Institutional environment and the local coping strategies for multiple use of water in Legedini, Ethiopia

M.Sc. Thesis by Martine Jeths

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Master thesis Irrigation and Water Engineering submitted in partial fulfilment of the degree of Master of Science in International Land and Water Management at Wageningen University, the Netherlands

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Summary

This MSc thesis research was conducted in Ethiopia as part of the project on Multiple water Use Systems (MUS) by the International Water Management Institute (IWMI) and Partners. The MUS project states that an integrated multiple use systems approach is more *sustainable* and more *effective* in *reducing poverty* then water projects with a disciplinary approach. The multiple use of water will have a positive outcome on the improvement of rural livelihoods, especially for women. As one of the project goals is to fight poverty, research will be done on how small-scale productive uses of water at the household level can be promoted in order to reduce *poverty*.

The principal study area for this thesis research was the Legedini Peasant Association in Eastern Ethiopia in the Dire Dawa Council. Legedini is situated in the arid lowlands below 1500m and is characterised by degraded land with erratic rainfall and no surface water. The people practise mixed subsistence farming, though cannot be self-sufficient and therefore depend on food aid. As Legedini is a water scarce area without any secure water source, the first priority of the Dire Dawa Administration is to provide the communities with safe drinking water (which means enough water of good quality). End 2002 the Dire Dawa Administrative Council commissioned the installation of a borehole for domestic water supply. The Hararghe Catholic Secretariat, a local NGO, engaged to implement the Development Assistance Program in this Peasant Association, installed a submerged pump powered by a diesel generator, infrastructure and developed the spring in the area. Besides introducing the new water system, HCS also introduced new crops and innovative methods of irrigation. All these measures created big expectations in the communities for the future, of being able to produce for the market and move beyond their food insecurity. Indeed these improved infrastructures and new practices brought benefits and expectations to the communities though also introduced new risks, dependencies and new vulnerabilities.

The vulnerability of this system became apparent when the pump broke down two years after becoming operational. The selected technology, which was the only suitable technology according to the water office, appeared to be too complicated, too costly and not sufficient imbedded in the institutional framework for this area and therefore not sustainable. Another threat can be the allurement of the water system to people from outside the PA even though Legedini cannot sustain more population and livestock pressure, since it is not very suitable for agriculture due to the limited water availability. The solution for improving rural livelihoods by promoting productive uses of water should be sought in creating other water source options and technologies that are affordable for the people, develop alternative sources of income or accept the fact that the people will stay dependent on external aid.

Since the concept of MUS aims at improving the livelihoods of the rural poor, one of the focus points is the promotion of small scale productive uses of water. Before introducing a small-scale MUS project the actual water quantity and quality demands as well as the future water requirements need to be assessed. These water demands should be compared with the actual water availability, including potential other water sources and considering water quality, before promoting or introducing new or other ways of water use. A useful tool for implementing MUS is the water ladder which gives the thresholds for promoting MUS. In water scarce areas with barely enough water for primary domestic use, promoting productive uses, e.g. through irrigation, is therefore not an option. The livelihood of the rural poor in water marginal areas can be improved by providing water at nearer distance and of better quality. With education on good water practises, health and sanitation, big steps can be taken in livelihood improvement. Once more water is used for hygiene, the excess or wastewater has potential to be reused for small productive uses such as irrigating a home garden. In order to arrive at an autonomous water system, cost recovery potential is needed (increased income) and in order to sell products, physical market access as well as market knowledge is required. Autonomy of the system is important to avert risks and to be less susceptible to external factors. In case of breakdown or financial problems within the system an emergency scenario should be available to avoid a local disaster.

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I would like to express my thanks to all the people in Ethiopia as well as in the Netherlands that made this research possible.

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My stay in Ethiopia and doing this research is interwoven with one person: Pauline Scheelbeek. I would like to thank Pauline for the moments of reflection on the research and experiences, mutual motivation, all the fun and good company.

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And last but not least I would like to thank my parents and brother for their unconditional support and confidence not only for this thesis, but during all my study activities.

Preface

Finally here it is my major thesis for fulfilling my MSc degree in International Land and Water Management. Sometimes a struggle, both in doing research and putting the ideas on paper, but it all made this research a valuable learning experience. It gave me new insights both for my field of specialisation as well as personal live.

During my studies I became interested in integrated water resource management and an integrated approach of tackling water use issues. What puzzles me is how the (scarce) water can be utilised and divided in such a way that the available water is used in an effective way, which can satisfy the stakeholders involved. Water is being used for many different purposes and often these issues are treated as isolated cases without broadening the scope of the topic and looking for alternative ways of dealing with the water use issues. I am interested in alternative concepts to look at the theme to come to a more effective use of the water. E.g. looking at wastewater not only from an environmental or health risk point of view, but seeing it as a window of opportunity to approach wastewater as a potential source of nutrients and water which would otherwise not be utilised. When looking for a thesis subject, the opportunity came along to do field research with the International Water Management Institute as they where looking for two thesis students to conduct research for their Multiple Use Project.

Starting this thesis my personal objective was to perform my thesis research as part of a larger project (the MUS project) and to make a contribution to this project as well as to develop insight into the practical implementation of the MUS concept. I hoped to contribute to the livelihood improvement of the rural people in Legedini with my research findings. Also the challenge and experience to conduct research in the rural area of Ethiopia appealed to me a lot.

One of the most difficult and confronting times for me was the last month of field research in Legedini: The water pump had broken down and there was a lot of uncertainty about when and if the pump could be repaired. From a researcher's point of view, it was very interesting since it clearly revealed the weaknesses in the system; however it made a big impression on me to experience the impact of water shortage on both men and livestock. People were getting skinnier since they had to walk long distances to collect water, which costs a lot of energy. The children were suffering from colds since there was less water for personal hygiene and the livestock was wearing out. It raised ethical questions on whether on not to provide water and if so at which terms. Should you provide assistance even if it creates expectations that cannot be fulfilled?

Now at the end of this thesis I can say that I gained personal insights, yet my contribution to the livelihood of the rural people in Legedini might be limited to having new friends. Still Legedini is in focus of HCS, CRS and IWMI, our research findings extended the knowledge base of Legedini and more research is carried out to contribute to improving the livelihoods of the peasants of Legedini. The ins and outs of a development project, its implementation and donor dependency were eye-openers to me. The topic of water stress and water scarcity was addressed during my study, yet to experience and see in practise what water stress really means had a great impact on me. It strengthens my vision and motivation to search for alternative and innovative ways of dealing with water use issues like reclamation of wastewater and the MUS approach.

Hopefully you will read this thesis with interest. More information related to Multiple Use systems can be found at the following web-sites:

http://www.musproject.net
http://www.iwmi.cgiar.org
http://www.irc.nl

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List of tables and illustrations

Abbreviations & Glossary

Ag/NRM	Agriculture and Natural Resource Management
BoA	Bureau of Agriculture (regional level)
BoH	Bureau of Health (regional level)
BoW	Bureau of Water (regional level)
CBHC	Community Based Health Care
CRS	Catholic Relief Service
CSA	Central Statistical Authority
DAP II	Development Assistance Program II
DCO's	Diocesan Catholic Secretariats
DDAC	Dire Dawa Administrative Council
DDAO	Dire Dawa Agricultural Office
DDHO	Dire Dawa Health Office
DDWMEO	Dire Dawa Water Mines and Energy Office
DPPLSAO	Disaster Prevention Preparedness and Labour Social Affairs Office
E.C.	Ethiopian Calendar (seven years behind the Gregorian calendar till December 31st, and eight years behind till september11th)
ECC-ECS	Ethiopian Catholic Church - Ethiopian Catholic Secretariat
ECC-SADCO	Ethiopian Catholic Church - Social and Development Commission
ECC-SDCOH	Ethiopian Catholic Church - Social and Development Co-ordinating Office of Harar
ECS	Ethiopian Catholic Secretariat
EPRDF	Ethiopian Peoples Revolutionary Democratic Front
ETB	Ethiopian Birr
EWS	Early Warning System
FDRE	the Federal Democratic Republic of Ethiopia
FFW	Food for Work program
HCS	Hararghe Catholic Secretariat
IMWI	International Water Management Institute

lpcd	litres per capita per day
m.a.s.l.	Metres above sea level
MoA	Ministry of Agriculture
MoWR	Ministry of Water Resources
MUS	Multiple-Use Water System or Services
NGO	Non Governmental Organisation
OFDA	Office of U.S. Foreign Disaster Assistance (USAID Disaster Assistance)
PA	Peasant Association
PHAST	Participatory Hygiene and Sanitation Transformation
PSNP	Productive Safety Net Programme
RRDCO	Regional Rural Development Co-ordination Office
SDPRP	Sustainable Development and Poverty Reduction Strategy Program
SUS	Single-Use System
USAID	United States Agency for International Development
WATSAN	Water and Sanitation
WSC	Water and Sanitation Committee
WU	Wageningen University
Kebele	area amounting to around 4 to 6 square kilometres
m.u.s.	Multiple-use water system or services, the sum of the institutions, services, resources, and infrastructure that allow a community to manage its water resources and the domestic and productive uses of water effectively and inclusively
Peasant Association	the lowest level administrative units consisting of about 200 to 300 households in the early nineties. (they comprise areas called kebeles)
sedeko	lit. dugged well (e.g. shallow well dug in the river)
woreda	sub-district, the lowest level above the peasant associations at which the government bureaucracy functions.
1 quintal	100 kg
1 quart	0.25 ha
1 saffi	50 kg

1 Introduction

This chapter provides some background information about Ethiopia, the country where the field research was conducted. It illustrates the context of this thesis research, and displays the problem definition as well as the objective of this thesis.

1.1 Background country

Ethiopia is a landlocked country comprising 1,12 Million km^2, located in the Horn of Africa. The country is a high mountainous plateau encircled by arid lowlands which make up approximately 60 percent of Ethiopia's land area. The highlands are separated into two main divisions by the Rift Valley, which runs from the Afar region in the Northeast straight through the country into the South-Western end, across Kenya and on into Tanzania. These two main divisions of the Ethiopian highlands are the western and the eastern plateaux and are the residence of 88 percent (MoWR, 2002) of the total population of 73 million (CIA, 2005). Due to the geological features of the country five climatic zones can be distinguished as are shown in table 1.1.

Map 1.1 Ethiopia and adjacent countries

Source: CIA, 2005

The highlands[1], account for about 95 percent of the cultivated land, due to their favourable conditions. Although rainfall is high in much of the elevated region, sometimes permitting two cropping seasons a year, overpopulation and occasional failures of the rains have created a situation of environmental degradation in many areas. The lowlands (*qolla*), are the pastoral areas and support 12 percent of the human and 30 percent of the livestock population. Due to insufficient water and grazing resources the pastoral people are forced to move seasonally from one place to another (Mesfin, 2001; Arsano, 2001; Blench et al., 2003).

Table 1.1 Ethiopia's climatic zones and their physical characteristics

Traditional Zone	Climate	Characteristic	Altitude (m.a.s.l.)	Average annual Temperature (°C)	Average annual Rainfall (mm)
Bereha	hot arid	desert	< 500	>27.5	<200
Qolla	warm semiarid	dry lowland	500-1500	27.5-20.0	200-800
Weyna Dega	cool sub-humid	mid altitude	1500-2300	20.0-17.5	800-1200
Dega	cool and humid	highland	2300-3200	17.5-11.5	1200-2200
Wirch	cold and moist	extreme highland	>3200	<11.5	2200

Source: WWD&SE, 2003a; Lemlem, 2001

Land is the basic agricultural resource on which Ethiopian society presently depends for the production of food, clothing, energy and housing. The agricultural sector accounts for 45% of the GDP, 90% of the national foreign exchange and 85% of the total employment. Out of the 112 million hectares total land area, about 56 percent is regarded to be suitable for cultivation, yet only 15 percent of the total land is presently under cultivation for the production of annual and perennial crops. Average food supply per day and per capita is between 1,600 and 1,700 calories, only 70 percent of estimated requirements. Out of the country's total population (growing rate 2.3 percent), 30 million

[1] For reasons of convenience in much literature, as well as in this research, a distinction between highlands with an altitude above 1500 m.a.s.l. and lowlands with an altitude below 1500 m.a.s.l. is made.

persons live in absolute poverty (according to the Ethiopian standard). Ethiopia has a relative[2] young population; the median age is 17 years, with an average life expectancy at birth of 48 years and a high infant mortality rate of 95 deaths/1,000 live births (CIA, 2005).

The sanitation situation in Ethiopia is very low; the development is limited and has not been a main concern of the government. Most of the population in rural and urban areas do not have access to safe and reliable drinking water and sanitation facilities. As a result above 75% of the health problems in Ethiopia are due to communicable diseases attributed to unsafe and inadequate water supply, and unhygienic waste management, particularly of human excreta. The coverage of population in Ethiopia with safe water is about 22% while proper sanitation approaches to 6% with urban areas taking most of the services, as is shown in table 1.2 and 1.3 (WWD&SE, 2003f; MoWR, 2002; Blench et al., 2003; Lemlem, 2001).

Table 1.2 Percentage of population with access to improved[3] sanitation in Ethiopia

year	1990	2002
rural	2	4
urban	14	19
total	4	6

Source: WHO and UNICEF, 2000 (updated 2004)

Table 1.3 Percentage of population with access to improved[4] drinking water sources in Ethiopia

year	1990	2002
rural	16	11
urban	80	81
total	25	22

Source: WHO and UNICEF, 2000 (updated 2004)

In 1959/1960 Ethiopia became for the first time a net food importer (Lemlem, 2001). In reaction to the 1984/1985 drought and famine, the government came with a Ten-Year Perspective Plan (TYPP) which main objective was to be self-sufficient in food production by the end of the plan period. The strategy to reach this end-term was to organise farmers into producers' co-operatives so they would have access to improved inputs and output marketing (Lemlem, 2001). Despite the efforts of the government the country is still not self-sufficient in food production, due to drought and unreliable rainfall, war, political problems, poor infrastructure, lack of appropriate technologies and insufficient institutional capacity (Lemlem, 2001). In 2003 Ethiopia was facing one of the biggest and most widespread droughts in its history. About 19% (13.2 million) of the population was in need of food assistance (CRS, 2003a).

[2] 43.9% of the population is younger then 14 years and 2.7% is 65 years and over (CIA, 2005)

[3] "Improved" sanitation technologies are: connection to a public sewer, connection to septic system, pour-flush latrine, simple pit latrine, ventilated improved pit latrine. The excreta disposal system is considered adequate if it is private or shared (but not public) and if hygienically separates human excreta from human contact. "Not improved" are: service or bucket latrines (where excreta are manually removed), public latrines, latrines with an open pit. (WHO and UNICEF, 2000)

[4] "Improved" water supply technologies are: household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection. "Not improved" are: unprotected well, unprotected spring, vendor-provided water, bottled water (based on concerns about the quantity of supplied water, not concerns over the water quality), tanker truck-provided water. It is assumed that if the user has access to an "improved source" then such source would be likely to provide 20 litres per capita per day at a distance no longer than 1000 metres. (WHO and UNICEF, 2000)

Ethiopia is naturally endowed with water resources that, if sufficient financial resources were made available, could easily satisfy its internal requirement for irrigation and hydropower (MoWR, 2002). Yet one of the difficulties is the water distribution, between 80 and 90 percent of the water resources are found in the 4 river basins of Abay (Blue Nile), Tekeze, Baro Akobo and Omo Give in Western parts of Ethiopia, where no more than 30 to 40 % of Ethiopia's population lives (MoWR, 2002). Annual surface runoff is estimated to be about 122 billion m^3 of water. Groundwater resources are estimated to be around 2,6 billion m^3. The expansion of irrigation schemes is important for the agricultural production, since the land degradation as well as the occurrence of dry years has caused production failures. Since the necessary continuing investment in soil and water conservation measures has not been undertaken in many regions even slight variations in precipitation can have extreme impacts on food security (Blench et al., 2003) The country has about 3.7 million hectares of potentially irrigable land, but the development of irrigation schemes has been minimal in the past, only 75,000 ha large-scale and 72,000 ha small-scale irrigation schemes have been developed by 1996 (MoWR, 2002). Indeed only a very small percentage of its potential is used.

Seven important ethnic groups can be distinguished in the country: the Oromo is the largest ethnic group, which covers 40% of the total population. 32% Belongs to the Amhara and Tigre group, 9% is Sidamo, 6% Shankella, 6% Somali, 4% Afar, 2% Gurage 2% and 1% belongs to other small ethnic groups. Besides from the diversity in ethnic groups, the country is divided in three religious groups. Almost 50% of the population is Muslim; about 40% Orthodox Christian and 12% is Animist. Amharic is the official language in the largest part of Ethiopia, while English is the major foreign language taught in schools. The literacy is low: half the male population is not able to read and write, while 65% of the women are illiterate (Caldwell, 1992).

Three different periods of governmental rule of major influence on rural live can be distinguished over the last century. The first period is marked by the reign of the modernising *Emperor*, Haile Selassie. Beginning in the 1920's Haile Selassie, took a series of steps to centralise power under his control, to weaken the power of the provisional nobility and to rationalise administration under a modern bureaucracy. The imperial government also tried to transform the national economy by introducing four five-year-development-plans. The first two plans did not bring any fundamental change in the agricultural production except for the coffee production. The third development plan on the other hand focussed on the importance of the agricultural sector, since Ethiopia became, as of the early sixties due to the population growth, a net food importer (Lemlem, 2001). Yet these development plans did not have the expected positive outcome. Before the fourth plan could be started in 1974 the Emperor Haile Selassie was repudiated by the military.

This military junta eliminated much of the top political and social elite. The new regime, the *Dergue*, was a Marxist regime and this period of ruling was marked by substantial change in the social, economic and political live of peasants, mainly because of a more enhanced level of government intervention in rural society. Initially this regime was popular, due to its socialist ideology, however this changed as the regime started to suppress its political opposites. Thousands of students, teachers, workers and other Ethiopians were imprisoned, tortured or executed. The introduced government's socialist program nationalised key industries and financial institutions, and increased government control over the economy and society. The most important event brought about by the regime was probably the *1975 land reform* which nationalised all land and abolished landlord-tenant relations (Amare, 1999).

A primary goal of the land reform, being rural equality and the ending of exploitation, it prescribed the allocation of land to all rural households on an equitable basis, thereby eliminating landlessness, at least for some time. Indeed the land reallocation strongly influenced the economic status and mobility of peasant households by determining their access to land, however the reform also led to specific patterns of economic inequality between households in stead of more equality (Amare, 1999) Farmers became organised in nearly 20,000 Peasant Associations (PA's). These PA's controlled the land distribution and had broad administrative as well as legal powers (Lemlem, 2001). Land reallocation continued until 1983, when only land that was the share of deceased people could be reallocated. All

forms of land redistribution were completely terminated in 1989 (Amare, 1999). By the end of the Dergue regime the PA's had become an extension of the state (Lemlem, 2001). Another major policy measure carried out by the Dergue regime on a national scale was the peasant *villagisation* or the forced concentration of households. It was conducted and justified as a means of providing services of various types of infrastructure, such as water, electricity and schools. However in practise only few of the facilities were provided, and its noticeable effect was to allow the government to gain better control of the peasantry for the purposes of taxation and creating agricultural co-operatives (Amare, 1999). The end goal of the villagisation was to have the entire population villagised around the year 1990 (Lemlem, 2001). *Taxation* had become a significant economic burden in the seventies and eighties. The term 'tax' includes the land tax and a multiple of other payments that peasants had to make as contributions to women's and youth associations etc. Peasants were taxed in a progressive manner on the basis of four socio-economic strata designed by P.A. officials who used a combination of indices such as estimated production, number of oxen and other income sources fort this purpose. Since most households did not produce an amount of grain that exceeded their needs, taxes often removed that portion of production that would have allowed them to attain self-sufficiency in grain supplies. The burden was especially acute on food-insecure households and those with minimal access to cash sources (Amare, 1999).

Continuing insurrection in the regions and a decade of warfare in the 1980's resulted in extreme running down of national resources and infrastructure as well as isolation from the major donors. In 1991, a coalition of rebel forces, the *Ethiopian People's Revolutionary Democratic Front* (*EPRDF)*, toppled the Dergue regime, a process which was accelerated as the Soviets stopped supporting the Dergue after the end of the Cold War. The national power was taken over by the *Transitional Government of Ethiopia (TGE)* and heralded a new period in which minimal government interventions in the countryside took place until administrative infrastructure could be rebuilt. In 1994 a new constitution was adopted and Ethiopia became a *Federal Democratic Republic (FDRE)*. The Federal Government introduced a number of reforms aimed at transforming the previously centralised economic policy to a new and free marketing economy (WWD&SE (2003c). A multi-sectoral political and administrative structure consisting of such units as capacity building, agriculture, health and security was put in place at the local, *woreda*[5] and regional levels. Reorganisation took place along the ethnic lines as well as land redistribution. The government also issued the Sustainable Development and Poverty Reduction Strategy Program (SDPRP) (MoWR, 2002). Various initiatives were introduced in the countryside, the most significant of which occurred in the agricultural sector. This included the implementation of an agricultural extension program which utilised Development Agents (DA) who resided in various localities, as well as the joint activities of the Ministry of Agriculture and various state-linked financial agencies. The program aimed to greatly enhance the availability of agricultural training, agricultural inputs, credit for agricultural and commercial activities, and the promotion of conservation practices. Land is still the property of the state and most farmers still see themselves as tenants of the state. Redistribution is the only mechanism by which land may be transferred from one user to another (Lemlem, 2001).

In general the pastoral lands of Ethiopia are divided into five areas namely, North-Eastern, Eastern, Southern, South-Western and Western. These areas are estimated to cover 78 million hectares (about 60% of its area). Ethiopia, has the largest livestock population of the African continent (data of 1988 in Arsano, 2001), with an estimated number of 30 million cattle, 23 million sheep, 13 million goats and 1 million camels. A big share of this livestock is living in these pastoral areas.

According to Arsono and other authors pastoralism is considered as a backward way of life by the ruling class (and thus policy makers). The Amharic term 'Zelan' for pastoralists implies being uncultured, aimless wonderer, lawless and vulgar. This perception is still shared by highlanders who were and still are politically dominant. Within Ethiopia the pastoral herders belong to the most marginalised groups of people and the post Dergue regime considered areas under pastoral production systems as 'areas of special problem'. The 1994 Ethiopian Constitution promulgated that pastoralist

[5] sub-district, the lowest level above the peasant associations at which the government bureaucracy functions

not to be displaced without their wish. However Arsano (2001) states that the absence of by-laws to effect this constitutional provision, the loss of land and watering points in favour of new concessions to state-sponsored investments continues unabated.

As explained before in 1975 land was formally brought under state ownership. All 'unsettled' or permanently uncultivated land in Ethiopia was conceived by the state authorities as 'no man's land', and hence claimed state property, hereby influencing the pastoralist livelihood to great extent. The law issued that pastoralists pay all dues to the state and they had to set up associations which simplified political control and taxation by state authorities (Arsano, 2001). In 1976 the Third Livestock Development Project (TLDP) was launched. The government developed activities that included water development (mainly construction of ponds in wet-season grazing areas), veterinary service, ranching and marketing, infrastructure such as buildings, access roads to development centres and range management and the settlement the 'nomadic' people for farming purposes (*villigisation*) (Mesfin, 2001; Arsano, 2001). Most of the State owned rangeland is in practice managed as common property and is usually controlled by an ethnic group, clan or other social units. They apply rules and traditional social control. Characteristic of the common land is low human density and high dispersion and mobility of both people and livestock to keep a long term ecological balance to check over-use (Dryland Husbandry Project, 1999).

1.2 Background research area

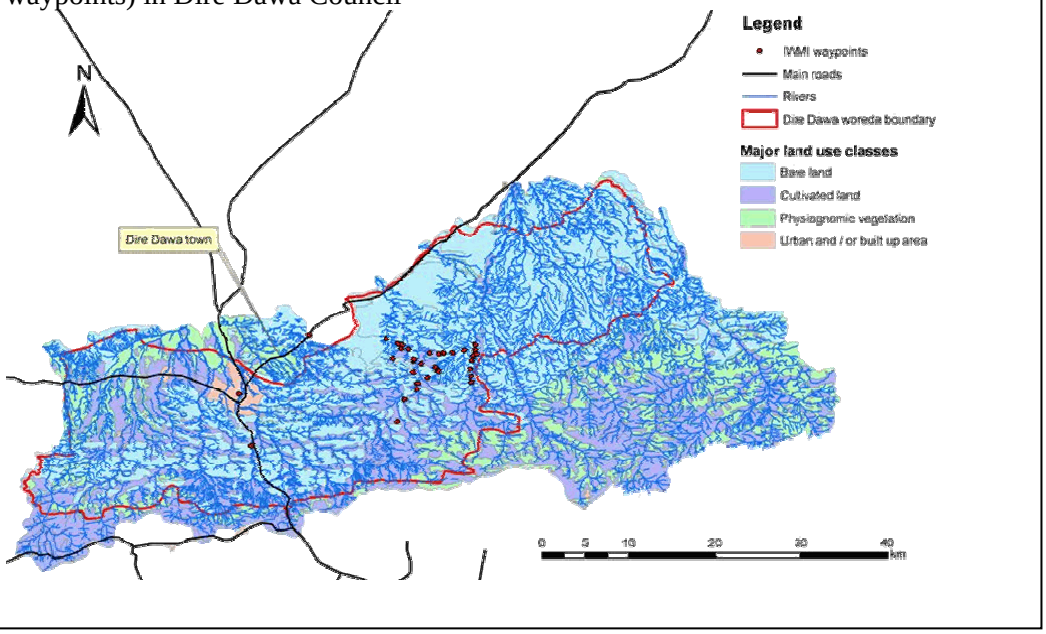
1.2.1 Dire Dawa Administrative Council

The *Legedini Peasant Association (PA)* is the boundary of the main research area and is located within the *Dire Dawa Administrative Council (DDAC)*. The Dire Dawa Administrative Council, one of the 11 Regional States, is situated in the eastern part of Ethiopia between geographic co-ordinate of $9^0$27 to 9^0 49' N and 41^0 38' to 42^0 19' E. Dire Dawa town, which is one of the largest and modern cities of Ethiopia, is the centre of the Administrative Council and lies 515km east of Addis Ababa.

Map 1.2 Administrative regions and zones of Ethiopia

All boundaries are approximate and unofficial
Graphic produced by UN Emergency Unit for Ethiopia; March 2000

Map 1.3 Location Dire Dawa town and communities in Legedini PA (marked waypoints) in Dire Dawa Council



The Council is bordered by Oromia National Regional State in the South and by Somalia National Regional State in the East, West and North and covers about 197,700 hectares, of which 194,500 hectares are rural area (WWD&SE, 2003c). The Council is totally located in the Awash River Basin and the altitude ranges from 950 to 2260 m.a.s.l. The year is divided into three seasons: a main rainy season (Meher or Keremt) between June and October, a dry season (Bega) from October to February, and finally a "small" rainy season (Belg) in March and April. The short rain however is unreliable and may start as early as the beginning of February or may be delayed until the end of March. The peak for the Meher rains lies in August and ranges from 550 mm in the Northern lowlands to above 850 mm in the Southern mountain ranges. Out of seven rainy months only the July and August rains exceed half of the potential evapo-transpiration (PET) (WWD&SE, 2003b) (see appendix VII: Evaporation and rainfall data in DDAC) Within the Council the monthly mean maximum temperature ranges from 28.7^{o}C, in the months of December and January, to 34.6^{o}C in the month of June. Likewise, the monthly mean minimum temperature varies from 14.5^{o}C in December to 21.6^{o}C in June (WWD&SE, 2003b).

Agriculture plays a key role in the regional economy of Dire Dawa Administrative Council, yet agricultural marketing is, like in the rest of the country, at very low standard and concentrated in the larger towns. The marketing system in the nation prior to 1974 was characterised by relatively high degree of competitiveness. After 1974, the military government abandoned the free marketing, distribution policy and introduced a wide range of state interventions in grain marketing. The marketing system was a closed marketing system in which the farmers are forced to sell their produce at a fixed price to the Agricultural Market Corporation (AMC) which is a government institution. The DDAC has several small markets and the largest is at Dire Dawa town where several agricultural products exchange (WWD&SE, 2003b). Trade and export are the most important economic activities for the town of Dire Dawa with its proximity to the border with Djibouti and facilities as an (international) airport as well as train station.

Table 1.4 Average production per ha in DDAC

Crop	Production in kg/ha
Sorghum	1400
Groundnut	2450
Peach	8000
Papaya	20000
Sweet potato	20000
Potato	19200

Source: WWD&SE, 2003b

Over 37450 ha of land is cultivated and about 1452 ha of land are already developed under traditional irrigation. The major crops produced are cereals, pulses, fruits and vegetables. The major constraint for agricultural development is the harsh climate: moisture stress and high temperature are the two most affective conditions. Besides the harsh climate also different natural hazards, such as recurrent drought, soil degradation as a result of erosion, rapid deforestation, flood and drainage problems, have resulted in low productivity of the region which cannot meet the requirement of the inhabitants in most cases (Table 1.4 and 1.5). Without improving the soil moisture to support the crop water requirements the food production will not be improved and therefore irrigated agriculture practises are needed. But the productivity of existing irrigated crops is much lower than it should be due to lack of funds and know-how of the farmers as well as inadequate extension agent coverage, lack of institutional support, absence of agricultural inputs and lack of credit services (WWD&SE, 2003c). Present land use and land cover of an area is usually a very good indicator of the agricultural potential of land agricultural development in the DDAC (WWD&SE, 2003b).

Table 1.5 List of crops, area, production and yield 2002 DDAC at household level

Crop	Area of Arable land in Hectare (Mean)	Production in kg (Mean)	Yield in (kg/ha) (Mean)
Sorghum	1.23	351	530
Maize	.74	156	258
Groundnut	.33	200	475

Note: Under each crop the yield and production are very low caused by the drought situation. Mean area of the arable land per household is >1ha. Drought is the most common cause of crop loss; confirmed by the households under consideration.
Source: WWD&SE (2003b)

According to the 1994 census the total population of the DDAC is estimated to be 251,864 out of which the urban population is 173,188 and that of the rural population as 78,676. The population is expected to grow at an average rate of 2-4 % for the next 30 years (WWD&SE, 2003c). There are over 35 ethnic groups in DDAC and nearly as many languages. There is a distinct difference between Dire Dawa town and the surrounding rural areas. In the rural areas 85 percent of the population is Oromo and 14 percent Somali. In Dire Dawa town the four main indigenous groups are Amhara (40%) Oromo (31%), Somali (14%) Guraghe (7%) and Tigrawe (3%). The dominating religion practised is the Islam by 98 percent of the total population (WWD&SE, 2003c).

The main water sources in the Administrative Council are rain, very few springs, groundwater, flood and hand dug wells. These water sources are not dependable during the dry season, especially those located at the lowlands, due to the fluctuation of the water table, and in some cases the sources dry out completely because of the non-availability of perennial rivers for continuous recharging of the groundwater. In the Administrative Council, there is not any perennial river or surface water body that does not dry-up. The water sources for both communities and livestock are protected and un-protected sources, which have been constructed by the government and aid agencies with participation of the communities. Groundwater is the source of virtually all of the rural domestic water in the Administrative Council. Domestic water supply in the rural part of the council consists of:

-Shallow wells with and without hand pumps fitted
-Protected springs with on spot and pipelines distribution
-Motorised systems
-Unprotected springs, ponds
-Rain water harvesting for clinic, schools etc.

The rural water supply and rural sanitation coverage is 24% and 3% respectively (WWD&SE, 2003f).

1.2.2 Legedini

The *Legedini Peasant Association (PA*) is a remote area, situated in the Dini[6] watershed, 31 km northeast of the town of Dire Dawa in Dire Dawa Administrative Council. The area has a total coverage of 9,300 ha, a population of 4,125 persons and a population density of 20 to 52 persons per km^2. About 205 ha is under cultivation in Legedini PA of which 4.5 ha is occupied with perennial vegetation (WWD&SE, 2003c). Most of the eleven villages in the Legedini PA are settled two generations ago. Before the inhabitants were pastoralist that moved seasonally with their livestock trough the vicinity in search of water and fodder. The agro-pastoralists that settled in the area have the Oromo ethnicity and are Muslim. Besides the settled agro-pasotralists, there are also nomadic people living in the area, which have the Somalic ethnicity (ECC-SDCOH, 2003).

The area is characterised by bimodal rainfall of 420-650 mm per year with the Belg[7] rains in March and April and the Meher[8] rains from July till September. March and April are the identified months for ploughing. The altitude ranges from 1100 to 1650 m.a.s.l. and is classified as *qolla* or lowland and, as most arid lowlands in Ethiopia, the area is characterised by rocky, degraded land with erratic rainfall.

No surface water is available, and only ephemeral rivers are found. The characteristics of the area are the severely degraded environment, the high potential evaporation of 210 to 320 mm per month, low water holding capacity of the soil, which leads to a low production of 400 to 600 kg of sorghum per ha per year (ECC-SDCOH, 2002) and a low level of income diversification opportunities.

Five main water sources are identified within the Legedini PA namely one shallow well, one unprotected spring, one water harvesting pond and in the past two years, two new water sources where developed viz. a borehole and a protected spring source. Not all the inhabitants use the same water source to fetch water. All water sources in PA are used for multiple purposes: domestic use (potable water, cooking, washing) as well as watering livestock.

The main problem of the area is its food insecurity caused by the degraded land, unreliable rainfall and the low crop productivity and has therefore been under food aid since 1984. Table 1.6 gives an indication of the amount of food aid needed in Legedini PA.

Table 1.6 Amount of Wheat Distributed by the DPCC and Number of People Receiving in Legedini PA from July to November 2002.

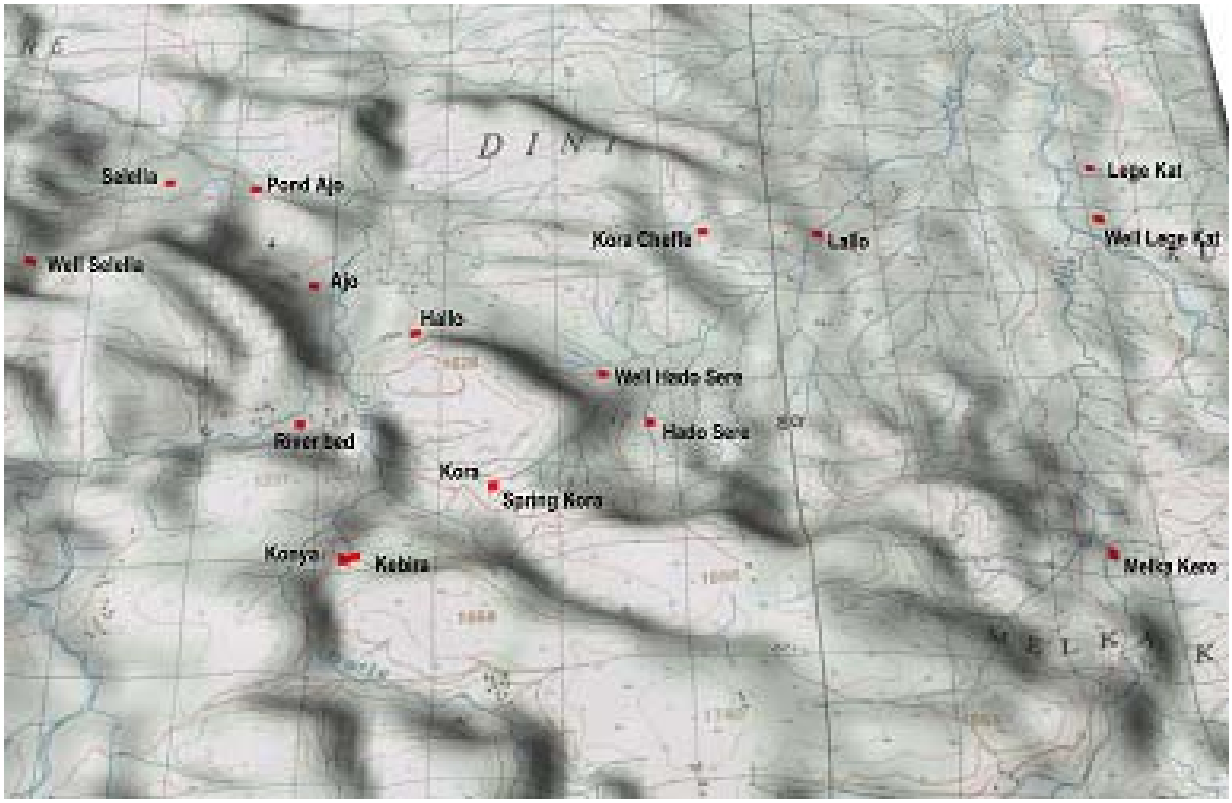
No of people	July	August	October	November	Sum
	wheat (kg)	wheat (kg)	wheat (kg)	wheat (kg)	wheat (kg)
700	6100	6100	6000	8800	27000

Source: WWD&SE (2003c)

In 2003 the Legedini Peasant Association was admitted to the Development Assistance Program II financed by the USAID. Part of the DAP II project consists of reforesting the hillsides and putting stone bonds as erosion protection measure and are, like all activities undertaken by DAP II part of the food for work program. Another important activity of the DAP II program was the development of two water sources of good potable quality[9] in the past two years (the before mentioned borehole and protected spring source), which are particularly benefiting the five communities of Ajo, Hallo, Edo, Edo Bolo and Kora.

