfer the practice. Need experienced support.</td></tr>
<tr><td>V [ ] It would be impossible to transfer the practice. Too site specific.</td></tr>
<tr><td>Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.)
Need to review master plan, if any. Downstream water users should be considered prior to planning diversion.</td></tr>
<tr><td colspan="2">Best Practices: Why this site/ case is considered to be a successful best practice; express this success in qualitative or quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations).

The reasons for considering the site as best practice site are:
• Replication: When many irrigation schemes in the country are operating at or below designed capacity, the users of this site have expanded the irrigable area progressively (from 100ha to 200 ha) and thus utilized the available water and land resources effectively.</td></tr>
</table>

- Sustainability: There is no sign of seepage loss along the canal route, which is attributed to the thick clay layer along the canal route and regular canal maintenance. The water users are market oriented and have established strong linkage with traders in the urban areas. Over 86% of the crops grown are high value horticultural crops thus, productivity of water is high.

Contact Organisation: (For further information; site visits' etc)	
Type of organisation:	Contact person: Dangachew Deressa
[X] government organization	Contact details: Head, West Shoa Zone OIDA Office, Ambo ……………………………… Tel: 251 11 236 6106
[ ] private organization	
[ ] NGO &/or CBO	
[ ] international agency	
[ ] other:	

Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar interventions)

Planning:

The following factors need to be considered during the planning of an irrigation scheme:

- Measures to treat or rehabilitate the catchment area should be considered so as to increase or maintain stream flow;
- Extension support in irrigation agronomy, crop protection, water management and marketing should be well planned
- Monitoring and evaluation system should be designed so as to measure the performance of
  - irrigation agronomy,
  - crop protection,
  - water management and
  - marketing

Design

Water measurement structures should be incorporated in the design

Construction

Implementation

O&M

The water users are market oriented and have established strong linkage with traders in the urban areas. Thus, in future interventions extension workers should play a catalytic role in establishing linkage with urban traders;

Beneficiary involvement

Realisation of benefits:

The Addis Ababa market has contributed for the success of the scheme. Income and living standard of the irrigators have increased.

Other Remarks or observations:

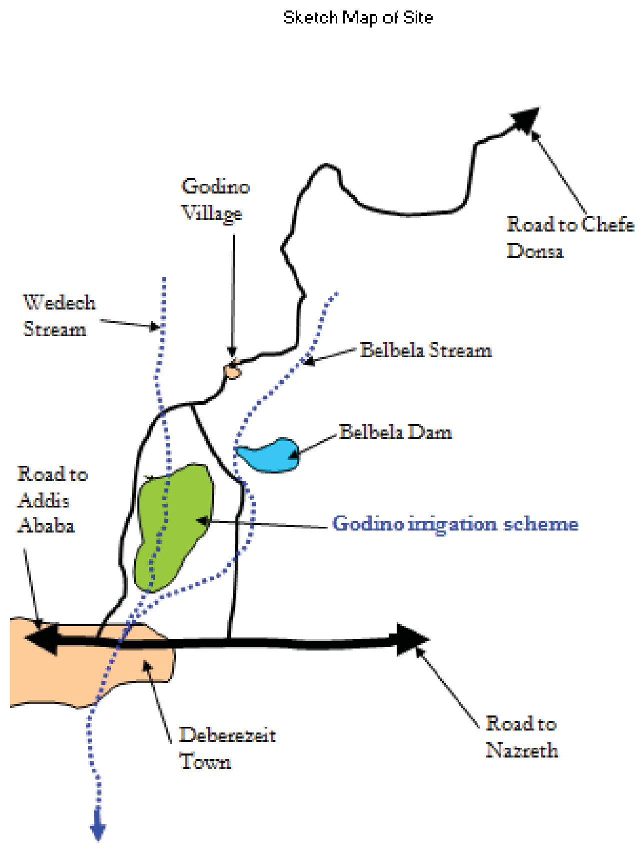
The irrigators benefited from Holeta Agricultural Research Center through training and provision of seeds. Thus, in future interventions, research centers should be invited to conduct irrigation related trials and get involved in the dessimination of technologies.

Contact person completing form: Leul Kahsay Gezehegn

Contact details: P.O.Box 23020 code 1000, Addis Ababa; email: samsonds@ethionet.et or leul_kahsay@yahoo.com

Godino

Date of Visit Not Visited	Category: Community Irrigation
Name of Site: Godino	Either water Harvesting; Community Irrigation or Private Public Irrigation
Geographic location of practice: Oromia Region, Adaa Woreda	Sketch Map of Site
(GPS) Coordinates: 8^o 50' N 39^o 01' E	



Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc
Name of Villages: Godino No. of Beneficiery Households: Total: 270

Characteristics of the area: Water Source is reservoir dam constructed in 1980.

Climate (AEZ) + Description: (Sets the climatic context - Arid; semi-arid; humid tropics; Mediterranean - Influences the types of crops that can be grown). Tepid sub-moist mid highlands

Average annual rainfall (mm) 860	
Months of Short Rains:	February - March
Months of Main Rains:	June - September
Mean annual ref. crop Evapotranspiration (mm): 1423	
Predominant soil type:	Clay
Topography:	plain - mild slope
Slope:	0 - 5%
Erosion:	small in plain land; High in the watershed
Period of year during which used: All year round	
Period of year during which benefits utilised: All year round	
Water Source: Reservior dam, which is under siltation problem	

Irrigated area: (ha) The original plan was to irrigate 290 ha. But, in 2004, only 140 ha (48.27%) were irrigated with a declining trend due to reservoir sedimentation.	
Method of water abstraction: (Pumped; gravity; artesian - Influences the pattern of supply and cost of irrigation water). Gravity (reservoir dam operated using a gate valve)	
Water delivery infrastructure: (Open channel; pipelines; lined; unlined - Influences the potential level of performance.) Unlined canal (main, secondary, tertiary and field canals); with no gates, and water measuring structures	
Type of water distribution: (Demand; arranged on-demand; arranged; supply orientated - Influences the potential level of performance.) Rotation	
Predominant on-farm irrigation practice: (Surface: furrow, level basin, border, flood, ridge-in-basin; Overhead: rain-gun, lateral move, centre pivot; drip/trickle - Influences the potential level of performance). Furrow (10 - 30 meter length) and uncontrolled flooding of fragmented plots (100 - 2000 square meter plots)	
Major crops (with percentages of total irrigated area): (Sets the agricultural context. Separates out rice and non-rice schemes, monoculture from mixed cropping schemes). The dominant irrigated crops are onion, potato, cabbage, sugar cane, and Teff, Data on cropping pattern was not available.	
Average farm size: (Important for comparison between schemes, whether they are large estates or smallholder schemes). 0.74 ha/household	
Type of management: (Government agency; private company; joint government agency/farmer; farmer-managed - Influences the potential level of performance). Farmer Managed	
Technical Description: The water source is the Wedecha Belbala reservoir dam, which was built in 1980. As the catchment lacks conservation works, the reservoir capacity is being undermined by sedimentation. Besides, lack of canal maintenance and high seepage are noted. As a result, the scheme is irrigating only 140 ha out of the designed 290 ha. The irrigation water application to the field involves wild flooding and was observed as a cause of erosion.The scheme has a WUA. The water charge amount in the area is Birr 10.00 per a quarter of a hectare. The collected money is used for canal repair and maintenance works. Irrigation schedule is by rotation. Farmers who attempt to divert water in to their farm outside of their turn are fined Birr 60.00. Due to the lack of credit and extension support, only the relatively resourceful farmers are getting the maximum benefit from the irrigation scheme. Cash poor farmers grow cereals (chick pea, lentils and vetch) while those with cash grow vegetables and harvest 2 – 3 times a year. WUA and the farmers individually are responsible for the irrigation operation	

Technical Details:

- **Socioeconomical Studies**: conducted using FAO and the implementing agencicy's (OIDA) own guidline. The data/reports used before implementation was: census data, secondary data from the district Agricultural Office, and primary data from the farmers.

- **Soils Study**: Conducted using OIDA guidline. The data used were: soil test result.
  Agronomy Study: Conducted using FAO and OIDA guideline. The data/report used was: soil study report, meteorological data, secondary information from the district Agricultural Ofice, and primary data from the farmers.

- **Geological study**: Conducted using ESRDF and OIDA guideline. Data used were: results of test pit excavated at the weir foundation and abutment, canal route, & prospective quarry site.

- **Hydrological Study**: Conducted using ESRDF, OIDA and Ministry of Agriculture guidelines. Data/reports used were: river gauge data, metreological data, land use data and maximum flood level mark on the river abutment. The major calculations made were: unit hydrograph, maximum flood, base flow and flood duration.

- **Environmental Impact Assessment**: Conducted using OIDA guideline. Data source: the various study reports and field observation.

- **Engineering Design**: Were conducted using ESRDF, OIDA and Ministry of Agriculture guidelines. The reports/data used were:

• hydrological study report, agronomy study report, geological study report and surveying output. The major calculatios were focussed on determination of: weir size, weir stability and canal and canal structures dimensions. Financial Analysis: was conducted using ESRDF guideline. Data source: agronomy report, engineering estimates, primary data from local market.	
Useful in: Describe the types of area where it can be used, the conditions where it produces good results, Sites of applications, etc. The site is close to Addis Ababa and other big urban areas. Traders purchase the produce at farm gate. Market is the key factor for attaining good results in this site. Thus, the experience from this site is useful in areas where the farmers are able to get attractive price for their produce.	**Limitations**: Describe the conditions or situations where it does not perform well and conditions that will restrict its wider application Farmers in remote areas do not use the irrigation water and land efficiently for lack of market.
Geographical extent of use: The area of the study country where it is found and the sort of areas where it could be used within the Nile Basin The intervention is practiced throughout the country.	**Effectiveness**: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do. Income and living standard of the irrigators have increased significantly
Other Sites where used:	There are many other CMI schemes with similar performance.
Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding, the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) ....The cost of construction of the scheme (except the reservoir dam) was Birr 308,900 (or US $ 48,645) in 1996; (1 US $ in 1996 = Birr 6.35) The cost was covered by the goverment & donor.	**Operation and Maintenance arrangements**: (Who manages, operates and maintains the works, how this is funded, conrtibutions levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) The users organize them selves to undertake canal mainatenance, which includes up to three days (3-4 hours/day) of removal of debris, sediment deposit and weed from the canals. There is no external assistance for the O&M of the scheme.
Benefits: (Estimate the returns achieved from the site if involves irrigation or costs saved in getting water if water for humans or livestock Income and living standard of the irrigators have increased significantly. For example, two farmers have bought cars for public transport; two farmers bought flour mills; over 70% of the farmers have built better houses; all of the farmers bought oxen for ploughing purpose and some bought dairy cows. The scheme has created employment opportunities for 500 seasonal labourers	Water User Association or User Group: (Provide details of the type of organisation, how it works and elects members, number of members and all other pertinent details). The users have a WUA, which is responsible for the allocation of water and O&M of the canals. It was established after the scheme was constructed. (No additional data was available).
Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users? How and why are they involved in the practice? Actual level of beneficiary involvement under operation: The scheme was initiated and constructed by the Ministry of Agriculture. Government office (OIDA) is responsible for extension related to irrigation and major maintenance work, if any; local traders are instrumental in establishing market link in Addis Ababa. **Who are the main beneficiaries**	**Enabling Environment**: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The scheme was initiated by the government. The implementing agency had manuals to guide the design and construction of irrigation schemes. **beneficiary involvement**

	demand based interventions
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The extension staff and the farmers were given training in horticultural crop production techniques by the Bureau of Agriculture.	**Extension support:** The Bureau of Agriculture through the Wereda office provides extention support mainly in agronomical aspects. The current extension support in water management is noted to be inadequate.
Environment benefits: The irrigation scheme is not linked with the upstream catchment protection works. The volume of water available for irrigation is declinig due to reservoir sedimentation. **Sustainability** **economic aspects** **cultural** **environmental aspects** **technical**	**Social/Cultural acceptability**: The irrigation scheme has brought a significant change in the livelihood of the irrigators. The scheme has opened job opporunity for many landless youngsters.
Advantages: • Traders purchase vegetables at the farm gate; • the increased income enabled the farmers to hire labor during periods of peak demand.	Disadvantages: • Sedimentation is threatening the life of the reservor dam, which is the source of irrigation water; • there are no water measurement structures.
Scaling Up: (Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;) The presence of good roads and market were the key factors for success in this scheme. Thus, provided that all other technical issues are addresed, access and market are the vital factors that would determine scaling up of best practices.	What is potential for applying all/parts of initiative elsewhere? (Score from 1 to 10 on list below with 10 being highly applicable) I [ ] Transfer of practice to another group/culture/land-use system, etc. II [ ] Easy to transfer the practice, but with minor adaptations for local conditions III [10] Transfer possible, but significant modifications/prerequisites to consider. IV [ ] Difficult to transfer the practice. Need experienced support. V [ ] It would be impossible to transfer the practice. Too site specific. Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.) Need to review master plan, if any. Downstream water users should be considered prior to planning diversion. Catchement treatment is necessary.
Best Practices: Why this site/ case is considered to be a successful best practice; express this success in qualitative or quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations). The reasons for considering the site as best practice site are: (1) the cropping pattern involves more of hroticultural crops, thus, productivity of water is high; and (2) the increased income of the farmers has opened employment opportunity for many landless people.	

