

The Role and Significance of Small Scale Irrigation in Improving Household Income in Ethiopia

Wakuma Dufera Tesgera and Wagari Guluma

Addis Ababa, Ethiopia

**Corresponding Author: Wakuma Dufera Tesgera, Addis Ababa, Ethiopia*

ABSTRACT

Critical studies on irrigation systems and developments in Ethiopia have been conducted by many researchers from the historical point of view up to the present time. This review discusses on the role and significance of small scale irrigation in improving household income in Ethiopia based on the current conditions of development and its contributions in improving the standard of living of household and its challenges. It is believed that irrigation practices are a good strategy in improving the standard of living of users in comparison to non-users. Irrigation users have higher living standard than that of non-use. On the other hand, evidence from many studies show that irrigation plays a significant role in the enhancement of food security and economic development of Ethiopia. Concerning the development of small scale irrigation in the country, Ethiopia has high potential of irrigable land and water resources. However, the exploitation of an irrigable land is only about 5 to 6 percent. This means, irrigation as a good strategy of improving standard of house hold living is not given attention by the public authority. As a result, its contribution to the national economy is not significant when compared to rain-fed agriculture. Therefore, public authorities, non-government bodies and researchers should participate for encouraging and motivating households to take part in small scale irrigation.

Keywords: Irrigation, Food Security, Living Standard Of Households

INTRODUCTION

Background

Ethiopia has typically a rural economy with the enormous majority of its population directly or indirectly involved in agriculture. Agriculture in the country is typically small- scale, rainfall dependent, traditional and subsistence farming with limited access to technology and institutional support services (Hundie 2014). The sector remains the mainstay of the country's economy in terms of income, employment and generation of export revenue. Its contribution to GDP, although showing a slight decline over the years has remained very high and it approximately contributes 38.5% of GDP, which is still far greater than the industry's share (15.6% of GDP), even though it was planned to balance the contribution of agriculture (Temesgen H. 2017).

According to Sargoi (2012), the development of small-scale irrigation is one of the major intervention strategies to boost agricultural production in the rural areas of the country. This helps poor farmers to overcome rainfall and water constraint by providing a sustainable supply of water for cultivation and livestock

farming, strengthen the base for sustainable agriculture, provide of increased food security to poor communities through irrigated agriculture and contributing to the improvement of human nutrition.

Irrigation is one means by which agricultural production can be increased to meet the growing food demands in Ethiopia. Small scale irrigation in Ethiopia (Jirane 2015; Kidane 2016) is a key to increase farmers' income, household employment and defending livelihoods against economic vulnerability by producing higher value crops for sale in markets and to harvest more than once per year. This sector being a crucial strategy not only increases income but also makes optional allocation of household labor. On the other hand small scale irrigation is a means for self-employment in household labor (Temesgen H. 2017). In turn, this provides them to build up their assets, buy more food and non-food household items, educate their children, and reinvest in further increasing their production by buying farm inputs or livestock (James and Maryam 2014).

In addition, small scale irrigation is one strategy for the allocation of paid and unpaid work

within households which strongly depends on the household members' individual characteristics. Typical farm households in rural areas allocate their labor among their own farm work and off-farm activities. As a result, they engage in different production activities which are both market oriented and subsistence in nature. Combining on and off-farm work of households is indeed an efficient way of household's labor resource use because it allows income levels compatible with farm survival as it takes in to account income opportunities stemming from the farm and alternative employment opportunities. Such labor allocation decision of households have received significant attention in agricultural activities (Bedemo 2013). Ethiopia has great potential in irrigable land and water resource. According to the Federal Ministry of agricultural and natural resource office report of 2016, there are about 4.3 million hectare of irrigable land and among this only 247,470 hectares of land have been irrigated. According to this report, Ethiopia is endowed with good potential of land which can lift the country out of poverty but it could not yet utilize this opportunity of resource.

Even if Ethiopia has a huge potential in terms of surface and ground water availability and land which are in most cases suitable for irrigation, its role in this sector is not as much as needed to reduce the problem of income. This underdevelopment of small scale irrigation and low level of income in the sector needs investigation. To identify the problem, few researches have been conducted in the country. To cite a few for example, the study conducted by Jirane (2015); Bedemo (2013); James and Maryam (2014), shows that the major constraints that slow down the development of the sub-sector among others are predominantly primitive nature of the overall existing production system, shortage of agricultural inputs and low level of users' participation in the development.

On the other hand Gbenga et al. (2015) and Asefa (2008) defined that the major problems of small scale irrigation are shortage of input supply, output marketing and credit service, training of farmers on improved crop and water management issues, rough supervision and monitoring of scheme activities are crucial. But all the researchers are failed to pinpoint the significance and role of small scale irrigation in improving household income. So, the gap is the role of small scale irrigation in improving household income. To fill this gap, the review

tries to assess on the role and significance of small scale irrigation on improving household income. This review therefore, concentrates on significance and role of small scale irrigation as tool for generating income in Ethiopia.

Objectives

General Objectives

The general objective of this seminar paper is to identify the role and significance of small scale irrigation in improving household income in Ethiopia.

Specific Objectives of the Study

The specific objective of this paper is to:-

- Identify factors determining small scale irrigation
- Explain the role of small scale irrigation in improving standard of living of household

Methodology

Collection of Data Type

The result of the review reveals that the characteristic of the data collection on small scale irrigation collected by different researchers is based on cross sectional data type. As I have reviewed many research findings, the type of data collection is cross sectional type. Researchers give their reason for using this is that the data type on participation of household in small scale irrigation is qualitative and such data is convenient with cross sectional data type than that of time series or panel data. To cite some of them, (Seleshi Bekele; Makonnen Loulseged; Aster Denekew 2008; Haile and Kassa 2015; Namara 2014; Kinfie Aseyehgn 2017 and Ambe 2018) used cross sectional data type.

Data Source and Methods of Collection

Quantitative data is collected from secondary sources. Secondary data for the review is collected from Central Statistics Authority (CSA), Ministry of Agriculture (MoA) and different research literatures.

Methods of Data Analysis

The collected quantitative data is analyzed using descriptive methods like tables, percentage, mean, pie chart and bar graph from the secondary data to analyze the significance of small scale irrigation in improving household income.

