Paper title: Concepts of Rainwater Harvesting and its Role in Food Security – the Ethiopian Experience

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Abstract
To insure food availability water centred development is a key strategy. According to the Food Security Strategy Document of the country in the coming 3 – 5 years 5 million people would be made to be food-secured and an additional 10 million people improve their food security status. For crop production RWH has two purposes: first to raise horticultural seedlings during the dry period and carry it to rains when they set in, second to provide water as supplementary irrigation whenever there is a shortfall in wet seasons, especially to the time of maturity.

Achievement reports of one year reveal that over 60,000 structures (hand dug wells, household and community ponds, cisterns, springs) constructed and 31, 386 ha of traditional irrigation is supported. In total over 93,000ha of land is irrigated by 732,336 households with a total of 3.7million people would benefit. RWH course with developed curriculum is being given in 25 Agricultural TVET colleges reaching 37,582 students.

On implementation a number of problems have been encountered. These, among others include seepage and evaporation losses not effectively controlled, unavailability of adequate lifting and drip systems, less attention given to soil storage techniques, poor maintenance of the previous schemes and limited technical capacity at the grass root levels. In conclusion, for insuring food security, effective seepage and evaporation control techniques should be researched and RWH that targets crop production (cereal) should also be given importance by focusing on soil storage aspects.

Introduction

Dry lands comprise about 67.7% of the total landmass, 45% of the total arable land and over 20million of the population. In the rural areas 76% do not have access to clean and safe drinking water consequently 47% children under the age of 5 die because of diarrhoea. Women or children travel, on the average, 20 km per day (average 5 km travelled to the source twice) to fetch their daily water requirement. Livestock spend 50-75% of their time looking for water reducing their grazing time leading to poor productivity. In these areas, high variability of rainfall, environmental degradation, drought, famine, and population pressure are common phenomenon. Seasonal or permanent streams are far away from the reach of poor farmers. Ground water is either deep or not available at all. The phenomenon, in 2002/2003 has left 14 million people victims of drought and famine. On the other hand the country is known as the Water-tower of North-Eastern Africa for its source of 12 big River Basins including the Blue Nile. Chronic food insecurity problem remained to be a paradox. The country is currently economically unable to optimally utilise its large rivers for different development purposes in line with national/regional/local interest. The only water resource available is rainfall as a local source and this is why RWH is extremely necessary.

Methodology

For many years in the country policy on rainwater is either lightly mentioned, or not there at all. There are no adequate guidelines or code of practices on Rainwater Harvesting (RWH) - both in rural and urban, conveyance mechanisms and construction standards for structural/soil storage facilities and non-inclusion of RWH to the institutional curricula.

Under the umbrella policy of the Agriculture development led industrialization (ADLI) there is Rural Development Policy and Strategy Document (RDPSD, 2002) and in this document it is clearly stated that the main problem in the so called dry, moisture-deficit or drought stricken areas **is not as such shortage of rainfall but rather utilization of available rainfall**.

The country is found in three broad agro-climates (namely: Wet, Dry and Pastoral). The strategy for the wet is use of high input, market oriented and production of high value crops for export; the strategy for the Dry is Sustainable Development and Poverty Reduction Program (SDPRP); and that of Pastoral is livestock marketing and insuring water availability. For livestock, construction of small storage structures (reservoirs) to reduce the walking distance to 5km radius will optimise feeding time and hence their productivity.

Rainwater harvesting is strongly linked to the later two strategies. More than 214 Districts of the country are said to be food insecure. Also, according to agriculture sector review undertaken in Ethiopia to tackle the problem of food insecurity and rural livelihoods it is recommended that investment need to be made on rainwater harvesting. To insure food availability water centred development is required. According to the Food Security Strategy Document (FSSD, 2002) of the country in the coming 3 – 5 years 5 million people would be made to be food-secured and an additional 10 million people improve their food security status. For this water-centred development is the key strategy. RWH both as soil and structural storages, small scale irrigation, subwatershed development/management and soil conservation activities are targeted. On average to produce one kilogram of marketable crop (grain) 1000 - 3000 litre of water is required (Isaya, V.S., 2001). Of course, rainwater harvesting should be promoted where irrigation is not a viable option. For backyard production rainwater harvesting has two purposes:

- To raise vegetable as well as fruit seedlings during the dry period and carry it to rains when they set in.
- To provide water as supplementary irrigation whenever there is a shortfall in wet seasons, especially to the time of maturity. There is also a growing need that water harvesting is promoted for the purpose of recharging the ground water.