[6] the Dini is the main ephemeral river running trough the PA of Legedini, after which the PA is named
[7] the small spring rains; in the highlands referring to the second most important sowing season
[8] long and heavy summer rain, normally called the big rain; also know as *keremt*
[9] other water sources found and used in the area are of poorer quality and less reliable

Map 1.4 Three dimensional mapping of the location of Legedini PA communities



Scale raster 1km by 1km

1.3 Research problem

The rural and urban poor use water for domestic as well as productive uses to sustain their livelihood. However in satisfying their different water needs, by this multiple use of water, they use water which is delivered either for domestic or productive use. Therefore this multiple use of water is often illegal and actively discouraged by governmental regulations. Recently the discussion is started among scholars and institutions that promoting multiple use water supply systems might be the way to provide the poor with sufficient water and so create new opportunities for tackling poverty. These approaches acknowledge that the rural poor not only need safe drinking water, but that the productive uses of the water have a positive impact on the living standards as well.

A learning alliance program was set up by the International Water Management Institute (IWMI) and 6 other lead institutions in order to further develop the multiple use approach. The other lead institutions involved are: Centro Internacional de Agricultura Tropical (CIAT), International Water and Sanitation Centre (IRC), Natural Resource Management Institute (NRI), International Development Enterprises (IDE), Mekelle University Ethiopia (MKU) and Khon Kaen University Tailand (KKU). Besides these lead institutions, national partners, associated partners and an Advisory Committee are involved in the MUS project. The project will be executed in five river basins amongst which the Nile basin where Ethiopia is enclosed. For Ethiopia the project does not only focus on the Nile basin, but has research areas selected all over the country (CPWF-28, 2003).

The two main objective of the Multiple Use Systems project are:
1) To generate a knowledge base and synthesise the knowledge into innovative models, guidelines, and tools for rural and peri-urban water supply systems that should fulfil both domestic and productive needs; be are sustainable and inexpensive and have a quantifiable positive impacts on food security, income, work load, health and well being, in particular of women and children.

2) To build the capacity of project partners and to engage, inform, prepare and build the capacity of other professionals and policy makers from the domestic and productive water sectors in NGOs, government, financing institutions, private sector, and development organisations, to up scale the implementation of multiple-use water supply systems (CPWF-28, 2003).

By these objectives the MUS project wants to contribute to achieving three of the UN Millennium Development Goals[10] of halving, by 2015, the number of people without sufficient *food and income* and the number of people without access to *safe domestic water*, while *empowering women* (CPWF-28, 2003).

The hypothesis of the MUS project is that integrated multiple use systems are more *sustainable* and more *effective* in reducing *poverty*. The multiple use of water will have positive outcome on the improvement of human health as well as rural livelihoods, especially for women. As one of the project goals is to fight poverty research will be done on how small-scale productive uses of water at the household level can be promoted in order to reduce *poverty*.

1.3.1 MUS Ethiopia

In the past Ethiopia has suffered from severe droughts which put a big stress on the water sector. Not only the agricultural sector but also the industrial, environmental and domestic sectors have experienced and suffered from these droughts. The Multiple-Use Systems project seeks to design, test and promote models, guidelines and tools for the upgrading of existing systems to systems where sources, users and uses are effectively integrated. The Ethiopian government has committed itself to the Millennium Development Goals (MDG) and to reach these goals, projects like the MUS project are granted and facilitated.

One of IWMI's development partners in Ethiopia is the Catholic Relief Service (CRS). The CRS was involved in the response to the severe drought in Ethiopia of 2003. In 2003 a new five year USAID funded Development Assistance Program (DAP) was started, i.e. DAP II. (CRS, 2003a) The CRS itself works with several Catholic missions through out Ethiopia among which the Ethiopian Catholic Secretariat (ECS) for the implementation of development projects. CRS is a strong promoter of Multiple Use Systems and has been applying their MUS concept for several years in Ethiopia amongst others. One of the ECS' sub-offices is the Hararghe Catholic Secretariat (HCS) based in Dire Dawa town and involved in the execution of the DAP II program in the research area. One of the components is the development of water supply systems based on Multiple Water Use.

1.3.2 Legedini and MUS

The Legedini Peasant Association in the Dire Dawa Administrative Council is one of the development sites of the HCS, which will be used by the International Water Management Institute as one of its learning sites. All villages in the Legedini Peasant Association are food-insecure, which is the reason of the government and the HCS to take the Legedini PA into the Development Assistance Program II. Part of the DAP II project is the development of water sources for which the HCS uses a MUS approach.

1.4 Problem statement

Legedini Peasant Association is a food insecure area with a harsh climate and no reliable surface water source. Water is the crucial limiting factor for the livelihoods and, next to other livelihood improvements; there is big need for good water access within the communities.

The lack of domestic water supply, poor access to sanitation facilities combined with the lack of personal hygiene practices, have resulted in alarming health hazard. The poor nutrition supply, micro-

[10] see United Nations Millennium Development Goals at http://www.un.org/millenniumgoals/

nutrient deficiency, poor access to immunisation and diarrhoea diseases, as a result of poor access to potable water, have compound effect to child mortality rate above the national standard. Among the major causes of food insecurity and/or poverty in the target area is the poor health status of the community, particularly of children and mothers. The direct causes of poor health are poor access to domestic water supply, poor health services and backward sanitation and hygiene practices, facilities and malnutrition (ECC-SDCOH, 2002). Providing integrated access to domestic as well as productive water at the village level provides clean domestic water for the rural poor and at the same time it creates livelihood diversification opportunities and can uplift poverty (Polak et al., 2004).

1.5 Research objective

The goal of the MUS project is to: "improve poor people's food security and health, reduce unpaid workloads, alleviate poverty and enhance gender equity through more effective use of small-scale water supplies, by generating and testing models, guidelines and tools for sustainable multiple-use water systems that are financially affordable to the poor" (Boelee and Behailu, 2005).

The scientific objective of this thesis research is to contribute to the development of the concept of MUS by finding out the bottlenecks between the different local practices of the water users and the rules and regulations within the MUS context through analysing a water supply system where MUS is taken into account in the design phase. The recommended adjustments should be feasible as well as applicable for the local users. For Legedini the redesign will focus on the infrastructure and the institutions. This thesis research is one of the pilot studies of the MUS project in Ethiopia and the Research Area is one of the Learning Sites of the IWMI.

1.6 Research questions

In order to reach the before mentioned objectives the research can be divided into three focus point: institutions and arrangements, local coping strategies and infrastructure. Special focus will be on the local coping strategies of the rural communities and households for using water for multiple purposes and the different institutions involved. The focal point will be on the strategies when people are experiencing water stress or water scarcity due to seasonal or annual droughts.

1.6.1 Main research topic

To analyse the institutional framework of rules, regulations and institutions over multiple water use and the local coping practises of the different water users in relation to the different water uses, within the DAP II project in the Legedini Peasant Association, in the Dire Dawa Administrative Council.

The following sub-questions were formulated in order to make the research topic operational.

1.6.2 Research questions

Institutions and arrangements

- Which institutions are involved in water management and water allocation in the Legedini PA and what is their influence and impact?
- Are there Water Users Organisations in which the water users are organised and is their original mandate adapted?

Local coping strategies

- Did the water users adapt the water system to their own needs and uses and if so, how?
- Do people react on change in water quantity and quality and if so what are their coping strategies related to different water quantity and water quality?
- What are the effects of these coping strategies on other water users and other water uses (quantity, quality, rights, institutional etc)?
- Are their conflicts between the different water users and if so how are they solved?

Infrastructure

- How much flexibility is there within the physical system to adjust it to changes in water uses and water needs and can it deliver the allocated water?

Analytical questions

- What institutional framework is needed for redesigning the water supply system to come to a more sustainable and effective multiple water use system?
- Can local coping strategies be a valuable input for redesigning the water supply system as a multiple water use system and if so, how?
- How does the MUS approach work in practice?

1.7 Outline of the thesis

This thesis report consists of eight chapters. The first chapter provides background information on the study, the study area and the objectives and research questions. The concepts and methodologies are elaborated in chapter 2. Chapters 3 to 6 give results and observations. Chapter 3 describes the institutions and organisations involved in the research area. Chapter 4 draws a picture of the livelihood and coping strategies of the peasants in Legedini. Chapter 5 focuses on the visited villages and their water systems. Chapter 6 gives a perspective on MUS from other visited sites in another geological setting. Finally in the last two chapters 7 and 8 the findings are discussed, conclusions drawn and some recommendations given.

2 Theoretical framework and methodologies

This chapter describes the different frameworks in which this research was put into effect. It elaborates the methodologies used and the setting.

2.1 Concepts

Some of the terminology used needs some clarification as well as a definition of what is understood by these concepts in this research.

2.1.1 Multiple Use Systems

Over the course of many years, the modern water 'sector' has been created, with its range of sub-sectors, each with its own approaches, doctrines, and sectoral boundaries. Water for domestic use is supplied by the drinking water and sanitation sector and water for agriculture by the irrigation sector. Irrigation made it possible to harvest a better yield and start cropping other species (like e.g. cash crops). In conventional irrigation system design, the designers mainly focused on the productive uses of water, as being assigned by agricultural departments. This sectoral approach succeeded in providing billions of people with safe water supplies; however the failure is that 20 to 30% of the world's population, especially the poorest and disproportionately women have not shared in these benefits (Moriarty et al., 2004b). This is very evident in the rural areas, but also in urban areas city dwellers may use domestic water for other purposes like small (informal) enterprises e.g. brewery or urban agriculture.

Integrated Water Resource Management is a reaction to the sectoral approach and tries to reflect the multiple identities and uses of water resources. The requirements for drinking water supply and small scale irrigation at the household level are closely related (WHO, 1995). Yet the use of drinking water for other purposes is informal and many times illegal. In many irrigation systems all over the world, the water delivered by these systems is used for many other purposes besides agriculture (Boelee and Laamrani, 2004), often because it is the only available water source. In many cases the water users have adapted the system to their needs, since the design does not comply with rural practice, however more recently designed or rehabilitated schemes will provide facilities like cattle water points, or washing basins. Actually parallel drinking water supply is not always planned in the areas where large-scale modern irrigation systems were realised. The same goes for domestic water supply systems whereby the water is used for small productive uses.

In a reaction to these failures, new approaches have been developed that are founded on a holistic way of tackling the problem of water supply. One of these holistic approaches is the Multiple Use System (MUS) approach, which recognises these multiple uses. The MUS concept is not a completely new one, yet within the project context it is tried to improve and operationalise the concepts and theories of MUS. This more holistic approach of MUS will in the end lead to a more sustainable water delivery system. This also asks for a reframing of the traditional supply-focused approach of the water sector. An alternative might be a livelihood based approach which is demand driven and also addresses the productive uses of domestic water.

The definition of MUS as used by the project is:
'A multiple-use system (m.u.s.) is the sum of the institutions, services, resources and infrastructure that allows communities to effectively and inclusively manage their water resources and the domestic and productive uses of water.' Within this MUS-concept three different water systems are identified:
Productive plus (prod+), Domestic plus (dom+) and End-users water systems

Productive+ means that the system is originally designed for delivering irrigation water, whiles in practice the water is also used for other means e.g. laundry, cooking. Also seepage water being reused for domestic use can be considered productive plus.

Domestic + is a water system designed for providing domestic water, whereby the water is also used for other domestic uses then drinking water and sanitation. E.g. watering the home garden, brick making, laundry, watering livestock
End-user system. There are no water providers; the water is individually collected by the household. Examples of this small scale collection are rooftop water harvesting and a personal well.

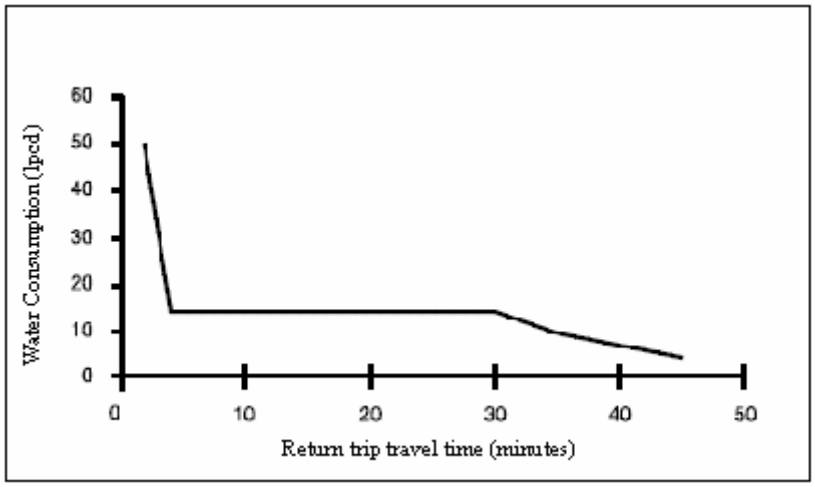
In many arid and semi-arid regions where irrigation structure is already available, domestic delivery is lacking or insufficient. The challenge for these marginal areas in providing drinking water is to utilise the existing structure. The advantage of using the existing irrigation infrastructure is that the water is delivered to the farm fields and often close to the homesteads. The problem to overcome might be the water quality, water handling and the supply sequence, which can be overcome with water storage facilities and point of use (or home) treatment (Boelee et al., 2000). Whilst in other regions there is a domestic water supply system, but no facilities for productive or other uses. Integration of the different water use will help to make better use of the limited water source and to create a more sustainable system. Treating domestic water supply service as an isolated case from other water uses is more expensive and has lesser change to cover all the area where no safe drinking water is available Boelee et al. (2000) state that it might be more cost-effective to improve the use of irrigation water for domestic purposes at household level than to exploit groundwater.

2.1.2 Livelihood and MUS

Difficult choices need to be made in the allocation of water between the different sectors especially if domestic water needs are to be met at an *affordable cost*. In national laws domestic water needs are given priority in allocation above other uses. Domestic use accounts for less than 10-20% of water use in the developing countries compared to 60-80 % for agriculture (Moriarty et al., 2004a). Even though the domestic water needs seem to be very small compared to agricultural water demand, in times of water scarcity the competition and conflict over the water can have a big impact on the domestic water supply. The distribution of water is closely linked to the distribution of livelihood opportunities. The recognition of the productive activities depending upon domestic water supplies is very important, since these productive activities contribute especially to the *livelihoods* of women and the poor. Having alternatives for income generation can make the difference between minimally viable livelihoods and destitution, therefore productive use of water at the household level is an important opportunity for the rural poor for livelihood diversification and income generation. It is very difficult to distinguish between the water used for domestic purposes and for some productive use at the household level, yet it is evident that the domestic water use to sustain livelihoods is an integral part of household coping strategies for the urban as well as rural poor (Howard and Bartram, 2003).

A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual household (Ellis, 2000). Construction of livelihood should be seen as an ongoing process, in which it cannot be assumed that the elements remain the same from one season, or from one year to the next. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its assets and capabilities without undermining its natural resource base. For the poor their resource base is the key to survival, and as such water resources and productive use are fundamental to life and the basis for many livelihoods (Soussan, 1998). Water resources can be directly used in livelihood activities and are important for the ecosystems on which livelihoods depend (Soussan, 1998). Time and energy saved by supplying water near the homesteads has a direct positive effect on the livelihoods of the rural poor.

Figure 2.1 Graph domestic water consumption in lpcd versus travel time in minutes



Source: WELL, 1998

A more equitable water distribution might be needed to meet the demand for greater small-scale household level utilisation of water for income-generating activities and therefore livelihood opportunities. A livelihood based approach of multiple water uses systems which is demand driven and also addresses the productive uses of domestic water changes the supply driven way of water delivery into a responsive (demand) approach. Productive use of water at the household level are often those water use activities that can not be listed under one of the sub-sectors, but take place at the intersection of those; often the water use activities are not recognised since they are informal. In many cases domestic water supply is under the mandate of the water and sanitation (WATSAN) sub-sector while water for agricultural production is supplied by the irrigation sector; however small-scale productive uses are rarely the focus of the irrigation sector. Yet these small-scale productive uses play an important role in the livelihood strategies of the (rural) poor by providing improved nutrition and income generation (Moriarty et al., 2004b), that is why multiple-use water supply systems can contribute to improving the livelihoods of the rural poor by addressing both health improvement and increased production and income (Pérez et al., 2004).

Several studies have shown, that health benefits are more related to water quantity, which create the opportunity to improve sanitation and hygiene behaviour then the quality of water consumed. (Boelee, 2000; Howard and Bartram, 2003). Most literature focus on water quality guidelines and water quantity guidelines are more difficult to trace. Tables 2.1 and 2.2 show two efforts to relate the accessibility and water volume used to the different water uses.

Table 2.1 Summary of requirement for water service level to promote health

Service level	Access measure	Needs met	Level of health concern
No access (quantity collected often below 5 lpcd)	More than 1000m or 30 minutes total collection time	Consumption – cannot be assured Hygiene – not possible (unless practised at source)	Very high
Basic access (average quantity unlikely to exceed 20 lpcd)	Between 100 and 1000m or 5 to 30 minutes total collection time	Consumption – should be assured Hygiene – hand washing and basic food hygiene possible; laundry/bathing difficult to assure unless carried out at source	High
Intermediate access (average quantity about 50 lpcd)	Water delivered through one tap on plot (or within 100m or 5 minutes total collection time	Consumption – assured Hygiene – all basic personal and food hygiene assured; laundry and bathing should also be assured	Low
Optimal access (average quantity 100 lpcd and above)	Water supplied through multiple taps continuously	Consumption – all needs met Hygiene – all needs should be met	Very low

Source: Howard and Bartram, 2003

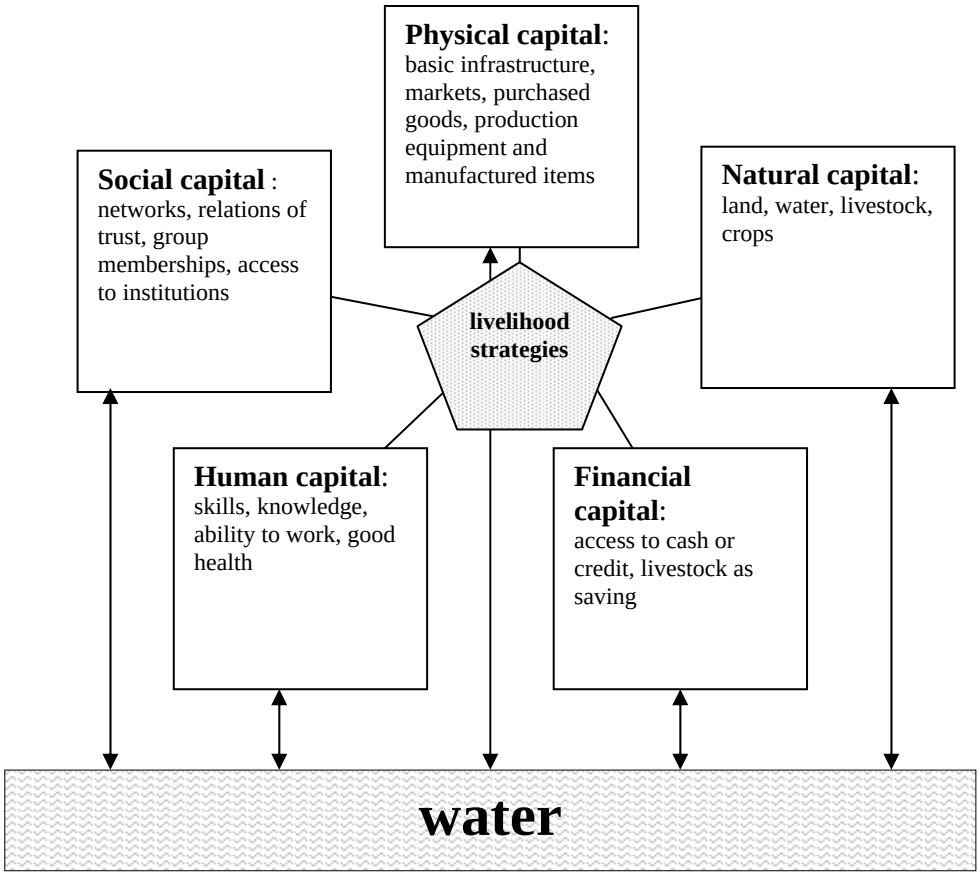
Table 2.2 Climbing the water ladder

Service level	Cost time/cash	Volumes (lpcd)	Needs met	Priority
No access	>1 km > 30 minutes	< 5	Too low for consumption & hygiene	Top priority
Basic domestic access	< 1km < 30 minutes	<15	Consumption just ok/ hygiene too low	Very high
Basic Multiple Use access	<0.2 km < 5 minutes roof water	20-50	Consumption just ok/ hygiene too low/basic livestock, fruit trees	High
Intermediate Multiple Use access	1 tap on plot, roof water, run-off, household tank	50-	Consumption, laundry and hygiene ok. Laundry/livestock vegetables, trees, small enterprise	Medium
Optimal Access	More house taps, large storage	100-200	Domestic needs met/ livestock, vegetables, trees small business	low

Source: water ladder developed by Barbara van Koppen for the MUS-project of the IWMI

Water is listed on the livelihood asset of natural capital in the livelihood strategies framework from Ellis (2000), however water has also a direct impact on the other capitals and vice versa especially in the context of arid or water scarce areas, as is visualised in figure 2.2.

Figure 2.2 Livelihood strategies framework related to water



Source: adapted from Ellis, 2000

Some examples of the relation between water and the different capitals:

Physical	>	infrastructure to deliver the water
Financial	>	water can be used for income generating activities; the operational costs of water delivery; the investment cost (e.g. users paying for the investments and thereby enhancing sustainability
Social	>	water has an impact on mutual relations; organisation around water use (allocation and access)
Natural	>	available water quantity and quality
Human	>	skill to mange the water, time saving in case of better access to water, impact of water quality on the health of people
Physical-human	>	how to operate the system; the manpower needed

The impact of introducing (multiple) water supply systems on the rural livelihoods are direct as well as indirect. E.g. time saving by having access to a water source nearby the homestead, income diversification by productive use, risk averting by a more reliable water source and crop diversification and nutrition by a more varied diet; indirect benefits, or not directly measurable effects, are training and knowledge on management and saving. It is important to realise that the water demands for productive uses of domestic water are marginal and at household level when compared to irrigated agriculture. Thus water can be classified as an asset of the household. Homestead gardens are often a

vital source of nutrition by providing variety in the diet and food security, by supplementing the staple diet (Soussan, 1998). Besides water quantity, water quality is very important as well for the health and productivity of the rural poor. Improved health is a basis for sustainable livelihoods. In order to come to sustainable rural livelihoods approach, majority as well as minority interests of water should be taken into account. The Multiple Water Use Systems approach is a proper approach, since it takes into account all the different users and uses within a water system.

Social relations, institutions and organisations are critical mediating factors for livelihoods because they encompass the agencies that inhibit or facilitate the exercise of capabilities and choices by individuals or households. Institutions will co-determine the success or failure of livelihood strategies. For improving the rural livelihoods these institutions should have a linkage within the community and between the communities as well as be able to communicate with higher governmental levels (Nicol, 2000). Therefore strengthening the social and human capital is very important. Lack of water is often a question of access to water and related to social assets as well. Yet in situations of water scarcity choices have to be made on which water use is valued most, which is very difficult, since every user will have his own priorities or bias. The strength of social as well as human capital is critical for implementing a successful Multiple Use System.

As food is perhaps the most important basic need off people, an overlap between the concepts of livelihood security and food security is to be expected. Niehof and Price look upon livelihood security as the more encompassing concept. Households with secure or sustainable livelihoods are also food secure, but reverse is not necessarily always the case. Water plays a crucial role in providing food security in arid regions, by sustaining and improving yields, which can be on very small scale around the homesteads or on the family plots. Unlike other assets water is very difficult to replace by another asset.

2.2 Methods and materials

The preparation for this study started in June 2004 with writing the research proposal and searching for literature. The field study for this thesis research was carried out from October 2004 until March 2005 at village level as well as regional level partly in the capital Addis Ababa, Dire Dawa town and field visits to Legedini Peasant Association.

In order to assess the research questions the following methods were used.

Literature review

In order to get a grasp of multiple water use systems, literature about multiple use systems was analysed in Wageningen in order to conceptualise the topic of multiple water use systems. In Ethiopia project documents of the CRS and HCS were analysed as well as general information about water management in Ethiopia was searched. Special attention was given to the design plans, project proposition and other secondary data related to the DAP II project. This information was combined and compared with governmental documents.

Stakeholder analysis and identification of key-informants

Throughout the period of investigation a stakeholder analysis was carried out. The stakeholder analysis is used to identify the key stakeholders within the project and to assess their interest, objectives, relationship and power as well as their effect on the system, activity or negotiations. The stakeholders exist of individuals, institutions, groups of people and organisations that are directly or indirectly involved in or influenced by the system. Interviewing one key person often led by snowball effect to the identification of other stakeholders. Analysis of secondary data resulted in the recognition of stakeholders as well. A stakeholder who is actively involved within a system and can influence a decision or outcome is considered to be an actor. Primary stakeholders are the intended beneficiaries of a project while the secondary stakeholders act as the intermediaries within a project. Besides it is

very important to realise that the researcher herself is a stakeholder as well and can have an impact on the final outcomes of the analysis. Therefore the researcher's objective and interest should be made explicit before starting the analysis.

Logically not all information can be gathered out of literature therefore key-informants were identified to assess crucial information and feed-back on the topics and cross check information. Especially the secondary data found in the project documents needed some verification. The following key-informants where approached:
HCS staff at different levels and different sectors was a crucial informant, especially field staff.
Informants from the **Dire Dawa Administrative Council**:

1 informant of the Development Office
2 informant of the Water, Mines and Energy office
1 informant of the Agricultural extension office

CRS staff as well as field workers
IWMI staff
Inhabitants of the **communities** involved.

Unfortunately it was not possible to make appointments or arrange meetings with all the different identified stakeholders.

Interviewing and surveys

Different interview methods were used and since the research is more descriptive the information will be qualitative and not quantitative. Semi-structured questionnaires with open ended questions were used to collect the basic data and information from the water users, Water Committees and other stakeholders. The focus of the questionnaire at household level was amongst others the water related activities, perceptions on the water quality and quantity, livelihood and coping strategies. Each theme of the questionnaire had a specific objective. Besides the semi-structured questionnaires also structured interviews were carried out. This way of questioning is useful to cross-check data with different (levels of) stakeholders and to gather qualitative data. The last method of gathering information by the stakeholders was during informal gatherings like chat-ceremonies, drinks and diner.

Institutional analysis

To get an insight into the institutional framework the nature of the existing institutions should be assessed. The institutional analysis covers both formal and informal institutions. Formal institutions are those such as government agencies, and they typically have a legally defined role, structure, and in some cases, sets of procedures. Informal institutions are those such as business, social or family networks or associations and are part of the social capital of the livelihoods of the peasants.

Site selection

The field work was conducted in the Legedini Peasant Association in Dire Dawa Administrative Council. This site was already selected by the HCS in collaboration with the IWMI for which a preliminary study was conducted from 17 to 21 August 2004 by Esther van de Hoeve. Since productive use was a large component in the Legedini study site, also other DAP II project sites in the highlands were visited which shed another light on the MUS concept. Due to like of time, damaged road and transport facilities it was not possible to visit all villages of the PA and the choice was made to have more time for specific villages, especially to follow the processes around the motorised scheme in Ajo village.

To be able to communicate with the inhabitants a field assistant was needed to help with translating from Oromifa, the local language into English. Since the research area, Legedini Peasant Association

is remote and only accessible by a four wheel drive vehicle, a car with driver was necessary to visit to the field sites.

Observation walks along the system and physical system analysis

The first field visits consisted of getting introduced to the communities, observation of the physical system and marking the different villages, roads and water sources by the use of GPS (Global Positioning System). The several waypoints were put into a map (see Map 1.4).

Selecting farmers and households for interviews

First introduction was done by HCS field staff to the PA chief. The PA chief then introduced us to the villagers and allowed the villagers to co-operate. Each visit first the village chief was approached to get his approval for conducting interviews. Then households were randomly chosen, yet it sometimes it occurred that the chief assigned persons to be interviewed. The risk of interviewing people who were assigned by the chief is getting biased information. Possibly only the better off are interviewed, or the ones with a relationship with the leaders. Some people could directly be approached e.g. people we met at the different water points. It was difficult to ask questions on sensitive topics like household economy, probably for reason of taxation. The peasants were rather careful in answering questions and reluctant to give specific data on e.g. number of animals. They even might exaggerate the negative aspects of their situation in order to justify their need of aid.

The research of Pauline

Pauline Scheelbeek from the Irrigation and Water Engineering Group of the WUR, performed her field research in the same period and at the same research site for her thesis titled: “Two containers of water a day; in quest of environmental sustainability and public health for the rural poor. Water quality, multiple uses and water division in the Lege Dini watershed area, Ethiopia”. This thesis research comprehended water sampling and quality analysis of the water sources in Legedini combined with household surveys about the knowledge and perceptions of the villagers about the water quality, health and sanitation.

Limitations/constraints of the Research

- The first field visit was during Ramadan, which comprehended that the villagers where tired during daytime and wanted to sleep and were only available for about 2 hours a day.
- It was difficult to make appointments in advance since it could be possible that the villagers were working on the fields, or joining a Food For Work project, or collecting their food aid.
- Other holidays during the field work period made it was not possible to meet with stakeholders, since they were not available.
- Staying overnight in the village was not an option, since it was not possible to find a translator willing to stay overnight and the HCS could not guarantee our safety. It could have saved time to stay in the PA and walk to the different sites during daytime and being able to follow the village life more closely and participate in it. However not speaking the local language would have been a very big limiting factor (as it would be impossible for a translator to assist you 24 hours a day).
- As mentioned before, part of the road was out of order; therefore it was not possible to visit all villages in the beginning of the field research period. Also flood coming from the highlands damaged part of the road during the field period.

Limited basic data available or very difficult to detect therefore some assumptions had to be made and choices on which data to use, or which would be most accurate. Some data was lacking in official documents as well, since the bureaux where not able to recover or collect these. E.g. there is only one meteorological station in the Dire Dawa Administrative Council which is located at Dire Dawa town (WWD&SE, 2003d). People where careful in expressing their opinion and critique on government

policies or project procedures. In previous times (especially under the Dergue regime), a lot of people were imprisoned for their critique on government policy. Also with the reassignment of staff information gets lost. Some information was ambiguous or conflicting like e.g. the number of PA's within the council.

In order to cross check what the actual discharge within the system is it might be useful to perform discharge measurements over different periods of time. As well as measuring the quantity of the waste water produced to give a recommendation for reuse on crops. Unfortunately it was not possible to perform water quantity analyses due to the pump failure there was no water within the system. Even if the pump would not have failed assessing quantitative water use at household level was not possible due to limited time and manpower, and the time schedules of the HCS field staff.

Most of the field work had to be co-ordinated via the NGO which was difficult to do, since making appointments with the staff was difficult due to their tight and ad hoc schedules. Most schedules were made on weekly basis and not very rigid. It occurred more then once that staff was in Addis Ababa, while the researcher was in Dire Dawa town. Several days the office was closed in Dire Dawa due to holidays, or staff in midst of the university exams or other obligations out-side the office. The NGO has a lot of information gathered, however there was not a good archiving mechanism, therefore some data and information was difficult to assess by the researcher. The target for DAP II program within the DDAC is the whole PA of Legedini or three PA's within the Council, therefore no specific attention was given to individual communities in project documents and targets like installed schemes are measured as totals and not specific differentiated to localities.

3 Institutions and organisations

3.1 Institutions & organisations at national level

Institutions are the formal rules, conventions, and informal codes of behaviour, that comprise constraints on human interaction. Examples of institutions are laws, land tenure arrangements (e.g. property rights) and the way markets work in practice. Organisations as distinguished from institutions are 'groups of individuals bound by some common purpose to achieve objectives'. Examples of organisations are government agencies (e.g. Ministry of Agriculture), administrative bodies (e.g. local government), NGO's, associations (e.g. farmers associations) and private companies (firms). Local level institutions may work differently from those operating over a larger territory, with overlaps and conflicts between them, e.g. customary land tenure may conflict with land ownership regulations passed in capital cities (Ellis 2000).

For the study area of Legedini the focus is on the governmental institutions at Dire Dawa Administrative Council level, since they were identified as the important stakeholders for the project site. These governmental institutions have to approve the projects and are responsible for the water, health and agricultural related activities unfolded in the project site.

The *federal level* is important since it sets out the policies and guidelines for their line bureaux in the different zones. The Federal government was also the initiator of the reorganisation and reassigning of staff of the Dire Dawa Administrative Council.

3.1.1 Government structures at federal level

Disaster Prevention and Preparedness Commission (DPPC)
The national Disaster Preparedness strategy has been developed by the government to strengthen the country's capacity to cope with natural calamities. At federal level the Disaster *Prevention and Preparedness Commission (DPPC)* is the secretariat of *National Disaster Prevention and Preparedness Committee (NDPPC)*. Disaster Prevention and Preparedness committees have been set up at woreda, zonal and regional level, enabling them to respond to warnings of deteriorating food security and threatening disaster if regional resources are inadequate (over 3 to 4 million people are structurally food insecure even under normal conditions). When the regional resources are inadequate the NDPPC must the involved in assuming food security at regional level and in case of inadequate national resources an international appeal will be launched by the NDPPC. Therefore, to accomplish these, the EWS has several detailed activities to be performed until it reaches the action. All EWS activities in the region are under the responsibility of the Dire Dawa Administrative Council. All international as well as local Non Governmental Organisations are only allowed to operate after signing an agreement with the DPPC and have to work with the relevant line ministries e.g. Ministry of Agriculture or the Ministry of Water Resources. All projects have to report back to the DPPC.

As defined in "Guideline for Early Warning System" disaster can be categorised into two types:
- Slow-onset disasters triggered by natural events (mainly drought)
- Rapid-onset disasters triggered by natural and man made events (flood, health epidemics and manmade disasters caused by conflict)

The Early Warning System (EWS) is geared to warn of drought related famine, by monitoring the agriculture cycle in crop growing areas and the pastoralists' economy in pastoralists areas.

Ministry of Water Resources (MoWR), is responsible for the preparation of plans, programs and feasibility studies for water resources utilisation, since all water sources in Ethiopia are state property (see box 3.1). It also carries out investigations, designs, supervision of construction and operation and maintenance of medium and large scale irrigation schemes. MoWR formulated 15 years programs and projects for all regional governments in the entire water sector, including water supply and sanitation.

The MoWR has several technical departments as are the Rural Water Supply and Sanitation Department, the Hydrology Department, the National Meteorological Service Agency (NMSA) and the Water Works Design & Supervision Enterprise (WWD&SE, 2003f and Werfring, 2004). The Hydrology Department co-ordinates the collection of hydrological date and has a system of gauging stations in the rivers of Ethiopia. The NMSA is amongst others responsible for the collection of climatological data, which are necessary for the design and management of irrigation schemes and agricultural extensions services. The Water Works Design & Supervision Enterprise is not a real sub-department of the MoWR. The enterprise works on contract basis and performs the big technical works and constructions like drilling boreholes and the construction of dams.

Box 3.1 Ethiopian Water Resources Management Policy

The Ministry of Water Resources issued the *Ethiopian Water Resources Management Policy* in August 1999 after it was endorsed by the council of Ministries. The Ethiopian Water Resources Management Policy is the basic policy framework for the management of the water resources of the country and it is based on the constitution and the federal government's macro-economic policies, development strategies and objectives for water resources development.

The policy addresses the general policy goals, objectives, principles and the cross-sectoral and sectoral issues of water resources management in a very comprehensive and detailed manner.

The overall objective of the Water Supply and Sanitation Policy is, as stipulated in the Federal Democratic Republic of Ethiopia Water Resources Management Policy, to enhance the well-being and productivity of the Ethiopian people through provision of adequate, reliable and clean water supply and sanitation services and to foster its tangible contribution to the economy by providing water supply services that meet the livestock, industry and other water users demands. Whereby the rural communities are ought to manage their developed water supply schemes and fully cover operation and maintenance costs.

Ministry of Agriculture (MoA) sets out the strategies for extension and development in the Agricultural Development Strategy. Werfring (2004) found that, through the regional and zonal bureaux, the MoA (via its Irrigation Development Department) is responsible for small-scale (traditional) irrigation schemes (-200 ha), to give technical advice and support and assist with construction of such schemes.

3.1.2 (International) Non-Governmental Organisations ((I)NGO's)

Catholic Relief Service was founded in 1943 by the Catholic Bishops of the United States to assist the poor and disadvantaged outside the country (CRS, 2003a) Catholic Relief Services Ethiopia (CRS/Et) has been supporting relief and development interventions in Ethiopia since 1958. In 1997, CRS/Et commenced a five-year USAID-funded development program (DAP) aimed at improving household food security in several targeted communities in different parts of the country (CRS, 2001). CRS/Et was involved in the response to the 2003 drought which resulted in the provision of over 500,000 metric tons (MT) of food assistance. In 2003 a new five year USAID funded Development Assistance Program (DAP II) is started. The CRS/Et works with local counter parts, one of which is the Ethiopian Catholic Secretariat (ECS) (see Appendix V and VI).

