OPEN ACCESS JOURNALS
Indiana Journal of Agriculture and Life Sciences
Abbriviate Tittle- Ind J Agri Life Sci
ISSN *(Online)*- 2583-1623
Journal Homepage Link- https://indianapublications.com/journal/IJALS
DOI-

INDIANA PUBLICATIONS
PRODUCTIVE AND QUALITY RESEARCH

Review Article

Volume-02|Issue-03|2022

Review on the Role of Small-Scale Irrigation on Household Food Security and Poverty Reduction in Ethiopia

Addis Hailu Demo*

Lecturer, School of Natural Resources Management & Environmental Science, College of Agriculture and Environmental Sciences, Haramaya University, Ethiopia

Article History
Received: 01.06.2022
Accepted: 27.06.2022
Published:30.06.2022

Citation
Demo, A. H. (2022). Review on the Role of Small-Scale Irrigation on Household Food Security and Poverty Reduction in Ethiopia. *Indiana Journal of Agriculture and Life Sciences*, *2*(3), 24-30.

Abstract: Ethiopia has been severely impacted by drought and other climate-related risks, leaving millions of people without food each year. A major factor in raising agricultural productivity and production is irrigation as a kind of agricultural intensification. The purpose of this review is to demonstrate how small-scale irrigation contributes to household food security and the eradication of poverty in Ethiopia. To address the issue of smallholder households becoming food insecure, the Ethiopian government has made a sizable investment in the creation of small-scale irrigation systems and plans to improve the current irrigation infrastructure. One of the best options for improving sustainable livelihoods, transforming growth, and reducing rural poverty in the nation is small-scale irrigation. According to many studies, having access to dependable irrigation water can help farmers adopt new techniques and intensify their farming operations, which will boost productivity and result in higher crop yields and profits. The availability of irrigation allowed farm households to increase crop output, provide higher and steady income and consumption, and enhance their level of food security. Small-scale irrigation is one of the practical alternatives to meet the country's domestic food demands, according to the review's findings. In general, irrigation lessens poverty by boosting household income, agricultural output, employment opportunities, risk stabilization and reduction, and credit availability. In order to combat poverty, the government should promote the growth of small-scale irrigation.
Keywords: Small Scale Irrigation, Food Security, Poverty, Irrigation, Food.

INTRODUCTION

Ethiopia's history shows that agriculture serves as the main engine for rural community life and the cornerstone for basic human fulfillment. This is because of the country's unique geographical and environmental conditions, which make it particularly well-suited for agricultural activity (Bekele *et al.*, 2000). Ethiopian agriculture, however, is characterized by small-scale subsistence farming methods with comparatively low crop and livestock yields. The country has 12 river basins with an average annual runoff volume of 122 billion m3 of water and an estimated 2.6-2.65 billion m3 of potential groundwater (Awulachew *et al.*, 2007; & MoA, 2011). It is estimated that Ethiopia alone has the capacity to develop 5.1 million hectares of land for irrigation using technologies such as river and spring diversion, pumps, gravity, pressure, underground water, water harvesting, and others (Tedros, 2014). Since irrigation water has become a very essential resource in agricultural production and poverty reduction due to the fact that agriculture is mostly rain-fed (Daniel, Z., 2015).

To address the issue of household food insecurity faced by smallholder farmers, the Ethiopian government has made a significant investment in small-scale irrigation schemes and plans to triple the current level of irrigation infrastructure by the end of 2020 (Haile and Kassa 2015). One of the best options for improving sustainable livelihoods, transforming growth, and reducing rural poverty in the nation is small-scale irrigation (Dereje & Desale 2016). It has a variety of effects on how rural residents live and develop (Dereje & Desale 2016). The diversity and intensification of crops, employment opportunities, livestock production, access to credit, and rising household incomes all benefit smallholders (Asayehegn *et al.*, 2011). According to Nahusenay & Madhun (2015), several research found a substantial correlation between small-scale irrigation development and poverty alleviation and argued that small-scale irrigation is an effective way to boost food production and reduce poverty (Fanadzo, 2012). A qualified analysis of the effects of small-scale irrigation on poverty reduction was made by Hussain *et al.* (2006), They claimed that irrigation reduces poverty both directly and indirectly, with the direct effects being realized through the intensification of labor and land, which leads to increased productivity, employment, and income, and the indirect effects being realized through improved local economies and increased welfare at a global level (Asayehegn *et al.*, 2011). A more empirical topic is how irrigation affects income and the level of poverty in a specific environment. Additionally, a variety of socioeconomic factors affect how many households participate in irrigation, there is a significant income gap between irrigation participants and non-participants, and this review paper will generally explore how irrigation affects several indices of poverty. More particular, it aims to disseminate knowledge on the connections between poverty and small-scale irrigation.

