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Review on Significant Constraints Arising in Small-Scale Irrigation Practice in Ethiopia

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Abstract: *Irrigation as an extra in farm output plays a vital role in increasing agricultural production and productivity. Small-scale irrigation is now one of the most critical interventions for increasing agricultural productivity in rural areas. Small-scale irrigation is one way of raising crop production to satisfy the rising demand for food and income generation in Ethiopia. The Ethiopian government has described small-scale irrigation as a major adaptation factor. Various policies and methods for alleviating prolonged droughts and food crises have been developed and implemented. Small-scale irrigation and rainwater production have been central to Ethiopia's new agriculture and rural development policy and plan over the last decade. These help farmers overcome rainfall constraints by providing a consistent supply of water for agriculture and livestock production. Despite substantial development, most small-scale irrigation activities and irrigation scheme efficiency in Ethiopia are still far from satisfactory. It has a big challenge and various limitations to accomplish the desired objectives. This study paper can be used as a benchmark for experts, scholars, and students to better understand small-scale irrigation's definition and practical constraints. This paper addresses the need for policymakers, irrigation administrators, and stakeholders to resolve these constraints and difficulties in boosting small-scale irrigation operations and addressing food security and poverty reduction in Ethiopia.*

Keywords: Small-scale irrigation, Poverty, Food Security, Policy, Ethiopia

1. Introduction

Ethiopia is a non-coastal and landlocked country with 1.13 million km^2 of land size in Eastern Africa. Geographically, it is located between 5°N and 15°N latitudes and 35°E and 45°E longitudes (Gebremeskel, G. & Kebede, A., 2015). Ethiopia's geological and climatic conditions include a higher degree of rainfall, unlike the rest of Africa, with an average altitude of 4,600 meters above sea level (Kasahun, D. 2007), hilly terrain with high plateaus, and undulating topography. The East African Rift Valley stretches from North East to South West and has several lakes, also separates the area. Ethiopia is a nation made up of ten autonomous regions and two town administrations divided laterally along ethnic lines.

Agriculture plays a pivotal role for an economic foundation in foreign exchange, jobs, revenue, and national economic growth. It contributes to about 90 percent of export earnings, 85 percent of job power, 70 percent of industrial raw material supplies, and 50 percent of GDP (World Bank, 2010). Though it has shown a slight decrease over the years, it still stayed firm at around 44 percent (Hagosa et al., 2011). Agriculture is primarily rain-fed, depending on spatially and temporally very volatile, unpredictable, and often insufficient rainfall. The agriculture sector also focuses primarily on plowing and drought management, which has enhanced crop production and livestock production for eras. In Africa, Ethiopia is the second most populated nation with ample land and water supplies: however, most of the settlement areas are heavily degraded, the quality of the land per capita is decreased, and soil and labor productivity are reduced. Abundant natural capital and qualified labor are afflicting Ethiopia with chronic food shortages and extreme rural poverty. To feed this exponentially increasing population, the comprehensive process for raising the agricultural product does not function well as land availability is constant. With fast population growth in recent years, agricultural land expansion continues to be the primary driver of deforestation. As a result, agricultural intensification fails, which has caused many populations to survive, relying on numerous food organizations' assistance and aid (Alemu, E. A., Kassa, B. & Yihdego, G., 2011; Abiyu, A. Tebeje, M. & Mekonnen E., 2015). Agriculture is affected by very variable rainfall conditions and frequent droughts, hurting Ethiopia's economy because of the heavy dependency on rain-fed farming. The advent of drought and insufficient irrigation systems leads to a real strain on water quality (Tewabe, D., & Dessie, M. 2020).

Internationally, irrigation plays a crucial role in global food production. Irrigation is also altering the lives of rural families by boosting their production and productivity. Rapid progress in the irrigation-protected area, mainly small-scale water usage, offers farmers the ability to improve their productivity consistently and adds to the consistency of food supplies (FAO, 2012). Irrigation development is recommended as a crucial strategy for improving farm production and promoting economic development

(Bahttarai, M., Sakihivadivel, R. Hussein, I. 2002). Small-scale irrigation is the leading contributor to overall irrigation in many African countries (Mwakalilaand, 2004). Small-scale irrigation experience in the developed world has demonstrated that it can be a vital indicator of drought relief and long-term agriculture and socio-economic growth mechanism. Participation in small-scale irrigation is essential to change the lives of rural households. (It stayed below estimates in sub-Saharan Africa until the last few years (Garcia-Bolanos et al., 2011).

