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Review Article

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Review on Impact of Irrigation on Poverty Reduction and Environmental Degradation in Ethiopia

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Abstract

Ethiopia's economy is dependent on agriculture. Agriculture is highly dependent on rainfall. But the uneven temporal and spatial distribution of rainfall has significantly affected agriculture. Population in Ethiopia is rapidly increasing landholding size is decreasing substantially. Recurrent drought and dry spells continue to affect productivity and hamper agricultural production of rain fed agriculture. The challenge of food insecurity due to its dependency on rain-fed and the inability to develop the irrigation potential in Ethiopia is a concern and it is also a bottleneck problem in Ethiopia. Therefore, it is not possible to address issues such as poverty reduction and environmental protection without putting in place a mechanism for the exhaustive and efficient use of Irrigation water. So, the aim of this paper is to review the impact of irrigation on poverty reduction and environmental degradation in Ethiopia. In line with this review introduction and expansion of irrigation in Ethiopia is economically valuable and an important mechanism in fulfilling food self-sufficiency. But, most of the schemes are non-sustainable to meet the advantage of irrigation and drainage schemes and many of them have been unsuccessful and even have had negative impacts on the environment.

Keywords: Irrigation; Poverty; Rainfall; Economy and agriculture

Introduction

Ethiopia's economy is dependent on agriculture, which contributes 43% of the GDP and 90% of exports [1]. It also employs 83% of the active population [2]. The agriculture is primarily rain fed and thus highly dependent on rainfall. But the uneven temporal and spatial distribution of rainfall has significantly affected the agriculture. The challenge of food insecurity due to its dependency on rain fed and inability to develop the irrigation potential in Ethiopia is a concern and it is also a bottleneck problem in Ethiopia [3].

Ethiopia has 12 major river basins. Ministry of water resources has identified 560 irrigation potential sites on the major river basins. The total potential irrigable land in Ethiopia is estimated to be around 3.7 million hectares [4]. However, just five percent of land is irrigated, and crop yields from small farms are below regional averages [1].

Irrigation is practiced in Ethiopia since ancient times producing subsistence food crops. However, modern irrigation systems were started in the 1960's with the objective of producing industrial crops in Awash Valley. In the 1960's, irrigated agriculture was expanded in all parts of the Awash Valley and in the Lower Rift Valley with benefits of flood control, hydropower and assured irrigation water supply. Although, certain aspects of the development during the pre-Derg era have wrong doings in terms of property and land rights, there has been a remarkable emergence of irrigation development and establishment of agro-industrial centers [4].

Currently, the government is giving more emphasis to the sub-sector by way of enhancing the food security situation in the country. Efforts are being made to involve farmers progressively in various aspects of management of small scale irrigation systems, starting from planning, implementation and management aspects, particularly, in water distribution and operation and maintenance to improve the performance of irrigated agriculture [4].

Based on the ministry of water resources classification, irrigation projects in Ethiopia are identified as large-scale irrigation if the size of command area is greater than 3,000 hectares, medium-scale if it falls in the range of 200 to 3,000 hectares and small-scale if it is covering less than 200 hectares [5]. According to the database developed in this study, currently, data on 791 schemes has been collected from different regional states of Ethiopia and the total estimated area of irrigated agriculture in the country is 107,265.65 hectares out of which 20,038.39 hectare is from small-scale, 30,291.26 hectares is from medium-scale and 56,936 hectares is from large scale.

In many droughts prone countries, including Ethiopia, there has been an optimistic view regarding irrigation development as a strategy to sustain agricultural production and ensure food security indicated that small-scale irrigation schemes would stabilize agricultural production system and assure food supply even in years with inadequate rainfall and increase the overall level of crop production in years with normal rainfall [6,7]. Another advantage of irrigation is that the possibility of intensification of agricultural practices, especially in areas where arable land is a scarce resource. Regardless of ensuring food security, the main problems resulting in the non-sustainability of irrigation and drainage schemes are degradation of irrigation land, reduced socio-economic condition, poor water quality, ecological degradation and ground water depletion [8].