Contact Organisation: (For further information; site visits' etc)	
Type of organisation:	Contact person:
[X] government organization [ ] private organization [ ] NGO &/or CBO [ ] international agency [ ] other:	Contact details:

Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar interventions)

Planning:
The following factors need to be considered during the planning of the irrigation scheme:

- Measures to treat or rehabilitate catchment area should be considered so as to mitigate reservoir sedimentation;
- Monitoring and evaluation system should be designed so as to measure the performance of
  - irrigation agronomy,
  - crop protection,
  - water management and
  - marketing

Design
Water measurement structures should be incorporated in the design

Construction

Implementation

O&M

Beneficiary involvement

Realisation of benefits:

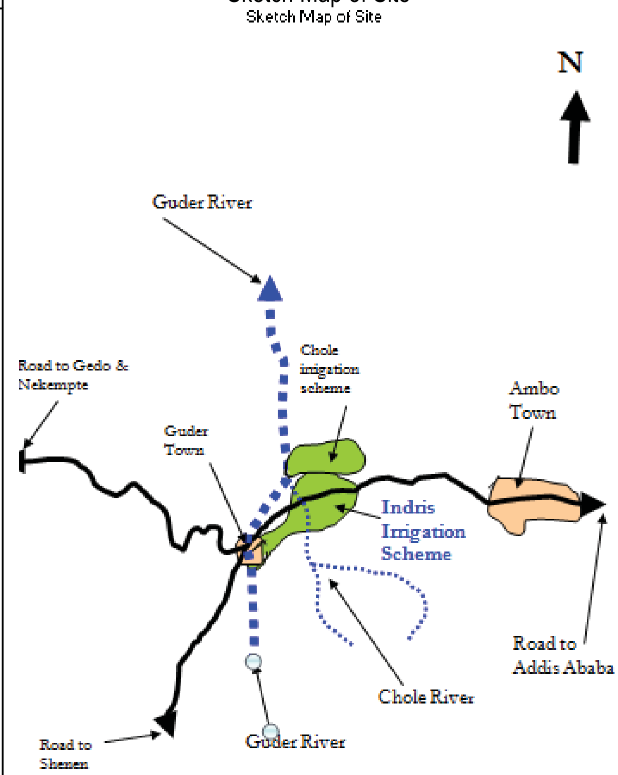
(i) The Addis Ababa market has contributed for the success of the scheme.
(ii) Income and living standard of the irrigators have increased significantly. Two farmers have bought cars for public transport; two farmers bought flour mills; over 70% of the farmers have built better houses; all of the farmers bought oxen for ploughing purpose and some bought dairy cows.
(iii) The scheme has created employment opportunities for 500 seasonal labourers

Other Remarks or observations:

Contact person completing form: Leul Kahsay Gezehegn

Contact details: P.O.Box 23020 code 1000, Addis Ababa; email: samsonds@ethionet.et or leul_kahsay@yahoo.com

Idris: Community Based irrigation

<table>
<tr><td>Date of Visit 20/11/2007</td><td>Category: Community Irrigation</td></tr>
<tr><td rowspan="2">Name of Site: Indris</td><td>Either water Harvesting; Community Irrigation or Private Public Irrigation</td></tr>
<tr><td rowspan="3">Sketch Map of Site
</td></tr>
<tr><td>Geographic location of practice: Oromia Region, Ambo Wereda</td></tr>
<tr><td>(GPS) Coordinates: 8^o 59' N 37^o 46' E</td></tr>
<tr><td colspan="2">Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc
Name of Villages: (i) Birbirsa Dokoma, (ii) Maladewe Aji, (iii) Agafile, and (iv) Guder Town No. of Beneficiery Households: Total: 1020 (Male 920, Female 100); Overall population = 5100</td></tr>
<tr><td colspan="2">Characteristics of the area: The area is endowed with land and water resource.</td></tr>
<tr><td colspan="2">Climate (AEZ) + Description: (Sets the climatic context - Arid; semi-arid; humid tropics; Mediterranean - Influences the types of crops that can be grown). Tepid moist mid highlands</td></tr>
</table>

Average annual rainfall (mm) 1059	
Months of Short Rains:	March - May
Months of Main Rains:	June - August
Mean annual ref. crop Evapotranspiration (mm): 1460	
Predominant soil type:	Clay
Topography:	plain - mild slope and undulating
Slope:	0 - 10%
Erosion:	High in steep slopes and near valley bottom
Period of year during which used: All year round	
Period of year during which benefits utilised: All year round	

Water Source: Perrenial river with reliable flow rate; recently water shortage is encountered due to increased irrigated area.

Irrigated area: (ha) 382

Method of water abstraction: (Pumped; gravity; artesian - Influences the pattern of supply and cost of irrigation water).
Gravity (diversion weir with control gate)

Water delivery infrastructure: (Open channel; pipelines; lined; unlined - Influences the potential level of performance.)
Unlined canal (except a small reach in the main canal lined with stone masonary)
(main, secondary, and field canals); with no gates, and water measuring structures

Type of water distribution: (Demand; arranged on-demand; arranged; supply orientated - Influences the potential level of performance.)
Rotation: once in 7 days for few hours

Predominant on-farm irrigation practice: (Surface: furrow, level basin, border, flood, ridge-in-basin; Overhead: rain-gun, lateral move, centre pivot; drip/trickle - Influences the potential level of performance).
Furrow (5 - 30 meter length) and uncontrolled flooding of fragmented plots (50 - 1000 square meter plots)

Major crops (with percentages of total irrigated area): (Sets the agricultural context. Separates out rice and non-rice schemes, monoculture from mixed cropping schemes).
In 2006/07: tomato =202 ha; onion =53 ha; potato=32 ha; cabbage=44 ha; others=51 ha

Average farm size: (Important for comparison between schemes, whether they are large estates or smallholder schemes).
Maximum 1.5 ha/household; minimum 1000 square meter/household; average 0.4 ha/household

Type of management: (Government agency; private company; joint government agency/farmer; farmer-managed - Influences the potential level of performance).
Farmer Managed

Technical Description: (Please describe in about 250 words the background of the irrigation development, how it is used, how it achieves its objectives and its main purpose - For local markets; home consumption; regional or national markets; export
The irrigation water source is stream diversion, which was constructed in 1993. In 2000, OIDA evaluation team identified the scheme as an exemplary one out of 97 schemes. The scheme was designed to irrigate 175 ha, but the farmers extended the main canal and branch canals and increased the irrigated area to 382 ha. This increment is considerably high compared to the average irrigated area of the abovementioned 97 CMI schemes, which was only 57% of the total designed capacity.

The canal route is clay and thus the conveyance system is water tight.The canals are properly maintained. The produce from the scheme is sold in the Addis Ababa market.

Technical Details:

- Socioeconomical Studies: conducted using FAO and the implementing agencicy's (OIDA) own guidline. The data/reports used before implementation was: census data, secondary data from the district Agricultural Office, and primary data from the farmers.
- Soils Study: Conducted using OIDA guidline. The data used were: soil test result.
- Agronomy Study: Conducted using FAO and OIDA guideline. The data/report used was: soil study report, meteorological data, secondary information from the district Agricultural Ofice, and primary data from the farmers.
- Geological study: Conducted using ESRDF and OIDA guideline. Data used were: results of test pit excavated at the weir foundation and abutment, canal route, & prospective quarry site.
- Watershed Management Study: conducted using OIDA Guideline. Data source: field observation
- Hydrological Study: Conducted using ESRDF, OIDA and Ministry of Agriculture guidelines. Data/reports used were: river gauge data, metreological data, land use data and maximum flood level mark on the river abutment. The major calculations made were: unit hydrograph, maximum flood, base flow and flood duration.
- Environmental Impact Assessment: Conducted using OIDA guideline. Data source: the various study reports and field observation.
- Engineering Design: Were conducted using ESRDF, OIDA and Ministry of Agriculture guidelines. The reports/data used were: hydrological study report, agronomy study report, geological study report and surveying output. The major calculatios were focussed on determination of: weir size, weir stability and canal and canal structures dimensions.
- Financial Analysis: was conducted using ESRDF guideline. Data source: agronomy report, engineering estimates, primary data from local market.

Useful in: Describe the types of area where it can be used, the conditions where it produces good results, Sites of applications, etc. The site is close to Addis Ababa and other big urban areas. Traders purchase the produce at farm gate. Market was the factor for attaining good results in this site. Thus, the experience from this site is useful in areas where the farmers are able to get attractive price for their produce.	**Limitations**: Describe the conditions or situations where it does not perform well and conditions that will restrict its wider application Farmers in remote areas do not use the irrigation water and land efficiently for lack of market.
Geographical extent of use: The area of the study country where it is found and the sort of areas where it could be used within the Nile Basin The intervention is practiced throughout the country.	**Effectiveness**: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do. Income and living standard of the irrigators have increased significantly
Other Sites where used:	There are many other CMI schemes with similar performance.
Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding, the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) ....The cost of construction of the scheme in 1993 was Birr 700,000 (or US $ 137,255; in 1993, 1 US $ = Birr 5.1). The cost was covered by the goverment.	O**peration and Maintenance arrangements**: (Who manages, operates and maintains the works, how this is funded, conrtibutions levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) The users organize them selves to undertake canal mainatenance, which includes up to three days (3-4 hours/day) of removal of debris, sediment deposit and weed from the canals. There is no external assistance for the O&M of the scheme.
Benefits: (Estimate the returns achieved from the site if involves irrigation or costs saved in getting water if water for humans or livestock During 2006/07, crop yields in ton/ha were as follows: Onion = 30 - 40; tomato = 17 - 20; potato = 12 = 13; cabbage = 13 - 14; green pepper = 3.2	**Water User Association or User Group**: (Provide details of the type of organisation, how it works and elects members, number of members and all other pertinent details). The command area encompases four villages. Farmers from each village were drawn to form the WUA after the scheme was constructed. As of 2005, the WUA is not active. At present, the O&M activities are not managed by the WUA but are done by the mutual understanding of the beneficieries.
Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users? How and why are they involved in the practice? Actual level of beneficiary involvement under operation: The scheme was initiated and constructed by the Ministry of Agriculture. Immediately after completion of the construction and commencement of irrigation, the ministry of Agriculture invited vegetable traders to visit the farm. OIDA is responsible for extension related to irrigation and major maintenance work, if any; Holeta Agricultural Research center identifies appropirate crop varieties, provides training in agronomy and plant protection to farmers and extension staff; local traders are instrumental in establishing market link in Addis Ababa.	**Enabling Environment**: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The scheme was initiated by the government. The implementing agency had manuals to guide the design and construction of irrigation schemes.

Who are the main beneficiaries	beneficiary involvement demand based interventions
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The extension staff and the farmers were given training in horticultural crop production techniques by Holeta Agricultural Research Center and bureau of agriculture in many occasions since the scheme became operational.	**Extension support:** The Bureau of Agriculture through the Wereda office provides extention support mainly in agronomical aspects. The current extension support in water management is noted to be inadequate.
Environment benefits: The irrigation scheme is not linked with the upstream catchment protection works. **Sustainability** **economic aspects** **cultural** **environmental aspects** **technical**	**Social/Cultural acceptability:** The scheme has influenced many other farmers in the vicinity to undertake irrigation.
Advantages: • Traders purchase vegetables at the farm gate; • Holeta Agricultural Research Center has been instrumental in availing seeds of improved horitcultural crop varieties and the associated management practices to the irrigators; • Irrigators have experience in growing tomato during the rainy season (off-season) and sell it at high price; • there is no conveyance loss as the canal route is clay; and • Indegenous community organization has helped in administrating the water disribution among the users when the WUA became inactive.	**Disadvantages**: • shortage of water due to expansion of the irrigable area within the command area and upstream water abstraction for new area development; • The strength of the WUA has been eroded (due to lack of follow up by the extension system) and water distribution among members is done by mutual understanding of the users (in-built system in the community); • members did not pay the nominal fee since 2005; and (iv) there are no water measurement structures;
Scaling Up: (Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;) The presence of good roads and market were the key factors for success in this scheme. Thus, provided that all other technical issues are addresed, access and market are the vital factors that would determine scaling up.	What is potential for applying all/parts of initiative elsewhere?
	(Score from 1 to 10 on list below with 10 being highly applicable)
	I [ ] Transfer of practice to another group/culture/land-use system, etc.
	II [ ] Easy to transfer the practice, but with minor adaptations for local conditions
	III [10] Transfer possible, but significant modifications/prerequisites to consider.
	IV [ ] Difficult to transfer the practice. Need experienced support.
	V [ ] It would be impossible to transfer the practice. Too site

	specific.
	Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.) Need to review master plan, if any. Downstream water users should be considered prior to planning diversion.

Best Practices: Why this site/ case is considered to be a successful best practice; express this success in qualitative or quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations).

The reasons for considering the site as best practice site are:

- Replication: When many irrigation schemes in the country are operating at or below designed capacity, the users of this site have expanded the irrigable area progressively (from 175 ha to 382 ha) and thus utilized the available water and land resources effectively.
- Sustainability: There is no sign of seepage loss along the canal route, which is attributed to the thick clay layer along the canal route and regular canal maintenance. The water users are market oriented and have established strong linkage with traders in the urban areas. Over 86% of the crops grown are high value horticultural crops thus, productivity of water is high.

