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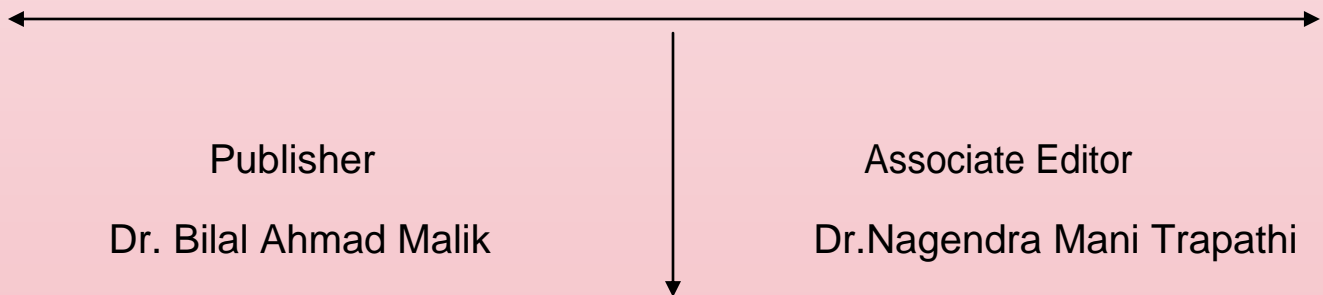
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## REVIEW ON THE ROLE OF SMALL SCALE IRRIGATION AGRICULTURE ON POVERTY ALLEVIATION IN ETHIOPIA

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### ABSTRACT

*About 85% of Ethiopian population has a subsistence mode of crop and livestock production. This form of agriculture contributes a large share of the gross national products (GNP). In Ethiopia, agriculture accounts for about 45% of the country's GDP, creates 85% of employment and 65% of the total exports. Ethiopian agriculture mainly depends on rain fed. Besides, the productivity of the sector is very low and lags behind the rate of population growth and partially reinforcing food insecurity of the country in the last decades. Currently, the government of agricultural policy of Ethiopia paid high attention to develop small scale irrigation through water harvesting technology in different corners of the country to support local farmers to improve agricultural productivity, ensure food security and reduce poverty. Use of irrigation agriculture is important to increase productivity, household incomes, employment, avail different products throughout the year and economic development. In Ethiopia, the average crop yields per hectare from irrigated land increases 2.3 times higher than the yield produced by rain fed agriculture. Higher productivity helps to increase returns to farmers' endowments of land and labor resources and produced more than twice per year. This implies that switching from subsistence production to market oriented production. Therefore, adoption of small scale irrigation is a viable strategy to increase production to meet the growing food demands, market-oriented production, to achieve food security, make food available, and improve the livelihood of rural households.*

**Keywords:** Agriculture, food security, irrigation, poverty, production.

### 1. INTRODUCTION

Agriculture remains the mainstay of Ethiopia's economy. About 85% of the economically active population lives in rural areas, particularly in the central highlands (FAO, 1996). The majority of the population has a subsistence mode of crop and livestock production. This form of agriculture contributes a large share of the growth national products (GNP). In Ethiopia, agriculture accounts for about 45% of the country's Gross Domestic Product

(GDP), creates 85% of employment and 65% of the total exports (Tiruneh *et al.*, 2001; MoFED, 2010). Despite its economic and social benefits, production and productivity of different agricultural crops in Ethiopia is mostly on a small scale and average crop yield is very low, as compared to other developing countries (Awulachew *et al.*, 2010; Kalkidan *et al.*, 2016). Besides, in many parts of Ethiopia, agricultural production is affected by environmental extremes (e.g. drought, high soil salinity, etc.) and the country has been seriously affected by climate change and related hazards, and millions of people have been left without sustenance mode of life every year. To increase productivity and diversify the livelihood scenarios as an option, development of small-scale irrigation schemes has been introduced through water harvest technology. Small scale irrigation is an important strategy in reducing risks associated with both rainfall variability, production of different crops twice or three times within a year and increasing income of rural farm-households. In attempting to do so, Ethiopia has yet developed not more than 5% of the irrigation potential.

