J. Sus. Agric. Sci. **Vol. 46**, No. 3. pp. 35 - 46 (2020)

Journal of Sustainable Agricultural Sciences
http://jsas.journals.ekb.eg/

Effects of Salinity on Producers' Livelihoods and Socio-economic Conditions; The Case of Afar Region, Northeastern Ethiopia

Getinet Belay Wondim[1], Ashenafi Worku Daba[1*] and Asad S. Qureshi[2]
[1]Ethiopian Institute of Agricultural Research (EIAR), Werer Agricultural Research Center, Werer, Ethiopia, [2]Irrigation and Water Management, International Center for Bio saline Agriculture (ICBA), Dubai, United Arab Emirates.

THIS STUDY was done to assess the effects of salt-affected soils on the livelihoods and socio-economic conditions of the farming communities in Afar National Regional State, Northeaster Ethiopia. Primary data were collected from 102 sample respondents selected using multi-stage sampling techniques from Amibara and Dubti districts. Descriptive statistics (mean, frequency, percentage) and inferential statistics (t-test and Chi-square test) were employed to analyze the quantitative data. The results of the study showed that in the study areas, the farming communities have been negatively impacted by soil salinity. According to the study, soil salinity has made deterioration of both livestock rearing (reduced in number) and crop production (low to complete loss) activities, which in turn lead to livelihood vulnerability of the household. The results of the study showed that due to soil salinity, land less ness and food insecurity have becoming the common manifestation of the areas under study. Hence, the quality of irrigation water used for irrigation, the land leveling problem and the method of irrigation water application have to be given due attention to halt further expansion of soil salinity. On the other hand, wider promotion and popularization of proven practices as well as innovating new ones need to be strengthened. Trainings and awareness creation on soil and water management practices could also be taken as an immediate solution.

Keywords: Salinity, Effect, Livelihoods, Socio-economic, Farming communities, Afar, Ethiopia

Introduction

Salinity is one of the major environmental problems throughout the world, with more than 3% of the world's total land mass affected by salinity and over half of the world's countries having at least some quantity of land affected. It has caused significant negative effects on agricultural production and impact on rural livelihoods (Corbishley and Pearce, 2007). It is typically the problem of the arid and semiarid zones of the world, with the majority of countries affected by salinity being in a broad belt extending from the African Sahara through the Middle East and into central Asia (ibid).

According to Metternicht and Zinck (2003), on average, 20% of the world's irrigated lands are affected by salts, but this figure increased to more than 30% in such countries like Egypt, Iran and Argentina. Mustafa (2007) reported that the world is losing at least ten ha of arable land every minute; from this, three of them are from salinization problem especially in irrigated arid and semi-arid regions of the world. Similarly, a number of researchers (Halcrow, 1982; Heluf,1985; Yonas, 2005 and Kidane et al., 2006) have also reported the widespread occurrence of salt affected (saline, saline sodic and sodic soils) and soda waters and soda lakes in the irrigated arid and semi-arid areas of Ethiopia. The problems of salinity and sodicity currently spread over a range of landscapes, including irrigated land, rain-fed dry land farming areas, and rangelands in the country.

In Ethiopia, irrigated agriculture has becoming increasingly important in meeting the demands of food security, employment, rural transformation

*Correspondence author: E-mail: ashuw21@gmail.com
DOI: 10.21608/jsas.2020.23444.1200
Received : 3/02/2020 ; Accepted: 23/03/2020

and poverty reduction as high population growth increases pressure on limited land resources and it is no longer possible to meet the needs of increasing number of people by expanding areas under cultivation. The sector has emerged as a panacea to sustainable and reliable agricultural development, and thus, for the overall economic development of the country. However, with an estimated irrigation potential of more than 3.5 million hectares, only about 20-23% is put under irrigated agriculture both by traditional and modern irrigation systems.

Irrigation development, particularly in the large-scale has started in Ethiopia with the establishment of state-owned commercial farms along the Awash River Basin under the Rift Valley. The Awash was the site of the first significant modern irrigation developments during the 1950s and 1960s (Rahmato, 2008). It accounts for a significant percentage of Ethiopia's total irrigated area and is thought to have potential for further development (Tiruneh, 2013). Since the establishment of large-scale irrigated farms, the farmlands of the basin are under continuous cultivation of different annual and perennial crops including cotton and most recently sugar cane. However, following poor practice of irrigation management salinity has been emerged as a major problem responsible for reduction of land productivity and natural resources degradation and discourage efforts to improve livelihoods, and expose people and the environment to risks (Mekonen et al., 2015).

Irrigated agriculture in Amibara district, Middle Awash, was started towards late sixties. The soils at the farm area were generally non-saline and groundwater table in the area was below 10 meters (Halcrow, 1983). However, subsequent miss-management of irrigation water, in the absence of a complementary drainage system, gave rise in waterlogging, salinization of fully productive areas and considerable losses in crop yields. This severe problem resulted in abundance of substantial cotton and banana producing areas. The main cause for salinity and abandonment was the rate of ground water rise from 0.30 meters to 0.50 meters per year. Beyond that in many areas of Amibara Irrigation Scheme, the ground water level in rainy season is above critical level (Gedion, 2009; Frew, 2012; and Ashenafi and Bobe, 2016).

