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REVIEW ARTICLE

A CRITICAL REVIEW OF SMALL SCALE IRRIGATION IN ETHIOPIA: PROSPECTS AND CHALLENGES

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ABSTRACT

Rural farmers in Ethiopia have been practicing traditional irrigation since ancient time. But, it is only in the 1970s that small scale irrigation got recognition by the then government. Nonetheless, currently, investment in small scale irrigation has been identified as a key poverty reduction strategy. To this end, it may be important to review the existing irrigation schemes and the major challenges associated with them, among others. This paper critically reviewed 12 relevant recent literatures on the sub-sector and presented discussions thereof. It is exhibited that farmers practiced various types/techniques of small scale irrigations such as river and stream diversions, rainwater harvesting, groundwater and hand-dug wells, motor pump schemes and so forth. However, small scale irrigation is by far underdeveloped which has limited its contribution to the agricultural production and food security in the country. Various reasons and constraints are indicated for its underdevelopment across documents. The major constraints include institutional, technical, financial, socio-economic and marketing related aspects. Examining these constraints and planning to tackle accordingly is one of the ways that the government and its partners could address to develop the small scale irrigation. As such, it is important to duly consider those aspects in future policy issues and agricultural interventions. More specifically, it is suggested to duly work on improving the technical know-how of farmer on irrigation technologies, extending credit facilities, expanding markets and road infrastructures and setting clear organizational structures for irrigation departments at various levels.

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INTRODUCTION

The Ethiopia's economy is heavily dependent on agriculture. On average, agriculture contributed about 48 per cent of Ethiopia's GDP. It equally accounted for 90 per cent of export earnings and 70 per cent of raw material inflow into agro-based industries. The agricultural sector is also the major employer, accounting for 85 per cent of total employment. The crop sub-sector accounts 60 per cent of the sector output, while livestock and forestry constitute 30 per cent & 10 per cent respectively. And peasant farms at household level are the backbone of the sector, cultivating about 96 per cent of the cropped area and producing 90 per cent to 94 per cent of all cereals, pulses and oilseeds (Central Statistics Agency [CSA], 2007; Ministry of Agriculture [MoA], 2011). The agriculture in Ethiopia is dominated by smallholder rain-fed systems. And it is mainly characterized by low and erratic rainfall which has contributed to limited agricultural productivity and food security in the country (Awulachew *et al.,* 2005; Haile and Kasa, 2015). One of the solutions to improve the agriculture production and food supply could be the development of irrigation system. Increasing food demand can be met in one or a combination of three ways: increasing the area of arable land, increasing agricultural yield, and increasing cropping intensity (number of crops per year). In most cases, expanding the area under cultivation is a finite option, especially in view of the marginal and vulnerable characteristic of large parts of the country's land. However, increasing yields in both rain-fed and irrigated agriculture and cropping intensity in irrigated areas, through various methods and technologies, are the most viable options for achieving food security in Ethiopia (Awulachew *et al.,* 2005; MoA, 2011). Recently, investment in small scale irrigation, which has a short history of recognition by government policies, has been identified as a key poverty reduction strategy (MoA, 2011; Haile and Kasa, 2015). So far, not much is documented in literature concerning small scale irrigation which may imply little emphasis given for the sub-sector.

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And even the available literature is mainly from the reports or publications of the governmental organizations. Nonetheless, in the efforts to develop the small scale irrigation, it may be important to review the existing irrigation schemes and the major challenges associated with them, among others. To this end, this paper reviewed recent literature on the area and presented discussions starting with the general irrigation development and its potential in Ethiopia, and confining to the types and major constraints of small scale irrigation.

Modern Irrigation Development and its Potential in Ethiopia

Though irrigation has been practiced in Ethiopia since ancient times, modern irrigation is started only in the second half of twentieth century. In the late 1950s, private concessionaires who operated farms for growing commercial crops such as cotton, sugarcane and horticultural crops started the first formal irrigation schemes in the upper and lower Awash Valley. In the 1960s, irrigated agriculture was expanded in all parts of the Awash Valley and in the Lower Rift Valley of Ethiopia. The Awash Valley saw the biggest expansion in view of the water regulation afforded by the construction of the Koka dam and reservoir that regulated water flows (Awulachew *et al.,* 2005).