## 2.OVERVIEW OF SMALL-SCALE IRRIGATION IN ETHIOPIA

In Ethiopia, irrigation agriculture was started in the 1960 with the purpose of producing industrial crops which is cotton and sugar on modern scale beginning (Birhanuand Peden, 2002; Teshome, 2006). However, local communities had already practicing irrigation by diverting water from rivers in the dry season for the production of subsistence food crops by traditional irrigation practice (Teshome, 2006). During 1970, modern Small Scale Irrigation (SSI) practice and management was started by the ministry of agriculture in the response to overcome droughts, which caused wide spread crop failures and consequently hunger and starvation (Awulachew *et al.*, 2010). Irrigation practices reduce the risk of crop failure by resulting from drought. At this time government paid high attention to develop the sector to fully it's potential by assessing and supporting local farmers to improve irrigation practices as well as the promotion of modern irrigation practices (Awulachew *et al.*, 2005).

Ethiopia has great irrigation potential, which is estimated as 5.3 million hectares of land of which 3.7million hectares can be developed using surface water sources and 1.6 million hectares using ground water and rain water management (MoFED, 2010; Awulachew and Mekonin, 2011).The average crop yield per hectare from irrigated land was increases 2.3 times higher than the yield produced by rain-fed agriculture (FAO, 2007). However, in the current situation irrigated agriculture produces less than 3% of the total food production of the country (Teshome, 2006; Kalkidan *et al.*, 2016). As a result, the productivity of the agricultural sector is very low and lags behind the rate of population growth and partially reinforcing food insecurity in the country (Awulachewet *al.*, 2010).This is

might be due to poor water storage capacity and large spatial and temporal variations in rainfall, high soil salinity, there is no sufficient water available for most small-holder farmers to produce more than one crop per year (Mekuria, 2003; MoFED, 2006). This leads; frequent crop failures followed by dry spells, occurrence of severe droughts and produce significant soil erosion which may reduce the potential productivity of farmlands. The current level of irrigation development is at about 640,000ha with further planned for implementation (Awulachew *et al.*, 2010).

Currently, the Ethiopian government has revised its strategy for irrigation development through water harvesting technology in farmers' field. The previous development target was to put additional 274,612ha by 2016 (WSDP, 2002). But, the ministry of water resource of Ethiopian is undertaking a total of 13 irrigation projects in different regions of the country. According to Teshome (2006), they form approximately a total area of 493,603ha and envisaged to be completed before the end of the irrigation development program planning period in 2016. This revised target is mainly related to large and medium scale irrigation and it is expected that the small scale irrigation sub-sector which is under the ministry of agriculture and rural development will also strive similar targets.

### **2.1. Why and where irrigation applicable**

According to FAO (1997) report, in the next 35 to 45 years, the need of food by world population will double, to meet the demand of food 90% of food production will have to come from existing lands and of which 70% of food will have supposed to come from irrigated land. Without irrigation farming world food security is impossible. Globally, irrigation practice is one of the possible means of feeding the rapidly growing population in the world (Mwamfupe, 2002; Kalkidan *et al.*, 2016). The sector provides about 40% of the worlds' food production from 18% of worlds' cultivated land (World Bank, 2001). About 70% of world water diverted from rivers or pumped from underground for irrigation purpose. Irrigation has basically influenced not only agricultural productivity but also the income, employment and long run economic development (World Bank, 1995). It can contribute much to poverty reduction primarily by enhancing the productivity of labor and land leading to higher incomes, higher wages and lower food prices and also it helps in economic development (Smith, 2004). In addition to this, irrigation agriculture improves water conditions in the soil, increases the water contents of plant fibers, dissolved nutrients and makes them available to plants (FAO, 1997). On the other hand, it can regulate temperature in the layer of the soil and the air available between ground layers which further control the growth and development of plants and the quality of the harvest indirectly. To sum up, irrigation agriculture is mostly

appropriate in the area of arid, semi-arid, humid and sub-humid climates in order to protect crops during periods of drought (FAO, 2003).

