

The Role of Small Scale Irrigation to Household Food Security in Ethiopia: A Review Paper

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Abstract

Ethiopia has been highly affected by drought and climate-related hazards, and millions of people have been left without sustenance every year. Irrigation as an agricultural intensification plays key role in increasing agricultural production and productivity. The Government of Ethiopia has identified small-scale irrigation as an important component of adaptation. This review paper is aimed to compile the existing literature on the role of small-scale irrigation scheme on the rural household food security and factors affecting the households' food security in the country. The country is blessed with abundant water resources and believed to have the potential of 5.1 million hectares of land that could be developed for irrigation. However, about 3% to 5% of the irrigable land was irrigated currently. Irrigation in Ethiopia is considered as a basic strategy to alleviate poverty and hence improve food security. It is useful to transform the rain-fed agricultural system that depends on rainfall into the combined rain-fed and irrigation agricultural system. Irrigated agriculture is becoming increasingly important in meeting the demands of food security, employment, rural transformation and poverty reduction. For Ethiopia, increase in agricultural production through diversification and intensification of crops grown, increased household income because of on/off/non-farm employment, source of animal feed, improving human health due to balanced diet and easy access and utilization for medication, soil and ecology degradation prevention and asset ownership are contributions of small scale irrigation. The value of per hectare crop production under irrigated settings is about twice that of under rain-fed settings. Household income and consumption are much higher in irrigated settings than in rain-fed settings. Hence, it was concluded that irrigation has positive role on the rural farming households' food security, and it should be a policy priority in Ethiopia for rural poverty alleviation, climate change adaptation and overall economic growth.

Keywords: Food security, Small-scale irrigation, Role

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1. Introduction

Ethiopia is a landlocked country, with a land area of 1.13 million km², found in Eastern Africa (MOA, 2010). Its population is estimated to be above 100 million and is the second most populous country in Africa next to Nigeria. According to UNDP human development index of 2012, Ethiopia is among least-developed countries with an annual per capita income of USD 453.57 and ranked 174 out of 187 countries (MoA, 2014). The economy is highly dependent on agriculture consisting of crop production and livestock rearing. Poverty is the central issue of the economic problem. Most of the population in Ethiopia lives in highland areas, with 85% being rural and dependent on agriculture with a low level of productivity (MoA, 2011).

Agriculture is the leading sector of Ethiopian economy as well as the overall economic growth of the country depends on the sector and the share of agriculture in GDP was 34.9% in 2017/18 (NBE, 2018). However, Ethiopian agriculture is characterized by small-scale subsistence production systems where crop and livestock yields are very low. The country is endowed with abundant water resources with 12 river basins with an annual runoff volume of 122 billion m³ of water and an estimated 2.6-2.65 billion m³ of groundwater potential (Awulachew *et al.*, 2007; Makombe *et al.*, 2011; MoA, 2011). Out of the total water resources, about 75% drains to neighbouring countries (MoWR 2001). Due to this, Ethiopia is considered the water tower of Africa (Makombe *et al.*, 2010). However, the agriculture in Ethiopia is heavily dependent on rainfall, which is highly varies both spatially and temporally. The intensity of recurrent droughts affects the livelihoods of agricultural communities and the whole economy.

Even though, Ethiopia has the potential for development in terms of both vast suitable land and availability of fresh water resources suitable for irrigation purpose, irrigation development in the country is in its infancy stage and not contributing its share to the growth of the agriculture sector accordingly. Currently, limited land is being cultivated under irrigated agriculture and crop production was predominantly based on rain fed agriculture (MOA, 2015). The agricultural land of Ethiopia under cultivation is about 12 million hectares (MoA, 2011). Ethiopia is alone believed to have the potential of 5.1 million hectares of land that can be developed for irrigation through the river and spring diversion, pump, gravity, pressure, underground water, water harvesting and other mechanisms (Tedros, 2014). Despite Ethiopia's large agricultural sector and water potential, growing human population, recurrent droughts and periodic floods, complicated with climate change that has been accompanied by severe soil and landscape degradation in some regions contributed to a situation of national food insecurity (FAO, 2011).

