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Review on Impact of Small Scale Irrigations in Household Food Security in Ethiopia

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Abstract
Agriculture is the leading sector of Ethiopian economy as well the overall economic growth of the country largely depends on the agricultural sector. However, Ethiopian agriculture remains characterized by small-scale subsistence production systems where crop and livestock yields are very low. In Ethiopia, an estimated 3 million of the country's people is food insecure and malnourished. Therefore, there is a call for different interventions, irrigation being one of the options, which could help in adapting strategies to cope up with the challenging drought. The country's irrigation potential is estimated at 3.7 million hectare, of which only about recent estimates indicate that the total irrigated area under small-scale irrigation reached to 853,000 ha during the last implementation period of PASDEP(Plan for Accelerated and Sustained Development to End Poverty) – 2009/10. The aim of this paper is to identify the impact of small-scale irrigation on household food security based on review of different literature. Different studies revealed that access to reliable irrigation water can enable farmers to adopt new technologies and intensify cultivation, leading to increased productivity, overall higher production, and greater returns from farming. Access to irrigation enabled the farm households to grow crops more than once a year; to insure increased and stable production, income and consumption and improve their food security status. The review concludes that small-scale irrigation is one of the viable solutions to secure household food needs in the country. However, simply providing irrigation infrastructure to farm households is not a guarantee that rural poverty and food insecurity are being reduced. In addition to that, an enabling socio-economic environment (like access to roads, markets, credit, training and information about innovations) must be provided to the poor farmers to actually make them engage in small scale irrigation farming and ensure to reduce deep rooted food insecurity and poverty.
Keywords: Intensify cultivation, Increase productivity, Small scale irrigation, Food security.

I: INTRODUCTION

Agriculture is the leading sector of Ethiopian economy as the overall economic growth of the country largely depends on the agricultural sector. The sector provides employment to 83% of the population, contributed 41.6% to the county's GDP in 2009/10 fiscal year (GTP, 2010) and 85% of its export earnings. Improving the productivity of the agriculture sector can thus undoubtedly benefit both the rural and urban population by providing more food and raw materials at lower prices; generate foreign exchange; provide a growing amount of labor and capital needed for industrialization; and provide market for industrial goods (MOA2011). However, the sector has remained in its rudimentary stage because of environmental degradation, unchecked population growth (2.4% per annum), small and fragmented landholding, high rate of urbanization (5%), and limited access to new agricultural technologies, traditional methods of cultivation, high dependence on natural factors and institutional support services (CSA 2012, MoFED 2012).

For this reason, the productivity and efficiency of the agricultural sector are low, which in turn, leads to the rampant food insecurity problem in the country (Awulachew et al. 2007). For example, in 2010 and 2011 the per capita domestic outputs (the country's food grain availability) were respectively 3 and 2.2 quintals per person. This value was largely less than the globally recommended per capita cereal production in 2009 that was 400 kg (4 quintals) per person (Li and Shangguan 2012). This justifies that the sector doesn't able the people to meet the food requirement. As a result, there is a recurrent and common food shortage in the country. Ethiopia is among the food aid recipient countries in the world (Todaro and Smith 2011). More than 30% of the population lived below the national poverty line in 2011(MoFED 2012).

Moreover, Agriculture in Ethiopia is heavily dependent on rainfall, which is highly varies both spatially and temporally. Despite Ethiopia's agricultural enterprises, a high and growing human population, recurrent droughts and periodic floods, complicated by 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).

This, therefore, calls for different interventions, irrigation being one of the options, which could help in adapting strategies to cope up with the challenging drought. Irrigation development, particularly in the small holder sub-sector has significant importance raising production and productivity to achieve food self-sufficiency and ensure food security at national level in general and household level in particular. The irrigated agriculture can also play a vital role to supply the required raw materials for domestic agro-industries and increase export earnings. Thus, considering the importance of the irrigation sub-sector in the overall country's development agenda, the Government of Ethiopia gives high priority to irrigation development including smallholder and large scale commercial schemes to exploit the untapped resources (MoA2011).