### 3. POVERTY

Poverty can be defined as a condition characterized by severe deprivation of basic human needs including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services (World Bank, 2001). Poverty can be classified as absolute and relative poverty. Absolute poverty refers to subsistence below minimum, socially acceptable living conditions, usually established based in nutritional requirements and other essential goods (Dessalien, 2000). Relative poverty compares the lower segments of a population with upper segments, usually measured in income quantity. Both types of poverty trends may move in opposite directions. For instance, relative poverty may decline while absolute poverty increases if the gap between upper and lower strata of a population is reduced by a decline in wellbeing of the former at the same time that additional households fall beneath the absolute poverty line (Dessalien, 2000).

In general, poverty takes various forms such as lack of income and productive resources to ensure sustainable livelihoods, hunger and malnutrition, ill health, limited or lack of access to education and other basic services, increased morbidity and mortality from illness, homelessness and inadequate housing, unsafe environments and social discrimination and exclusion (UN, 1995). It is also characterized by lack of participation in decision-making and in civil, social and cultural life. It occurs in all countries: as mass poverty in many developing countries, pockets of poverty amid wealth in developed countries, loss of livelihoods as a result of economic recession, sudden poverty as a result of disaster or conflict, the poverty of low wage workers and the absolute hardship of people who fall outside family support systems, social institutions and safety nets. Poverty is dynamic, its determinants varying both seasonally and from year to year (Smith, 2004). According to UNHCR (2004), poverty as a human condition characterized by the sustained or chronic deprivation of resources, capabilities, choices, security and power necessary for an adequate standard of living and other civil, cultural, economic, political and social rights. Therefore, poverty can be described as the state of being without the necessities of daily living, often associated with need, hardship and lack of resources across a wide range of circumstances.

### 3.1. Indicators (Measurements)

Indicators are the tools for tracking change and attributing the change to certain interventions. The most poverty indicators encompass both inadequate income and inadequate access to non-income dimensions such as basic services, personal security, empowerment to participate in decision-making and others (UNHCR, 2004). There are also other poverty indicators which consist; low level of education, poor nutrition, high vulnerability to disease and calamities (Bryceson and Jamal, 1977). Thus, in most developing countries including Ethiopia, rural population is significantly poorer than the urban population. Measuring poverty accurately is important within the context of gauging the scale of the poverty challenge, formulating policies and assessing their effectiveness. The current poverty measure has two main components (Fremstad, 2008).

### 3.2. Income Poverty (Poverty thresholds)

Poverty threshold are the amounts of money (dollar) that are compared with a family's resources. If a family's resources fall below the threshold, they are considered to be living in poverty. It mainly based on the levels of financial income and it is also used to determine poverty line. Poverty line is the boundary between poverty and non-poverty as determined by governments. It is based on the cost of subsistence needs in a given country (Krieger, 2002).

## 4. IMPACT OF IRRIGATION ON POVERTY REDUCTION

Irrigated agriculture has expanded significantly over the past five decades (Zewdie *et al.*, 2007). World irrigated areas have almost doubled from 139Mha in the 1961 to over 273Mha in 2001 (IWMI, 2002). It seems to be a general consensus that improving agriculture and enhancing agricultural productivity will remain a key strategy for rural poverty alleviation in most developing countries (Awulachew *et al.*, 2010). Improved access to food by the poor through their own increased production or enhanced purchasing power and economic ability to buy food would be the most effective way to move poor people out of poverty mainly in low productivity areas (Hussain and Hanjra, 2004). Irrigation leads to poverty reduction by its contribution due to five key dimensions in socio-economic activities of rural communities. These dimensions includes; production, income and consumption, employment, food security and other social impacts contributing to improve welfare. On the other hand, irrigation agriculture can reduce poverty by three pathways; micro, meso and macro pathway.