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Population in Ethiopia is rapidly increasing land holding size is decreasing substantially. Recurrent drought and dry spell continue to affect productivity and hamper agricultural production of rain fed agriculture.

Therefore, it is not possible to address issues such as poverty reduction, environmental protection without putting in place mechanism for the exhaustive and efficient use of water which includes building irrigation schemes, expanding infrastructure, introducing modern irrigation equipment, strengthening agricultural extension, and training program.

Objective

To review the impact of irrigation on poverty reduction and environment degradation in Ethiopia.

Literature Review

Areal description of Ethiopia

Ethiopia has a tropical monsoon climate with a wide topographic-induced variation. The mean annual temperature varies from less than 7-12°C in the cool zone to over 25°C in the hot lowlands. Mean annual potential evapotranspiration varies between 1700-2600 mm in arid and semi-arid areas and 1600-2100 mm in dry sub-humid areas. Rainfall in Ethiopia is highly erratic, resulting in a very high risk of intra-seasonal dry spells. Considering the water balance and the length of the growing period, Ethiopia can be divided into areas without a significant growth period with little or no rainfall, areas with a single growing period and one rainy season, and areas with a double growing period and two rainy seasons [9].

The total population of the country is estimated at 99 million (2015), of which 81% is rural [9]. The annual population growth rate is 2.6 percent over the period 2005-2015. The Ethiopian economy is mostly based on agriculture. Most of Ethiopia's cultivated land is under rain fed agriculture. The progressive degradation of the natural resource base coupled with climate variability has aggravated the incidence of poverty and food insecurity [4]

Poverty in Ethiopia

Poverty is general scarcity or the state of one who lacks a certain amount of material possessions or money. It includes social, economic, and political elements.

Poverty in Ethiopia is characterized by inadequacy or lack of productive means to fulfill basic needs such as food, water, shelter, education, health, and nutrition. According to [10], the poverty situation in Ethiopia clearly shows the prevalence of six major factors that are highlighted as contributing to the exasperation of poverty in Ethiopia. These include low agricultural production, low non-farm income, low education, poor health, high population growth, and weak institutional structures. The challenge of food insecurity in Ethiopia is a bottleneck problem. The major cause of food insecurity in the country is due to its dependence on rain-fed agriculture and its inability to develop its irrigation potential [3]. As a result, the Government of the Federal Democratic Republic of Ethiopia formulated the "Agricultural Development Led-Industrialization" (ADLI) strategy which emphasized the need for giving priority to the development of agriculture as a fundamental basis for industrialization in Ethiopia. ADLI took agriculture as the prime mover of the Ethiopian economy. Increasing agricultural output and productivity taken as the core of the strategy. One of the supply side agricultural supports is water harvest and irrigation.

Irrigation

Irrigation is 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. 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. According to [11] Irrigation methods are divided into two groups related to delivery and application of water on soil. These are surface irrigation and pressure irrigation methods.

Surface irrigation method

Surface irrigation has evolved into an extensive array of configurations which can be broadly classified as:

- Basin Irrigation
- Border Irrigation
- Furrow Irrigation
- Uncontrolled Flooding

As noted previously, there are two features that distinguish a surface irrigation system:

- The flow has a free surface responding to the gravitational gradient; and
- The on-field means of conveyance and distribution is the field surface itself [11].

Surface irrigation methods draining the water to the depth give more successful results for plants with long roots.

Basin irrigation

In the basin irrigation method, water is delivered to borders whose corners have been heightened by soil barriers [11].

Border irrigation

The border irrigation method resembles with basin irrigation method. However, the width of the basin is shorter, the length of the basin is longer and the basin ends are wider. A certain inclination is required for flow in the border irrigation method.

Furrow irrigation

Furrow irrigation is conducted by creating small parallel channels along the field length in the direction of the predominant slope. Water is applied to the top end of each furrow and flows down the field under the influence of gravity. Water may be supplied using a gated pipe, siphon, head ditch or bank less systems. The speed of water movement is determined by many factors such as slope, surface roughness, and furrow shape but most importantly by the inflow rate and soil infiltration rate [12].