The Ethiopian Catholic Secretariat (ECS) is a non-profit making organisation of the Ethiopian Catholic Church. ECS is the umbrella organisation for the different Diocesan Catholic Secretariats (DCSs) throughout the country and co-ordinates and assists the DCS with the execution of their

activities and programs. The ECS in its present form was established in 1965 and got its first organisational structure in 1971. The first Constitution of ECS was approved in January 1973. In accordance with that constitution, the Administrative Board of ECS was established. Between 1974 and 1985 ECS's main focus was gathering and distributing food and medicines in the form of emergency relief. One of the ECS' operational sub-offices is based in Dire Dawa town: the Hararghe Catholic Secretariat (HCS), which started its operation in humanitarian relief food distribution in the emergency program about 20 years ago (for more information see appendix V and VI). The role CRS/Et plays is one of facilitator in financial as well as technical support to the ECS and DCS's. CRS sets out the framework for the development project, in line with the government policies and confers directly with the different Ministries in Addis Ababa.

CRS/Et is a strong promoter of developing water systems as a multiple use systems. It takes a leading role in having the different sectors (water, agriculture and health) involved in the project development proces. CRS/Et's strategy for promoting MUS addresses is reflected by having one technical advisor on water (hydrologist) for both domestic and agriculture. This demonstrates that CRS/Et is not only promoting MUS in theory but also putting the approach in practise and setting a good example of having the domestic as well as the productive sector integrated.

CRS has regular meetings with the Ministries and though their projects have to follow government guidelines, CRS is able to discuss innovations like Multiple Use Systems and promote more intra-sectoral co-operation.

The largest financier for the CRS/Et is USAID (United States Agency for International Development) and therefore CRS/Et depends for a great deal on the donor policies for project implementation. Still USAID needs to follow the policies of the Ethiopian government for the set up of projects as well.

Recently the government policy on development and aid projects changed, which had big implications for all running projects. All development and aid projects must be linked to the new Safety Net Program, which has as starting date January 2005. Therefore all funding for the DAP II program will be ended at the end of 2005. New proposals for new projects have to be submitted, following the guidelines in the new Safety Net Program. The Safety Net Program is based on an integrated watershed management framework, which focuses on the integration of sectoral activities within a given watershed for the maximum impact on household food security. The strategic goal is to reduce the overwhelming poverty in Ethiopia by promoting food security and strengthening civil society. Therefore the HCS and CRS have to make an action plan to wrap up the DAP II program by the end of 2005.

3.2 Institutions & organisations at Dire Dawa regional level

3.2.1 Structure until July 2004

Dire Dawa Administrative Council (DDAC) is one of the 11 Regional Autonomous States and special Administrations structured in the Federal Government in line with the decentralisation policy. The boundaries of these new states were based on the river catchments and the different ethnicities. The DDAC has its own Bureau and Line offices responsible for all activities in the area of natural resource management, agriculture, public health and food security. These technical bureaux and offices are the natural partners for the community in maintaining sustainable water and sanitation activities (CRS, 2003b). The Council has a lot of autonomy for governing, as long as this is within the guidelines from the Ministries and depends on the Ministries for the assignment of staff and resources. These National Policy & Plans are communicated by the different Ministries to the regions. The Dire Dawa Administrative Councils Region Agricultural Policy was adapted from the Federal Agricultural Development Strategy (from MoA), based on the available resources in the Peasant Associations. The Agricultural Bureau identified the Dire Dawa region as a drought prone area and planned a serious irrigated agricultural development program.

Over the past year (2004-2005) some changes within the organisational structure have occurred. According to the second nation wide census conducted in the year 1994, Dire Dawa Administrative Council comprises Dire Dawa and Melka-Jabdu towns and 28 peasant associations, however other research and documents show that up to 38 peasant associations exist in the Administrative Council with about 416 settlement villages (WWD&SE, 2003f). Its total population is estimated to be 251,864 (1994 census). Out of these persons about 173,188 (70% of total) reside in the two towns, while the remaining population numbering 78,676 (30% of the total) lives in the rural areas (WWD&SE, 2003f).

Dire Dawa Disaster Prevention Preparedness and Labour Social Affairs Office (DPP & LSA office), the regional office of the Disaster Prevention and Preparedness Committee, has the responsibility for the co-ordination of all development projects in the food insecure areas, which Legedini PA is one of. Box 3.2 gives an overview of the procedure followed for a water development project.

Water related Projects and Programs are formulated for Dire Dawa Administrative Council by two projects conducted at the national level, namely

- The National Water supply and Sanitation Master Plan
- The Water Sector Development Project

The National Water Supply and Sanitation Master Plan project, completed on December 31st 2003 formulated four urban water supply and sanitation projects for Melka Jabdu and Dire Dawa towns, however rural water supply and sanitation projects are not formulated (WWD&SE, 2003f) In the Water Sector Development Project, 6 urban projects i.e. 2 sanitation and 4 water supply projects and 10 rural water supply projects were formulated and in this program also rural sanitation projects are not articulated (WWD&SE, 2003f). These two projects are however not concurrent about the urban and rural water demands (see table 3.1).

Box 3.2 Procedure for getting a development project approved (in this case a water development project)

Implementation of development projects will be done by external agents like local NGO's.

- The request for development will be made by the community to the DPP & LSA office.
- After receiving the application of the community a feasibility study will be carried out by the Water Office (in the case of a water project).
- After this the Water Office will look for funding at e.g. UNICEF.
- All water supply schemes are only made after a request of the communities. The communities most express their needs otherwise no one will come to look after it.
- First the Water Office will identify the project and after that e.g. the HCS will have their identification phase.
- After this the HCS will summit their project proposal which has to be approved by the Water Office (amongst others). A
- After the approval of the involved offices the implementation and construction can commence.

In some case the Water Office will ask the HCS to get involved in the execution of a project.

Different kind of water demands are recognised by the DDAC and are under the responsibility of several sub-sectors. Non-domestic demand includes light industrial, commercial and public requirements. Light industrial are small manufacturing and processing plants that require relatively

small amounts of water. Commercial includes all the hotels, business and trade establishments. Public includes government offices, hospitals, schools and public services such as street flushing, parks maintenance etc. A 5% allowance will be made for non-domestic demands in rural communities; this is due to the ever-increasing numbers of schools, development centres, and police stations, clinics and animals/veterinary health centres in the rural parts of the region.

Urban water supply is under the accountability of Dire **Dawa Water Supply and Sewerage Service Office.** The sanitation management in Council is fragmented, solid waste collection and disposal is under the **Health Office**, while faecal sludge collection and disposal is under the **Water Supply and Sewerage Office** and urban drainage lines construction and maintenance is under the **Town Administration Office**.

The **Water, Mines and Energy Office** (WMEO) has the responsibility and mandate of rural water supply in the Administrative Council. The WMEO has to:

- Survey the quantity and distribution of water resources,
- Study water utilisation to determine conditions and methods required to its' optimum utilisation.
- Undertake studies and supervise water quality
- Issue permits to construct and operate dams and other water works.
- Determine water tariffs and collect charges
- Prescribe water quality and sewerage treatment standards
- Undertake minerals and energy exploration study, issue license and regulating minerals prospecting and mining operations.
- Undertake training to promote mining and energy development. (WWD&SE, 2003f)

The Administrative Council, with the resources allocated from the government, the assistance of the non-governmental organisations and the communities, has made great effort in providing potable water to the population. This resulted in reduction of the travel distance by mothers and children in search of water which created the opportunity to have many children enrol in school and to use the time saved for other significant social activities (WWD&SE, 2003f). In the rural vicinities, there exist in total 154 rural water supply schemes, out of which 26% were not functional in 2003, primarily due to the water shortage and spare parts problems (WWD&SE, 2003f).

The WMEO is responsible for the control and execution of water projects. The technical officials at the WMEO declare that the first priority of the office is to provide the communities with drinking water; therefore not much attention is given to other water uses, since providing enough drinking water is already difficult task to fulfil. For this reason MUS is not taken into account from the design stage and is considered as the next step, after implementing a potable water supply system. Big maintenance is the responsibility of the Water, Mines and Energy Office, yet they are depending on the Ministry for financing and assigning staff. The Water Office has also a sub-office which gives technical advice about irrigation, but for the agronomic part the Agricultural Office is responsible.

Education and extension is recognised by the WMEO as an important aspect of improving people's health and productivity however the WMEO does not have any resources for extension work and these activities are considered to be a task of the Health Office.

According to the WMEO the Ministry of Water Resources uses the WHO and African standard for water quantity as guideline. However it its difficult to give a minimum volume which should be delivered since it is very well possible that a volume of 20 lpcd can be supplied for the first year, but that the well will draw down after some time and this volume cannot be reached anymore. And it is proposed to make an allowance of 10 litres per person per day for 14% of the population of the town and 25 litres per person per day for 60% of the rural population for watering the livestock (WWD&SE, 2003f).

Table 3.1 Recommended quantity of water supply

Recommended from	volume lpcd	use	note
Title II projects from USAID / CRS	at least 20	rural	to meet essential health-related household and personal needs, including drinking, cooking, personal hygiene, cloths washing and cleaning
WMEO	10	rural area	
WMEO	15	urban area	
WHO standard	50	rural	developing countries
WHO standard	150	urban centres	developing countries
National Plan of Action (NPA)	20		within a range of one to two kilometres distance from the dwelling
Water Sector Development Project	15-20	rural (domestic)	
Water Sector Development Project	30-40	urban (domestic)	

CRS/Et states that although actual water usage in Ethiopian rural communities is often very low, even when water is plentiful, projects should be designed to supply a minimum of 20 litres per person per day. If system capability cannot be achieved, for reasons of inadequate water sources or high costs, the Cooperating Sponsor must justify why it proposes to supply a lesser quantity of water (CRS, 2003b).

Box 3.3 Steps in the identification of a water development project.

1. communities will identify the water sources and inform the office
2. discharge measurement will be done by the office in order to find if the source has enough water (source if efficient)
3. population data will be gathered by the elders and the influencing people within the communities
4. feasibility study will take place
5. first option: look for spring development: most sustainable since this is a gravity driven system
6. second best option: hand dug well with hand pump
   - treadle pumps only used for irrigation purposes
7. in case of no other possibility of developing a water source, a motorised system will be implemented
   - The community should cover the running costs. (In case of replacement the communities face a problem since they will not have enough funding to purchase new equipment).
   - Big maintenance will be the responsibility of the government. In all villages there will be a Water Committee that will collect the fees: (often set at 0.10 Birr per 20 litres of water)
   - The fees will be used to purchase fuel and small fast moving parts.

The money is administrated in bookkeeping and the bankbook is kept in the Water Office. Each month the money will be registered

The Agricultural Development Office (ADO)

The agricultural extension services are the key to progress and development by the Administrative Council. Different extension services exist in DDAC, however not in all the Peasant Associations. Development Agents (DA) are assigned for the implementation of all the extension activities with the assistance of the subject matter specialist at various levels. At the same time they are supervising the

work of the Development Agent. The DA's live within the communities and are responsible for setting up trial plots, nurseries and other extension work.

One of the sub-offices of the ADO is the livestock office. Its task is to distribute maintenance feed, hay and straw to bridge drought months, till the PA's come self-sufficient in livestock feed through modern feed development and stock reduction and replacing animals with high yielding ones and providing veterinary services (WWD&SE, 2003c).

The Health Office

The Health Office is based on another location in town. There are no integrated activities between the Health Bureau and the other governmental offices like the Water Mines and Energy office.

The Health Bureau has extension workers that go into the communities to educate the rural people on health and sanitation. Most activities will be conducted at or with the health post in the PA. During the field work period two female extension workers stayed for two weeks in the village of Ajo. Their activities were however not coordinated with the NGO working in the area. But the health workers of the HCS have a program together with the extension workers of the Health Bureau, which is part of the DAPII which is the Community Based Health Care Program. One of the methodologies the bureau is working on with the help of the HCS is the promoting of PHAST (Participatory Hygiene and Sanitation Transformation).

3.2.2 New structure, still under development

Since July 2004 a major restructuring is taking place of the different governmental offices in the Dire Dawa district, which is initiated by the central government. **The Regional Rural Development Co-ordination Office** was and all the offices are still in the middle of the reorganisation with as consequence that their mandates are not defined yet and new employees are in the procedure of being assigned and old staff gets reassigned. This reorganisation was not finalised at time of field work. Like its predecessor (the DPP & LSA office) the RRDC falls under the supervision of the Ministry of Agriculture.

Due to this reorganisation the Water, Mines and Energy Office had a problem with their technical staff. All technicians were reassigned (by the federal government) to the Road Authority Office in Dire Dawa and as a consequence a lot of experience is lost. Those reassigned technicians had 15 to 20 years of experience in the field and are very familiar with the different project sites and the problems farmers might encounter. The technicians were not replaced by new ones and therefore there is not enough manpower left to go into the field. The WMEO made a request to the Road Authority Office to hire their technicians to perform the big maintenance in the water schemes. A procedure was started to have the reassignment reversed.

On 15ht of May 2005 new general elections for the Ethiopian Government are to be held, which had clearly an effect on the speed in which decisions were taken. A lot of uncertainty and therefore stand still in procedures and an expectant attitude occurred. People being more careful in expressing themselves since it might be possible that their jobs are in the balance as a different government would get power and new policies would become effective.

The RRDCO coordinates several line offices namely the Agricultural Development Office, Disaster Preparedness and Prevention Office and Water, Mines and Energy Office. The Health, Education and Rural Development Offices are under a different Bureau. In the future the Health, Education, Food Security and Rural Development will also be under the umbrella of the Regional Rural Development Co-ordination Office at regional level, but for the time being this is still in the pipeline.

Not only on regional level reorganisations are taking place, at PA level a reorganisation is as well on the way. Legedini PA will be merged into one PA together with is adjoining PA's of El Hamer and

Ayale Gumgum. Some of the inhabitants did not accept this reorganisation and moved to other PA's. This merge is very convenient for the continuing of the DAP II program in Dire Dawa Administrative Council, since all these three PA's are in the DAP II program. The HCS has successfully lobbied to have the three PA's together in one in stead of merged into separate PA's. However this merge is in contrast with the decentralisation trend of the past time, and has the risk of becoming more difficult to govern (see Appendix III for further information).

3.2.3 Non Governmental Organisations

A number of **Non Governmental Organisations (NGO's),** both international (INGO) and local NGO's are involved in the water supply development sector in the rural part of the Administrative Council; especially in the domestic water supply sector. The NGO's are not depending on financing by the government, but the government has to give permission for the co-operation. Without a contractual agreement with the government the (I)NGO's are not able to work and therefore the (I)NGO's depend on the government policies.
The major NGOs' participating in the council are: the Lutheran World Federation, the Hararghe Catholic Secretariat (HCS) and the Ethiopian Social Rehabilitation and Development Fund (ESRDF).

The main area of interventions of the above mentioned NGOs' are mainly on the construction of hand-dug wells, spring developments, ponds construction and rainwater harvesting and the lists of schemes constructed by the non-governmental organisations working in the council (WWD&SE, 2003f). The NGO within this research is the **Hararghe Catholic Secretariat** (HCS), which is responsible for the implementation of the DAP II project and the multiple water use systems in Legedini. HCS' scope and goals will shape the way in which the project is implemented as well as the end terms when the HCS is phasing out.

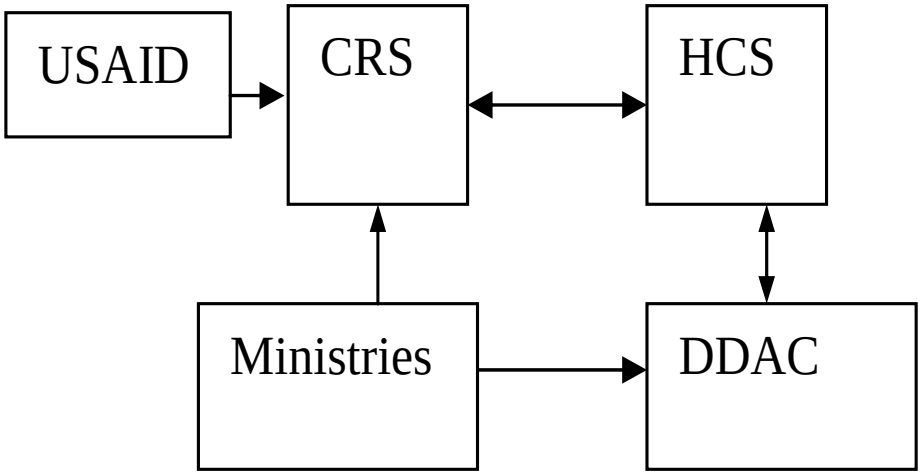
The Hararghe Catholic Secretariat (HCS) is the Development and Welfare operational body of the Apostolic Vicariate of Harar (1881), which is a member of the Catholic Episcopal Conference of Ethiopia (HCS, 2001). (ECC-SDCOH, 2003) The early HCS activities were limited to basic primary health care, nutrition and free food distribution. After 1984/85 drought the HCS expanded its program, both in content and scope, from emergency to rehabilitation. In 1989/90, in collaboration with the Agriculture offices, the HCS initiated, using the Food for Work (FFW) program, a natural resource conservation program. Simultaneously, the office was also involved in activities like; provision of agricultural inputs and human and livestock health promotion activities in particular to emergency and post emergency rehabilitation, and community water supply through surface and ground water development activities could be mentioned among others (ECC-SDCOH, 2002).

HCS is a local organisation committed to promoting sustainability at the community level, without any discrimination of creed, race and behaviours and is convinced that communities have the strengths and capacities to fully support community-based systems (CRS, 2001). The non-discrimination policy is reflected in the workforce as well; people with different creed as well as ethnicity are employed. One of the limitations of the HCS is the dependency on its donor (CRS is its largest donor, which receives funding from USAID); changing donor policies has big implications for the execution and continuation as well as the performance of projects.

Due to the Government's request of re-registration of the National Catholic Church and the new legal status (the current Constitution of ECS was endorsed on April 1st, 1999) obtained by the Ethiopian Catholic Church Ethiopian Catholic Secretariat (ECC-ECS), the different dioceses have been requested to re-organise themselves according to the new ECC-ECS' legal framework (HCS, 2001). One of the new structures was the set-up of a Social and Development Commission (SADCO), which has to coordinate and manage the Social and Development Activities of the Ethiopian Catholic Church (ECC). For the Apostolic Vicariate of Harar the Ethiopian Catholic Church Social and Development Co-ordinating Office of Harar (ECC-SDCOH) was established. The ECC-SDOH replaces the HCS, yet since it is a new structure and still under development, the name is not much in use yet and most

project beneficiaries (as well as the researcher) still use the name of the HCS or just call the project implementers people from the 'Catholic'.

Figure 3.1 Communication-lines between the governmental and donor agencies



The HCS has frequent contact with the different line offices involved. However not all activities are co-ordinated. The health office has extension programs without involving the HCS and the other way around. The closest co-operation exists between the DDRDO and especially the Water and Agricultural Offices.

Within the current organisational structure each program has one program co-ordinator, yet for the DAP II the co-ordination is more centralised in order to be able to learn from the different sites and copy the successes

One of the methodologies the HCS is working on and promoting is PHAST (Participatory Hygiene and Sanitation Transformation). The PHAST approach is part of the implementation of a Multiple Use System by the HCS. Training is given by several HCS employees in collaboration with the CRS to governmental workers as well. One of the strategies is to bring the water and health bureau together for co-operation, whereby the health bureau provides the fieldworkers.

For future activities the HCS will focus on the multiple use of water and relate to this agro business.

3.2.4 The DAP II program in Legedini, Dire Dawa Administrative Council

The Development Assistance Program II, which goal is to alleviate poverty by improving household food security, is one of the largest programs implemented by the HCS. One of the strategies to reach this goal is the implementation of multiple use water systems as part of one of the two components of the DAP II: Agriculture and Natural Resource Management (Ag/NRM) and Community Based Health Care (CBHC). With the support of CRS/Et the HCS was able to develop an own MUS strategy for implementation.

Other project sites of the HCS have already functioning MUS implemented and it is one of the HCS' approaches for improving and implementing water systems. The standard multiple water use system as designed by the HCS consists of potable water tap, a washing basin and an animal trough, all using the same water source.

The first priority of the implemented water systems in Legedini is the provision of potable (domestic) water, however small productive use is already taken into account at the design stage and the system is

provided with animal troughs and washing basins. Other uses like small scale irrigation were not foreseen at the design stage and were added after the implementation of the delivery system.

The actual procedure followed for the DAP II project:
The project was initiated by the villagers: they went to the local government and requested for water facilities. After that the government did research and decided that a development program could be started in Legedini PA. The job was offered to the HCS which wrote the five-year DAP II proposal for the Legedini-site for the years 2002-2007. The project is implemented starting upstream in the Legedini catchment towards downstream. The village of Kora was the first to be developed and all activities are for the benefit of the whole PA (watershed approach) and the PA is regarded as one entity. The HCS provided the materials and the villagers provided labour, which was compensated as Food For Work. At that time the villagers had no time for other work and fully participated in the construction of the water system: the villages participated for more then 50% in the construction of the system. They carried and provided the stones, carried the pipelines, constructed the reservoir together with the constructor (and expertise from HCS). The location of the distribution point water taps was selected by the villagers (had the option to choose out of two locations).

At that time the Disaster Prevention and Food Security Office was responsible for the project agreement:

1. HCS presents the project profile
2. Together with the line bureaux (water and agriculture), the HCS prepared the detailed project proposal
3. Then the agreement was be signed with the different offices involved (water, agriculture)

According to CRS (2003c) local government technical bureaux are the natural partners for the community in maintaining sustainable water and sanitation activities. The involvement of local craftsmen and spare part vendors needs to be enhanced since the government is not capable of covering maintenance requirements for each water point.

The HCS has a close relation with the Rural Development Bureau. Monitoring: the HCS and the line bureaux will quarterly report to the Rural Development Bureau, as well as execute quarterly field monitoring activities. Since the RD Bureau only existed since July 2004 of field there was only 1 program active (at time of fieldwork).

The implementing agency is quarterly reporting (in English) to the donor agency and government partners at zone and regional bureaux level. Regular feed back will be submitted from the donor and government partners to the implementing agency with comments and enquiries which is used as two-way communication system to improve the performance of the project according to the mutually accepted annual and/or quarter action plan.

DAP replaced by Productive Safety Net Program (PSNP)

At the time of field visits the DAP II for the DDAC was half way and the midterm reports had to be completed. Part of the project activities where already handed over to the communities, but some activities still have to begin. Due to the phase over of the DAP II to the new Safety Net Program, all activities need to be wrapped up and handed over to the communities and the responsible line departments. Luckily the three PA's[11] of the DDAC that are under the DAP II can be phased over to the new Safety Net Program that should commence in January 2005. However the beginning of the new programs within the framework of the Productivity Safety Net Program was postponed till March, since the government was not ready yet and the agreement could not be signed.

The Productive Safety Net Programme is a component of the Government's Food Security Programme (FSP), and as such, is an integral feature of a coherent food security investment strategy for

[11] El Hamar, Ayale Gumgum and Legedini

chronically food insecure woredas of the country (PSNP, 2004). The beneficiaries of the programme are resource-poor and vulnerable to shocks, and often fail to produce enough food even at times of normal rains in the country.

4 Livelihood and coping strategies

4.1 Legedini general

The eleven villages in Legedini Peasant Association are distinct by the positioning within the area (like elevation), in the number of inhabitants and the dispersion of the houses. None of the villages has electricity, a telephone connection, a house connection to water or a sanitation system and all of the villages are only accessibly by a seasonal road. The road was constructed as part of the DAP II Food For Work project and can only be used by four-wheel drive cars or motorcycles. The journey to Dire Dawa town takes five, up to six hours of walking and people will stay overnight, before returning to the villages, as it is dangerous to walk after dark, due to the hyenas and other wild animals. The public services, being the clinic, primary school (up to fourth grade), agricultural extension office and the HCS field office, are all based in Ajo, the central village of the PA, which is the first on and the easiest accessible by road of all the villages within the PA.

Each village consists of several homesteads: round huts, called *tukuls*, build from stone and plastered with a mixture of mud and straw with a conical thatch roof on a wooden basis. Within the tukul there is a cooking place, living room and bedroom separated by a low wall, which main function is to keep the animals out of the bedroom. Small animals stay in the tukul overnight, and some houses have a small fenced area inside to keep the sheep and goats outside the living area. The homesteads are fenced by thorny brushes to keep the wild animals like hyena's out and the livestock in. Some of the houses like the small village shops have a corrugated iron roof. The households are nuclear since most households consist of a married couple and their unmarried children. A newly wed couple will form a new household. Decision making is done jointly by men and women, though both have their specific responsibilities and tasks within the household. On average six persons are living in one household and average land size per family is 0.44 ha (ECC-SDCOH, 2002). The crop land is fenced as well with thorny bush to keep the animals (esp. goats) away from the crops.

The climatic conditions and the altitude are the major determining factors for the farming systems possible, therefore pastoral livestock farming is predominant in Legedini like in the other arid and semi-arid regions of Ethiopia A pastoral production system is defined as those systems in which 50 percent or more of household gross revenue comes from livestock or livestock related activities, or where more than 15 percent of the household food energy consumption consists of milk or milk products produced by the household itself. An agro-pastoral production system is one in which more than 50 percent of household gross revenue comes from farming and 10-50 percent from pastoralism (Admassu, 2001). The pastoralist livelihood in Legedini, depends for a large extent on animal husbandry, supplemented with crop cultivation of rainfed sorghum and maize, which are the dominant crops in the area since these are the only crops suitable for the area without supplemental irrigation. Due to insufficient watering and grazing resources people were forced to move seasonally from one place to another. Over the past 2 generations the people were forced to make a transition into a agro-pastoralist way of living due to the land degradation caused by overgrazing and stimulated by the villagisation policy. According to some elderly inhabitants, a lot has changed in the past two generations. Land degradation had become worse, due to overexploiting of the area, caused by the population pressure. Perennial crops like, papaya, citrus, coffee are only cultivated under supplemental irrigation (WWD&SE, 2003c; Mesfin, 2001; Arsano, 2001) Some farmers started to cultivate sorghum under spate irrigation, by diverting the floods provoked by the rain in the Eastern Hararghe highlands. However the yields are not enough to be self-sufficient: the average household produces only enough food for about 3 months, and the communities depend on food aid, which is provided as Food For Work.

The main productive use of water is for watering the livestock, which contributes to improved livelihoods of the inhabitants, as depend on their livestock for milk production, draft power and capital saving. Irrigation by is not practised on large scale, except in Kora village and besides some farmers

who experiment with irrigating papaya trees and other crops. Due to increased government involvement and the DAP II project the livelihood situation as well as the environment improved considerably over the last years and made the people very amenable to visitors and co-operative to projects.

The most important feature determining the livelihoods and coping strategies of the inhabitants of Legedini, is their vulnerable environment with erratic rainfall, degraded land, no access to surface water, low crop productivity. Together with the lack of alternative employment opportunities, the vulnerable environment makes them food insecure. Because of this food insecurity the Legedini PA was admitted to the DAP II project that foresees in improving their livelihoods.

Some differences between the villages exist due to the resource availability and accessibility, however in general the livelihood strategies do not differ much for the households within the settlements of Legedini PA. A general lack in diversification of assets as well as no opportunity to accumulate savings makes them vulnerable. The households are nuclear, since most households consist of a married couple and their unmarried children, the household is independent, primary relying on its own labour and the main employment is agriculture and husbandry. A newly wed couple will form a new household. Main cultivated crops are rainfed sorghum and rainfed maize. The irrigation initially practised is spate irrigation, whereby floods coming from the Eastern Hararghe highlands are diverted to the plots. Livestock and labour are the important assets of the household economy. The households rely on their own grain production though most households have to purchase grain as well to fulfil their needs. In Legedini the inhabitants will acquire their additional grain as part of the Food For Work program. Non-agricultural income is limited in amount e.g. selling charcoal and wood and occasionally seasonally migration to town. In general it can be stated that the inhabitants do not participate in the cash-based economy. The economic and social institutions and practices are manifestations of community level support and co-operate networks, in the context of otherwise nuclear households.

4.2 Income diversification, food production and strategies

The most important ***human capital*** for the peasants is their *labour*. Practically all adults are illiterate, but the children can attend school up to grade 4 in Ajo village. Each family tries to send at least one child (often a boy) to school, even though the paying for school materials is a heavy burden for the household, but seen as an investment for the future. Most villagers would like to send their children to secondary school, however this is far away in another PA and only view children are able to attend this school and stay with relatives. Most likely the educated children will move to town in search for jobs and a higher living standard and example for this is the pump operator who has a high level of education (grade 4) when compared to the other inhabitants. He wants to safe money and then move to town to start a business. Knowledge about farming practises is limited to husbandry, traditional apiculture and rainfed cultivation of maize and sorghum. When pastoralists are being forced to become agriculturists, due to the villagisation policy or the degraded environment, without having the necessary knowledge about the new practises this is a disuse or even waste of human capital. Still the peasants are eager to learn, and request information and help of the HCS, agricultural extension and health services. There even is a plan to have schooling in the evening for the adults. Knowledge exchange and mutual learning takes place within and between the villages and new practises are borrowed. The access to clean and reliable water has positive health effects on the villagers as stated by the nurse in Legedini and found by the research of Pauline Scheelbeek (Scheelbeek, 06). Before the DAP II project water had to be fetched at long distance and was of poor quality. Time allocation is an essential variable when studying livelihood generation and how the time is spend is very gender sensitive (Niehof and Price, 2001). The impact of time gained from collecting water from an improved water system nearby the homesteads is very evident. Besides taking a lot of time, which can also be spend on other productive activities, the travel distance has a negative effect on the human health, since it costs a lot of energy and the diet of the peasants are very limited, in amount as well as

variation. Women, responsible for collecting domestic water, state that they have more time left to look after their children, which otherwise would be left unattended.

Besides being used both as a ***capital asset*** and as a *resource* for production, *livestock* is an indicator of wealth as well. The more livestock one owns, the more status and power one has. Different types of animals fulfil different needs and different strategies and reasons for keeping them are present. Camels are used for transportation and as financial asset or saving mechanism and not quickly sold (Box 4.1). Goats are the least constrained since their feeding habits allow them to thrive on hillsides and lowland areas unsuitable for anything else. Oxen are kept for their draft power and cows for milk. Livestock diversification is also a livelihoods strategy. Grazing land is especially scarce in the cropping season, when small ruminants are prevented from browsing everywhere and have to be herded on individual plots. After harvesting the sorghum and maize the animals can browse on the crop residues. Still in the dry spell, the area does not have enough fodder for all the livestock and the pastoralist have to herd their flock to other areas, inside as well as outside the Peasant Association (see Appendix XII Map Legedini and surrounding PA's).

Camels, cows, goats and sheep are milked, which is the task of the women; the revenues of the milk sale can be spend as they wish. The major part of the milk produced is for home consumption, though there are some initiatives (women milkgroup) to sell the milk and eggs in Dire Dawa market. The surplus milk (not needed for consumption) is sold (all milk is mixed). Due to the new water system, more water is available (esp. for the small ruminants) and the milk production of the animals has increased (more water available) as well (Van Hoeve, 2004) as created more time for the women to set up organisations like the milk group. Poultry is culturally determined as women business and kept for egg production, which surplus is sold as well. Using the livestock as a cash resource is limited to selling once or twice a year and is a process of impoverishment, since it is as loss of productive and reproductive capacity. Small ruminants are the principal source of cash. The opportunity time for selling the large animals is when the animals are mature enough and the price is right. Occasionally, in the case of a good yield, some of the sorghum will be sold by the prosperous households while the poorer households try to prevent this.

Box 4.1 Example of the different roles livestock fulfil

Quote farmer from Hallo village: "We use our camel as train and our donkey as car"

Even though *apiculture* is considered as a sideline business of agricultural practice, it is a sustainable agricultural sub-sector which many rural farming communities practice and a way of income generation to improve food security. Due to the climatic condition of the Dire Dawa Administrative Council, the bee forages are limited to natural vegetation such as acacia and citrus trees in all watersheds in the Administrative Council. In fact cultivated crops could serve the purpose to create forage opportunities. The DDAC has a forage development plan to augment livestock feed shortage, improve bee forage scarcity and will enable the mixed farmers and livestock producers to run bee keeping as a sideline business and improve honey supply to the administrative council (WWD&SE, 2003c). The DAP II project introduced other hives then the traditional ones, which can be kept on the fields and simultaneously promoted the cultivation of other crops in order to create forage opportunities for the bees, while the bees can pollinate the fruit plants and thus contribute to the crop diversification.

Since the inhabitants are not really taking part in the cash-based economy their ***financial capital*** is also very limited. Livestock in stead of savings on a bank account is their capital asset. Market prices for buying and selling fluctuate and are not favourable according to the community members. Non-agricultural income might be small in amount, but is still an important contribution to meet the household shortages. In Legedini the non-agricultural income is limited to the selling of charcoal and firewood, which is especially one of the coping strategies of the younger men, who do not have much

livestock at their disposal yet. One of the initiatives of the DAP II project is to educate the people about credit and putting money on the bank, so livestock will not be needed as a saving mechanism.

Traditional organisations and institutions on community level are present in Legedini and part of the *social capital* of the peasants. There are manifestations of co-operative networks or support systems at community level like Idir and Equb (see box 4.2). A new initiative for cooperation, based on the traditional Idir, started during the DAP II. The women of two villages created a milk group, to be elaborated in paragraph 5.2.2. Informal *family networks* are present as well e.g. taking in a parent, brother or sister in the household or sending children away to the grandparents to help them out. The younger people will help the sick and elderly with e.g. collection water. Not all households participate in these networks but they are important survival strategies and besides these networks, the households operate autonomous in providing for their livelihood. Hospitality and sharing is interwoven in their culture.

Box 4.2 Explanation of Idir and Equb

Eder or *Idir* is a traditional insurance system organised at community level. It is an association that collects a contribution from its members in order to pay for funeral or marriage expenses. The contribution of the household is predetermined and if the household head is not able to provide the contribution in cash, he or she will contribute in food. This can be on regular basis or when the event occurs. Members also provide labour and food to accommodate guests during the mourning period (Tamiru, 2003). Several households in each village are member, however this is not compulsory.

Iqub or *Equb* is a saving group in which community members contribute cash regularly. Members receive money on a rotational basis. These savings enable the accumulation of cash for the purchase of cloths and animals. Type of saving or revolving fund arranged by members of a community (MOFED, 2002) Men and women have separate saving groups.

The more prosperous communities are also those that are able to ventilate their needs and know how to access help from outside. On religious days people do not work, but will gather for ceremonies at the mosque or for chat ceremonies.

Physical capital varies per village, but the facilities (school, clinic, agricultural extension office) in Ajo town are at the disposal of the whole PA. The accessibility of the school depends on the remoteness of the villages. Kora village for example will only send the older children to school in Ajo, because of the walking distance. The smallest children that are not able to attend the public school will attend the Koran school in their village. All of the villages are opened up by a road, constructed as part of FFW activities, although the road is often in disrepair. Each village has one or more mosques and small village shops are also available in the PA. Kora, Hallo, Ajo, Edo and Edo Bolo village have an improved water system[12] in their vicinity.

Natural capital is limited due to the degraded environment, but many initiatives are unfolded to upgrade the environment. The land degradation in Legedini PA is for a major part the result of overgrazing and cutting of the vegetation cover for construction and fuel wood. The HCS promotes erosion mitigation practises, like making stone bunds along the contour lines, terracing and site closure, in which the inhabitants actively participate as part of the Food for Fork Program. The practise of collecting firewood from the hillsides and burning charcoal is prohibited by federal law, since it contributes to the degradation of the hillsides, yet without any other income diversification option it is still practised.

[12] Implemented by the HCS as part of the DAP II project

The inhabitants have access to private and communal grazing land. Although people can not officially own land (since land reform of 1975), everyone has a sense of ownership. The official policy is that everybody has an equal right to use land, however the property rights in practise shows that this is all but equal. In time of scarcity the livestock will be herded outside the PA as well, which often leads to conflict with the other users. Other activities of the DAP II are the introduction of other seed varieties and seed fairs, to extend the crop productivity.

The water source is often claimed by the villages closest to the source. Three principal types of water use are recognised by the inhabitants of the Legedini research area: domestic, livestock and small scale irrigation. Domestic use can be divided in water needed for drinking and food preparation, for ablution before going to the mosque, washing cloths and households utensils, latrines and personal hygiene. For the water needed for the animals a distinction is made between the small ruminants and the larger livestock. Small scale irrigation is taken up in the last year by Ajo, Hallo, Edo and Edo Bolo, and is limited to irrigation of some papaya trees within the homestead and some experiments on communal plots with irrigated sesame, groundnut and haricots. On average a household will use 1 up to 4 jerry cans of water with a volume of 20 litres a day, depending on the distance to the source, the water fee and if the water has to be carried on their back or with the help of animals.

Water has multiple identities, depending on the meaning and value given to the water by its users. Water is needed for drinking, food preparation, hygiene, socio-religious customs, and production and is essential for good health. Each user will have its own priority of water use, depending on the composition of the household, the gender of the user, the livestock composition and other productive needs. Community mapping performed by HCS staff showed the different values attributed to water by women and men. Women give priority to water of good quality for domestic use, while the men prefer to have water for irrigation.

Box 4.3 Benefits of the developed water system according to a female water user.

Woman of Hallo village states: Before the project the problem with the water was not only the lack of water but also the fact that the women had to leave the house and leave their children unattended during their search for water. This had a big impact on the health situation of the children.