Small scale irrigation development and management was started in the 1970s by the Ministry of Agriculture (MoA), in response to major droughts. Although, certain aspects of the development during the Imperial regime (1930 – 1974) have wrong doings in terms of property and land rights, there has been a remarkable emergence of irrigation development and establishment of agro-industrial centers during the Derg regime (1975 – 1991) (MoA, 2011). Recently, thecurrent Ethiopian governmenthas given more emphasis to small scale irrigation asa way of enhancing thefood security situation in the country (Haile and Kasa, 2015). Efforts are being made to involve farmers in various aspects of management of small scale irrigation systems, particularly, in water distribution and operations to improve the performance of irrigated agriculture (Awulachew *et al.,* 2005). Though the government effort is recognized in promoting modern irrigation systems of various scales, it is observed that the development of irrigation is far behind meaningful utilization of the resource potential that the country has in the sector.

Due to abundant water resource potential, Ethiopia is considered as a water tower of Africa (World Bank, 2006). It has 12 river basins which are estimated to have about 122 billion cubic meters of surface water and 2. 6 billion of ground water potential. Besides, the country has also large amount of irrigable land potential which is estimated to be 3.7 million hectares (MoA, 2011). However, despite inconsistence on the amount of actually irrigated land across documents, it is commonly observed that the percentage is very small compared to its potential. In figure, total land under irrigation is estimated to be in the range between 160,000-200,000 hectares which is about 5 per cent of the country's irrigable land (Awulachew *et al.,* 2005, 2007; World Bank, 2006; Makombe *et al.,* 2007). According to the Ministry of Agriculture (2011), this share reported to be between 10- 12 per cent of the total irrigable potentials. With respect to the small scale irrigation; the Ministry of Water and Energy indicated that, of the 197,250 hectares under irrigation in Ethiopia, a total of 98,625 hectares (20. 8 per cent) of land is under small scale irrigation though the total small scale irrigation potential is around 472,900 hectares (http://www. mowr. gov. et) In general terms, there are some reasons forwarded for the underdevelopment of irrigation. These factors mainly include presence of deep gorges and valleys on the major rivers basin, lack of adequate capital, uneven spatial distribution of the surface water resources, and absence of appropriate water resource policy till the last decade (Awulachew, 2005; MoA, 2011). Nevertheless, the challenges in the small scale irrigation development in particular are not beyond the control of human efforts, as will be discussed sooner.

Types of Small Scale Irrigation

In Ethiopia, irrigated agriculture is being practiced under various categories or scales. One of the common ways of classification is the one provided by the Ministry of Water and Energy. According to the Ministry, irrigation development is classified, based on the size of the command area, into three types: small scale irrigation systems (<200 ha[1]), Medium scale irrigation systems (200-3,000 ha), and Large scale irrigation systems (>3,000 ha) (http://www.mowr.gov.et). So far, amongst those types, 46 per cent of irrigation developments fall under small scale irrigation category (Makombe *et al.,* 2011). The small scale irrigation includes both traditional schemes up to 100ha and modern schemes up to 200ha. Traditionally, farmers have built small-scale schemes on their own initiative, sometimes with government technical and material support. They manage through their own water users association or committees which have long existed to manage traditional schemes. A typical association comprises up to 200 users who share a main canal or a branch canal. Or they may be grouped into several teams of 20 to 30 farmers each. Such associations handle construction, water allocation, operation and maintenance functions (Ministry of Water Resources [MoWR], 2002). And the farm size of an individual farmer practicing the small scale irrigation usually varies between 0. 25 and 0. 5ha (Awulachew *et al.,* 2005). Regarding the types or techniques, it is can be seen that there are various types of small scale irrigation practices and they are summarized as follows.

River and Stream Diversion: These are usually built on perennial rivers or springs with adequate base flow and mainly practiced in the midlands and highlands of Ethiopia (Gebregziabher, 2008; MoA, 2011). Traditional diversions are often used for small plots while those developed by the government or NGOs provide opportunities for irrigation at community level (Gebregziabher, 2008). However, because these structures do not have storage on the stream they are not capable of regulating the flow. Hence, diversion schemes with storage facilities can be provided to minimize the inconveniences and inefficiencies during water flow fluctuations. In addition, rivers with large width and deep alluvial material are costly to be handled by small scale irrigation. Thus, intakes on the banks were used instead of complete barrier across the river (MoA, 2011).

Motor Pump Scheme: These are often used to lift water from rivers, lakes, ponds or hand-dug wells where diversion by gravity is not possible. They are typically used for high-value crops as in Haramaya district of Hararge zone and Zeway

[1] ha = hectares

Dugda district in Oromia Region. The use of such irrigation is increasing in most parts of the country because the technology is easy to operate and can be used by individual households. The government has been selling motor pumps through cooperative associations so as to reach farmers, who may otherwise not be able to afford, and because landholdings are so small that collective use of the pumps is assumed to be advantageous. However, cooperatives are often criticized for being less efficient in resource management than private operators, which can increase the risk and maintenance cost to individual farmers and possibly cause social conflicts (Gebregziabher, 2008). Here, one way to the solution can be providing pumps with credit arrangements because farmers, growing high value crops in particular, could benefit more from such irrigation technologies. It is noted that existing market prices of agricultural products are relatively better where market oriented and timely productions are followed. And farmers are also found successful mainly in areas with good market access and better service delivery (MoA*,* 2011).