The Government of Ethiopia has been pursuing policies to alleviate poverty in a variety of political, cultural, and social reform projects since 1992. It has demonstrated a firm determination to advance agricultural production and rural growth by allocating more than 10% of the national budget (MOA 2013). Since 1973, modern small-scale irrigation systems have been developed by the federal or regional government in Ethiopia to combat catastrophic climate change and drought. The practice of irrigation is one way of increasing crop production to satisfy food and other services in Ethiopia (Diederen et al., 2002). In Ethiopia, irrigation development is given significant attention and is seen as the best way to resolve insufficient rainfall and small land size (Ayele G. K., 2011; Hagos et al., 2009; Haile, G.G. & Kasa, A.K. 2015). As a result, a variety of activities were undertaken to enlarge irrigation development in the country. Agricultural Development Led Industrialization (ADLI) acknowledges irrigation as a vital insight into sustainable development and supports small-scale irrigation growth. The introduction of small-scale irrigation is one of the primary measures to improve agricultural productivity in rural areas to tackle rainfall limitations by offering a reliable supply of water for farming and livestock production (FAO, 2003). As a result, small-scale irrigation (SSI) contributes to poverty elimination through expanded development that leads to income growth and encourages economic growth and employment (Garcia-Bolanos et al., 2011).

The study also proposed that one of the best options to be explored for healthy and sustainable food security production is the extension of irrigation development on several scales, including river drainage, the installation of micro dams, and water storage systems (Ruttan, 1984). The government began to focus on small-scale irrigation capacity to boost food security and promote small-scale irrigation for farmers and the population by providing assistance and financing to implement new technologies, rehabilitate and update traditional systems following significant famines in 2000/2001 (Habtamu, G. 1990).

In East Africa, Ethiopia is known for its rich water infrastructure and is referred to as the water tower because of its extensive water supply (Eneyew, A., Alemu, E. Ayana, M., & Dananto, M., 2014). Estimates have shown that the country has enough water to extend about 3.73 million hectares. An adequate supply of 12 river basins with 122 billion cubic meters of annual drainage and a predictable groundwater capacity of 2.6-2.65 billion cubic meters. (Awulachew et al., 2007; Makombe et al., 2007; MOA, 2011). Ethiopia uses only about 190,000 hectares (less than 5 percent of the potential) of its available reserves of water for irrigation (MoFED, 2006). Though Ethiopia has adequate water sources, irrigation and water control technology have not yet wholly benefited from its agricultural system (Awulachew et al., 2010). Despite the substantial expansion, the productivity of the most restricted irrigation systems in Ethiopia is very far from satisfactory (Amede, 2015; Awulachew & Ayana, 2011; Carter & Danert, 2006; Teshome, 2003). The Ethiopian farming system is overwhelmed by very unpredictable rainfall patterns and frequent drought. However, it is determinant to the national economy. This influence is felt by the rapid population growth, grassland degradation, weakened drought-affected animals, and deforestation due to pursuit for living standards. As a result, food deficits frequently turn into drought in the least adverse climate. The country faces one of the world's most significant food production challenges and economic development (FAO, 2006). 85% of the population's life relies on agriculture. In recent memory, in 1972/73, 1983/84, 2002/03, Ethiopia has suffered three significant drought-induced food shortages and famines that have cost many lives (Awulachew et al., 2005).

Furthermore, without identifying challenges, the management of irrigation water, the institutional and administrative constraints, and the biological and physical problems of small-scale irrigation could not be effective. As a result, this paper aims to bridge the research gap and provide a helpful knowledge base for practitioners, policymakers, non-profit project managers. And policymakers who make a significant contribution to the impact of small-scale irrigation on the community's socio-economic and livelihoods and establish a firm foundation to advance knowledge and facilitate theory development.

2. Research Questions

- What are the concept and definitions of small-scale irrigation in the Ethiopian context?
- What are the determinants that obstruct small-scale irrigation practice in rural Ethiopia?