Box 4.4 Example of value given to water by male water user

Quote village chief Edo Bolo:
"The soil is very fertile and if God would give us water we can cultivate whatever crop we like. When we can cultivate crops we would have less livestock." "We don't give a thing about the livestock". Which is a remarkable statement, since livestock herding is interwoven in their culture and identity, but crops are more profitable. The chief states that water is the key of development: if they would be able to cultivate crops like onion, tomato, potato they can earn a lot of money and maybe even buy a car and then they could easily get diesel and even make more money

Vegetables and fruits are not cultivated by the inhabitants (except for some experiments) and have to be bought in Dire Dawa town. Not all households are able to purchase vegetables and if vegetables are bought this is once or twice a month because of the long trip to Dire Dawa town. Other commodities that the households are in need of are diesel, coffee, soap, salt, oil, grain, chat[13] (some of the chat is cultivated within the PA and sold within the PA or in town) and household utensils. With the

[13] Chat is a stimulant leaf and suppresses hunger. It is chewed during chat ceremonies at special holidays and feasts and has an important social-cultural status.

introduction of the new water system, water for domestic use has to be bought, as is the diesel required for the generator that powers the pump. It is quite difficult to assess how much grain a households needs, though women can give an indication per month. Still annual requirements are difficult to estimate and depend very much on the yields (and one can question the sincerity of giving information) and the dependency on food aid received.

4.3 Coping with seasonality/drought/different seasons

The seasonality of agriculture introduces fluctuations in the income, expenditure, and nutritional patterns of peasant households. The coincidence of diminishing grain supplies and increasing grain prices is a liability for the economic status and food security of households. As Amare (1999) states "peasants are not passive victims of this seasonal disjuncture; they implement seasonal coping strategies that balance the need to maintain their economic and food security." However one can questions whether this is valid in a food insecure area like Legedini. A seasonal strategy can be recognised in contributing labour to Food For Work programs at times when not much work is to be done on the field. The NGO plans most of the FFW activities when the peasants are not very occupied with other activities. People receive wheat and oil for their contribution to the FFW activities, even though they prefer sorghum; they are able to make their traditional food injera out of it. Other (seasonal) coping strategies are the sale of larger animals, wood and charcoal to compensate for shortage and even selling surplus grain, yet the poorer households try to avoid this. A reliable mechanism to cope with seasonal food shortage is the selling of animals though the animals have to be sold at a lower price since their condition is not optimal, so if possible the selling will be postponed till the physical condition of the animals gets better and the prices are higher. An additional strategy is the exchange of larger animals for smaller ones.

In the dry spell, the peasants reduce their water use and prioritise their water use. First priority is given to domestic potable use, the second priority is the livestock and the least is water for hygiene. In case irrigation is one of the productive uses, the requirements will not be fulfilled (except for Kora village where some maintenance irrigation will be applied) as is further elaborated in paragraph 5.5.

Before the government and the HCS installed the borehole and water infrastructure the inhabitants used ponds to accumulate the rainwater. During the day they would use these ponds for domestic purposes and watering their livestock while at night the wild animals would come to drink. Only rainfed sorghum and maize were cultivated. In the dry season, when the ponds were dried up the villagers had to travel to other PA's (Ayale Gumgum, Kortu and Melka Kero), to fetch stream water, water the livestock and let them brows. It would take the pastoralist a whole day to get to the water source, to collect the water and to let the livestock drink (see table 4.1). Mainly the women and children are responsible for collecting the domestic water. The walk to Melka Kero takes about 6 hours, depending on the village they belong to and whether the animals are allowed to browse along the trip.

Table 4.1 Travel time to water source

Settlement	water point	hours of walk (roundtrip)
Ajo	Melka Kero	12
Hado Sere	Melka Kero	12
Edo Bolo	Ayale Gumgum	12
	Melka Kero	12
Edo Bolo	Kora	6

Note: Especially in the dry season this trip is undertaken 3 times a week with an overnight stay at Melka Kero

The pastoralist did not water their animals on daily basis, but depending on the water tolerance of the different species (see table 4.2). Long distance trekking to watering points has impact on the water and food intake efficiency, growth and development of the animals, since the energy taken will be used for

trekking instead of growth and development (WWD&SE, 2003c). Van Hoeve (2004) found that by providing water in the vicinity the number of spontaneous abortions diminished noticeably.
Since there is no perennial river or surface water body, which does not dry-up in the DDAC, water for livestock must be provided from the water supply schemes, available in the vicinity, be it ponds, springs, wells or protected systems (see table 4.3. for an indication of the daily livestock water requirement in Legedini PA). Therefore the DDAC proposed to make an allowance in of 25 litres per person per day for 60 percent of the rural population for watering the livestock. As can be derived from table 4.4 this amount is by far not enough to sustain all the animals kept[14].

Table 4.2 Estimated water requirement of livestock

Animal	watering interval (days) (1	water intake (litres) (1	daily water req. (litres) (1	daily water req. (litres) (2
camel	5-6	80-100	13-20	50
camel	5	60-80	12-16	
donkey	each day	30	30	16
cow	each day	30	30	27
goat	each day	3	3	5
sheep	each day	3	3	5

(1Derived from WWD&SE, 2003c) and own field work
(2Estimated water requirement of livestock under Sahelian Conditions. Source: FAO, 1986

Table 4.3 No of animals in Legedini PA and total daily water requirement of livestock

Animal	Number of animals	daily water req. (litres) per animal	daily water req. (m^3)
Cattle	1996	30	60
Goat	2425	5	12
Sheep	1259	5	6.5
Donkey	208	30	6.5
Chicken	194	n.k.	
Honey bee colony	44	n.k.	
Total			**85**

Source: Van Hoeve, 2004

There is a risk of overgrazing near the water sources; therefore the water sources should be spread. The spacing between the different water sources also depend on the distance animals can cover to reach the water point as well as the watering interval. For Sahelian countries the walking distance is considered to be 6 to 10 km from the grazing area to water for cattle and 3 to 5 km for goats (FAO, 1986; WWD&SE, 2003c).

Table 4.4 Average number of animals per household and the daily water requirement

no of animals		Daily requirement (litres)/ animal	total
0.5	camel	50	25
1	donkey	16	16
1.5	cow	27	41
10	goat/sheep	5	50
	total		**132**

[14] It was difficult to calculate the average number of animals kept by the households. It is undoubtedly an underestimation, but at least it given an indication on the minimum volume of productive water needed for their livestock.

Small scale irrigation

Besides the traditionally practised spate irrigation by some farmers, experiments started with drip irrigation. The drip irrigation practised can better be described as 'drop' irrigation. Empty USAID oil tins with a volume of 4 litres, get a new destination. The tins are pierced with a small hole in the bottom and then attached to a branch of a tree. From these holes the water will drop on the ground under the papaya trees and moisture the root zone of the trees and need to be refilled after one day. This practice was initiated by the HCS and demonstrated at the trial plot in Ajo and copied by the farmers in the area. This small scale irrigation enables the farmers to produce cash crops and crops to improve their diet. Many inhabitants with access to one of the two developed water schemes are growing papaya trees. Most trees were still young at time of research and did not give any fruits yet. Other crops under irrigation in Kora village are potatoes, citrus, and the nursery for seedlings. On the trial plot in the communal compound of Ajo, besides papaya[15], also groundnut, sesame and haricots can be found. Appendix VIII lists irrigation requirements for different crops within Dire Dawa Administrative Council.

[15] Papaya is a high potential crop: it can easily be cultivated, gives a lot of fruits and is a valuable source of Vitamins A and C and thus can contribute to an improved diet (http://www.FAO.org and http://www.swedish.org).

5 The villages, the water systems, rules and regulations

Legedini PA was recognised by the Dire Dawa Administrative Council for their request for water facilities. The first interventions, started as government project, were 6 to 7 hand dug wells (up to 25 meter deep), yet they failed; according to the documents because the sources dried up (WWD&SE, 2003f and table 5.1). Therefore another plan was made to construct of 5 Hand Dug Wells that should serve 9 villages with a total number of beneficiaries of 3600[16] (WWD&SE, 2003f), yet this plan never became effective. A preliminary study was executed and some test drilling[17] was performed under supervision of the Water Mines and Energy Office by the Water Works Design & Supervision Enterprise. Those two boreholes are 124 meter downstream of Ajo borehole, but these failed as there was no water.

Table 5.1 Non-Functional Rural Water Supply Schemes in Dire Dawa Administrative Council

Villages with water supply scheme	Types of schemes	Types of pumps	Constructed By	Year of construction (E.C.)	No. of Beneficiaries			Year service stopped (E.C.)
					Households ♂	Households ♀	Total Benef.	
Hallo	HDW	Afridev[1)]	WMEO	1990	280	20	1800	1992
Selella	HDW	Afridev[1)]	WMEO	1990	130	6	816	1992
Edo	HDW	Afridev[1)]	WMEO	1990	170	-	1020	1992
Koyna	HDW	Afridev[1)]	WMEO	1991	60	5	390	1993

[1)] The Afridev hand pump is a public-domain pump which can lift water up from depth of 10 m to 45 m. There is only a minimum training required for routine maintenance. http://www.lifewater.ca/afridev.htm

The HCS got involved in the Legedini PA with the development of a reliable water infrastructure with good quality water for the benefit of the entire[18] PA, as part of the DAP II in 2003. Two major constructions were executed: one developed spring source and distribution network at Kora village and one borehole in Ajo village with connected distribution network. Both schemes will further on be presented as two cases.

5.1 Institutions at local level and community based within the PA

The villages in the Dini watershed are member of the Peasant Association Legedini. A Peasant Association is the lowest level administrative unit for the government and the first PA's were established during the Dergue regime. The boundaries of most of the PA's are based on natural boundaries like watersheds. Each PA has an elected chief. The chief of Legedini, (at time of writing), was elected 4 years ago and will stay chief until the villagers are not satisfied with him anymore. The PA leader fulfils a key role in the contact of the villages with the different line offices. Besides this PA chief some villages have their own village leader. The persons in a leading position are the better off in the society, as they have the means to put time in their leadership. The poorer in the society need all their resources to survive on daily basis. Besides the PA leader and the village chief, the imams and the elderly play an important role in advising and conflict settlement within and between the communities.

The Legedini Peasant Association is considered as one entity by the project implementers. All activities are for the benefit of the whole PA. However people live in one of the 11 villages and have

[16] The total number of beneficiaries in table 5.1 is 4026

[17] The villagers referred to those drillings, yet it was not made clear to them, that those drillings where for testing: the communities feel that the government failed in providing them with water. Therefore it is important to clearly communicate with the communities about what is being done and for which reason, to prevent that the communities feel that they are left out.

[18] However this was not clearly communicated to the villages that the project is planned for the whole PA, thus the developed water sources area for the benefit of all.

their own village structures, though there are kinship-relations between the villagers and young people also marry outside their village. The Food For Work activities take place all over the PA, for the benefit of the whole PA, in which the villagers can participate.

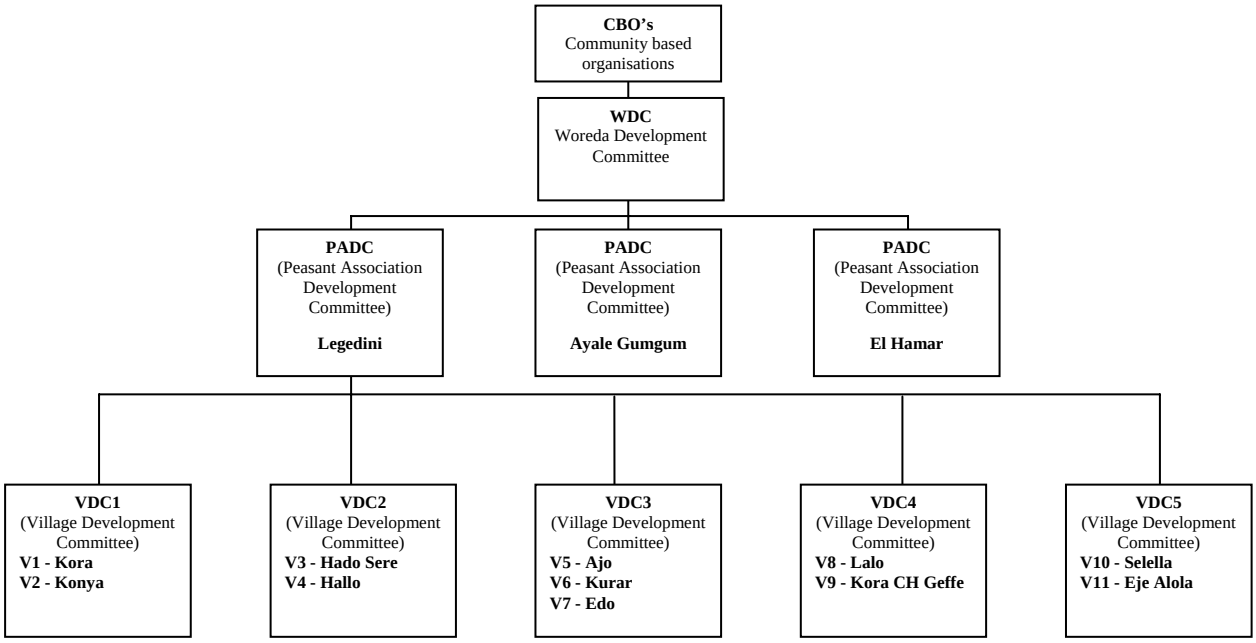
By the DAP II project some new institutional structures were promoted. Amongst them are the Water Committee and the Village Development Committee.

Each village has (or should have) a *Village Development Committee (VDC*). The Village Development Committee leaders have been granted authority by the PA administration to manage communal lands and water points. In order to make the rehabilitation of degraded hillsides sustainable the community needs to be involved in decision-making during planning, implementation and management. Village Development Committees should be based or linked to traditional structures and systems. One of its tasks is to gather the villages if an issue rises on which the villagers need to decide and vote upon. In case official visitors are coming, e.g. representatives of the CRS the VDC will notify the inhabitants and makes sure that everybody is around in the village.

When asked about the different committees and organisations in the community it appeared that not all inhabitants were aware of these different organisations. Some for example could list the names of the Water Committee members, or name other committees. Others stated that there was no such thing as a Village Development Committee.

Kora has a village development committee, which is responsible for the planting of forest trees, security and maintenance of the road. The village development committee will gather the citizens increase a government official or donors will come to visit the village.

Figure 5.2 Village Development Committees



The PADC has five different types of members: the village health committee (VHC), village Water Committee (VWC), agricultural agent, community elder, and the PA administration.

The CRS, as the main fonder of the Title II/DAP II program has some conditions for supporting the project. An important indicator for Title II project is the establishment of a Water Supply and Sanitation Committee (CRS, 2003b) within the community. The committee should:

- Define and manage the operations of the project
- Have a legal basis and be authorised to administer financial accounts

- Have input into project planning (CRS, 2003b)

Where available the Co-operating Sponsor, which is the HCS for this study area, should build upon traditional community structures, since it is better to work with traditional patterns of community leadership and organisation that have proven to be effective in the past, than to set up procedures and rules for project development that are imported from outside the community. Sanitation is considered to be an essential part of potable water supply improvements and therefore sanitation must be linked to water supply (CRS, 2003 c). As women often have the most gain from improvements in water supplies and sanitation they should be represented within the Water Committee[19]. The community is expected (through its Water Committee) to undertake routine maintenance and repairs on its water and sanitation system, but the CRS recognises that the community probably will need technical and financial assistance for major technical problems and repairs. Therefore the HCS should help set up an agreement with the local government technical bureaux, which have been involved throughout the project development cycle, for assistance in the event that major interventions are needed in the future, as well as act as a partner with the community in developing a long-term monitoring plan (CRS, 2003b). As can be seen in the next paragraphs this is a nice precondition, however reality is more persistent.

So for each of the two developed water supply systems a Water Committee had to be formed. Indeed Water Committees where identified, for both the developed water systems, yet it was difficult to assess their composition and how the different committees relate to each other. There is one general Water Committee based in Ajo and three sub-committees in the other three villages of Edo, Edo Bolo and Hallo for the motorised scheme and one Water Committee for the developed spring system of Kora. Each committee received a training in facilitated by HCS staff about operation and small maintenance, the fee collecting and how to set up rules.

The different Water Committees are further elaborated in the next paragraphs.

Rules

Two types of rules are present: the local, traditional rule and the formal governmental rule. The local rule has the first preference of the villagers; however the formal[20] rule is becoming more and more important. Most problems can be solved at PA level and only in case of insolvable disputes the villagers will go to court in Dire Dawa town.

Local rule

The village chief and the elderly play a crucial role in ensuring that the rules are obeyed. In the past violent incidences occurred which even led to killing, but the conflict is solved and nobody wants to talk about it anymore (let bygones be bygones). The local ruling is preferred and most problems are solved at PA level.

The following steps are taken in case of violating a rule:
1 A punishment will be set
2 In case the person refuses the punishment, the elderly will kill one of his livestock (e.g. slighting the throat of a goat) and eat it on the spot.
3 They can also go to the formal court in the Peasant Association
4 The last step is that the person has to go to court in Dire Dawa. At this point the person is expelled from the society and cannot come back[21].

[19] Women usually have to carry the water, maintain the water points, clean the latrines, wash the clothes and prepare the meals
[20] The first written formal rules where constituted by King Menelik, who assigned persons to execute these rules. Thereafter the court was established to look after the implementation of the formal governmental laws.
[21] Social exclusion is the worst punishment a person can get.

Rules about the use of the communal grazing land

As mentioned in the introduction most of the State owned rangeland is in practice managed as common property and is usually controlled by an ethnic group, clan or other social units. They apply rules and traditional social control. Characteristic of the common land is low human density and high dispersion and mobility of both people and livestock to keep a long term ecological balance to check over-use (Dryland Husbandry Project, 1999). All the villages have access to communal land, which is divided per village. Each village has its own rules about the access and use of this land. As a soil conservation measure certain communal lands are closed. Each closure site should have its own management committee which is democratically elected by the villagers. Often these villagers are already experienced managers of enclosed areas on their private land (CRS 2001). There are for example set times for entering the area, or the use of it (only cut and carry from it). Yet, the exact rules about the use of these lands are not known by all the villagers. Conflict is solved by the local rule of the elderly. When it is allowed to enter the enclosed area is also decided upon by the elderly. For some of the young men the production of charcoal is the only ways of making a living and is connived at. There is also a federal law, which states that it is illegal to cut firewood from the hillside in order to protect them against erosion. However the law is not enforced by the government within this area.

Settling in village

Some co-operation exists between the villages, but it is not easy for newcomers to settle in a village. The newcomer needs to get permission of the village to settle and if the villagers agree he will receive some land, otherwise he cannot survive.

In case a person wants to live in the community he has to respect the rules, if not he goes to jail, but this has never happened. Whenever someone commits a crime the villagers will ignore him, even his wife. Then the perpetrator will ask to be excused.

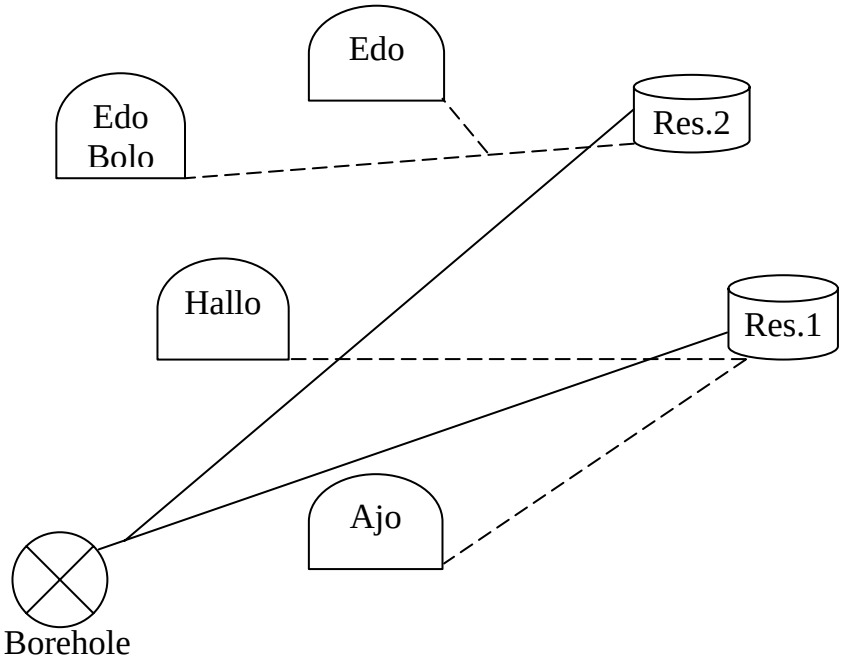
5.2 Ajo, Hallo, Edo and Edo Bolo: the villages connected with the motorised scheme

5.2.1 Motorised scheme Ajo

End 2002 a borehole was sunk, commissioned by the Water, Mines and Energy Office (WMEO). The Ethiopian Social Rehabilitation Fund financed the drilling, UNICEF[22] financed the civil works, one generator, one pump, the pipes and one reservoir and the implementation was done by the WMEO. The extension work was provided by the HCS as well as one reservoir and one standby diesel generator. Four villages are connected with the borehole and the corresponding distribution network viz. Ajo, Hallo, Edo and Edo Bolo. The water is pumped from a depth of 72 meters into two reservoirs, with a capacity of 25 m^3 each. Ajo and Hallo village share one reservoir and Edo and Edo Bolo share the other one. Both reservoirs are cleaned on monthly basis when the reservoirs are empty with the use of an endemic plant Olea which is found in the mountains. The valves connecting the reservoirs with the pipelines going to the taps are always opened. So far no discharge measurement or monitoring of the water table draw done was performed by the Water Mines and Energy office. (Water table draw down was only measured to determine the discharge of the well after the drilling works were completed).

[22] as part of UNICEF's nation wide program of providing access to potable water

Figure 5.2 Water infrastructure motorised scheme Ajo village



Schematic drawing water infrastructure motorised system not on scale

Technical aspects

One person in Ajo village is responsible for and able to operate the pump, which is only operated in the morning or at night time. According to the operator to prevent overheating due to the high temperatures during day time in the pump house, yet according to the generator characteristics the max, ambient temperature can be 40°C. The fuel is stored at the generator, but kept in separate supplies for the two reservoirs. The reservoirs are filled on rotational basis, most of the time they are refilled each other day (depending on the season). In the dry season the reservoirs have to be filled each day (because the livestock will need this water as well). The dependency on the fuel is the limiting factor for refilling the reservoirs on daily basis[23]. Each turn the reservoirs are filled with 25 m^3, (the water tops over the reservoirs if filled), unless there is not enough fuel then the reservoirs will be filled halfway. The Water Committee will report to the operator when the pressure goes down so he can refill the reservoirs (so the reservoirs are not always completely empty at time of refill).

Figure 5.3 Generator characteristics

Rated power	30 KVA	24 KW
Speed	1500 rpm	
Max altitude	1000 m	
Max ambient temp	40°C	
Freq	50 Hz	
Volt	400 V	
Current	43.2 A	

Both generators are from the year 2002

[23] According to the design it is possible to fill both reservoirs on daily basis. Jamail (the operator) states that filling the Ajo/Hallo reservoir takes about 4 hours and the filling of the other one about 6 hours. Unfortunately it was not possible to check this, since the pump broke down during the field period.

Distribution of water

All the four villages have set *tap-opening hours* and a *restriction on the volume* each household is allowed to take, even though the villagers do not consider this as a restriction. There is a limitation on how much water might be taken for irrigation.

The infrastructure has some flaws:

- One pipeline comes from the reservoir of Edo Bolo and Edo and is split up with a T-junction into two lines with each a separate valve, however these valves are broken and the valve at the reservoir is always open. The Water Committee does not have spare parts for the generator or valves in stock, but the taps and the pipes they can repair when needed
- At several points there a leakages in the pipelines, as well as leakage around the valves.
- The main valve between the pump and main pipeline going to the reservoirs is broken, so all the water in pipeline falls back into the borehole when the generator is turned off.
- Water losses also occur when the reservoirs are filled: the operator stops pumping when the water overtops at the reservoir.
- The reservoir shared by Ajo and Hallo is not elevated enough, to have enough head to pressurise the line to the watertap in Hallo village in order to serve Hallo to the full extend. When water level in the reservoir drops, Hallo does not get water and the village has to go to Ajo to collect water from their tap. Hallo discussed this problem with the HCS, yet the problem could not be solved. The village would like to have its own reservoir.
- It happened once that the generator broke down due to overheating. The money at the bank was not enough, so the water bureau contributed as well. After the repair of the pump the villagers contributed money again.

Fuel issue

The dependency on diesel is a big burden for some of the villages.
Two different explanations are given for the lack of diesel:

- The price of the diesel
- The difficulty of collecting the diesel

The issue of lack of money to buy fuel is difficult to address, since especially the men do not like to admit that there is not enough money to buy fuel.

The difficulty of fetching the diesel is the transport facility (or the lack of it). If the villagers are lucky the HCS will come with a vehicle with diesel otherwise a man is going to Dire Dawa town with donkeys to fetch the fuel. But the road is very rough and the donkeys get wounds at their back from carrying the heavy loads of fuel from Dire Dawa to Ajo. As stated by Nuria, member of the Water Committee in Ajo: “if we would use more donkeys to fetch the diesel, we have more donkeys with a bad back.”

Box 5.1 Illustrations fuel issue

November 2004: The village of Edo Bolo experiences a water shortage due to the lack of diesel. Sometimes the village is two weeks without water.

December 2004: Due to the shortage of diesel the village of Edo cannot pump up the water from the borehole, so they have to fetch water at Ajo. Two different opinions are present for the reason of the shortage of diesel. One group states that it is because of lack of money to buy fuel, while the other group argues that there is enough money, but there is no fuel available.

What the exact reason for the shortage on fuel is, might not be clear, yet it is evident that the shortage itself puts a restriction on the quantity of water used from the borehole.

5.2.2 Ajo Village

Ajo village is the central and largest village in the Legedini PA and hosts the public service of the PA.. It consists of 68 households, with an average of 6 persons per households, which makes a population of about 400 persons. The village is quite organised and most people in this village know about the development services and how to access them, probably due to the fact that the PA leader is a resident of Ajo. The other advantage for Ajo village, is that the borehole was constructed within its boundaries and thereby attracting a lot of attention from governmental organisations as well as NGO's.

Local government workers are based in Ajo village and have their own facilities. There is a *primary school* up to grade four in Ajo village, for the benefit of all the children of the PA, yet for the younger children from the villages most remote from Ajo the walk to school is too long. It is government policy that young governmental employees like nurses, and teachers have to live and work for two year in the rural areas. The clinic in Ajo has one nurse, who speaks only a little Oromifa, who is responsible for the health of the whole PA. He vaccinates, gives birth-control and monitors new born babies. There is a Development Agent assigned for Legedini, but he left since he went to university. At the time of field research the agricultural office stayed abandoned.

There are plans to use the second generator for generating electricity for the school and the clinic at night time. It might be a option to have a night school; the villagers are interested in night school but especially the women do not have time for attending classes at night. Ajo village has not decided yet whether or not an electricity committee will be established. The chairman is the person responsible to organise a village meeting to discuss this. Another problem for using the second generator is the fuel supply for it (both costs as well as fetching it)

Besides Idir and Equb manifestations there is also a group of youngsters, in which the adolescent men are organised and contribute money. They already have quiet some savings, however no concrete plans on where to spend the money on. They expect the government or the NGO to help them with ideas on how to spend the money.

The traditional water source for Ajo is a big water harvesting pond, located between the communities of Selella and Ajo, which was constructed about forty years ago by the villages themselves, without help from outside. At that time the society was very small, people from the different villages worked together and even stayed overnight at the site. The pond was upgraded as part of the DAP II project and can now contain water for a longer period (up to six months, depending on the rains), but it is hardly enough to bridge the dry spell. All neighbouring villages use this pond. Washing in the pond is not allowed, which is the only restriction for its use.

In the past conflicts around water were solved by the traditional ruling of the elderly, but since the borehole was installed in Ajo no major conflicts occurred about the water (since there is more water available).

Box 5.2 Features Ajo pond

The dimension of pond Ajo:

length (m)	width (m)	depth (m)	volume ($m^{3)}$
44	42	2,5	4620

Source: own field measurements

It contained water till January 2005, which was enough for about 3 months.

People from the surrounding villages as well as the nomads, use this pond to water their livestock. Besides this productive use the water is also used for domestic us. (Most women will filter the water through cloth when pouring into the container).

Milkgroup

Twelve women from Ajo and Selella village are organised in a *milkgroup,* which was founded 3 years ago. Before this time the milk was only used for home consumption, but due to the shortage of wood (because of the closed areas), they needed another income generating activity. Every woman has to contribute 10 Birr per month. All milk (from the goats, cow and camel will be mixed), to be sold will be collected in the morning at a central point, often taken there by their children, from which one woman will take the milk to the market in Dire Dawa town for sale (3 Birr per litre). The women take turns in going to the market and each woman will receive her share. Before the HCS got involved in the area, the women would use the money earned by selling the milk and milk products for their household, but after a training of the HCS they will save the money for the future. Up till now the milkgroup has been very successful, with a savings of 4000 Birr in the bank and is thinking of expanding its activities. With the money saved the group is thinking of getting a grain mill on wind energy or generator, so they do not have to go to another village, yet expect to get some advice from the government or the HCS on how to spend it. The villages of Hallo and Lallo recently started with forming a milkgroup as well.

Physical system

There is one water distribution point with four taps to collect drinking water. Next to the tap there is a washing place to do the laundry without a water tap; the women pour the water bought at the tap into the washing basin. The waste water is just drained away into open field. There is one extra tap on the community administrative compound where the HCS offices are build as well as a shower house which is not used. This compound has several demonstration plots with different crops cultivated and trees grown for shade around the buildings. The tap is only used for watering the compound. is was observed that village chief and the pump operator took water from this tap and used it outside the compound, which was disregarded by the community. The clinic has an own tap; however this was shut off during the field period, since the clinic did pay for the water.

Water Committee

In the water management committee, which has to manage the borehole and the maintenance of the generator, only inhabitants of Ajo take place (because they live closest to the borehole) The Water Committee was elected by a general meeting, in Ajo, where all the villages that use the borehole were present. Within the three other villages (Hallo, Edo Bolo and Edo) there is a water distribution/fee collecting committee. These committees are in charge of collecting the fees, sanitation, and small maintenance of the distribution points. Those committees are sub-committees of the water management committee. When interviewing the water users about the different Water Committees, there was some confusion about these committees. It was difficult to make distinction between them.

In short there is one central Water Committee with sub-committees in the villages for daily operation and fee collection. Each Water Committee will amend own by-laws, which are orally agreed upon (not written since people are illiterate).

Table 5.2 Composition Water Committee Ajo

Name	Gender	Function	Task
Jemal Uso	M	Pump operator and auditor	Operating the generator and monitoring the money administration (O&M)
Nuria Omare	F	Collector/care taker	Collects the money
Amina Siyo	F	Supervisor	Cash collector
Nefisa Sjeka	F	Cashier	

There is one person who operates the generator and fills both the reservoirs in order to avoid conflict between the villages or damage.

The Water Committee was established 1.5 years ago, after the construction of the borehole, as a precondition of the HCS. The water sub-committees of Ajo, Hallo, Edo Bolo and Edo Kurar meet once a week. At the meeting the collected fees of the villages will be handed over to the cashier (from Hallo village) who takes the money to the bank (and keeps some for buying fuel). Women are chosen as water caretakers (also request from DAP II project, to have women involved in the committees). The members of the Water Committee where democratically chosen by the communities, during a general meeting of all villages in Ajo, based on their reliability and capacity and the first committee members attended a training of 5 days in Dire Dawa town about the small maintenance and management. After that they were formalised.

Whenever a big investment is needed, e.g. in case of generator break down, all the villages (Hallo, Ajo, Edo and Edo Bolo) will contribute the money needed to hire a technician and material from Dire Dawa.

Tap opening hours

The tap is opened from 7 to 10 in the morning and from 4 to 6 in the afternoon, to enable everyone to get a share of the water. The opening hours are not very strict: sometimes the tap opens later (e.g. once it was observed that the tap opened at 8.30).

At the tap the women fill the jerry cans (20 litres) and pay for the water to the caretaker (a woman). The caretakers are responsible for opening the taps and collecting the fees at the tap. The two women take turns in collecting the fees, if one works at the tap in the morning the other woman will work in the afternoon. Both of them get compensated for their time: they can fetch the water for their household for free and if they go to town (to the bank) the other villagers will cover for their work. People will help in the field with the harvesting of the crops.

The people take 2 to 5 jerry cans per day: the water is used for washing cloths and the children and their body, cooking and drinking, for sanitation and watering the small ruminants at the house,. After using the water for the household, the water left can be used for irrigation, however this is not much. It is very difficult to make a distinction between the volume of water used for domestic purpose and the water used for productive purpose as all the water is taken to the homestead and not kept separately. The water users can only give a rough estimation of the volumes of water needed and used for the different activities.

The villagers claim that there is no restricted use though people are not allowed to take more water then they would need according to their own standards (the water use is much lower then 15 lpcd partly due to custom their nomadic tradition). So in principle there is no restricted use on the water for drinking purposes, but the water caretaker knows how large the household is and how much they need.

There is a big social control and everybody knows who might take 2, 3 or 4 jerry cans of water. (For domestic purpose the households need 1, 2 or 3 jerry cans and an addition one is for the animals and the home garden). The household can use the water as it wishes for drinking water, livestock or the papayas, but the water used for the papayas is restricted to watering three of them. In Ajo the households are only allowed to water 3 trees, yet the exact volume is not defined. When the water harvesting pond contains water, the animal troughs are locked, since it will cost too much fuel if the livestock uses water from the borehole.

Ajo does not experience any water shortage according to the villagers, but in case of fuel shortage the number of jerry cans that can be taken will be decreased. Every household can collect 1 jerry can and if there is enough water they receive a second one.

Ajo village is the resort for Edo, Edo Bolo and Hallo in case of diesel shortage and besides these three villages also Selella and Eja Alola (which lies on the other side of the mountain) come to Ajo to collect water. These neighbouring villages only use the water for domestic purposes. They take 2 jerry cans per donkey (the donkeys cannot carry more) as they are restricted by their assets to take more water. During the rainy season these villages have their own source of water for the livestock, but in the dry season they experience a lack of water. Some of the nomadic people will incidentally come as well.

When asked who has the first priority in case of fuel shortage the first priority is given to the other villages because they come from a large distance and do not come everyday. When they run out of fuel someone will go to town to buy fuel and the next day they can pump again.

Rules and water pricing

At first the people had to pay a monthly fee per household of 3 Birr. However the communities protested against this, since each household pays the same contribution, though does not take the same amount of water (water use is related to fuel use). After the establishment of the Water Management Committee and negotiation with the committee it was decided, in a general meeting of the four villages, to apply volumetric water pricing[24], with a fixed price per volume taken. Everybody pays the same price per volume water taken. In case someone does not pay the fee the Water Committee will report to the Village Committee. This is the PA village committee in which people from the different villages are seated. During the field period to water price was risen from 10 Birr cents to 15 Birr cents per 20 litres, due to the higher fuel prices.

If someone does not comply with the rules he will get punished. The first time he has to pay 1 Birr, the second offend will cost 10 Birr and the next 50 Birr. The last step is to take someone to court and expel him from the water. If a person is not able to pay for the money he or she can be excused by the Water Committee or pay in kind.

In December 2004 the Water Committees using the borehole in Ajo started on book-keeping the collected fees (see table 5.3). The account book is kept in the office of Antenna (the nurse) in the clinic. It is not very clearly written down and the book is not a cash book.

[24] In fact the households are spending more money on the water: 6 Birr per month, assuming that each household will buy 2 jerry cans a day à 10 Birr cents.

Table 5.3 Account Edo and Ajo village

Date (E.C.)	Village	Amount (Ethiopian Birr)		In cash/ on the bank (Ethiopian Birr)	Total Lege Dini (Ethiopian Birr)
money saved before 3-4-97					232.6
3-4-97	Edo	95.65	Collected fees for December		
3-4-97	Ajo	162.00	Collected fees for December	162.00	490.25
13-4-97	Ajo	120.00	20 litres of fuel	42.00	370.25

The money is collected each day at the water tap when the villagers are purchasing the water. The money will be counted every month, and is collected by the pump operator at the villages. The receipt of the bank is kept by the chairman of the PA. The money will be counted every week at the collector's house and be registered on paper (it was not possible to see the paper because the person was not around: went to the sedeko at Ayale Gumgum to get water).

Box 5.3 opinion Ajo village about future

If the village would have enough water they can grow many other crops (different vegetables, fodder, trees for shade and high valuable cash crops like sesame and groundnuts). The soil is very fertile, so water is the limiting factor. A future problem they foresee is the migration of people from outside Legedini to the area; especially if more water resources are available it will be a very lucrative area to live. Also the Food for Work program attracts a lot of people.

5.2.3 Hallo village

Hallo village is located close to Ajo village, on the other side of the ephemeral river Dini on a higher elevation then Ajo and consists of 81 households including the semi-permanent villages of Lallo and Kora Cheffe. For the livestock they use the stream of Melka Kero. Before the DAP II project there was no clean water available for them and diarrhoea was very prevalent. Now that they have access to clean water from the taps in their village, the villagers claim to have no cases of diarrhoea. Besides the homesteads with some papaya, there is also a big papaya plot, with about 60 trees in it, several people claim to be the owner of this plot and according to the HCS this is a trial plot and different opinions about the water use and volume allowed for this plot are prevalent. The HCS provides the fuel for the owners of the demonstration plots in Hallo and Ajo. Before the DAP II project there were problems of conflict and times were hard. The villagers discussed their problems and decided to dig their own hole and making their well together with Hado Sere village. But at night other villages of Melka Kero take the water from their well; therefore they had guards at night at their well in the dry season.