Similarly, in Dubti district, Lower Awash, soil salinity is a serious problem due to poor irrigation management practices and insufficient drainage development. Silesh et al. (2016) reported that, based on time series satellite image maps, from the year 1972 to 1994, the average annual expansion rates of saline sodic and sodic soils were 0.075% and 0.21%, while from 1994 to 2014, 0.34% and 0.57% of the irrigated land has become saline sodic and sodic, respectively. This further indicates that the expansion rate of saline sodic and sodic soils within the given forty-two years is 26.5% and 36%, respectively.

This problem has deleterious impact on soil fertility, which in turns reduces the crop production and soil productivity (Farifteh et al., 2006). Salt affected soils can have major effects on soil physical properties resulting from the swelling and dispersion of soil colloidal particles caused by the presence of excess exchangeable Na, and finally results in water infiltration, air movement, root penetration and seedling emergence problems (Pearson, 2004 and Amira et al., 2019). Salinity is a biotic stress that hinders the growth of crops by limiting water and mineral take-ups, affects human and animal health as well as the whole ecosystem (Rengasamy, 2006; USDA 2008 and Samah and Rania, 2017). Generally, this problem is resulting in food insecurity and poverty in the affected areas due to declining soil fertility and low agricultural productivity.

Because of soil salinization, in these areas, sustainability of irrigated agriculture is threatened to the extent that substantial area of cultivated land has got abandoned to the unproductive wasteland. The process has continued in recent years putting a considerable amount of agricultural land out of production each year in the country. Moreover, salinization is expected to get worse in arid and semi-arid areas of Ethiopia (including Amibara and Dubti) due to climate change effects and an increasing use of poorly managed irrigation water (Qureshi, 2016 and Elsayed et al., 2017). So far, no researches have been done to explore the impact of salinity on the socio-economic condition and livelihoods of the producers, who are forced to leave with this problem. Therefore, this study was initiated to investigate the effects of salinity on producers' socio-economic and livelihood conditions and their coping strategies for sustainable livelihood in the presence of salinity.

Research Methodology

Description of the study areas

The study was conducted at Amibara and

Dubti districts of Afar National Regional State, Northeastern Ethiopia. The Afar regional state is located within the great rift valley parts of northeastern Ethiopia. Amibara and Dubti are among the 32 districts of the Afar regional state found in the Middle and Lower Awash Valley Basin, respectively. Dubti district is geographically located between 11°50' N latitude and 41°00' E longitude while Amibara district lies between coordinates of 09°13' and 09°30' N latitude and 40°05' and 40°25' E longitude. The altitude of the districts ranges from 665 – 815 meter above sea level for Amibara and 503 meters above sea level for Dubti. The climate of the districts can generally be described as arid to semiarid. In the districts, with the expansion of large-scale irrigation scheme along the Awash river basin, irrigated agriculture is the dominant production system for the last five decades. Thus, salinity is then the major production constraint resulted from irrigated agriculture.

Sampling techniques and sample size

Multi stage purposive random sampling techniques were employed in selecting study sites and sample respondents. In the first stage, the study districts were selected purposively based on prevalence of salinity problem due to long term mechanized irrigated state farms and commercial agricultural practices. Secondly, from the two districts, sample sites have been identified with the same criteria as of the districts and two kebeles from Dubti and four kebeles from Amibara were selected purposively. In the third stage, only agro-pastoralists with farmlands were purposively considered from the total population. Lastly, using random sampling technique, 102 crop producer sample respondents were selected from six kebeles of the two districts (67 from Amibara and 35 from Dubti).

Types and sources of data

In the study, both primary and secondary data were used. Secondary data were collected from different sources like districts office of agriculture and pastoral development, different published and unpublished documents and others. Primary data were also collected from structured household survey questionnaires, key informant interviews and focus group discussions.

Data analysis techniques

The qualitative and quantitative data collected through structured questionnaires, key informant interviews and focus group discussions have undergone descriptive and inferential statistical analyses by using mean, percentage, frequency, t-test and chi-square tests. STATA version 14 software was used to carryout statistical analysis. The mean, percentages and frequency were used describe the data on demographic, socio-economic and institutional characteristics of the respondent households in the study area. A t-test was used to test the statistical mean differences of continuous variables of respondent households between the two districts while the chi-square test was used to check the relationships of discrete variables within the districts.