Pressurized irrigation method

In pressurized irrigation systems, water is pressurized and precisely applied to the plants under pressure through a system of pipes. Pressurized irrigation systems, as opposed to surface irrigation

systems, are more effective in the application of irrigation water to crops. They provide improved farm distribution, improved control over timing, reduced wastage of land in laying field distribution network, reduced demand for labor, and better use of limited water resources (ICID, 2017. In the pressurized irrigation method, the water is given to the soil by using closed pipe systems with additional energy or a drawing effect [11].

According to [13], there are many types of pressurized irrigation systems but the two major ones are drip irrigation systems and sprinkler systems. Among them, there are many types depending on the type of field, the crop, and the kind of water delivery fittings needed, but the components of the basic system remain the same.

As [13] discussed pressurized irrigation systems have the potential to avoid the water loss related to surface irrigation increasing the open irrigation application efficiency from 45% to 60% to pressurized irrigation with efficiency in the range of 75% to 95%. While open canals systems have high labor requirements for maintenance pressurized systems have skilled labor requirements. Pressurized irrigation systems need from one-tenth to one-quarter of the man-hours that surface systems require. Driven by the need to reduce labor input into agriculture and the love of high technology, pressurized irrigation systems are costly and out of reach of small-holder farmers in developing countries.

Sprinkler irrigation

In sprinkler or overhead irrigation, water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns [13].

Drip irrigation

Drip irrigation, also known as trickle irrigation or micro-irrigation, or localized irrigation, is an irrigation method that allows water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters. It is done through narrow tubes that deliver water directly to the base of the plant [13]. Irrigation has two primary objectives 1 To supply essential moisture for plant growth, which includes the transport of essential nutrients to leach or dilute salts in soil [14]. Irrigation is pivotal to the agricultural, social, and economic growth of the nation.

Irrigation has provided stability to food production. It is increasingly argued that at the macro-level of irrigation, there is no food grains constraint in India [15]. It is claimed that the incidence of poverty is high as 69% in areas with less than 10% cropped area under irrigation. Irrigation development necessarily triggers the employment generation in agriculture. Making it possible to grow more than one crop in a year, irrigation has contributed to increasing in cropping intensity [14]. Irrigation has proved to be the most effective drought-proofing mechanism and the single biggest factor in bringing about a large measure of stability in agricultural production.

Irrigation results in the degradation of water quality. Irrigation by its nature uses pure water consumptively, leaving less water to transport salts and other contaminants. Irrigation may be viewed as the intensification or acceleration of a natural process [16].

Irrigation is vital to the well-being of the people in this world and plays a significant role in local, national, and international growth and development. However, irrigation also has created problems, such as salinization of land and water resources and environmental damage [14].

Irrigation in Ethiopia

The development of irrigation and agricultural water management holds significant potential to improve productivity and reduce vulnerability to climatic volatility in any country. Although Ethiopia has abundant rainfall and water resources and plans to significantly increase its irrigated land, its agricultural system does not yet fully benefit from the technologies of water management and irrigation. According to [17], the key technical, socio-economic, institutional, and environmental challenges to meet this plan are lack of irrigation scheduling, the low performance of schemes, constraints on scale-up of irrigation projects and protecting irrigation development sustainability.

Another obstacle to irrigation development is the underperformance of existing irrigation schemes. Many irrigation projects are operating significantly under their design capacity, operating at just 64% of their design capacity, and small-scale schemes account for 90% of the gap [17]. Lack of operations/maintenance, Human capacity, and Research/ management capabilities are the main reasons for the low performance.