Contact Organisation: (For further information; site visits' etc)	
Type of organisation:	Contact person: Dangachew Deressa
[X] government organization	Contact details: Head, West Shoa Zone OIDA Office, Ambo ……………………………… Tel: 251 11 236 6106
[ ] private organization	
[ ] NGO &/or CBO	
[ ] international agency	
[ ] other:	

Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar interventions)

Planning:

The following factors need to be considered during the planning of an irrigation scheme:

- Measures to treat or rehabilitate the catchment area should be considered so as to increase or maintain stream flow;
- Extension support in irrigation agronomy, crop protection, water management and marketing should be well planned
- Monitoring and evaluation system should be designed so as to measure the performance of
    - irrigation agronomy,
    - crop protection,
    - water management and
    - marketing

Design
Water measurement structures should be incorporated in the design

Construction

Implementation

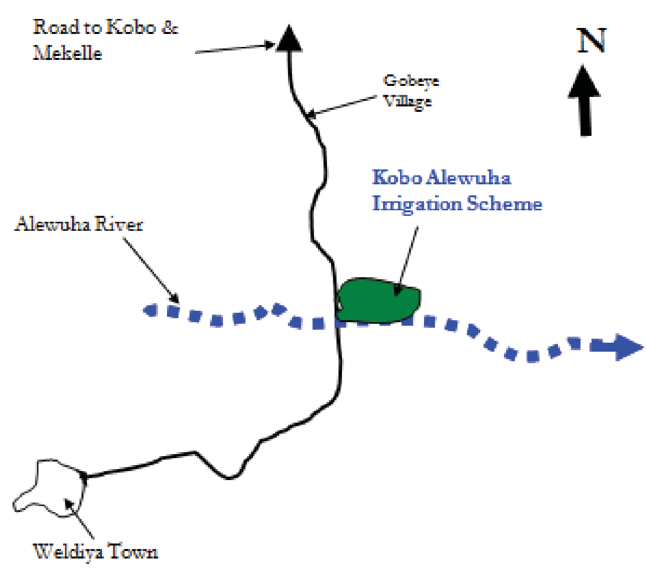
O&M
The water users are market oriented and have established strong linkage with traders in the urban areas. Thus, in future interventions extension workers should play a catalytic role in establishing linkage with urban traders;

Beneficiary involvement
When the formal WUA became inactive, the indegenous organiztional setup of the community helped to effectively distribute water among users and maintain canal at the begining of the irrigation season. Thus, in the future, WUA should be established by building upon

indegenous community organizations
Realisation of benefits: The Addis Ababa market has contributed for the success of the scheme.
Other Remarks or observations: The irrigators benefited from Holeta Agricultural Research Center through training and provision of seeds. Thus, in future interventions research centers should be invited to conduct irrigation related trials and get involved in the dessimination of technologies.
Contact person completing form: Leul Kahsay Gezehegn
Contact details: P.O.Box 23020 code 1000, Addis Ababa; email: samsonds@ethionet.et or leul_kahsay@yahoo.com

Kobo Alewuha (CMI)

Date of Visit Not visited	Category: Community Irrigation
Name of Site: Kobo Alewuha	Either water Harvesting; Community Irrigation or Private Public Irrigation
Geographic location of practice: Amhara Region, Kobo Wereda	Sketch Map of Site
(GPS) Coordinates: 11^o 55' N 39^o 41' E	



Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc

Name of Villages: ?? No data	No. of Beneficiery Households:?? No data

Characteristics of the area: The area is endowed with land and water resource.

Climate (AEZ) + Description: (Sets the climatic context - Arid; semi-arid; humid tropics; Mediterranean - Influences the types of crops that can be grown). Warm sub moist lowlands

Average annual rainfall (mm) 1070	
Months of Short Rains:	March - May
Months of Main Rains:	July - September
Mean annual ref. crop Evapotranspiration (mm):1496	
Predominant soil type:	Clay loam
Topography:	plain -
Slope:	0 - 3%
Erosion:	small in plain fields
Period of year during which used: All year round	
Period of year during which benefits utilised: All year round	
Water Source: Perrenial river with reliable flow rate	
Irrigated area: (ha) 382	

Method of water abstraction: (Pumped; gravity; artesian - Influences the pattern of supply and cost of irrigation water).
Gravity (Diversion weir with control gate)

Water delivery infrastructure: (Open channel; pipelines; lined; unlined - Influences the potential level of performance.)
Unlined canal (main, secondary, tertiary and field canals); with no gates, and water measuring structures

Type of water distribution: (Demand; arranged on-demand; arranged; supply orientated - Influences the potential level of performance.)
Rotation

Predominant on-farm irrigation practice: (Surface: furrow, level basin, border, flood, ridge-in-basin; Overhead: rain-gun, lateral move, centre pivot; drip/trickle - Influences the potential level of performance).

Furrow (5 - 30 meter length) and uncontrolled flooding of fragmented plots (50 - 1000 square meter plots)

Major crops (with percentages of total irrigated area): (Sets the agricultural context. Separates out rice and non-rice schemes, monoculture from mixed cropping schemes).

The **dominant irrigated crops are tomato**; onion; potato; sugar cane, and cereals. Data on cropping pattern was not available. Cropping intensity is 200%

Average farm size: (Important for comparison between schemes, whether they are large estates or smallholder schemes).
No data

Type of management: (Government agency; private company; joint government agency/farmer; farmer-managed - Influences the potential level of performance).
Farmer Managed

Technical Description: (Please describe in about 250 words the background of the irrigation development, how it is used, how it achieves its objectives and its main purpose - For local markets; home consumption; regional or national markets; export The irrigation water source is a diversion from the Alewuha River. The diversion weir was completed in 1996 but, the canal construction was finalized later. In collaboration with the Agricultural office, the WUA has established demonstration plots & nursery to demonstrate how to produce a variety of high value crops. Currently, the farmers are growing high value crops and the cropping intensity is 200% with a possibility of a third harvest. As the farm is located on the Weldiya – Mekelle main road, the farmers receive competitive price at farm gate.

Technical Details:

- **Socioeconomical Studies**: conducted using FAO and the ESRDF guidline. The data/reports used before implementation was: census data, secondary data from the district Agricultural Office, and primary data from the farmers. Soils Study: Conducted using ESRDF guidline. The data used were: soil test result.
- Agronomy Study: Conducted using FAO and ESRDF guideline. The data/report used was: soil study report, meteorological data, secondary information from the district Agricultural Ofice, and primary data from the farmers.
- Geological study: Conducted using ESRDF. Data used were: results of test pit excavated at the weir foundation and abutment, canal route, & prospective quarry site.
- Hydrological Study: Conducted using ESRDF guidelines. Data/reports used were: river gauge data, metreological data, land use data and maximum flood level mark on the river abutment. The major calculations made were: unit hydrograph, maximum flood, base flow and flood duration.
- Environmental Impact Assessment: Conducted using ESRDF guideline. Data source: the various study reports and field observation.
- Engineering Design: Were conducted using ESRDF guidelines. The reports/data used were: hydrological study report, agronomy study report, geological study report and surveying output. The major calculatios were focussed on determination of: weir size, weir stability and canal and canal structures dimensions.
- Financial Analysis: was conducted using ESRDF guideline. Data source: agronomy report, engineering estimates, primary data from local market.

Useful in: Describe the types of area where it can be used, the conditions where it produces good results, Sites of applications, etc. The site is located on the Mekelle - Dessie road and close to other big	**Limitations**: Describe the conditions or situations where it does not perform well and conditions that will restrict its wider application

urban areas. Traders purchase the produce at farm gate. Market was the factor for attaining good results in this site. Thus, the experience from this site is useful in areas where the farmers are able to get attractive price for their produce.	Farmers in remote areas do not use the irrigation water and land efficiently for lack of market.
Geographical extent of use: The area of the study country where it is found and the sort of areas where it could be used within the Nile Basin The intervention is practiced throughout the country.	**Effectiveness**: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do. Income and living standard of the irrigators have increased significantly
Other Sites where used:	There are many other CMI schemes with similar performance.
Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding, the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) ....The strucure was built using government resources. Cost data was not avilable.	**Operation and Maintenance arrangements**: (Who manages, operates and maintains the works, how this is funded, conrtibutions levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) O&M is undertaken by the users. WUA is responsible for coordinating the users. The users undertake canal mainatenance, which includes up to three days (3-4 hours/day) of removal of debris, sediment deposit and weed from the canals. There is no external assistance for the O&M of the scheme.
Benefits: (Estimate the returns achieved from the site if involves irrigation or costs saved in getting water if water for humans or livestock No quantitative data. But, it is noted that the income of the farmers has improved from the sale of various produce.	Water User Association or User Group: (Provide details of the type of organisation, how it works and elects members, number of members and all other pertinent details). The scheme has WUA. It was established after the scheme was constructed. It is strong and has effective byelaws where the duties and responsibilities of each member are defined.
Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users? How and why are they involved in the practice? Actual level of beneficiary involvement under operation: The scheme was initiated and constructed by the Ministry of Agriculture. Bureau of Agriculture is responsible for extension service; Who are the main beneficiaries	**Enabling Environment**: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The scheme was initiated by the government. The implementing agency had manuals to guide the design and construction of irrigation schemes. beneficiary involvement demand based interventions
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The extension staff and the farmers were given training in horticultural crop production techniques by the Bureau of Agriculture.	**Extension support:** The Bureau of Agriculture through the Wereda office and Kobo-Girana Valley Development Project provide extention support mainly in agronomical aspects. The current extension support in water management is noted to be inadequate.

<table>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Environment benefits:
The irrigation scheme is not linked with the upstream catchment protection works.

Sustainability economic aspects
cultural
environmental aspects
technical</td><td>Social/Cultural acceptability:
The irrigation scheme has brought a significant change in the livelihood of the irrigators.</td></tr>
<tr><td colspan="2">Advantages:
(i) Kob-Girana Valley Development Project has established demonstration plots & nursery to demonstrate how to produce a variety of high value crops; (ii) Traders purchase vegetables at the farm gate</td><td>Disadvantages:
(i) There are no water measurement structures; (ii) potato crop and new seedlings of banana are attacked by porcupine.</td></tr>
<tr><td colspan="2" rowspan="8">Scaling Up: (Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;)
The presence of good roads and market were the key factors for success in this scheme. Thus, provided that all other technical issues are addresed, access and market are the vital factors that would determine scaling up of best practices.</td><td>What is potential for applying all/parts of initiative elsewhere?</td></tr>
<tr><td>(Score from 1 to 10 on list below with 10 being highly applicable)</td></tr>
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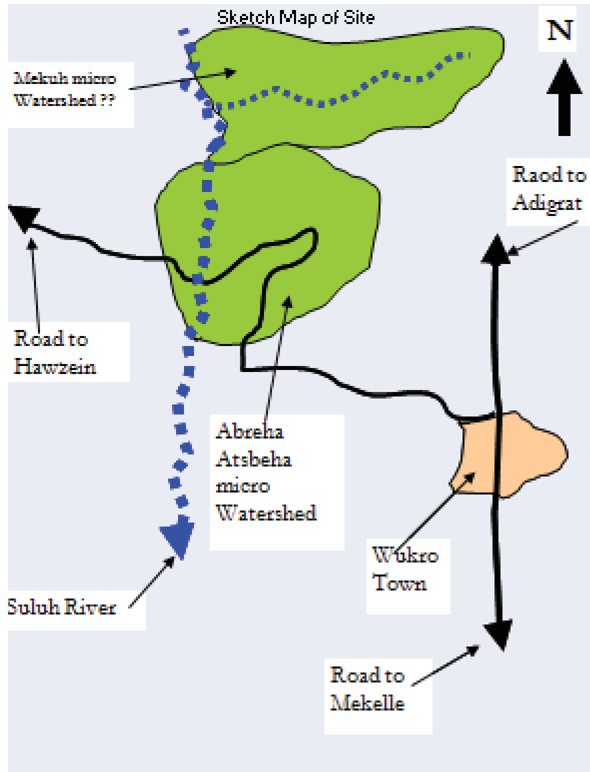
<tr><td>Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.)
Need to review master plan, if any. Downstream water users should be considered prior to planning diversion.</td></tr>
<tr><td colspan="3">Best Practices: Why this site/ case is considered to be a successful best practice; express this success in qualitative or quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations).