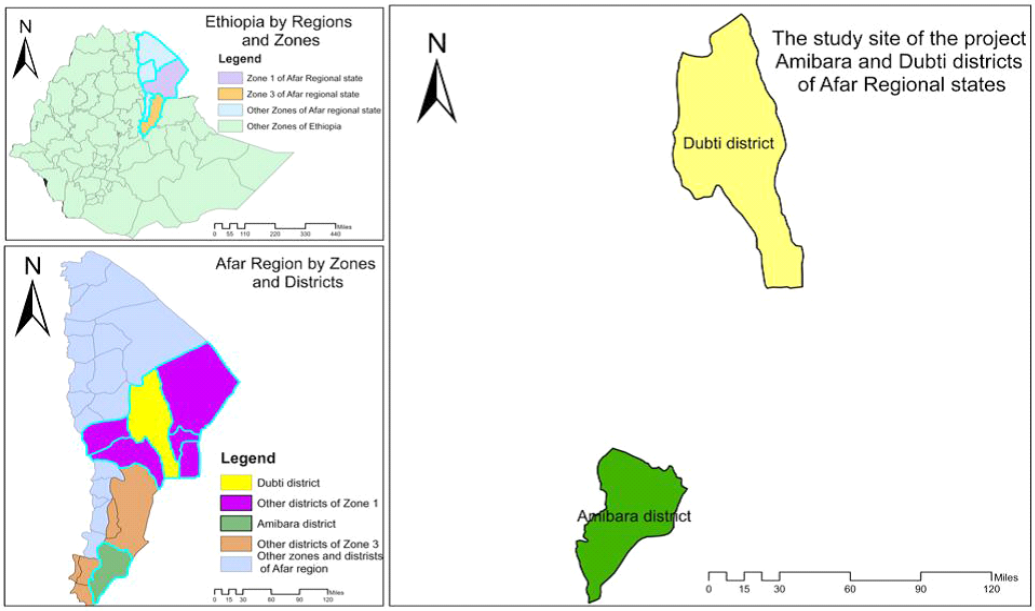

Fig. 1. Map Of The Study Areas

Results and Discussion

Characteristics of household respondents

Demographic characteristics of sample respondents

The demographic characteristics of the respondents included gender of the household heads, age of household heads, family size and composition, and marital status of the household heads. From the total (120) sample respondents, 67 (65.69%) were from Amibara district and the remaining 35 (34.31%) were from Dubti district. With regard to the gender distribution of the sample households, only 10 (9.8%) were female while the remaining 92 (90.2%) were male-headed. 60% of the female-headed households were from Amibara and 40% were from Dubti. Within the district, 11.43 % of the Dubti and 8.96% of the Amibara respondents were female-headed while 88.57% and 91.04% of the Dubti and Amibara respondents respectively were male-headed households.

The mean age of the respondent household was 39.51 years with a maximum of 82 years and minimum age of 20 years of old while the Std. Dev. ± 11.88. The mean age of household head of Amibara was 39.98 years and that of Dubti was 38.6 years. However, there is no statistically significant mean age difference respondents of the two districts.

The average family size of the sample respondents (102) was seven, which is almost similar to regional average; with minimum and maximum size of 1 and 20, respectively. In reference to age groups, the household members with less than 15 years of age and those household members with more than 64 years of age ranges from 0 to 6; while those household members with age of between 15 and 64 ranges from 0 to 8. These indicate that out of 102 contacted households, there are households with only 1 member and with 20 members. On average, family size and productive family members of the survey areas were, 6.67 and 0.84, respectively with dependency ratio calculated as the proportion of household members less than 14 years of old and older people from the age of 64 from active population.

Labour availability is important factor that constraint productivity in Pastoral household members. In this case, on average the dependency ratio is approximately equal to one. This implies that 50% population is economically dependent in a family that has 1 to 20 members per family.

Socio-economic characteristics of respondents

The socio-economic characteristics included level of education of the household heads, livestock size (holding), farmland size (hectare), livelihood (income) sources and others. As far as level of education is considered, almost 50% of the households in the study areas were, illiterate (cannot read and write) and 36.28% were at least able to read and write while only 13.73% of the respondents had access to secondary education.

TABLE 1. Distribution of respondents by gender across districts

Gender of respondents	Districts						χ^2_value
	Amibara (n=67)		Dubti (n=35)		Total (n=102)		
	Frequency	percentage	Frequency	percentage	Frequency	percentage	
Male	61	91.1	31	88.6	92	90.2	
Female	6	8.9	4	11.4	10	9.8	0.159

Source: Field survey data, 2016.

TABLE 2. Age and total family size of respondents

Descriptions	Amibara			Dubti			Total			t-value
	Mean	Std. Err.	Std. Dev.	Mean	Std. Err.	Std. Dev.	Mean	Std. Err.	Std. Dev.	
Age	39.98	1.41	11.52	38.6	2.14	12.66	39.51	1.18	11.88	0.56
Total family	7.15	.41	3.38	5.74	.62	3.64	6.67	.35	3.52	1.94*

Source: survey data, 2016.

Note: *, indicates significant at 10% probability level.

TABLE 3. Level of education of sample respondents by districts

Level of education	Districts						χ^2_value
	Amibara (n=67)		Dubti (n=35)		Total (n=102)		
	Frequency	percentage	Frequency	percentage	Frequency	percentage	
Illiterate	34	50.8	17	48.6	51	50.0	
Adult education	11	16.4	7	20.0	18	17.7	
Primary education	11	16.4	8	22.9	19	18.6	1.732
Secondary education	11	16.4	3	8.6	14	13.7	

Source: Survey data, 2016.

Livestock ownership is a proxy for wealth. Among Afar pastoralists, livestock asset holding and type of species mainly determine wealth. This is because; livestock are the sources of food, income, prestige and security in times of hardship in pastoral communities. Therefore, in this study the number of livestock measured by tropical livestock unit (TLU) was used to estimate the livestock asset of individual households. This was done because households were observed having different composition of livestock; hence, a unit of measurement for livestock was needed to use livestock as an indicator variable to compare households. As depicted in the table below (Table 4), the different livestock species kept by respondent households were cattle, camel, goat and sheep with average holding of 9.09, 2.75, 2.42, 0.91 TLU, respectively while donkey, horse and poultry were not common. The per capita livestock holding was found to be 3.64 TLU on average, which is lower than (4.5 TLU) what was considered the minimum level to sustain traditional pastoral households in East Africa (Davies and Bennett, 2007).