The irrigation potential of the country is estimated to be about 3.7 million hectares. Recent estimates indicate that the total irrigated area under small-scale irrigation in Ethiopia has reached to 853,000 ha during the last implementation period of PASDEP(Plan for Accelerated and Sustained Development to End Poverty) – 2009/10 and the plan set for development of small-scale irrigation is 1,850,000 ha, which is planned to be achieved by the end of the five years GTP of 2015(GTP, 2010). The existing irrigation development in Ethiopia, as compared to the resources potential that the country has, is not significant and the irrigation sub-sector is not contributing its share accordingly (MoA2011).Despite the above challenges, in some of the implemented small scale irrigation schemes are contributed well for the country's food security and poverty reduction strategies as compared to rain fed agriculture.

However, simply providing irrigation infrastructure to farm households is not a guarantee that rural poverty and food insecurity are being reduced. In addition to that, an enabling socio-economic environment (like access to roads, markets, credit, training and information about innovations) must be provided to the poor farmers to actually make them engage in small scale irrigation farming and ensure deep rooted food insecurity and poverty(Norton, 2010). There for the objective of these reviews is to review the impact of small scale irrigations on household food security, the current status irrigation in Ethiopia and to reviews different impact assessment methods that are used in investigating the impact of irrigation schemes on household food security.

2. Small-scale Irrigation

Irrigation is the supply of water to agricultural crops by artificial means designed to permit farming in arid regions and to offset the effects of drought in semi arid regions and even in areas where total seasonal rainfall is adequate on average; it may be poorly distributed during in a year and variable from year to year (Woldeab, 2003). Small scale irrigation is irrigation usually on small plots, in which farmers have the major controlling influence and using a level of technology which the farmers can effectively operate and maintain (carter, 1991).In Ethiopia there are five types of small scale irrigation systems used by farmers: Diversion system(diverting natural river flow), spate system(that use occasional flood flows), spring system(that use flows from spring), storage system(that store water behind dam) and lift system(that extracts water from rivers, irrigation canals, reservoirs and wells (Berhanu and Pendel,2003).

2.1 Existing Irrigation Development in Ethiopia

■ Small scale-irrigation (SSI); which are often community-based and traditional methods, covering less than 200 hectares. Examples of SSIs include household-based RWH, hand-dug wells, shallow wells, flooding (spate), individual household-based river diversions and other traditional methods; .These irrigation schemes vary widely in size and structure, from micro irrigation (RWH), to river diversion, pumping, and small or large dams, etc. These schemes can be subdivided into:

■ Medium-scale irrigation (MSI), which is community based or publicly sponsored, covering 200 to 3,000 hectares. Examples of MSIs include the Sille, Hare and Ziway irrigation schemes.

■ Large-scale irrigation(LSI); covering more than 3,000 hectares, which is typically commercially or publicly sponsored. Examples of LSIs include the Wonji-shoa, Methara, Nura Era and Fincha irrigation schemes.SSI schemes are the responsibility of the MoARD and regions, while MSI and LSI are the responsibility of the MoWR. Note that while it is relatively easy to identify and map LSI and MSI, the information related to SSI is not readily available and data about many RWHs are extremely difficult to capture due to poor information management and availability of data (Seleshi Bekele Awulachew 2010).

2.3. Small scale irrigation Management

According to Byrnes (1992) irrigation management activities include three dimensions. These are (1) water use activities (2) control structure activities and (3) organizational activities

Water use activities: Management activities focusing on the provision of water to crops in an adequate and timely manner includes acquisition, allocation, distribution and drainage. Acquisition is the first management activity concerning the acquisition of water from surface or subsurface sources, either by creating and operating physical structure such as dams' weirs or wells or by actions to obtain some share of an existing supply. Allocation refers to the assignment of rights to users thereby determining who shall have access to water. Distribution refers to the physical process of taking the water from a source and dividing it among users at certain places, in certain amounts, and at certain times. Drainage is important where excess water must be removed (Byrnes, 1992).