Box 5.4 Trial plot Hallo

Jaja from Hallo village manages the (trial) plot with about 60 papaya trees. Every 4 days he pays 24 Birr for using the water for his papayas (6 Birr per day > 40 jerry cans per day) He uses 4 jerry cans in the house: 1 for drinking, 1 for cooking, 1 for washing cloths and body and 1 for cleaning the house. The large animals will be taken to Hado Sere.

Since the pump failure he uses 4 jerry cans for the same purposes though the animals are taken to the sedeko at Ayale Gumgum, as the Hado Sere well is dry.

Together with Jamal and Radhid from Ajo village he made an **irrigation group**. The three of them contribute money and buy fuel for pumping the irrigation water.

When asked whether Jaja would consider himself as a big farmer he replied that he sees to himself he is an average farmer.

Hallo village has one chairman who is elected by the villagers as well as a women representative. Besides those representatives the village has a cashier, who is assigned for cash collection and is audited by the chairman. The village makes use of a secretary of Ajo village.

Physical system

There is a main valve that can be opened and closed. When this valve is opened the water goes to the drinking tap. After this valve there is another pipe with a valve going to the livestock drinking place. This tap will only receive water when the main valve is opened. The village has a central water point with an animal trough (with separate tap) and a washing basin. The waste water from the washing basin is diverted to the adjacent field.

Water Sub-Committee

The cashier that collects the money to buy the diesel is elected by all the four villages. The money will be deposited to someone else. The person who buys the diesel receives vouchers to buy the diesel.

Table 5.4 Composition Water Sub-Committee Hallo

Name	Gender	Function	Task
Fatuma Mohamed	F	Money collector	One of the two who collect money at the tap
Yaya Mohamed	M	Cashier	Collects the money and buys the fuel and takes the money to the bank
Dabo Aden	F	Money collector	Sells the water and collects the money at the tap
Sherif Anmed	M	Auditor??	If there is no water coming from the tap, he goes to Ajo to Jemal to tell him to start the generator
Zeyneba Musa	F	Not in the committee anymore	Used to be one of the money collectors

(It takes a big effort before they can name all the members of the Water Committee, apparently the villagers don't think in such a kind of structure).

The Water Sub-Committee was established 1 year ago and elected by the village. The 4 persons of the Water Committee are responsible for the O&M of the whole system and received a training of 3 days by the HCS in Dire Dawa town. The villagers affirmed that there was an election for the Water Committee in Ajo which all the villages attended. The small repairs on the pipe system, they can do by themselves and for other small maintenance they hire a man from Ajo village. The taps are daily

cleaned. One woman is responsible for collecting the water fees. The savings from the fees is used for buying the cheaper materials for maintenance.

Water use

If the households have money, they fetch between 2 and 4 jerry cans of water per day and pay 0.10 Birr per jerry can for it. This water is used for drinking and cooking not for washing or other hygienic purposes like flushing the latrines. Only a little water is used for praying purposes. A woman states that if the households have enough money they can buy up to 6 jerry cans. But due to the shortage of money they only get 2 jerry cans at the tap for the most necessary purposes (3 jerry cans at maximum)

Box 5.5 Reuse of domestic wastewater

Water without soap which was used for cooking and cleaning household utensils is often given to the small ruminants at the homestead. Ablutions before praying or going to the mosque take place in the field, so this water is reused at the spot.

Water with soap is just poured out in most cases. An argument often used for not reusing their laundry water is that it will burn the leaves of the plants. However, if the water is put in the USAID tins and applied via drip irrigation to e.g. the papaya trees, the water will directly reach the soil without touching the leaves. Also for hygienic point of view this is a good technique instead of spraying or pouring the water over the crop; in case the wastewater (from bathing) is contaminated with faecal coliforms the health risk is limited, since the water will not touch the fruits and there is no physical contact with the water.
In Selella village the wastewater of washing is given to the eucalyptus trees.

A drainage facility to convey the wastewater lacks at the washing basins. In some cases the farmers have dug a small furrow to convey the water to the crop land. The excess water from the tap (by spilling water and cleaning the tap place) is not collected put flows away.

Water shortage

In case of water shortage in Hallo (no water coming from tap, often because not enough diesel to fill up the reservoir) Hallo village will collect water at Ajo. When there is a water shortage in Ajo village, Hallo will go to Kora. They don not need to pay for the water at Kora, but they can only go there for two 2 days (especially when there are a lot of people), after that they have to go somewhere else. The livestock is at Melka Kero stream which is the closest by (nearer then the Ajo pond) and convenient for them. When this stream is dry there is a problem: there is not enough water and the people at Melka Kero don not want to give them water.

Box 5.6 Collecting water for irrigation

Several farmers from Hallo: “even if no water can reach the taps in Hallo, since the reservoir water level is too low; we still irrigate. We collect water with the donkeys from Ajo, because this is a nearby source and therefore it is possible to collect water for irrigation.

5.2.4 Edo Bolo village

According to the village chief the Edo Bolo settlement consists of 60 households[25], the largest household consists of 12 persons and the smallest has 3 persons living in it. Nowadays they have more awareness about the negative effects of having a big family and a population that grows to fast and birth control is applied.

They have three sites to collect water for their livestock and in case no water is coming from the tap:

- Melka Kero
- Ayale Gumgum (forth and back takes 12 hours together). Before the tap in Ajo they would go to Ayale Gumgum
- Kora (3hrs forth and 3 hrs back)

Village chief Abdulah Raman Ahmed, was elected in a general meeting of the village over one year ago. The chief has to be chosen with one voice and will continue to be the chief as long as the villagers are satisfied with his performance. Besides the village chief there is also a secretary and a cashier. One man is learning for accounting, but at present they rent a person from Dire Dawa town to do the accounting of the money. The village has also a women committee with one representative assigned that gives information on women issues and a Water Committee. The people of Edo Bolo are not really worried about people migration to the village because of the water facilities, since it is not easy to settle in the village (see box 5.7).

Box 5.7 Settling in the village of Edo Bolo

"Nobody has come to our village by themselves. It happened once that a person came to the village to ask if he could become member. For that he had a paper, given to him by his own village, that stated that he is a poor man and with the request for the villages to give him shelter. If somebody comes as a guest to the village he cannot survive: he has to become a village member. So they first received him as a guest and provided a place for him to start a new live and then he became a member of the village."

Water Sub-Committee

For operation and maintenance of the system two men are assigned and got a workshop in Dire Dawa town by the HCS about the operation and maintenance of the system. The daily operation of the system; the opening of the taps is done by one of the women of the Water Sub-Committee.

[25] However information from the clinic shows that Edo Bolo has 19 households. The villagers tend to exaggerate their situation in order to receive more help.

Table 5.5 Composition Water Sub-Committee Edo Bolo

Name	Gender	Function	Task
Abrahman Yuya	M	Care taker	Maintenance pipes
Kedija Mume	F	Daily cash collector	Collects the money at the tap
Mustafa Musa	M		Informs Jemail when the water in the reservoir is finished
Halima Omer	F	Chief cashier	Keeps the money and deposits it to the big Water Committee
	F	Mediator	receives the daily collected money from the cash collector and gives the money to the chief cashier
Omer Mahamed	M		Assists Halima; when there is no diesel he goes to Ajo to pay for the diesel

Water fee

The water fee is also established at 10 Birr cents per jerry can of 20 litres. 1 Birr per month per household was collected for savings for maintenance. There were not much savings at the time of fieldwork since the water system had only been operational for 7 months. There is no restriction on water use and if they have enough money to buy diesel even the livestock can get water from the system according to the respondents.

1 household gets 4 jerry cans of water per day, but this is not enough. They also need water for the small ruminants and to clean their cloths etc. The crops like papaya and vegetables they water randomly.

Water shortage

In case of water shortages from the tap or no water in the tap at all peasants from Edo go to the other PA of Ayale Gumgum. There is a stream of good quality for their livestock and drinking water and they prefer this water over the water from the pond near Ajo, because the quality is much better, however in case of a very dry spell this stream is dry. In the dry season conflict over water occurs. In the past the rule was: who comes first with his livestock has the first right. However this led to violent conflicts, so the elders got involved and the fighting stopped. Most of the time the people will try to solve conflict by discussion; again the elders are very important in conflict settlement. They made an arrangement about when each village will have his turn, but even then people will hide in the grass and go before their turn. Even if there was enough water they would have conflicts over the water. But now with the new developed water schemes there is less conflict; and only water scarcity for their livestock.

Box 5.8 Future prospect Edo Bolo village

Respondents of Edo Bolo village:
For the future we believe that the government will solve our water problem and we wait for more water. If there is enough water the villagers do not foresee a problem when more people come to the area: if there is enough water, why should there be a conflict? When asked if other people coming to the area will be allowed to take water, the village chief replied: "How can we refuse water to someone if in the past we didn't have enough water *ourselves?"*

Chief Edo Bolo:
If it is possible to get another pump they could harvest more water and use this for irrigation. He would cultivate cash crops and from this money the village could buy a car and with this car it would be easy to transport fuel. Then there is no need to keep livestock. (he does not care about the livestock: this is strange since keeping livestock is part of their cultural identity).

5.2.5 Edo village

Edo village consists of 20 households. The village chief is Omar Mohamed. He was elected by the villagers for a period of five years and during this period the villagers will evaluate his performances and if he has good capacities he has the opportunity to be re-elected for another five years. Whenever there is a conflict within the village the chief and the village elders will meet and decide what has to be done. The village has a animal trough, drinking water tap and washing basin as well.

The villagers have big expectations for the future: to produce more marketable crops and sell those in Dire Dawa town, with the money earned they can buy a car, which makes is easier to purchase the fuel needed for the generators

Water Sub-Committee

Table 5.6 Composition Water Sub-Committee Edo

Name	Gender	Function	Task
Ame Oso	M	Care taker	Maintenance pipes
Nuria Abdo	F	Daily cash collector	Collects the money at the tap
Abdrehman Ahmed	M	Cashier	Monitors the collection of the money (for Edo Bolo and Edo) and brings money to the bank

5.2.6 Additional water sources besides the motorised scheme

The village of Edo Bolo constructed a large water harvesting pond, but is not finished sine it cannot retain water. The soil needs to be compacted, which takes about one to one and a half year; the livestock is used to speed up the compaction process. The same is valid for the pond constructed by Selella village. Hallo has constructed a water harvesting pond as well but it falls dry very early, due to poor construction.

Small farm ponds were constructed in Ajo village about a year ago, though the water percolates very quickly because of the sandy soil. The HCS promised to bring canvas or plastic to line the pond after the rains.

Rooftop water harvesting in Ajo is found at the clinic and before the construction of the borehole at the school. When the borehole was constructed the reservoir at the schoolyard was disconnected from

the gutters in order to use the reservoir as storage for the water pumped from the borehole. However the capacity of this reservoir was too small. The gutters were not reconnected since there was no request from the villagers to the HCS or the government to fix it.

At the school yard there is a water tap constructed by WMEO and financed by UNICEF in august 2003, however this is in disuse. According to a Water Office engineer this tap has 1 single borehole. It was not clear who installed rooftop harvesting structure and the reservoir at the school compound and were the water of the reservoir was used for (it might be possible that the water from the water reservoir was distributed to this tap).

Box 5.9 Option for another borehole

A Reconnaissance Study Report was made by CRS/Et (26 Jan-5 Feb 2003) for the possibility of installing a second borehole in Legedini PA. Location is 8 km upstream of Ajo borehole at Eja Alola for the benefit of 250 households. Vertical Electrical Survey (VES) was applied and based on the result from the geophysical investigation the minimum depth of the borehole is assumed 100 meter and the maximum depth 130 meter. Water experts from CRS, HCS and Government have been involved in the study. At the field sites community representatives were involved as well.

This created expectations with the communities. When asked about what they would see as a solution is to have this second borehole put in place. However HCS staff doubt whether this is feasible and no start was made at time of fieldwork.

5.3 Selella and Hado Sere; unprotected water source

The most important water source for ***Selella*** village is an unprotected spring up in the mountains. Early in the morning women and children gather at the spring to collect the drinking water in jerry cans and transport the water on their donkeys downhill. After collecting the drinking water their livestock (camels, goats, donkeys) will be watered by providing them water in a drinking bowl in order to prevent the animals of entering the water, especially goats will try to enter the water. When the animals are finished drinking the people can wash them. This water source is shared with the neighbours uphill (other PA). In case of water shortage in Ajo village, Ajo will use this spring source as well. Traditional rules exist, about how much water the people can take in time of drought and at which hours (to give the spring time to replenish). At low water level, the water is only taken for drinking water; the livestock will not receive water from the spring.

The spring never runs out of water, but the water level will drop during the dry spell from November to March, with a maximum discharge of 0.35 l/s according to the HCS. When asked about their perception of the water quality one pastoralist replied: "**we drink together with the monkeys and other animals**"; referring to the fact that the water quality is not good, but they have no other option. One of the future plans of the HCS is to develop this spring[26] and construct a multiple water use delivery system, however it is not clear if this MUS system will have the potential of fulfilling all water demands of the village. Besides the spring source Selella uses the big water harvesting pond, situated between Ajo and Selella as well.

The principal water source for ***Hado Sere*** is a small traditional shallow hand-dug well of about 5 meter, named Ela Dera[27]. Ela Dera was as a joint project with Hallo village, but at present time the

[26]the HCS is thinking of constructing a spring box and filter the water by rapid chloration or a sand filter, yet the plans are still in the pipeline and its is very uncertain whether the plans will be further developed, since the DAP II will be faced over at the end of 2005

[27]Ela Dera means well with long distance in Oromifa; i.e. deep well

principal water user is the village of Hado Sere. The water collected is used for both domestic purposes as well as watering the small ruminants. The well is difficult accessible since it is very deep with a steep slope. In order to prevent the animals[28] from entering[29] and thereby contaminating the water, the area is fenced. During the rainy season the well is completely filled and has sufficient water in it for the several households, but in the dry season, in the months of November to January the well dries up. There are no norms or restriction on how much water might be taken, but there is not enough water for the whole village in the dry spell and it is very time consuming to collect the water. The large livestock is watered by the men at Melka Kero albeit its far distance (takes more then 12 hours for roundtrip) it is preferred above other water sources in the vicinity, since the water at Melka Kero is easier accessible. At Melka Kero the water is for free, while in Ajo they have to pay 0.10 Birr per jerry can.

Box 5.10 Water collecting time dry spell at Ela Dera

Example of a woman collecting water.
She daily collects four jerry cans of water at the well of Hado Sere. Two jerry cans are used for cooking and drinking and the other two are used for the small animals. The well has hardly any water in it and has a bad smell. She uses a small bottle which is opened on one side to ladle the water. There are 35 households in Hado Sere and normally they all come to collect water at this well. People would stay the whole night to collect water. The rule is who first comes, first serves. The woman will filter the water with her scarf because there is a worm in the water. The woman came at 6 in the morning to fill her 4 jerry cans, at the time of visiting her it is 11 o'clock and she is not finished filling her jerry cans. It takes over 5 hours to fill her jerry cans; so a rough estimating is that within 24 hours about 20 jerry cans can be filled (recharge well of 0.3 l/minute).

The general income generating activity is husbandry. When visiting the village most men were out to herd their livestock; compared to the other villages Hado Sere has a more pastoralist production system. On first sight Hado Sere seems to be the poorest village in the PA, yet it is difficult to assess how much livestock they own since the men are out with the livestock and villagers are not willing to say how much livestock they have. Still it could be noticed that they have little access to water for personal hygiene and the community feels that they are left out by the government as well as the HCS.

5.4 Kora village and the developed spring source

Kora village, with 34 households, is situated in a valley with the water sources high up hill and the farm plots along the sides and in the valley downhill. The farmers are able to use the excess water (the water not needed for the domestic uses and the animals) on their plots, which makes them the more prosperous village of the Legedini PA also because it has a low cost water delivery system. Crop rotation is practised to prevent the soil from deteriorating (by diseases or reduced fertility). The village has a big compost belt which is used as natural fertiliser. The most profitable cash crop for them is pepper, potato and papaya, but oranges and lemons would be very valuable cash crops as well. Still the peasants need to buy vegetables in Dire Dawa town, which is a long trip. According to the HCS and the inhabitants water quantity and quality is constant whole year round as is confirmed by the research findings of Scheelbeek (2006). The neighbours (17 households) also take water from the taps.

Uphill in the mountain of Kora village, the HCS developed a spring source. The spring, called Arata, arises from the mountain with a discharge of 0.8 l/s (which was raised to 1.0 l/s after the development) and is conveyed by gravity via a pipeline to a (night)storage reservoir with a capacity of 10 m^3. From the (night)storage reservoir a closed pipe system transports the water to a water tap, a washing basin

[28] especially goats are good climbers
[29] in the rainy season the water table is high enough for the animals to reach the water

and an animal trough and to the lower lying fields, where irrigation often takes place at night. The taps are situated up-hill, with the drinking taps upstream of the livestock water place (presumably to prevent contamination). Due to the favourable positioning of the farm plots, all the water can be transported *by gravity* which makes it a *low running cost system*, with a better cost recovery potential. The farmers use a flexible hose, provided by the HCS, to irrigate their crops. A portion of the water is used for the nursery, where seedlings are grown for covering the hillsides as protection against erosion. In case the flexible hose deteriorates, the village will buy a new one from their savings. The villagers state that their health has improved since the new water delivery system, because more water is available for hygiene and they have the opportunity to cultivate some vegetables and papayas. If the discharge in Kora improves the HCS wants to extend the system with a pipe to Hado Sere. The people of Kora say that there is water in the mountain and therefore want another spring development. This is not possible as the first spring might be diverted if the second source in the mountain will be developed.

Operation and Maintenance Kora

Table 5.7 Composition Water Committee Kora

Name	Gender	Function	Task
Ahmed Adasali	M		Receives collected money and gives to cashier
Abrahim Mohamed Bela	M	Care taker	Cannot perform any repairs but reports problem and gets someone to help from water office in Dire Dawa
Adema Aser	F		
Sarah Abdurmuse	F		
Fatuma Ibro	F	Cashier	

The maintenance is done by the Water Committee, (5 members), they will clean the system and execute small repairs. If they have spare parts they do the reparations themselves, otherwise the committee will go to Dire Dawa town to buy spare parts since they have enough money to buy those. There is a problem in case pipes have to be joined: there are no spare parts for T-junctions. When asked about the reservoir and the spring discharge the water committee has no idea about its capacity and quantity of water (so it appears that the committee is not good informed about the basic features of their system). In the case of a problem or a major breakdown in the system the committee will report this to the chairman of the PA in Ajo, who will report this to the HCS. The whole villages ensembles in a meeting to discuss what kind of maintenance needs to be done and by consensus is decided what will be carried out by the Water Committee. For the maintenance and cleaning the savings are used. The Water Committee received training in Dire Dawa, where they learnt how to open the tap and to repair it when it breaks down, yet not follow-up training was given to the new members of the Committee. The Water Committee also made an irrigation schedule together with the elderly.

The people of Kora village used to pay a monthly fee of 3 Birr for using the water and the services, which is independent of the volume of water taken. The water itself everyone can take for free, they now only have to pay a monthly contribution of 1 Birr per household head per month, which is used as saving for maintenance.

Water uses

Even though villagers state that there is abundant water, there are rules and regulations about the water use (see paragraph 5.5 pump failure). Who breaks the rules will be punished by the Water Committee. The small ruminants as well as the cattle are watered at the animal trough, and are allowed to take as much water as they need. Even though there is abundant water, the households only use two jerry cans for domestic use per day. The cultural custom of scanty use of water is very dominant. Productive use of water for irrigation has proven to be successful (besides the productive use for livestock). There is a

big papaya plantation, nursery for seedlings and experiments with different kind of crops like potato, pepper, haricots and more. The advantage and success of the system can be attributed to the abundance of water and the low running costs and simple technique, since water can be distributed solely by gravity.

Even though this village is the most prosperous of the Legedini PA, and was able to make a profit of 1000 Birr over last year of the productive use of water, it is still far from being self-sufficient. The villagers are still in need of Food Assistance to supplement the household income. Another weaker point is still the dependency on the development organisation for technical support, spare parts and training.

5.5 Pump failure motorised scheme and the consequences

After being in operation for about 2 years, the pump in the borehole of Ajo village failed on 15th of January 2005. This pump failure, revealed weaknesses in the system and made it possible to analyse peoples coping strategies in case of water shortage. The timing of breakdown could not have been worse: it happened in the driest month, when the Belg rains still had to come. The other water sources in Legedini, except for the spring Arata in Kora, were dried up. The principal water source for the livestock, the big water harvesting pond near to Ajo was depleted; the discharge of the Selella spring was extremely low and the hand dug well at Hado Sere hardly had any water in it, therefor people had to fall back on water sources of poorer quality and at larger walking distance.

In the mean time the reservoirs are cleaned, as they were empty. This created the opportunity to follow the procedures for filling the reservoirs and measure their filling time the moment the pump would be fixed. In case the pump is fixed the operator will call a meeting of the Water Committee in which they have to decide which reservoir will be filled first. The operator thinks it will be the reservoir of Edo, since this was the reservoir first finished and the one that should have its turn at the moment the pump broke down.

It is not exactly clear why the pump failed. The generator operator tried to fill the reservoir of Edo and Edo Bolo and observed that no water was coming up out of the borehole. He tried both generators, but had to conclude that the submerged pump was not working. The operator is able to maintain the generator but does not have any expertise on other malfunctions of the system. Therefore help is sought at the Water, Mines and Energy Office, since the office is responsible for larger maintenance and the communities assumed that the problem will be quickly solved. The operator went to town to request for help, but there was no technician of the WMEO available in Dire Dawa. The Water Office promised to send a technician, for which the community had to wait for three weeks till a technician came who could only confirm that the pump was not working. A cause for the failure could not be given, since the pump was still sunk in the borehole. A small crane will be needed to pull up the pump (since at depth of 72 meters, a long cable needs to be wind up). The Ajo community kept waiting for help and expected each day that someone would come. Since the pump broke down during election time even the mayor of Dire Dawa came by to visit Ajo (for propaganda purposes). The villagers expected that he would take action, yet nothing happened and the trust of the communities in government officials diminished again.

Several explanations might be possible for the cause of the breakdown:

- bad maintenance
- bad operation: e.g. in case discharge is more then 1.6 l/s the water table does not stabilise after pumping which leads to draw down of the water table. Tests showed that the well level was recovered to a level of 40 m within 10 minutes if the discharge is set at 1.6 l/s (see Appendix X).
- dry pumping: water level dropped (though should be an emergency break in it as it was recommended in the design report to have an automatic level control system installed with the pump with the upper electrode position of 60m below ground level; see Appendix X)

Without lifting the pump out off the borehole it is not possible to draw any conclusion on why the pump failed. The rural water supply hydrologist at the Water Mines and Energy Office guessed that there was an electrical problem like a shortcut with the installation, but he could not specifically say why the pump failed.

The WMEO started looking for a new pump since the office has no spare pump available. And since the WMEO did not have a budget for a new pump it made a bid to the Dire Dawa Provisional Administration, as well as the HCS for a contribution (the estimated cost will be around 50 to 60 thousand Ethiopian Birr). Most probably it will take one and a half unto two months to get a new pump.

From where to get water?

Kora village has still a good continuous water source; however the demand pressure on the system increased. Besides the villagers of Kora, Konya, Hado Sere and Ejo Dorate (=other PA) that normally collect their water at Kora, the villagers of Ajo, Selella, Hallo, Edo, Lalo, Kora Cheffe, Konja and Adade (=other PA) are coming to Kora as well to fetch water, even at night-time. Kora tried to supply water to the whole PA for about a week, but this did not work, because the demand is too high and the village still needs a basic maintenance flow for irrigating their perennial crops; however the people from outside Kora do not think that Kora uses the water for irrigation at this time of high demand. For the first week the other villages were allowed to take as much water as they could for themselves and the animals (there is a limited volume of water that the people can take with the, one donkey can carry two jerry cans of 20 litres each) and Kora had a restriction on water use for irrigation since potable water has the first priority.

The Dini river is one of the alternative water sources for the people of the villages. The Dini is an ephemeral river, fed by the floods coming from the highlands in the rainy season. After the rains the water will retain for several day (depending on the duration of the rain) in the river bed and by digging a small hole the people are able to collect some of this water. Even though the water is filtrated through the sand, the quality of the water is not suitable for cooking and for drinking according to the users. But they have no choice as they need the water and will cook it before consuming (question is whether people will always cook before consuming). In order to prevent animals (like monkeys and hyenas) to take water from these small holes they will be covered after use.

In the neighbouring PA of Melka Kero, at a walking distance of about 6 hours, there is a water point called *Lege Kat* where the animals are taken in the dry season. The way of collecting water is the same as for Dini: digging a hole in the riverbed. The water quality is assumed to be better then the water in the Dini riverbed. See Pauline Scheelbeek 2006 for water quality analysis.

Physical condition of people, livestock and crops

As the pump broke down in the driest month, the other nearby water sources were dried up. Therefore water was collected at water sources further away from the settlements, which put a heavy load on the people. The water consumption (quantitative use) is cut back. The first priority was given to water for cooking and drinking and then to watering the livestock. Washing was only done at the water sources and not at the homestead. Washing hands with water before praying was substituted with rinsing hands with sand. Due to the lack of water for personal hygiene the occurrence of children with a common cold and other illnesses is raised considerably according to the nurse. It was observed that the villagers looked tawnier and the children were less active, as a lot of energy was spend on travelling those long distances.

Livestock

The livestock was taken to the further away watering points. This travel is exhausting, especially for the smaller animals like goats and sheep. Most villages of Legedini will take their livestock to Melka Kero PA. It was observed that long travelling distance to the water points had a big impact on the

animal health. The animals became thinner since the animals had to spend a lot of energy on trekking instead of growth and development. For the smaller ruminants the trip can be to exhausting and will die along the way. Greater danger of being attacked by wild animals in the dry season as the livestock is more vulnerable and the hyenas are more active during daytime. Not only water is the limiting factor, also to lack of fodder due to failing and shortage of rain, forces the pastoralists to herd their animals in other areas.

Crops

The only crops still in the field were the perennial and irrigated crops. Most of the papaya trees were wilting due to the water shortage. The rainfed maize and sorghum had already been harvested end October and beginning of November. Irrigation is not possible in the four villages (Ajo, Hallo, Edo and Edo Bolo), as collecting the water for irrigation from a far away located source is not an option. This is too time consuming (and therefore too costly) and there are not enough draft animals available to collect the extra water; besides the water needed for primary needs (drinking for people and livestock) is already cut down.

Picture 5.1 Jamail at sedeko

Picture 5.2 dried livestock pond Ajo

Picture 5.3 wilting papaya trees

Institutional flaw and weakness in the system

No initiative was taken by the government offices or the NGO. The communities were kept in the dark about what was going to happen. No information was going into the communities, about what the malfunction of the pump caused, when it can be solved and if it will be solved. The communities are kept ignorant about what is going to happen. The communication lines between the governmental offices, the NGO and the communities were not clear: where to get information, who knows what and most important who is responsible for what. The communities expected the HCS to help them, yet no field staff had been around for some weeks (priorities in other PA's, where the DAPII is carried out as well). The only way to get information for the communities was to send people to town. This strategy was adopted by the communities e.g. the village chief went to town to sit on the doorstep of the Water Office till he would receive help. However he had to come back as he run out of money without succeeding to get information and help.

The pump operator claims there is a pump failure, while in town they think that there is an operation failure by the operator. Before looking at the problem conclusion are drawn about the (in)capability of the peasants to manage their system. This attitude reinforces the dependency of the rural communities on external help of the government and NGO's.

The water delivery system itself is not transparent for the users; the users cannot identify the problem themselves, do not know how the problem can be solved and how much money would be needed to repair the system.

The Water Mines and Energy Office is in the midst of reorganisations. Field staff and technicians are reassigned to the Road Authority, by higher administrative level. The office is looking for a technician to send to Legedini, but so far (first three weeks after pump failure) no one was found. Another problem the Water Office is facing is the lack of other resources, besides having no manpower, there are not enough transport facility and funds available.

Problem is the pump needs to be replaced. The estimated costs lie between 50000 and 60000 Ethiopian Birr, which the Water Office can not pay for. This is controversy to their responsibility. In future do not for see problem of paying (however no guarantees, strange because cannot pay at the moment).
The communities expect a lot of help from the NGO, since the NGO has built a close and strong relationship with the communities. However at the time of the pump failure, the field worker was not around and when the problem became known no action was undertaken by the field worker. The problem of the pump failure was not announced by the field worker to the water engineer and other staff at the HCS office. The HCS is not responsible for solving the problem, yet did not take action to look into the problem either. The HCS has no resources for the pump replacement or repair, but could use its network for raising funds or looking for a solution. Since the pump failure hampers the sustainability of the DAPII projects a bigger commitment of the NGO would be expected.

Obviously there was no emergency plan developed as part of the system design. Within the DAPII only the construction of facilities is budgeted and no plan was made for replacing big parts. The possibility of premature system failure was not reckoned and no water buffer was provided in case repair would take some time. After the ending of the program funding stops and the communities should be able to maintain their facilities with the help of the line offices. The lifetime of the motorised scheme is put at 15 years and no recommendations are made for afterwards.

6 Other visited sites

HCS had been carrying out the DAP program in other sites as well. This created the opportunity to compare different sites (also food insecure areas). The other sites visited are located in East Hararghe Zone and situated in the highlands.

Eastern Hararghe has its own regional laws and a longer history with water management and irrigated agriculture. Irrigation is practised to a larger extent and boreholes exist here for a longer time and therefore there is more experience with motorised schemes. The systems are more complex; however the institutions are stronger as well, since they where established many years ago. Traditionally the inhabitants are peasants cultivating indigenous teff, vegetables, maize, chat, coffee etc. and with irrigation it is possible to cultivate two crops a year, which makes the systems very lucrative. The main productive use of water in the highlands is for irrigation.

The attraction of people in search for water is not regarded as a risk in the highlands, when compared to the lowlands. Most people are already settled for a long time and practised (settled) agriculture, in contrast to the wandering pastoralist in the lowlands. Most communities want to have an improved water scheme in their vicinity.

The advantage for the farmers in the highlands is that there are spring sources available to develop: due to the location and geography the water can be conveyed by gravity which makes the system less expensive (no fuel needed for distributing the water). Springs are an important source of clean and safe water supply in the rural areas of Ethiopia. Most springs yield more then 0.1 litre per second (about 8.5 m^3 per day) and night storage might be required to make use of all the water CRS (2003b) since the springs have a continuous discharge, though the discharge of the springs vary during the seasons.

6.1 Meta Woreda

Seven PA's were selected by the government to participate in the DAP II project. The project proposals where discussed and approved by the different responsible authorities at woreda level: Natural Resource Management Bureau, Water Bureau, Irrigation Office, Health Bureau and the Agricultural Office.

The communities participated in the construction works by contributing labour and local materials as part of the Food for Work project. The 7 PA's have 4717 households and 20717 inhabitants, living in 52 villages divided over 26 watersheds. Several villages share the same watershed. Within the 26 watersheds, (which are interconnected micro watersheds) 320 different committees are established. And people from several villages are combined in to 1 watershed committee. All the 7 PA's are connected by access roads which are constructed by the villages as part of the Food for Work project. (500 people contribute 1 day of labour per week to the Food for Work project.)

4 different types of development committees are created:
- water development committee
- health development committee (managing pit latrines, washing facilities and health education)
- agricultural development committee
- natural resource development committee

Each committee has 4 members which are elected by the villages.

Each committee has his own bylaws. For the whole PA there is one general bylaw established by the PA leaders. But each committee can adapt the bylaw on the contribution the people have to pay. Three Peasant Associations have one nursery. Some PA's were merged into one according to the watershed border (governmental re-division) (also taking place in Dire Dawa).

Gona town in the PA of Gona.
Spring development project (which started 2 years ago with the implementation of the DAP II project) implemented.
Here is a closed/restricted area which is used as learning site for the other farmers of the PA's. The protected area covers a size of 21.2 ha. The people can only make restricted use of the protected area: cut and carry off the grass, which is sold at the market. The money is put in the bank as saving for future projects. Since the upstream protection of the area the original discharge of the spring of 0.1 l/s increased with 0.1 to 0.2 l/s. Each year the discharge of the spring is measured/monitored by the HCS.

Korami Bala.
This village consists of 110 households with an average of 5 persons per household. The village has a protected spring box. The village contributed 9000 Birr and free labour as well a local construction materials (the big stones to build the reservoir). Before the spring development the farmers did not use the water for irrigation, because there was not enough discharge, but now after the construction and the protection works upstream the discharge increased. But there is not sufficient water for irrigation: in the dry season the discharge decreases. The water is used for multiple purposes: for drinking, washing, watering livestock and irrigation.

The discharge of the spring is 0.2l/s in the dry season and 0.28 l/s in the rainy season. First the water is stored in a reservoir with a capacity of $10m^3$. From there the water is conveyed by pipe to 1 distribution point with four taps. There is a separate pipe from the reservoir going to the cattle trough. Both pipes can be closed by a valve, which is the responsibility of the Water Committee. The reservoir has a overflow, which is connected to a pipe, this abundant water can be used for irrigation. The washing basin does not have a separate tap the women take the water from the drink water tap by jerry can. There is not much water coming from the overflow pipe and there is not a pond connected to it. One farmer has made a canal (dug) but there is no water. The water from the cattle trough is also drained to a field (this look used) when asked if a farmer would on purpose let the trough overflow so he could irrigate the staff thinks that this is so.

The water development committee has 7 members
2 women in the committee of which one is responsible for opening the valves. The committee collects the 1 Birr per household per month and saves this in the bank. The HCS provided them with hand tools.

The tap is open between 7.00 and 11.00 hours.
They use 40 litres per household per week for washing cloths, but this can increase according to family size. The women use the natural soap for cleaning (kind of fruit). The drainage water from the water tap is conveyed to a small pond from which the farmer takes water to irrigate his plots: potato, onion, carrot. The HCS has supplied the village with improved seeds. Farmers that are allowed to irrigate where selected according to the capacity of the spring. These farmers have their plots close to the reservoir. Irrigation takes place at night: this is when the reservoir is filled up and the excess water will go to their fields. Traditional ponds are used to accumulate the water near their plots.

The villagers pay a monthly fee of 1 Birr per household for the water. The users can take as much water as they like for drinking and washing purposes. In practise people take 20 to 40 l/day according to their household size. (But according to a woman sometimes they take more water, but most of the time 40 litres is sufficient and when asked to the staff weather this would be a problem because some households will take more water they replied that it is not a problem because there is sufficient water). When asked whether there is no conflict between farmers that are allowed to irrigate and the ones who are not and in case there is a conflict would communal plots for irrigation be a solution the field staff replied that there are only individual plots and there seems to be no conflict between to farmers that some farmers can irrigate and others can not.

Some calculations

In case each household would use 60 litres per day for domestic use 110*60=6.6 m^3 will be used by the village per day.

The spring harvest per day is 0.2 l/s (minimum) > about 17 m^3

More then 10 m^3 is available for productive use on daily basis.

Other villages downstream come also to Korami Bala to collect water. One of the future plans of the HCS is to develop a spring downstream for this village.

6.2 Kersa Woreda

Burak Jeneta PA is situated in the highland at 2400 meter. Agriculture maize, wheat, barley, teff, chat, tobacco and eucalyptus are the major crops cultivated; there are trails with potato, carrot, cabbage and tomato in the nursery. Traditional irrigation was introduced by one farmer about 30 years ago; three other farmers followed him and saw the benefit from irrigation. After this they hired farmers from another region to help them construct the irrigation system. Before the DAP project the spring was used for multiple use: drinking water, livestock and irrigation by two villages. Within the DAP the spring sources was developed and used by two villages. For the development of the system a construction committee was formed which will graduate after the completion of the construction. The village leader and one member of the Water Committee have a seat in the construction committee. The following governmental institutions were involved in the development of the project:

- The Irrigation Authority visited the side for the irrigation canal
- The Oromia East Hararghe Water bureau for the drinking water component
- The Oromia East Hararghe agricultural bureau (which provides agricultural extension) has a water and an agronomic part.
- The health office of the HCS trains the village about health and pit latrine use at household level.

The headwork is a spring box which protects the 5 springs, total discharge of about 11.6 l/s, from siltation, animals and people entering the water. Upstream protection as well as gorge bank protection is put in place. There is a lot of silt and run-off. The spring box is next to a big gorge, with the two villages on both sides of the gorge. The village on the left side bank of the gorge constructed an earthen canal to convey the water from the spring; each year after the rains they had to reconstruct the as the floods would damage it. The project constructed a flume to cover the gorge and two lined canals one on the left bank (100 meter), one on the right bank (105 m). The right bank villagers use the water directly from the spring box at day time. At night the water is conveyed to night storage on the left bank side. During day time the left bank farmers can use this water. The gate between right and left bank is opened at 6.00 and closed at 18.00. The Water Committee is in charge of the operation of the gate.