This depicts that households in the study areas pursued different types of livelihood strategies to complement livestock and livestock related income. The figure below (Fig. 2) showed the different means of livings reported by the sample households. According to the survey results, although livestock and livestock related income sources were the dominant means of living in pastoral and agro-pastoral livelihood systems, farming (crop sale), off-farm employment and permanent employment have been becoming the major sources of income reported by 96.08%, 37.25% and 27.45% of the respondents, respectively.

TABLE 4. Livestock ownership of sample households (TLU)

Livestock species	Amibara			Dubti			Total			t-value
	Mean	Std. Err.	Std. Dev.	Mean	Std. Err.	Std. Dev.	Mean	Std. Err.	Std. Dev.	
Cattle	9.99	1.29	10.61	7.34	1.44	8.52	9.09	.99	9.98	1.28
Camel	2.25	.72	5.88	3.69	2.58	15.25	2.75	.99	10.07	-0.68
Goat	2.09	.33	2.67	3.03	.49	2.94	2.42	.28	2.79	-1.62
Sheep	.92	.12	.98	.89	.18	1.04	.91	.09	.99	0.14
Total livestock	15.27	2.06	16.84	14.95	3.69	21.86	15.16	1.84	18.61	0.08

Source: survey data, 2016.

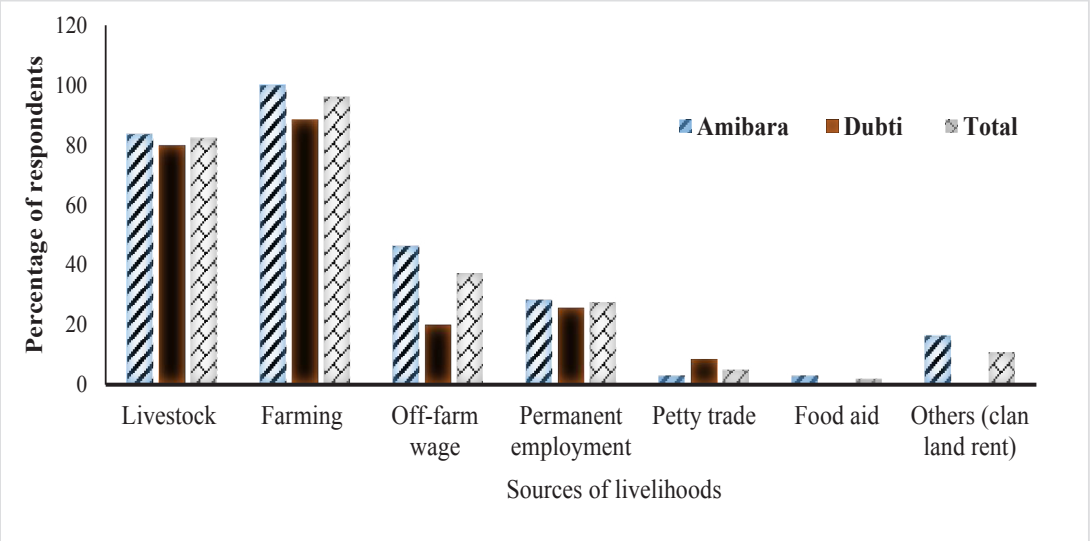

Fig. 2. Different types of livelihoods by respondents

As far as the proportion of income is considered, farming or sale of crops took nearly 49% of the total annual income whereas sale livestock and livestock products, off-farm wage employment and permanent employment contributed about 24%, 13% and 11% of the total annual households' income, respectively.

On average in the study areas, a household possessed 1.47 hectare of farmland with a minimum and maximum of 0.15 and 6.5 hectares, respectively. The result of the t-statistics test showed that there is significant mean difference ($P< 0.01$) in farmland size among households of the study districts. Households at Dubti district have larger farmland than households of Amibara district. Similarly, the number of parcels that the household had differ significantly ($P< 0.1$) between districts with a combined mean of 1.25 and a minimum and maximum of 1 and 3 parcels, respectively. A household at Dubti had 1.37 parcels of farmland on average whereas at Amibara a household had 1.19 parcels of farmland (Table 5).

The distance from the residences to the farmland also varied significantly according to the result of the survey data. The mean distance of the farmland from the residence house was 2.64 kilometers at Dubti district while it was 1.50 kilometers at Amibara district with a combined mean distance of 1.89 kilometers and a minimum and maximum distance of 0.1 and 12 kilometers, respectively (Table 5).

Farmlands vary with fertility status due to various reasons and respondents were asked to categorize their own farmlands in terms of fertility status as poor (infertile), average and good (fertile) by themselves. Accordingly, 43.28% of the Amibara respondents and 57.14% of the Dubti respondents responded that their farmland is poor (infertile) while 50.75% of the Amibara and 37.14% of the Dubti respondents categorized their farmland as average and nearly 6% of respondents from both districts grouped their farmland as good (fertile) (Table 6). Generally, the result of the analysis showed that the majority of the farmlands possessed by respondents are poor in terms of fertility.

Agricultural activities and crop production in the study areas of Amibara and Dubti districts are fully operated using irrigation water sourced mainly/entirely from Awash River. As described earlier, irrigated agriculture has been dated in the late 60s at both districts thanks to the expansion of state-owned commercial farms.

