Rainwater Harvesting In Ethiopia: Capturing Realities and Harnessing Opportunities

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Abstract

In a bid to curb the threat of recurring crop failure, food insecurity, and drought quandaries, the government of Ethiopia has rapidly expanded on-farm based rainwater harvesting (RWH) interventions. Undoubtedly, the scheme has proffered numerous advantages to its beneficiaries, but it was not without setbacks. This study has attempted to appraise the recently launched RWH activities and analyze its performance in the light of key environmental and socioeconomic dimensions. Data were drawn from sample households in the Amhara and Oromia Regional States. A total of 300 households, drawn from 12 rural *kebeles*[1], were engaged in the study. It was found out that while RWH has contributed to the enhancement of land productivity and food production, the intervention has also suffered from inadequate knowledge base, weak institutional integrations, emergence of malaria, biases in approaches, gender and poor misrepresentation, distorted subsidy policies, etc. Policy issues relevant to the intervention were identified, analyzed, and discussed.

1. Introduction

1.1 Background

Currently, about 52% of Ethiopians or 214 districts of the country are food insecure. In 2006, for instance, about 15 million people were unable to feed themselves. These problems are induced, mainly from anomalies observed in the distribution of rain in the cropping seasons, coupled with the rapid land degradation taking place in most agricultural plots of Ethiopia. In this regard, RWH has demonstrated enormous contribution to the sustained and enhanced crop productivities especially in China and India.

According to reports of UN officials, Ethiopia is among the nine countries of Africa which possesses great potential for RWH. It is estimated that the country could feed 520 million people through RWH. Though the technology dates back to the Axumite period (560 BC) (Fattovich 1990), it was only after 2003 that the Ethiopian government recognized its importance and promoted it on on-farm rainwater ponds.

Of a total of ten regional states of the country, close to one million RWH ponds were constructed in four major regional states. Between 2003 and 2005, about 20,000 ha of land were irrigated from RWH ponds. Moreover, in 25 of the newly incepted Agricultural Colleges, where rural development agents are training, a new course, called Rainwater Harvesting, has been imbedded to the curriculum.

As any technological intervention has the pros and cons, it is imperative to undertake a critical assessment of RWH, which would furnish critical information for the current polarized views, which are for and against RWH. While government promotes RWH as a seamless intervention, several critics denounce its expansion in the context of widespread agricultural land shortages, resurgence of malaria, and presence of giant rivers in the country. Therefore,

[1] *Kebele* is the smallest administrative unit

this paper attempts to appraise the opportunities and challenges of the newly promoted RWHs vis-a-vis environmental, socioeconomic, and policy dimensions.

1.2 The Conceptual Framework

Putting aside the biophysical parameters of crops, the volume of yield obtained by a given household in rural Ethiopia is constrained by the impact of declining land sizes and its continued fragmentation due to the rapid population growth (Figure 1). This reduced land size is further constrained by land degradation, where soils are subjected to physical losses, declining water holding capacity, depletion of soil organic matter, and gradual coarsening of the soil texture. At last, agricultural yield is constrained by the increased variability of the rainfall. Those factors significantly affect the carrying capacity of agricultural lands. In this study, it is hypothesized that the efficient execution of RWH could not only bridge the gap between D and C, but also transcends to B.