3 Methodology

A systematic review can be explained as a research method and process for identifying and critically assessing relevant research and collecting and analyzing data from such research (Liberati et al., 2009). Therefore, this study followed a qualitative approach primarily based on a systematic analysis of established literature on small-scale irrigation definition and constraints. The choice of this approach was based on its potential to offer detailed research knowledge and comprehension. The archival process has periodically collected findings, facts, and information from the literature. After that, the literature search methodology was used to identify research search words, i.e., small-scale irrigation activities. A systematic review aims to find all empirical evidence that meets predefined inclusion criteria to answer a specific research question or hypothesis. Consequently, the procedure involved screening the compiled literature on the grounds of the paper's importance to the field of research and the authors' credentials.

4 Literature Review

4.1 Definition and Concept of Small-scale Irrigation

Defining small-scale irrigation is somewhat arbitrary since the term varies from place to place. Yeah, Smout, I. K., and Shaw, R. J. (1999) and Kedir & Alamireuw (2006) define irrigation on a small scale as irrigation, typically, small plots where farmers have control over the level of technology they can operate and maintain are used. Farmers run the schemes, and farmers are generally interested in the schemes being created. These systems can be owned or run by individuals or by society. There is a little rivalry between writers regarding how large the narrative should be or how many people may be interested in a small irrigation scheme. Yeah, Smout, I. K. and Shaw, R. J. (1994), in their research in India, discovered that most small irrigation schemes represent a community of farmers, typically ranging from 5 to 50 households.

Small-scale irrigation is an irrigation system described as irrigation on small plots where farmers have control power and must be involved in planning and border decisions (Tafesse, 2007). Small-scales are rarely used in the literature and debates on agricultural production, although the most common concept is less than two cultivated land hectares (Conway, 2012; IFAD, 2011a; Hesselberg, 2013; Thapa & Gaiha, 2011). Of course, the commercially feasible scale of a family farm depends on several factors, not least the soil's quality and the weather conditions. The varieties of crops it is prone to produce, both nature and demand, and whether two or three crops can be harvested from the same land each year.

In his irrigation research studies in West Africa, Van't Hof (2001) proposes a multi-criteria definition of three-dimensional small-scale irrigation: (A) the control surface must be less than 40 hectares; (B) the total surface area per irrigator shall be less than 10 hectares; and (C) the whole irrigation population. In India, however, Seleshi says that the hectare will cross 200 hectares, but the catchword is that irrigation is owned by the society and benefits many community members. FAO (1997) found in Zimbabwe that small-scale irrigation schemes vary from 2 hectares to 228 hectares of land, but each plot is usually less than 10 hectares, as Van't Hof (2001) suggested. The Ethiopian background indicates that small-scale irrigation is an irrigation scheme set up on up to 200 hectares of command land (Dejene, A Yilma, S. 2003). Small-scale irrigation (SSI) systems have been adopted as an alternative to rising production and diversifying livelihood scenarios (Mengistie & Kidane, 2016).

4.2 Factors that Influence Small-scale Irrigation Practices

Small-scale irrigation has an immense potential to raise the income of poor rural communities in developed countries such as Ethiopia (Mekonnen, A., Kidane, D., Teklay, D., 2015; Kebede, G., 2011; Awulachew, S.B.; Merrey, D.J. 2008, James, B.; Maryam, M.O. 2014, Demeku, S.D.; Descheemaeker, K.; Haileslassie, A.; Amede, T. 2011). Small-scale irrigated farming has enormous potential and benefits. It would reduce crop failure caused by rainfall fluctuations. It allows farmers to increase productivity (by cultivating two or three harvests per year rather than one) and supplementing farmers' income-producing high-value cash crops. However, it is not yet free of challenges and hurdles. In particular, irrigation schemes have struggled due to low stakeholder involvement and land tenure uncertainty. Social, technical, religious, and gender issues pose a barrier to beneficiaries' full and equitable participation [Kidane, D.; Mekonnen, A.; Teketay, D., 2014; Mekonnen, A., Kidane, D., Teklay, D., 2015]. According to Epherm (2008), household food security in Ethiopia's north-eastern region has been closely correlated with various socio-economic, biological and physical factors affecting household food safety, such as household age, dependence ratio, crop size, and widespread livestock manure use. There are several issues with the developments in irrigation in Ethiopia.