Econometric Model

A good selection of model for exact identification of the research to get targeted objective result is very important. In this review of the research title, “the importance and significance of small scale irrigation in improving house hold income in Ethiopia “is conducted by many researchers. These researchers used in similar way of cross sectional data type with different model to find the final result. Some researchers used logit model while the others used probit model. There are also other researchers who use propensity score matching model .To cite as example; (Aregawi 2014b; Ayele 2011;Jirane 2015; Woldegebrial 2013) used logit model. The expected outcome of the researchers for the data is participation of household in small scale irrigation($Y=1$ if individual participate and $y=0$ otherwise).Although the data is qualitative type; it had better use descriptive (percentage, average, bar graph and pie chart) and probit model. An expected outcome is significance of small scale irrigation in improving income($Y=1$ if it improve income, $0=$ otherwise).In this case probit model is better than logit model because in probit model we can express a hidden (latent)variable but by logit model no hidden variable can be explained. So, the hidden variable is significance of small scale irrigation. This means small scale irrigation is significant if and only if it improves income.

LITERATURE REVIEW

Theoretical Review

Basic Definitions and Concepts

Definition of a Household

Different definitions by different researchers have been given to the meaning of household. According to SargoI (2012), a household is a unit of people living together headed by a household head. Apart from the head of the household, there may be a spouse, children and permanent dependents like elderly parents or temporary dependents like a divorced daughter or unemployed son.

Definition of Irrigation and its Classification

Irrigation

Irrigation is the artificial application of water to soil for the purpose of crop production. Irrigation water is supplied to supplement the water available from rainfall and the contribution to soil moisture from ground water (Huffman 2010). Irrigation is scientifically supported means of artificial mechanism for

taking water to fertile land and using it (Gbenga et al. 2015).

It is a method by which land precipitation may be maintained by supplying water to the intended farm land. In this case, water for agricultural production can be sought from mowing rivers, collection of rainwater by building dams and reservoirs and pumping up from the ground (Nasir 2014).According to Makombe (2015), irrigation is defined as the supply of water to agricultural crops by artificial means, designed to permit farming in arid regions and to offset the effect of drought in semi-arid regions and even in areas where total seasonal rainfall is adequate on average; it may be poorly distributed during the year and variable from year to year.

Classification of Irrigation

Classifying irrigation using scale varies from country to country. Example, in India irrigation scheme of 10,000 hectares is classified as ‘small’ while in Ghana, the largest irrigation scheme is 3000 hectares (Ambe 2018). According to (Hirko, Ketema, and Beyene 2018), irrigation schemes in Ethiopia, can be grouped in to three based on scale: large scale schemes, which can irrigate up to 3000 hectares of land and they are usually established and run by the state; medium-scale schemes can irrigate an area of 200-3000 hectares of land and most of times accomplished by state farms and enterprise. The third category is small-scale schemes which can irrigate up to 200 hectares of land mainly owned and managed by smallholder farmers organized into community groups or water-use associations. In the similar way, the study conducted by Makombe (2017) shows that irrigation is classified as small (less than 200 ha), medium (200 to 3,000 ha) and large-scale (over 3,000 ha) schemes based up on the command area.

Empirical Review

Status of Irrigation Development in the World

Different literatures witnessed that irrigation practice is an age-old art practiced for thousands of years in the world. According to Elemo (2014) , an estimated eight million hectares of land were irrigated worldwide during 1800s. During the early 1950s, the irrigated area in the world increased to about 94 million hectares (Seleshi Bekele et.al 2008).A century later, this area had increased by about 40 million hectares and in 2008 irrigated areas in the world increased to 304 million partially as a result of

new irrigation technology. Due to high increase in population and increase in demand of food, irrigated agriculture has been an engine for agricultural development since World War II. Historically, civilizations have been dependent on development of irrigated agriculture to provide jobs, income and to enhance food security to the people(S B Awulachew et al. 2007).

Tefera and Cho(2017) believe that irrigation has been practiced for a long time of years in the Nile Valley. Egypt claims to have the world's oldest dam built about 5000 years ago to supply drinking water and for irrigation in order to promote agricultural development. At that time, basin irrigation was introduced and still plays a significant role in Egyptian agriculture. Irrigation has been practiced in Egypt, China, India and other parts of Asia for a long period of time. India and Far East have been using irrigation to grow rice for nearly 5000 years. The Nile valley in Egypt, the plain of Euphrates and Tigris in Iraq were under irrigation for 4000 years (Mohammed 2016). Irrigation is the foundation of civilization in several regions. Egyptians have loading for irrigation continuously for a long period of time on a large scale. The land between the Euphrates and Tigris, Mesopotamia, was the breadbasket for the Sumerian Empire and the civilization developed from centrally controlled irrigation system (Abiyu 2016).

According to Aregawi (2014), the Indus Valley Civilization in Pakistan and North India from

2600 BC also had an early canal irrigation system. Large scale agriculture was practiced and an extensive network of canals was used for the purpose of irrigation. Sophisticated irrigation and storage systems were developed including the reservoirs built at Girnar in 3000 BC. Evidence also shows that irrigation in China began about 4000 years ago. There were reservoirs in Sri Lanka which is more than 2000 years old (World Bank 2010).

Status of Irrigation Development in Africa

There is a need to prioritize irrigation development in Africa not only because of the existence of agricultural water resources, but also the high value of irrigated agriculture on the continent and the large number of rural poor that could benefit from high productivity as a result of irrigation investment. The data from 12 selected African countries namely Madagascar, Ethiopia, Tanzania, Zimbabwe, Mozambique, Angola, Kenya, Zambia, Eritrea, Malawi, Burundi, Rwanda account for a total potential of irrigation land 17.7 million hectare.

But from this available potential land, only 10.8 % (1.9 million hectare) is used for irrigation and the remaining 89.1 % of land is underutilized. Low level of irrigation development in Africa may be due to high irrigation investment costs, perceived failures of past irrigation projects, limited government commitment, poor rural infrastructure, fragmented farmers and crops with low water requirements (Legesse 2018).