According to the 2018 Humanitarian and Disaster Resilience Plan in southern and southeastern Ethiopia, 7.9 million people are currently in need of emergency food assistance mostly in the pastoralist areas (UNDP, 2018). Irrigation in Ethiopia is considered as a basic strategy to alleviate poverty and hence food security. Improving the productivity of the agriculture sector can undoubtedly benefit both the rural and urban population by providing sufficient food and raw materials at lower prices; generate foreign exchange; provide a growing amount of labor and capital needed for industrialization (MOA, 2011). Thus, considering the importance of irrigation sub-sector in the country's development agenda is very important. The Government of Ethiopia gives high priority to irrigation development to exploit the idle resources (MoA, 2011). It is useful to transform the rain-fed agricultural system that depends on rainfall into the combined rain-fed and irrigation agricultural system. Irrigation, water harvesting and agricultural research were considered to play a significant role in ensuring long-term food security. Irrigation contributes to livelihood improvement through increased income, food security, employment opportunity, social needs fulfillment and poverty reduction (Asayehgn, 2011; MoARD, 2012).

Therefore, knowledge about status and performance of different irrigation practice and its contribution to household income is important. Therefore, a comprehensive literature review on the impacts of small-scale irrigation scheme on the rural household food security in particular, livelihood in general is very essential for monitoring and evaluating the progresses of the irrigation scheme, identifying constraints for future strategies that address water scarcity, and consequently food security issues at household and national levels. The objective of this review paper is to compile the existing literature on the role of small-scale irrigation on households' food security, factors affecting the households' food security and to identify the critical issues and suggest the best strategies for future intervention on the irrigation program in Ethiopia.

2. Overview of the Role of SSI in The Household Food Security

2.1. Basic Concept of food security and its definition

Food security concept originated in the mid-1970s during the international discussion on global food crisis. The initial focus of food security attention was primarily on food supply problems of assuring the availability and to some degree the price stability of basic foodstuffs at the international and national level (FAO, 2005). Thus, in the 1970s the issue of food security referred to the national food supply's capacity to meet the population's energy and nutrient needs. Many development workers have understood the concept of household food security as the availability of food in the world market place and on the food production systems of developing countries (Bedeke, 2012). Along with air, water, and shelter, food is a necessity for life. Food plays a role in our health, economy, and culture and is a critical part of a sustainable, resilient community. Inadequacies in global, national, regional, and local food systems have made the correlation between healthy food and healthy communities increasingly evident (WFP, 2012).

Different organizations defined food security in different ways. According to Clay (2011), food security is a situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. On the other hand, in the present study, food security is defined as adequate availability of and access to food for households to meet the minimum energy requirements as recommended for an active and healthy life (Hussein *et al.* 2013).

2.2. Dimensions of food security

Jrad *et al.* (2010) elaborated four dimensions of food security as food availability, food accessibility, food utilization and stability.

Food availability refers to the physical presence of food which may come from own production, purchases from internal market or import from overseas (Jrad *et al.*, 2010; Gregory *et al.*, 2011). On national level, food availability is a function of the combination of domestic food stocks, commercial food imports, food aid and domestic food production, as well as the underlying determinants of each of these factors.

Food access is the ability to obtain sufficient food of guaranteed quality and quantity to meet nutritional requirements of all household members (Jrad *et al.*, 2010). On the other hand, Kuwornu *et al.* (2012) explained that food access is determined by physical and financial resources as well as by social and political factors.

Food utilization refers to ingestion and digestion of adequate and quality food for maintenance of good health. This means proper biological use of food, requiring a diet that contains sufficient energy and essential nutrients as well as knowledge of food storage, processing, basic nutrition, childcare and illness management (Jrad *et al.*, 2010).