Control structure activities: Management activities focusing on the structures required for water control include design, construction, operation and maintenance. Design involves the design of dams' diversions or well to acquire water, of systems of rules to allocate it, of channels and gates to distribute it and of drains to remove it. Construction involves the construction of the structures to acquire, distribute and remove water, or implementation of rules that allocate it. Operation refers to the operation of the structures that acquire, allocate, distribute or remove water according to some determined plan of allocation. Maintenances is the final control structure activity. This provides

for the continued and efficient acquisition, allocation, distribution and drainage (ibid).
Organizational activities: Management activities focusing on the organization of efforts to manage the structures that control irrigation water include resource mobilization conflict resolution communication and decision-making. The activity of resource mobilization entails marshalling management and utilization of funds manpower, materials, information or other inputs needed to control water through structures or to undertake various organizational tasks. The activity of communication entails conveying information about decisions made, resource requirements etc. to farmer or any other persons involved in irrigation managements. The activity of decision making entails the processes including planning involved in making decision about the design, construction, operation or maintenance of structures; acquisition, allocation, distribution or drainage of water or the organization deals with these activities (ibid). It was assumed that devolving management responsibility with or without some form of scheme ownership to the irrigating farmers, improves scheme performance water distribution and productivity, while saving public resources for agencies to carry out such tasks (IWMI, 2005). Merrey et al. (2002) also indicate that irrigation management transfer helps reduce the government's recurrent expenditures for irrigation. Irrigation systems in many developing countries were established with substantial financial contribution from international donors. It was assumed that the government and or water users would be able to incur the cost of operation and maintenance (O & M) of the systems made possible by enhanced financial gains from improvement in productivity levels of irrigated agriculture.

2.4 Irrigation Agriculture in Ethiopia

The history of irrigation in Ethiopia traced to the 1st century where the ancient people produced subsistence food crops and fruits along the river banks. Grove (1989) argued that irrigation is a very ancient agricultural practice which was extensively used by a number of early civilizations such as the ancient Egyptians and Ethiopians (Cited in Chazovachii 2012). The modern irrigation in Ethiopia, however, documented in the 1960s where the government designed large irrigation projects in the Awash Valley to produce food crops for domestic consumption and industrial crops for exports (MoWE 2012). The first-five-years national policy in 1950s (1957-62) prioritized to the development of the infrastructure services. The second-five-years plan (1963-67) focused on manufacturing, minerals and electric power development. Both gave less attention to agriculture by assuming that the sector was self-sufficient in supplying food for the ever-growing population and raw materials to the emerging industries (Lakew 2004).

However, the outcome of the policy was different from the expectation. The sector was not self -sufficient. Ethiopia has turned from food self-sufficiency to food import and food aid in its history. For this reason, the third-five-years plan (1968-1973) focused on the agricultural sector, and identified three developmental programs (large scale mechanized commercial farms, comprehensive package program and the minimum package program) aiming at generating employment and produce surplus for exports (Lakew 2004). Development of irrigation farming (river diversion, dams, water harvesting structures, etc.) was taken as a good alternative to achieve the third-five year national strategic plan (Desta 2004) because of the unreliability and the insufficiency of rainfall in the country. Immediately after the third-five year plan, several studies have been made to estimate the irrigation potential of the country. A German Engineering Team and the United States Bureau of Reclamation Team carried out comprehensive survey and feasibility studies on the potential of the large rivers in the 1970s. The government also undertook extensive studies in the 1980s on the water resource potential of the rivers.