Rainwater Harvesting: Water harvesting is capturing the runoff, collecting, storing and utilizing the stored water for the intended use. It can generally be categorized into two as in-situ water conservation practices and runoff based systems. These systems are important in Ethiopia, particularly in drought prone areas of the country, where there are frequent crop failures and associated famine is often unavoidable. Since 2002, rainwater harvesting has been implemented by the government, particularly in drought prone areas. However, in many instances technical problems have resulted in failure usually because of weak study on the potential of water catchments and lack of proper shade management (MoA, 2011).

Groundwater and Hand-Dug Wells: This is commonly used for domestic water supply. However, in areas where shallow ground water resources are available, it is possible to use existing water lifting technologies like treadle pumps to extend its use for irrigation. Since they are suitable for individual holding, they can be better developed and managed for irrigation of small areas with appropriate and affordable water application systems such as drip system and groundwater recharging techniques. It is indicated that there is abundant ground water resources potentials in such areas as the midlands and highlands of the Southern Nations Nationalities and Peoples Region (SNNPR), Oromia Region, East Hararge zone and parts of Amhara Region) (MoA, 2011).

Micro Irrigation: These refer to individualized small scale irrigation technologies for lifting, conveying and applying irrigation water. It includes sprinkler systems, drip irrigation, treadle pumps, and wind mills systems. These are recent introductions in the area of small scale irrigation and they are affordable to be used by smallholders in their small plots. In addition, they are appropriate to conserve and use the available limited resources - the water, in a more efficient manner, particularly in arid and semi-arid areas where scarcity of water is a critical problem (MoA, 2011). However, despite their introduction, there is little evidence of the availability of good quality systems in the local markets (Gebregziabher, 2008).

Major Constraints of Small Scale Irrigation

Though small scale irrigation has been practicing by the small household farmers in rural Ethiopia, its development has not contributed significant enough to agricultural production and food security (Awulachew *et al.,* 2005). Its underdevelopment is attributed to various challenges and constraints in the irrigation development sub-sector. The major constraints hindering better utilization of small scale irrigation potential could be categorized as follows:

Institutional Constraints: Lack of clear mandates and responsibilities of key stakeholders is one of the institutional constraints in small scale irrigation development. There is poor coordination between institutions dealing with irrigation development. For example, there are no clear cut duties and responsibilities between the Department of Agriculture and Department of Service Cooperative and Promotion (Yassin, 2002). In addition, lack of clear water use rights between users is observed in most part of irrigation areas (MoA, 2011). This usually creates conflicts between the upstream and downstream users working on their irrigation scheme. Moreover, among other institutional challenges are poor linkage between research and extension systems, inadequate irrigation extension service, inadequate supply of agricultural inputs, limited priority given to irrigation development, and inadequate baseline data and information on the development of water resources (MoA, 2011; Eneyew, 2014).

Technical Constraints and Knowledge gaps: These are associated with the technical aspects of irrigation technology and know-how of its operation and management. Farmers have limited knowledge in modern irrigation techniques and water management. This is evidenced by the fact that farmer tends to have poor irrigation scheduling and crop water requirement balance and inappropriate irrigation methods in terms of cost and/or relevance. In addition, there is inadequate community involvement and consultation in scheme planning, construction and implementation of irrigation development (Eneyew, 2014). This may tend to raise the issue of sustainability of the irrigation schemes.

Socio-economic Constraints: These are challenges related with the social and economic characteristics of rural farmers in Ethiopia. Poor economic background of farmers or water users has resulted in poor social and physical infrastructures for the development of irrigated agriculture. For instance, due to lack of integration in resources mobilization for irrigation, diversion structures built by farmers are washed out by floods each season and farmers are forced to reconstruct structure every season. This has created work redundancy and raise cost of irrigation (MoA, 2011). Besides, the tradition of farmers in investing in watershed development activities and resource conservation and management is low. Moreover, water thefts, conflict on land and water distribution are common problem in many irrigation schemes (Eneyew, 2014).