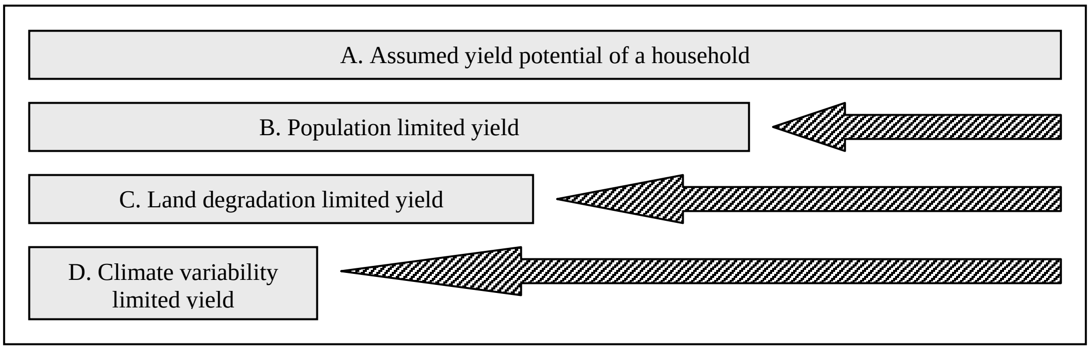


Figure 1: Conceptual framework of yield-limiting variables.

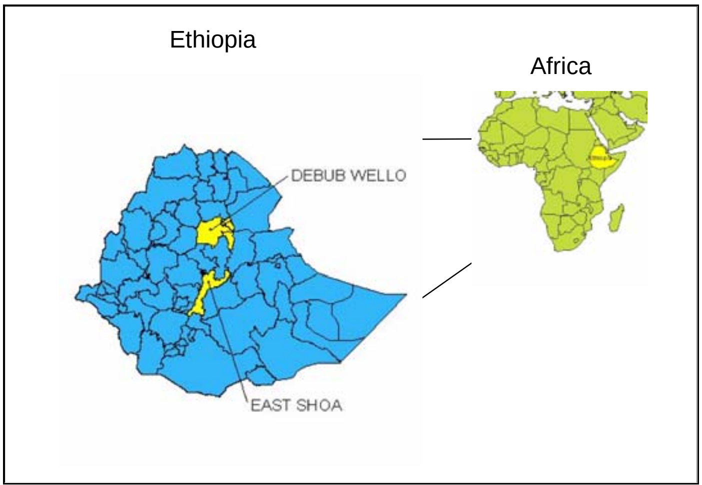
2. Research Method

2.1 The Study Area

This study was conducted in 12 sample *kebeles*, selected from five districts of three zones in the Oromia and Amhara regional states of Ethiopia. Sample districts include *Boset*, *Dugda Bora*, *Tehuledere*, *Kalu*, and *Bati* (Map 1). Sample districts are generally characterized by low amount and highly variability of rainfall distribution. Besides, they are inhabited by higher population density on a rapidly depleting land resource. Predominantly, rainfed sorghum and maize crops are cultivated. To curb the problem of recurrent food shortage and droughts, the Ethiopian government has rapidly expanded RWH in those sample areas.

2.2 Data Acquisition and Analysis

A total of 300 households were involved in the detailed household survey. In each sample district, 60 households consisting of 30 RWH Users and 30 Non RWH -Users were systematically chosen. The data acquisition instruments include: household survey, focused group discussion (FGD), key informant interview, and personal observation. In the household survey, a structured questionnaire survey was used. Each FGD composed of six to eight elders/ community leaders. The research is exploratory and descriptive and therefore both qualitative and quantitative analysis was employed.



Map 1: Location of the study area

3. Appraisal of RWH Practices in the Central Ethiopia

3.1 Assessment of Catchment Area

It was found out that the problem of water scarcity, due to the deteriorating rainfall characteristics, has been intensifying through time. The amount of rain has been decreasing and its distribution has become erratic. Especially in the drier districts, rainfall anomalies are a norm than exception.

Erecting ponds at high gradient plots is labour-intensive. It is challenging especially for households headed by women, physically weak persons, and in a community where collective work is uncommon. However, once the structures are planted on steep plots, there are fewer chances for collapse. According to farmers, plots at a high gradient provide firm physical structure. On the other hand, installing RWH ponds on low gradient plots have both advantages and challenges. The advantage is ease of excavation. The problem, on the other hand, is the dominance of fine textured soils which contain montmorilonite minerals. Soils with montmorilinitic property pose significant physical (engineering) limitations as it alternatively swells and shrinks. Such properties often result in the fast collapse of concrete based ponds.