Table 1: The Status of Irrigation Potential in Ethiopia visa-a-vis other Selected African Countries

Country	Total Potential area for irrigation (in 000 ²)	Area used for Irrigation (in 000 ²)	Under used Potential area(in 000 ²)	Percentage use of irrigation to total potential area
Angola	6 700	75	6275	0.1
Burundi	185	14	111	7.5
Eritrea	Na	28	Na	Na
Ethiopia	3637	190	447	5.2
Kenya	352	67	279	19.03
Madagascar	1500	1087	413	72.5
Malawi	162	28	72	17.3
Mozambique	3300	107	193	3.2
Rwanda	160	4	Na	2.5
Tanzania	828	150	678	18.11
Zambia	520	46	374	8.8
Zimbabwe	331	117	194	35.34
Total	17675	1913	9036	10.82

Source: calculated from the data of MoARD, 2006, Na* =Not assigned

The data presented by MoARD from table 1 reveals that Madagascar is the first user of irrigation which accounts about 1.1 million

hectare of land or 72.5 % of its total potential land area. But the remaining countries like Ethiopia, Kenya, Angola, Rwanda, Tanzania,

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Zambia, and Malawi use 5.2 %,19.03 %,0.1 %,2.5 % ,18.11 %, 8.8 % and 17.3 % respectively. This data reveals that Africa has high potential water and irrigable land resources which can move living of the society out of poverty. But the emphasis given to this sub sector is very low and the resource remains underutilized. This shows that the overall use of irrigation in Africa is not more than 10 % of the total potential irrigable land.

History of Irrigation Potential and its Situation in Ethiopia

Modern irrigation was started at the Awash River basin with bilateral cooperation of Ethiopia and Dutch company, during the 1950s for the productions of commercial crops such as sugar cane and cotton (Gebremedhin and Asfaw, 2015). Resent source indicates that, the total area of irrigated land in Ethiopia increased from 885,000 ha to 2.4 million ha from 2011 to 2015 with a plan of increasing irrigated land to 4 million by 2020 (MoNR, 2012), including the 658,340 ha of land developed with high and medium irrigation schemes (NPC, 2015). But there is a plan to expand the high and medium schemes to about 954,000 hectares by the end of the GTP-II (2019/20). Evidence also shows that, in Ethiopia, farm size per household is 0.5 ha and the irrigated land per households' ranges from 0.25 - 0.5 ha on average (MoA, 2011).

Ethiopia is a rich country in water resource and most of the time it is termed as a water tower of east Africa because of its abundant water resource availability (Elemo, Edo, 2014). It has a huge potential of water resource which accounts 122 billion meter cube annual surface runoff and 2.9 billion meter cube groundwater, though it is characterized by uneven spatial and temporal distributions (Tesfa and Tripathi, 2015). But Ethiopia is using a very little of its abundant water resource potential for irrigated agriculture (Mohammed, Seid Abdie. 2016). Even though there is no similar evidence about the potential it have from different sources, it has a high potential. The estimated total irrigable land potential in Ethiopia is 5.3 million hectare assuming use of existing technologies, including 1.6 million ha through rain water harvesting and ground water (Awulachew, 2010). This indicates that there are potential opportunities to vastly increase the area of irrigated land. According to Awulachew (2010) given this high potential, if it is successfully operated, irrigation in Ethiopia could play a significant role in the agricultural transformation of the country, contributing up to ETB 140 billion to the economy and potentially moving up to 6 million households into food security.



Source: (CSA, 2018)

Figure1. Irrigation Potential in River Basin of Ethiopia

Table2. Irrigation Potential in River Basin Ethiopia by Region

Region	Traditional SSI (in Ha)	Number of farmers	Modern SSI (Ha)	Number of farmers	Private SSI.	Medium SSI	Total irrigation (Ha)	
Addis Abeba	352	8608	0	0	0	0	352	0.12
Afar	2440	16640	0	0	2000	39319	43759	15.11
Amhara	64035	384250	5752	17166	0	0	69787	24.11
B/Gumuz	400	2000	200	170	0	0	600	0.21

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D/Dawa	640	1536	860	2696	0	0	1500	0.52
Gambella	46	373	70	280	0	0	116	0.04
Hareri	812	558	125	71	0	0	937	0.32
Oromia	56807	113614	17690	61706	2614	35376	112487	38.85
SNNR	2000	2700	11577	45000	800	20308	34685	11.98
Somali	8200	16400	1800	7000	0	2700	12700	4.39
Tigray	2607	25692	10000	40000	0	0	12607	4.35
Total	138339	572371	48074	174089	5414	97703	289530	100

Source: Awulachew and Mekonin (2011), cited by Yohannes(2019)

The data in table 2 reveals that Ethiopia has great potential of irrigable land as well as high availability of water resources. But the usage of this water resource is not as expected. For example from the available irrigable land Amara has 24.11%, Oromia has 38.85 %, and Afar region has the lowest which is 0.12 %. Even though irrigation users are more food secured and have better in living standard than non-users of irrigation, household participation in irrigation is still very low. The study conducted by Namara (2014) indicates that out of the existing cultivated area only about 4 to 5 percent is irrigated, with existing equipped irrigation schemes covering about 640,000 hectares. According to him a significant portion of cultivated land in Ethiopia is currently not irrigated.

The Significance of Small Scale Irrigation in Ethiopia

Improve household Livings

As various scholars like Chazovachii(2012) confirmed that, small holder irrigated agriculture had proven to be a viable and attractive alternative for poor farmers especially in developing countries like Ethiopia. In addition, he asserted that returns from intensive irrigated agriculture even on tiny plots could greatly exceed returns from rain fed cereal production. The study result by Chazovachii indicates that in developing countries such as Ethiopia, small scale irrigation schemes were counted on to increase production, reduce unpredictable rainfall risk and provide food security and employment to poor farmers.

In general, irrigation farming is the source of income for the poor rural people that are mostly women, widows, and orphans. Similarly, some empirical results show that irrigation farming enables the growing of green vegetables, wheat, tomatoes, cotton, maize and even sugar-cane among others (Gbenga et al. 2015). In contrast, Shitundu (1994) reports that more than 70% of the poor people in the world live in areas relying mostly on agricultural activities and sometimes

mining and fishing for survival. Besides, as Makombe et al. (2017) proposes that, about half of the family heads in the informal sectors are employed as peasant farmers. And as population is ever increasing, land set aside for irrigation farming has been excessively subdivided rendering most units sub-economic irrigation schemes. This author also postulates that, land is deteriorating very rapidly in the country and in most cases farmers do not have access to or buying power to purchase certified seeds and fertilizers (Elemo 2014).