The farmers are growing high value crops and the cropping intensity is 200% with a possibility of a third harvest. They have established market at their farm gate. The income of these irrigators has been high compared to those in the vicinity who are irrigating more of cereals.</td></tr>
<tr><td colspan="2">Contact Organisation: (For further information; site visits' etc)</td><td></td></tr>
<tr><td>Type of organisation:</td><td colspan="2">Contact person:</td></tr>
<tr><td>[X] government organization</td><td colspan="2" rowspan="5">Contact details:</td></tr>
<tr><td>[ ] private organization</td></tr>
<tr><td>[ ] NGO &/or CBO</td></tr>
<tr><td>[ ] international agency</td></tr>
<tr><td>[ ] other:</td></tr>
<tr><td colspan="3">Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar</td></tr>
</table>

interventions)
Planning: The following factors need to be considered during the planning of the irrigation scheme: • Measures to treat or rehabilitate the catchment area should be considered so as to increase or maintain stream flow. • Extension support in irrigation agronomy, crop protection, water management and marketing should be well planned. • Monitoring and evaluation system should be designed so as to measure the performance of o irrigation agronomy, o crop protection, o water management and o marketing
Design • In light of the establishment of factories that manufacture PVC and PE pipes in Ethiopia, designers should examine the viability of using pipeline in the conveyance and application of irrigation water; • Water measurement structures should be incorporated in the design
Construction
Implementation
O&M Access road and market linkage are the key success factors in this scheme.
Beneficiary involvement
Realisation of benefits: The location of the scheme, which is near to a major highway, has contributed for better farm gate price.
Other Remarks or observations: The scheme has benefited from the technical assistance of the Kobo-Girana Valley Development Project, which has better expertise compared to those in the Wereda Agricultural Offices. Thus, upgrading the skill of the staff at the Wereda Agricultural Offices would be instrumental in improving productivity of irrigation schemes.
Contact person completing form: Leul Kahsay Gezehegn
Contact details: P.O.Box 23020 code 1000, Addis Ababa; email: samsonds@ethionet.et or leul_kahsay@yahoo.com

Abreha Atsbeha (Water Harvesting)

Date of Visit Not visited	Category: Water Harvesting
Name of Site: Abreha Atsbeha	Either water Harvesting; Community Irrigation or Private Public Irrigation
	Sketch Map of Site
Geographic location of practice: Tgray Region; Kilte Awlaelo Wereda	
(GPS) Coordinates: 13 ^o 51' N 39^o 31' E	

Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc

Vilage name = Abreha Atsbeha	Total House Holds: 992

Characteristics of the area: The area used to be degraded & moisture deficit area with poor agricultural productivity. It is now rehabilitated.

Climate (AEZ) + Description: Semi arid	
Average annual rainfall (mm) 550 mm	
Months of Short Rains:	Mar - April
Months of Main Rains:	July - Sep
Mean annual ref. crop Evapotranspiration (mm): 1700	
Predominant soil type:	Sandy and Sandy loam
Topography:	Plain valley, hilly catchment
Slope:	0- 5% farm land; 20 - 45% hillside;

Erosion: Now >70% arrested		
Period of year during which used: All year round		
Period of year during which benefits utilised: All year round		
Water Source: Rain (from runoff and recharged ground water)		
Cultivated area: No data but, 80% of the farmers are irrigating small plots each.		

Technical Description: Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems:

- Runoff generated from the hilly and undulating landscape used to inundate the farmlands with flood. Field crops were damaged by the flood and silt deposition;
- Farmlands, grazing lands and hillsides were eroded heavily resulting in big and numerous gullies and removal of a significant layer of the top soil;
- As a larger proportion of the erratic and intensive rainfall was transformed in to runoff, field crops used to suffer from moisture deficiency;
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency for a period of 7-month/year.

At the hillsides and the undulating terrain of the watershed, hillside terraces, trenches and micro basins were constructed and reinforced with grasses and bushes. Gullies were plugged with check dams and subsequently were reclaimed for cultivation. At the foot of the slopes, trenches were constructed to capture the excess rainwater and allow it to infiltrate. A series of interconnected percolation ponds were constructed along the natural water course. Soil and stone bunds were constructed on the farm land to capture rain water and protect the land from erosion. In general, 70% of the watershed is conserved and rehabilitated, and 80% of the farmers are irrigating using water from springs, river diversion, water tanks, and shallow wells. The above physical measures improved the productivity of rain fed crops and fodder grass. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased.

Technical Details: (Describe the studies that were carried out before implementation, any design manuals or guidelines that were used for implementatation, Relevant Reports and Design Data used in Designs, and any major calculations made incluidng runoff, available water supplies irrigation area or number of people supplied with water etc.).

Local Level Participatory Planning Approach (LLPPA) was used in preparing the watershed development plan. The community and technical staff of the Agricultural office jointly identified the SWC measures to be implemented in the site. The guideline used in determining the dimensions of the various SWC works was adopted from {Volli Carucci. 2000. Guidelines on Water Harvesting and Soil Conservation for Moisture Deficit Areas in Ethiopia: The Productive Use of Water and Soil: Manual for Trainers. WFP. Addis Ababa, Ethiopia}.

Useful in: Describe the types of area where it can be used, the conditions where it produces good results, Sites of applications, etc. The technology adopted in the site can be replicated in all areas where the available land is under pressure due to population pressure.	**Limitations**: Describe the conditions or situations where it does not perform well and conditions that will restrict its wider application The technology can not be successful in areas where the community is not adequately sensitized on the associated benefits.
Geographical extent of use: The area of the study country where it is found and the sort of areas where it could be used within the Nile Basin	**Effectiveness**: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do.

The technology is used throughout the country including in those situated in the Nile Basin.	Successful results are reported in all of the moisture deficit areas. Crop yields were perceived to be considerably higher on treated cultivated lands with soil and water conservation measures, but the extent depends on the general rainfall pattern. In contrast the response from farmers on untreated land suggests that crop yields are highly vulnerable to moisture stress. Farmers are able to harvest fodder grass from marginal lands and able to increase productivity of livestock. Production of honey has increased due to the enhanced biomass productivity.
Other Sites where used: are using the indicated technology.	All regions of Ethiopia, particularly the moisture deficit ones,
Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding, the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) No data. The majority of the work was done using Food for Work grain input. Farmers have also contributed own resources.	Operation and Maintenance arrangements: (Who manages, operates and maintains the works, how this is funded, conrtibutions levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) The scheme does not have cost of operation. The community has realized the benefit of the intervention and is now undertaking maintainance works on its own.
Benefits: (Estimate the returns achieved from the site if involves irrigation or costs saved in getting water if water for humans or livestock. As a result of the integrated WH efforts the following impact are observed in the watershed: • The advancement of gullies was halted and the gullied area was reclaimed for cultivation. Moisture stored behind the check dams is used for growing fruit trees; • The farmland is safe from inundation by flood and silt deposition; • The ground water is adequately recharged and is being used for irrigation, livestock and domestic water supply. Currently, there are 660 shallow hand dug wells; • The hillsides are covered now with indigenous and introduced grasses, bushes and trees; • The stoppage of free grazing has eliminated the recurrence of contagious livestock disease; • The income of the community is improved from the sale of various agricultural produce. For example, the annual cash income of one farmer in 2004, 2005 and 2006 was Birr 9,000; 22,000; and 32,000, respectively	: (Provide **Water User Association or User Group** details of the type of organisation, how it works and elects members, number of members and all other pertinent details). There is a Planning Committee (PC) in each of the Kebeles (lowest administrative units) of the site. There are also PCs at each village within the Kebele. It was the Kebele level PC in collaboration with the lower level (village) PC who were responsible for the planning activities of the watershed. In each village, the people are organized in to Development Teams comprising of 25 people each. In Abreha Atsbeha watershed, the people are organized in to 38 Development Teams. Each Development Team has its own chairperson and secretary and is responsible for carrying out SWC works on the land holdings of the team members including that of aged and disabled neighbours. They are also required to implement their share of SWC works on the communal areas – mainly on the hillsides.

Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users? How and why are they involved in the practice? Actual level of beneficiary involvement under operation: Ministry of Agriculture and Rural Development and World Food Program initiated the intervention as part of their routine task. Both agencies operate through their branch offices with technical backstopping from their respective Head Quarters The community in the watershed is the beneficiry as well as key decision maker in the process. Who are the main beneficiaries	**Enabling Environment**: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The concept of watershed development approach was initiated by the Government in the 1980s. Since then there were several training activities and implementation in the field. The approach was strengthened with the establishment of the MERET project, which is run by the Ministry of Agriculture and Rural Development and World Food Program. beneficiary involvement demand based interventions
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The frontline staffs from the Agricultural Office were trained by the MERET project before and during the implementation. The training focused on technical aspects of the SWC measures, skills in watershed planning, community participation, etc.	Extension support: (Details of any extension services provided and whther any help is given in assessing annual O&M needs and preparing costs and how the community has benefitted from this). The extension support was successful in convincing the community to (i) prevent their livestick from free grazing from the entire watershed, and feed them by cutting grass, (ii) incorporate crop residue back in to the soil, (iii) try new drought resistant crops such as pigeon pea, (iv) prepare and use of compost.
(**Environment benefits:** Whether it has been completed as part of part of watershed development or intergated management approach, how it fits in, visible benefits achived in terms or water avaialability, reduction in erosion, vegetative growth etc). The intervention was conducted within a predetermined watershed. The implemented measures have resulted in • Reduction of erosion rate, • increase of soil moisture and subsequently biomass productivity. In other areas, similar intervention has helped in the revival of springs, wells and streams. **Sustainability** **economic aspects** **cultural** **environmental aspects** **technical**	**Social/Cultural acceptability**: The community has appreciated the visible benefits of the interventions, such as: improved water availablity for irrigation; adequate grass supply for their livestock, better crop productivity, and stoppage of the active gullies.
Advantages: (Strengths of the approach adopted, how well it fits into the community and meets its needs, is it affordable and relicable, will the	**Disadvantages**: (Contraints that restict its effectivesness, the risks involved in its developments, the conditions under which it will not work or have redcued impact etc.).

<table>
<tr><td colspan="2">commmunity continue to operate, maintain and use it after outside assistance has gone and reasons for this etc.).

The interventions were identified in consultation with the community to curb the problems of poor agricultural productivity. They were implemented with minor demonstration and follow up by extension workers. After realizing the benefits, the farmers have continued to maintan and upgrade the structures on their own farm without external support.</td><td>The major constraint in promoting the indicated approach is the challenge in building consensus among the whole watershed community. Besides, as the benefits associated with the intervention are realized after more than 1 year, farmers could easily frustrate and abandon the implementation from the very begining or may not afford the time to maintain the measures constructed. For the first time, incentives could be necessary.</td></tr>
<tr><td colspan="2" rowspan="8">Scaling Up: (Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;) Efforts to scale up the indicated measures can not be constrained by climatic or cultural beliefs. But, incentives might be required when introducing the measure to new areas or cash poor farmers.</td><td>What is potential for applying all/parts of initiative elsewhere?</td></tr>
<tr><td>(Score from 1 to 10 on list below with 10 being highly applicable)</td></tr>
<tr><td>I [ ] Transfer of practice to another group/culture/land-use system, etc.</td></tr>
<tr><td>II [ ] Easy to transfer the practice, but with minor adaptations for local conditions</td></tr>
<tr><td>III [10] Transfer possible, but significant modifications/prerequisites to consider.</td></tr>
<tr><td>IV [ ] Difficult to transfer the practice. Need experienced support.</td></tr>
<tr><td>V [ ] It would be impossible to transfer the practice. Too site specific.</td></tr>
<tr><td>Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.)</td></tr>
<tr><td colspan="3">Best Practices: (Why this site/ case is considered to be a successful best practice; express this success in qualitative or quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations).

The site has employed integrated WH techniques on watershed basis. In many parts of the country, various SWC techniques were implemented on the hillsides, gullies, grazing & farm land to retain rainwater on watershed basis. The communities were able to get quick benefit in terms of increased biomass production and availability of water for various uses. Reduced flooding damage and erosion are also among the quick benefit that are attributed to the indicated approach. Besides, this approach is applicable to all land uses and topography. It could thus be easily replicated in view of the quickness of the multiple benefits and the simplicity of each of the SWC measures.</td></tr>
<tr><td colspan="2">Contact Organisation: (For further information; site visits' etc)</td><td></td></tr>
<tr><td>Type of organisation:</td><td colspan="2">Contact person: Mr. Betru Nedassa</td></tr>
<tr><td>[X] government organization</td><td colspan="2" rowspan="2">Contact details
MERET Project Coordination Office, Ministry of Agriculture and Rural Development
Email: ffwp@ethionet.et Tel: 251 11 552 53 21</td></tr>
<tr><td>[ ] private organization</td></tr>
</table>

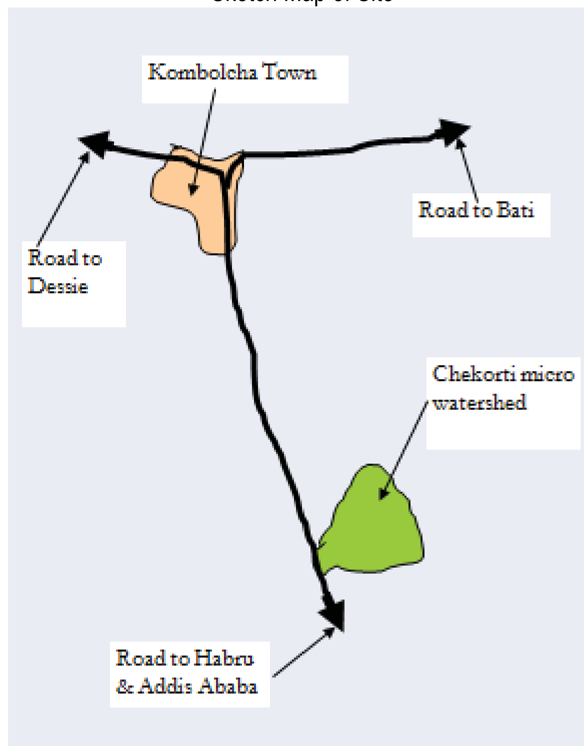
[ ] NGO &/or CBO [ ] international agency [ ] other:		
Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar interventions)		
Planning: Community has to participate in the planning. For effective result, the communities need to be sensitized using various techniques including multimedia. Study tour could be arranged locally for the community leaders and innovative farmers.		
Design The interventions should be simple, technically sound and cost effective.		
Construction Quality control should be given emphasis. Poor workmanship would lead to structural failure and consquently the farmers may loose confidence on the intervention.		
Implementation The interventions that yield immedidiate benefit should be implemented first.		
O&M As long as there are tangible benefits from the interventions, farmers can undertake the O&M effectively on their own initiative.		
Beneficiary involvement The beneficieries have to be involved from the planning stage. They have to be organized and select planning committee who would interact with extension workers and get feed back to the community. The general assembly of the community should be able to establish byelaws for the implemntaion and O&M of the interventions.		
Realisation of benefits: Such as markets; achieving better returns - crop selection &/or market linkages etc). Research and extension workers should have to coordinate efforts in establishing partnership between the community and the private sector involved in marketing of agricultural products.		
Other Remarks or observations:		
Contact person completing form: Leul Kahsay Gezehegn		
Contact details P.O.Box 23020 code 1000, Addis Ababa, Ethiopia; Email: leul_kahsay@yahoo.com OR samsonds@ethionet.et		