Along with large scale commercial state farms and private commercial farms, smallholder farms have been flourished in the region in general and at the study districts in particular. Hence, farming activities are as old as expansion of large scale irrigated commercial state farms. The major crops grown in the districts were cotton, maize, onion, tomato and other vegetables. Cotton was the most popular commercial fiber crop best suited at Dubti and Amibara till recently. However, presently it has been substituted by sugarcane. According to the results of the survey analyses, almost all (100%) producers of the study districts have access to irrigation water, 49% of the total respondents cultivated maize as a staple food crop, 30% of the respondents, all from Amibara, produce cotton, while onion and tomato were cultivated by 30% and 27% of the total respondents, respectively (Table 7).

TABLE 5. Farm size, number of plots and distance of farmland to home of respondents

Variable	Amibara			Dubti			Total			t-value
	Mean	Std. Err.	Std. Dev.	Mean	Std. Err.	Std. Dev.	Mean	Std. Err.	Std. Dev.	
Farmland size (hectare)	1.21	.151	1.23	1.97	.250	1.48	1.47	.136	1.37	-2.76***
Number of plots/parcels	1.19	.053	.43	1.37	.101	.59	1.25	.049	.50	-1.71*
Distance from home to farmland (kilometers)	1.49	.273	2.24	2.64	.532	3.15	1.89	.260	2.63	-2.13**

Source: survey data, 2016
Note: *, **, *** indicate significant at 10%, 5% and 1% probability level, respectively

TABLE 6. Fertility status of farmlands of respondents

Fertility status of the farmlands	District						χ^2-value
	Amibara (n=67)		Dubti (n=35)		Total (n=102)		
	Frequency	%	Frequency	%	Frequency	%	
Poor	29	43.3	20	57.1	49	48.0	1.8451
Average	34	50.8	13	37.1	47	46.1	
Good	4	5.9	2	5.7	6	5.9	

Source: survey data, 2016.

TABLE 7. Major crops produced by respondent households

Descriptions	Amibara (n=67)		Dubti (n=35)		Total (n=102)		χ^2_value
	Frequency	%	Frequency	%	Frequency	%	
Maize producers	22	32.8	28	80	50	49.0	20.46***
Cotton producers	31	46.3	0	0.0	31	30.4	23.26***
Onion producers	22	32.8	9	25.7	31	30.4	0.55
Tomato producers	16	23.9	12	34.3	28	27.5	1.25

Source: survey data, 2016.
Note: ***, indicates significant at 1% probability level .

As depicted in the table above (Table 7), there are significant statistical differences (P< 0.01) between maize and cotton producers of Amibara and Dubti districts. Large number of Amibara respondents produced maize and cotton. However, although not statistically significant, 34% of the Dubti respondents produced tomato whereas only 24% respondents did the same at Amibara.

Soil salinity and its effects on producers

Community awareness about salinity

Almost all respondents have reported that their farmland was affected by salinity even though the degree and its extent varied among households and districts. The severity of salinity was rated as low, medium, high and very high at the time of survey and households were asked to determine the severity of their farmland salinity upon the given rate. The result showed that 40.20% of the respondents were answered as medium, 37.25% of them as high and 13.73% as low while 8.82% as very high severity (Table 8).

The result of the trend analysis, as depicted below in Fig. 3, showed that there are difference between respondents on trends of salinity at their respective locality. Subsequently, 91.18% of the total respondents were thought that salinity is increasing while 5.88% and 2.94% of the respondents responded that salinity is has no change and is decreasing in their respective localities, respectively as shown in the figure below (Fig. 3).

TABLE 8. Severity of farmland salinity of sample respondents

Severity of salinity	Amibara (n=67)		Dubti (n=35)		Total (n=102)		χ^2_value
	Frequency	%	Frequency	%	Frequency	%	
Low	10	14.9	4	11.4	14	13.7	0.78
Medium	28	41.8	13	37.1	41	40.2	
High	23	34.3	15	42.9	38	37.3	
Very high	6	8.9	3	8.6	9	8.8	

Source: survey data, 2016.

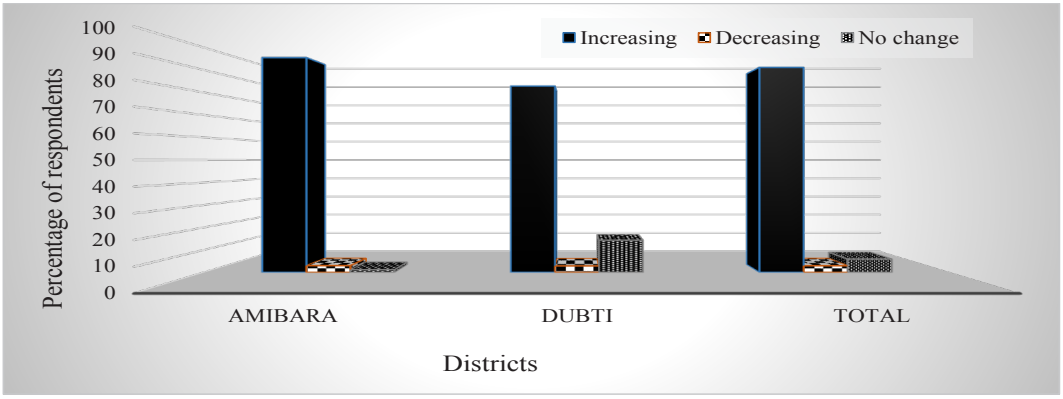

Fig. 3. Trends of salinity in the study areas

The increasing trend of salinity indicates that producers are not trying to cope with the salinity problem at their capacity in various ways. This might be associated with the absence of continuous assessments on the status of the problem and lack of technical knowhow as well as technological options in the areas so that producers have no choices except living with the problem.