#### 4.1. Micro pathway

Irrigation enables to the smallholders to achieve higher yield. The average crop yields per hectare from irrigated land increases 2.3 times higher than the yield produced by rain fed agriculture (FAO, 2007). Higher productivity helps to increase returns to farmers' endowments of land and labor resources and it affects cropping intensity positively (Dahawan and Datta, 1992). Farmers in many parts of the countries are produced more than twice per year by using irrigation agriculture and they substituting low yielding and low profitable crops with new high yielding and more profitable crops. This implies that switching from subsistence production to market oriented production.

The role of irrigation is enabling the adoption of green revolution technologies, including modern varieties and their effects on income, employment, prices, food security and overall growth in micro pathway (Reardon and Taylor, 1996). Increased employment for the poor may originate from the labor intensive nature of irrigation developments construction and subsequent maintenance and from intensive cultivation both on their own farm as well as on farms of other large farmers who may find it difficult to provide extra labor from family resources during peak season. Additional employment opportunities may come from non-farm activities generated through increased demand for inputs and increased supply of outputs. This helps to improve and stabilize wages and in particular enables the poor to negotiate their wage terms with their employers (Bakker *et al.*, 1999). Rising wage incomes are particularly important for the landless. These mechanisms may result in higher permanent incomes for the poor. Higher permanent incomes help to reduce chronic poverty, while stable incomes help to reduce temporary poverty that arises from income fluctuations. This is direct effects of irrigation on poverty reduction (Kalkidan *et al.*, 2016). As the benefits of irrigation infrastructure are closely tied to the ownership of land, the first-generation beneficiaries tend to be large, medium and small landowners respectively. The landless may benefit in the long run in several other forms, through increased employment, higher and stable wages and lower food prices.

Crop intensification, diversification, and market-oriented production make food available and affordable for the poor and rich alike. Nevertheless, the main beneficiaries of low and stable food prices are the poor and landless households in rural areas and the urban poor, as they tend to be net buyers of food and spend a major part of their monthly expenditure, up to three-quarters, on basic food. Due to poverty-related resource constraints, nonfood Expenditure, recreation, health, education, and the environment tend to be reflected in decreasing order in the poor's budget calculus. Better and affordable food improves nutrition and health, which in turn has a favorable



impact on learning capabilities and skills of the poor. Higher incomes improve human capital formation, which in turn improves productivity and returns to human capital and physical endowments.

#### 4.2. Meso pathway

It is mainly due to the secondary benefits of irrigation. For instance, the effects of additional employment may spill over to landless workers in adjoining rain fed areas who migrate to irrigated areas to take advantage of the employment opportunities. Landless households are known to be a major source of labor in irrigation agriculture. Similarly higher wage and lower food prices benefit the general community let alone the irrigated community. Irrigation infrastructure funding decision influences both government and private sector decision-making. Governments tend to allocate more resources for infrastructure facilities to high potential favored areas. Financial institutions, such as banks respond to similar incentives and tend to open their branches to these high potential areas which in turn may become nuclei of growth. This sets into motion a process of market integration and technological transformation which makes modern infrastructure and financial services accessible to the poor peoples.

Access to low cost institutional credit has strong productivity enhancing and consumption smoothing effects which has significant influence on poverty. Access to irrigation facilities helps improve participation and decision making by the poor, at both micro and meso levels (van der Hoek *et al.*, 1999). This is particularly true in settings with farmer managed irrigation systems. Farmers' involvement in irrigation management and decision making delivers direct benefits at farm household level and indirect benefits at system level. At the household level, benefits in terms of higher water productivity, profitability and labor saving due to higher water use efficiency, improved maintenance and accountability management. These effects translate into system wide benefits thereby improving the overall performance of irrigation systems and promoting its sustainability. The decentralization of authority and user participation in irrigation management helps improve productivity, efficiency and equity (Svendsen, 1993). Multiple uses of irrigation water and irrigation infrastructure provide significant benefits to the landowners and land poor at the community or regional level (Jensen *et al.*, 1998). People in these areas depend upon irrigation water for all their requirements, including agriculture, domestic and livestock water uses (Meinzen-Dick and Bakker, 1999; Meinzen-Dick and van der Hoek, 2001).