Irrigation can improve income and employment if farmers can access markets for inputs and produce, food pricing systems reflect real costs of production, and farmers diversify beyond staple cereals. As Tsegazeab (2016) indicates, irrigation intensifies input especially labor throughout the year and it motivates to self-employment and decreases leisure time of active labors. This raise off-farm income, it encourages withdrawing active labor force from irrigation activities and placing to off farm income activities which reduces irrigation participation of farm households. Furthermore, farm households have that accesses to market information are able to compare, the net income from rain-fed and irrigation farming. Similarly, it assists in purchasing of the right input at the right time from the right enterprise and supplying of the products to the right customer with a reasonable price.

Therefore, irrigation farming contributes significantly for household especially in terms of income in rural areas. Due to most of the rural household are unemployed, most families' income levels are relatively low and possibly not enough to acquire their basic commodities and services. As I have reviewed different researches, small scale irrigation has greater potential in improving the households' living standard.

Employment Creation

Among the many benefits of irrigation, employment generation is crucial. Since, labor is one of the major inputs used in small-scale

irrigation farming, trained and experienced labors are essential production factors. Family labor is the major source of labor for both irrigation farming as well as for non-irrigated areas (Ambe 2018). And in most cases demand for labor is higher during peak production period which means for transplanting, weeding and harvesting farmers hire additional labor. Both male and female laborers are involved in the production activities. Male labors are involved in all production activities whereas females are mostly involved during planting, weeding, and harvesting.

Thus, irrigation provides seasonal employment for people in the surrounding farms. Hired labor is paid in cash or in kind or both when performing works in irrigation. The irrigation system also acts as an employer to the irrigators (Chazovachii 2012). The beneficiaries have shifted from once a year (rainy season) to two and three harvests and efficiency in labor use has been increased due to irrigation. Similarly, the average labor cost (calculated only for hired labor) for irrigation user is more than doubled than the non-user households. This implies that, irrigation is a stimulus to increased employment opportunity. Most smallholders draw from the same family labor sources to supplement for certain operations by the help of neighbor and casual wage labor. The development of the irrigation schemes has created job opportunities for the nearby farmers in addition to the irrigation users in the traditionally slack dry times (Makombe et al. 2017).

The study result analyzed by Kinfu (2017) indicates that there are two sources of additional demand for labor created by irrigation projects. Irrigation projects firstly require labor for construction and on-going maintenance of canals, wells and pumps etc. This is likely to be an important sector of employment for the poor, especially the landless rural poor or rural households with excess labor or seasonal excess labor. Secondly, increased farm output as a result of irrigation stimulates demand for farm labor both within the main cropping season and across new cropping seasons, increasing both numbers of workers required and length of employment period. Rural poverty levels may therefore be reduced by increased employment opportunities. In addition there may be effects that extend to other areas if irrigation projects reduce migration to urban areas, and so reduce the pool of job-seekers and relieve the downward pressure on urban wages and the upward pressure on prices

of housing and other urban infrastructure (Hundie, 2014). The study conducted by Ambe, (2018) also supports this idea. He says that the mean hour invested on irrigated farm is significantly higher than the rain fed only farm for all activities from plowing to thrashing.

Contribution of Irrigation as Food Security

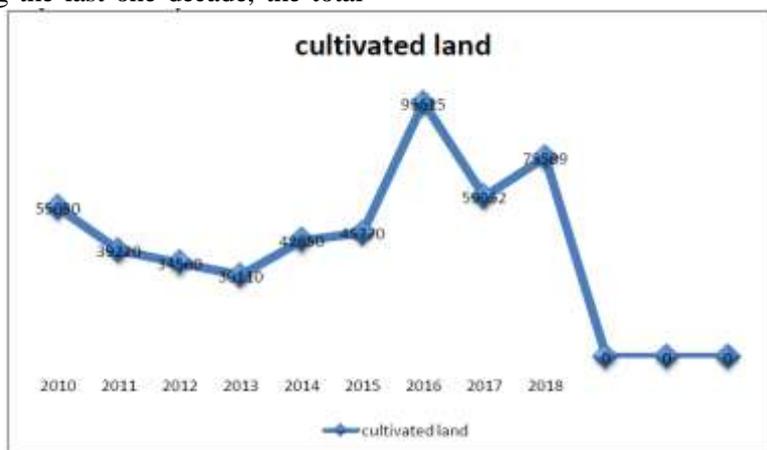
The irrigation system also acts as a source of food security during times of drought. During the time of drought, non-irrigators come to buy grain maize from the system. The irrigators do not experience any grain shortage like the dry land counterparts of non-irrigators. A study conducted by Damtew (2017) indicates that household food security in the north eastern part of Ethiopia is strongly associated with various socio-economic and bio-physical factors that influence the food security status of households were age of household head, dependency ratio, size of cultivated land, total number of livestock owned, manure application, land quality and farmer's knowledge on the effect of land degradation on food security.

An empirical study by Woldegebrail (2013) on the sampled households out of the total irrigation users resulted that (82%) of irrigation user households were food secure, 6% of irrigation user households were mildly food insecure while 10% of irrigation user households were moderately food insecure and only 2% of irrigation user households were severely food insecure. Similarly, out of total non-user, 46% were food secure, 11% of non-user were mildly food insecure while 28% of irrigation non-user were moderately food insecure and 15% of non-user were severely food insecure. The result indicates that irrigation user households are more food secure than irrigation non-user households. According to the study conducted by ministry of agriculture and rural development (2007), irrigators are more food secured than non-irrigators. This means that irrigation is a chopping mechanism for improving food security of households. The study conducted by FAO (2015), indicates that irrigation users are more food secured than those non-users.