Legend for Waterharvesting schemes	
1. Open Pond - excavated in natural conditions	
2. Haffir/ crescent shaped dam/Water Ponds/Pans	
3. Small Dam - earth embankment	
4. Sub-Surface Dam	
5. Sand Dam	
6. Well - shallow hand dug - with SSI	
7. Well - Deep hand dug - with SSI	
8. Spring Development for SSI and/or other uses	
9. Roof Water Harvesting (Domestic Use)	
10. Runoff Water Harvesting (Domestic Use)	

11. Runoff Water Harvesting (Agricultural/Homestead Use)		
12. Rock and other surface catchment systems		
13. River water harvesting (diversions) for small scale irrigation		
14. Spate Irrigation		
15. Recharge Structures		
16. Insitu Water harvesting Measures/ Soil and Water Conservation techniques on arable rainfed lands		a. Conservation tillage
		b. Planting Pits
		c. Katumani Pit
		d. Semi-Circular Bunds
		e. Negarim
		f. Tied Contour ridges
		g. Contour Stone Bunds
		h. Fanya Juu
		i. Earth Bunds with external catchment
		j. Contour ridges with external catchment

Chekorti (Water Harvesting)

Date of Visit Not visited	Category: Water Harvesting
Name of Site: Chekorti	Either water Harvesting; Community Irrigation or Private Public Irrigation
Geographic location of practice: Amhara Region; Kalu Wereda	Sketch Map of Site



(GPS) Coordinates: 11 ^o 00' N 39^o 46' E

Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc

Vilage name = Chorisa

Total House Holds: 485

Characteristics of the area: The area used to be degraded & moisture deficit area with poor agricultural productivity. It is now rehabilitated.

Climate (AEZ) + Description: Semi arid	
Average annual rainfall (mm)	1069mm
Months of Short Rains:	Feb - Mar
Months of Main Rains:	July - August
Mean annual ref. crop Evapotranspiration (mm): 1460	
Predominant soil type:	clay loam
Topography:	Rolling - hilly
Slope:	5 - >40%;
Erosion: Now declining	
Period of year during which used: All year round	
Period of year during which benefits utilised: All year round	
Water Source: Rain (from runoff and recharged ground water)	

Cultivated area: No data	

Technical Description: Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems:

- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation;
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

Output: Various SWC works that are appropriate for each land feature and land use in all parts of the watershed were implemented. Hillsides were treated with hillside terraces, semicircular terraces, trenches, etc. and plantation of various seedlings. Arable lands were treated with soil bund, stone bunds, cut-off drains etc. Many plastic lined ponds and concrete/masonry tanks were constructed near to homesteads. Gullies were plugged with check dams and reinforced with various plantations. Spring development and river diversion works for irrigation were also conducted.

Technical Details: (Describe the studies that were carried out before implementation, any design manuals or guidelines that were used for implementatation, Relevant Reports and Design Data used in Designs, and any major calculations made incluidng runoff, available water supplies irrigation area or number of people supplied with water etc.).

Local Level Participatory Planning Approach (LLPPA) was used in preparing the watershed development plan. The community and technical staff of the Agricultural office jointly identified the SWC measures to be implemented in the site. The guideline used in determining the dimensions of the various SWC works was adopted from {Volli Carucci. 2000. Guidelines on Water Harvesting and Soil Conservation for Moisture Deficit Areas in Ethiopia: The Productive Use of Water and Soil: Manual for Trainers. WFP. Addis Ababa, Ethiopia}.

Useful in: Describe the types of area where it can be used, the conditions where it produces good results, Sites of applications, etc. The technology adopted in the site can be replicated in all areas where the available land is under pressure due to population pressure.	**Limitations**: Describe the conditions or situations where it does not perform well and conditions that will restrict its wider application The technology can not be successful in areas where the community is not adequately sensitized on the associated benefits.
: **Geographical extent of use** The areas of the study country where it is found and the sort of areas where it could be used within the Nile Basin The technology is used throughout the country including in those situated in the Nile Basin.	**Effectiveness**: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do. Successful results are reported in all of the moisture deficit areas. Crop yields were perceived to be considerably higher on treated cultivated lands with soil and water conservation measures, but the extent depends on the general rainfall pattern. In contrast the response from farmers on untreated land suggests that crop yields are highly vulnerable to moisture stress. Farmers are able to harvest fodder grass from marginal lands and able to increase productivity of livestock. Production of honey has increased due to the enhanced biomass productivity.

Other Sites where used: All regions of Ethiopia, particularly the moisture deficit ones, are using the indicated technology.

Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding,	**Operation and Maintenance arrangements**: (Who manages, operates and maintains the works, how this is funded, conrtibutions

the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) **No data**. But, the majority of the work was done using Food for Work grain input.	levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) The scheme does not have cost of operation.
Benefits: Erosion and runoff from the arable lands and hillsides are reduced. Much of the rainwater is retained in the soil profile and enabled to improve the productivity of rain fed crops and fodder grass. Ground water is adequately recharged resulting in the revival of springs and streams. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased. The income of the community is improved from the sale of various agricultural produce.	**Water User Association or User Group**: (Provide details of the type of organisation, how it works and elects members, number of members and all other pertinent details). A planning committee (involving 5 men and 5 female) with technical support from the DA and experts from the Wereda Agriculture Office prepared the watershed plan. The plan was discussed and approved by all community members. There is a strong sense of ownership of the developed assets.
Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users. How and why are they involved in the practice? Actual level of beneficiary involvement under operation: Ministry of Agriculture and Rural Development and World Food Program initiated the intervention as part of their routine task. Both agencies operate through their branch offices with technical backstopping from their respective Head Quarters The community in the watershed is the beneficiry as well as key decision maker in the process. **Who are the main beneficiaries**	**Enabling Environment**: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The concept of watershed development approach was initiated by the Government in the 1980s. Since then there were several training activities and implementation in the field. The approach was strengthened with the establishment of the MERET project, which is run by the Ministry of Agriculture and Rural Development and World Food Program. **beneficiary involvement** **demand based interventions**
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The frontline staff from the Agricultural Office was trained by the MERET project before and during the implementation. The training focused on technical aspects of the SWC measures, skills in watershed planning, community participation, etc.	**Extension support:** (Details of any extension services provided and whther any help is given in assessing annual O&M needs and preparing costs and how the community has benefitted from this). The extension support was successful in convincing the community to (i) prevent their livestick from free grazing from the entire watershed, and feed them by cutting grass, (ii) incorporate crop residue back in to the soil, (iii) try new drought resistant crops such as pigeon pea, (iv) prepare and use of compost.
Environment benefits: (Whether it has been completed as part of part of watershed development or intergated management approach, how it fits in, visible benefits achived in terms or water avaialability, reduction in erosion, vegetative growth etc). The intervention was conducted within a predetermined watershed. The implemented measures have resulted in (i) reduction of erosion rate, (ii) increase of soil moisture	Social/Cultural acceptability: The community has appreciated the visible benefits of the interventions, such as: improved water availablity for irrigation; adequate grass supply for their livestock, better crop productivity, and stoppage of the active gullies.

and subsequently biomass productivity. In other areas, similar intervention has helped in the revival of springs, wells and streams. Sustainability economic aspects cultural environmental aspects **technical**	
Advantages: (Strengths of the approach adopted, how well it fits into the community and meets its needs, is it affordable and relicable, will the commmunity continue to operate, maintain and use it after outside assistance has gone and reasons for this etc.). The interventions were identified in consultation with the community to curb the problems of poor agricultural productivity. They were implemented with minor demonstration and follow up by extension workers. After realizing the benefits, the farmers have continued to maintan and upgrade the structures on their own farm without external support.	**Disadvantages**: (Contraints that restict its effectivesness, the risks involved in its developments, the conditions under which it will not work or have redcued impact etc.). The major constraint in promoting the indicated approach is the challenge in building consensus among the whole watershed community. Besides, as the benefits associated with the intervention are realized after more than 1 year, farmers could easily frustrate and abandon the implementation from the very begining or may not afford the time to maintain the measures constructed. For the first time, incentives could be necessary.
Scaling Up: (Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;) Efforts to scale up the indicated measures can not be constrained by climatic or cultural beliefs. But, incentives might be required when introducing the measure to new areas or cash poor farmers.	What is potential for applying all/parts of initiative elsewhere? (Score from 1 to 10 on list below with 10 being highly applicable) I [ ] Transfer of practice to another group/culture/land-use system, etc. II [ ] Easy to transfer the practice, but with minor adaptations for local conditions III [10] Transfer possible, but significant modifications/prerequisites to consider. IV [ ] Difficult to transfer the practice. Need experienced support. V [ ] It would be impossible to transfer the practice. Too site specific. Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.)

Best Practices: (Why this site/ case is considered to be a successful best practice; express this success in qualitative or quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations).

The site has employed integrated WH techniques on watershed basis. In many parts of the country, various SWC techniques were implemented on the hillsides, gullies, grazing & farm land to retain rainwater on watershed basis. The communities were able to get quick benefit in terms of increased biomass production and availability of water for various uses. Reduced flooding damage and erosion are also among the quick benefit that are attributed to the indicated approach. Besides, this approach is applicable to all land uses and topography. It could thus be easily replicated in view of the quickness of the multiple benefits and the simplicity of each of the SWC measures.

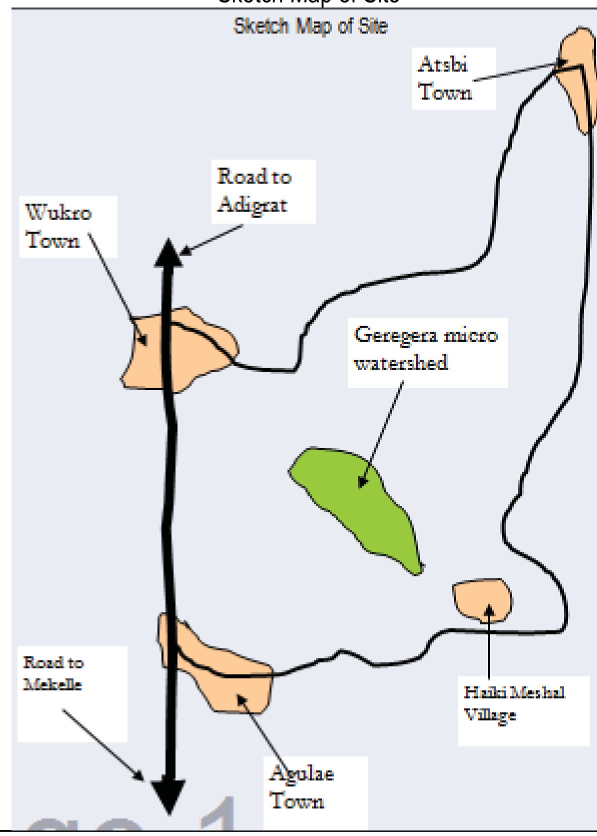
Contact Organisation: (For further information; site visits' etc)		
Type of organisation:	Contact person: Mr. Betru Nedassa	
[X] government organization	Contact details MERET Project Coordination Office, Ministry of Agriculture and Rural Development Email: ffwp@ethionet.et Tel: 251 11 552 53 21	
[ ] private organization		
[ ] NGO &/or CBO		
[ ] international agency		
[ ] other:		
Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar interventions)		
Planning: Community has to participate in the planning. For effective result, the communities need to be sensitized using various techniques including multimedia. Study tour could be arranged locally for the community leaders and innovative farmers.		
Design The interventions should be simple, technically sound and cost effective.		
Construction Quality control should be given emphasis. Poor workmanship would lead to structural failure and consquently the farmers may loose confidence on the intervention.		
Implementation The interventions that yield immedidiate benefit should be implemented first.		
O&M As long as there are tangible benefits from the interventions, farmers can undertake the O&M effectively on their own initiative.		
Beneficiary involvement The beneficieries have to be involved from the planning stage. They have to be organized and select planning committee who would interact with extension workers and get feed back to the community. The general assembly of the community should be able to establish byelaws for the implemntaion and O&M of the interventions.		
Realisation of benefits: Such as markets; achieving better returns - crop selection &/or market linkages etc). Research and extension workers should have to coordinate efforts in establishing partnership between the community and the private sector involved in marketing of agricultural products.		
Other Remarks or observations:		
Contact person completing form: Leul Kahsay Gezehegn		
Contact details P.O.Box 23020 code 1000, Addis Ababa, Ethiopia; Email: leul_kahsay@yahoo.com OR samsonds@ethionet.et		
Legend for Waterharvesting schemes		
1. Open Pond - excavated in natural conditions		
2. Haffir/ crescent shaped dam/Water Ponds/Pans		
3. Small Dam - earth embankment		
4. Sub-Surface Dam		
5. Sand Dam		
6. Well - shallow hand dug - with SSI		
7. Well - Deep hand dug - with SSI		
8. Spring Development for SSI and/or other uses		
9. Roof Water Harvesting (Domestic Use)		

10. Runoff Water Harvesting (Domestic Use)		
11. Runoff Water Harvesting (Agricultural/Homestead Use)		
12. Rock and other surface catchment systems		
13. River water harvesting (diversions) for small scale irrigation		
14. Spate Irrigation		
15. Recharge Structures		
16. Insitu Water harvesting Measures/ Soil and Water Conservation techniques on arable rainfed lands		a. Conservation tillage
		b. Planting Pits
		c. Katumani Pit
		d. Semi-Circular Bunds
		e. Negarim
		f. Tied Contour ridges
		g. Contour Stone Bunds
		h. Fanya Juu
		i. Earth Bunds with external catchment
		j. Contour ridges with external catchment

Gergera (Water Harvesting)

Date of Visit Not Visited	Category: Water Harvesting
Name of Site: Gergera	Either water Harvesting; Community Irrigation or Private Public Irrigation

Sketch Map of Site



Geographic location of practice: Tgray Region; Atsbi Wemberta Wereda

(GPS) Coordinates: 13 ^o 46' N 39^o 41' E

Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc
Vilage name = ??
Total House Holds: 300

Characteristics of the area: The area used to be degraded & moisture deficit area with poor agricultural productivity. It is now rehabilitated.