The studies concluded that most of the international rivers have a huge potential for hydroelectric and irrigation purposes. For example, the annual runoff of the rivers is estimated to be 122 billion metric cubic (BM3). The irrigation potential from the natural reservoirs and groundwater is estimated about 40 BM3, totally 162 BM3(Awulachew et al. 2007). Since the population of the country in 2012 was about 90 million, the yearly per capita water resource availability in Ethiopia was 1800M3, which is relatively large volume compared with the Arab region 3300M3 per year in the 1960s and 900 M3per year in 2010 (Haddad et al. 2011). Table 1 show that the irrigation potential of the rivers is estimated about 3.7 million hectares. The Wabi-shebelle and Abbay river basins have the highest catchment area (202220 and 198891 km2respectively). Of the total river-based irrigation potential, Genale Dawa, Baro-Akobo and Abbay respectively account for about 28%, 27% and 22% of the irrigation potential of the country. Of the runoff flows, Abbay, Baro-Akobo and Omo-Ghibe account for about 45%, 20% and 15%, respectively.

Table 1: Irrigation potential for the major international river basin in Ethiopia

River	Mean Annual water flows (BM^3)	Catchment Area (km^2)	Irrigation potential (ha)	Irrigated Land in 2010 (ha)	Irrigation Intensity (%)
Tekezze	7.6	83476	83368	33760	40.49
Abbay	52.6	198891	815581	65404	8.02
Baro-Akobo	23.6	76203	1019523	18571	1.82
Omo-Ghibe	17.9	79000	67928	56057	82.52
Rift vally	0.12	52739	139300	35846	25.73
Mereb	0.26	54600	67560	910	1.35
Afar Denakil	0.86	63853	158776	627	0.39
Awash	4.6	110439	134121	120375	89.75
Wabi-Shebel	4.6	202220	237905	31701	13.32
Genale-Dawa	5.8	172133	1074710	4910	0.46
Total			3798782	368160	10

Source (MoWE)

The total irrigated area in the country in 2005/2006 was about 8% of the potential (Hagos et al. 2009) and it was about 10% in 2010 (MoFED 2012). This irrigation intensity is lower than China (52%), Kenya (20%) and India (33%) (Hussain et al. 2006, Mati 2008) but is relatively higher than the Sub-Saharan Africa 6% (Norton et al. 2010).

Taking the huge amounts of irrigation potential, Ethiopia can feed to the population of the whole Africa. However, the rivers are not exploited for irrigation as expected and fully. Awash, Omo Ghibe and Tekezze rivers are relatively in a better position in irrigated agriculture in which their irrigation intensity was relatively higher compared to other rivers. The current irrigation schemes have covered only 368 thousand hectares, 10% of the potential. Thus, irrigation agriculture in Ethiopia is still immature. With regard to the regional irrigation uses, Addis Ababa has utilized about 67% of its irrigation potential and followed by Dire Dawa (34%) and Afar region (30%). Tigray region has been used only 2% of its irrigation potential. The reasons for the poor development of irrigation in the country are fragmented and small farmland, political instability, lack of technologies, government-owned land policy, lack of financial resources, and weak institutional set up in the region (country) (Awulachew et al. 2007).

3. Concept of Food Security

The history of food security was emerged in the mid of the 1970s when a critical shortage of food grain occurred globally and then the World Food Conference defined food security in terms of food supply in 1974. At the 1996 World Food Summit, 182 nations agreed on the definition as a physical and economic access by all people at all times to sufficient, safe and nutritious food, and dietary food preference for an active and healthy life (Todaro and Smith 2011).This definition has four pillars (food availability, accessibility, utilization and stability). This enables to set threshold and distinguish food security from food insecurity situations.