Irrigation enables farmers to improve crop production and intensification thereby sustaining and improving livelihoods and food security. In Ethiopia, private peasant farmers use irrigation at small scale level to enable them increase crop production and as a means of raising income. Small scale irrigation not only increase crop production, but also improves cropping intensity and reduces the effect of erratic rainfall. The

practice of irrigation may not be possible for every farmer and could not be possible to expand the area. The study conducted by Seleshi Bekele; Makonnen Loulseged; Aster Denekew (2008) reveal that during the last one decade, the total

irrigated land by private peasant farmers ranged between 63 and 175 thousand hectares which is 0.8 to 1.8 per cent of the total area covered under rain-fed agriculture, respectively.



Source: MoANRM, 2018

Fig 2. Irrigated area under Small-holder Private Farmers (2010 -2018 (in ha)

The data presented above shows that cultivation of land for irrigation is continuously decreasing from 2010 to 2013 and slightly increased from 2013 to 2015. But the cultivation of land use for irrigation sharply increased 2015 and 2016. This rapid increase may be due to the increase in youth unemployment and as a result emphasis has been given by government to reduce the problem of food insecurity through irrigation use in agriculture. According to (Legesse 2018), the significance of SSI has high potential in creating food security as well as generating income. As I have reviewed the significance of small scale irrigation as an instrument of food security, irrigation users are better food secured than that of non-users. The major type of crops produced by irrigators includes Teff, barley, maize, wheat and sorghum. The data conducted by FAO (2015) also tells us that irrigation help households in improving food security through an increase of agricultural production.

Drought Relief Savings

The irrigation scheme farmers are always food self-sufficient. While farmers living in dry land often rely on food aids from government, this is not the case with the irrigators on the scheme. By not providing drought relief to the irrigators and their families the government is making a enormous financial saving. The government saving only captures the cost of purchasing maize or other crops without even taking into account transportation costs, manpower costs and other logistical support required in the distribution of this relief packages. In addition a

complete drought relief package could include other commodities like beans which, if included, would double the drought relief requirement (Gbenga et al. 2015).

Improving Household Income

It is expected and revealed that irrigation would improve income earning (Chazovachii 2012; Kinfe 2017). According to Kinfe, irrigation beneficiaries earned an annual mean income of 10161.5 Birr per household, which is 33.6% higher than that of non-users. Irrigation use has a positive impact on households earning from crop, and livestock, while the value of off farm income earning was higher for non-users. Close examination of the data exhibit that remunerative off farm income sources like cart and trade were the results of irrigated agriculture whereas inferior livelihood activities like fire wood and charcoal selling, and casual work were dominated by non-irrigators. Similarly Aregawi (2014) concluded a better result of irrigation on increasing income that irrigators earned 47.4% higher than that of non-irrigators from crop alone.

Irrigation has high contributions to food security, asset ownership and income of rural households. 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). Irrigation users invest the additional income gained from irrigation in different activities. The review made on the role of irrigation in increasing household income shows that some irrigation users provide in community services, while others in educating their children.

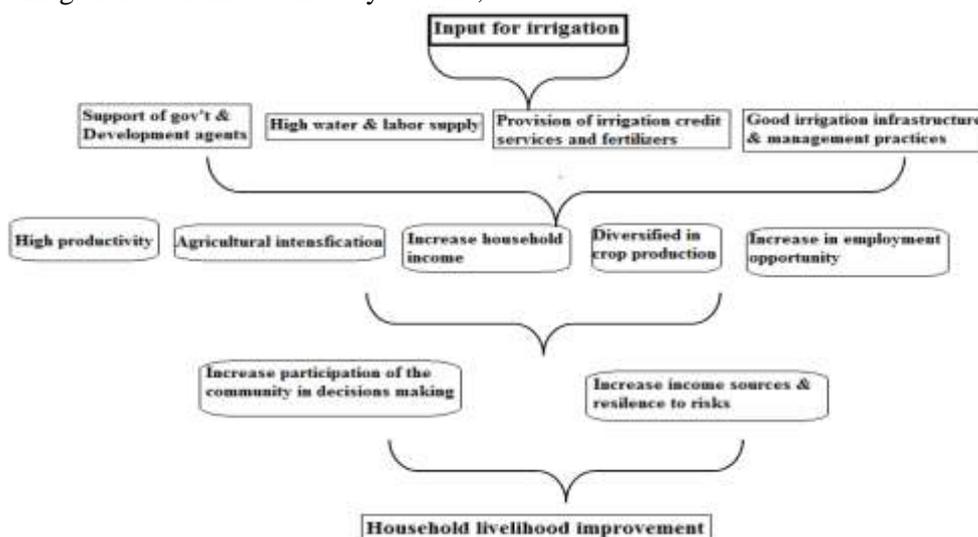
In addition, increasing income from irrigation made them to access materials for their children and replaced the labor of their children engaged on-farm by hired labor. It decreased the number of dropout schooling. Surface irrigation systems are labor intensive operation and it requires engagement of more labor than rain-fed agriculture keeping other things unchanged. Therefore, irrigation can increase employment opportunity and rural households' income. I also reviewed the contribution of irrigation as source of income and its direct impact on creating employment and food security. Many researchers agreed with this area as irrigation 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 (Mohammed 2016).

Creation of Assets

Irrigators manage to acquire assets using incomes from the scheme. For example, farmers on the irrigation scheme can buy trucks,

cultivators, ploughs, harrows and own small cars which are bought from scheme generated incomes. The cars help in the transporting of produce to the market. Farmers could also buy animals from the scheme incomes if they wish (Hirko, Ketema, and Beyene 2018).

According to World Bank (2010), irrigating households increase an average of 20% in their annual income since adopting irrigation, and in some cases up to 30%, due to cultivation of higher value crops, intensified production and reduced losses. Nutrition is said to have improved as various fruit and vegetables became locally available. The most successful households have increased their assets, particularly livestock which is an important form of saving and wealth accumulation. Some have bought new farming equipment to further increase productivity. In Ethiopia, the average crop yields per hectare from irrigated land increases 2.3 times higher than the yield produced by rain fed agriculture (Fikirie and Beyene 2017). 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' (Kidane 2016).