Climate (AEZ) + Description: Semi arid

Average annual rainfall (mm)	400 mm
Months of Short Rains:	April
Months of Main Rains:	July - August
Mean annual ref. crop Evapotranspiration (mm):	1700
Predominant soil type:	clay loam
Topography:	hilly and mountainous landscape

Slope:	5 - >60%;
Erosion: Now declining	
Period of year during which used: All year round	
Period of year during which benefits utilised: All year round	
Water Source: Rain (from runoff and recharged ground water)	
Cultivated area: No data	

Technical Description: Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems:

- The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Farm lands at the foot of the hills used to suffer from flooding, silt deposition and gully formation;
- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation. As a result, the people used to take their livestock for grazing to the Afar lowlands (10 – 15 km) during the dry months;

Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

Output: Various SWC works that are appropriate for each land feature and land use in all parts of the watershed were implemented. Hillsides were closed and treated with trenches, hillside terraces, etc. and plantation of various seedlings. Arable lands were treated with soil bund, stone bunds, cut-off drains etc. Gullies were plugged with check dams and reinforced with various plantations.

As of 2001, the entire watershed is almost covered with various physical SWC works. However, there is a still a need for biological SWC measures

Technical Details: (Describe the studies that were carried out before implementation, any design manuals or guidelines that were used for implementatation, Relevant Reports and Design Data used in Designs, and any major calculations made incluidng runoff, available water supplies irrigation area or number of people supplied with water etc.).

Local Level Participatory Planning Approach (LLPPA) was used in preparing the watershed development plan. The community and technical staff of the Agricultural office jointly identified the SWC measures to be implemented in the site. The guideline used in determining the dimensions of the various SWC works was adopted from {Volli Carucci. 2000. Guidelines on Water Harvesting and Soil Conservation for Moisture Deficit Areas in Ethiopia: The Productive Use of Water and Soil: Manual for Trainers. WFP. Addis Ababa, Ethiopia}.

Useful in: Describe the types of area where it can be used, the conditions where it produces good results, Sites of applications, etc. The technology adopted in the site can be replicated in all areas where the available land is under pressure due to population pressure.	**Limitations**: Describe the conditions or situations where it does not perform well and conditions that will restrict its wider application The technology can not be successful in areas where the community is not adequately sensitized on the associated benefits.
Geographical extent of use: The areas of the study country where it is found and the sort of areas where it could be used within the Nile Basin The technology is used throughout the country including in those situated in the Nile Basin.	**Effectiveness**: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do. Successful results are reported in all of the moisture deficit areas. Crop yields were perceived to be considerably higher on treated cultivated lands with soil and water conservation measures, but the extent depends on the general rainfall pattern. In contrast the response from farmers on untreated land suggests that crop yields are

	highly vulnerable to moisture stress. Farmers are able to harvest fodder grass from marginal lands and able to increase productivity of livestock. Production of honey has increased due to the enhanced biomass productivity.
Other Sites where used: All regions of Ethiopia, particularly the moisture deficit ones, are using the indicated technology.	
Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding, the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) No data. But, the majority of the work was done using Food for Work grain input. Farmers have also contributed own resources.	**Operation** and Maintenance arrangements: (Who manages, operates and maintains the works, how this is funded, conrtibutions levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) The scheme does not have cost of operation. The community has realized the benefit of the intervention and is now undertaking maintainance works on its own.
Benefits: Runoff from the hillsides is no more a threat to the downstream arable fields. Much of the rainwater is retained in the soil profile and enabled to improve the productivity of rain fed crops and fodder grass. Ground water is adequately recharged resulting in the revival of springs. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased. The income of the community is improved from the sale of various agricultural produce.	**Water User Association or User Group**: (Provide details of the type of organisation, how it works and elects members, number of members and all other pertinent details). No data.
Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users? How and why are they involved in the practice? Actual level of beneficiary involvement under operation: Ministry of Agriculture and Rural Development and World Food Program initiated the intervention as part of their routine task. Both agencies operate through their branch offices with technical backstopping from their respective Head Quarters The community in the watershed is the beneficiry as well as key decision maker in the process. Who are the main beneficiaries	Enabling Environment: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The concept of watershed development approach was initiated by the Government in the 1980s. Since then there were several training activities and implementation in the field. The approach was strengthened with the establishment of the MERET project, which is run by the Ministry of Agriculture and Rural Development and World Food Program. beneficiary involvement demand based interventions
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The frontline staffs from the Agricultural Office were trained by the MERET project before and during the	**Extension support**: (Details of any extension services provided and whther any help is given in assessing annual O&M needs and preparing costs and how the community has benefitted from this). The extension support was successful in convincing the community to (i) prevent their livestick from free grazing from the entire watershed,

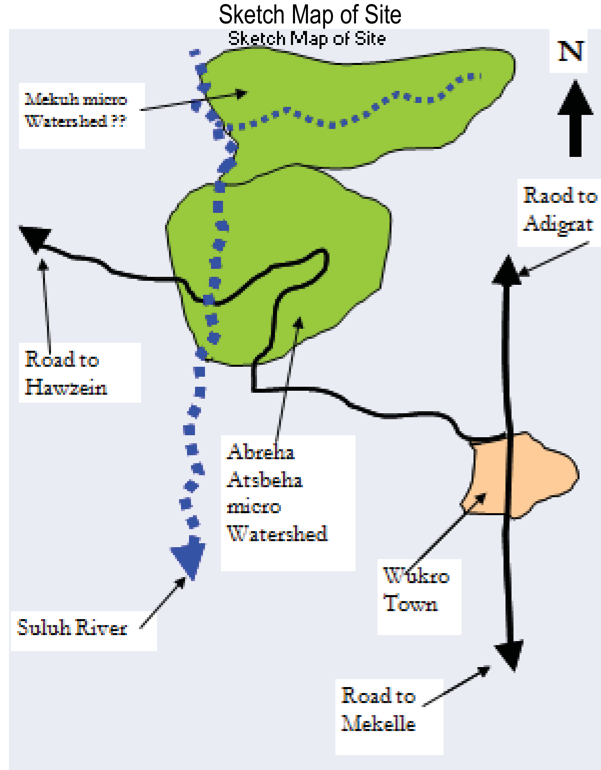
implementation. The training focused on technical aspects of the SWC measures, skills in watershed planning, community participation, etc.	and feed them by cutting grass, (ii) incorporate crop residue back in to the soil, (iii) try new drought resistant crops such as pigeon pea, (iv) prepare and use of compost.
Environment benefits: (Whether it has been completed as part of part of watershed development or intergated management approach, how it fits in, visible benefits achived in terms or water avaialability, reduction in erosion, vegetative growth etc). The intervention was conducted within a predetermined watershed. The implemented measures have resulted in (i) reduction of erosion rate, (ii) increase of soil moisture and subsequently biomass productivity. In other areas, similar intervention has helped in the revival of springs, wells and streams. Sustainability economic aspects cultural environmental aspects technical	Social/Cultural acceptability: The community has appreciated the visible benefits of the interventions, such as: improved water availablity for irrigation; adequate grass supply for their livestock, better crop productivity, and stoppage of the active gullies.
Advantages: (Strengths of the approach adopted, how well it fits into the community and meets its needs, is it affordable and relicable, will the commmunity continue to operate, maintain and use it after outside assistance has gone and reasons for this etc.). The interventions were identified in consultation with the community to curb the problems of poor agricultural productivity. They were implemented with minor demonstration and follow up by extension workers. After realizing the benefits, the farmers have continued to maintan and upgrade the structures on their own farm without external support.	**Disadvantages**: (Contraints that restict its effectivesness, the risks involved in its developments, the conditions under which it will not work or have redcued impact etc.). The major constraint in promoting the indicated approach is the challenge in building consensus among the whole watershed community. Besides, as the benefits associated with the intervention are realized after more than 1 year, farmers could easily frustrate and abandon the implementation from the very begining or may not afford the time to maintain the measures constructed. For the first time, incentives could be necessary.
Scaling Up: (Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;) Efforts to scale up the indicated measures can not be constrained by climatic or cultural beliefs. But, incentives might be required when introducing the measure to new areas or cash poor farmers.	What is potential for applying all/parts of initiative elsewhere?
	(Score from 1 to 10 on list below with 10 being highly applicable)
	I [ ] Transfer of practice to another group/culture/land-use system, etc.
	II [ ] Easy to transfer the practice, but with minor adaptations for local conditions
	III [10] Transfer possible, but significant modifications/prerequisites to consider.
	IV [ ] Difficult to transfer the practice. Need experienced support.
	V [ ] It would be impossible to transfer the practice. Too site specific.
	Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.)

Best Practices: (Why this site/ case is considered to be a successful best practice; express this success in qualitative or quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations). The site has employed integrated WH techniques on watershed basis. In many parts of the country, various SWC techniques were implemented on the hillsides, gullies, grazing & farm land to retain rainwater on watershed basis. The communities were able to get quick benefit in terms of increased biomass production and availability of water for various uses. Reduced flooding damage and erosion are also among the quick benefit that are attributed to the indicated approach. Besides, this approach is applicable to all land uses and topography. It could thus be easily replicated in view of the quickness of the multiple benefits and the simplicity of each of the SWC measures.		
Contact Organisation: (For further information; site visits' etc)		
Type of organisation:	Contact person: Mr. Betru Nedassa	
[X] government organization	Contact details MERET Project Coordination Office, Ministry of Agriculture and Rural Development Email: ffwp@ethionet.et Tel: 251 11 552 53 21	
[ ] private organization		
[ ] NGO &/or CBO		
[ ] international agency		
[ ] other:		
Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar interventions)		
Planning: Community has to participate in the planning. For effective result, the communities need to be sensitized using various techniques including multimedia. Study tour could be arranged locally for the community leaders and innovative farmers.		
Design The interventions should be simple, technically sound and cost effective.		
Construction Quality control should be given emphasis. Poor workmanship would lead to structural failure and consquently the farmers may loose confidence on the intervention.		
Implementation The interventions that yield immedidiate benefit should be implemented first.		
O&M As long as there are tangible benefits from the interventions, farmers can undertake the O&M effectively on their own initiative.		
Beneficiary involvement The beneficieries have to be involved from the planning stage. They have to be organized and select planning committee who would interact with extension workers and get feed back to the community. The general assembly of the community should be able to establish byelaws for the implemntaion and O&M of the interventions.		
Realisation of benefits: Such as markets; achieving better returns - crop selection &/or market linkages etc). Research and extension workers should have to coordinate efforts in establishing partnership between the community and the private sector involved in marketing of agricultural products.		
Other Remarks or observations:		
Contact person completing form: Leul Kahsay Gezehegn		
Contact details P.O.Box 23020 code 1000, Addis Ababa, Ethiopia; Email: leul_kahsay@yahoo.com OR samsonds@ethionet.et		
Legend for Waterharvesting schemes		
1. Open Pond - excavated in natural conditions		

2. Haffir/ crescent shaped dam/Water Ponds/Pans		
3. Small Dam - earth embankment		
4. Sub-Surface Dam		
5. Sand Dam		
6. Well - shallow hand dug - with SSI		
7. Well - Deep hand dug - with SSI		
8. Spring Development for SSI and/or other uses		
9. Roof Water Harvesting (Domestic Use)		
10. Runoff Water Harvesting (Domestic Use)		
11. Runoff Water Harvesting (Agricultural/Homestead Use)		
12. Rock and other surface catchment systems		
13. River water harvesting (diversions) for small scale irrigation		
14. Spate Irrigation		
15. Recharge Structures		
16. Insitu Water harvesting Measures/ Soil and Water Conservation techniques on arable rainfed lands		a. Conservation tillage
		b. Planting Pits
		c. Katumani Pit
		d. Semi-Circular Bunds
		e. Negarim
		f. Tied Contour ridges
		g. Contour Stone Bunds
		h. Fanya Juu
		i. Earth Bunds with external catchment
		j. Contour ridges with external catchment

Mekuh (Water Harvesting)

Date of Visit Not visited	Category: Water Harvesting
Name of Site: Mekuh	Either water Harvesting; Community Irrigation or Private Public Irrigation
	Sketch Map of Site



Geographic location of practice: Tgray Region; Kilte Awlaelo Wereda

(GPS) Coordinates: 13 ^o 53' N 39^o 32' E

Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc Vilage name = Gemad
Total House Holds: 1209

Characteristics of the area: The area used to be degraded & moisture deficit area with poor agricultural productivity. It is now rehabilitated.

