25th WEDC Conference Addis Ababa, Ethiopia, 1999

INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION

Rainwater harvesting in Ethiopia: an overview

Getachew Alem, Ethiopia

RAINWATER HARVESTING TECHNIQUE broadly includes roof water harvesting, run-off harvesting, flood water harvesting and subsurface water harvesting (Finkel and Segerros, 1995). In large part of the world, runoff water harvesting is best known and practiced in the semi arid areas where annual rainfall is in the range between 400 and 600 mm. The runoff irrigation facilities in the Negev Desert were built during the Israeli Babataean and Roman -Byzantine periods back in the 1,300-2,900 years (Evaenari et.al. 1971 in run-off irrigation by Tauer and Humborg, 1992), and this practice provided a livelihood for a considerable population of more than 2000 years ago and continuing until about 700 AD (in rain water harvesting by Pacey and Cullis, 1986).

The history of water harvesting in Ethiopia dated back as early as the pre Axumit period (560 BC). It was a time when rainwater was harvested and stored in ponds for agricultural and water supply purposes. Anthropologists (Fattovich, 1990) have documented evidences of the remains of ponds that were once used for irrigation during this period. A roof water harvesting set up is still visible in the remains of one of the oldest palaces in Axum; the palace of the legendary Queen of Sheba. Other evidences include the remains for one of the old castles in Gondar, constructed in the 15-16th century, which used to have a water harvesting set up and a pool that was used for religious rituals by the kings. In south of the country, the Konso people have had a long and well established tradition of building level terraces to harvest rain water to produce sorghum successfully under extremely harsh environment; low, erratic and unreliable rainfall conditions. It is in deed one of the wonders of this country,and it has been practiced for millennium; a symbol of struggle for survival by the Konso people against the adversaries of nature.

Brief description of the natural resources

Ethiopia is located in the tropics between 3^0 and 14^0 N. Latitude, and 33^0 and 48^0 E Longitude. The total land area is estimated at 109.3 million Ha, and it is endowed with abundant water and land resources, and experiences a wide range of altitudinal and climatic variation; from an area below sea level to a highland of over 4,400 masl, and from a desert to moist rainforest. The wide range of diversity in the agroecology enables the country to produce many kinds of crops and livestock. However, the country also experiences the most difficult terrain for infrastructure development; road construction, water supply systems, etc.

The Annual rainfall ranges between 400 and 1300 mm (table 1). Hararghe and Tigrai experiences high variations in the rainfall, and they are drought prone regions. The seasonal rainfall is influenced by the movement of the Inter Tropical Convergence Zone (ITCZ) which influences the location of the low and high pressure fronts and the air (wind) movement in the tropics. Moreover, the rainfall is strongly correlated with altitudinal variations.

Ethiopia's agriculture is predominantly rainfed with a potential of nearly 3.5 million ha of land suitable for irrigated agriculture. The population has grown dramatically over the last three decades, increasing from 25 million in the 1960s to nearly 60 million in 1998 leaving a pressure on the agricultural land, forests and the environment at large. Coupled with this and as a result of localized and global climatic anomalies, Ethiopia experiences pervasive land, water and environmental degradation which leaves the country to recurrent crop failures and sever food shortages which at times upsets the political and economic setting of the country.

Paradoxically, Ethiopia is very well known for its enormous water resources potential. It is still known as the water tower of Africa, the source of the Blue Nile and many transboundary rivers. Indeed there are very many rivers with high annual flow rates, and most of the runoff harvested leave the country through these transboundary rivers. The major river basins with high run-offs include Blue Nile (48. per cent), Omo-Gibe (16 per cent), Baro - Akobo (11 per cent), Genalle-Dawa (5 per cent) and Awash

Table 1. Long-term average rainfall

Provinces	Long-term (mm)	%	CV	Rainfall of worst year yr.	% of avg.
Arsi	872	96	16	1980	69
Bale	766	84	26	1965	69
G.Gofa	747	82	21	1963	48
Gojam	1170	128	10	1983	82
Gondar	986	108	19	1966	78
Hararghe	477	54	27	1984	49
Illubabor	1304	143	13	1965	67
Kefa	1322	145	11	1980	81
Shewa	830	91	11	1965	77
Sidamo	837	92	24	1980	51
Tigray	571	62	29	1984	44
Wellega	1210	132	20	1970	48
Wello	837	92	24	1980	51
Ethiopia	913	100	7	1984	78