Based on this the MoARD and Regional Agricultural Bureaux,

- Acquired different technologies within the country and abroad (China, Kenya, Yemen, Israel, India, Sudan, etc.), which was carried out before two years.
- Household based rainwater harvesting systems are more favoured because they are said to be divisible in the use of water for human, livestock drinking and backyard high value horticultural crops.
- Piloted technologies and prepared technological packages (Rainwater Harvesting Extension Packages Ministry of Agriculture, 2002).
- Provided practical training to ToT at various levels
- Prepared RWH courses (RWH Technology I, II, and III) and started giving to the 25 agricultural TVET colleges
- Carried out monitoring and evaluation of implemented packages

Achievements

A detailed achievement by type of technologies (aggregate figure of main four regions) is given on table 1 below. Double of this is planned this physical year (2004/05).

Table 1: Summary of achievements of four regions in 2003/2004 physical year [1]

N°	Type of technologies	Achievements	Beneficiary Households	Estimated area of land
1	Shallow wells (hand dug wells) construction	308,338	308,338	18,500
2	Shallow wells improvement	850	850	51
3	HH trapezoidal surface ponds	205,787	205,787	6,173.61
4	Cisterns/tanks	5,632	5,632	168.96
5	Cisterns improvement	877	877	26.31
6	Community ponds	49,311	-	-
7	Spring development	32,727	-	-
8	River diversion in ha[2]	37,020	148,080	37,020
9	Runoff diversion in ha	31,386	62,772	31,386
Total			**732,336**	**93,326**

A RWH working title has been created at all levels – districts and regions and qualified professionals assigned. Most of them are from Arbaminch Water Technology Institute. Some regions have established and others are on the process of establishing plastic welding centers for lining surface ponds. RWH curriculum is also under improvement.

In Amhara region (North western part of the country) from the total completed water harvesting structures, reaching 242,000 in number, over 42,000 have started production. And as a result 21,194 ha of land is under irrigation and 148, 244 farm households are benefiting. Of these 14% (21,194) are women headed households. Irrigated area in the region is primarily aggregated from shallow well, river diversion and spring development.

Total irrigated land in Oromiya (central eastern and western part of the country) is 65,508ha, when the plan was 68,565ha (95.5% achievement). By this 343,953 (92%) households have become beneficiaries. Again 379 hectares traditional irrigation through river diversion is under establishment on top of 31,311ha that already exists. Of the total planned 216,290 pond 75% is in food insecure Districts and the remaining 25% is in non-food insecure Districts. The stored water apart from drinking and crop production farmers have used it by selling, making mud for house construction, making soil blocks and raising seedlings at the nursery.

So far within the country 732,336 schemes reaching 93,236 households means 3.7 million people will benefit assuming 5 members per household. Therefore, this is believed to contribute to household food security. Along with the storage facilities low cost water lifting and family drip equipments/systems have been and are being promoted. This includes treadle pumps, watering cans, family drip kits and tie-ridgers. However, the amount required with respect to the number of schemes is far below the requirement. Hand lifting and watering using cans to the root of each plant is time and labor consuming to many farmers.

[1] **Assumptions taken in the production of the above table:**

i. The size of the pond is on average 143 meter cube and will provide supplemental irrigation to 300 meter square of crop land.
ii. Hand dug well it is assumed that 300 meter square area can be fully irrigated two times in a year, hence 600 meter square.
iii. Traditional irrigation is that on average 0.25ha per household is assumed (i.e. 1ha per 4 households)
iv. Flood diversion is that on average 0.5ha would benefit one household (i.e. 1ha per 2 households)

Procurement, welding and distribution of geomembrane plastic for surface pond lining is also another major activity being carried out. The involvement of private entrepreneurs in the production as well as distribution of the above items is seen growing from time to time.