Climate (AEZ) + Description: Semi arid

Average annual rainfall (mm)	550 mm
Months of Short Rains:	Mar - April
Months of Main Rains:	July - Sep
Mean annual ref. crop Evapotranspiration (mm): 1700	
Predominant soil type:	Sandy loam
Topography:	Rolling, hilly catchment
Slope:	0- 15% farm land; 20 - 45% hillside;
Erosion: Now reduced	

Period of year during which used: All year round	
Period of year during which benefits utilised: All year round	
Water Source: Rain (from runoff and recharged ground water)	
Cultivated area: No data but, average land holding per family is 0.75 ha.	

Technical Description: Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems:

- The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Farm lands at the foot of the hills used to suffer from flooding and silt deposition;
- Farmlands, grazing lands and hillsides were eroded heavily resulting in big and numerous gullies and removal of a significant layer of the top soil;
- Field crops used to suffer from moisture deficiency as a larger proportion of the erratic and intensive rainfall was transformed in to runoff;
- Grazing lands were unproductive due to overgrazing-induced land degradation;
- The flow rate of the only perennial tream in the site was very small and could not support agricultural activities other than its service as the church's holy water.
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

Output: At first, 8.5 ha degraded land was closed, covered with SWC works and then allotted to 34 landless people. After evaluating the impact more land was closed and covered with more SWC works. Gullies were plugged and planted with perennial trees. The flow of the stream was revived and was diverted to supply 23 water tanks used as night storage. All of the additional rehabilitated and developed area was allotted to 42 landless youngsters.

Technical Details: (Describe the studies that were carried out before implementation, any design manuals or guidelines that were used for implementatation, Relevant Reports and Design Data used in Designs, and any major calculations made incluidng runoff, available water supplies irrigation area or number of people supplied with water etc.).

Local Level Participatory Planning Approach (LLPPA) was used in preparing the watershed development plan. The community and technical staff of the Agricultural office jointly identified the SWC measures to be implemented in the site. The guideline used in determining the dimensions of the various SWC works was adopted from {Volli Carucci. 2000. Guidelines on Water Harvesting and Soil Conservation for Moisture Deficit Areas in Ethiopia: The Productive Use of Water and Soil: Manual for Trainers. WFP. Addis Ababa, Ethiopia}.

Useful in: Describe the types of area where it can be used, the conditions where it produces good results, Sites of applications, etc. The technology adopted in the site can be replicated in all areas where the available land is under pressure due to population pressure.	**Limitations**: Describe the conditions or situations where it does not perform well and conditions that will restrict its wider application The technology can not be successful in areas where the community is not adequately sensitized on the associated benefits.
Geographical extent of use: The areas of the study country where it is found and the sort of areas where it could be used within the Nile Basin The technology is used throughout the country including in those situated in the Nile Basin.	**Effectiveness**: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do. Successful results are reported in all of the moisture deficit areas. Crop yields were perceived to be considerably higher on treated cultivated lands with soil and water conservation measures, but the extent depends on the general rainfall pattern. In contrast the response from farmers on untreated land suggests that crop yields are highly vulnerable to moisture stress. Farmers are able to harvest fodder grass from marginal lands and able to increase productivity of livestock. Production of honey has increased due to the enhanced biomass productivity.

Other Sites where used: All regions of Ethiopia, particularly the moisture deficit ones, are using the indicated technology.	
Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding, the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) No data. But, the majority of the work was done using Food for Work grain input. Farmers have also contributed own resources.	**Operation and Maintenance arrangements**: (Who manages, operates and maintains the works, how this is funded, conrtibutions levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) The scheme does not have cost of operation. The community has realized the benefit of the intervention and is now undertaking maintainance works on its own.
Benefits: The introduced measures improved the productivity of rain fed crops and fodder grass. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased. As a result of the above integrated WH efforts the following impact are observed in the watershed: • The advancement of gullies was halted and the gullied areas were reclaimed for cultivation. Moisture stored behind the check dams is used for growing forage and fruit trees; • The farmland is safe from inundation by flood and silt deposition; • The ground water is adequately recharged and is being used for irrigation, livestock and domestic water supply. Currently, at the Kebele level there are: 103 motor pumps used for irrigation, 15 treadle pump, 23 night storage water tanks; 57 productive shallow hand dug wells (out of 112); 39 small plot drip irrigation systems; • Biogas digesters are planted in 31 sites; • The hillsides are covered now with indigenous and introduced grasses, bushes and trees. As a result, farmers are able to harvest grass for fodder and thatching. Productivity of apiculture is improved and farmers are able to harvest honey three times a year; • The income of the community is improved from the sale of various agricultural produce. For example, one model farmer is reported to own the following: 1 hand dug well, 1 plastic lined pond, 1 motorized pump, dairy cows, and 40 bee hives.	**Water User Association or User Group:** (Provide details of the type of organisation, how it works and elects members, number of members and all other pertinent details). Each village has a planning committee responsible for the overall development plan of the village. Members of the committee are: 3 from public associations; 1 village representative; 1 representative of the church; and 2 influential elders. This committee is responsible for the preparation of the watershed development plan in consultation with the extension workers.
Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users. How and why are they involved in the practice? Actual level of beneficiary involvement under operation: Ministry of Agriculture and Rural Development and World Food Program initiated the intervention as part of their routine task. Both agencies	Enabling Environment: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The concept of watershed development approach was initiated by the Government in the 1980s. Since then there were several

operate through their branch offices with technical backstopping from their respective Head Quarters The community in the watershed is the beneficiry as well as key decision maker in the process. Who are the main beneficiaries	training activities and implementation in the field. The approach was strengthened with the establishment of the MERET project, which is run by the Ministry of Agriculture and Rural Development and World Food Program. beneficiary involvement demand based interventions
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The frontline staffs from the Agricultural Office were trained by the MERET project before and during the implementation. The training focused on technical aspects of the SWC measures, skills in watershed planning, community participation, etc.	**Extension support**: (Details of any extension services provided and whther any help is given in assessing annual O&M needs and preparing costs and how the community has benefitted from this). The extension support was successful in convincing the community to (i) prevent their livestick from free grazing from the entire watershed, and feed them by cutting grass, (ii) incorporate crop residue back in to the soil, (iii) try new drought resistant crops such as pigeon pea, (iv) prepare and use of compost.
Environment benefits: (Whether it has been completed as part of part of watershed development or intergated management approach, how it fits in, visible benefits achived in terms or water avaialability, reduction in erosion, vegetative growth etc). The intervention was conducted within a predetermined watershed. The implemented measures have resulted in • reduction of erosion rate, • increase of soil moisture and subsequently biomass productivity. In other areas, similar intervention has helped in the revival of springs, wells and streams. Sustainability economic aspects cultural environmental aspects technical	**Social/Cultural acceptability**: The community has appreciated the visible benefits of the interventions, such as: improved water availablity for irrigation; adequate grass supply for their livestock, better crop productivity, and stoppage of the active gullies.
Advantages: (Strengths of the approach adopted, how well it fits into the community and meets its needs, is it affordable and relicable, will the commmunity continue to operate, maintain and use it after outside assistance has gone and reasons for this etc.). The interventions were identified in consultation with the community to curb the problems of poor agricultural productivity. They were implemented with minor demonstration and follow up by extension workers. After realizing the benefits, the farmers have continued to maintan and upgrade the structures on their own farm without external support.	**Disadvantages**: (Contraints that restict its effectivesness, the risks involved in its developments, the conditions under which it will not work or have redcued impact etc.). The major constraint in promoting the indicated approach is the challenge in building consensus among the whole watershed community. Besides, as the benefits associated with the intervention are realized after more than 1 year, farmers could easily frustrate and abandon the implementation from the very begining or may not afford the time to maintain the measures constructed. For the first time, incentives could be necessary.

Scaling Up: (Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;). Efforts to scale up the indicated measures can not be constrained by climatic or cultural beliefs. But, incentives might be required when introducing the measure to new areas or cash poor farmers.	What is potential for applying all/parts of initiative elsewhere?
	(Score from 1 to 10 on list below with 10 being highly applicable)
	I [ ] Transfer of practice to another group/culture/land-use system, etc.
	II [ ] Easy to transfer the practice, but with minor adaptations for local conditions
	III [10] Transfer possible, but significant modifications/prerequisites to consider.
	IV [ ] Difficult to transfer the practice. Need experienced support.
	V [ ] It would be impossible to transfer the practice. Too site specific.
	Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.)

Best Practices: (Why this site/ case is considered to be a successful best practice; express this success in qualitative or quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations). The site has employed integrated WH techniques on watershed basis. In many parts of the country, various SWC techniques were implemented on the hillsides, gullies, grazing & farm land to retain rainwater on watershed basis. The communities were able to get quick benefit in terms of increased biomass production and availability of water for various uses. Reduced flooding damage and erosion are also among the quick benefit that are attributed to the indicated approach. Besides, this approach is applicable to all land uses and topography. It could thus be easily replicated in view of the quickness of the multiple benefits and the simplicity of each of the SWC measures.

Contact Organisation: (For further information; site visits' etc)	
Type of organisation:	Contact person: Mr. Betru Nedassa
[X] government organization	Contact details MERET Project Coordination Office, Ministry of Agriculture and Rural Development Email: ffwp@ethionet.et Tel: 251 11 552 53 21
[ ] private organization	
[ ] NGO &/or CBO	
[ ] international agency	
[ ] other:	

Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar interventions)

Planning:
Community has to participate in the planning. For effective result, the communities need to be sensitized using various techniques including multimedia. Study tour could be arranged locally for the community leaders and innovative farmers.

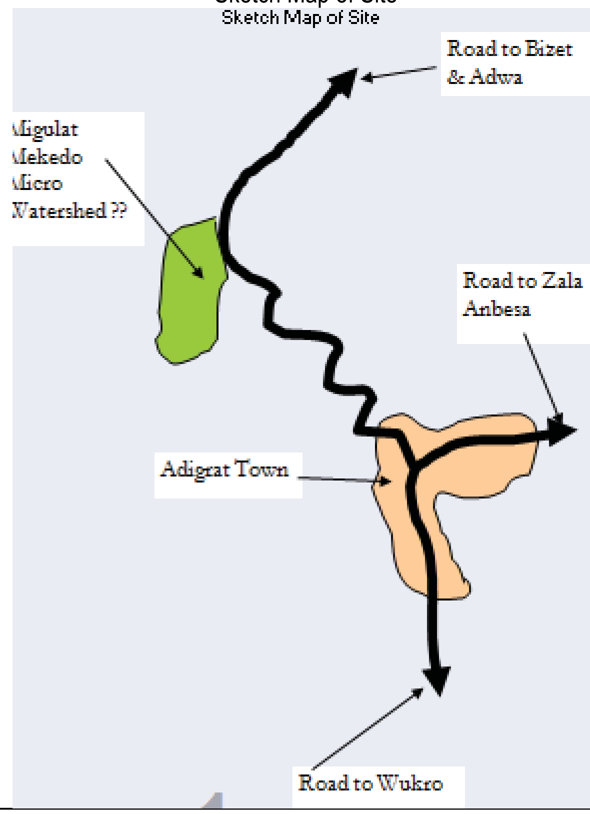
Design
The interventions should be simple, technically sound and cost effective.

Construction
Quality control should be given emphasis. Poor workmanship would lead to structural failure and consquently the farmers may loose confidence on the intervention.

Implementation The interventions that yield immedidiate benefit should be implemented first.
O&M As long as there are tangible benefits from the interventions, farmers can undertake the O&M effectively on their own initiative.
Beneficiary involvement The beneficieries have to be involved from the planning stage. They have to be organized and select planning committee who would interact with extension workers and get feed back to the community. The general assembly of the community should be able to establish byelaws for the implemntaion and O&M of the interventions.
Realisation of benefits: Such as markets; achieving better returns - crop selection &/or market linkages etc). Research and extension workers should have to coordinate efforts in establishing partnership between the community and the private sector involved in marketing of agricultural products.
Other Remarks or observations:
Contact person completing form: Leul Kahsay Gezehegn
Contact details P.O.Box 23020 code 1000, Addis Ababa, Ethiopia; Email: leul_kahsay@yahoo.com OR samsonds@ethionet.et

Legend for Waterharvesting schemes		
1. Open Pond - excavated in natural conditions		
2. Haffir/ crescent shaped dam/Water Ponds/Pans		
3. Small Dam - earth embankment		
4. Sub-Surface Dam		
5. Sand Dam		
6. Well - shallow hand dug - with SSI		
7. Well - Deep hand dug - with SSI		
8. Spring Development for SSI and/or other uses		
9. Roof Water Harvesting (Domestic Use)		
10. Runoff Water Harvesting (Domestic Use)		
11. Runoff Water Harvesting (Agricultural/Homestead Use)		
12. Rock and other surface catchment systems		
13. River water harvesting (diversions) for small scale irrigation		
14. Spate Irrigation		
15. Recharge Structures		
16. Insitu Water harvesting Measures/ Soil and Water Conservation techniques on arable rainfed lands		a. Conservation tillage
		b. Planting Pits
		c. Katumani Pit
		d. Semi-Circular Bunds
		e. Negarim
		f. Tied Contour ridges
		g. Contour Stone Bunds
		h. Fanya Juu
		i. Earth Bunds with external catchment
		j. Contour ridges with external catchment

Migulat Mekedo (Water Harvesting)

Date of Visit Not visited	Category: Water Harvesting
Name of Site: Migulat Mekodo	Either water Harvesting; Community Irrigation or Private Public Irrigation
	Sketch Map of Site 

Geographic location of practice: Tgray Region; Ganta Afeshum Wereda

(GPS) Coordinates: 13 ^o 53' N 39^o 28' E

Description of the Community: (Including no of beneficiaries; gender groups; number of households; names of villages; overall population; etc

Vilage name = Migulat and Mekedo

Total House Holds: No data

Characteristics of the area: The area used to be degraded & moisture deficit area with poor agricultural productivity. It is now rehabilitated.