Source: An economic overview, World Bank, Nov.1996, Addis Ababa, Ethiopia

(4 per cent). The total annual runoff is estimated at 110 Billion m^3, and only less than 5 per cent is used in the country, the remaining leave the country as transboundary rivers such as Blue Nile, Baro Akobo, Wabi Shebele, Tekeze, etc.

Interms of the use of its water resources for water supply and agricultural purposes, only 0.2 Million Ha of land is currently under irrigation and approximately 25 per cent of the people have access to potable water of some kind. The present water requirement for irrigation (to produce a one season crop) will require approximately less than 3 per cent of the total runoff. In hypothetical terms, the present population and the water resources potential of the country matches at approximately 5 m^3 per person per day, and this is a very high figure compared to the 20 liters per capita water consumption rate which is only available to less than 25 per cent of the population. This clearly indicates the availability of untapped and abundant water resources in the country.

To harness these resources, there is a big task ahead and a real challenge with a lot of opportunities. The effective utilization of these resources require a lot of capital inputs, trained manpower, the development of infrastructure (road, energy power, etc.) and enabling policy environment.

Rainwater harvesting practices

Rainwater Harvesting is when the precipitation is collected from a small/large surface area (catchment) and directed through channels to a storage facility or to a near by field or retained at the site itself (in-situ). The rain-water-harvesting techniques most commonly practiced in Ethiopia to day are run-off irrigation (run-off Farming), flood spreading (spate irrigation), in-situ water harvesting (ridges, micro basins, etc.) and roof water harvesting. These techniques, though dates back in the antiquity, their importance has not been recognized until very recently, it was following the devastating drought and famine of the 1980s.

Run - off farming

Run-off irrigation is widely used in Hararghe for the production of major crops in the area; sorghum, and chat (Chat edulis). The technique is based on the use of runoff produced from the adjacent upland farms, and made to be diverted for use back in the farm at a lower elevation. This technique is well adapted for crop production in the highlands of Hararghe with altitudes in the range between 1700 and 2500 masl. In these areas, crop productivity has been significantly increasing, and production is getting stabilized even at bad seasons. Every bit of runoff from the farm is harvested and it is used for irrigation, and it is now becoming a common practice in Alemaya District. During the early part of the season, one or two run-off irrigation improves the establishment of the crop stand and the last season runoff (again three or four irrigation) will bring the crop to full maturity. The practice is now a days increasingly becoming a reliable technique for stable crop production even under highly erratic and unreliable conditions.

The technique is quite simple and it is done manually. While spreading the run-off in the farm, it is relatively labour intensive, in order to avoid soil erosion and damage to the land. In Alemaya District, East Hararghe, farm run-off are also collected in small embanked gullies, and the ponded water is used for irrigating valuable (perennial) crops such as chat (Chat cadulis), coffee and fruit trees.

Directing runoff water into plots where crops are raised, thereby making a productive agriculture possible in otherwise unpromising semi arid environment is increasingly becoming important for many farmers in Eastern Hararghe. Crop productivity through harvesting, conserving and using the water for crop production is an integral part of the farming system.

Flood spreading (spate irrigation)

This technique is similar to the one described above, run-off farming, both employs rainwater without temporary water storage facility. However, it is different in the source of water and size of the stream, and the environment (terrain, climate) under which it is practiced. The runoff from the highlands are appearing as flash flood at the lowland downstream where the rainfall is low, unevenly distributed and most often inadequate for crop production. The flash flood, as it appears along the river bank, is diverted using temporary structures to small individual farm lands located along the river banks, and the diverted water is spread into the field as supplementary irrigation. The flood, depending upon the rainfall situation in the upland areas, stays in the river bed generally not more than two hours. Two to three irrigation at early and late part of the season will bring the crop to full maturity, and crop yields are dramatically increased relative to the traditional practice where crops most often fail.