Impact of irrigation on poverty reduction in Ethiopia

In drought-prone areas of Ethiopia, there has been an optimistic view regarding irrigation development as a strategy to sustain agricultural production and ensure food security. For instance, [7] indicated that small scale irrigation schemes would stabilize the agricultural production system and assure food supply even in years with inadequate rainfall, and increase the overall level of crop production in years with normal rainfall. Another advantage of irrigation is the possibility of intensification of agricultural practices, especially in areas where arable land is a scarce resource. Irrigation provides the means of maximizing production with double or multiple cropping, taking full advantage of modern technologies and high yielding crop varieties. Moreover, irrigation provides farmers an opportunity to grow high value crops like vegetables and fruits that require a year round and generous supply of water to grow. Such diversification of agricultural products will ensure a reliable income source for the farming community.

When we look at the performance level of irrigation in Ethiopia, small scale schemes have had a better record of success than large-scale schemes [6]. According to Food and Agriculture Organization, small scale irrigation systems are defined as being controlled by single farmers or farmers' groups and are usually less than 200 hectares [5]. Many development organizations believe small scale irrigation methods are an effective way to increase food production.

Discussion

Research conducted on the impact of small-scale irrigation on the socio-economic development of the society in Kemisse Zone and Dewa Cheffa Woreda reveals that small scale irrigation has an impact on the social and economic wellbeing of households [6]. According to [6], the skill of farmers after the introduction of irrigation was better than that before the introduction of irrigation such as plowing, threshing, harvesting, and use of the agronomic practice. All the farm households are working on their farm on the daily basis, which is a big; change as compared to before the introduction of the schemes.

Land use intensity and crop diversification were improved due to increases in the acreage of the main crop and cultivation in both seasons as a result of irrigation development in the study area. Almost the entire farm household increased production of multi-item and market-oriented types of crops two cycles per year. The finding of the study concluded that the introduction and expansion of irrigation are economically valuable and an important mechanism in fulfilling food self-sufficiency in the study area particularly and the development process in Ethiopia (Tables 1-3).

Fruit and vegetable before irrigation (M)			**Fruit and vegetable after irrigation (M)**		
Minimum	Maximum	Mean	Minimum	Maximum	Mean
75	3000	766.25	1070	255000	19594
M=income					

Table 1: Comparison of income generated from fruit and vegetable before and after irrigation.

Food self-sufficiency status	**Frequency**	**Percent**	**Total**
Sufficient	25	83.3	83.3
Insufficient	2	6.7	6.7
No change	3	10	10
Total	30	100	100
Source: Survey result [6]			

Table 2: Food security status of the society after the development of irrigation.

Profitable Product	**Frequency**	**Percent**	**Total**
Yes	25	83.3	83.3
No	5	16.7	16.7
Total	30	100	100

Table 3: Profitability of the products.

According to [18] survey data gathered from a total of 1024 households from 8 irrigation sites in 4 regional states of Ethiopia showed that the mean per capita income of rain fed farmers is below the poverty line. Interestingly also the mean per capita income values up to the eighth income decile are lower than the assumed poverty line. However, the mean per capita income for irrigators and the overall sample is higher than the poverty line, and the gap between mean per capita income and the poverty line widens in proportion to the size of irrigated area (Table 4).

Deciles	**Rainfed**	**Irrigation**	**Overall**	**1st Quartile**	**2nd Quartile**	**3rd Quartile**	**4th Quartile**
First	38.5	114.5	72.6	90.8	80.4	116.5	233.4
Second	166.8	331	236.4	274.6	242.6	362.9	520
Third	285.6	503	391	385.5	466.7	538.9	708.2
Fourth	401.6	648.2	526.8	509.3	584.3	658.8	960.2
Fifth	514.2	850.9	651.5	673.4	813.8	864	1268.3
Sixth	617	1127.9	842	827	1035.8	1270.1	1641.1
Seventh	774.2	1507	1099.5	1112.8	1245.2	1766.1	2295.2

Eighth	984.5	2067.9	1542.5	1481.8	1729	2506.7	3294.9
Ninth	1379.2	3231.7	2425.7	2033.6	2374.8	3889.2	4796.6
Tenth	4152.5	8736.3	7096.5	6395.6	7447.2	9352.3	10212
Mean	930.7	1908.3	1487.3	1369.6	1613.7	2230.9	2492.7
Poverty line	1075	1075	1075	1075	1075	1075	1095
Poor	498.5	498.5	492.8	503.4	527	525.2	602.9
Non-poor	2688.4	3497.1	3290.5	2980.4	3123.2	3998.4	3718.5
%poor	77.1	58.5	65.7	66.3	58.9	53.9	41.8
Gini coefficient	0.449	0.546	0.507	0.507	0.515	0.537	0.503
Deciles ratio	11.6	26.9	20.7	14.8	20.1	22.6	16.4

Table 4: Distribution of per capita income by income deciles for irrigators and non-irrigators.