Producers were asked how do they know whether their farmland was affected by salinity or not? And as a result 21.57% of the respondents were answered that they know by observing white crust on the surface, 19.61% by observing dark brown colour and 43.14% by observing both white crust and dark brown colour at the surface of the farmland.

Soil salinity could be caused by different factors. Here in this study producers were asked about their perception of probable causes of salinization in their localities. Out of the total sampled respondents, 86% have thought that the quality of the water used for irrigation as the main causes of salinization followed by land leveling problem (46%), irrigation methods (45%), drainage problem (41%), parent material (26%) and amount of irrigation water (25%) (Table 9).

Effects of salinity among producers

Salinity has exerted both direct and indirect effects on the general livelihoods of producers in the study areas. The direct effects reported by respondents were abandoning of farmland (29.41%), decreasing farm productivity (52.94%), and decreasing household income (8.82%) as shown in the table below (Table 10).

On the other hand, the indirect effects were increasing food insecurity (29.41%), decreasing employment opportunity (3.92%), increasing landlessness (45.10%), increasing dependency (5.88%) and both increasing food insecurity and landlessness (8.82%) (Table 10).

Table 11 reports the proportion of household respondents with different levels of productivity losses caused by salinity. The productivity loss caused by salinity in the study areas ranges from complete loss to less than 10% loss. According to the result of the survey data, 44.12% of the respondents responded that they lost 50% of their productivity due to salinity while nearly 14% have reported a complete loss of production. 32.35% and 8% of the total respondents were lost 25% and 10% of their productivity because of salinization.

TABLE 9. Perception of household respondents about causes of salinity

Causes of salinity	Amibara (n=67)		Dubti (n=35)		Total (n=102)		χ^2_value
	Frequency	%	Frequency	%	Frequency	%	
Parent material	12	17.9	17	42.9	27	26.5	7.35***
Irrigation water quality	59	88.1	29	82.9	88	86.3	0.53
Irrigation methods	23	34.3	23	65.7	46	45.1	9.15***
Land leveling problem	32	47.8	15	42.9	47	46.1	0.22
Amount of irrigation water	14	20.9	11	31.4	25	24.5	1.38
Drainage problem	34	50.8	8	22.9	42	41.2	7.38***

Source: survey data, 2016

Note: **, *** indicate significant at 5% and 1% probability levels, respectively

TABLE 10. Direct and indirect effects of salinity on sample respondents

Effects of salinity	Amibara (n=67)		Dubti (n=35)		Total (n=102)		χ^2_value
	Frequency	%	Frequency	%	Frequency	%	
Direct effects							
Abandoning farm land	14	20.9	16	45.7	30	29.4	10.046*
Decreasing farm productivity	40	59.7	14	40.0	54	52.9	
Decreasing household income	8	11.9	1	2.9	9	8.8	
Indirect effects							
Increasing food insecurity	22	32.8	8	22.9	30	29.4	
Decreasing employment	3	4.5	1	2.9	4	3.9	
Increasing landlessness	27	40.3	19	54.2	46	45.1	8.1301
Increasing dependency	6	8.9	0	0.0	6	5.9	

Source: survey data, 2016
Note: *, indicates significant at 10% probability level

TABLE 11. Productivity losses due to salinity as reported by household respondents

Productivity losses	Districts						χ^2_value
	Amibara (n=67)		Dubti (n=35)		Total (n=102)		
	Freq.	%	Freq.	%	Freq.	%	
Complete loss	10	9.8	4	3.9	14	13.7	2.71 (0.61)
50% loss	26	25.5	19	18.6	45	44.1	
25% loss	24	25.5	9	8.8	33	32.3	
10% loss	6	5.9	2	1.9	8	7.8	
Less than 10% loss	1	0.9	1	0.9	6	1.9	

Source: Field survey data, 2016

Both the direct and indirect effects of salinity have caused the households to lose their productive capacity and increased their vulnerability to poverty and food insecurity. Accordingly, the results showed that 49 (48.04%) of the total 102 sampled respondents were not food secured. Of which 30 (61.22%) of the food deficit households were from Amibara district while 19 (38.78%) of them were from Dubti district. However, the difference was not statistically significant. The deficit period distributed all over the year but the most commonly reported months of deficit were March, April, May and June. The possible justification for this situation is that these months are the driest and hottest periods in the region and livestock have been traced for long distance in search of feed and water so that households couldn't get milk even for immediate consumption.

Households also use different strategies as a copping mechanism of food shortages in the communities. In the study areas, as a tradition of pastoral and agro-pastoral communities, mutual support system was the most common strategy applied among the households at the time of shocks and risks. However, with the weakening of the pastoral traditional system, this mutual support strategy has been broken since recently. As the result, other strategies have been adopted by the communities either through themselves or by external bodies (governmental and non-governmental organizations).

According to the survey results, 79.59% of the total food deficit households used food for work activities as a copping strategy while 24.49% of them used donors' food aid as additional strategy. Food purchase (20.41%) and mutual support (14.29%) were another means of copping food deficit among households of the study areas.