The food availability refers to the sufficient quantities of food with appropriate quality supplied through domestic production or imports including food aid. Food access is the presence of adequate resources to acquire appropriate foods for a nutritious diet. It is an entitlement or command over the food supplied. Utilization of food is to meet adequate diet, clean water, sanitation and health care to search a state of nutritional well being. It is about the cultural acceptability of the food in the local communities. Stability of food refers to the level of resilience to shocks and other crises. Thus, the concept of food security consists of food and non-food inputs, and can attain with the fulfillment of the above four food security elements. The importance of irrigation agriculture comes in bold on the food supply, stability and access principles. Irrigation improves agricultural productivity through solving the rainfall shortage and encourages farmers to harvest year-round. The sector generates employment to some members of the family especially to wife and children. The family can take the balance and nutritious food from their crop, fruit and vegetable produce. Irrigation can motivate rural farmers to use more of modern inputs. Irrigation can be a source of an additional income for the rural farmers (FAO 2011, Bacha et al. 2011, Dillon 2008, , Dauda et al. 2009). Food security can be measured and evaluated using either supply-side approach or demand-side approach. The food supply equation deals with the food availability issues, for example, food production index, per capita output, food aid delivery, livestock index, crop index and others. The food demand equation, on the other hand, studies about the accessibility mainly focusing on income, anthropometrics index, consumption expenditure, nutrition index, diet diversity score, calorie intake index, hunger index and other derived indicators (Norton et al. 2010).

Depending upon the objective of the studies, some scholars preferred food supply while other scholars preferred the food distribution. Randela et al. (2000) shows that supply variables are more powerful determinant of household food security than the demand variables. If the supply is high, people have access to food and the demand variables are not so significant. Supply variable shows food availability while demand approach indicates food access or entitlement so that the demand-side approach is the most preferable (G/egziabher 2008). For example, the world has enough food to provide at least 2.15 kg per person a day for the world population but the world had about 800 million food insecure and malnutrition people in 2011 (FAO 2011). More than half of the population of less-developed countries are food insecure and have earned less than 1.25 USD per day in 2010 (Todaro and Smith 2011). The world will have about 370 million food insecure and mal-nutritious people in less developed countries in 2048 (FAO 2011).Similarly, Ethiopia has recorded a considerable economic growth since 2000, more than 7% annually, though it has, on average, about 3 million food insecure and malnourished people (MoFED 2012). The WFP, FAO and World Bank dataset show that the per capita domestic food production in Ethiopia between 2004 and 2012 was more than the global recommended per capita food grain. However, there was a significant level of food aid flows between the periods. This justifies that the availability of food supply doesn't indicate the command of the people over the supplied food. Food entitlement takes higher weight than the food availability. Therefore, the food supply is a necessary condition and food access is a sufficient condition for food security, and this is the reason that this study has preferred the expenditure-based demand-side of the food security analysis.

3.1 Small-scale Irrigation and Food Security in Different Regions and Countries

This study reviewed the contribution of small scale irrigation on household food security. G/egziabher (2008) compared farm production in irrigation and rainfall-based areas of Tigray and found that the rain-fed areas produced subsistence crops and encountered a chronic food deficit while the irrigation-based areas produced cash crops with surplus production due to post-harvest storage facilities, and doubling or tripling effects of irrigation. Construction of 126 surfaces and 54 sprinkler irrigations in the Arab countries also led to the cultivation of high-value horticultural crops such as tomatoes, peas, green peppers, groundnuts, maize, cucumbers and rape (Singh et al. 2009).

Small-scale irrigation in Ethiopia enabled households to diversify production to new types of marketable crops like fruits, cash crops and vegetables (Eshetu 2010). Without physical participation in irrigation schemes, farmers in Ghana have enjoyed indirect benefits (spillover effect), for example, market stabilization, access to nutritious diet, access to improved seed varieties and technical knowledge, and so forth (Kuwornu and Owusu 2012).

Irrigation investment in India enabled farmers to increase diversification of crops, and use of more chemical inputs like pesticides, fertilizers or improved seed varieties (Bhattarai et al. 2007) and switched from low-value subsistence production to high-value market-oriented production in China (Huang et al. 2006). A similar study in China in 2005 shows that cropping intensity was higher for irrigated (111-242%) than for rain-fed areas (100-168%); agricultural yield was higher in irrigated areas (e.g. rice yields 3-5.5 tons/ha) than in rain-fed areas (don't exceed 4 tons/ha); and employment and wage rates were higher in irrigated areas with a 50% differential (Huang et al. 2006). Irrigation in Arab increased cropping intensity up to 300% between 1992 and 1996 (Singh et al. 2009).