Given the assumed poverty line, the proportion of poor households among those households with no access to irrigation is higher than those who have access to irrigation. The poverty reduction impact of access to irrigation is very much influenced by the size of the irrigated area [18].

The study conducted on the poverty impacts of agricultural water management technologies in Ethiopia showed that there is a significant difference in agricultural income (both crop and livestock) among users and non-users of Agricultural Water Management Technologies (AWMT) reported that those with access to AWMT were found to use higher farm inputs and have a significantly higher share of their products supplied to the market implying increased market participation. Accordingly, the value of fertilizer, seed, labor, and insecticide used and the size of loan received from microfinance institutions were significantly higher for users of AWMT compared with non-users. This may imply that because of access to AWMT, there is an increased intensification of agriculture. This is expected to have wider effects on the economy. Not surprisingly, users were also found to have significantly higher asset endowments such as male adult labor, oxen, livestock, and landholding, which may imply that those with access to AWMT have managed to build assets discussed that there is about 22% less poverty incidence among users compared to non-users of AWMT. In other words, individuals with access to AWMT are in a better position to meet their consumption requirements, food and non-food. There is also a significant difference in the poverty gap and severity of poverty among users and non-users, implying that access to AWMT is an effective instrument to narrow the poverty gap and inequality (Table 5).

Category	**poverty incidence value**	**poverty depth value**	**poverty severity value**
Access to AWMT			
Users (n=876)	0.478	0.198	0.111
Non-Users (n=641)	0.623	0.282	0.167
Z-statistic	-484.2***	-381.6***	-282.0***
*, **and *** significant at 10, 5 and 1 percent level of significance.			

Table 5: The effect of irrigation on incidence, depth and severity of poverty (poverty line=ETB 1821.05).

An empirical case study from Tigray region on poverty reduction with irrigation investment found that the average income of non-irrigating households is less than that of the irrigating households by about 50% (Table 6).

Welfare	**Irrigators**	**Non-irrigators**	**t-test**
Income and consumption	**Mean**	**Mean**	
Income from rain-fed farming in 2005/06 (Birr)	1372	1377	0.022
Income from irrigated farming in 2005/06 (Birr)	1406	0	-6.863***

Total cropping income in 2005/06 (Birr)	2778	1464	-3.777***
Non crop farming income 2005/06 (Birr)	1973	321	-0.95
Total off-farm income in 2005/06 (Birr)	721	779	0.608
Total income of the household in 2005/06 (Birr)	8457	4713	-2.053*
Total consumption expenditure in 2005/06 (Birr)	2763	2194	-3.088***
Proportion of income from farming	0.76	0.66	-5.234***
Per capita income (Birr)	2227	1288	-2.510*
Poverty incidence (%)	0.44	0.56	3.111***
* Means significant at 5%. ** Means significant at 10%. *** Means significant at 1%			

Table 6: Summary of statistics for selected variables used in estimating the treatment effect.

Reported that a large number of people have been beneficiaries from large scale irrigation schemes. The report indicated that Wonji Sugar Estate, Metahara Sugar Estate, Upper Awash Agro-Industry Enterprise, and Finchaa Sugar Estate, alone, support more than 100,000 employees and their families. Recognizing this fact, the Government of Ethiopia is currently expanding irrigation areas mainly near these four irrigation schemes under the framework of the National Water Sector Development Program.