### 4.3. Macro pathway

This path way works at the national and global level. It is widely important for economic growth and for poverty alleviation. Irrigation infrastructure development can bring technological change and cause for economic growth. Economic growth helps to raise long term and permanent incomes and draw poor people from poverty permanently. In general, irrigation led technological changes are the key driver behind productivity growth in the agriculture sector. This is due to its potential to increase overall food grain productivity; employment and income thus alleviate poverty and hunger (Freebairn, 1995). New irrigation agricultural technology may benefit the poor in long run in two ways; by reducing the cost of production and lowering food prices and by generating more nonfarm employment opportunities. The poor may enter into these new markets both as purchasers of goods and services or sellers of their products and surplus labor to other sectors (Datt and Ravallion, 1998; Kalkidan *et al.*, 2016). Therefore, irrigation multipliers may vary from country to country, it helps to makes agricultural productivity growth delivers large benefits to the rural communities including the poor and a large share of these benefits accrues via indirect channels and in the long term.

### 4.4. Contribution of Irrigation to Agricultural Productivity

In many low productivity and unexploited water resources areas, irrigation agriculture is being suggested as a key strategy to enhance agricultural productivity and stimulate economic development (Bhattarai *et al.*, 2002). Irrigation farming is recognized increasing land productivity, enhancing food security, earning higher and stable incomes and increasing prospects of multiple cropping and crop diversification (Hussain *et al.*, 2001; Smith, 2004). According to Hussain and Hanjra (2004), in some part of the world, cereal crop production more than doubled between 1995 and 2001 due to the combined effect of expansion of irrigation agriculture and the use of high yielding varieties and fertilizers.

In Ethiopia, agriculture is primarily rain fed; it depends on erratic and often insufficient rainfall. As a result, there are frequent failures of crop production (Abonesh *et al.*, 2006; Kalkidan *et al.*, 2016). Therefore, irrigation agriculture has the potential to stabilize crop production and mitigate the negative impacts of variable or insufficient rainfall. The development of irrigation and agricultural water management holds significant potential to improve productivity and reduce vulnerability to climactic volatility in the country (MoFED, 2010; Kalkidan *et al.*, 2017). In addition, irrigation agriculture is plays essential role in the performance of agriculture which increases income growth and income growth is essential for economic growth (Hussain and Biltonen, 2001).

Likewise, Zhou *et al.* (2008) argued that, irrigation practice contributes to agricultural production in two ways; increasing crop yields and enabling farmers to increase cropping intensity and switch to high-value crops. Thus, it can be an essential technological intervention to increase household income. So, it enabled increase income through the multiple cropping seasons and higher prices fetched in the dry season. It has improved yields and led to shift by most farmers to production of high value crops (Mowo *et al.*, 2002).

#### 4.5. Contribution of Irrigation on Food Security

Food security is defined as a situation in which all household have both physical and economic access to adequate food for all members and where households are not risk of losing such access and a situation in which people do not live in hunger or fear starvation (FAO, 2003). According to World Bank (1986) and FAO (1996), “Food security is meet when “all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life”. The main cause of food insecurity is the fluctuation in the amount and distribution of rain fall (Regassa *et al.*, 2006; Kalkidan *et al.*, 2017). Then, to tackle the problem associated with the erratic nature of rainfall, alternatives should be sought to get dependable production from agriculture. The issue for food security of many developing countries is serious concern. Irrigation is one means by which agricultural production can be increased to meet the growing food demands and sustain food security. Increasing food demand can be met in three ways: increasing agricultural yield, increasing the area of arable land and increasing cropping intensity (number of crops per year) (Awulachew *et al.*, 2010). Many researchers underline the importance of irrigation as a viable strategy to increase crop yields and to achieve food security in developing nations including Ethiopia where there is sufficient irrigation potential (Abraham *et al.*, 2015).