Source: Developed from the concept of literature

Fig3. Conceptual Framework Developed from Literature Review

Entrepreneurial Skills

Irrigators can develop entrepreneurial skills over the years. The skills might help them to budget for their cropping activities, can manage their own affairs and can borrow and repay debts by participating in the irrigation scheme. In

addition, the irrigation pattern enhances business activities for the local dealer who supplies the scheme with inputs. The high value crops grown in different irrigation schemes require high levels of fertilizer and chemicals and these are mainly purchased from the local dealers. Transporters could also benefit from the

farmers who hire trucks to carry produce to the markets (Ambe 2018). I reviewed many research articles concerning contribution of irrigation in developing entrepreneurial skill for households. For example the study by (Nyirenda 2015; Fikirie and Beyene 2017; and Kidane 2016) states that irrigation user households gain entrepreneurial skill through time as they can get high income from selling of high valuable crops and vegetables on their plot of land. This high income enables the producers to buy agricultural inputs and as a result the productivity further increases. This increase productivity help the participants invest on large area of land.

Challenges of Small Scale Irrigation in Ethiopia

According to Fikirie and Beyene (2017), the core constraints and challenges of irrigation 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. The study by Fikirie and Beyene expresses as the above as economic constraints are linked with market price for irrigation crops, change in interest rate and market accessibility. 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.

According to Awulachew, Erkossa, and Namara (2010), there are four challenges of irrigation in terms of institutional, human and technical capacity, capability, policy context, and funding. The constraints are explored at each decision-making level. On the other hand the study by (Haile and Kassa 2015) shows that the major challenges of small scale irrigation are explained as technical constraints and knowledge gaps as inadequate awareness of irrigation water management, inadequate knowledge on improved and diversified irrigation agronomic practices, shortage of basic technical knowledge on irrigation, inadequate baseline data and information on the development of water resources, lack of experience in design, construction and supervision of quality irrigation projects, low

productivity of existing irrigation schemes, inadequate community involvement and consultation in scheme planning, construction and implementation of irrigation development, poor economic background of users for irrigation infrastructure development, to access irrigation technologies and agricultural inputs, where the price increment is not affordable to farmers.

In addition, I reviewed concerning the challenges of small scale irrigation in the country whether there is different finding for the problem and challenges of the study. The challenges that determine performance of small scale irrigation depends on: cropping pattern, market accessibility, maintenance and spare parts, social and political, and land tenure policies (Tefera and Cho 2017). The result of this review show that the finding of a small scale irrigation challenges by different researcher is little difference. As I reviewed, the result may be due to the factual practical condition adapted in different area. This people's practical adaptation may be the country's different agro ecological condition. As a result the people's understanding (awareness) and the socio-economic make-up of the society in different area and the intensity of the problem may vary. On the other hand, the one that is considered as challenge in one area or region may be considered as good opportunity in another area of the country. These may be one reason for the variation of the findings.

DATA ANALYSIS

Significance of Agriculture to Ethiopian Economy

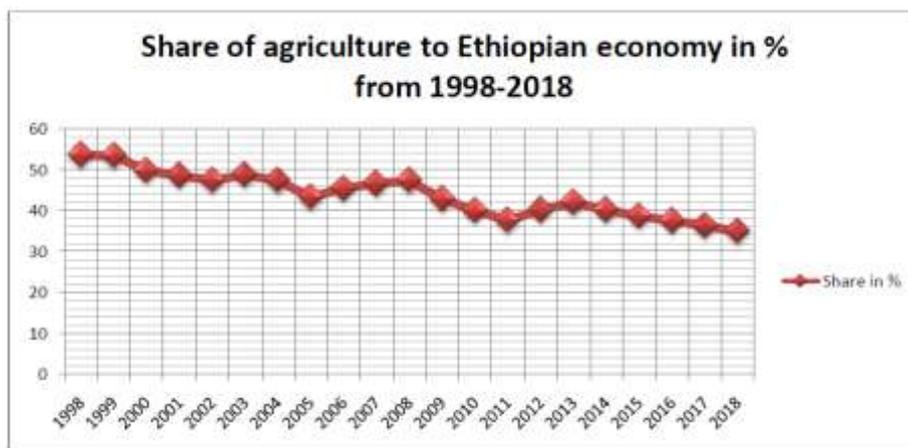
According to CSA (2007), the contribution of agriculture is included in GDP of the country by adding the two seasons of Belg and Meher together. As agriculture has many subsectors under it like animal rearing, forestry, fishing and crop production, among these, crop production has the lion's share in its contribution to Ethiopian economy. Fig 4 is the summation of all agricultural subsectors that contributed to Ethiopian economy from 1998 to 2018.

The data presented in fig.4 shows the share of agriculture to Ethiopian economy. The review reveals that more than half of the country's economy is from agriculture before 20 years. This means that the share of agriculture was about 52 % in 1998 and this trend in share of agriculture to the economy slightly decreased to 38.5 % in 2018. This decrease in share of

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agriculture to GDP may be due to high attention given by the current government to enhance small holder farmers that shifts the economy from agrarian to industrial through ADLI strategy implementation.

The review also reveals that even if the trend of the share of agriculture to Ethiopian economy is decreasing, the decline is not more than 2 %. This indicates that still agriculture is the pillar of country's economy.



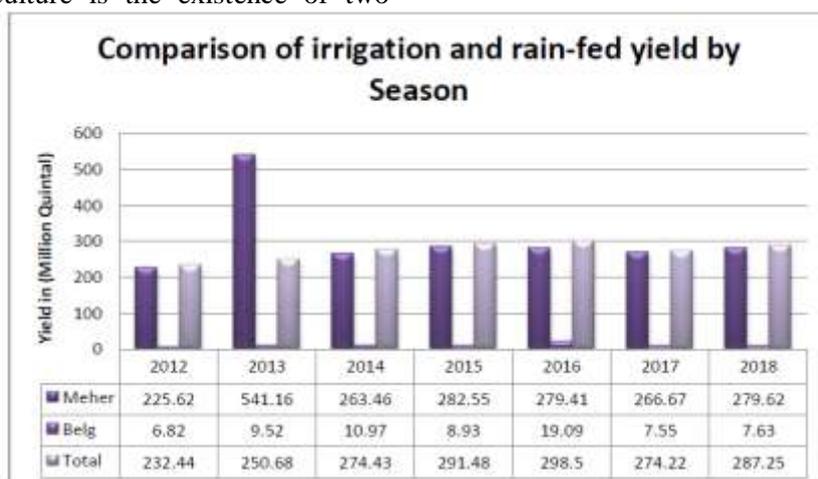
Source: Calculated from literature review

Fig4. Share of Agriculture to Ethiopian Economy

Season of Harvesting Agricultural Crop Product in Ethiopia

Meher or Main season is when all irrigation user and non-irrigation users produce at the time of rainy season. But Belg season is a time that only irrigation users produce by the help of surface water or ground water and some minimum use of rain. According to CSA (2011), a major Ethiopian agriculture is the existence of two

well-known crop production seasons referred to as the Meher (or main) and Belg (short rain) Seasons. The generally accepted definition of the Meher season is that of the long rainy season, which normally occurs from June to September. The Belg Season most often refers to small but timely rainy season, which normally occurs from February to May but in limited areas of the country.