***Corresponding Author:** Addis Hailu Demo

Objective

The objective of this review paper is to review the Role of small-scale irrigation on the household food security and poverty reduction at household level.

ETHIOPIA'S HISTORY OF IRRIGATION

Various academics put on hold historical perspectives of irrigation in Ethiopia. Ethiopia has a long history of irrigation development, primarily small-scale irrigation; however, modern irrigation began in the 1950s thanks to a partnership between the Ethiopian government and a foreign business, focusing primarily on the commercial irrigated farms in the Awash Valley (Yalew, 2010). With the entrance of agriculturalists from Sudan and maybe Semitic immigrants from Yemen, Ethiopia began using irrigation. Both groups brought irrigation-based seed cultivation to Northern Ethiopia during the Axum Empire's reign in 1000 B.C. This enables us to recognize and comprehend that irrigation in Ethiopia hardly qualifies as a modern practice (Eliyas, 2011).

In an effort to combat droughts, which resulted in widespread crop failures and, as a result, hunger and malnutrition, the ministry of agriculture began modern Small-Scale Irrigation (SSI) technique and management in 1970. (Awulachew *et al.*, 2010). The probability of crop failure due to drought is decreased by irrigation measures. The government at the time devoted close attention to the sector's development, evaluating and assisting local farmers to enhance irrigation practices and promoting modern irrigation practices (Awulachew *et al.*, 2005).

Concept of Food Security

The notion of food security was developed in the middle of the 1970s amid the international debate on the world food crisis. At first, food supply issues that affected ensuring the availability and, to some extent, the price stability of fundamental commodities at the global and national levels received the majority of attention (FAO, 2005). As a result, in the 1970s, the term "food security" referred to the nation's ability to meet the population's dietary requirements for nutrients and energy. The idea of household food security is widely understood by development professionals to refer to the availability of food on the global market and in developing nations' food production systems (Bedeke, 2012). Food is a requirement for life, just like shelter, access to water, and air. Food is an essential component of a sustainable, resilient community and plays a part in our health, economy, and culture. Due to shortcomings in the global, national, regional, and local food systems, the link between wholesome food and vibrant communities is becoming more and more clear (WFP, 2012). Different organizations have different definitions of food security. Food security, according to Clay (2011), is a state in which everyone always has physical, social, and economic access to enough food that is safe, nourishing, and fits their dietary needs and food choices for an active and healthy life. Contrarily, the definition of food security used in this study is appropriate access to and availability of food for households to achieve the minimal energy needs as prescribed for an active and healthy life (Hussein *et al.* 2013).

The Need for Small Scale Irrigation in Ethiopia

Irrigation has a long history in Ethiopia (Mengistie & Kidane, 2016). Irrigation systems' primary goal is to increase agricultural production in both qualitative and quantitative ways (Sesen Hadush, 2013). Harvests must be increased so that people can either produce enough food to last through the time between harvests or sell their excess to make some money to buy food. Irrigation has been practiced in Ethiopia during the past few decades to improve rural development and food security (WB, 2006). Small-scale irrigation is the most well-liked and favored type among them. Due to the systems' simple flexibility to local environmental and socioeconomic conditions, small-scale irrigation is chosen since it helps to mitigate environmental deterioration and the lack of non-farm revenue in rural areas. But more importantly, the current shift in the development paradigm to "development from below," a strategy included under "sustainable development," has made small-scale irrigation important (Hadush, 2014). Additionally, small-scale irrigation programs are appealing because to the modest capital investment needed and the recipients' proven ability to manage, operate, and maintain the systems (Muez, 2014).