According to G. Gebremeskel, G. & Kebede, A. (2015), any of these issues will contribute more or less to technical deficiencies and skills gaps in small-scale irrigation practices. In this scenario, the problems presented here are characteristic of small-scale irrigation. (a) lack of knowledge on irrigation water resources, such as irrigation timing procedures, water-saving irrigation systems, water measurement processes, irrigation and maintenance operations; (B) lack of knowledge on improved and diversified agronomic irrigation practices; (C) lack of specific knowledge; (D) scheme-based approach rather than area / catchment-based approach to small-scale irrigation schemes development, (E) insufficient baseline data and knowledge on water resource development; (F) lack of expertise in planning, building and tracking quality irrigation projects; (G) low productivity of existing irrigation schemes; (H) inadequate community participation and engagement in the planning, design and implementation of

irrigation development schemes, (I) insufficient consumer economic context in the growth of irrigation facilities, access to irrigation technology and agricultural inputs where price increases are not affordable.

Tadesse, M. & Belay K., (2004) also perform a study on the economic benefits of irrigation in the Donny and Bato Degaga irrigation projects in the Awash Valley of the Regional State of Oromia, certain food security irrigation schemes, and draws lessons learned from the success and failure of irrigation. As indicated in the survey, the key cash crops produced were onion, tomatoes, and pepper. The growth in irrigation cultivation in these irrigation schemes significantly improved irrigation consumers' access to basic needs. The results indicate that small-scale irrigation problems include: weak application of fertilizer, ineffective field management, uneven distribution of labor to sustain irrigation networks, scarcity of irrigation water, a tendency to consider irrigation facilities as government properties, and business concerns. Consequently, the findings indicate that irrigation will become a source of work and produce income for residents.

Tesfaye, G., Haile, M., Gebremedhin B., Pender, B. J. & Yazew, E., (2000), in their research on small-scale irrigation management and institutional factors in Tigray, addressed the following problems: lack of understanding of the environment of small-scale irrigation, difficulties in providing input facilities and technical advice, lack of sustainable use, lack of productive use of water supplies are some reason for low productivity and lack of feasibility in small-scale irrigation schemes. In general, it is difficult to discuss all the restrictions that obstruct the practice of small-scale irrigation. Accordingly, this review paper reflects only on significant limitations. These limitations are defined and discussed in the following section by biological, physical, technological, and infrastructure-related causes, economic factors, and leadership and administrative factors.

4.2.1 **Biological Factors**

Biological influences do not specifically influence small-scale irrigation practices but affect small-scale irrigation efficiency. Many biological factors influence the procedure, but the most significant aspects are soil salinity and crop disease. Soil salinity is one of the problems with chemical soil depletion that affects soil productivity in Ethiopia's lowlands. Salinity directly or indirectly impacts the livelihoods of households. The direct impacts are related to land abandonment, decreased crop production, and decreasing farm incomes. Soil salinity may be a significant limiting factor that jeopardizes crops' ability to support the expanding human population. It is characterized by a high concentration of solvent salts that reduces the yield of most crops significantly.

On the other hand, in Ethiopia, the prevalence and spread of crop diseases is the main obstacle for improving crop productivity, as improved and sensitive seeds adapted to irrigation have not been regularly given (Dejene et al., 2008). With the effects of diseases and pests, farmers lose more than a quarter of their production. Thus crop disease is, to date; is a big problem for users of small-scale irrigation, in particular, agriculture in general. In the other seasons of the year, pests and diseases are more severe than in the summer. There is more water in summer, resulting in a reduction in the disease (Woldemariam P. & Gecho Y., 2017). In Ethiopia, as a consequence of these crops being produced without appropriate disease and pest control systems, crops will be unable to survive pests and diseases, which will reduce yields and the productivity of irrigation activities (Awulachew et al., 2005).

4.2.2 **Environmental, Technological, and Infrastructure-related Factors**

Increased reliance on irrigation has not been without detrimental environmental consequences. Small-scale irrigation practices in Ethiopia, depletion, water loss, and weeding are significant physical barriers. Many environmental issues face the development of irrigation in the regions. In several parts of the world, farmers conduct irrigation without knowledge of the need for crop water, the method of applying water, and the interval of irrigation. Lack of information on irrigation water management factors has caused the waste of irrigation water, degradation of some infrastructure, and waterlogging problems in some farms (Gebremeskel, G. & Kebede, A., 2015). According to a study conducted by Dejene, S., Teshome, W., Makombe, G., Bekele, S., and Prasad, K. (2008), the critical problems limiting the supply of adequate irrigation water in the command area under the Gibe Lemu irrigation scheme were water misuse, water shortage, and poor coordination of water distribution. Water scarcity, misappropriation, and poor water distribution coordination were irrigation issues in the Gambella Terre irrigation scheme. Water quality has emerged as a significant irrigation issue; rivers and streams are contaminated due to ongoing upstream industrialization and inadequate industrial waste management (Berehanu, 2007; Nile Basin Initiative, 2001).