Stability of food is the continuous supply of adequate food all year round without shortages (Jrad *et al.*, 2010). To be food secure a population, household, or individuals must have access to adequate food at all times. The concept of stability can therefore refer to both the availability and access dimensions of food security.

2.3. Situation of Food Security in Ethiopia

With more than 100 million people, Ethiopia is the second most populous country in sub-Saharan Africa and has one of the fastest-growing economies in the world. The foundation of its economic growth is agriculture, which

employs 80% of the population. Ethiopia could potentially reach middle-income status by 2025 with an emphasis on boosting domestic savings rates, private sector development and improving the trade logistics (CARE, 2014). However, poverty is still a big obstacle to overcome in Ethiopia. Consequently, chronic and acute food insecurity is prevalent, especially among rural populations and smallholder farmers. About 10% of Ethiopia's citizens are chronically food insecure and this figure rises to more than 15% during frequent drought years. 2.7 million People were requiring emergency food assistance in 2014 and 238,761 children required treatment for severe acute malnutrition in 2014 (UNICEF, 2014).

The National Food Security Strategy (FDRE, 1996) reports that as the Ethiopian population grew from 15 million in 1951-55 million during early the 1990s, the production of cereals dropped on per capita basis by more than 25% from around 200 kg in early 1950s to 150 kg in 1992. The proportion of population unable to attain their minimum nutritional requirements is estimated at 52% of the rural population and 36% of the urban population (MOA, 2008). According to FAO (2010), 41% of the Ethiopian population lives below the poverty line and more than 31 million people are undernourished. The concentrations of food insecurity and malnutrition are prevalent in rural areas with a population of six to seven million chronically food insecure and up to 13 million seasonally food insecure. Ethiopia faces a major emergency related to what could be the worst drought in 50 years. The Ethiopian Government announced that 10.2 million people would need emergency food assistance in the first half of 2016 because of the ongoing drought (FAO, 2016). Climatic shocks have greatly affected successive harvests.

Empirical evidence of food security in Ethiopia indicates the prevalence of a high level of food insecurity, with significant individual and spatial characteristics. The specific food security studied by Hailu (2012), generally similar to other systems, food-system sectors are interconnected, and failures in the food system express themselves as problems across all sectors. For this reason, failures in food production, processing, and distribution strain other sectors such as food access, and make it difficult to pinpoint a single cause of any given food system failure. Similarly, failures in others systems like transportation and land use negatively affect the food system by limiting such things as food production opportunities or travel to food retail outlets.

The Government of Ethiopia launched the Humanitarian Requirements Document for 2016, making an appeal for US\$1.4 billion, of which \$1.1 billion is required for emergency food assistance. WFP, together with the Government is tasked with assisting approximately 7.6 million people, but WFP currently only has three percent of the necessary funding required for the ongoing response. According to 2010 report, 5.2 million people in Ethiopia faced an uncertain food security situation. The worsening food security situation was attributed primarily to poor rainfall (UN, 2010). According to the revised humanitarian requirement document, released on April 2011, the total number of people requiring humanitarian assistance was estimated at 3.2 million (USAID *et al.*, 2011). The Government of country is providing strong leadership to mitigate the worst effects through a range of health, water, food distribution and agriculture-related interventionist. Looking to 2016, the UN Ethiopia Humanitarian Country Team report underlines the seriousness of the situation, "Food assistance in early 2016 is likely to be required throughout an extended eight-month 'hunger season' when food aid in Ethiopia is typically required for only four months of the year" (UN, 2016).