Conclusion and Recommendations

The lowland areas of Ethiopia, characterized as arid and semi-arid climatic conditions, are the potentially suitable areas of irrigated agriculture. Owing to this fact, it was in the early 60s that large-scale irrigation schemes development was started along with the Awash River basin resulted in expansion of irrigated agriculture. However,

this development was not without threats, of which soil salinity is becoming the major one hampering crop and livestock productivity and causing livelihood vulnerability. This study, was then intended to show how the soil salinity problem affects the productivity and livelihoods of producers within the affected areas of Amibara and Dubti districts in Afar region of northeastern Ethiopia. The study employed descriptive statistical analyses of data collected from 102 randomly selected respondents using multistage sampling techniques.

The results of the analyses of the demographic characteristics of respondent households have showed that in both the study areas farming is a male dominated who are within active age group having average family size of less than ten people. With regard to the socio-economic characteristics of sample households, half of the respondents were not attended any form of education, the per capita livestock holding was found to be lower than the minimum level to sustain livelihoods. Households in the study areas were found statistically different in terms of farmland size, number of parcels and distance from residence home to farmland. The results of the study also revealed that maize was the dominant crop produced by respondents followed by onion, cotton and tomato. However, according to the results of the study, the hitherto productive districts have significantly lost their productivity due to soil salinity in the last decades and the families' livestock holding deteriorated over time along with the fertility status and productivity of their farmlands. Both crop production and livestock rearing as the major sources of livelihoods are not doing enough to support the day-to-day needs of the households. The results of the study signified that the farming communities of the study areas have been struggled with the impact of the soil salinity since the last decades.

The findings of the study also revealed that the trends of salinity have been increasing alarmingly and the status of their farmland in terms of salinity level was found to be ranged from medium to very high (86%). Households differed significantly on the perception of the causes of soil salinity. However, the overall result showed that the quality of the water they used for irrigation (86%), land leveling problem (46%) and irrigation methods (45%) were mentioned as the most probable causes. The study further revealed that soil salinity has exerted both direct and indirect impacts on the livelihoods of the community living in the study area. Among the direct effects mentioned by the respondents, decreasing productivity (from 10% to complete loss of crop) and abandoning of farmlands were the major ones. On the other hand, increasing land less ness and food insecurity (46% of the household) were reported as the indirect effect of soil salinity.

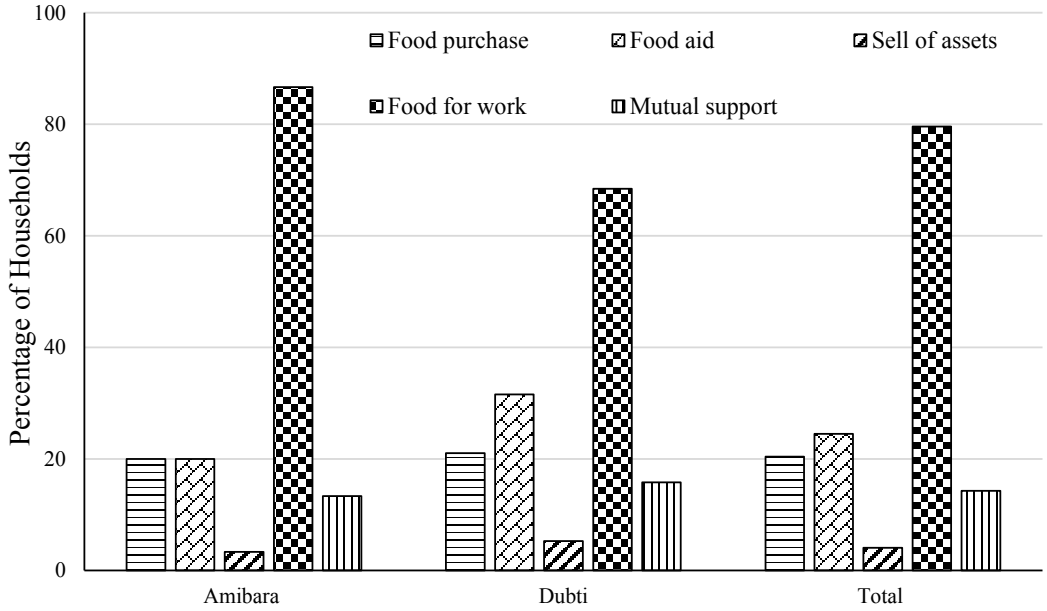

Fig. 4. Food deficit copping strategies of sampled households

Finally, the following suggestions are forwarded from the findings of the study;

- The irrigation water quality at major diversion canals along the Awash river basin need to be regularly monitored and checked by research institutes and irrigation water authorities in order to minimize the most probable cause of soil salinity.
- Awareness creation and consecutive trainings about soil and water management practices should be given both for experts and for farmers constituting theoretical and practical aspects to increase the level of understanding about salinity and water management.
- Reclamation and amendment methods and practices of soil salinity developed so far through research have to be widely demonstrated and popularized through extension system in order to improve the productivity level of the already salt affected soils.
- Researches on developing alternative and new technologies that are salt tolerant and enable producers to live with salinity problems need to be given due attention.

References

Amira M. EL-Tahan, Asal M. Wali, O. M. Ibrahim and E.E. Kandil. (2019) Saline Water As Supplementary Irrigation and Plant Spacing in Relation to The Productivity and Quality of Quinoa under Calcareous Soil Conditions Saline Water As Supplementary Irrigation and Plant Spacing in Relation to The Productivity and Quality of Quinoa under Calcareous Soil Conditions. *Journal of Sustainable Agricultural Sciences*, **45** (3), 67-79.