Weeding related problem is more problematic because it hurts the production process mainly at the stars' time. Thus as farm households lose time, material, labor costs, diseases, and pests, they can only result in production costs without benefit or even usual profit (Gebrehiwot Yihdego, A. et al. 2015). Fragmented farmland and Irrigation schemes maintenance challenge is a big deal related to physical constraints. The other issue with small-scale irrigation practice is the shortage of spare parts for pumps on the local market, plus the cost of new ones, which creates difficulties for its irrigation activities (Gebrehiwot Yihdego, A. et al., 2015).

The other factor that is the bottleneck in small-scale irrigation practice is the lack of infrastructure. Approximately 64% of Ethiopia's land area is situated more than 5 kilometers from the all-weather highway. About 48 million people in Ethiopia's rural areas live more than 2 km away from the closest all-weather road. On average, households are more than 10 kilometers away from dry-weather roads and 18 kilometers away from public transit facilities. The rural markets in Ethiopia are limited. The transaction costs of entry are high due to a lack of transport infrastructure (Kasahun, D. 2007, Kaur, N, Getnet, M., Shielis, B., Tesfaye, Z., Syoum, G. & Atnafu, E., 2010). Some farmers have complained about the poor condition of rural roads and the lack of public vehicles (Chazovachii 2012). The other fundamental problem relevant to the infrastructure problem is the lack of a nearby marketplace. This issue relates directly to transaction costs and is used as a proxy. These discourage irrigation participation when transaction costs increase. Studies suggest that the further the distance from the farmers' residence area to the market, the lower the probability that farmers will engage in small-scale irrigation practices (Aseyehegu et al., 2012).

The difficulties associated with irrigation technology's technical features and the expertise required in its application, usage, and maintenance are a lack of human resources in the field of irrigation technology, agronomy, planning, mapping, and drilling. The primary concern is a lack of agricultural awareness (Awulachew et al., 2010; MOA, 2011). Carter and Danert (2006) discovered that small irrigation projects appeared to be governed by a single profession, primarily engineering and that many NGOs performed small irrigation work without enough workers. Irrigation staff lacks technical expertise in water management, such as evaluating water requirements, operating gateways, determining irrigation periods, and measuring and assessing water utilization.

4.2.3 **Economic Factors**

Economic constraints are related to market prices for irrigation crops, changes in interest rates, and market accessibility (Brown and Nooter, 1995). Imported supplies, such as fertilizers, chemicals and gasoline, have increased over time, partly due to ETB deflation in world currency markets. As a result, they use less fertilizer on their farming plots than is recommended. Chemicals like pesticides and herbicides are also expensive to add. Imported agricultural products, such as fertilizers, pesticides, and oil, have risen in price over time, owing mainly to the Ethiopian birr's depreciation in global currency markets. As a result, their farm's fertilizer use is below the recommended level. Chemicals like pesticides and herbicides are also expensive to use (Gebrehiwot Yihdego, A. et al., 2015). Market prices fluctuate based on the principle of supply and demand (Mohammed, S., 2002**)**. The lack of close access to the market has drastically decreased the profits that farmers might otherwise receive. Price knowledge is chaotic, some small-holder farmers get it from neighbors or friends visiting the markets, and some don't get it. Users of irrigation do not have a supply chain to offer their production (Tafesse, M., 2003**)**. The price of agricultural inputs will encourage/discourage farmers from using inputs that enhance production. Tashome W. (2003) indicated that input prices contribute significantly to the use of improved seeds. If the legislation on input pricing does not invite farmers, it will hurt the increased use of agricultural inputs.

The lack of long-term and short-term credit availability affects the output of the irrigation scheme. Farmers with access to credit may purchase the irrigated farm inputs needed on time relative to those without credit access. Farmers will be unable to pursue irrigated farming if they cannot obtain a budget to purchase inputs with their own money and if they do not have access to credit at the appropriate time and place. Fertilizers, improved seeds, and pesticides require a significant financial investment to purchase (Gebremeskel, G. & Kebede, A., 2015). There is no long-term or short-term credit availability, and there is an obvious need for financing purchases such as fertilizer, improved seeds, and chemicals (Gebremedhin et al., 2006; Nile Basin Initiative, 2001; Yihdego, 2016). Microfinance institutions and informal financial institutions such as Equb provide credit services to customers. It encouraged the use of new technological developments, such as improved seed varieties (Haile, T, 2008, 38). Similarly, according to Gebremedhin, B. & Peden, D. (2002), credit facilities from Ethiopian institutions are restricted by banking regulations.