There are seasonal rivers/streams that originates in the highlands of Eastern Hararghe, and ends up in the lowland areas in Dire Dawa Zuria. Many farmers along these river banks are practicing flash flood spreading for crop production. With Food for Work (FFW) assistance and technical support received from the Hararghe Catholic Church in Dire Dawa, farmers were able to establish simple diversions (using wooden trash and soil material) and canals to convey the flood water into their farms. In 1998, one farmer, in Legeoda Merga Peasant Association, was able to raise his sorghum yield from 3 to 8 quintal (1 quintal = 100 kgms) in 1.2 Ha. land. Another farmer got a bumper harvest using the same technique, yield increase from 8 quintals to 20 quintals of sorghum again from approximately the same size of holding. The low yield in the former was due to the use of local variety (red sorghum, Jieldi).

The Church is promoting this technique through assigning technicians who provides support in land preparation and canal design, and the use of FFW to employ the additional manpower required for the development of structures particularly during the first year. Now, requests to the Church for assistance is increasing, and more and more farmers are practicing this technique. The impor-

tance of this technique is being very well recognized and it is spreading at an encouraging pace.

Water harvesting ponds

Traditional ponds have been used in Ethiopia for millennium, some estimates it as early as 560 BC (Fattovich, 1990). They are used to harvest rainwater for both human and livestock watering in most rural areas, particularly in the arid and semi arid areas where annual rainfall is less than 600 mm. Ponds are simple to construct and it can be managed by the community. Approximately 15 to 20 per cent of the people and over 80 of the livestock in Ethiopia uses water from either rivers/streams and ponds.

There are an estimated over 2000 traditional ponds in Ethiopia (quite a small number compared to over 2 million ponds in the United States). They are used primarily for domestic water supply and livestock watering. The size of the ponds range from 650 M^3 to several thousands, and they serve for 3 to 6 months only. In Dalocha alone, Silte District, Gurage Zone, about 150 traditional ponds are used for human and livestock watering. The most common type of pond is the excavated type. The distribution of these ponds generally is in the arid and semi arid areas where the Sahilian climatic condition prevails. Traditional ponds are major sources of water in the rift valley where ground water is deep and other sources of water are not feasible.

These days, the use and promotion of ponds even for livestock watering is increasingly becoming difficult and challenging by the spread of deadly child-hood malaria, and for this reason most NGOs are unable to promote and support pond construction due to environmental constraints.

Roof water harvesting

Large scale and modern water supply schemes in rural Ethiopia remains a challenge owing to the unique and rugged terrain, and the scattered settlement pattern of the rural people. One technique that appeals today that can be of significant importance in the development of the subsector is roof water harvesting at household level. This technique is so important in the rural areas [in the highlands] where the terrain is rugged, and the villages and hamlets are scattered. In such areas it is difficult to think that communities can be served by a centralized water supply schemes, at least it is expensive. Other sources require long walk and time for women and children to fetch water.

The roof water harvesting in Ethiopia has the advantage of being low cost, relatively simple in design (household technology), less laborious and it saves time. It provides adequate water during the rainy season, a period when the rural people are busy with the farm activities and when there is shortage of labour. They are more appropriate in areas where there are no rivers, ground water sources around, and where rainwater is the only feasible means of providing a water supply. The quality of water is also reported as good compared to other water sources in the rural areas.

The emergence of this technique these days is due to the increasing shortage of water from the conventional sources, shallow wells, perennial springs, rivers/streams

In earlier times, roof water harvesting practices were confined to urban areas only. However, its use in the rural areas are increasingly becoming important these days as more people in the rural areas are having corrugated roof houses. This is particularly evident in Hararghe case where projects are being initiated. The cost at household level for 2 to 3 m^3 capacity set up will cost in the range between US $ 75 and 88. For example a 15 m^3 capacity circular ferrocement tank with its accessories costs approximately US$ 1500.