There are a lot of technologies under development and testing. For example use of bamboo for rope and washer pumps substituting PVC pipes (Amaro District from Southern part of the country), use of micro-tube drip systems with local filter material by Arbaminch Water Technology Institute, among others could be mentioned. Also there are prototypes of collapsible bladder tanks acquired for testing. These will have great contribution to the promotion of RWH, thus alleviation of household food security.

As it is presented on table 1 above, except dry river diversion that includes runoff spreading activities aspects of soil storages have not been adequately addressed. Up to now on the on-going promotion of rainwater harvesting there are more tendencies that structural storages (deep ponding) seems to have been over emphasized while that of soil storage aspect and watershed development is less treated. Soil storage aspects of rain/runoff harvesting known in other parts of the world (Hai, M. T., 1998) are very limited in terms of their application. They are being experimented by the research and at the same time demonstrated to students at the TVET colleges. Soil storage has more advantage as it does not require lifting and water application to the root of each plant. It also contributes to the recharge of the ground water (Oweis, T., Prinz, D., and Hachum, A., 2001, William, C., Chris, and Alain, S., 1992). By deep ponding we can not address other crops such as cereal grains, which are more needed by the farmers for their food security. Soil storage has more traditional base and lower cost so that its adoption rate can be faster compared to deep ponding. Therefore, more emphasis needs to be given in the future.

Based on local biophysical and socio-economic situations, when the approach of implementation is reviewed across regions in the type of technology selected and modality of implementation there is a variation. For example there are more tendencies on surface ponds (that includes effort of plastic lining) in Oromiya and Tigri regions than other regions. Likely, there are more shallow wells and cisterns considered in Amhara and SNNP than other regions.

The Ministry of Agriculture and Rural Development (MoARD) is presently running 25 Agricultural Technical Vocational Education and Training (TVET) colleges situated in different parts of the country. The major role of the TVET colleges is to train 10^{th} grade complete school leavers in agriculture i.e. rainwater harvesting, soil conservation, crop sciences, animal sciences, among others. Rainwater harvesting is one of the main courses that is being given in these centres together with many other agricultural courses. The training is given both on theoretical and practical techniques including field study visits and practical exercising as well as by incorporating successful experiences in other parts of the country and abroad. In total there are 37,582 students attending the course.

At the end the trainees would have sufficient knowledge and be qualified to adopt the innovative techniques in their respective places of assignment in the rural areas. There have been efforts made to prepare curriculum on rainwater harvesting however, with some loose ends and gaps. As water harvesting is a developing science the curriculum is progressively under improvement and further development.

Water harvesting in soil or structural storage for productive uses can cover a wide range of different levels extending from individual household storage system to diversion and/or making dams on seasonal or permanent flows for small and medium scale irrigation. Nevertheless, at this juncture, the MoARD is primarily concerned with rainwater/runoff

harvesting in small and local storage structures for individual households or small groups of households.

Constraints encountered

With some variation among regions, soil storage and watershed treatment aspects of RWH are missing primarily due to capacity reasons. Hand lifting and watering by cans is time and labor consuming resulting in wastage of stored water. High seepage and evaporation losses (estimate of 24 and 6liters/day.m^2, respectively), high sediment in the ponds, loosing productive land to surface ponds, cost versus benefit for cisterns being of excessive payback period, technical capacity limitation at the grass-root level during implementation and insufficient extension follow up on already established schemes, concern on malaria and inadequate local market in view of the targeted high value horticultural crops are to be mentioned.

Conclusion

In the current practice both by Regions and Federal level it is felt that the emphasis given to soil storage aspect of rainwater harvesting that is runoff farming is little if not nil. Therefore; RWH that targets crop production (cereal) should also be given importance by focusing on soil storage aspects of RWH. A pond though has a role as one contributor to food security at HH level it must not however, be seen in isolation. Aspects of catchment/watershed treatment, seepage and evaporation control, soil and water conservation, conservation tillage, and integration of low cost lifting techniques and family drip systems, among others are required. Maintenance of previous schemes should be planned and targeted. Maintenance crew should be trained and assist farmers .There should be a follow up on already established schemes.

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