Source: calculated from World Bank (2016) and CSA (2018)

Fig5. Comparison of irrigation and rain-fed yield in millions of quintal (2012-2018) in Ethiopia

The data presented from the above reveals that, annual production of irrigation crop is too low. This means the annual crop productions in 2012 was 2.93 % and 2.66 % in 2018. This data result tells us that even though irrigation has greatest significance in moving households out of poverty, the participation is still too low and

currently annual crop yield from irrigation is decreasing 6.4 %, 2.8 % and 2.66 % in 2016, 2017, and 2018 respectively. As I reviewed, this may be due to two reasons. One is the country's structural change that shifts from agricultural sector to industrial and service sector. The second major reason is due to the challenges and

problems that hinder the participation in irrigation like availability of land, financial constraint, lack of awareness or training, lack of market, infrastructural supply constraint. Generally, the Meher Season (rainy period) provides ideal growing conditions for the longer maturing crops. Planting and harvest of Meher crops can extend to December or January in some areas. Most of the time holders rely on short maturing crops for planting during the Belg rainy period and harvest of the crops is in June or July. A point of contention arises with respect to the pure definition of the Belg crop. According to CSA (2011), Belg cropping practices are heterogeneous across different portions of the country. The nature of the sowing period also overlaps with some of the Meher Season crops. Consequently, the report on Belg Season crops in the past faced a problem of a clearly defined growing period. It is important not to overlook or miss agricultural practices performed all year round due to use of irrigation or soil moisture from sufficiently dried areas that from time-to-time are swampy or marshy. To help clarify the two-crop season, CSA used the following definition as; - “Belg Season Crops are defined as any crops that are harvested during the months of March to

August, while those crops that are harvested during September to February are considered Meher (main) season crops. Therefore, the contribution of crop to GDP from agricultural sector is based on these two categories of season in the country.

The yield harvested in Belg season and Meher added together to calculate total annual crop production in the country. From this annual total crop production, more than 95 % of the yield is produced during the main season (Meher) and irrigation crop production is below 8 % in every year. As far as concerning availability of resources, the country has great potential of underground and surface water as well as human resources. This great variation of production between Meher (main season) and Belg season tells us that the emphasis given to this sub sector by the government and the awareness of households in using SSI as poverty reduction is too low. Although many researchers believe the significance of irrigation in improving household income, the implementation of this sector by the help of technology or in traditional way is not as expected. According to the CSA (2013), from the total cultivated area of land, only 3.49 % is used for irrigation cultivation.

Table5. Total cultivation of land (2013) for main season and Belg season

Year	Total arable land	Cultivated for irrigation	% of cultivation for irrigation
2013	14,337,647.65	1,327,860.70	4 %

Source: CSA, 2013

The data above reveals that cultivation of land use for irrigation is too low (4%) and this also tells us participation of households in cultivating their land for irrigation is too low. On the other hand, the country’s arable land which is cultivated only during the main season and for grazing land (Meher season) is 96 % and the remaining (4%) of land is cultivated for irrigation. According to CSA (2007), from the total arable land area of 13,463,000 hectare, only 3.4 % of the land is used for irrigation purpose and the remaining 88.7 % and 7.9 % are cultivated during main season or for commercial farming purpose respectively. This reveals that land and water use for irrigation in the country is not given attention.

The Role of Irrigation in Agricultural Development

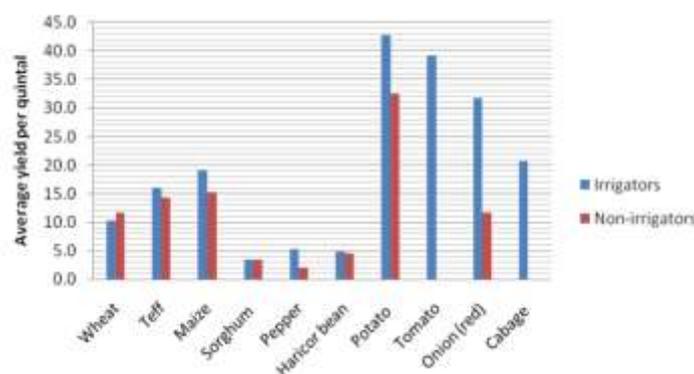
The development of irrigation and agricultural water management holds significant potential to improve productivity and reduce vulnerability to climactic volatility in any country. Although Ethiopia has abundant rainfall and water

resources, its agricultural system does not yet fully benefit from the technologies of water management and irrigation. The majority of rural dwellers in Ethiopia are among the poorest in the country, with limited access to agricultural technology, limited possibilities to diversify agricultural production given underdeveloped rural infrastructure, and little or no access to agricultural markets and to technological innovations. These issues, combined with increasing degradation of the natural resource base, especially in the highlands, aggravate the incidence of poverty and food insecurity in rural areas. Improved water management for agriculture has huge potential benefits in efforts to reduce vulnerability and improve productivity(Kinfe Aseyehgn 2017). According to Kinfe, primary rationales for developing the irrigation sector in Ethiopia include:

- Increased productivity of land and labor, which is especially pertinent given future constraints from population growth

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- Reduced dependence on rainfall, thereby mitigating vulnerability to variability in rainfall
- Reduced degradation of natural resources
- Increased exports
- Increased job opportunities, and promotion of a dynamic economy with rural entrepreneurship.
- Despite significant efforts by the Government of Ethiopia (GOE) and other stakeholders, improving agricultural water management is hampered by constraints in policy, institutions, technologies, capacity, infrastructure, and markets. Addressing these constraints is vital to achieve sustainable growth and accelerated development of the sector in Ethiopia



Source: FAO, 2015

Fig2. Average crop yields per quintal per household (1 quintal = 100 kg).