At the onset of RWH expansion, acute paucity of topographic/soil information was noted in the country. As a result, ponds were constructed randomly. Through time, however, farmers bestowed due consideration to topographic variabilities and the associated soils. While concrete-based structures have qualified for high-gradient plots, ponds constructed from plastic lining (geo-membrane) have become palatable for low-lying plots.

In principle, shaping or treatment of catchment surface boost the runoff yield collected by the ponds. However, more than 75% of pond catchments (Plate 1) are covered by various forms of vegetation, which results in enhanced infiltration of rainwater and reduced run-on to the ponds.

One of the major challenges in rural Ethiopia is the ever-growing magnitude of soil erosion. Ethiopia is among the three most countries of the world affected by massive soil erosion. Annually, Ethiopia losses up to 200 tones of soils from every hectare of agricultural lands. Erosion in the form of sheet erosion is massively taking place on croplands. In this study, the contribution of RWH for the reduction of soil erosion was observed in the field. Also, farmers and key informants have confirmed such relationships. This is because several water conservation structures are utilized on the command areas. Other assumed ecological functions of RWH include the replenishment potential of the ground water, which in effect is perceived to enrich springs and wetlands. Of course, this perception is subject to scientific investigations.

Plate 1: Ponds surrounded by vegetative cover.

About 80% of respondents had their ponds located within a 10 meter radius from their houses. Most RWH Users in the past preferred to put their ponds very close to their homesteads. Such preference could be partly attributed to the problem of land tenure insecurity. In Ethiopia, land belongs to the public, which partly contribute to land tenure insecurity. Its impact is demonstrated by government's effort to redistribute lands so as to enable the landless youngsters to share the land resources. Through such redistributions, several farmers have lost part of their terraced and vegetated lands. In fear of such losses, farmers have been doubtful of digging ponds at outlying plots where there are chances of losing it in the re-distribution process.

However, with respect to future plan of locating ponds, more than 75% of respondents have the preference to erect it afar. The reason could be due to the new land policy of the government, which gives wider room for land ownership. The other factor could be the issue of health. Ponds situated at closer distances to homesteads are believed to exacerbate the malaria incidence, and locating ponds afar is assumed to evade mosquitos.

3.2 Analysis of Water Storages

Silt marks observed on uncovered ponds demonstrates that some of them had never been filled at all. Close to 30% of the ponds were found empty in *Dugda Bora* and *Bati* study sites (Plate 2). On the other extreme, where rills are diverted to the ponds, the volume of run-on yield exceeds the water carrying capacity of ponds. Siltation of sediments due to run-on sediments is another problem and its problem is intense where silt traps are not in place. However, unless farmers de-silt it on a timely basis, there is a higher chance of silted ponds.

Close to 90% of the 150 RWH Non-Users expressed their interest to acquire ponds. Similarly, 88% of the RWH beneficiaries are interested to possess additional ponds. However, both categories of respondents prefer to locate their additional ponds far away distances from their homesteads. The reason could be: to get away from uncovered ponds (*death traps*), to keep mosquitos at bay, and to irrigate cereal crops with pond water.

Plate 2: Ponds without water.

3.3 Appraisal of Water Abstraction

In general, irrigating crop fields through pumping eases the burden of water lifting. However, it is blamed for excessively wasting the water. In some areas, there are attempts to irrigate not the land but the root of crop through a low tech "drip irrigation" (Plate 3). This system has proved to boost yield by 40% in China.

Plate 3: Low-tech drip irrigation system. The left picture shows the low cost while the right one shows advanced drip irrigation.

3.4 Analysis of Water Utilizations

Almost all RWH Users utilized their pond water for horticultural crops. However, multiple functions of RWH were observed in the study areas, i.e., for domestic purposes- in *Dugda Bora*; beef fattening - in *Boset*; tree nursery - in *Boset*; selling domestic water - in *Boset*; cultivation of chat - in *Tehuledere* & *Kalu*; and bee-hiving - in *Bati*, *Tehuledere*, *Boset* districts.