Irrigation impact on environmental degradation

Environment is the complex of physical, chemical, and biotic factors (such as climate, soil, and living things that act upon an organism or an ecological community and ultimately determine its form and survival. Humans affect the environment negatively through polluting non-veg diet, technology, deforestation, excess usage of commodities and Wastage of resources: water, power, petroleum etc. [19,20].

Despite the positive contribution of irrigation development for food security and poverty reduction, many irrigation schemes have been unsuccessful and even have had negative impacts on environment [21]. Main problems resulting in the non-sustainability of irrigation and drainage schemes are degradation of irrigated land (salinization, alkalization, water logging and soil acidity, Reduced socio-economic conditions(increased incidence of water related disease, increased inequity and weaker community infrastructure, poor water quality(reduction in irrigation water quality and water quality problem for downstream users), ecological degradation(reduced big diversity in project area and damage to downstream ecosystem due to reduced water quality and quantity) and ground water depletion[22].

In Ethiopia, although irrigation has been long practiced at different farm levels, there is no efficient and well managed irrigation water practice which directly or indirectly affects the environment [23] as cited by [3]. Environmental impact refers to any change in the environment or in its components that may affect human health or safety, flora, fauna, soil, air, water, climate, natural or cultural heritage and other physical structures, social, economic or cultural conditions [24].

Research conducted on environmental impacts of small scale irrigation schemes in Ethiopian Rift Valley Lake Basins discussed that deforestation; overgrazing, poor watershed management, soil salinity, soil acidity, communicable and non-communicable diseases, and water loggings are the major problems of all schemes that are induced due to irrigation [3]. Aquatic and terrestrial weeds, water theft, drainage problems, seepage, flow obstruction, and plowing of sloppy lands without proper conservation techniques are additional environmental problems that are observed in all schemes due to a lack of continuous follow-up and frequent maintenance in the main canal and the accompanying irrigation infrastructures. As most households perceived soil erosion as a major environmental threat to irrigated crop production. Two major types of soil erosion were identified in this case study. Sheet erosion due to overtopping irrigation water and rill erosion were created due to the upstream seepage flowing out the surface of downstream fields. Erosion due to wrongly aligned furrows was observed. The problem of sedimentation in study areas increased year to year after the implementation of the irrigation schemes. As compared to rain-fed fields, elevated salinity levels and lower pH values have been measured in the studied irrigation schemes and land degradation is observed in their plots since the implementation of irrigation schemes.

A case study conducted in Ethiopia/Finchaa valley and Wonji/Shoa irrigation scheme resulted in unfavorable electric conductivity which leads in some instances to soil crusting and has a negative impact on infiltration rate. The study showed that In Wonji/Shoa the groundwater table has risen due to improper irrigation management and seepage of reservoirs. In Finch, a valuable ecosystem has been destroyed due to the establishment of the scheme and increased migration [18]. The study showed that the most crucial environmental impacts of large-scale irrigation in Ethiopia which could be identified are related to improper irrigation management and the development of irrigation projects on saline and saline-sodic soils. Investigations showed that in some fields of the Wonji/Shoa Plantation the groundwater table is less than one meter below the soil surface due to inefficient application of water and seepage of water from reservoirs and unlined distribution canals.

Observations made during the field visit of the Fnchaa sugar factory irrigation project indicate that the obvious malfunction of the wastewater treatment plant of the sugar factory poses a threat to downstream water bodies, especially to Finchaa River and to its ecosystem and malaria transmission seems to have increased because of the irrigation (Chala) (Table 7).

S/No	Scheme	Basin	Hydrology/Natural resources	Water quality	Soil quality
1	Wonji	AWASH	Rising water table, Seepage of reservoirs	Slight EC increase	Water logging infiltration
2	Oromiya		Inefficient water use (except Marcos)	Stagnant water	Salinity
3	Amibara II		Flood hazard, degradation	Linkage with Lake Beseka(very high sodium content)	Salinity
4	Ziway Holota			Toxicity	Salinity Permeability increase
5	Indris	BLUE NILE	Water diversion		Risk of water logging Low fertility
6	Lomi Wuha		Erosion risk		Nutrient deficit, alkaline
7	Fincha		Destruction of Ecosystem	Low EC	Low organic matter, infiltration
8	Hare	Rift Valley Lakes	Degradation, erosion, deforestation	Water logging	Low organic matter

Table 7: Summary of irrigation development impacts on the environment.