4.2.4 **Socio-cultural and Demographic Factors**

There are so many issues relating to socio-cultural and demographic problems. However, this study paper discusses the fundamental problem of socio-cultural and demographic problems in the Ethiopian context, such as household-headed education, household size, household-headed sex, and household-headed age. Education has a positive effect on the possibility of small-scale irrigation. And households with a greater family size are often more likely to implement small-scale irrigation. Besides, households with more extension services are more likely to embrace micro-irrigation than households with no agricultural extension service from their counterparts. Different researchers consider education level, as the literate farmer is most likely interested in small-scale irrigation activities than the illiterate (Abiyu, A. Tebeje, M. & Mekonnen E., 2015**;** H**e** et al**.,** 2007). It can be attributed to knowledge about the technology that can be accessed by schooling, reading, or using social media. On the other hand, literate farmers can schedule higher income by using irrigated and rain-fed farming rather than being hesitant to engage in small-scale irrigation practices instead of illiterate farmers.

The impact of household size on irrigation adoption should be mixed, and that a prior sign is not assigned to the variable under consideration. A farmer with a more significant number of families involved in farming activities is more likely to afford to use

potentially valuable inputs to increase production **(**Hadush, 2014;). Thus a farmer with a large family workforce would be able to use labor-intensive agricultural inputs.

According to the findings of various studies, male-headed households are more likely to engage in irrigation practice and have a larger irrigated area than female-headed households (Aseyehegu et al., 2012; Gebregziabher, G.; Giordano, M. A.; Langan, Simon; Namara, Regassa E., 2014). In most cases, small-scale irrigation in rural areas is an additional farming activity and an additional income source to cover additional household costs. Female-owned households may find it challenging to engage in small-scale irrigated agriculture. Women's participation in farm and off-farm activities is far lower than that of men due to cultural barriers. Female-headed households are likely to engage in less small-scale irrigation than male-headed households.

From the findings of different studies, household age, farmers' participation in irrigation practices, and participation intensity are negatively affected (He et al**.,** 2007; Beyan et al**.,** 2014; Nhundu et al**.,** 2012; Wang et al., 2015). A farmer's age can create or erode confidence in technologies. In other words, a farmer may become more risk-averse towards new technology with age. There are mixed findings of the direction of impact, still. Younger farmers were expected to be more likely to implement micro-irrigation technologies.

4.2.5 Administrative and Leadership Factors

Weak and ineffective Irrigation Management: Water Use Teams (WUTs) are not adequately structured to manage irrigation. Users have a very problematic social interaction. At the operational level, the supporting regulatory frameworks of groundwater entities are non-existent. Stakeholder efforts in irrigation conservation have not been harnessed. These problems, in turn, have had a drastic impact on the management and usage of the capital generated. The limited administrative ability of local authorities to assist in the autonomous management of small-scale irrigation (SSI), the issue of social incompatibility between contemporary crop patterns and indigenous farming patterns, hinders the productivity of the irrigation method (Dejene et al., 2008).

Lack of access to fertilizers and seeds: In Ethiopia, supplies of inputs from the government or similar channels are mostly only available during the rainy season. During the irrigation season, farm inputs, particularly fertilizers, are scarce and relatively expensive, and access to both input and export markets is limited (Awulachew et al., 2005; Carter and Danert, 2006; MOWR, 2007). Every kebele has two or three extension workers assigned to support farmers' productivity in the Ethiopian context. However, there is practically a significant problem in farmers' interaction with extension agents the number of interactions with the extension agents each year. Through demonstrations and discussions, agricultural extension agents visit farmers regularly to raise awareness of new farming practices. While extension agents working in various locations were more likely to be involved in administrative activities in addition to their actual job (Hadush, 2014)