2.4. Contribution of Irrigation to Household Food Security

Irrigation has key role to stabilize agricultural production and mitigate the negative impacts of variable or insufficient rainfall (Getaneh, 2011). It has also potential to increase both yields and cropping intensity (Awulachew *et al.*, 2010). In terms of income, irrigation has a strong impact. FAO (2010) revealed that, the value of per hectare crop production under irrigated settings is about twice that of under rain-fed settings. Household income and consumption are much higher in irrigated settings than in rain-fed settings, and a 50 percent point gap is common. Irrigation investments can have broader food security and poverty reduction impacts, if efforts are geared towards revitalizing and up-grading existing traditional SSI schemes, with support to enhance access to input supply, output marketing and extension to facilitate access to information and innovations (Awulachew *et al.*, 2010). Similarly, an Impact studied by Desta (2013) revealed that contribution of irrigated agriculture to income is about 70% in the highly irrigated villages as compared to 60% in two other low irrigated areas. At the same time, the absolute size of agricultural income is also the highest in the highly irrigated village despite the lower landownership size and cultivated holding by more than 30% over the low irrigated village. The highly irrigated village has higher per hectare agricultural income by over 50% over the low irrigated village.

The cash crop economy with important cash flow offers a wide range of off-farm income possibilities as compared to subsistence farming (Kelilo *et al.*, 2010). The irrigation schemes increased households' income compared to situation before implementation of the schemes and thus contributed to improvement of household food security status (Mengistu, 2007). The construction of small-scale irrigation schemes has resulted in increased production, income, diet diversification; and reduced hungry months from 6 to 2 months (July and August), increase in diversity of crops, shift from cereal livestock system to cereal-vegetable-livestock system (IFAD, 2011). Irrigation benefits the poor through higher production; higher yields, lower risk of crop failure, and higher and year-round farm employment (Asayehgn, 2011; Abraham, 2015). Therefore, irrigation enables smallholders to

adopt more diversified cropping patterns, and to switch from low value staple production to high-value market-oriented production. Increased production makes food available and affordable for the poor. Irrigation contributes to livelihood improvement through increased income, food security, employment opportunity, social needs fulfillment and poverty reduction (MoARD, 2012). The participation in irrigation use has increased annual household farm income by 19,474.8 birr for participant households than non-participant households and their physical asset holding which is valued 27502.4 ETB (Legesse *et al.*, 2018).

Generally, irrigation water is vital resource for many productive and livelihood activities and has positive role in poverty alleviation (Worku, 2011). The development of irrigation and agricultural water management holds significant potential to improve productivity and reduce vulnerability to climatic volatility in any country (MoFAD, 2012; MOFAD, 2013). In recognition of the importance of the agriculture sector, including the irrigation sub-sector in the overall economic development of the country and in realizing the objectives set in the rural development policy and strategy, various donors and development partners should have engaged in the provision of technical and financial support towards improving food security and alleviate poverty. Many researchers argue that increasing cropping intensity and agricultural yield through various methods and technologies (like irrigation) are the most viable options for achieving food security in Ethiopia.

2.5. Factor affecting the households' food security in Ethiopia

Combinations of natural and man-made factors have resulted in this serious and growing food insecurity problem in many parts of the country. The immediate causes of food insecurity include frequently recurring droughts and erratic rainfall patterns, ecosystems degradation, rapid population growth, the low levels of technology employed in agriculture and the resulting low productivity of the sector, poor rural infrastructure and legacies of the past policy constraints are also considered as basic causes of food insecurity and widespread poverty in the country (MoARD., 2007). Other factors are contributing to trap Ethiopia in the current state of food insecurity and poverty are production fluctuations, low non-farm employment, low income, regional fragmentation of markets, high rate of natural degradation, low level of farm technology, high level of illiteracy and inadequate quality of basic education, poor health and sanitation, high population growth, poor governance and inter-state, intra-state military conflicts and wars (Asefa, 2012).

According to ECHA (2014), the overall food security is deteriorating following poor rains, both in livestock keeping and farming areas, swarms of locust have affected food production in eastern parts of the country. Ethiopia is a disaster prone country. Around 12 million people in the country are regularly exposed to droughts, floods, landslides, epidemics and earthquakes. These regular shocks have many negative consequences such as forced internal displacements of population, destruction of assets and livelihoods, extreme poverty, under nutrition and extreme food insecurity. Erratic rainfall, shortage of farmland due to population pressure, soil erosion, lack of oxen, low price of sheep and sheep diseases, frost, water logging and problem of pests and plant diseases. Poor soil fertility, land shortage, frost attack, chronic shortage of cash income, poor farming technologies, weak extension services, high labor wastage, poor social and infrastructural situation have caused the problem of food insecurity (Berhanu, 2007; Tilaye, 2010; Hussein, 2013).