Ethiopia has also to combine these with enhancing water availability for production and expansion of irrigation that can lead to security in terms of getting a reliable harvest as well as intensification of cropping (producing more than ones per year). Rahmato (1999) reported that, investment on water management schemes will stabilize agricultural production and promote food security in areas of uncertainty and scarcity of rainfall. Irrigation also makes possible agricultural intensification. It provides the means of maximizing production with multiple cropping taking the advantages of modern technologies and high yielding crop varieties. In general, it is a vital tool to achieve food security through increasing agricultural products, intensifying the cropping patterns, increasing income by producing high-value crops and protecting soil in developing countries where agriculture is dominant in economy (Seid, 2002).

#### 4.6. Contribution of Irrigation to Household Income

Irrigation has high contributions to food security, asset ownership and income of rural households (Tedros, 2014). Increased 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 a few to mentioned (Kalkidan *et al.*, 2017). Most of the time, irrigation utilization greatly supports the livelihood of the non-irrigation users through employment opportunity; the daily laborers work in the irrigation farms of the irrigation users fully or partly (FAO, 2000). Irrigation users invest the additional income gained from irrigation in different activities. Some irrigation users provide in community services, while others in educating their children. Besides, increasing income from irrigation made them to access materials for their children and replaced the labor of their children engaged on-farm by hired labor. It decreased the number of dropout schooling (Kinfu, 2012). Surface irrigation systems are labor intensive operation and it requires engagement of more labor than rain-fed agriculture keeping other things unchanged. Therefore, irrigation can increase employment opportunity and rural households' income. This in turn enables to get access to food by improving purchasing power of individuals. It is found that existence of irrigation can increase income by creating more employment since it is labor intensive (Getahun, 2011).

#### 5. CONSTRAINTS ON IRRIGATION AGRICULTURE

Despite of its vital role, irrigation agriculture do not free from challenges and constraints. The core constraints and challenges are associated into biological, physical, economic, socio-cultural and political issues. Besides, soil salinity, depletion of water, flood and erosion, drainage challenges, maintenance challenges quality of design, pest infestation and input shortages as well as water borne diseases are some of biological and physical challenges for irrigation practice (Donald, 1995; World Bank, 1995; FAO, 1997). The economic constraints are linked with market price for irrigation crops, change in interest rate and market accessibility (Brown and Nooter, 1995). The social and cultural issues like land tenure policies are a significant challenge for performance of irrigation schemes especially in developing countries. In addition, the cooperation of larger range of government institutions and individuals such as irrigation department, extension and rural works, banks and planning bodies (Donald, 1995). To sum up, all these above mentioned challenges and constraints are expected to grow all of the more severe with increasing population, higher food demand, increasing temperatures and changing precipitation patterns (FAO, 2003).

## 6. CONCLUSION

In Ethiopia, irrigation agriculture was started in the 1960 for the purpose of producing industrial crops which is cotton and sugar cane on modern scale beginning. However, local communities had already practicing irrigation by diverting water from rivers in the dry season for the production of subsistence food crops mainly vegetables by traditional irrigation practice. Irrigation reduced poverty by its contribution due to five key dimensions in socio-economic activities of rural communities. These dimensions includes; production, income and consumption, employment, food security and other social impacts contributing to improve welfare. Besides, it can also reduce poverty by three pathways; micro, meso and macro pathway. In moisture stress areas, irrigation agriculture is being suggested as a key strategy to enhance agricultural productivity and stimulate economic development. It recognized increasing crop productivity, enhancing food security, earning higher and stable incomes and increasing prospects of multiple cropping and crop diversification. Despite of its importance, irrigation agriculture constrained by biological, physical, economical, social, cultural, political and salinity.

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