The night storage reservoir has a spill way, which is especially needed in the rainy season. A silt trap is constructed at the inlet and will be cleaned up regularly. The spillway joins with the outlet and fills another reservoir downstream. In the field (on the right side) a farmer stores water in a traditional pond. 30 years ago they had there first earthen canals which they extended and extended downstream. Farmers do not drink the water from the irrigation canal when working in the field, since they chew chat. They will drink milk or tea.

Since the construction of the headwork the water can only be used for irrigation. There is another tap installed in the village (the water is coming from a different spring) as well as a cattle trough. Both

villages (both sides of the gorge) use the same drinking tap. The night storage for the drinking tap is a closed reservoir. The overflow of the reservoir is used for irrigation. The capacity of the reservoir is 10 m^3 which fills up within 8 to 10 hours. There is also a shower installed, but it is not functioning well: the showerhead is broken though the villagers like the shower. Before they used to wash themselves in the river (the water in the gorge), but the shower is much better and it is next to the mosque which is very convenient for them. There is enough pressure on the line since the reservoir is higher up the hill. The water is of better quality since the spring is protected, before there was contamination of animal dung of the water and the cows would drink from it; the villagers had stomach problems and children were ill from diarrhoea. Now there are no germs in the water anymore.

The people use traditional soap for washing (kind of yellow fruit).The washing basin drains to the nursery

There is one Water Committee for both sides of the gorge (and thus for both villages). The traditional Water Committee consisted of an elder person. The head of the Water Committee operates the main gates and also regulates which farmers will get water. Before the new scheme the farmers also used this distribution schedule. The Water Committee is based on the traditional committee. The 7 Water Committee members were elected by the villages. Membership is on voluntary basis and in case the villagers complain about them or when a member movers out of the village, they will be replaced. The Committee was strengthened by the HCS: the members got training about the operation and maintenance of the system as well as agricultural extension.

Table 6.1 Composition Water Committee

committee members	
1	Chairman
1	Vice-chair
1	Cashier
1	Water and sanitation
1	Secretary
1	Operation and Maintenance
1	Auditor

The Water Committee collects a monthly fee. Since October 2004 the people receive drinking water from the tap. They pay 1 Birr/household per month, which was decided in a general meeting and reached by consensus. As the water is conveyed by gravity from the spring to the tap, the villagers do not need to buy fuel. If someone, for example an elder person is unable to pay, he is excused and does not need to pay the fee.

The contribution for the irrigation system is not fixed yet. The week after the field visit there would be a workshop and after that the price would be fixed in a general meeting.

The risk of allurement of other people does not exist as most communities want to have the same development in their own villages.

After completion of the development, the HCS will handover the system to the Water Committee (after giving them training and tools) and the woreda governmental institutions. The HCS will stay for a maximum of two more years in this woreda (for the duration of the DAP II program on Natural Resource Management).

7 Discussion

7.1 Institutions and arrangements

Elections
On the 15th of May 2005 new general elections for the Ethiopian Government were to be held, which had clearly an effect on the speed in which decisions were taken. A lot of uncertainty and therefore stand still in procedures and an expectant attitude was prevailing under the governmental staff. The staff was careful in expressing themselves since it might be possible that their jobs are in the balance if a different government would get power and new policies would become effective. Likely this had an effect on the building and strengthening of the new Regional Rural Development Co-ordination Office structures. Because of the reorganisation of the Dire Dawa Administrative Council, a lot of uncertainty is created about the continuing of the projects, partly due to the loss of expertise and experienced people caused by reassignment.

Institutional weakness
The premature pump failure revealed the institutional weaknesses in the system, which otherwise would have occurred after a longer period of being operational, at the moment the NGO would have completely phased out and more dependency on the system would be created. The unclear information lines between the Line Offices and the communities are not incidental. Often the communities are ignorant about the problems faced and what to expect from the different Line Offices. This institutional gap appears to be partly temporally and partly systematic. The systematic problem is that the DDAC Line Offices do not have enough funding to sustain programs and depend on external donors and thus are not able to perform their tasks according to their mandates. For example in the Legedini case there is no Development Agent from the Agricultural Office and the Water Mines and Energy Office, which is responsible for the water component, lacks human as well as financial resources to support the projects. The NGO (in this case the HCS) is filling the gap till certain extent and only temporarily. This hampers the sustainability and success of the development program (the DAPII), when the NGO phases out and the project is handed over to the community. Most of the field activities are on account of the NGO. An exception is the training the Water Committees received from the HCS and the WMEO (WMEO provided a hand-toolkit as well as extension). The Health Office has only one activity in Legedini: the Community Based Health Care Program, which is part of the DAP program, and implemented at the health post within Legedini (two women were staying in Ajo for two weeks for health extension work). However the impact is very limited while sanitation is an important element for the success of Multiple Use System to improve health and thus improving livelihoods as well as the promotion of water use for hygiene purposes, which will lead to the production of more wastewater that has potential for productive use. The WMEO has also a sub-office which gives technical advice about irrigation, but for the agronomic part the Agricultural Office is responsible. The temporal gap is caused by the reorganisation taking place in the Council. Due to the (re)-assignment of staff, like the reassignment of the technicians to the Road Authority, it will take time to rebuild the Offices' knowledge and expertise base.

Institutions and MUS
The Water Mines and Energy Office is responsible for the control and execution of water projects. The technical officials at the WMEO declare that the first priority of the office is to provide the communities with drinking water, so not much attention is given to other water uses, since providing enough drinking water is already difficult task to fulfil (comment by WMEO official). The water office has a supply oriented approach and not like MUS a demand oriented approach. For this reason MUS is not taken into account from the design stage and is considered as the next step, after implementing a potable water supply system. Big maintenance of the water schemes is the responsibility of the WMEO, in case the communities are incapable to execute this, yet the Office depends on the Ministry of Water Resources for financing and staff assignment. Opportunity of a MUS system is its cost recovery potential, that increase people's ability to pay for the water service.

Mutual co-operation of the Line Offices as well as with the NGO can be improved. Since the Food Security Office, Agricultural Extension Office and the Water Mines and Energy Office are based on the same compound they have more interaction with each other than with the Health Office which is based at another location in town. Some negotiation takes place at office level yet field activities are rarely co-ordinated between the NGO and offices. For example there are no integrated activities between the Health Bureau and the Water Mines and Energy office. It would be better if integration of activities would take place. The WMEO can give technical support, advice and material for supporting sanitation activities like pit latrines. The problem though is that not all communities are interested in pit latrines and therefore promotion by the Health Office will be necessary.

The new structure of the Regional Rural Development Co-ordination Office has the potential for more collaboration between the different line offices and hopefully will create clearer communication lines towards the communities. Also the new PA cabinet creates the opportunity for an integrated approach at field level and thereby the opportunity for implementing MUS. A disadvantage might be that the PA's will cover a larger area that might be more difficult to govern, or that people are left out (the voiceless, poorer ones).

Water quantity guidelines for MUS
There are no guidelines or policies about Multiple Water Use Systems in the Administrative Council. Yet when identifying water sources the different uses are recognised. For example the Dire Dawa Integrated Resource Development Master Plan Project made future water demand projection for the peasant associations based on estimations of domestic water demand, public demand/non-domestic demand and livestock/animal demand. The only remark the Water Office makes regarding different types of water sources is that unprotected water sources are not recommended for potable use. The recognition of different water uses is a first condition for a Multiple Use Approach.

7.2 DAPII Legedini

Since the project has an integrated watershed management approach, the information gathered by HCS in the baseline study is not specified per village, because this would not service the aim of the program. Some of the basic data like number of animals and number of people can only be estimated since the people in pastoralist areas cannot or will not tell the number of animals and farm size. Besides being afraid that the government is collecting data for taxes, people also move a lot within the area, so it is difficult to estimate how many people are living in a village.

According to HCS staff the water development program in the PA is following the watershed management approach. It started in Kora village and they will go to Hado Sere. Hado Sere had full participation in the spring development in Kora, but this was not confirmed by the respondents of the communities. The neighbouring villages are allowed to use the water of the potential village, since the project approach is that of watershed management. The availability of potential good water sources makes that the focus is on those villages (Kora and Ajo), however the water system is developed with the intention to have the whole watershed benefiting from it. The communities within the watershed should share the resources. Still it was not made clear to the people in Legedini the difference between owners and beneficiaries of the system. The owners are the communities in which vicinity the system is developed and that participated with the construction and from which the Water Committee members are selected. They are the ones to which the system will be handed over after the phase over of the NGO. Those owners are not the only beneficiaries of the developed water system; however this was not clearly communicated to the villages at time of implementation. At least for the time being the developed water sources are for the benefit of the entire PA (at least until the whole PA is developed, even is there is not enough water to sustain all).

The DAPII consist of several stages and the strategy is to phase out or over at the end of each activity. This is a gradual process of handing over the responsibility to the communities throughout the five year program. At the end the NGO will have completely phased out and all the activities are handed

over to the communities. The spring in Kora is already handed over to the communities although the communities still depend and expect assistance from the HCS. So even if the ownership is handed over to the communities they are not able to maintain the system independently. Due to the new Productivity Safety Net Program it is uncertain what is going to happen with the unfinished or current activities. The DAPII had to be wrapped up end 2005 and most likely this will have a negative impact on the sustainability of the developed activities as they require time for enhancing sustainability. Besides the DAPII project activities the HCS unfolds other activities as well in the Legedini Peasant Association. This is very confusing for the villagers as they cannot make a distinction under which mandate the activities are implemented.

There is no emergency or back up plan nor by HCS, nor by the Line Offices in case of system failure, like a credit program or an emergency water storage facility. The HCS made a design for the motorised scheme with a lifespan of 15 years yet there is nothing calculated or put aside for unforeseen expenditures. It seems that only hydro-geological features were taken into account in the decision-making for the borehole and not socio-economic features like whether the communities will be able to pay for the system and operate the system accordingly.

Community based organisations
Each village should have a Village Development Committee as well as Community Based Health Committee or birth attendants. When asked about the different organisational structures within the communities and the way of representation, there was a lot of indistinctness. Some respondents could name different organisations or committees, their members and their tasks, while others where ignorant about these organisations. Some committees were formed as precondition of the DAPII, but still need a lot of strengthening and capacity building to really be functioning independently.

Water Committee
As precondition for implementing water delivery scheme, Water Committees were established during the DAP II. According to CRS and DAP documents these Village Water Committees (VWC) should ensure that their developed water points are properly developed, managed, operated and maintained, able by community contributions during the construction phase and through regular collection of water user fees from all benefiting households. Often it was not exactly clear when the Water Committee was established and who the committee members are. All the committees have female members as was a precondition from the HCS to have women represented within the committee as they often have the most gain from improvements in water supplies and sanitation (CRS, 2003b). There are two different types of Water Committees formed within the DAP II project: the Water Development Committee that is involved in the construction and co-ordination of the installation of the water schemes and the village Water (Sub) Committee responsible for the daily maintenance and fee collection. It was confusing for the interviewees to make the distinction between them and probably some information did not come across in the translation process. The motorised scheme in Ajo had been operational before the Water Committees were established, yet the communities started paying from the first day. Apparently the Water Committees are established on paper, while practise is less clear and the committees are not able to perform as they should. The committees need more time to strengthen, but unfortunately the NGO was to phase over end 2005.

The Water Committees all received a training on operation, maintenance and fee collection from the HCS at the start of the project. At the training the Water Committees were taught how to take care of the water and the engine and how to manage the money. At the time of field research the villages had not enough money in the bank to buy a new generator. So if they need a new generator they will go to the government and if the government will not or cannot help they will ask the HCS for help. No follow-up training has taken place and not all the knowledge is dispatched to the new Water Committee members. It needs more time and effort to interiorise the system. An example for this is that the members of the Water Committee of Kora did not know the capacity of the night storage reservoir and do not have any idea about the daily volume of water used. Only one person can operate the generator of the motorised scheme in Ajo, so in case of absence of the operator the villages are not able to pump up water (though the operator is training another person himself). An important hurdle

for the Water Committee is the fact that the members are illiterate and have no knowledge about account keeping. Still the organisation as such fits in their traditional ways of organising. The way in which they have to collect money requires the enhancement of their administrative, technical and financial capabilities.

According to the CRS' Guidelines for the development of small scale rural water supply and sanitation projects in Ethiopia, sanitation is considered to be an essential part of potable water supply improvements and therefore sanitation must be linked to water supply. However the sanitation part of the developed water sources is poorly developed and needs more attention from the HCS.

7.3 Coping strategies and livelihoods

The peasants have their own traditional structures which have influence on their livelihoods and are mechanism to overcome bad times. One is not obliged to be part of a saving group or to take part in Idir, but it is a widely appreciated system. It shows that the peasants have their own ways to get organised, which have been working well for many years in sustaining their livelihood. These traditional structures have the potential to form a good basis for building new organisational structures upon even though the groups are not big and do not extend beyond the communities.

As explained in the theoretical framework when people or households are just coping, they try to manage a stressful event or situation for which they could not prepare. Hence coping is a short-term reactive response, which has not been premeditated and therefore does not have a strategic character (Niehof & Price, 2001). Contrary to what can be observed in Legedini. Here the dependency on Food Aid in the capacity of condition of Food For Work, has become a structural manner of dealing with their food insecurity. In fact the people are very much depending on the different agencies for help. Big expectations exist of the Catholic, as they refer to the HCS, to provide them with a secure future. They even rely more on the HCS then on the government as the HCS field staff has built a closer relationship with the villages, pays more frequent visits to the communities and provides the communities with more support, both extension as well as financial. Own initiative by the villagers is sometimes limited due to lack or resources and their reliance on external help, in fact their coping strategies are built around the fact that they receive and also expect help and advice. The attitude of the peasants is dualistic on one hand they take a lot of initiative e.g. in construction water harvesting ponds, requesting help and copying (farm)practises from each other, yet on the other hand they are reluctant to take initiative in spending money, and wait for the NGO to come up with a plan. A nice example for this is the group of adolescent men that has saved money but does not how where and how to spend it on and wait for the government to come with an initiative. In contrast with this waiting attitude is action undertaken to get water facilities in the Peasant Association. This request came from the villagers themselves. It seems that the waiting attitude occurred once the project was in place.

To receive development assistance the community has to come with a request for help. Communities should know how to phrase their request and whom to address. A project will not be initiated by the line offices. So the skill to take bureaucratic hurdles in order to get access to and help from governmental organisations is an important asset e.g. the strategy used in case of failure in the water system is to go to the water bureau in town and step into the office. A restriction for development is that only strong, emancipated and good represented communities, which are able to voice their needs and are able to make a request to the government for help or assistance, have a chance at getting a development project. It was evident that the communities rely on support of the governmental offices yet the offices lack the capacity, resources and staff to support the communities on frequent basis.

The impact of a multiple water use system on the livelihoods was very evident. The *human capital* base improved as the health situation ameliorated noticeably by the improved water sources, due to time saving and improved water quality. This effect was clearly observed at time of the pump failure in Ajo; health situation of the peasants deteriorated according to nurse in the area. Market knowledge is a crucial asset for promoting productive use of water in order to make profit. The DAPII project had positive affects of having more children attending school and children dispatching information to their

parents e.g. the cultivation of papaya trees. The cultivation of vegetables and fruits in the home garden provides a varied diet and thus improves the nutritional status of the households. On the other side the new technology requires skill to maintain the system and knowledge extension. Due to the integrated approach of DAPII *the physical capital* not only increased with the developed water system, but also the improved road made the communities better accessible for the development organisations and external visitors like governmental extension workers. Also the physical access to markets is important for promoting water for productive use, in order to sell the produce. However the dependency on the physical capital also creates a new vulnerability if livelihood strategies are based on these infrastructures and these infrastructures cannot be properly maintained. The integrated watershed approach of DAPII increased the *natural capital* considerably, by erosion mitigation practises, closed areas and other upgrading activities. For the development of a spring upstream protection is needed to increase and sustain the spring discharge. As the productive use of water creates other income generating activities, there is no need to sell charcoal, firewood and fodder and thus protects the environment from further exploitation. An example is the promotion by the HCS of stoves on manure instead of firewood. Still the travel distance to the different water sources dictates the maximum water use. The access to cash and credit (*financial capital*) was introduced by the DAPII. In stead of using animals as saving mechanism the HCS promoted to put money on the bank. According to van Hoeve 2004 the number of animals reduced considerably. Keeping less animals needing water diminishes the pressure on the water sources and makes the peasants less vulnerable to droughts. In times of drought the condition of the livestock goes down, which decreases the value of their livestock. It can also create room for promoting other productive uses, like cash crops (e.g. 1 papaya tree has the same daily water requirement as a goat). An important feature of the motorised system is the dependency on fuel, which is a big hurdle for the water users. In order to be able to buy fuel, they should take part in the cash-based economy. The Multiple Water Use system creates opportunities for extending *social* initiatives for co-operation. There is room for initiatives like the milk group in Ajo and the irrigation group. However a new (MUS) system can change (power) relations within the communities. Which community has access to the water and within these communities which inhabitants will profit most? For optimal use of the productive water, the formation of market access groups (based on traditional structures like Idir) are advisable as most inhabitants in Legedini do not actively take part in the monetary economy, in order to market their produce. These groups can also be used as mechanisms to absorb price fluctuations and thus risk aversion.

Each change in assets can have a positive as well as negative effect. It depends on the room of manoeuvre between the different assets to deal with shocks and vulnerability. For the Legedini case there is a risk of being trapped in underdevelopment. The development project creates facilities and opportunities so that people will remain in Legedini instead of seasonal migration as is the traditional practise or migration to town and therefor puts more pressure on the area. The ultimate goal of the DAP II project is to improve the food security and to make the people self-sufficient. The promotion of productive use of water within a MUS system creates the opportunity to diversify in crops and be less depended on aid. According to Amare (1999) reliance on the market for any component of the food supply is perceived as a source of vulnerability, as indeed it often is, considering price fluctuations and the lack of access to cash. So to reach this goal the villagers must be able to market their crops. One of the problems to overcome is the physical access to markets. If they do not have a road, they do not have access to the market and cannot sell their crops. So there is no point in promoting productive use if the products cannot be traded in case the farmers will produce more then is needed for subsistence. To come to an autonomous water delivery system, the community should be able to finance the system. Community level financing requires sustainable levels of social and human capital (Nicol, 2000). For the Legedini case it was obvious that interventions change livelihood systems (Niehof & Price, 2001).

7.4 Water Use, Rules and Regulations

Each water source (the developed ones as well as the traditional sources) has its own rules about when to take water and how much and for which purposes. The rules for the newly developed water sources are still developing and amended in by-laws. The rules are reflecting the dynamics of the water system

and vary for each situation, depending on time of year or situation when water becomes scarce. A conflict exists between restricted or non-restricted use of water. When asked, the villagers state that there is no restriction on the quantity of water that they are allowed to take, yet there is a big social control on how much water each household can take. It is not allowed to take more water, then the volume needed for domestic purposes, and use this for irrigation (on top of the allowed water for irrigation). For the animals the rules are more resilient, often only the small ruminants are watered near the homesteads, with the water collected for domestic use. So it seems that in the case of the motorised scheme, the productive use of water for irrigation is not promoted by the Water Committee and even considered illegal if a large quantity of water is applied. A plausible explanation might me that the restriction was because of the fuel shortage. For the larger animals most peasants will go to the larger ponds and streams, since the livestock also needs to browse and this water is for free. For the motorised scheme irrigation is only allowed if the water user buys the fuel himself in town. People are restricted in their water use by the dependency on fuel. However the persons that buy and fetch their own fuel take more water e.g. the large papaya plot in Hallo. So who has the money and facility to fetch fuel has the access to water and can keep on improving his livelihood in an upwards spiral, as long as system does not breakdown. In case of system failure the risk exist that the perennial crops wither and the investment is lost; all depends on whether a person is able to take the risk to grow crops. When asked about the people buying extra fuel to have water for irrigation, HCS field staff denies the existence of this practise. The large plots are demonstration plots and not farmers' plots. The fuel bought by the HCS is used to water these plots. However the person that looks after the plot can have the profit from it. It appeared that the field staff was not rightly informed, or not properly informed about the actual strategies. The rules of the traditional sources like sedeko's in the rivers are somewhat different. This water is regarded as common property and thus common access resource. Who comes first can serve first.

Unfortunately it was not possible to asses how much water is actually used on weekly basis from the borehole as measurement on water volume where not possible since the pump broke down. Another indicator for the volume of water taken from the taps is the collected water fees. However it was not possible to get these figures, since a book account only started a month before the pump broke down and is still not very detailed. When asked about the daily collected fee, the water caretakers could not give an accurate figure (much too low for the number of jerry cans filled).

It was not possible to make a clear distinction between the volumes of water used for the different practises, since the women will use the water for domestic purposes as well as for watering the small ruminants, from the same containers. On average the water quantity used is low namely about 7 lpcd for domestic use and watering the small ruminants.

In case of water shortage the users will prioritise the water use and cut down on the quantity of water used. There is little room for adaptation to changing water quality besides filtering and cooking the water before drinking and trying to select the sources for different use: best quality for high quality use (which is potable water). At the time of the pump failure in Ajo the people who used the motorised scheme tried to collect water of equal quality at Kora village, which is the closest by. This increased water demand at Kora put al lot of pressure on the system. For the future the people are afraid that if the fuel price goes up they will not be able to afford the water from the motorised scheme (already some people cannot pay for the water).

Within the NGO different opinions prevail about the water source and its beneficiaries. According to field staff the spring source of Kora is only for Kora village and its direct neighbours, as the system will not be sustainable if more people will use the spring. Therefore Kora spring is not promoted as water source for the whole PA. However other NGO workers state that all activities of the DAPII are for the benefit of the whole PA, including the water sources. In the water management committee consists only of Kora people and Kora village is the one paying for operation and maintenance. The inhabitants of Kora state that they do not deprive outsiders from water, since they knew what it was like to have no water. However when water stress is too high, they will claim their first right (which is also water use for productive use), which is regarded as logical and fair by the other villagers. The

community in which vicinity the sources are developed feel ownership, since it is in their locality and they contributed the work.

According to HCS field workers irrigation with the water from the borehole was not be promoted. The only irrigation that will be promoted is spate irrigation and water harvesting. Yet practise shows that for small productive use as watering papaya domestic water from the borehole is used. The demonstration plots constructed by the HCS, are however irrigated with water from the borehole. It appears that the HCS regards the concept of irrigation as an activity on larger scale then watering crops at the homestead. The Multiple Use from the borehole identified by the HCS is drinking water, laundry animals as is reflected by the infrastructure put in place: potable water taps, washing basin and animal trough.

7.5 Water sources and their capacity

The first attempts by the Dire Dawa Administrative Council were to develop water sources in the direct vicinity of the different villages (and not following a watershed approaches like the DAPII). Since those sources failed other potential sources were assessed. Only two developed sources are suitable for supplying potable water year-round, however it is very questionable that providing the whole PA with water from those two sources will be sustainable.

There is a discrepancy between different calculations, depending on which data is used. For example it is very difficult to assess the number of households. 4125 persons live in Legedini, according to government documentation (WWD&SE, 2003c), yet this number is difficult to assess since a large number exist of nomad population. When basing calculation on number of household found during field work, the developed water systems look more promising in providing enough water.

The livestock **pond near Ajo** has a total capacity of 4620 m^3,which is enough water for about one and a half month for all the livestock (see table 4.3) in Legedini during the dry spell.

Hado Sere contains after the rains about 15 m^3 (rough estimation of 1.5*2*5=15 m^3). It replenishes in the dry season with a discharge of 0.3 litres per minute (see Box 5.10).

The discharge of the well at **Selella** has a maximum discharge of 0.35 l/s, but drops considerably during the dry spell. If this source is developed and improved (there exist a plan by the HCS for sand filtration or rapid chlorinating) and connected with a storage reservoir with a pipeline to Selella village. It can have a capacity of 30 m^3 a day. Which is enough for basic Multiple Use for 100 households (30000/50=600 persons), on condition that the discharge will be 0.35 l/s year round.

Two different figures for the discharge of **Kora** spring were given by HCS field staff. One discharge of 0.3 l/s and according to other information the discharge of the Kora spring is improved by the project from 0.8 l/s to 1 l/s (daily: 86400 litres). The amount of 1l/s seems to be very high: this gives a total volume of 86 m^3 per day with only a storage reservoir of 10 m^3. Therefore calculations are based on a discharge of 0.3 l/s (daily: 25920 litres). According to the water committee of Kora the 54 households of Kora and 17 households of the neighbouring village of Konya collect water. However other respondents state that more villages are using this spring like Hado Sere and Ejo Dorate (it was confirmed by people from Hado Sere that they collect water at Kora). The estimation is that about 110 families will use this spring source. Not all the water collectors will take the same amount of water, depending on their ability to carry water and if the livestock is watered at the animal trough in Kora. Assume that Kora irrigates at night (8 hours) a volume of 8640 litres is used for the crops. State that 71 households use the water from Kora for their livestock, which is a daily water requirement for livestock of 71*155=11005 litres per day and leaves 6275 litres for domestic use for the 110 households, or 57 litres per household. This is below the minimum required volume, but above the average domestic water use per household in the PA of Legedini.

Not even half of the borehole capacity of the **motorised scheme Ajo** is used per week (due to reasons already stipulated in chapter 5). Both reservoirs are filled each other day in case there is enough fuel. So three times a week 50 m^3 is used. This gives a water use of 21 m^3 per day. Assuming that Ajo, Hallo, Edo and Edo Bolo are only using this water, a total number of 203 households collects water from the borehole. 21 m^3 per day for 203 households would mean that each household takes 5 jerry cans per day. This water is used for both domestic and productive use. The productive use consists of watering the small ruminants, other livestock and irrigating some plots. The actual water use per capita per day is lower then 16 litres, which is lower then the recommended guideline of 20 lpcd for domestic use. Comparing these figures with the estimated water use by the respondents, they actual use might even be much less and around 7 litres per capita per day for domestic use. An explanation for this might be that less water is being pumped or reaching the taps. Possibly the reservoir is filled before it is completely empty; water in the pipeline falls back into the borehole after switching off the pump, and in case of fuel shortage the reservoirs are not completely filled. Additional losses are leaking valves and pipes as well as spilling of water when filling the jerry cans.

According to the design (see Appendix II) a volume of 350 m^3 can be supplied per week (10 hours of pumping with a capacity of 1.6l/s gives 57.6 m^3 per day, minus losses and taken into account the total reservoir capacity of 50 m^3). HCS' calculations estimated a daily livestock water demand for the whole PA to be 1000*20=20m^3. This leaves 30m^3 for domestic use for 1500 persons or 250 households (based on domestic water requirement of 20 lpcd and household size of 6 persons). This is enough water for the four villages of Ajo, Halo, Edo and Edo Bolo. However future population and livestock growth is not taken into account as are other productive uses.

According to the water ladder 50 lpcd is required for basic Multiple Use, so the capacity of the borehole is enough to sustain 1000 person or about 165 households, which is less then the number of households depending on the borehole.

Estimated daily available water in Legedini is listed in the following table:

Water point	Daily capacity (m^3)	Max. temporal storage capacity (m^3)
Borehole Ajo	50	
Kora	26	
Hado Sere	0.43	15
Selella	30	
Ajo pond		4620
Total	106.43	4635

The above water sources should provide the daily water requirement for livestock of 85 m^3 and 83 m^3 for a total population of 4,125 persons requiring 20 lpcd.

There is not much room for manoeuvre to adapt to motorised scheme to the different use, which is for a large part caused by the lack of financial resources as well as the pump failure. One feature that was clearly adapted was the water fees (at first monthly fee, which was changed into volumetric water pricing). The motorised scheme is too expensive to be financial autonomous and will leave the communities dependent on external help, for big maintenance and big expenditures. Most of the water is used for domestic purposes which do not give a direct cost recovery. When comparing the motorised scheme with the developed spring of Kora this becomes very evident. Over the last year the total profit of the village of Kora amounted to 1000 Birr, whereby the villagers did not have a volumetric water pricing system and abundant water to use for productive use (especially irrigation). The cost recovery of the Ajo system is low (see calculations in Appendix X). The system is designed for 15 years. What will happen with the system after the design life time is not clear. There is not any plan made and it even might be possible the borehole will not harvest any water after 15 years. It is unclear whether enough water is available in the aquifer for a second borehole, besides a second borehole will have the same problem of cost recovery. Even though the motorised scheme is not

sustainable, there are no other options available to supply enough water of good quality. To be less dependent on the motorised scheme promotion and development of other water sources is needed.

The water quantity guidelines are not met, partly because the sources are not used to their full extent. The reasons for this under-utilisation are divers. One important reason is culturally determined. The peasants in Legedini have a nomadic background and their traditional custom of using little water is not easy to change. Even if more water would be available they would rather use this water for productive use then for personal hygiene. Therefore supplying more water will not change habits unless it is imbedded in a water and sanitation extension program (the opposite is also true, an extension program will not succeed unless there are enough water facilities). Only half of the capacity of the motorised scheme is used due to the high running cost (water fee), the dependency on fuel and system losses. The communities of Edo, Edo Bolo and Hallo seldom use their own taps and collect their water at Ajo village and therefore take less water due to the travel distance. The other reason for not meeting the water quantity guidelines was the pump failure which led to absolute water scarcity.

7.6 Comparing the Legedini case with other DAPII project sites

An important remark is that these areas are also food insecure, which was the reason to be taken in the DAPII. When comparing the MUS systems in the highland with the Legedini case, which is in the lowland, the effects of a low cost year-round reliable system are very evident. Also the climatic conditions are very important. The primary productive use of water in the highlands is irrigation whilst in the lowlands this is animal husbandry. The highland schemes have more potential for self-sufficiency with the improved water systems as they can improve their yields considerably with the supplemental irrigation. The earnings from the livestock with earnings from cash crops should be compared to make an analysis which productive uses are most profitable for the farmers and advisable for each different situation.

It is unlearn whether or not there is an institutional gab in East Hararghe Zone. The irrigation tradition exists for a longer time and farmers have been organised around water before. The Water Committees in the highlands were adapted from the traditional organisational structure around water and therefore have a more profound basis then the Water Committees in Legedini.

Multiple use of water from the same source is tried in several areas though not in Legedini. In Gedensar PA there is a deep well with a discharge of 20 l/s. This is a project first planned for providing drinking water and irrigation water. First the potable water supply part was developed after that there was room for irrigation development. The discharge of the water sources dictates whether the water can be used for drinking as well as irrigating. Also in the areas with spring development the water is used for multiple purposes. Only excess water can be used for irrigation and not all households will equally profit from this excess water. All depends on the location of the farm plot (downstream and closest to the water source), whether or not a farmer has the possibility to use the water.

The allurement of people coming into the area is not a problem in the highlands, since most people are already settled for a long time and have been farming in the highlands. Most communities want to have a same kind of scheme developed in their own village.

8 Conclusions and Recommendations

8.1 Legedini

Water is the limiting factor for livelihood improvement in the Legedini Peasant Association and thereby the limiting factor for promoting MUS. It is not only a problem of the division of water between the different uses, but also of absolute water scarcity. Still the benefits on the livelihoods of both the developed multiple water use systems in the Legedini Peasant Association are very evident. The improved water quality has a positive effect on the health status of the inhabitants. The time and energy saved, especially by women, by having water source close to the homesteads creates the opportunity to exploit new activities, like the milk group in Ajo. It has a positive effect on the health status of the children, since the women have more time to look after them. The increased water quantity and availability creates the opportunity to cultivate crops for enhancing their diet or income by selling surplus production. The condition of the livestock ameliorated as well due to the improved access to water. By selling crops instead of firewood and charcoal, the environment will be less loaded and gets a chance to recover, which increases the natural capital of the inhabitants. If the water systems can be made more reliable the livelihoods can improve even more, and uplift poverty with ultimate goal of self-sufficiency.

The complexity of the problem of food insecurity as well as the successfulness of the project requires inter-institutional collaboration. In order to come to a more sustainable and effective multiple water use system, which is used to its maximum potential a closer co-operation between the different line offices involved is needed. Health education and extension as well as water management and agricultural extension are needed to make optimal use of a multiple use system in order to improve livelihoods.

The inhabitants of Legedini use less water then the15 lpcd recommended by the Water Mines and Energy Office, the reason for which are divers. The cultural habit of using little water is difficult to change; the people will rather use the extra water for productive purposes then for personal hygiene. Education is needed about the linkage between hygiene and water use. Indeed if they do not about the positive health implications of using more water for personal hygiene (like washing their hands before milking, cooking, breast feeding) they will not use more water. Therefore only supplying more water is not enough (big change that people will not make maximum use of the available water) it should be combined with education. The technical design does not fit the context. The motorised scheme is too expensive to use for most inhabitants due to the fuel required to pump up the water. Irrigation as productive use by a motorised scheme in the Legedini context is not feasible if it should have the intention of being autonomous with good cost recovery. The water is too costly to use for irrigation unless the peasants are able to make a good profit out off it. Yet to be able to produce for the market a lot of other conditions need to be filled as well, like having market access and knowledge of the market system.

Another important lesson learnt from the DAPII in Legedini is that the project goals should be made explicit and very clearly communicated to the beneficiaries.

8.2 Adapting MUS system in Legedini

The future for Legedini is questionable due to its lack of water resources and degraded environment. It looks like the Legedini Peasant Association will stay depending on external aid for a long time even though the government lacks the resources to support the communities, therefore solutions must be sought to make the system more autonomous and more reliable.

The difficulty of the hydrological setting of Legedini PA is the low ground water level. The dept of 72 meter cannot be surmounted with treadle or hand pumps, therefore will depend on a motorised system.

A solution will be to develop multiple sources for multiple uses instead of one single source for all uses. Unless research is done about the aquifer and the possibilities of a second borehole, expanding the system with a second borehole is not recommended. In case a second borehole is feasible it should be made very explicit in advance who is responsible for big maintenance and replacement as well as an assessment should be made, whether the villages are able to buy and provide the fuel for the generator. A Water Committee is very important for the daily maintenance of the water system and (follow-up) training should be provided by the government as the NGO's will phase out after ending the development project. The high illiteracy level can be a problem for good bookkeeping, yet might be tackled by training and appropriate bookkeeping. For the Legedini area the new PA cabinet has the potential to combine the knowledge and expertise of the different sectors and a good opportunity for integrated activities and a more holistic MUS approach (health, water, agriculture working together at field level).To raise awareness on the quantities of water taken as well as needed for the different uses, one can let the households measure the different water quantities used (see appendix XI).

Creation of additional water sources should be sought in rooftop water harvesting, small farm ponds for the cultivation of vegetables and water harvesting ponds outside the vicinities for the livestock. At present the water for livestock is the most important productive use for the Legedini area, but the peasants see the opportunity of small scale irrigation, so in future their priority might change (which was stated several times by male farmers).

The runoff water harvesting ponds for the livestock should be situated outside the communities (to prevent health risk of mosquitoes breeding place in the vicinity). Walking some distance to watering points with the larger livestock is not a problem; along the way the animals can browse (if allowed at those sites). However livestock watering ponds can attract too much animals and create environmental degradation around the ponds caused by overgrazing, therefore proper site management is needed. Upstream watershed protection is needed as well to prevent high sedimentation in the pond as well as optimise the water collection. Livestock can move to other sources, yet perennial crops cannot, therefore reliable supplemental sources of water are needed near the plots e.g. rooftop water harvesting, to bridge the gap between the rainy season and the dry spell, in case irrigation is promoted. The advantage of this supplemental source is that it can also be used as emergency storage for the first priority use of drinking water in case of a system failure of e.g. the motorised scheme. In Appendix VII calculations are made on the possibility of promoting rooftop water harvesting in Ajo village by using the lined roofs and irrigating papaya trees. A disadvantage is that small scale water harvesting is more expensive to construct compared to large scale schemes. According to HCS staff only the roof of the school is interesting for developing roof top water harvesting. Therefore a consideration needs to be made if the investment is worthwhile. Even if cost recovery is low all opportunities for improving the livelihoods of these food insecure households should be assessed. If each household would be able to grow one papaya tree (or another crop like tomato) this can already make a difference for the food insecure households and improve their nutritional status and thus uplifting poverty. Promoting spate irrigation is also one of the strategies of the HCS. For promoting spate irrigation it is important to know the water quality (some water in the council is saline) as well as the discharge of the river throughout the year. A storage facility is needed to divert the floods and retain the water for a longer period of time. Reuse of domestic wastewater, even if the volume is low, has the opportunity to water some crops at the homestead. For example one papaya tree needs 4 litres of water a day, when applied as drip irrigation with the use of tins. To make optimum use of this wastewater a storage container is needed. One important feature of al those additional sources is that they should bridge the gap between the water requirement and availability in the rainy season with the dry season and thus take into account the different water demands throughout the year.

Climbing the water ladder
Estimated daily available water in Legedini is listed in the following table:

Water point	Daily capacity (m^3)	Storage capacity (m^3)
Borehole Ajo	50	
Kora	26	
Hado Sere	0.43	15
Selella	30	
Ajo pond		4620

The above water sources should provide the daily water requirements for livestock which is 85 m^3 and 83 m^3 for domestic use for a total population of 4,125 persons requiring 20 lpcd.

At the moment two water sources are suitable for domestic use the borehole and Kora spring. These sources can supply 18 lpcd (76000 / 4125), which is above the rural standard of the Water Mines and Energy Office. In case the spring in Selella can be developed 25 lpcd (76 m^3 and 30 m^3 divided by 4125) of potable water can be provided. The other water sources are suitable for productive use, especially for livestock and additional water sources should be further developed like e.g. rooftop water harvesting. In Appendix IX some calculations were made based on the buildings in Ajo village with a corrugated roof. It shows that with proper construction and storage facilities about 132 papaya trees can be grown (almost 2 per household).