Water conservation for agriculture

Today quite a significant portion of the cultivated land are protected against soil erosion by soil bunds (a structure of approximately 30 cm height). The major conservation structures commonly practiced in Ethiopia include soil bund, stone bund, fana yaju and grass strips. They are constructed in contour or graded depending on the rainfall of the area. For high runoff areas graded structures are used. These structure are not only reducing soil erosion but also conserve water in situ. Constructing level terraces is a well established traditional practice in Konso. Other traditional water conservation methods in cultivated lands include open and tide ridges practiced in Hararghe, Wollo and Tigrai. Micro basins are also used for growing tree plants. In North Shewa, runoff from farm lands are stored down streams in large pits for later use, for irrigating tree plants using watering cans.

Institutions involved in the promotion of rainwater harvesting

NGOs are the ones in the forefront in the promotion and development and use of small scale rainwater harvesting schemes for both household and agricultural uses. It is a strategy towards enhancing household food security, a national strategy drawn by the government over its Five Year Development Plan (1996-2001). Several international and indigenous NGOs are implementing rainwater harvesting in Eastern Hararghe, East Shewa, Tigrai, Wolo and Gondar

The government has established commissions in four regions; Tigrai, Amhara, Oromia and Southern Nations and Nationalities People's Regional states. Commission for Sustainable Agricultural and Environmental Rehabilitation (COSAER) is mandated to promote, develop and manage the regional land and water resources sustainable for agricultural uses. The government through its Regional states is also engaged in large scale water harvesting scheme as part of this plan. Over the five year plan, there was a plan to construct approximately 500 micro dams each in Tigray and Amhara Regional States. In 1997/98 alone, the Amhara

Regional State was able to achieve only 3 earth dams, and six diversion structures in Wollo and Gondar zones only (From CO-SAERAR leaflet published in 1998, Bahir Dar). The two regions are now recognizing that these are ambitious plans, and they are considering for revision. However, the plans clearly indicates the seriousness and commitment on the side of government to under take every available means to develop water resources to improve the food security situation in the regions.

The Government plans are water harvesting from large size (macro) catchments and it is quite different from that of the NGO projects which are small scale [micro] in size. The later objective is on the development of small scale [farmers] water harvesting projects both for crop production and household water supply purposes.

The Ministry of Agriculture through its extension program was also promoting water conservation activities particularly in moisture stress areas. In the 1980s, it was supporting limited roof water harvesting projects financed by IFAD.

With regard to the institutions capacity building, recently there were two workshops held to promote rainwater harvesting techniques and enhance its use widely in the rural areas. The workshop was supported by SIDA (East African Regional Bureau) in cooperation with Water Action, an indigenous NGO. Following these workshops, a rainwater harvesting committee was established, and efforts are being made to strengthen and upgrade the committee to a level of Association, Ethiopian Rainwater Harvesting Association.

Recommended strategies for development

Population growth in Ethiopia and shortage of resources demanded the people to intensive forms of development, and rain water harvesting for both domestic water supply and for agricultural purposes is increasingly becoming important. The following strategies are recommended for sustainable use of rainwater harvesting:

- Focus on small scale rain water harvesting schemes that are now being promoted by NGOs.
- Multisectoral approach to the conservation, use and management of rain water.
- Involve the grass root in local decision making, planning and management and use of the resources.
- Promote run-off farming for a sustainable household food security.
- There are rich ideginous knowledge in different parts of the country and they should be researched and documented.
- Create adequate interest among policy makers, planners and water project mangers.

References

FATTOVICH, RODOLFO, 1990. *Remarks on the Pre-Axumite Period in Northern Ethiopia*. Journal of Ethiopian Studies. Vol. 23: 1-33.

FINKLE AND MICHAEL SERGERROS, 1995. *Water Harvesting. Proceedings of the SADC ELMS practical Workshop held in Windhock and Okakarara*, Namibia, 10-28 May, 1993. Report series No. 33.

PACEY, ARNOLD AND ADRIAN CULLIS, 1986. *Rainwater Harvesting. Intermediate Technology Publications*, London.

RAUER, W. AND G. HUMBORG, 1992. *Run-off Irrigation in the Sahil Zone*. Remot sensing and geographical information systems for determining potential sites.

WORLD BANK, 1996. *An economic overview. Submitted for World Bank Consultative Group*. Addis Ababa, Ethiopia.

GETACHEW ALEM, Ethiopia.