Several studies in the past have indicated that people of Ethiopia have experienced long periods of food insecurity that might be ascribed to several factors that include occasional droughts and degradation of farmlands. These factors have limited the "physical, social and economic access to sufficient, safe and nutritious food necessary to meet the dietary needs and food preferences for leading an active and healthy life" for majority of the residents (Gilligan *et al.*, 2011). Land degradation coupled with unpredictable rainfall and drought cause a serious problem on households' food security in Ethiopia. Besides, overgrazing, improper cultivation practices, mismanagement of land resource are the main causes for food insecurity (ATA. 2011). The population growth and scarcity of resources, small landholding, farmers' skills and low level of education, inappropriate production systems and marketing services, drought and variability of rainfall, urban expansion, off-farm unemployment and traditional, social and cultural factors were major causes of food insecurity in the study area (Woldeamanuel, 2009).

In this regard, different researchers agree that the causes of the existing food insecurity problem in Ethiopia are numerous and interrelated. These includes rainfall variability, soil degradation (Woldeamanuel, 2009; ATA. 2011; AFI., 2012; Bewket, 2012), inappropriate storage facility, pre and post-harvest crop loss, inability of the households to purchase food, small and fragmented land size, lack of off-farm income opportunity, the under development of livestock sub-sector, inadequate credit and extension services and tenure insecurity (Bewket, 2012). Similarly, the majority of the severest food crises after the second half of the 20th century were caused by a combination of several factors. The most common causes of food insecurity in the country were; drought and other extreme weather events, pests, livestock diseases and other agricultural problems, climate change, military conflicts, lack of emergency plans, corruption and political instability, cash crops dependence, aids and rapid population growth (AFI., 2012).

3. Conclusion and Recommendations

Agriculture remains to be the leading sector in the national economy of Ethiopia. The country is endowed with a wide range of natural resources such as land, irrigation potential and agro ecological diversities favorable for the growing of various crops. Despite, the huge potential the country has in terms of water availability and land, which are in most cases suitable for irrigation development, irrigation development is in its infancy stage and the country is not benefiting from the sub-sector accordingly. As result, the country faced with many socioeconomic problems, such as limited access to education, water supply and food. High population growth, environmental degradation, and climate variability compound the intensity of the problem. Lack of access to irrigation and the dependence of Ethiopian agriculture on rainfall have made food production in Ethiopia vulnerable to the variability of weather and climate.

The importance of irrigation development for the countries food security, and particularly at small holders' level need prime consideration to raise production, achieve food self-sufficiency, and ensure food security at household in particular and national levels at large. The irrigated agriculture play a vital role in supplying with sufficient amount and the required quality of raw materials for domestic agro-industries and increase export earnings. Increase in agricultural production through diversification and intensification of crops grown, increased household income because of on/off/non-farm employment, source of animal feed, improving human health due to balanced diet and easy access and utilization for medication, soil and ecology degradation prevention and asset ownership are contributions of irrigation.

There are a large number of small-scale irrigation schemes that have been developed in different parts of the country by the Government and through the support of different funding agencies. However, due to different environmental and management factors, most of these schemes are not being exploited fully and irrigation in general is not contributing its share accordingly to the overall economic development of the country. Hence, considering the limitations the government should give emphasis to the irrigation sub-sector in order to enhance the capacity, increase its contribution in the overall economic development of the country, improve food security, and reduce poverty. In recognition of the importance of the agriculture sector, including the irrigation sub-sector in the overall economic development of the country various donors and development partners should have to engage in the provision of technical and financial support towards improving food security and alleviate poverty.

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