Of major land degradation problems in Ethiopia physical and chemical land degradation is the major one. Degradation caused due to inadequate irrigation water management is at an alarming rate. Due to Inadequate irrigation water management, 11 million ha of land in Ethiopia are salt-affected soils, about half of these soils are saline and the remaining half is saline-sodic and sodic soils (Figure 1) [25].

Figure 1: White salt crusts on the surface soils of irrigated lands in the A wash River basin indicate the presence of severe soil salinity.

Zewdu S, et al. discussed that there is a correlation between LULC changes and soil salinization from long-term irrigation practices. The levels of soil salinization in the study area are increasing from year to year.

Studies were done on Land-use/land-cover dynamics in Sego Irrigation Farm, southern Ethiopia has revealed that the extent of cultivated land, which was 38.1% in 1984 has increased to 60.7% by 2010, with an average change of 58 ha per year. The extent of land, which was intensively and sparsely cultivated in 1984 and 1995, was converted to barren and fallow land due to irrigation-related salinization problems. The water body/swamp/, which was 55 ha in 1984 has significantly decreased to 2 ha by 2010. Land-use changes have been attributed to factors such as population pressure and environmental changes as more land area was put under irrigated cultivation, leading to salinization and lowering the productivity of the soils in the area (Table 8) [26].

Salinity class	Area change						Change/year (1984-2010)	
	1984		1995	2010				
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Non-saline	4376	64.9	3979	59	2702	40	-64	-1.9
Slightiy saline	1755	26	1777	26.3	2360	35	23	1.1
Moderately saline	514	7.6	916	13.6	1485	22	37	4.1
Strongly saline	48	0.7	75	1.1	200	3	6	5.5
Water body	53	0.8	0	0	0	0	-2	
Total	6747	100	6747	100	6747	100	-	-

Table 8: Salinity class derived from NDSI and the rate of change for 1984, 1995 and 2010.

Research conducted on the Fentale irrigation project in central Oromia addressed that the water loss in the scheme is leading to and enhancing critical environmental concerns water, land, and salinity which can exacerbate the early positive impact of the project. Livestock development in the project, cattle trough, and modern forage production was not given due emphasis. The parallel approach to design and construction is quoted as one of the reasons for limitations on the quality and endanger the environment without giving room for environmental impact assessment.

Conclusion

In line with this review introduction and expansion of irrigation is economically valuable and an important mechanism in fulfilling food self-sufficiency. The development of irrigation reduces vulnerability to climate change and increases the possibility of intensification of agricultural practices. Irrigation provides product maximization and farmers an opportunity to grow high-value crops which ensures a reliable income source for the farming community. Irrigation also advances farmers' skill; improve land-use intensity and crop diversification and increase market participation and per capita income of irrigators. As a result, poverty is reduced. But Ethiopia's irrigation is non-sustainable to meet this advantage of irrigation and drainage schemes. The key technical, socio-economic, institutional and environmental challenges are lack of irrigation scheduling, the low performance of schemes, constraints on scale-up of irrigation projects, and Protecting irrigation development sustainability. The underperformance of existing irrigation schemes, Lack of operations/ maintenance, Human capacity, and Research/management capabilities are the main reasons for the low performance.

Despite the positive contribution of irrigation development to food security and poverty reduction, many irrigation schemes in Ethiopia have been unsuccessful and even have had negative impacts on the environment. The main problems resulting in the non-sustainability of irrigation and drainage schemes are degradation of irrigated land(salinization, alkalization, waterlogging, and soil acidityReduced socio-economic conditions(increased incidence of water related disease increased inequity and weaker community infrastructure poor water quality(reduction in irrigation water quality and water quality problem for downstream users, Ecologicaldegradation (reduced big diversity in the project area and damage to the downstream ecosystem due to reduced water quality and quantity) and groundwater depletion

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