Currently, a shift of landuse type, from cereals to horticulture, is taking place in the study area. According to Ngigi *et al.* (2005), such land use changes are driven by the need to improve agricultural production and livelihoods. More than 75% of respondents believe that it is difficult to cultivate cereals through pond water. One factor could be due to the fact that cereal farms are located at far away distances from residential units and ponds. The other factor could be due to the intensive labour requirement for cereal crop irrigation. At this vantage point, it is important to analyse the patterns of water stress in cereal production system. Commonly, the time-span of dry spells (which fall within the growing period) lasts for a maximum three weeks. If pond water is applied to the crops once on the seventh day of the dry spell, the crop could escape wilting or drying. Experiences in China show that maize could be supplemented by pond water. While the majority of respondents believe RWH could not salvage cereals, 33% of respondents think the otherwise.

In most sample households, the agricultural produce suffices for a maximum of nine-month consumption. The remaining months would fall short. This is the period in which most Ethiopian farmers adapt different coping strategies, such as cutting trees for charcoal making, selling livestock, off farm activity in nearby urban canters, etc. One of the great merits of RWH-based agriculture is therefore to fill the food gap in such critical periods, especially through vegetables.

Research reports (Hussien and Hanjra, 2003) have confirmed that RWH directly boosts yields and gives farmers the ‘water security’. This implies that RWH users could be engaged in enhancing productivity inputs. Respondents at all districts have reported that RWH ponds are useful not only to the rich but also to the poor households.

4. Policy Constraints of RWH

The following policy issues are found critical to affect the success of RWH in the study area:

4.1 Poor Targeting: While RWH was primarily targeted to address the poorest of the poor, the findings of the research was quite the opposite. It was those who are better informed and those who have better resources who grabbed the advantages of RWH. Knowingly or unknowingly, the intervention has failed to embrace the poor, women-headed and physically-weak households as witnessed in the study areas.

4.2 Biases in Approaches: Most RWH practices in Ethiopia have biased towards semi-arid areas. This is due to the misconception that RWH could turn arid and semi-arid into agricultural lands. However, temperate areas, which receive “*adequate*” annual rainfall, suffer significantly from crop failure due to the erratic nature of rainfall. The role of RWH to buffer dry spells has not been given due consideration in all sample villages. The other RWH bias is the higher propensity to utilize RWH for horticultural than cereal crops.

4.3 Disoriented Subsidy Policy: Currently, the Ethiopian government has decided to withdraw its financial and material support for the expansion of RWH ponds. On the contrary, soil and water conservation activities are still heavily subsidised through food-for-work schemes, which might be due to the long term economic and environmental return. During the group discussion at Bati district, several farmers challenged the decision of the government, through the question “*which comes first: rehabilitation of degraded land or ensuring food production through expansion of ponds*”? Farmers argue that government should continue to support RWH making.

4.4 Poor Linkages: RWH is a crosscutting issue and various forms of linkages, i.e., institutional, professional, and the like are mandatory. It stipulates the active engagement of professionals such as civil engineers, agronomers, health practitioners, crop protectionists, economists, environmentalists, etc. Likewise, the strong linkage within sectors of the government (e.g., Agriculture, Water Resources, Health, etc.) and cooperation with NGOs and research institutions is imperative. However, those linkages were absent in the survey areas. Currently, RWH is new to many farmers of the survey areas where the available micro-credit services have not been tuned to the expansion of RWH. Hune (2004), too, noted that the availability of credit facilities for RWH in Ethiopia has been limited.

4.5 Inadequate Knowledge Base: Before the launching of RWH, prior experiment was conducted in the Nazareth area, which is characterized by erratic rainfall, sandy soil, deep water table, etc. The technology generated from this area was diffused to the rest of the country. The approach followed was “one size fits all”. There have been two practical limitations. First, the area selected for experimentation was not representative enough for the diversified nature of the whole country including the study area. The second limitation was that the generated knowledge was mainly engineering (mainly structural) and cost-benefit analysis. Information on water lifting, irrigation scheduling, irrigation amount, crop protection, storage systems of vegetables, the maintenance of ponds, etc., were not addressed.