In terms of yield per hectare of land, small-scale irrigation can be very effective. To produce the same amount of crop production, large-scale schemes can use up to fifteen times more energy than small-scale ones (Iticha, 2019). This does not imply that small-scale irrigation is without its difficulties and challenges. Low levels of efficiency, a lack of funding, poor marketing, and limited extension services are a few of them. It is clear from the foregoing concept and the current socioeconomic realities that Ethiopia cannot achieve its reduced poverty objectives utilizing the current land and water usage systems (Sesen Hadush, 2013). If long-term solutions are not discovered, the problem of food insecurity will worsen and poverty will grow. However, as research suggests, the answer is to improve small-scale irrigation systems across the nation. The MoARD and regions are in charge of SSI programs (Awulachew, 2010). Traditional schemes, contemporary diversion schemes, micro/medium dams, and pumps are several types of SSIS.

Small-Scale Irrigation's Impact on Domestic Food Security

Agricultural productivity must be stabilized through irrigation in order to lessen the effects of erratic or insufficient rainfall (Getaneh, 2011). Additionally, it may raise yields and cropping intensity (Awulachew *et*

***Corresponding Author:** Addis Hailu Demo

al., 2010). Irrigation has a significant impact on income. According to FAO (2010), the value of agricultural production per hectare in irrigated settings is around twice as high as in rain-fed settings. A 50 percent point difference in household income and consumption between irrigated and rain-fed environments is not uncommon. If efforts are directed toward reviving and upgrading existing traditional SSI schemes, with support to improve access to input supply, output marketing, and extension to facilitate access to information and innovations, irrigation investments may have broader impacts on food security and poverty reduction (Awulachew *et al.,* 2010). Similar to this, Desta (2013) study showed that irrigated agriculture contributed roughly 70% of revenue in the highly irrigated villages compared to 60% in the two other low irrigated areas. Despite the fact that the highly irrigated village has smaller landownership and cultivated holding than the lowly irrigated village by more than 30%, the absolute amount of agricultural income is likewise the largest in this community. Over 50% more agricultural income is generated per hectare in the highly irrigated village than in the lowly irrigated area.

Compared to subsistence farming, the cash crop economy has significant cash flow and a wide range of opportunities for off-farm income (Ahmed *et al.,* 2019). The irrigation projects improved household food security because they raised household income compared to the circumstances prior to the projects' installation (Mengistu, 2007). Reduced hunger months from 6 to 2 months (July and August), improved diversity of crops, and a switch from a cereal-livestock system to a cereal-vegetable-livestock system have all been brought about by the building of small-scale irrigation systems (IFAD, 2011). The poor profit from irrigation because it increases output, yields, crop failure risk, and year-round farm employment (Asayehegn, 2011; & Abraham, 2015). As a result, irrigation enables smallholder farmers to employ more diverse cropping strategies and transition from producing low-value staples to high-value, market-oriented crops. Food for the needy is now more accessible and affordable because too increased production. Through increased revenue, food security, employment opportunities, the satisfaction of social needs, and the decrease of poverty, irrigation helps people live better lives (MoARD, 2012). Participation in irrigation use has boosted yearly household farm income for participant households by 19,474.8 birr over non-participant households, and their physical asset holding is worth 27502.4 ETB (Legesse *et al.,* 2018). In general, irrigation water is an essential resource for various subsistence and productive activities, and it helps to reduce poverty (Worku, 2011). The advancement of irrigation and agricultural water management has the potential to significantly increase productivity and lessen a nation's susceptibility to climatic instability (MoFAD, 2012; MOFAD, 2013). As a result of the importance of the agricultural sector, which includes the irrigation subsector, to the nation's overall economic development as well as the achievement of the goals set forth in the rural development policy and strategy, a number of donors and development partners should be required to provide technical assistance as well as financial support to reduce poverty and improve food security. Numerous researchers contend that the most practical strategies for achieving food security in Ethiopia involve raising cropping intensity and agricultural productivity using a variety of techniques and technology (such as irrigation).