A time series (1992-2004) study in the Arab countries indicated that irrigation enabled farmers to grow multiple crops two to four times a year. It also enabled them to expand their cultivated area, increase farm yields and increase household incomes (Singh et al. 2009). State owned irrigation farming in Zimbabwe hired some disadvantaged people (women, widows, orphans and people living with HIV/AIDS). The government also encouraged other disadvantaged people to use and participate in irrigation schemes. As a result, these people have grown green vegetables, wheat, tomatoes, cotton and sugar cane, and subsequently, have increased their annual incomes up to 70% (Moll 2004). Small scale irrigation schemes in the Chakuda village (Gambia) and Mutambara (Zimbabwe) have increased the income of the participants. The returns from the irrigated horticulture were greatly exceeded the returns from rain-fed cereal production. The positive change in income and yield translated into increased expenditure, investment and construction. For example, 26% of the irrigation farmers were replacing their house with corrugated metal roofing while 45% were built new houses. They were also easily covered some basic needs like cooking oil, paraffin, educational needs and farm inputs (Chazovachii 2012).

A study in Ethiopia and Uganda found that irrigation is a positive and significant determinant of income and consumption and a negative determinant of poverty. Irrigation sector can increase household incomes, lower food prices, provide on/off-farm employment and increase opportunities (Torell and Ward 2010).Small scale irrigation in Nigeria was a source of income and employment (Dauda et al. 2009).Irrigation in Hama Mavhaire (Zimbabwe) provided a source of self reliance and income for old people who didn't intend to migrate. More shopping and market centers resulted from irrigation development have provided more jobs to the people (Chazovachii 2012). Irrigation development in Vietnam significantly enhanced farm employment opportunities (in hundred thousand) (Huang et al. 2006). Irrigation development in rural areas of India helped to keep people in the rural areas, migrated from rain-fed agro-environment to intensively irrigated environment (Bhattarai et al. 2007). Irrigation schemes in South Africa have increased employment opportunities, and stabilized and increased rural wage rates; and increased family consumption of food through enhancing food availability, reducing levels of consumption shortfall, increasing of irrigation incomes and reducing food prices thereby ensure food security (Fanadzo 2012). Investment in small-scale irrigation schemes has a positive impact on consumption and overall assets accumulation. Irrigation schemes in different countries (E.g. Gambia, Zimbabwe, China, etc.) enabled the participants to increase wealth (build houses with corrugated metal roofing, purchased jewelry items), take varied diet (Bhattarai et al. 2007, Huang et al. 2006) and consume own food instead of depending on food handouts from the government (FAO 2011). Irrigation in Ethiopia increased yields per hectare, income, consumption and food security (Hagos et al. 2009). Huang et al. (2006) identified five key dimensions (production, income, employment, food security, and other social impact) in which small scale irrigation schemes can contribute to uplift socioeconomic and rural poverty. Four elements how irrigated agriculture can reduce poverty – improving agricultural productivity, employment generation, linkage among different sectors of the rural economy, and increasing opportunities for rural livelihood diversification (Huang et al. 2006, Hussain et al. 2006). Expansion of irrigation schemes in Ghana increases asset accumulation (e.g. radio, house, bicycle and motor pump), and durable asset acquisition positively correlate with irrigation use (Kuwornu and Owusu 2012). Generally, different empirical studies in Asia and Africa show strong linkages between irrigation development, agricultural productivity, agricultural growth and food security.