Other considerations related to administrative concerns include the poor institutional ability for preparation, architecture, execution, administration and maintenance, including irrigation advisory services. There is no coordinated approach to mapping and monitoring current irrigation at certain government levels. There is no project control and institutional memory; low-level administrative and legal bodies have no significant water management role and conflict resolution (Awulachew et al., 2010). Lack of communication with stakeholders: the complex bureaucracy and the requirement for collateral from the government agency are significant barriers to the development of irrigated agriculture (Mohammed, S., 2002). The government lacks adequate control over water charges, water rights, water dispute resolution processes, incentives for stakeholder participation, and incentives for accurate reporting, all of which contribute to the risk and uncertainty of many irrigation projects (Awulachew et al., 2010). The poor relationship between research and advancement in irrigation water management remains poor (Awulachew et al., 2005; MOWR, 2007). Data shows that farmers who have received irrigation training are engaged in irrigation activities and irrigate more regions than farmers who have not received irrigation training (Abiyu, A. Tebeje, M. & Mekonnen E., 2015).

5 Conclusion

This review explored the challenges of small-scale irrigation development, categorized in different parts by numerous scholars and researchers in Ethiopia. The first issue relates to biological factors that hinder the effectiveness of small-scale irrigation practices, such as salinity and crop disease. Environmental, technological and infrastructure-related issues are addressed in the second section. Under this section, depletion, loss of water, weeding, degradation of some infrastructure, problems with waterlogging, lack of infrastructures such as road access, public transport and the marketplace, challenges associated with the technological aspects of irrigation technology and skills in operation, use and maintenance identified as a significant constraint.

On the other hand, economic factors such as the price of imported supplies, such as fertilizers, chemicals and gasoline, lack of long-term and short-term credit availability, market prices for irrigation crops, changes in interest rates and market accessibility are considered to be the third major constraint issue. Socio-cultural and demographic factors, such as household education, household size, household sex, and household age, are discussed as crucial factors in the fourth section.

Besides, administrative and leadership-related factors. Evidence that the critical challenges of irrigation use are inadequate management capacity and lack of knowledge. Training for farmers on how to use and maintain irrigation, although this is a necessary condition for effective and sustainable irrigation management, is a significant constraint of small-scale irrigation practices in Ethiopia.

The current study's general recommendation is to inform policymakers, development agencies, and irrigation administrators to address these critical issues to improve irrigation development efficiency. Irrigation management must be approached creatively. Farmers should be the focus of this innovative approach. In this regard, emphasis should be placed on empowering farmers through planning, providing credit-based special irrigation services, and the legalization of water use systems. Many schemes have salinity, sediment accumulation, and soil erosion as a result of poor management. Mobilization of local capital and effective management of property and land is essential for alleviating specific causes, as is water conservation through physical and biological measures. A lack of adequate capacity is strongly linked to poor irrigation management. Training for farmers and water user associations provided by the government and non-governmental organizations would directly impact irrigation growth. There is a clear need to increase irrigators' access to market knowledge in other regions to improve the system as a whole. A practical extension system should be put in place to help farmers manage conventional irrigation efficiently. It should also encourage these stakeholders to improve irrigated farming in Ethiopia by reducing barriers and improving the available enabling factors.

Besides, the lack of evaluation and feedback from the schemes implemented and the deficient level of capacity building for irrigators in terms of training and exchange of experience has contributed significantly to the inefficiency of water and irrigated crop management, which has resulted in intangible benefits for the user communities. Moreover, the lack of appropriate mandates or an undefined extension of responsibility for irrigation and integration among the institutions concerned, complemented by inadequate provision of agricultural inputs and rural credits in the country, has been a bottleneck to the overall irrigated agricultural extension activities. These numerous factors negatively affect household poverty, crop production and productivity. As a result, the amount of land developed by modern irrigation projects to ensure the use of irrigation potentials for agricultural production remained low, coupled with other constraints. Closing yield gaps on exiting irrigation schemes and optimizing products' benefits could be areas that need immediate intervention. Increasing water efficiency, improving operating and maintenance systems, improving market linkages, providing institutional services and implementing a value chain approach are among the areas of action that could lead to better irrigation systems. As part of the transition between the short-and long-term planning horizon, efforts to expand irrigation consider socio-political equity and environmental sustainability. In general, there is a lack of proper communication between key stakeholders. Besides, there is also a lack of monitoring and evaluation systems. Small-sale management is a cross-sectoral activity by its nature. The finding of this study implies that the lack of proper communication between actors in area small-scale irrigation is very high. Therefore, the authors recommend establishing an alliance and coordination between key stakeholders, and the policy document should be revised based on the problem raised.

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