Ashenafi Worku and Bobe Bedadi. (2016) Studies on Soil Physical Properties of Salt Affected Soil in Amibara Area, Central Rift Valley of Ethiopia. *International Journal of Agricultural Sciences and Natural Resources.* **3** (2), 8-17.

Davies, J., and R. Bennett. (2007) Livelihood adaptation to risk: constraints and opportunities for pastoral development in Ethiopia's Afar Region. *Journal of Development Studies,* **43** (3), 90-111.

Eldeiry, A. and García, L. A. (2008) Mapping Soil Salinity Using Soil Salinity Samples and Variograms: Case Study in the Lower Arkansas Basin.

FAO (Food and Agriculture Organization). (1988) Salt Affected Soils and Their Management. Soil Resources, Management and Conservation Service FAO Land and Water Development Division. FAO *Soils Bulletin* **39**, Rome, Italy.

Farifteh, J., Farshad, A. and George, R.J. (2006) Assessing salt-affected soils using remote sensing, solute modeling and Geophysics. *Geoderma,* **30** (2), 191-206.

Fernández, B., Siebe, N., C-Cram S., Palasio. J. L. (2006) Mapping soil salinity using a combined spectral response index for bare soil and vegetation (a case study in the former lake Texcoco, Mexico). *Journal of Arid Environments*, **65**, 644-667.

Frew Abebe. (2012) Appraisal and mapping of soil salinity problems in Amibara area of middle awash basin *MSc Thesis*, School of Graduate Studies, Haramaya University. Haramaya, Ethiopia.

Gedion Tsegaye. (2009) Surface water- Ground water Interactions and Effects of Irrigation on Water and Soil Resources in the Awash Valley. MSc Thesis, Addis Ababa University. Addis Ababa, Ethiopia.

Ghassemi, F., Jackeman, A.J., and Nix, H.A. (1995) Salinization of land and water resources: human causes, extent, management and case studies. CAB International.

Halcrow, W. (1983) Water Management Manual. Amibara irrigation project. Water resources development authority, Ethiopia.

Halcrow, W. and Partners, T. (1982) Drainage and Salinity recommendations for field drainage. WARDA.

Heluf Gebrekidan. (1985) Investigation on Salt-affected Soils and Irrigation Water Quality in Melka Sadi-Amibara Plain, Rift Valley Zone of Ethiopia. MSc. Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Kidane Giorgis, Abebe Fanta, Heluf Gebrekidan, Fentaw Abegaze, Wondimadegne Chekol, Hibstu Azeze, Asegid Ayalew, Messele Fisseha and Mohammed Bedel. (2006) Report of the National Task Force on Assessment of Salt Affected Soils and Recommendations on Management Options for Sustainable Utilization. EIAR.

Mariey S A. and R A. Khedr (2017) Evaluation of Some Egyptian Barley Cultivars under Water Stress Conditions Using Drought Tolerance Indices and Multivariate Analysis. *Journal of Sustainable Agricultural Sciences*, **43** (2), 105- 114.

Mekonnen, A., Kidane, D., Teketay, D. (2015) Analysis of pastoralist's adaptation to climate change and variability in the dry land areas of Ethiopia Afar

national regional state lower Awash basin. In Proceedings of the High-Level Policy Forum, Semera, Ethiopia, 6–7 March 2014; Afar National Regional State, United Nations Development Programme Ethiopia Country Office: Addis Ababa, Ethiopia.

Moursi E, R M. Khalifa, A M. Meleha, and M A. Aiad (2019) Effect of Irrigation Scheduling at Different Management Allowable Deficit Using Pan Evaporation on Wheat Yield and Water efficiencies at North Delta, *Journal of Sustainable Agricultural Sciences*, **45** (1), 11-25.

Metternicht, G.I. and Zinck, J.A. (2003) Remote sensing of soil salinity: potentials and constraints. *International Journal of Remote Sensing,* **85**, 1-20.

Mustafa, M. A. (2007) *Desertification Processes*. Published by UNESCO Chair of Desertification, University of Khartoum Printing Press. pp 230.

Pearson K. E. (2004) The basic effects of salinity and sodicity on soil physical properties. Available at http://waterqualityMontana.edu/docs/methane/basics_highlight.shtml.

Postel, S. (1999) Pillar of Sand: Can the Irrigation Miracle Last? W.W. Norton and Co., New York, NY.

Rengasamy P. (2006) World salinization with emphasis on Australia. *Journal of Experimental Botany* **57**, 10-17.

Sileshi Abbi. (2016) Status of Salt Affected Soils, Irrigation Water Quality and Land Suitability of Dubti/Tendaho Area, North Eastern Ethiopia. *PhD Dissertation,* Haramaya University. Haramaya, Ethiopia.

Tester, M. and Davenport, R. (2003) Na^+ Tolerance and Na^+ Transport in Higher Plants. *Annals of Botany,* **91**(5), 503-527.

USDA (United Stated Department of Agricultural) Natural resource Conservation Service. (2008) Soil Quality indicators, *Adapted from the Nature and Properties of soil,* 10th edition, Nyle C. Brady, Macmiillan Publishing Company.

White, R.E. (2006) *Principles and practice of soil science the soil as a natural resource.* Fourth edition. 133-154.

Yonas Girma. (2005) Appraisal, Spatial structure and Mapping of soil salinity and Irrigation water quality of Yellen Jeweha areas in North Shewa zone of the Amhara region. *MSc Thesi*s, Alemaya University.