Basic MUS is achievable based on water availability. The threshold of 50 lpcd for Basic Multiple Use is just enough for the Legedini area. One household requires about 155 litres per day for the animals (see table 4.4), this is about 25 litres per person per day for the livestock and leaves 25 litres for domestic use (and irrigating some crops e.g. 4 litres for 1 papaya). Besides absolute water availability other conditions need to be fulfilled as well. The institutions at Council level as well as field level need to be strengthened. The villages are not able to have an autonomous system and will be in need of governmental assistance. Rules need to be set about access to the water sources and maximum volume to be taken per individual and which use is allowed with the water (especially to which extent irrigation is allowed). This requires a strong institutional environment in which the rules are obeyed and can be enforced. The purchase of fuel and the water fees should not be a limitation for the volume of water a water user can obtain. Additional tasks that the Water Committee might exploit in the future are cattle purchase and resale scheme during drought, extension, input provision, grains storage, co-ordinating credit and savings co-operatives. In order to use all water sources to their full potential the problem of underutilisation needs to be addressed. So the water users should be able to buy fuel, health extension should be provided and the most profitable productive use of water, livestock or cultivation should be assessed.

All suggestions depend on whether money will be available by a NGO for further development and are in the context of humanitarian aid as it will be very difficult to create an autonomous MUS system with good cost recovery in this food insecure area. The communities are not able to save enough money to maintain the motorised scheme but for the time being there are no other options for providing enough domestic water.

8.3 MUS

The general goal of the MUS approach is to improve the livelihoods of the rural poor. Only supplying water for single purpose use is not enough to reach this goal. The water system should be imbedded in an institutional framework and in a technical design that fit the context and have to possibility for multiple uses. Co-operation between the different line-offices is important to match the different activities planned. Different water sources should be selected for the best possible use depending on the water quality and the water quantity and the deviations throughout the year as well as the different

demands throughout the year, like seasonal peaks for productive use. Different sources should be promoted for the different uses to have an optimised system in which the vulnerabilities are spread. Multiple Use of Water by the use of multiple sources does not automatically mean that water of lower quality can be used for productive use. All different uses have a minimum required quality (see also thesis Pauline Scheelbeek, 2006). If one source is not sufficient in quantity or quality for the different uses one should look for additional sources.

The MUS approach has a lot of potential for improving the rural livelihoods. It is a concept that is easily adapted by the users, provided that the users are trained and instructed about how to use the system. When using water for productive use it creates income generation opportunity to become more self-sufficient. On the other side it can create new vulnerabilities especially in an arid and food insecure context. As soon as a tap is installed the users expect water to come from it and adapt their livelihood strategies to this water availability as was observed in the Legedini case where livelihood strategies changed from trans-pastoralism to settled-agriculture and small scale irrigation. This created new vulnerabilities as water should be available year-round, especially in during the dry spell for irrigation of perennial crops as obviously crops cannot go to the water source as livestock and people can. In Legedini the new introduced water delivery systems increased the peasants' dependency on government assistance for big maintenance instead of becoming more self-sufficient.

The MUS concept builds on the integrated water management approach and aims at improving rural livelihoods. The improvement of these rural livelihoods should not focus on the natural (e.g. water source) and physical (conveyance system) capital without improving the human capital (extension and capacity building).

Contribution to replicable scenario for smarter investments in MUS

Before introducing a multiple use system a baseline study should be made which should encompass an assessment of not only hydro-geological features, but socio-economic features as well. Questions like the following should be answered. What will be the effect on the user and what needs to be changed? Will (improved) water system attract more people? Is there enough water available to deal with population growth? Who will have access to the water? Which users and which uses will get priority in case of water stress? For example will priority be given to the people already living in the area and using the source for all their uses; or will priority given to drinking water for all? Is there room for adapting the system to changing uses? Do the users have the opportunity to use the water facilities to maximum capacity? Will water use increase by health education? Is external financing required and available?

Basic water needs are the first condition to be met, before promoting productive use or in other words the provision of water for productive use should not deprive the provision of basic needs. A good tool for assessing the possibility of **MUS is the water ladder**. It gives a threshold which should be reached before Basic Multiple Use can be promoted (see also table 2.2). An important feature is the maximum allowable distance to reach the water source, as the travel time limits the water volume used.

Service level	Cost time/cash	Volumes (lpcd)	Needs met	Priority
Basic Multiple Use access	<0.2 km < 5 minutes roof water	20-50	Consumption just ok/ hygiene too low/basic livestock, fruit trees	High

A distinction should be made between the different water uses to assess how much water is needed, when it is needed and of which quality. If one water source is not enough able to deliver enough water for multiple use, a system should be created in which multiple use is regulated by the use of multiple sources. In case of designing a Multiple Use System based on one water source the potable water taps, upstream from animal trough (or productive use) in order to prevent contamination.

Technology used for MUS

The water sources should be upgraded with simple adaptations. In case of designing a single source

Multiple Use System the potable water taps should be installed upstream from e.g. the animal trough in order to prevent contamination. The systems should not be technically too advanced, use simple technology. Simple technology is often cheaper to access and requires less maintenance, more reliable and easier to repair under village conditions. Develop as much as possible spring sources, since these have low running costs. Motorised schemes should only be installed if adequate arrangements are made to pay for their running costs and spare parts should be local available. Open water sources should be fenced in order to prevent pollution by animals entering the water, or people falling into the water. Storage facilities will be needed for short term (e.g. night storage) and long term (to bridge dry spells) water storage. Rooftop water harvesting can be a good source for supplemental homestead irrigation. Simple water treatment facilities are needed to upgrade the water source (to higher quality).

Water use rules

When promoting multiple uses the different uses should be clearly defined in order to make a distinction between these uses and to be able to prioritise the different uses in case of water scarcity. For implementing these rules a strong institutional environment is needed that is able to enforce the rules in case of conflict.

Livelihoods

If cost recovery required and production for market takes place the users should take part in the cash-based economy. Therefore knowledge on market mechanisms is needed like e.g. price elasticity, the kind of products demanded by the market. Physical market access by good rural roads is needed for the movement of people, services and goods between the rural villages and the regional market towns. Willingness of the people is needed to fully participate in the project and to take responsibility for their system as well. A sense of community ownership can be created by having the communities contributing labour and local materials to the construction of the scheme, in order to create a more sustainable system. A water management committee should be installed, however it is important to realise that it takes time and resources to strengthen the water committee.

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Appendices

Appendix I: Rural livelihood analysis framework

A Framework for micro policy analysis of rural livelihoods (Ellis, 2000)

A Livelihood platform	B Access modified by	C In context of	D Resulting in	E Composed of	F With effects on
Assets Natural capital Physical capital Human capital Financial capital Social capital	*Social relations* Gender Class Age Ethnicity *Institutions* Rules and customs Land tenure Markets in practise *Organisations* Associations NGOs Local administration State agencies	*Trends* Population Migration Technological change Relative prices Macro policy National econ. Trends World econ. trends *Shocks* Drought Floods Pests Diseases Civil war	**Livelihood strategies**	*Natural Resource-based activities* Collection Cultivation (food) Cultivation (non-food) Livestock Non-farm NR *Non-NR-based* Rural trade Other services Rural manufacture Remittances Other transfers	*Livelihood security* Income level Income stability Seasonality Degrees of risk *Environmental sustainability* Soils and land quality Water Rangeland Forests biodiversity

Appendix II: Motorised Scheme Ajo

Design motorised scheme made by the HCS

Design period	15 years
Annual population growth rate	3%
Present domestic water consumption	15 lpcd
Assume uniform daily water requirement during design period	
Future domestic water consumption	20 lpcd
Daily cattle water requirement	20 lpcd
Pumping per day	10 hours
Population projection	$Pn=Pp(1+i)^n$
Present population area	4800
Present cattle population area	1000
Average discharge demand from taps	1.73 l/s
Max discharge demand (Qav. * 3)	5.19 l/s
Assumed depth well	100 m
Assumed (draw) discharge well	2 l/s
Elevation reservoir above borehole	45.54 m
Height reservoir	2.25 m
Total static head	147.79 m
Head losses	40.59 m
Total head loss	188.38 m > 200 m
A submersible centrifugal pump with head of 200 m and a capacity of 2 l/s with an efficiency of 70% could be installed.	
Pump power capacity	7 kW
Power of the generator	14 kW calculated -> take 17.5 KVA generator set

Present domestic water demand is stated to be 4800*15= 72000 l/day
Future domestic water demand (after 15 years) is calculated to be 7478*20=149560 l/day
Max (peak) day demand = 149560*1.1=164516 l/day
Joint future water requirement for cattle and human per day=20000+164516=184516 litres
Total capacity well: 2l/s*10hours/day=72000 l/day.
Since the yield of the well per day assumed is less than the day consumption, the total population will be satisfied up to 7 years but it needs another source or well after that year.

Analysis and discussion of the calculations made by HCS

The population number of 4800 is the total assumed present population in Legedini PA. It is an estimation of the people living in the area and the nomads within a radius of 15km from the borehole. The population growth is taken into account in the design, yet livestock numbers is assumed to be stable. Since livestock is taken into account, water from the borehole is also promoted for productive use. Future productive uses were not taken into account. After calculations HCS expect that this system will provide enough for coming 7 years, but assuming a capacity of 2l/s in 10 hours of pumping yields 72000 l/day, which is exactly the calculated present daily domestic water demand.

Daily livestock water demand for the whole PA is estimated to be $1000*20=20m^3$. This leaves $30m^3$ for domestic use for 1500 persons or 250 households (based on domestic water requirement of 20 lpcd), which is far less then the population of 4800. Based on other data from the DDAC a daily water requirement of $85m^3$ for livestock was calculated (see paragraph 4.3)

It appears that calculations were made assumptions and some of the conclusions drawn are not accurate. Its is very difficult to draw conclusions from the calculations as the calculations are based on assumptions and estimations

Water Well Drilling Completion Report For Legedini Peasant Association.
Prepared by the Ethio Drilling & Water Engineering PLC in December, 2003

Total depth	72 m
SWL (static water level)	39.93 m
Yield	1.6 l/s
DWL (draw down water level)	56.65 m
Type of Casing & Diameter	PVC 65/8”
Total length of Blind casing	55.20 m
Total length of Screen casing	16.80 m
Total length of Surface casing	2.30 m
Pumping position	67.70 m
Starting date	12-11-2002
Drilling completed on	12-12-2002

The project area is generally dominated by volcanic and sedimentary rocks. Rocks samples were collected every one-meter for proper description of the formation of the well. The well was identified having soft, medium and hard rock types at different depths.

Lithology of the well

Thickness layer (m)	**Lithology**	**Range (m) from Surface**
2	Sandy clay	0-2
8	Highly weathered travertine moderately crushed	2-10
14	Silty sand (yellowish in colour)	10-24
6	Silty sand, derived from loosely deposited travertine (leached limestone)	24-30
3	Highly weathered travertine, coarse to moderately crushed	30-33
1	Moderately to highly weathered travertine with angular cuttings of limestone and travertine	33-34
4	Loosely deposited travertine with some fine to medium grained sand	34-38
2	Coarse sand (moderately to highly weathered)	38-40
3	Dark grey limestone, slightly to moderately weathered	40-43
1	Slightly weathered dark grey limestone	43-44
12	Moderately weathered medium to fine sand	44-56
7	Moderately to highly weathered medium to coarse sand	56-63
7	Moderately to highly weathered dark grey limestone with angular cuttings	63-70
2	Red clay	70-72

Recommendation:
-Install an appropriate capacity submersible pump, which have discharge rate of 1.5-2l/s at its maximum efficiency performance level
-Install the pump at a position of 67.7m from the ground level
-An automatic level control system should be installed with the pump with the upper electrode position of 60m below ground level
-Set the submersible pump to discharge at a rate of 1.6 l/s (if discharge is more then 1.6 l/s the water table does not stabilise after pumping: water table draw down. Tests showed that the well level was recovered to a level of 40m within 10 minutes if the discharge is set at 1.6 l/s).

Appendix III: the new PA cabinet

Within the communities a capacity building office will be established at PA level based on and organised by the three departments of Agriculture, D P & P, Water, Mines and Energy. All activities will be under the Rural Development Office and in the future health extension service will be established as well. At PA level there is a Natural Resource Agent, an Animal Health Agent and an Agricultural Agent involved.
PA administrative cabinet at PA level will consists of:

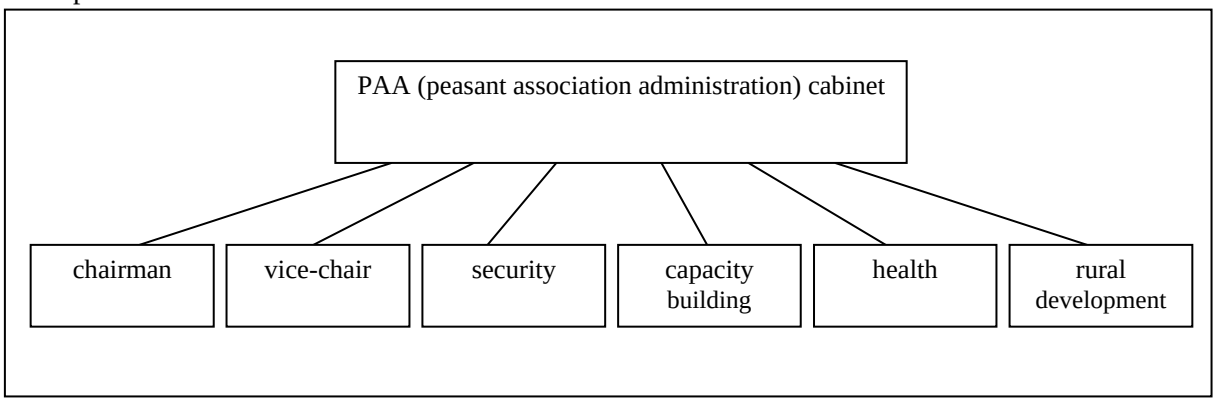
- Chairman
- Vice-chairman
- Security
- Rural development sector
- Capacity building/education sector
- Health sector

First three representatives are elected out of the communities by the communities within the PA. The elections for the representatives from the PA where held in January 2005. The other three members are governmental workers assigned to the area. The person of the education sector is assigned by the schools in that area, the health sector by the health post or clinic in the area; these three persons are not residents of the area.

The new structure should be working as from the start of the next year Ethiopian Calendar (11th September 2005 European Calendar). It will have a bottom up approach. The PA will prioritise their problems and then consult with the PA cabinet which will channel the request to the relevant authority. So the six persons in the cabinet will take the responsibility for the development of their area (PA).

One of the ADO officials was asked whether the illiteracy of the cabinet members might be a problem, since the persons assigned by the government can write, and this could provoke an unequal partnership with the other cabinet members. The aim is to have people that are literate in the cabinet, but the government does not foresee big problems, if they are not, since the PA representatives voice the needs of the people in the PA.

Composition of future PAA cabinet



Togheter with the formation of the PAA cabintet are reorganisation of the PA's in on the way. The PA's of Legedini, El Hamar and Ayale Gumgum are merged into one PA called Legemehar Ayale. It will have 963 households and 32 teams. 1 team consists of 30 farmers (or households)

Appendix IV: DDAC water data

Table IVa Projected per capita domestic water demand (lpcd) and population percentage by mode of services

Mode of services	2005	2010	2015	2020	2025
House connections	19%	20%	21%	23%	26%
	126	139	154	170	187
Yard connections	36%	45%	54%	62%	68%
	55	61	67	74	82
Neighbourhood users	23%	18%	13%	8%	4%
	24	26	29	32	36
Public tap	22%	17%	12%	7%	2%
	24	26	29	32	36
Average demand (lpcd)	55	64	76	90	106
Adjusted domestic demand	66	78	92		
Rural demand (public tap)	47%	62%	85%	90%	100%
	25	25	30	35	35

source: WWD&SE (2003e)

Table IVb Projected Rural Domestic Water Demand for Dire Dawa Administrative Council

Description	2005	2010	2015	2020	2025
Population Growth Rate (%)	2.40	2.40	2.40	2.40	2.40
Population (nr)	122535	149872	183309	223023	271342
Coverage(% by level of services)					
Public Taps	47	63	85	90	95
Service Level (lpcd)					
Public Taps	24	26	29	32	36
Water Demand (m^3/day)					
Public Taps	1382	2455	4519	6423	9280
Total domestic demand	1382	2455	4519	6423	9280
Climatic adjustment factor	1.1	1.1	1.1	1.1	1.1
Adjusted domestic day demand	1520	2700	4970	7065	10208
Public Demand/Non-domestic demand	76	135	249	353	510
Livestock water demand	1838	2248	2750	3345	4070
Average day water demand	**3434**	**5084**	**7969**	**10764**	**14788**
Loss in distribution system	172	254	398	538	739
Total average day water demand (m^3/day)	**3606**	**5338**	**8367**	**11302**	**15528**
Maximum day factor	1.45	1.45	1.45	1.45	1.45
Maximum day demand	**5229**	**7740**	**12132**	**16388**	**22515**
Peak hour factor	2	2	2	2	2
Peak hour demand	**7212**	**10675**	**16734**	**22604**	**31056**

source: WWD&SE (2003e)

Appendix V: The Catholic Relief Service and the Water Supply and Sanitation Strategy

The CRS was founded in 1943 by the Catholic Bishops of the United States to assist the poor and disadvantaged outside the country (CRS, 2003a). The guiding principles for all CRS activities are drawn from the basic tenets of Catholic Social Teaching. CRS policies and programs reflect and express the teaching of the Catholic Church, yet at the same time the CRS assists persons on the basis of need, not creed, race or nationality. Most of the CRS programs all over the world are implemented by local partners, like organisations of the Catholic Church, other faith-based organisations, secular organisations an local governments. The target communities need to be treated as partners as well if sustainable change is to be achieved (CRS/EARO, 2003).

Catholic Relief Service Ethiopia (CRS/ET) has been working in Ethiopia for over forty years with the mandate to work with the most vulnerable populations in order to respond to and help them meet their immediate needs and to support development within their communities.

The main program areas of the CRS Ethiopia are:

- Agriculture/natural resource management (AG) (strategic goal: increased production of poor households in targeted watersheds)
- Health/HIV/AIDS/Water and Sanitation (HE) (to improve health status of target communities)
- Micro Finance (MF) (alleviate poverty by responding tot the financial needs of as many active poor as possible through an autonomous, sustainable micro finance institution)
- Safety Net/Emergency Response (SN/ER) (to save the lives of those most affected by emergencies, to promote the dignity of the poor and vulnerable, and to reinforce social determination for development)

Water is needed for a wide variety of domestic, agricultural, commercial and industrial uses. In rural communities, available water must be allocated to irrigation, livestock watering, food processing, beer brewing and other commercial activities supporting the *livelihoods* of the residents. Meanwhile the disposal of human excreta and other wastes may seriously degrade the quality of groundwater and surface water. This calls for a strategy for water supply and sanitation (CRS/EARO, 2003). The Catholic Relief Services/East Africa developed a regional strategy for water supply and sanitation based on two propositions viz. *Water means life and sanitation means health.* This strategy is attended to assist the CRS regional and country staff in planning effective and sustainable water and sanitation programs and projects that better meet the needs of the people in the region (CRS/EARO, 2003). Because water and sanitation serve so many essential purposes related to human welfare and quality of life, it has often been seen as the engine with the potential to transform a variety of sectors, including general economic developments, community revitalisation, public health, environmental protection, small-scale industries and even political reform (CRS/EARO, 2003).

The strategy for East Africa is based on a series of water-related studies carried out within the region in which CRS was involved. For example in 1998, the CRS took the lead in conducting a USAID-financed programmatic environmental assessment of small-scale irrigation activities in Ethiopia. In March 2003 a USAID-financed workshop was organised in Dire Dawa town to review the 1999 environmental study of potable water and sanitation projects and to formulate guidelines for future project development in Ethiopia (CRS/EARO, 2003).

The primary goal of CRS/EARO activities in water and sanitation is: *To improve the health of the communities through integrated and sustainable water and sanitation systems.* Secondary goals to be reached with this water and sanitation strategy are amongst others sustainable livelihoods, environmental protection, behavioural changes and emergency response. Safe water supply by itself has only a minor effect upon health if good sanitation conditions are not addressed. Therefor future

CRS projects must consider water supply, sanitation and hygiene education to be a package intervention. Software considerations like training, hygiene education and management are more important to projects success than hardware like the technical engineering and construction facilities. Health outcomes and long term project sustainability are more positively affected by good software approaches than by good engineering applications.

In order to reach the goal of the strategy, the following strategic objectives are formulated for the implementation of programs and projects.

- *Promote Community Participation and Empowerment*

CRS supports the empowerment of communities to take ownership of both their problems and the necessary solutions. In order to use and mange projects properly, the communities must accept responsibility for meeting their water and sanitation needs. The CRS supports the formation of water and sanitation committees, by providing training in leadership as well as in water systems operation and maintenance, creating community financing schemes and encouraging community monitoring and evaluation.

- *Promote Health/Related Behavioural Change*

CRS will promote changes in health-related behaviour by increasing the knowledge of the health impacts of water and sanitation of the communities involved.

- *Promote **Multiple Water Use** and Environmental Protection*

Sustainability of water supply systems is dependent upon the overall sustainability of the water resources found in the area. CRS promotes multiple uses of water, not only domestic uses but also agricultural and commercial applications that support the development of sustainable livelihoods on a catchment basis, in order to ensure that all valid needs are met. This will also require a sustainable environment and therefore the CRS is committed to protect the environment through integrated water use planning, natural resource management and sound project development (CRS/EARO, 2003).

- *Establish Appropriate Sanitation Facilities*

Sanitation facilities should take into consideration the local cultural practises and employ an appropriate level of technology for the participating communities.

- *Establish Sustainable Water Systems*

Depending on the geographic, environmental, socio-economic, and cultural realities of each project location, an appropriate water system will be selected together with the communities.

The regional guidelines, including policy directives required by USAID for Title II funded projects to be used for the planning of projects and programs are:

1. Sanitation must be linked to water supply.
2. Water quality monitoring must occur in all potable water systems.
3. The planning, design, implementation, operation and maintenance of potable water and sanitation projects must be in conformance with these guidelines.

The following indicators and guideline statements should be followed for the planning Phase (CRS/EARO, 2003):

Community participation and needs assessment

- Work together with the community
- Build upon traditional community structures, if available
- Encourage the community to contribute part of the project cost in labour and local materials
- Assist the community to establish effective links with the local government bureaus and private sector involved in the provision of maintenance and repair services and the supply of spare parts.
- Projects should be based on needs identified by the community

Water source identification

- All potential water sources should be identified
- All projects should draw water from protected sources
- Groundwater sources are generally preferable to surface water sources

- Whenever surface water sources, especially rivers and streams, are considered for development, the communities immediately upstream and downstream should be consulted and involved in the decision making process prior to implementation
- Where possible, projects should use water sources that will remain reliable to meet the demand throughout the year and for the design life of the project

Watershed considerations

- All projects should be considered as part of the overall watershed
- Where possible, projects should be part of an integrated watershed management approach and *support multiple uses of water*

Water quality

- Water quality should be a primary concern in all water projects
- A continuous effort should be made to maintain drinking water quality at the highest practical level
- All water sources should have acceptable water quality
- All water sources should be regularly monitored for water quality

Water quantity

- Projects should have the capability of supplying at least *20 litres of water per person per day* to the service population

Sanitary surveys

- Project approval must include a sanitary survey assessing health risks

Water supply and sanitation committee

- A water supply and sanitation committee should be established at the onset of the project to define and mange its operations
- Committee should be representative of the community
- Women should be fully represented on the committee
- Women should be encouraged to take on leadership roles in the committee

At the end of the implementation phase the CRS and its partners should maintain a basic set of technical reference document in its country office. CRS and partners are responsible for the development of a handing over plan for the transfer of its responsibility at the completion of the project to the water supply and sanitation committee and the local technical bureaus.

The long turn indicators for the sustainability phase are(CRS/EARO, 2003):

Operations

- The community should be fully responsible for the continued operations of the water supply and sanitation system.
- CRS and its partners should continue to assist the community for an appropriate period of time following completion of project implementation

Maintenance

- The community should have a plan to carry out routine maintenance and repairs
- The water supply and sanitation committee should be responsible for carrying out the maintenance plan

Community management

- The community should ensure that the water supply and sanitation committee reports regularly on the status of the water and sanitation system

Institutional links

- CRS and its partners should assist the community to maintain effective links with local government technical bureaus

Monitoring

- The community should have a plan for the routine monitoring of system operations and community sanitation and hygiene practises
- The water supply and sanitation committee should be responsible for carrying out the monitoring plan

Program evaluation

- CRS and its partners should carry out an external evaluation of projects at the completion of the overall program

In addition to USAID regulations, water and sanitation projects in Ethiopia need to take into consideration Ethiopian legislation. The Federal Governments of Ethiopia published its Environmental Policy in 1997 and several water supply and sanitation regulator and planning documents over 2001-2003. The following legislative and regulatory requirements of these Ethiopian documents have been considered in the preparation of the USAID guidelines (CRS, 2003b):

- Environmental Impact Assessment Proclamation (No. 299/2002)
- Environmental Pollution Control Proclamation (No. 300/2002)
- Standard of Drinking Water –specifications (2^{nd} edition ES261/2001)
- National Water Supply and Sanitation Master Plan (Ministry of Water Resources, 2003)
- National Drinking Water Quality Guidelines (Ministry of Water Resources, draft 2003)
- Ethiopian Public Health Proclamation
- Ethiopian Health Guidelines
- Environmental Health Guidelines

CRS has always looked upon water and sanitation improvements as interventions intended to protect and improve the health of poor and marginalised communities. The donor, USAID, emphasizes the impact of water quality and quantity. Most important factor found in all water and sanitation projects is the intention to improve the health of the users of the projects.

Appendix VI: The Development Assistance Program

The Development Assistance Program (DAP) reflects CRS/Ethiopia's shift from a relief-oriented model to an integrated community-based model of development where vulnerable communities are offered a variety of activities that address food security gaps. The DAP is based on an integrated watershed management framework, which focuses on the integration of sectoral activities within a given watershed for the maximum impact on household food security. The strategic goal is to reduce the overwhelming poverty in Ethiopia by promoting food security and strengthening civil society through the implementation of integrated programs. The experiences developed and the lessons learned from DAP I were encouraging enough to lead to the establishment of DAP II (ECC-SDCOH, 2002). For the Dire Dawa Administrative Council (DDAC) the second Development Assistance Program (DAP II) program will be implemented in the years 2003-2007, by the ECC-SDCOH (also know as HCS), in three peasant associations (PA) viz. El Hamer, Legedini and Ayale Gumgum. The ultimate goal of DAP II is to alleviate the overwhelming poverty by *improving household food security* of the inhabitants of those three PAs.

The DAP II Program consists off two components:

- Agriculture and Natural Resource Management (Ag/NRM)
- Community Based Health Care (CBHC) to improve the health status of the communities

The development of potable water system is one of the elements of the CBHC component.

Amongst the objectives of the DAP II are (ECC-SDCOH, 2002):

- Improve livestock production through production of animal feed and construction and rehabilitation of ponds.
- Improve health status of the most vulnerable group in the community -children under 5 years of age, pregnant and lactating mothers via health and nutrition counselling (education), monthly growth monitoring, environmental sanitation and home management.
- Improve access to potable water at community water supply system
- Improve the institutional capacity of the targeted community for sustainability of development concepts of the project.

Since the DAP II is funded with Title II program resources, the DAP program has to comply with the Title II program objectives. Title II water supply and sanitation projects are expected to contribute to the USAID/Ethiopia objective of Enhance Household Food Security in Target Areas (CRS/EARO, 2003). This objective contains five critical intermediate results:

1. increased agricultural production
2. increased household income
3. improved health status
4. maintaining the natural resources base
5. maintaining emergency response capacity

To a certain extent the small-scale water and sanitation activities funded under Title II generate results that support all of these crucial areas. Where possible, the project should be part of an integrated watershed management approach and support multiple uses of water.

Activities

Small-scale irrigation is one of the activities planned to enhance food security at the household level. The basic strategy for DAP II is an integrated watershed management (IWM) approach that enables integration of activities in different sectors as are: human health, natural resource management, potable water development and supply, infrastructure development, agricultural production promotion, income generating activities and capacity building of the target community in the direction of self help development initiative (ECC-SDCOH, 2002). *Multiple use of water for human consumption and livestock production is the top priority* of the 3 Peasant Associations in Dire Dawa in order to run the livelihood production system in which crop husbandry and livestock rearing is dominant. Besides

these socio-economic problems also infrastructural constraints such as lack of feeder roads for market access, distant or non-existent health facilities, and inadequate transport are limiting the livelihood production system (ECC-SDCOH, 2002).

ECC-SDCOH water development department will be responsible for the implementation of the water program with full collaboration with the Water, Mines and Energy department in Dire Dawa. Next options are assessed for the development of a water system.

1. Water resource development will be spring protection. Springs protected in DAP II will be designed to make groundwater discharge more efficient, to facilitate community use, to maximise storage capacity, and to protect the source from pollution and contamination.
2. Second option will be to explore the potential to develop hand-dug wells. Hand-dug wells are usually restricted to areas where the aquifer is unconsolidated and lies close to the surface.
3. In those cases where groundwater levels are deep, ECC-SDCOH will use alternative funds to support borehole construction.
4. Some targeted communities will be unable to pursue one of the three mentioned options due to the particular hydro geological conditions in their area. In such cases, ECC-SDCOH will support the construction of roof rainwater catchment systems on community structures, such as schools and health clinics, which are often attended by women and children. Such catchment systems are relatively cheap to construct provided that the housing structures are already roofed with zinc/iron sheeting and the project area receives not more than 3-4 months of rainfall per year, however, roof catchment systems will only be considered as a supplementary water supply option for the targeted community.

CRS' experience in Ethiopia demonstrates that well-functioning Water and Sanitation Committees play an important role in improving the food security of their communities. As such, *CRS/ET requires that all of its potable water projects have a functioning Water Committee or a suitable equivalent structure in place*. These committees are usually comprised of 5-7 members, at least two of whom are women. WSC training will focus on financial management, operations and maintenance of the developed water systems. Training will last for at least three days, with an initial supply of hand tools and spare parts provided to the committee upon completion. In general, major responsibilities of a WSC will include the following:

Mobilising and sensitising the community

- Initiating and facilitating community labour, material and money contribution
- Creating accessibility and good working environment
- Participation in site selection for water points and sanitation facilities
- Co-ordinating labour flow during establishment and maintenance
- Ensuring that the water point has appropriate fencing and drainage
- Appointing pump caretakers to manage and maintain the water point
- Appointing a treasurer to collect and document water user fees
- Facilitating the promotion of health education on sanitation and hygiene
- Facilitating the promotion of household latrine construction and usage.

Before the development of any scheme a Water Committee should be established to enable to co-ordinate the involvement of the community in cost sharing. Each water point will have a committee representing their respective villages and they are responsible for all water supplies and their functions. To ensure the operation of the system, Water Committees will collect monthly water fee from each water point users as per the rate agreed by the community. The option of fee payment per unit water point visit (per bucket) will be left to the community to decide based on their economic status. This fee will be used to maintain the schemes when its fail, even in the long run it can be use for the construction of new water schemes when the structure finished its lifetime. There will committee of 5-7 members organised per site as a management team. These committees will have by-laws, roles and responsibilities. In order to effectively fulfil these responsibilities, training will be

provided for the water management committees in organisational management, financial management of user fees collected.

Any irrigation activities will incorporate mitigation measures to minimise potential mosquito breeding sites by reducing the pooling of stagnant water and at the community level, there will be an emphasis on building the capacity of community health workers. In CRS/ET program areas, ponds will be constructed for livestock only. CRS/ET has no plan to support ponds for either drinking or irrigation purposes during the DAP period.

The following waterpoint were identified in Legedini according to the Five Years DAPII Proposal for Dire Dawa Administrative Council 3 PA's (Legedini, Ayale Gumgum, and El Hamar (ECC-SDCOH, 2002).

Village	**Source type**	**Number of schemes**	**Site source name**	**Users**	
				HH	**people**
Kora	Spring	1	Lege Hora	500	1750
Selela Dini	Spring	1	Medde Sellela	130	455
Gewanta	Hand dug well				
Hajo	Hand dug well				
Hado sere	Hand dug well				
Dini	Hand dug well				
	Roof water catchment	3	Public institutions		

ECC-SDCOH will pilot the use of *Participatory Hygiene and Sanitation Transformation (PHAST*) in the DAP II with the expectation that this participatory approach will be more effective at getting communities to analyse their traditional hygiene and sanitation practices and develop plans for improving them. Building on recommendations from a USAID-sponsored assessment of Title II water and sanitation projects in Ethiopia, CRS/ET where ECC-SDCOH was active member developed a water and sanitation strategy[30] (see Appendix V; ECC-SDCOH, 2002) based on the following five principles:

- The primary purpose of water & sanitation interventions is to improve community health.
- Sanitation improvements must always accompany water supply improvements.
- Software considerations are more important to project success than hardware.
- Project success is measured in terms of increased community usage of water & sanitation facilities.
- Project success can only occur through the empowerment of communities to take responsibilities for the control of their water supply and sanitation needs.

A Village Health Committee (VHC) will be elected by the community, nearby the health institution. The VHC will have the responsibility of mobilising the villages for immunisation campaigns, assisting Community Health Workers in co-ordinating home visits, organising households for health education and ensuring that registration books are kept at the village level and used for decision making.

Many communities in these areas are presently isolated from development assistance because there are *poor access roads connecting them with the main roads.* If road access does not exist, it is not possible to develop water resources for domestic consumption or irrigation, to market cash crops, to transport tree seedlings for planting, or to improve community access to health care. For this reason,

[30] At time of field research PHAST was not fully put in practice in the research area.

DAP II will support the construction and *maintenance of access roads* so that all communities in the targeted watersheds will be linked with existing roads.

Improving the natural resource management in the upstream catchments is the point of departure for promoting surface water harvesting activities for multiple uses. Hence, the water harvesting activities will be integrated with the overall watershed management design and implementation strategy to be conducted on pilot scheme basis. Spate irrigation which is among the traditional practices in Dire Dawa will be promoted integrated with water storage facility side by side to fill the gap of the water demand at peak dry seasons. Though water harvesting looks a new technique the target area farmers had good traditional knowledge of improving soil moisture to harvesting in spate system. In areas like Dire Dawa, seepage and evaporation are the major problems reducing the water holding capacity. Measures like increasing the depth and covering the exposed surface with different means, the use of linings (plastics, clay, cement) will be recommended in order to minimise the evaporation loss which is estimated about 1.4 to 1.8 meters annually under the Dire Dawa context as well as seepage losses. These measures have resulted in improved water-holding capacity of water harvesting ponds, which now provide water up to three months following the rainy season. Generally, one of the disadvantages of livestock ponds in semi-arid and arid areas is that households wind up fetching their drinking water from them if there is no other alternative nearby. Since the quality of this water is usually poor, it leads to increased rates of diarrhoea disease. Experience shows, however, that this disadvantage can be negated if livestock ponds are promoted in conjunction with potable water source development and health education promotion.

After completion every created infrastructure will be handed over the respective village owners. This periodic handing over creates a sense of ownership for the villagers. The established village level organisations are regulating the wise use of these assets and penalise the community members in case of violation of the bylaws (ECC-SDCOH, 2004) Each village will have its own village development committee (VDC) as well as a PA development committee (PDAC).

Organisation

The DAP II project is assigned for 2003-2007 under the auspices of The Disaster Prevention and Preparedness Commission in Addis Ababa. The ministries of Health, Water and Agriculture are partner within the project. The project Agreement was signed on 10th of January 2003 by the following parties:

- Disaster Prevention Preparedness and Labour Social Affairs Office (DPPLSAO)
- Dire Dawa Agricultural Office (DDAO)
- Dire Dawa Health Office (DDHO)
- Dire Dawa Water Mines and Energy Office (DDWMEO)
- And the Ethiopian Catholic Church Social and Development Co-ordinating Office of Harar (ECC-SDCOH).

The DPPLSAO will only fulfil a facilitating role with the project whilst the DDAO, the DDHO and DDWMEO are responsible for the support, collaboration, implementation, monitoring and evaluation of the agricultural & natural resource management, health and community water development activities respectively. The ECC-SDCOH will implement the projects, via the HCS supported by USAID Title II resources through its co-operating sponsor the CRS/Ethiopia, which means that the DAP Project is part of Food For Work program (FFW) and the communities are paid in food for their labour contribution (CRS, 2001). Food-for-work rations (from Title II resources), will be provided to community members to perform the activities. The traditional FFW ration includes 3 kg of wheat grain and 120 gram of vegetable oil per person day.

The HCS is responsible for submitting quarterly monitoring reports as well as a midterm and a final report at the termination of the project (ECC-SDCOH, 2004). The co-ordination of DAP II activity is with institutional and structural arrangement from site level animator to Wereda and then to the area program co-ordination and at the secretariat development commission and finally CRS/ET the co-

operative sponsor partner. The project may be amended, renewed of terminated prematurely if by all parties agreed upon (Project Agreement DDAC for DAP II).