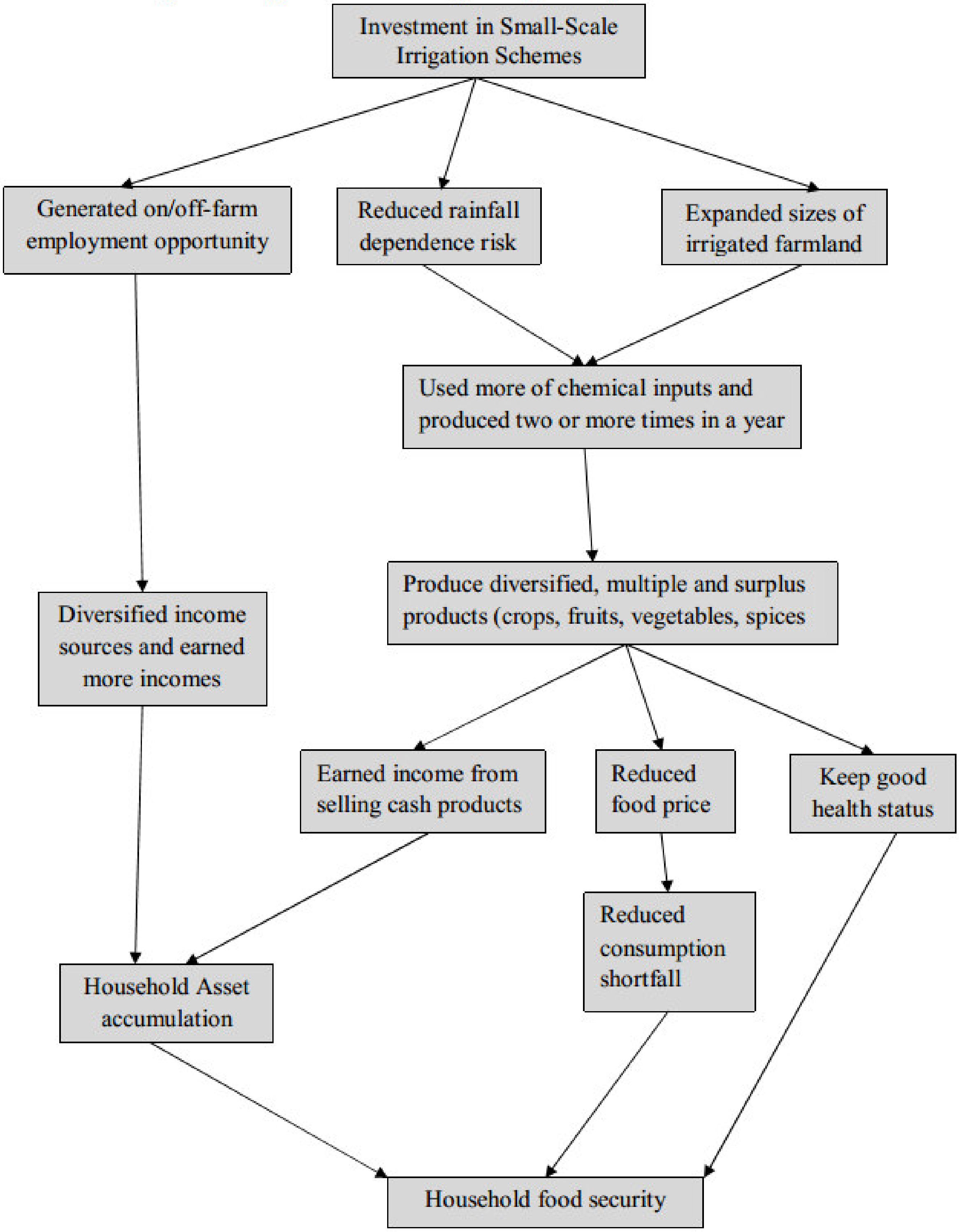
3.2 Irrigation-Food Security Linkage

Farmers in Ethiopia are unable to produce sufficient amounts because of erratic and untimely rainfall, and accordingly, the government has given great attention to small scale irrigation agriculture as a means to ensure food security and alleviate poverty (Awulachew et al. 2007). The adoption of new technology innovation (e.g. irrigation) is the major driving force for agricultural growth and poverty reduction (Norton et al. 2010). Swamikannu and Berger (2009) constructed an irrigation-poverty dynamics linkage model to explore how irrigation can reduce poverty. This study modified the Swamikannu-Berger model and built small scale irrigation-food security frame work.