Effects of Small-Scale Irrigation on Reducing Poverty

As evidenced by the findings of several research, irrigation has a favorable impact on agricultural output. The following are the proofs: Studies on the effects of community-managed irrigation on household income and poverty reduction in Tigiray, according to Sesen (2013), reveal that irrigation has the first direct impact on output levels. According to research Lipton and colleagues conducted on the effects of irrigation in Asia, irrigation boosts overall farm output, which raises farm profits even with constant prices. That investigation discovered that there are at least three possible causes for higher output levels. First, irrigation increases yields by lowering crop loss caused by irregular, inconsistent, or insufficient rainfall. Second, irrigation makes it possible to grow different crops, which raises yield annually. Thirdly, irrigation makes it possible to cultivate a larger amount of land in places where rainfed production is either impractical or insufficient. Evidence for these impacts is pervasive, well-documented, and uncontroversial, according to Davis (2017). For instance, the FAO claims that irrigation can increase yields for most crops by 100 to 400%, and that higher, less risky, and more continuous levels of rural employment and income result from the higher cropping intensities, yields, and more intensive and higher value crops and cultivation techniques of irrigated compared to rain-fed agriculture. Increased productivity contributes to higher returns on farmers' investments in labor and land. Hussain and Hanjra contend that having access to dependable irrigation water enables farmers to enhance their farming practices and embrace new technologies, which increases productivity and boosts crop yields and returns.

Getaneh (2011) reports that research on the effects of specific small-scale irrigation schemes on household income and the likelihood of poverty in Ethiopia's Lake Tana basin demonstrates that access to irrigation increases the opportunity for crop intensification and diversification, which raises cropping income, boosts crop productivity, and stabilizes crop risk. Anwar's (2014) research found that having access to water has allowed irrigating households to diversify their crops, raise their farming intensity, reduce crop failure, and ultimately increase productivity and farm revenue. According to Hadush Hailu (2014), Getaneh irrigation benefits the poor by boosting output and yields, lowering crop failure risks, and boosting year-round employment on farms and in other sectors. Smallholders can move

***Corresponding Author:** Addis Hailu Demo

from low value staple or subsistence farming to high value available and affordable for the poor by using irrigation to adopt more diverse cropping patterns. Indirect links occur at the regional and national levels and have a significant positive impact on the national economic growth that benefits the poor since investments in irrigation lead to production and supply shifts.

Small-Scale Irrigation's Effects on Food Security and Self-Sufficiency

In Ethiopia, irrigation increased yields per hectare, revenue, and food security (Hagos *et al.*, 2009). Development of small-scale irrigation systems is one of the key strategies employed to ease the burden of food insecurity. Make sure each farmer has the capacity to produce or purchase their own food, as that is one major aspect (Zewelde *et al.*, 2015). According to 2005 research by IFAD, the development of small-scale irrigation systems in Ethiopia has increased revenue in the Oromia and Southern Nations, Nationalities, and People region and reduced the number of hungry months from six to two. In a similar vein, case studies of the three irrigation schemes in the Tigray region showed that, even though the farmers did not become food self-sufficient for the entire year after the development of the irrigation schemes, most of them were able to feed themselves for longer than they had before the irrigation interventions (Mintesnot *et al.*, 2004). Similar to this, a case study comparing the food security situations of irrigation users and non-users in the small-scale irrigation scheme in the Oromia Region showed that irrigation users were in a better position than non-users, with about 65% of irrigation users having access to enough food compared to only 29% of non-users (Tefera & Cho, 2017).