According to FAO (2015), for those low productivity and unexploited water resources countries like Ethiopia, irrigated agriculture is suggested as a key strategy to enhance agricultural productivity and stimulate economic development. In the same way, Nyirenda (2015) and Kidane (2016) states that irrigation farming is a good strategy in increasing crop production, enhancing food security, earning higher and stable incomes and increasing prospects of multiple cropping and crop diversification. According to Hundie (2014), in some part of the world, cereal crop production has 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. As I review different research findings regarding the role of irrigation development in agricultural development, there is no much debatable idea. This means the different studies show that irrigation is good strategy in increasing agricultural product for all agrarian countries. The study conducted by Yohannes (2019) reveals that irrigation is essential to increase agricultural productivity in order to eradicate poverty, improve the economy, and reduce land degradation.

Significance of Small Scale Irrigation to National Economy of the Country

The role of agriculture to national economy is estimated on the basis of the estimated

production during the *Meher* (main rainy season) and the *Belg* seasons or small rainy season (CSA 2007). According to CSA, the contribution of irrigation is included in the production during the *Belgseason* although not explicitly stated in the document. Farmers use full irrigation to grow crops during the dry season when crop production using rain is not possible. This implies that household's get additional income from irrigation in comparison to farmers who can only grow during the main rainy season. Under small scale irrigation system, irrigation does not replace rain fed agriculture but supplements it.

Large scale schemes, however, are under full irrigation throughout the year. Nyirenda (2015) in his study tried to explain net gross margin calculations from irrigation that an average income of about Birr 2800 /ha, which is equivalent to USD 323/ ha. As a result, Nyirenda compares to the calculated gross margin for rain fed which is USD 147/ha. This indicates that after accounting for annual investment replacement cost, net gross margin from irrigation is more than two times higher than gross margin from rain fed agriculture. When we disaggregate net income by irrigation typology, we also see a strong difference between the categories. Average income from small scale but modern schemes is about USD 355/ha while from small scale traditional is about USD 477/ha. This may sound counter intuitive in the sense that schemes with

The Role and Significance of Small Scale Irrigation in Improving Household Income in Ethiopia

permanent structures and well lined canals should have led to better returns. The reason for higher margins for traditional schemes may have to do with high average investment cost of USD was equivalent to 8.67 ETB in 2005/06 prices. The relatively longer irrigation experience and, hence, acquired improved

irrigated crop management practices of farmers working and the composition of crops grown under traditional system may also contribute to this difference. The development of modern irrigation schemes is a recent phenomenon in Ethiopia.

Table6. *The Benefits of SSI in Ethiopia by Region*

Region	Vegetable and pulses (Ha)	Fodder (Ha)	Total (Ha)	Profit (Million Dollar)	Total number of beneficiary(in 000)
Addis Abeba	0	0	0	0	0
Affar	314,394	141,047	455,440	1,066	2,58
B/Gumuz	15,861	259	16,120	37	91
Dire Dawa	0	51	51	0.08	0.3
Gambella	594	0	594	2.3	3
Harari	0	46	46	0.2	0.3
SNNP	77,602	40,569	118,171	399	670
Tigray	5,686	6,596	12,282	45	70
Oromia	261,401	172,218	433,619	1,041	2,457
Somali	27	219	245	1	1
Amhara	314,394	141,047	455,440	1,066	2,581
Total	989,959	502,052	1,492,008	3,657.58	5,933.6

Source: USAID, 2018

The data presented by USAID (2018) indicate that the annual contribution of SSI to the national income is about 3.6 billion US Dollar and in Ethiopian current currency exchange rate in January /2020, it is estimated about 83.2 billion of Ethiopian currency. This share of irrigation to national income of the country is high. Regarding the beneficiary of irrigation, the total number of households is around 6 million and this reveals that the participation of households in SSI is too low. In addition, 1 million ha of land, economically and biophysically suitable for SSI development in Ethiopia, and Amhara, Oromia and SNNP have the highest SSI profitable regions. In addition, the major types of crop production in SSI are vegetable and pulses. About 989,959 hectare land is used for production of vegetables. The data also reveals that SSI is important in generating household labor employment creation. According to USAID (2018), about 5.9 million people of the country have been benefited from SSI profit. Generally, the significance of SSI is multidirectional.

CONCLUSION AND RECOMMENDATION

Conclusion

The review of this research indicate that the importance and significance of small scale irrigation as a good means of improving household income in Ethiopia. Small scale irrigation as part of agriculture has

multifunctional for the users of households. The review result shows that farmers who use small scale irrigation are more food secured and better in their life than that of non-users by producing two or more in a year.

Ethiopia is endowed with both human and natural resource. Huge potential of irrigable land, high labor force availability and large rivers together make the country abundant resource endowed in Africa. More than 50% of the country's economy depends on agricultural sector. This agricultural activity is either by the help of rain-fed (main rainy season) or by the help of irrigation to feed the population of the country. Agricultural sector is characterized by traditional farming system and as a result productivity is low. Therefore, less consideration given by administrative leaders caused the country economically the least in the continent. This tells us that great potential is needed to create responsiveness for households. Although the significance of irrigation is to lift income of household, social mobilization by the concerned part is less and this problem made the available human and natural resource to stopover idle that caused people persist in poverty.

In addition, the challenges for underutilization of the available resource may be lack of agricultural input, low demand for the product (lack of market) and lack of infrastructure like road transport.

Recommendation

- ✓ Despite Ethiopia has very high potential on development of irrigation, Small scale irrigation is surrounded by leadership challenges. So leaderships should take part to motivate irrigation users.
- ✓ Land and water use policy should be clear by the government to make idle resources be productive
- ✓ Government should supply infrastructure such as road transport in rural areas.
- ✓ Knowledge (skill) on Small scale Irrigation development and utilization were the challenge to users. So the government of Ethiopia should be make synergies between small scale user.

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