Financial Constraints: These constraints usually include shortage of survey and construction equipment, shortage of adequate budget for design studies and financial capacity of Water Users Associations (WUAs), among others (MoA, 2011). From the farmers' side, lack of long and/or short-term credit provision is one of the financial factors which often limit the expansion of modern irrigation technologies. It is exhibited that, unlike cooperatives which are legal entities, WUAs cannot access credit or hold bank accounts (Carter and Danert, 2006). For instance, in case of water lifting technologies, most farmers use their own money rather than credit to buy pumps, but where credit was available motor pump adoption increased (International Water Management Institute [IWMI], 2011).

Moreover, besides inadequate capacity for irrigation equipment, the cost of inputs for irrigation farm is also found to be high. Itrequires higher financial costs for purchasing inputs like fertilizers, improved seeds and chemicals (Berhanu, 2006as cited in Eneyew, 2014).

Marketingrelated constraints: Such constraints are associatedwith market infrastructures and marketinginformation system. As farmers often use irrigations to grow marketable crops and vegetables, inadequate marketing systems usually reduce their benefit thereof. It is commonly indicated that farmers have no/little rational place or customer for selling their produces. They have also little bargaining power as they lack market price information and have no facilities to store produces for sale another day, in case the price of the day does not favor them (Eneyew, 2014). Besides, markets may not be available nearby and there can be considerable competition (IWMI, 2011). In addition, there are insufficient spare parts and support services for maintenance of irrigation technologies, water lifting technologies like motorized pumps, in particular. As a result, farmers commonly report frequent break down of machineries which has led to delays in agricultural activities and dissatisfaction with the technologies (Tadesse *et al.,* 2008 as cited in IWMI, 2011).

Conclusion and Implications

This review paper has discussed the irrigation development and its potential, the various types of small scales irrigations and the major constrains associated with the small scale irrigation development. Though the irrigation potential of the country is high, it has not been utilized to significantly improve the farmers' agricultural productivity and food security. Rural farmers in various agro-ecologies have been practicing traditional irrigations schemes for long period of time. However, they could not surpass the traditional subsistence farming even though one of the important resource for their agriculture is already available – water. This has been due to various reasons and constraints associated with the small scale irrigation schemes. Examining those constraints and planning to tackle accordingly is one of the ways that the government and its partners (Donors and NGOs) could address to develop the sub-sector. So that the agricultural production and food security could be improved which, in turn, have a significant role in poverty reduction in rural area.

To expand small scale irrigation in rural area, one of aspects that need a due consideration is improving the technical knowhow of farmer on irrigation technologies and its operations. Farmers need to have adequate information about modern irrigation schemes through various on-the-job and/or off-the-job trainings. Besides, Extension services should reach farmers appropriately especially where rainwater harvesting is practiced, as farmers faced technical problems in construction and management that followed. This will help to increase the adoption of modern technologies and their efficient and effective usage. In addition, there need further researches on technical and financial feasibility of the systems, particularly on micro irrigation types. Besides, the financial issues should also be considered for the expansion of the irrigation schemes. Access to credit facilities need to be improved to allow poor famers to gain access to irrigation technologies. There need to explore credit arrangements and supportive initiatives to enable farmer access the technologies without collateral or proof of future income.

This is particularly important for farmers who produce market oriented high value crops using motorized pumps for their irrigation schemes. In addition, there need to supply adequate budget for the design and contractions of modern schemes where farmers could not afford to manage the cost. In particular, diversion schemes from rivers with large width and deep gorges are costly for small scale farmers. And this could be one of the gaps that donors or NGOs, after carefully study of the potential areas, could possibly work on in collaboration with the local administrative frameworks. Moreover, the marketing system of rural farmers also needsa substantial attention. Developing markets and road infrastructures is required to improve farmers' access to market. Besides, it is necessary to improve the capacity of farmers to grow high value crops and build their bargaining power for good prices. In addition, in order to reduce the dissatisfactions related with the cost and maintenance expenses of modern irrigation technologies, there need to explore additional options like establishing rental markets, encouraging businessmen to engage in the sale of spare parts and after sale services, particularly in water lifting technologies (for example, motor pumps). Finally, clear organizational structures and set ups are required to improve the functionality of small scale irrigation schemes. Due to poor structural basis and management capacity of Irrigation departments at various levels, gaps are created in the operation and implementation of irrigation schemes. Thus, government has to build strong and relevant structural arrangements across hierarchies. This will help to improve coordination between institutions working on irrigation development. Here, a due emphasis has to be given on constructing databases for irrigation schemes at district level Agricultural offices. This will greatly enable government or donor/NGO's to easily access appropriate data whenever they want to conduct need assessments, researches and/or projects in the area of irrigation. In addition, strengthening institutional capacity would enable to set clear duties and responsibilities of various organs in the irrigation sub sector. It would also help to solve water use related conflicts between farmers, as there is a common conflict between Water User Associations who often come to terms through traditional negotiations.

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