Climate (AEZ) + Description: Semi arid

Average annual rainfall (mm)	500 mm
Months of Short Rains:	Mar - April
Months of Main Rains:	July - Sep
Mean annual ref. crop Evapotranspiration (mm): 1700	
Predominant soil type:	clay loam
Topography:	hilly and mountainous landscape
Slope:	20 - >100%;

Erosion: Now declining	
Period of year during which used: All year round	
Period of year during which benefits utilised: All year round	
Water Source: Rain (from runoff and recharged ground water)	
Cultivated area: No data	

Technical Description: Prior to the commencement of the integrated watershed development program, the site was characterized by the following water related problems:

- The hilly landscape was devoid of vegetative cover and consequently much of the rainfall was transformed to runoff;
- Due to the removal of a significant layer of the top soil coupled with moisture deficiency agricultural productivity was very low;
- Grazing lands were unproductive due to overgrazing-induced land degradation;
- There was severe shortage of water even for domestic use. Rainfall is low and erratic. To overcome moisture stress, farmers are used to divert runoff in to their field.
- Consequently, agricultural production was very low; and the watershed community was subjected to food deficiency.

Output: Various SWC works that are appropriate for each land feature and land use are implemented in all parts of the watershed. Hillsides were treated with hillside terraces, semicircular terraces, trenches, etc. and plantation of various seedlings. Arable lands were treated with soil bund, stone bunds, cut-off drains etc. Many ponds are constructed in the cultivated field and homesteads. Gullies were plugged with check dams and reinforced with various plantations.

At present, the watershed has a good coverage in terms of physical SWC works. But, there is a big room for biological SWC measures

Technical Details: (Describe the studies that were carried out before implementation, any design manuals or guidelines that were used for implementatation, Relevant Reports and Design Data used in Designs, and any major calculations made incluidng runoff, available water supplies irrigation area or number of people supplied with water etc.).
Local Level Participatory Planning Approach (LLPPA) was used in preparing the watershed development plan. The community and technical staff of the Agricultural office jointly identified the SWC measures to be implemented in the site. The guideline used in determining the dimensions of the various SWC works was adopted from {Volli Carucci. 2000. Guidelines on Water Harvesting and Soil Conservation for Moisture Deficit Areas in Ethiopia: The Productive Use of Water and Soil: Manual for Trainers. WFP. Addis Ababa, Ethiopia}.

Useful in: Describe the types of area where it can be used, the conditions where it produces good results, Sites of applications, etc. The technology adopted in the site can be replicated in all areas where the available land is under pressure due to population pressure.	**Limitations**: Describe the conditions or situations where it does not perform well and conditions that will restrict its wider application The technology can not be successful in areas where the community is not adequately sensitized on the associated benefits.
Geographical extent of use: The area of the study country where it is found and the sort of areas where it could be used within the Nile Basin The technology is used throughout the country including in those situated in the Nile Basin.	**Effectiveness**: (Describe whether it has achieved its objectives, how well it has done and the general strenghts of the practice and whwther it has in fact achieved what it set out to do. Successful results are reported in all of the moisture deficit areas. Crop yields were perceived to be considerably higher on treated cultivated lands with soil and water conservation measures, but the extent depends on the general rainfall pattern. In contrast the response from farmers on untreated land suggests that crop yields are highly vulnerable to moisture stress.

	Farmers are able to harvest fodder grass from marginal lands and able to increase productivity of livestock. Production of honey has increased due to the enhanced biomass productivity.
Other Sites where used:	All regions of Ethiopia, particularly the moisture deficit ones, are using the indicated technology.
Cost: (If possible, and applicable, please indicate the total budget for the best practice, the sources of funding, the implementation period, the total cost and cost per cubic metre of watre stored or per ha irrigated, beneficiary contributions, etc.) No data. But, the majority of the work was done using Food for Work grain input. Farmers have also contributed own resources.	**Operation and Maintenance arrangements**: (Who manages, operates and maintains the works, how this is funded, conrtibutions levied per user, percentage of payment received against amounts requested, any assistance and support received from Government or other organisations, etc) The scheme does not have cost of operation. The community has realized the benefit of the intervention and is now undertaking maintainance works on its own.
Benefits: As a result of the above physical measures, arable lands are changed in to a series of benches and hillsides are rehabilitated. Erosion and runoff from the arable lands and hillsides are reduced. Much of the rainwater is retained in the soil profile and enabled to improve the productivity of rain fed crops and fodder grass. Ground water is adequately recharged resulting in the revival of springs. One new spring has emerged. The enhanced water availability enabled to irrigate fruit trees and horticultural crops. As a result of the increased biomass production, livestock and apiculture productivity was increased. The income of the community is improved from the sale of various agricultural produce.	**Water User Association or User Group**: (Provide details of the type of organisation, how it works and elects members, number of members and all other pertinent details). A planning committee (involving 5 men and 5 female) with technical support from the DA and experts from the Wereda Agriculture Office prepared the watershed plan. The plan was discussed and approved by all community members. In addition to the abovementioned Kebele-level Committee, each village has also a planning committee responsible for the overall planning and implementation within the respective villages.
Stakeholders and beneficiaries: (Who are the main initiators, actors, stakeholders, beneficiaries and users. How and why are they involved in the practice? Actual level of beneficiary involvement under operation: Ministry of Agriculture and Rural Development and World Food Program initiated the intervention as part of their routine task. Both agencies operate through their branch offices with technical backstopping from their respective Head Quarters The community in the watershed is the beneficiry as well as key decision maker in the process. Who are the main beneficiaries	**Enabling Environment**: (Policies, design standards and manuals that made the concept possible, where the community obtained the idea, was it demand based or introduced by Government or private sector initiatives, etc.) The concept of watershed development approach was initiated by the Government in the 1980s. Since then there were several training activities and implementation in the field. The approach was strengthened with the establishment of the MERET project, which is run by the Ministry of Agriculture and Rural Development and World Food Program. beneficiary involvement demand based interventions
Training support: (Details of any training carried out before, during and after construction and how the community has benefitted from this). The frontline staffs from the Agricultural Office were trained by the MERET project before and during the implementation. The training focused on technical	**Extension support**: (Details of any extension services provided and whther any help is given in assessing annual O&M needs and preparing costs and how the community has benefitted from this). The extension support was successful in convincing the community to (i) prevent their livestick from free grazing from the entire watershed, and feed them by cutting grass, (ii) incorporate crop residue back in to

aspects of the SWC measures, skills in watershed planning, community participation, etc.	the soil, (iii) try new drought resistant crops such as pigeon pea, (iv) prepare and use of compost.
Environment benefits: (Whether it has been completed as part of part of watershed development or intergated management approach, how it fits in, visible benefits achived in terms or water avaialability, reduction in erosion, vegetative growth etc). The intervention was conducted within a predetermined watershed. The implemented measures have resulted in (i) reduction of erosion rate, (ii) increase of soil moisture and subsequently biomass productivity. In other areas, similar intervention has helped in the revival of springs, wells and streams. Sustainability economic aspects cultural environmental aspects technical	**Social/Cultural acceptability**: The community has appreciated the visible benefits of the interventions, such as: improved water availablity for irrigation; adequate grass supply for their livestock, better crop productivity, and stoppage of the active gullies.
Advantages: (Strengths of the approach adopted, how well it fits into the community and meets its needs, is it affordable and relicable, will the commmunity continue to operate, maintain and use it after outside assistance has gone and reasons for this etc.). The interventions were identified in consultation with the community to curb the problems of poor agricultural productivity. They were implemented with minor demonstration and follow up by extension workers. After realizing the benefits, the farmers have continued to maintan and upgrade the structures on their own farm without external support.	**Disadvantages**: (Contraints that restict its effectivesness, the risks involved in its developments, the conditions under which it will not work or have redcued impact etc.). The major constraint in promoting the indicated approach is the challenge in building consensus among the whole watershed community. Besides, as the benefits associated with the intervention are realized after more than 1 year, farmers could easily frustrate and abandon the implementation from the very begining or may not afford the time to maintain the measures constructed. For the first time, incentives could be necessary.
(**Scaling Up:** Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere - e.g., a specific climate or specific cultural beliefs or social relations which are important for the success of this practice;) Efforts to scale up the indicated measures can not be constrained by climatic or cultural beliefs. But, incentives might be required when introducing the measure to new areas or cash poor farmers.	What is potential for applying all/parts of initiative elsewhere? (Score from 1 to 10 on list below with 10 being highly applicable) I [ ] Transfer of practice to another group/culture/land-use system, etc. II [ ] Easy to transfer the practice, but with minor adaptations for local conditions III [10] Transfer possible, but significant modifications/prerequisites to consider. IV [ ] Difficult to transfer the practice. Need experienced support. V [ ] It would be impossible to transfer the practice. Too site specific. Other specific remarks: (e.g., agreements, regulations, provisions regarding Intellectual Property Rights, etc.)
Best Practices: (Why this site/ case is considered to be a successful best practice; express this success in qualitative or	

quantitative terms; whether all or only part of the practices of the site can be conidered best Practice - name them and give reasons why and provide any Conclusion and Recommendations). The site has employed integrated WH techniques on watershed basis. In many parts of the country, various SWC techniques were implemented on the hillsides, gullies, grazing & farm land to retain rainwater on watershed basis. The communities were able to get quick benefit in terms of increased biomass production and availability of water for various uses. Reduced flooding damage and erosion are also among the quick benefit that are attributed to the indicated approach. Besides, this approach is applicable to all land uses and topography. It could thus be easily replicated in view of the quickness of the multiple benefits and the simplicity of each of the SWC measures.		
Contact Organisation: (For further information; site visits' etc)		
Type of organisation:	Contact person: Mr. Betru Nedassa	
[X] government organization	Contact details MERET Project Coordination Office, Ministry of Agriculture and Rural Development Email: ffwp@ethionet.et Tel: 251 11 552 53 21	
[ ] private organization		
[ ] NGO &/or CBO		
[ ] international agency		
[ ] other:		
Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon fture similar interventions)		
Planning: Community has to participate in the planning. For effective result, the communities need to be sensitized using various techniques including multimedia. Study tour could be arranged locally for the community leaders and innovative farmers.		
Design The interventions should be simple, technically sound and cost effective.		
Construction Quality control should be given emphasis. Poor workmanship would lead to structural failure and consquently the farmers may loose confidence on the intervention.		
Implementation The interventions that yield immedidiate benefit should be implemented first.		
O&M As long as there are tangible benefits from the interventions, farmers can undertake the O&M effectively on their own initiative.		
Beneficiary involvement The beneficieries have to be involved from the planning stage. They have to be organized and select planning committee who would interact with extension workers and get feed back to the community. The general assembly of the community should be able to establish byelaws for the implemntaion and O&M of the interventions.		
Realisation of benefits: Such as markets; achieving better returns - crop selection &/or market linkages etc). Research and extension workers should have to coordinate efforts in establishing partnership between the community and the private sector involved in marketing of agricultural products.		
Other Remarks or observations:		
Contact person completing form: Leul Kahsay Gezehegn		
Contact details P.O.Box 23020 code 1000, Addis Ababa, Ethiopia; Email: leul_kahsay@yahoo.com OR samsonds@ethionet.et		
Legend for Waterharvesting schemes		
1. Open Pond - excavated in natural conditions		
2. Haffir/ crescent shaped dam/Water Ponds/Pans		
3. Small Dam - earth embankment		
4. Sub-Surface Dam		
5. Sand Dam		

6. Well - shallow hand dug - with SSI		
7. Well - Deep hand dug - with SSI		
8. Spring Development for SSI and/or other uses		
9. Roof Water Harvesting (Domestic Use)		
10. Runoff Water Harvesting (Domestic Use)		
11. Runoff Water Harvesting (Agricultural/Homestead Use)		
12. Rock and other surface catchment systems		
13. River water harvesting (diversions) for small scale irrigation		
14. Spate Irrigation		
15. Recharge Structures		
16. Insitu Water harvesting Measures/ Soil and Water Conservation techniques on arable rainfed lands		a. Conservation tillage
		b. Planting Pits
		c. Katumani Pit
		d. Semi-Circular Bunds
		e. Negarim
		f. Tied Contour ridges
		g. Contour Stone Bunds
		h. Fanya Juu
		i. Earth Bunds with external catchment
		j. Contour ridges with external catchment