The Household Incomes of Small-Scale Irrigation Users and Non-Users

Irrigation in Ethiopia is favorably connected with household income and spending and adversely correlated with poverty, according to numerous research. These studies have demonstrated that households having access to irrigation water are substantially less likely to be impoverished than households without such access. First and foremost, there is direct proof from several studies that irrigation can increase farmers' incomes under the right circumstances. Studies on the effect of community-managed irrigation on household income and poverty reduction in Tigiray, according to Sesen (2013), demonstrate that irrigation has an impact on raising household income and lowering poverty. According to the (PSM) result, the average annual income of irrigation users was ETB 4003.21, while that of non-users was ETB 797. This meant that there was a mean income difference of ETB 2720.88 between the two groups, indicating that there is an impact on this figure. A small-scale irrigation project has a beneficial influence on households' farm income and household food security using consumption expenditure as a proxy, according to Muez's (2014) study on the impact of small-scale irrigation on rural household food security in Tigiray. According to the study, participants in irrigation programs in 2012/2013 had yearly farm revenue and food consumption expenditure per adult equivalent that were, respectively, 48.9% and 36.4% greater than those of non-participants. According to Anwar (2014) study about impact of small-scale irrigation on household welfare indicated that access to small-scale irrigation has a profound impact on improving the livelihoods of smallholder farmers. The PSM model results for the outcome variable per adult consumption expenditure indicated the average treatment effect on the treated was in the range of 1800-2400 ETB depending on the matching algorithm under consideration. The mismatched sample was used to determine the equivalent figure, which came to 2451 ETB. The analysis demonstrates that irrigating households have a higher quality of living than non-irrigating households, presuming that consumption expenditures are a reliable proxy for measuring welfare. Irrigation is becoming a technique to boost total annual income for many households, according to Getaneh (2011) studies about the influence of chosen small-scale irrigation projects on household income and the possibility of poverty in the Lake Tana basin of Ethiopia. His econometric analysis showed that access to small-scale irrigation increased mean household income significantly (approximately ETB 3,353 per year, or a 27% increase over non-irrigating families), even after controlling for other factors that affect household income.

The journal of agricultural sciences, according to Kinfe Aseyehegn *et al.* (2012), indicates that the overall household income of irrigation users would be higher by Birr 26,593.60 than those who do not engage in irrigation farming, holding other factors constant. Agricultural households can exploit farm resources in at least two different ways thanks to irrigation. First, it makes it possible to grow vegetables and cereal crops twice, and occasionally even three times, annually. Second, it lowers the cost of purchasing fodder and increases animal output by providing feed during the dry seasons. Therefore, taking part in small-scale irrigation helps farm households enhance their well-being by increasing revenue while lowering risk and balancing household spending.

Relationship between Irrigation and Food Security

Due to unpredictable and infrequent rainfall, Ethiopian farmers are unable to produce enough food, thus the government has placed a high priority on small-scale irrigation agriculture as a way to ensure food security and reduce poverty (Awulachew *et al.*, 2007). The main factor promoting agricultural growth and poverty reduction is the implementation of new technological innovations, such as irrigation (Norton *et al.* 2010). In order to investigate how irrigation can lessen poverty, Swamikannu & Berger (2009) built an irrigation-poverty dynamics coupling model. This study created a framework for small-scale irrigation-food security by modifying the Swamikannu-Berger model. According to this conceptual framework, irrigation

***Corresponding Author:** Addis Hailu Demo

program investments can reduce farmers' heavy reliance on rainfall. It improves the amount of irrigated farmland and creates jobs as well. It encourages farmers to utilize more chemical inputs and produce two or three times per year. According to studies, small-scale irrigation was used in developing nations to boost productivity, lessen the consequences of irregular rainfall, and give the unemployed a place to work (Chazovachii, 2012; & Torell & Ward, 2010). In semi-arid tropical nations, irrigation is a crucial investment in rural development that may have both immediate and long-term effects on poverty and food security (Bhattarai *et al.*, 2007). Investment in small-scale irrigation generates employment possibilities both on and off the farm, boosts consumer spending, and builds assets. As a result, irrigation brings down food prices, enabling the underprivileged to purchase and acquire the necessary food at reasonable prices (Huang *et al.*, 2006). The productivity of irrigated farmland is improved by the use of more chemical inputs and year-round cultivation of high-value cash crops, which allows people to consume nutrient-rich food and maintain good health. According to Awulachew *et al.* (2007), irrigation expansion boosts input productivity, reduces sensitivity to rainfall unpredictability, and fosters a dynamic rural economy. Reliable small-scale irrigation increases land productivity, crop yields, and application of mineral fertilizers, which, in turn, enables diversification into non-traditional and market-oriented products (high value crops, vegetables, and fruits) and positively affects the diet, incomes, health, and food security of farm households (Eshetu, 2010). (Torell & Ward, 2010). In order to demonstrate the role that small-scale irrigation plays in guaranteeing food security and luring foreign investment to the economy, the study constructed the model.