4.6 Incompatible Policy Interface: It was found out that while the Ethiopian Water Resources Management Policy (1999) states “any water which is collected in a neighbourhood is considered dangerous as it proliferates malaria” (2006), the food security strategy of the country has put the collection of water in the form of ponds as a strategic intervention in rural areas.

4.7 Land Tenure Insecurity: Secure land tenure is believed to boost investment on the land by farmers. The fact that RWH beneficiaries preferred to locate ponds very close to their homesteads and their interest to locate their planned ponds at far distances from homesteads demonstrates the problem of land insecurity experienced in the past. The new Land Use and Administration Proclamation in Ethiopia (No. 456/2004) has mitigated the level of land insecurity. However, still there are various factors of land tenure insecurity issues, which play a disincentive role to invest in RWH and tree planting at distant farmlands.

5. Conclusion and Recommendations

In the face of rising rural population pressure, increasing rainfall variability, and the ever worsening land degradation problems, RWH in Ethiopia would have unparalleled contribution to mitigate the emerging and ever complicating threats. Results of the study demonstrated that RWH in Ethiopia has addressed three basic factors: offered improvement in the amount of food supply; contributed to improved land management practices, and capacitated RWH users.

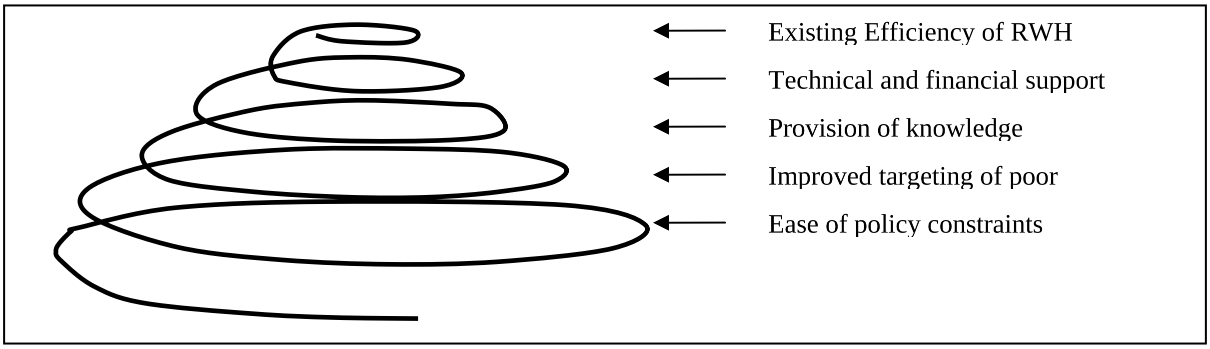


Figure 2: Opportunities for enhanced efficiency of RWH in Ethiopia.

By resolving the biophysical, socioeconomic and policy constraints (Figure 2), it is safe to conclude that the situation of millions of poor farmers could be improved through RWH, via the reduction of vulnerability to crop failure, malnutrition and seasonal food deficits.

In light of the key findings of the research and the conclusion drawn, the following recommendations are suggested for critical consideration:

i) There should be enhanced space for information exchange among various stakeholders. Farmers should be involved in the planning, designing, implementation, and monitoring of RWH.
ii) Integrated institutional arrangements should be promoted to co-ordinate and streamline the design, implementation and evaluation of RWH technologies.
iii) There should be on-farm trials for various RWH types tailored to different land uses, soils, and slope categories.
iv) Water management should be seen as one strategy of maintaining food security, and RWH should be synergized with other strategies to foster sustainable development;
v) Opportunities for equal access of women and other marginalized farmers to the benefits of the RWH should be provided; and the relation between land tenure, RWH rights and the introduced water harvesting technologies should be carefully considered.

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