This conceptual framework indicates that investment in irrigation schemes can relieve farmers from high dependence on rainfall. It increases irrigated farmland and also generates employment. It encourages farmers to produce two or three times in a year and use more of chemical inputs. Studies show that small scale irrigation in developing countries was counted on to increase production, reduce the dependence effects of unpredictable rainfall and provide jobs to the poor (Chazovachii 2012, Torell and Ward 2010). Irrigation in semi -arid tropical countries is an important investment rural development that can have direct and indirect impacts on food security and poverty (Bhattarai et al. 2007). Investment in small -scale irrigation creates on/non-farm employment opportunities; increases consumption expenditure and accumulating assets.

Accordingly, irrigation lowers food prices so that the poor can afford and get access to the required food at fair prices (Huang et al. 2006).Use of more chemical inputs and year round production in irrigated farmland improves productivity, and shifts from subsistence crops to high-value cash crops, which in turn enable people to take nutritious food and keep good health status. Awulachew et al. (2007) explained that irrigation development increases productivity of inputs, mitigate vulnerability of rainfall variability, and promote rural dynamic economy. Reliable small scale irrigation increases land productivity, crop yields and application of mineral fertilizers, which, in turn, enables to diversify into non-conventional and market-oriented products (high value crops, vegetables and fruits (Eshetu 2010), which positively improves farm households' diet, incomes, health and food security (Torell and Ward 2010). Thus, the study built the model to illustrate the contribution of small scale irrigation in ensuring food security and attracting inward investment in the economy.

Figure 1: Irrigation-food security linkage conceptual framework



Source;(Nugusse, et al.2012)

4. Conclusion and Recommendation

Conclusion

- Small scale irrigation investment has both positive and negative impacts
    - ✓ positive impacts includes;-
- Increased irrigation areas, reduction in rainfall risk, increased water reliability.
- Farm household's decision on irrigation.

- Small-scale irrigation in Ethiopia enabled households to diversify production to new types of marketable crops like fruits, cash crops and vegetables.
- Increased yield of crops and marketing, reduced unemployment.
- Reduced inequality and poverty.
- High economic Growth and improve food security
- Reinvestment
  - ✓ negative impacts includes,-
- Some of the negative impacts are disease break down, soil salinity problem, degradation and logging in downstream.

Recommendation

■ Reverse degradation and rehabilitate watersheds, including drainage and salinity management measures, and include soil quality assessment in project design.
■ Develop a salinity management strategy by measuring salinity and sodicity levels for prioritized schemes.
■ Include environmental flows and downstream water use demands in project design.
■ Mitigate health impacts of irrigation, by linking WSM interventions to health concerns, e.g., drainage for malaria control.
■ Link watershed management (WSM) interventions to irrigation development and roll out innovative initiatives, e.g., a forestation, beehives, and other livelihood diversification measures.
■ Provide timely and relevant input supply; follow up the maintenance and operation of the irrigation schemes.
■ Many studies explained that effective and strong local institutions (formal and informal) are important for the success of small scale irrigation schemes.
■There is a strong need to enhance access to institutional support services such as credit and extension. Availing market information on input and output marketing will only achieve the desired impacts if an effective extension system is in place to guide farmers to understand the issues related to the optimal application inputs, targeted planting dates and product quality to enable them respond well to market incentives.
■ Capacity building in various aspects of irrigation management. Provide the necessary policy framework at all levels to give more attention to poor people (especially women) – enable women to be a major beneficiary of investments.
■ Improve policies for enhancing private sector investments in irrigated agriculture development, especially manufacture and sales of micro irrigation technologies as well as other input and output market functions.
■ Project planning should be a step-wise exercise that avoids 'too ambitious' projects, with limited resources for adequate baseline studies, stakeholder consultations and effective implementation.

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