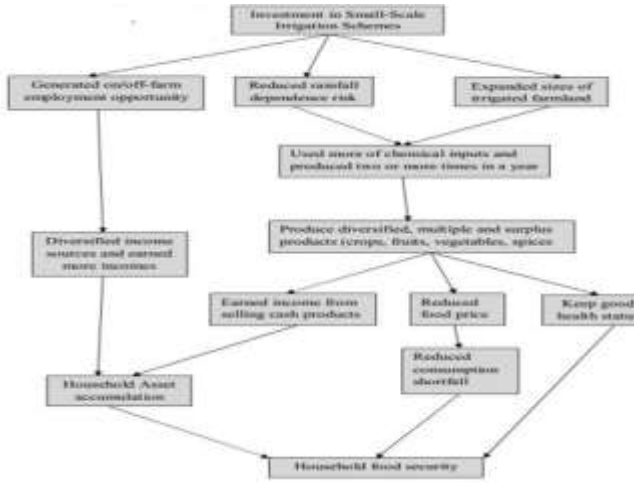

Figure 1: Irrigation food security linkage conceptual frame work
Source: (Nugusse *et al.*, 2012)

CONCLUSION AND RECOMMENDATION

Ethiopia's agriculture is heavily reliant on the inconsistent and unpredictable rainfall. Due to the farmers' low agricultural production and the irregular rainfall, which is the result of their rain-oriented farming strategy, poverty cannot be reduced. As a result, the nation has been noted for its extreme poverty for many years. Small-scale irrigation in Ethiopia has a wide range of effects on the improvement of rural people's means of subsistence. It alters the way of life of farmers either directly or indirectly. Through the intensification and diversification of crops, the raising of livestock, the creation of jobs, the growth of revenue, and the assurance of adequate food. According to evidence, farmers now have more food security than they did before irrigation development, and farmers who utilize irrigation have better incomes and food security than farmers who don't. By boosting agricultural output and productivity, providing impoverished people with on- and off-farm employment opportunities, and raising irrigators' incomes, irrigation has the capacity to combat poverty. Small-scale irrigation, therefore, both directly and indirectly, has a significant impact on raising farmers' income and reducing poverty through various dimensions, including crop diversification, stability, and risk reduction, as well as increased agricultural production and productivity, raising household income, opening up job opportunities, improving access to credit, and encouraging participation in local decision-making. The government and other relevant bodies should improve small irrigation since it has the ability to reduce frequent climate change and unpredictable rainfall and is simple to adapt to and use on a personal level. Although small-scale irrigation has the potential to reduce poverty and has a favorable impact on rural farm households' income, it is subject to numerous limitations and only covers a small area. Therefore, the responsible body should seek to advance and expand its technological growth. The difference in income between irrigation users and non-users existed. The responsible organization should spread awareness and offer credit services for household purchases of seeds or other inputs. Raising awareness through education, extending and expanding finance services, and increasing irrigation quality and quantity are crucial steps toward raising income and, ultimately, reducing poverty. The ability of irrigation to lessen poverty should inspire interested parties to support research on irrigation and agriculture in general. Enhance the policies that encourage private sector investment in the development of irrigated agriculture, particularly the production and sale of micro irrigation technology as well as other input and output market activities.