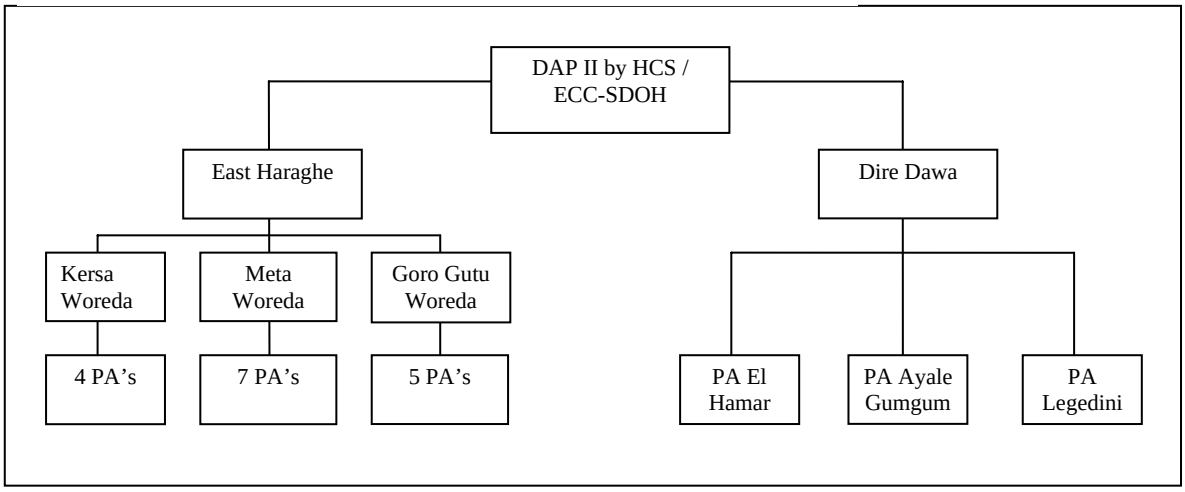
After the five year period the project will be handed over to the communities and the line offices are responsible for the sustainability of the project by follow-up activities.

Implementation

The project will be supported by the overall program management staff of the head office. ECC-SDCOH development co-ordination department will be responsible for the overall implementation of the program. The DAP II co-ordination is conducted together with the East Hararghe Zone. The development commission agriculture and natural resource unit, the Water and Sanitation (WATSAN) and the health unit will be directly responsible for the implementation of the project together with site level technicians and support staff.

The DAP II Project co-ordinator together with the M&E, water engineer and health co-ordinator other co-ordination staff will co-ordinate at office level the entire program in the two regions, Dire Dawa and East Hararghe. In addition the co-ordination team is responsible for the bilateral and multilateral communication with government and NGO partner offices through reporting and monitoring. The Woreda co-ordinator together with the sector technicians at site level is responsible for regular monitoring and implementation of their respective regional activities. In addition it is the duty of the Woreda co-ordinator to facilitate co-ordination and collaboration with the local government offices and community in order to facilitate sustainable transparent implementation of the project. The Woreda co-ordinator has additional responsibility of reporting regularly to the ECC-SDCOH co-ordination office and work as a channel for the communication and reporting to respective partners. The water technicians are based in each of the three regions of the project area. The project at each respective site will utilise government staff expertise in monitoring and facilitation of project accomplishment and ensuring sustainability.

Structure DAPII with in Dire Dawa Administrative Council



The project had periodic reports, which is anticipated one of the major monitoring tool to measure the quantitative and qualitative results. As described in project design part of the project-monitoring plan, the reports are mostly collected for submission on quarterly and annual bases to partners. However, the basic data collected at site level is documented on monthly basis, which is compiled and reported at quarter level for the co-ordination office.

There are two evaluations plans for the mid term and final at the end of the project period. The co-operating sponsor (CRS/ET) and government partners will conduct both the mid-term and final evaluations separately.

Appendix VII: Evaporation and rainfall data in DDAC

Table VIIa Monthly climatologic data meteo station Dire Dawa

MONTHLY REFERENCE EVAPOTRANSPIRATION PENMAN MONTEITH						
Meteo station: Dire Dawa				Country: Ethiopia		
Altitude: 1150 m				Co-ordinates: 9.46 North		41.31 East
Month	**Avg. Temp. °C**	**Humid. %**	**Wind km/day**	**Sunshine Hours**	**Radiation MJ/m^2/day**	**ETo-PenMon mm/day**
January	21.7	39	363	8.8	20.3	6.1
February	23.3	43	328	8.0	20.5	6.1
March	24.7	44	380	7.8	21.3	6.8
April	26.1	48	397	7.4	20.9	6.9
May	27.6	35	354	8.4	21.9	7.8
June	28.7	30	475	8.1	21.0	9.3
July	27.2	41	484	7.5	20.3	8.1
August	26.6	41	441	8.0	21.5	7.8
September	26.2	35	363	7.7	21.1	7.5
October	25.5	28	363	8.3	21.1	7.7
November	23.1	30	363	9.4	21.4	6.9
December	21.8	30	311	9.3	20.5	6.1
Year Av.	**25.2**	**37**	**385**	**8.2**	**21.0**	**7.2**

Source: WWD&SE, 2003f; Year of data collection unknown.
Note: The ETo-PenMon appears to be extremely high.

Table VIIb Monthly rainfall data meteo station Dire Dawa

MONTHLY RAINFALL DATA		
Meteo station: Dire Dawa		Country: Ethiopia
Eff. Rain method: USDA S.C. Method		
Month	**Rainfall (mm/month)**	**Effective Rainfall (mm/month)**
January	15.9	15.5
February	16.6	16.2
March	65.1	58.3
April	52.6	48.2
May	34.9	33.0
June	15.7	15.3
July	70.7	62.7
August	112.4	92.2
September	65.7	58.8
October	24.8	23.8
November	9.9	9.7
December	8.5	8.4
Year Total	**492.8**	**442.0**
Eff rain form:	Peff=(Pmon*(125-0.2*Pmon)/125	for Pmon ≤ 250 mm
	Peff=125=0.1*Pmon	for Pmon > 250 mm

Source: WWD&SE, 2003f; Year of data collection unknown.
Note: method used to calculate the effective rainfall is the USDA soil conservation method, which gives a higher effective rainfall then the effective rainfall used for irrigation requirement calculations.

Irrigation requirement per hectare for different crops in DDAC

Month		Sorghum		Maize		Groundnut		Soybean		Tomato		Onion		Pepper		Coffee		Papaya		Citrus		Mango	
& crop		10^3m^3	mm	10^3m^3	mm	10^3m^3	mm	10^3m^3	mm	10^3m^3	mm	10^3m^3	mm	10^3m^3	mm	10^3m^3	mm	10^3m^3	mm	10^3m^3	mm	10^3m^3	mm
Jan	(1)					1,51	151	1,19	119	1,04	104			0,41	41	1,08	108	1,69	169	1,1	110	1,86	186
	(2)									0,79	79	0,77	77	1,16	116								
Feb	(1)					1,65	165									0,99	99	1,61	161	1,03	103	1,73	173
	(2)									1,16	116	1,51	151	1,27	127								
Mar	(1)					1,16	116									0,84	84	1,69	169	0,9	90	1,71	171
	(2)									1,84	184	1,71	171	1,56	156								
Apr	(1)					0,07	7									0,97	97	1,96	196	1,06	106	1,82	182
	(2)	0,1	10	0,1	10	0,21	21	0,21	21	2	200	1,36	136	1,69	169								
May	(1)															1,38	138	0,65	65	1,62	162	2,26	226
	(2)	1,01	101	0,83	83	0,76	76	1,41	141	1,35	135			0,57	57								
Jun	(1)															1,79	179	0,96	96	2,06	206	2,61	261
	(2)	2,54	254	2,7	270	2,29	229	3	300														
Jul	(1)															1,11	111	0,38	38	1,31	131	1,67	167
	(2)	1,77	177	2,24	224	1,99	199	2,26	226														
Aug	(1)															0,71	71	0,32	32	0,82	82	1,25	125
	(2)	0,36	36	0,93	93	1,04	104	0,92	92														
Sep	(1)							0,21	21	0,55	55	0,51	51	1	100	0,9	90	1,02	102	0,94	94	1,45	145
	(2)					0,02	2																
Oct	(1)							1,41	141	1,57	157	2,04	204	1,72	172	1,29	129	1,87	187	1,29	129	1,87	187
	(2)																						
Nov	(1)					0,39	39	2,27	227	2,34	234	2,19	219	2,06	206	1,25	125	1,94	194	1,25	125	1,85	185
	(2)																						
Dec	(1)					0,77	77	2,12	212	2,18	218	1,45	145	1,9	190	1,16	116	1,8	180	1,16	116	1,84	184
	(2)																						
Total	(1)					5,53	553	7,19	719	7,67	767	6,19	619	7,08	708	13,46	1346	15,88	1588	14,55	1455	21,92	2192
	(2)	5,79	579	6,8	680	6,31	631	7,79	779	7,13	713	5,34	534	6,26	626								

(1) Dry Planting Crop
(2) Wet Planting Crop

Source: WWD&SE (2003e)

Appendix IX: Rooftop water harvesting potential Ajo village

Table IX Calculation of number of papaya trees that can be irrigated by supplemental rooftop water harvesting in Ajo village

Building	length (m)	width (m)	area (m^2)	volume (rainfall of 420 mm) m^3	effective volume (m^3)	no of papaya trees	storage capacity (m^3)
Clinic	14.40	7.70	111	47	26	16	13
Latrine Clinic	4.2	4.2	18	7	4	3	2
Shop next to clinic	6	5	30	13	7	4	4
Shop next to agr. office	4.3	3.7	16	7	4	2	2
house	3.9	2.2	9	4	2	1	1
HCS building 1	9.7	5.3	51	22	12	8	6
HCS building 2	11.8	5.3	63	26	15	9	8
shower	2.7	1.9	5	2	1	1	1
Generator house 1	6.6	5.3	35	15	8	5	4
Generator house 2	6.4	4.3	28	12	6	4	3
School	38.9	9.3	362	152	85	53	43
Latrine school	6.9	4.4	30	13	7	4	4
Small school	12.6	5.4	68	29	16	10	8
		Total school		**193**	**108**	**68**	**55**
Agricultural office	9.8	3.3	32	14	8	5	4
	8.9	3.8	34	14	8	5	4
Latrine agr. office	2.4	1.9	5	2	1	1	1
	Total agricultural office			**30**	**17**	**11**	**9**

Total irrigation requirement for papaya in DDAC: 1588 mm (=1.6 m); area 1 papaya tree: 1 m^2.

Yearly rainfall ranges between 420 to 650 mm for the Legedini PA. To be on the 'safe' side calculations are done with the lowest level of 420 mm.

Not all water rainfall is effective. Therefore it is assumed that about 80% will be collected in the reservoir (some water is needed for flushing sand and other pollution can be caught on the roof and will be available for collection). Irrigation efficiency is estimated to be 70% in case drip irrigation with the tins is practised.

The rain will fall, spread over some months. In case the collected water is used for supplemental irrigation, it is only needed to bridge the dry spells. So a smaller storage capacity is needed to irrigate the calculated number of papaya trees (assumed that in the rainy season no additional irrigation is needed). The reservoirs will be needed several times a year between the rains, but should at least have to capacity to bridge the Bega which lasts for 5 months. To be on the safe side 6 months are taken in the calculation. Assumption is made that the collected water is only used for supplemental irrigation (and not domestic use or other productive uses).

Calculations:	
Effective volume	0.8*0.7*roof area*420 mm of rain
No of papaya trees	effective volume/1.6
Storage capacity	effective volume/2

The estimation of 4 litres per day in the USAID tins for the papaya trees, by the peasants amounts a total volume of 1.46 m^3 per year, which appears to be a good estimation; only the different water requirements during the months is not taken into account. The highest monthly irrigation requirement is 196 mm in the month of April (see Appendix VIII) or a daily requirement of 6.5 litres per papaya tree. However the field period was after the large rains, therefore it can be assumed that 4 litres a day is a good assumption for the water requirement in the dry season.

Appendix X:Cost recovery motorised scheme Legedini

Some calculations made on the different water delivery systems, to give an indication of the actual costs.

Investment cost- relate to the total cost of the physical components of water supply and sanitation/sewerage schemes. The term includes the cost of materials, equipment and labour.

Construction cost of different schemes in the project is determined by using the cost curve based on the costs of various project in the country and in the region (WWD&SE, 2003f).

Rehabilitation cost – the cost of rehabilitation of not functional schemes has been determined as percentage of the initial investment cost of schemes e.g. for the motorised system in Legedini this will be:

Motor pump	100 percent of the investment cost
Generator set	100 percent of the investment cost
Public standpoint	50 percent of the investment cost
Cloth washing basin	50 percent of the investment cost
Cattle through	50 percent of the investment cost

The **reinvestment** costs are the costs for renewal of components of the system which lifetime is shorter then the total duration of the project and will need periodic replacement. The estimated lifetime of a selection of equipment:

Borehole	15 years
Reservoir	50 years
Pumping equipment	10 years
Diesel generator	10 years

Derived from WWD&SE, 2003f

This already shows that the projection of 15 years, used for the technical design (see Appendix II), requires a pump and generator replacement before the end of the design period.

The annual maintenance costs have been determined by using a percentage of the physical investment cost of each item (WWD&SE, 2003f). The recommended percentage is shown below:

Schemes	**Percentage from the investment cost**
Borehole	1
Motor pump	3
Diesel generator	2
Reservoir	0.5
Public fountains and water meters	0.5
Electrical and Mechanical Equipment	3
Pipelines	0.7

The Integrated Resource Development Master Plan Study Project recognises the vital importance of employment of basic staff on permanent or part-time basis for the sustainability of rural water supply schemes. Even though the water system will be managed at community level by Water Committees, the need of governmental staff for guarding, routine maintenance and repair, operation of motorised

schemes and reporting of the malfunctioning of the schemes, as well as monitoring bill collection is evident.

Cost recovery pump

Pump: live expectancy is 15 years according to the design; however the Master Plan Studies takes 10 years.

Replacing pump: 50000 Birr this means a yearly depreciation of 5000 Birr (without interest)
This is a yearly contribution of 5000/203= 25Birr per household (203 households) or when paying per volume (and assuming that all the water taken is paid for).
Reservoirs are filled 3 times a week, which gives an annual volume of 7800m^3 or 390000 jerry cans -> An additional contribution of 1,3 Birr cent per jerry can (5000/390000=1.3 Birr cents) In case the pump should be paid back within a year this would double the price per jerry can to a total of 27 Birr cents (0.15 Birr basic fee plus 0.13 Birr for pump replacement). It is very evident that the communities cannot afford this, since Legedini is a food insecure area and the people do not earn enough to be self-sufficient, let alone pay a lot for the water. A long term credit facility might be feasible, yet a 10 year planning is to long time span for peasants that live from season to season.

Cost recovery diesel generator

The battery of the generator breaks down once or twice a year. A new battery will cost 350 Birr.
Purchase price of the generator not known.

Yearly maintenance costs

Pump: 3%*50000=1500
Borehole: 1%*150000=1500
Reservoir: 0.5* 2*75000=750
Pipelines: 0.7* n.a.
Equipment: 3%* n.a.

Diesel price: 3.50 Birr/litre up to 6 Birr/litre

According to the pump operator it takes about 4 hours to fill the reservoir Ajo and Hallo and uses 10 litres of fuel and thus costs 60 Birr. The reservoir of Edo and Edo Bolo takes 5 hours to fill and needs 12.5 litres of fuel and so it costs 75 Birr to be filled.

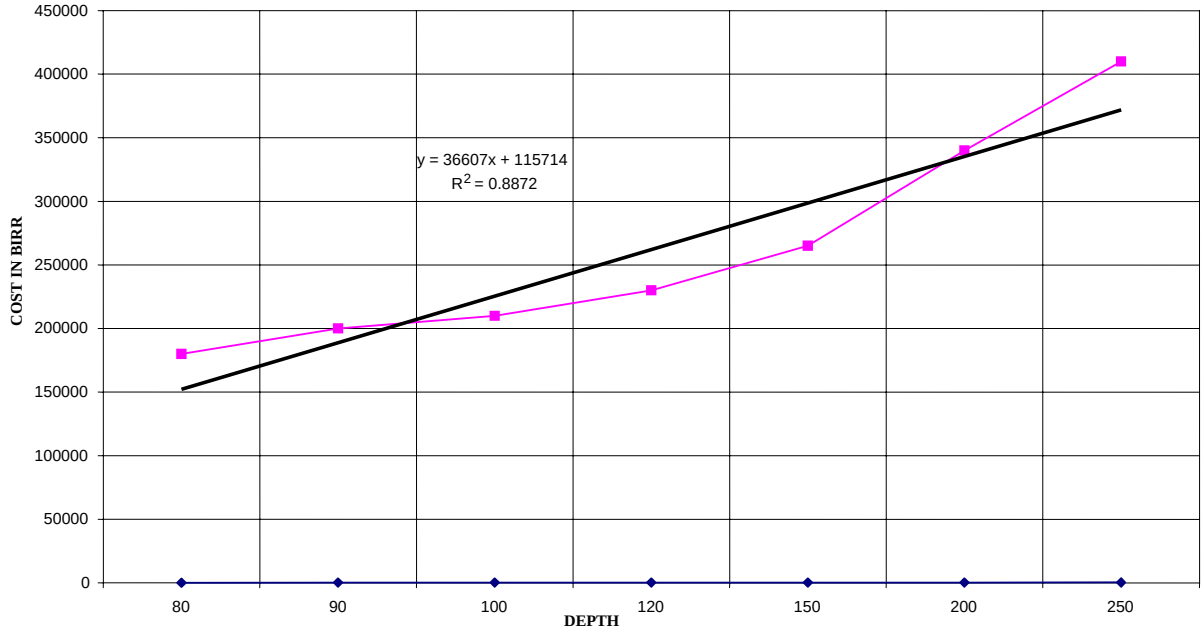
If all the collected water is paid for, the total fee paid for the 2 reservoirs is 250 Birr (50000/20 * 0.10 Birr). So 115 Birr can be saved for maintenance at each turn (when filling three times a week 345 Birr can be saved).

According to the account book Edo and Ajo collected 257.65 Birr over the month of December 2004. Comparing these figures with the collected fees it seems that not all the pumped water is paid for. A reason might be the occurrence of water losses in the system so that less water is reaching the taps then is pumped up. But more likely is that not all the water collected at the taps is paid for. It is evident that the accounting mechanism is not transparent enough. With an improved accounting mechanism the cost recovery might be higher.

According to the Water Committee in Ajo per month 10 jerry cans of fuel are used to fill the reservoirs. These 200 litres of diesel can be used to fill the reservoirs eight times per month (200/22.5) or twice a week, which gives a volume of water of 100 m^3 per week. In case fuel shortage only reservoir Ajo gets filled. This reservoir can be filled 20 times per month (200/10) or 5 times a week and give a total volume of 125 m^3 per week. It is more economic to fill only the reservoir of Ajo as this cost less fuel then filling the reservoir of Edo and Edo Bolo.

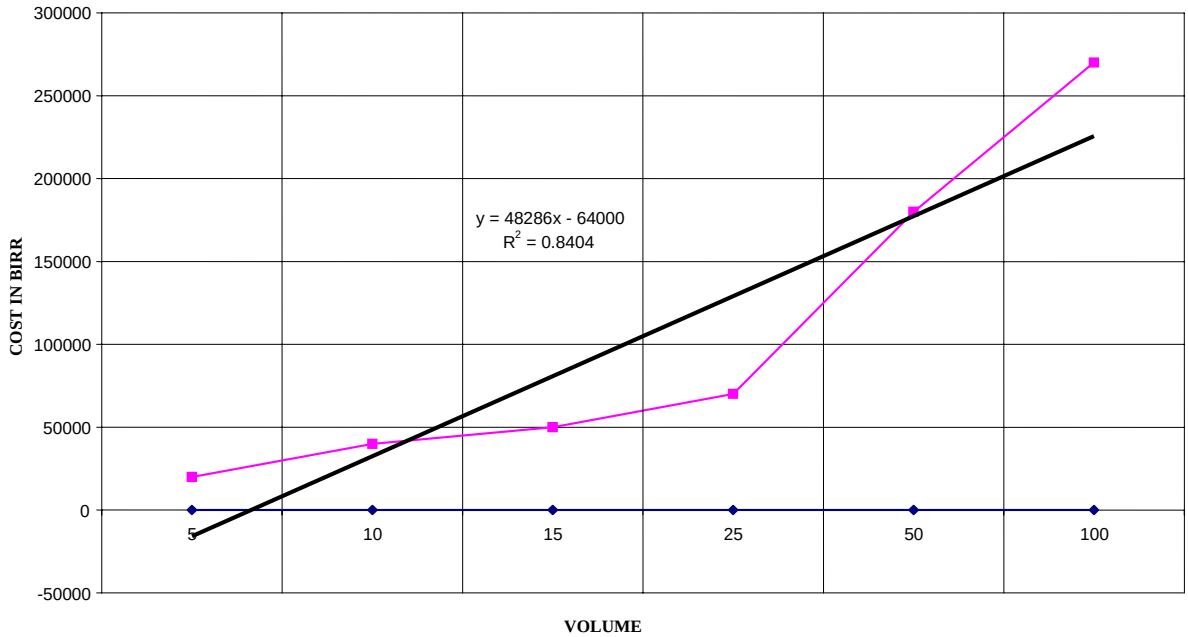
According to fee collector Ajo tap: about 70 people collect water (1 to 3 j.c) per day and she collects about 7 to 10 Birr a day, which gives 210 to 300 Birr a month which corresponds with the registered money over the month of December 2004.

COST OF CONSTRUCTION OF DEEP BOREHOLE

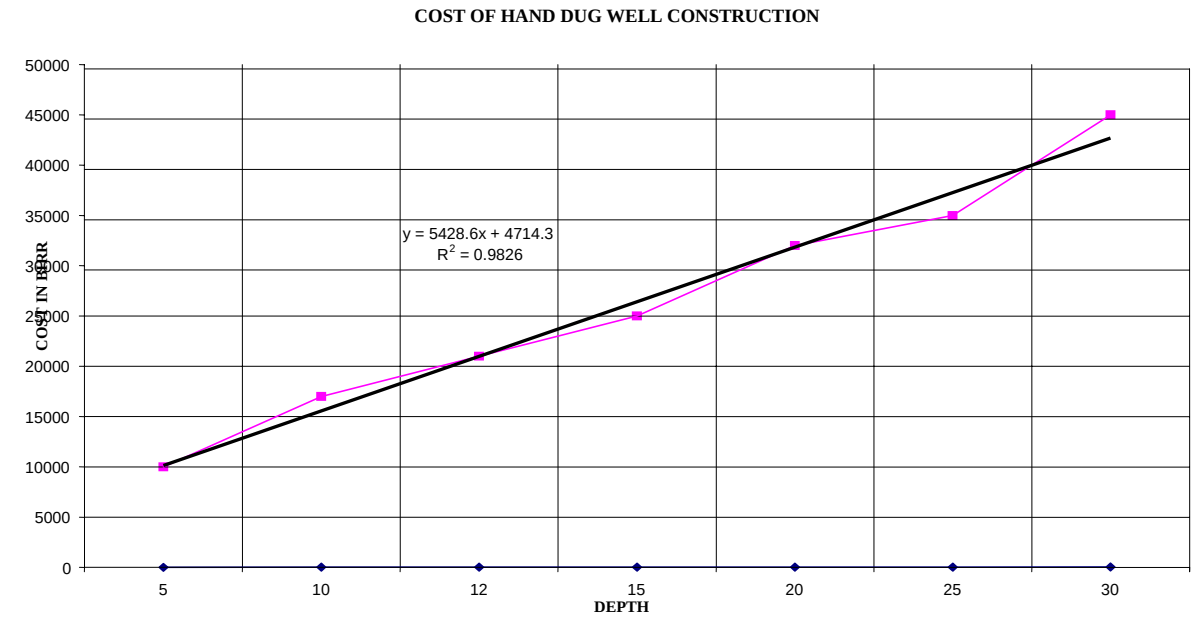


Source: WWD&SE, 2003f

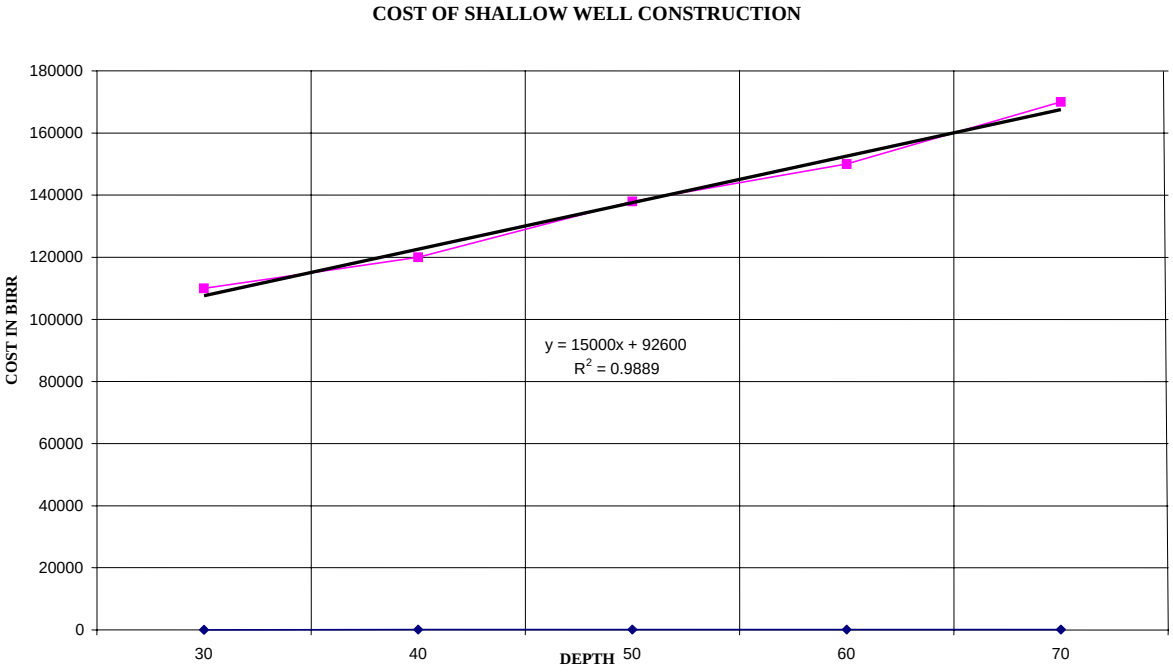
COST OF CONCERET RESERVIORS



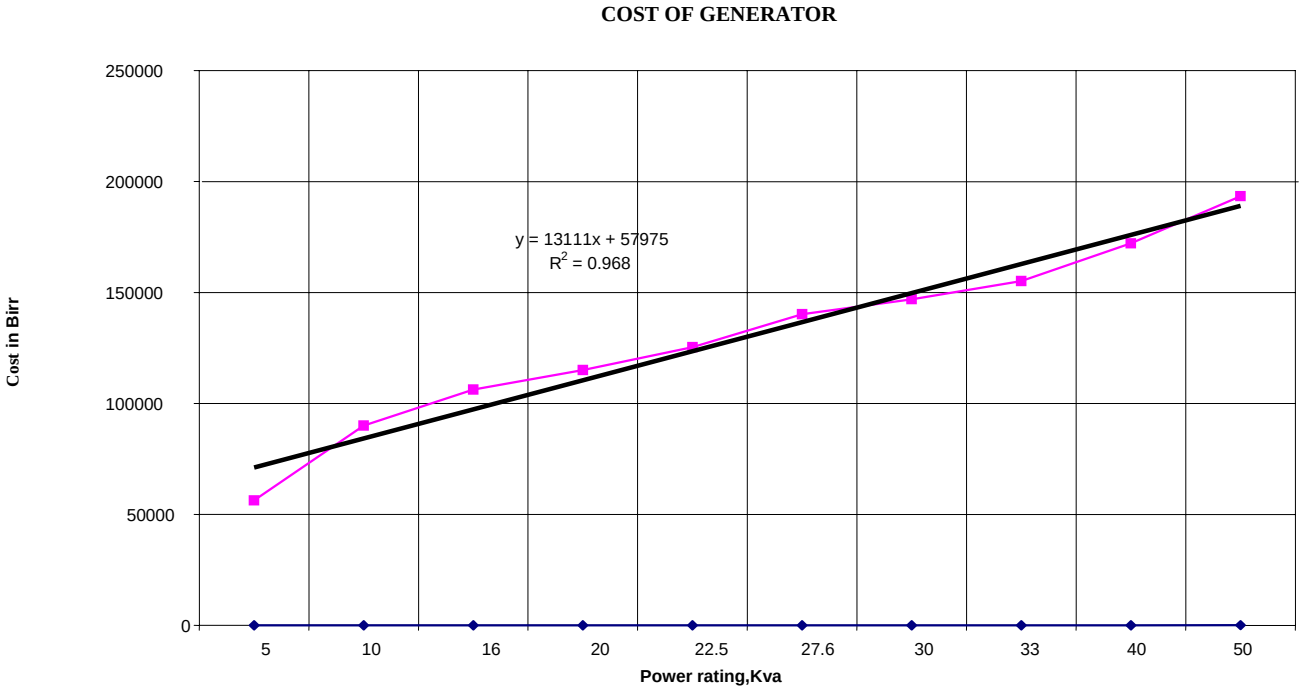
Source: WWD&SE, 2003f



Source: WWD&SE, 2003f



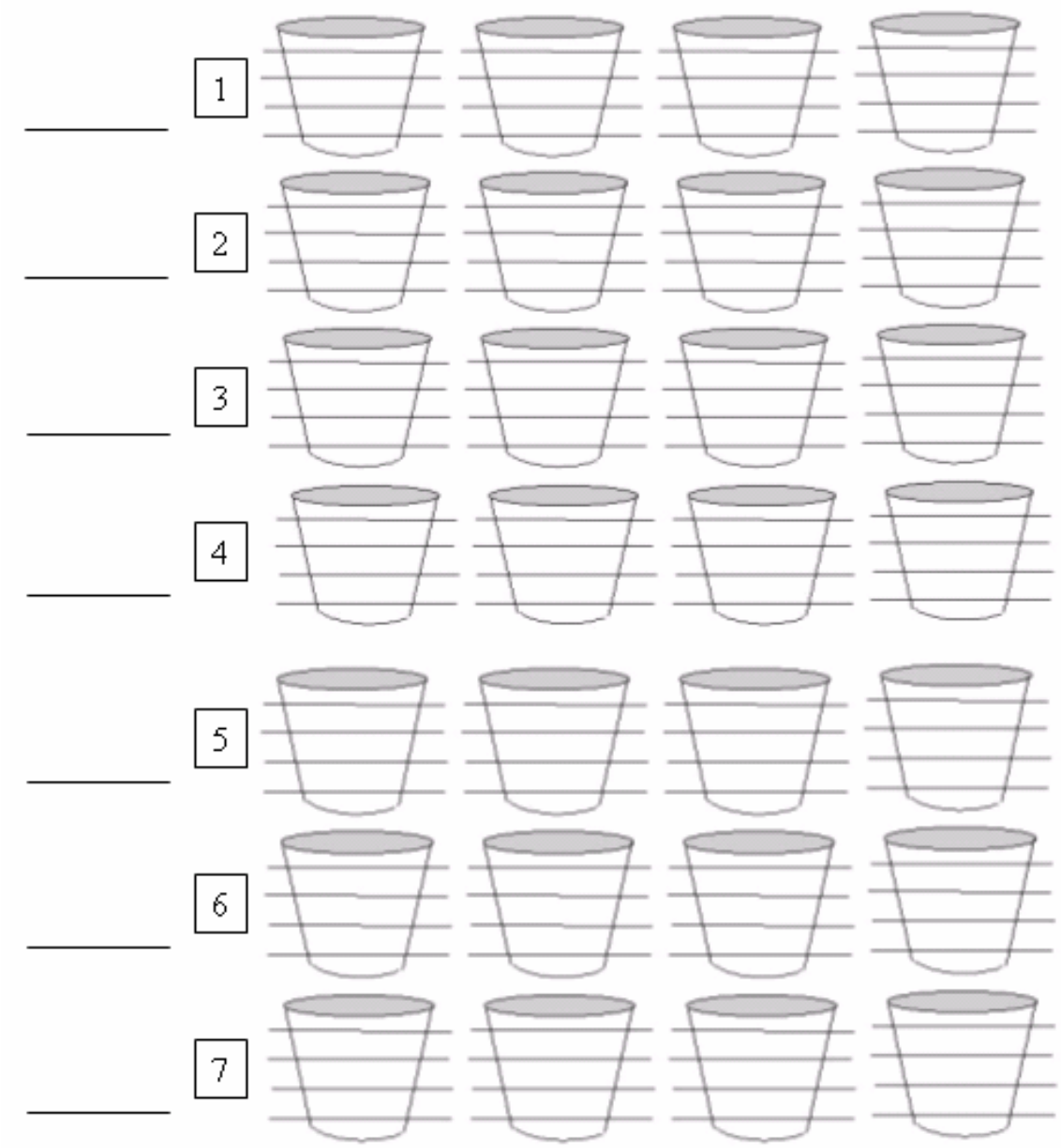
Source: WWD&SE, 2003f



Source: WWD&SE, 2003f

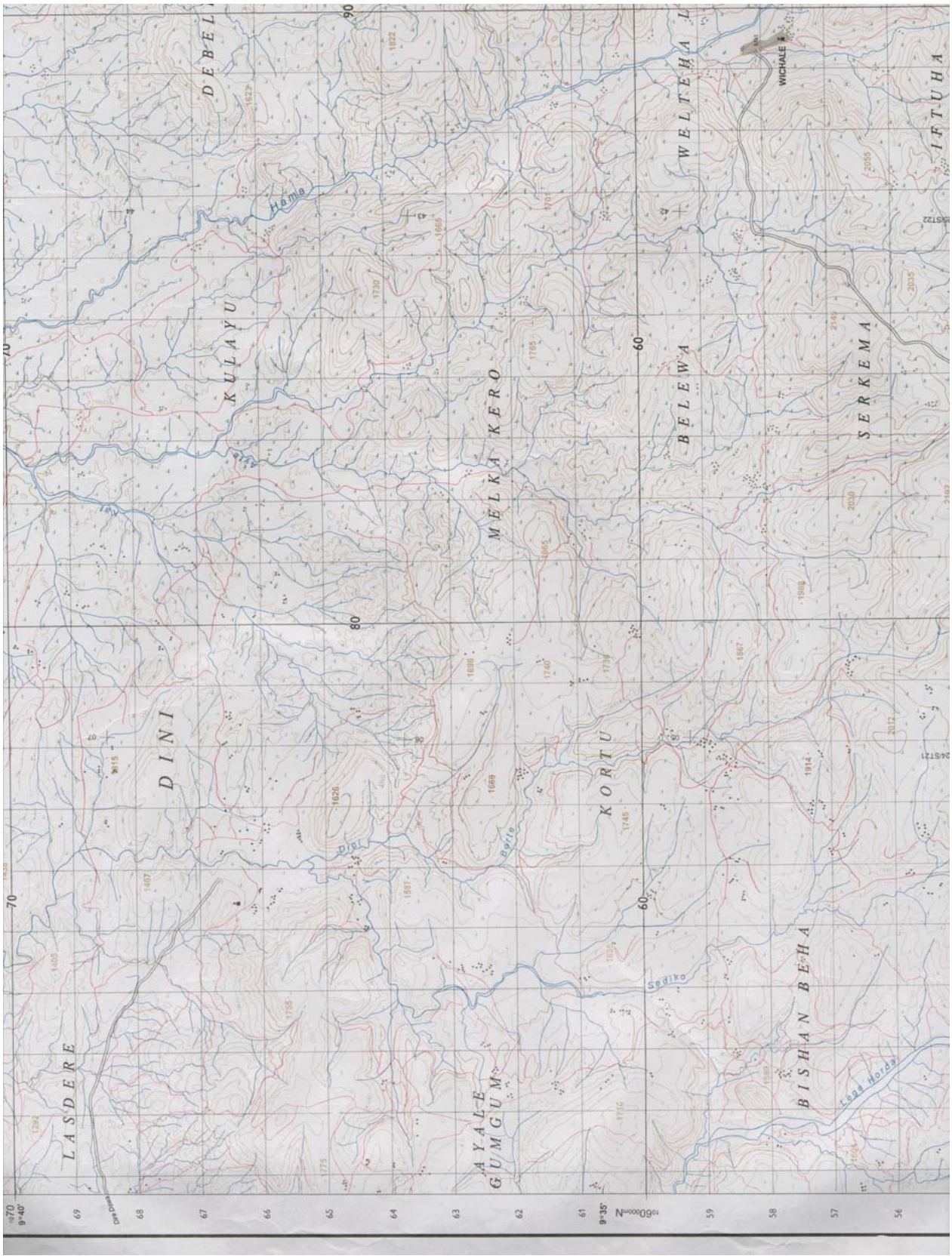
Appendix XI: Household water use

Have the water users measure the water they use or throw away for 30 days, by providing them with buckets marked with lines at 1/4, 1/2, 3/4 and full. Let them measure the amounts per day. For each day they will shade in the number of buckets that they threw out. The data sheets have to encompass all 30 days.



Source: Amy Collick by e-mail contact January 2005

Appendix XII: Map Legedini and surrounding PA's



Scale: raster 1 kilometre by 1 kilometre