Conflicts of Interest
The author declares no conflict of interest

REFERENCES

1. Yihdego, A. G., Gebru, A. A., & Gelaye, M. T. (2015). The impact of small-scale irrigation on income of rural farm households: Evidence from

***Corresponding Author:** Addis Hailu Demo

Ahferom Woreda in Tigray, Ethiopia. *International Journal of Business and Economics Research*, *4*(4), 217-228.
2. Ahmed, J. (2019). The role of small-scale irrigation to household food security in Ethiopia: a review paper.
3. Kinfe, A., Chilot, Y., & Sundara, R. (2011). Effect of small-scale irrigation on the income of rural farm households: The case of Laelay Maichew District, Central Tigray, Ethiopia. *Journal of Stored Products and Postharvest Research*, *2*(10), 208-215.
4. Awulachew, S. B., & Merrey, D. J. (2007). Assessment of small scale irrigation and water harvesting in Ethiopian agricultural development. *International Water Management Institute (IWMI)*.
5. Awulachew, S. B., Merrey, D., Van Koopen, B., & Kamara, A. (2010, March). Roles, constraints and opportunities of small-scale irrigation and water harvesting in Ethiopian agricultural development: Assessment of existing situation. In *ILRI workshop* (pp. 14-16).
6. Awulachew, S. B., Yilma, A. D., Loulseged, M., Loiskandl, W., Ayana, M., & Alamirew, T. (2007). *Water resources and irrigation development in Ethiopia* (Vol. 123). Iwmi.
7. Belay Bedeke, S. (2012). Food insecurity and copping strategies: a perspective from Kersa district, east Hararghe Ethopia. *Food Science and Quality Management, J. Nutr. ISSN*, 2224-6088.
8. Bekele, S. (2000). *Water resources investigation and design guideline for potential exploitation in limited data situation: the case of Abaya-Chamo basin* (Doctoral dissertation, Ph. D Dissertation, TU Dresden).
9. Clay, J. (2011). Freeze the footprint of food. *Nature*, *475*(7356), 287-289.
10. Daniel, Z. (2015). The impact of irrigation schemes on farmers' income and livelihoods in the Upper East Region of Ghana. *Published MPhil Thesis, Kwame Nkrumah University of Science and Technology, Ghana*.
11. Davis, K. F., Rulli, M. C., Seveso, A., & D'odorico, P. (2017). Increased food production and reduced water use through optimized crop distribution, Nat. Geosci., 10, 919–924.
12. Mengistie, D., & Kidane, D. (2016). Assessment of the impact of small-scale irrigation on household livelihood improvement at Gubalafto District, North Wollo, Ethiopia. *Agriculture*, *6*(3), 27.
13. Desta, B. (2004). Impact of community managed irrigation scheme on farm production efficiency and household food security: The Case of Weliso and Wechi Districts of Ormia Region. *An MSc Thesis Presented to the School of Graduate Studies of Alemaya University*.
14. Elias, A. (2011). *Sustainability of small scale irrigation schemes: a case study of Nedhi Gelan Sedi small scale irrigation in Deder Woreda, Eastern Oromia* (Doctoral dissertation, MA thesis School of Graduate Studies, Addis Ababa University, Ethiopia).
15. Fanadzo, M. (2012). Revitalisation of smallholder irrigation schemes for poverty alleviation and household food security in South Africa: A review. *African journal of agricultural research*.
16. Ghanem, H. (2010). *Addressing food insecurity in protracted crises*. Food and agriculture organization of the United nations (FAO).
17. FAO. (2005). Assessment of the world food security situation. *Committee on World Food Security, Thirty-First Session, May 23–26, 2005*.
18. Hadush, H. (2014). *Adoption and impact of micro irrigation on household income: the case of Eastern Tigray* (Doctoral dissertation, Mekelle University).
19. Haile G, Kassa K (2015). Irrigation in Ethiopia: A review. *Academia Journal of Agricultural Research*, *3*(10), 264-269
20. Hussain, M., Hussain, Z., & Ashfaq, M. (2006). Impact of small scale irrigation schemes on poverty alleviation in marginal areas of Punjab, Pakistan. *International Research Journal of Finance and Economics*, *6*(6).
21. Hussein, B. (2006). Major causes of household food insecurity in Wuchale-Jidda Woreda, Oromiya national regional state. *PhD diss., MA Thesis, Addis Ababa University*.
22. Iticha, M. D. (2019). Review on the impact of small scale irrigation scheme on household income and poverty reduction in Ethiopia. *population*, *10*(17).
23. Aseyehegn, K., Yirga, C., & Rajan, S. (2012). Effect of small-scale irrigation on the income of rural farm households: The case of Laelay Maichew District, Central Tigray, Ethiopia.
24. Legesse, L., Ayele, A., Tasewu, W., & Alemu, A. (2018). Impact of Small Scale Irrigation on Household Farm Income and Asset Holding: Evidence from Shebedino District, Southern Ethiopia. *Journal of Resources Development and Management*, *43*, 1-8.
25. Dereje, M., & Desale, K. (2016). Assessment of the Impact of Small-Scale Irrigation on Household Livelihood Improvement at Guba Lafto Woreda, North Wollo, Ethiopia. *Ethiopia: the case of three selected kebeles. Addis Ababa, Ethiopia*.
26. MOA (Ministry of Agriculture) (2011). *Small-Scale Irrigation Capacity Building Strategy for Ethiopia*. Addis Ababa, Ethiopia
27. MoARD (Ministry of Agriculture and Rural Development). 2012. Ethiopia's Agriculture
28. Muez, H. A. (2014). *The Impact of Small-Scale Irrigation on Rural household Food Security: The case of Emba Alaje woreda* (Doctoral dissertation, Mekelle University).
29. Anwar, A. W. (2014). Impact of Small Scale Irrigation on Household Welfare.
30. Legesse, L., Ayele, A., Tasewu, W., & Alemu, A. (2018). Impact of Small Scale Irrigation on Household Farm Income and Asset Holding: Evidence from Shebedino District, Southern

***Corresponding Author:** Addis Hailu Demo

Ethiopia. *Journal of Resources Development and Management*, *43*, 1-8.

31. Asayehegn, K. (2012). Negative impact of small-scale irrigation schemes: A case study of Central Tigray regional state, Ethiopia. *Agric Res Rev*, *1*(3), 80-85.
32. Norton, G., Alwang, J. and Masters, W. (2010). Economics of Agricultural Development World Food Systems and Resource Use (2nd Ed.). Madison Avenue, New York, NY 10016.
33. Swamikannu, N., & Berger, T. (2009). Impacts of small scale irrigation on poverty dynamics in the White-Volta Basin of Ghana: An integrated multi-agent simulation approach. In *7th International Science Conference on the Human Dimensions of Global Environmental Change, April* (pp. 26-30).
34. Chazovachii, B. (2012). The impact of small scale irrigation schemes on rural livelihoods: the case of Panganai irrigation scheme Bikita District Zimbabwe. *Journal of Sustainable Development in Africa*, *14*(4), 217-231.
35. Bhattarai, M., Barker, R., & Narayanamoorthy, A. (2007). Who benefits from irrigation development in India? Implication of irrigation multipliers for irrigation financing. *Irrigation and Drainage: The Journal of the International Commission on Irrigation and Drainage*, *56*(2-3), 207-225.
36. Huang, Q., Rozelle, S., Lohmar, B., Huang, J., & Wang, J. (2006). Irrigation, agricultural performance and poverty reduction in China. *Food policy*, *31*(1), 30-52.
37. Eshetu, S., Belete, B., Goshu, D., Kassa, B., Tamiru, D., Worku, E., Lema, Z., Delelegn,A., Tucker, J. and Abebe, Z. (2010). Income Diversification through Improved Irrigation in Ethiopia: Impacts, Constraints and Prospects for Poverty Reduction.
38. Torell, G. L., & Ward, F. A. (2010). Improved water institutions for food security and rural livelihoods in Afghanistan's Balkh River basin. *International Journal of Water Resources Development*, *26*(4), 613-637.

***Corresponding Author:** Addis Hailu Demo