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Improving agricultural productivity on salt-affected soils in Ethiopia: Farmers' perceptions and proposals

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This paper presents the results of a baseline study carried out to understand farmers' perceptions about the existence of salinity in their farmlands and its impact on agricultural production and household food security. The strategies adopted by farmers to deal with the salinity and food insecurity problems are also discussed. The survey data were collected from a total of 300 farmers from five districts of Ethiopia. Farmers were selected using a random sampling from a household list. Focus Group Discussions were conducted with farmers in each district to investigate their perceptions of the soil salinity, its impacts and their adaptive strategies. Data were collected using a semi-structured questionnaire and analyzed using SPSS descriptive statistics and chi-square test. Farmers' responses showed that they were concerned about increasing soil salinity problems and its impact on their crop productivity and well-being. The results show that observing white crust and dark brown color of the soil are the major indicators used by farmers to identify salinity on their fields. Poor irrigation and drainage management problems are perceived as the main causes for salinity development. Salinity directly effects crop productivity and household incomes, which leads to food insecurity. The crop production losses due to soil salinity ranged from 10 to 70%. Performing off-farm jobs, selling household assets and joining food aid programs are the common coping strategies adopted by farmers. Farmers' perceptions on salinity should be used as an entry point by different stakeholders to develop strategies for the salt-affected areas.

Key words: Soil salinity, food security, crop productivity, coping strategies, rural poverty.

INTRODUCTION

Land degradation due to increasing soil salinization in arid and semi-arid regions of the world is evolving as the major menace for sustainable agricultural production and food security for the rising population (Ventura and Sagi, 2013; Hasanuzzaman et al., 2014). Globally, over 1,000 million ha of land is affected by the twin problems of salinity and sodicity (Wicke et al., 2011). Currently, 33% of the irrigated area (76 million ha) is affected by different levels of salinity and it is estimated that by 2050, more than 50% of the farms around the world will be salt-

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affected (Jamil et al., 2011; Kumar and Shrivastava, 2015). Soil salinization affects 19 million ha of land in sub-Saharan Africa (Tully et al., 2015). They are found largely in the countries of Eastern Africa, along the coast of Western Africa, the countries of the Lake Chad Basin, and in pockets of Southern Africa. Main drivers of salinity development in these regions are poor irrigation practices, rising groundwater levels due to inefficient drainage, and seawater intrusion into coastal farming areas due to the rising sea level and over-pumping of groundwater.

Ethiopia stands first in Africa in the extent of salt-affected soils due to human-induced and natural causes. Although no systematic nationwide data on the extent of salinity problem in Ethiopia is available, many researchers have reported that currently 11 million ha of land is exposed to salinity (Abegaze et al., 2006; Gedion 2009; Frew, 2012; Ashenafi and Bobe, 2016). This corresponds to 9% of the total landmass and 13% of irrigated area of the country (Birhane, 2017). These soils are concentrated in the Rift Valley, Wabi Shebelle River Basin, the Denakil Plains and various other lowlands and valleys of the country, where about 9% of the population lives (Tenalem et al., 2013; Sileshi, 2016). The growing prevalence of these soils is undermining the sustainability of irrigated agriculture, as it reduces natural biodiversity and farm and livestock productivity in the country.

With about 3% population growth, future food security as well as the livelihood for a considerable portion of the population remains a challenge to the government. Since agricultural production in Ethiopia is predominantly rain-fed, it is extremely vulnerable to changes in precipitation patterns and other adverse impacts of climate changes. Mitigating salinity to increase the productivity of existing salt-affected soils and preventing newly developed areas from the spread of salinity is of paramount importance for agricultural development in the country.

Salinity problem in Ethiopia has manifested to the extent that farmers are experiencing huge crop losses while many farms have gone out of production over the last decade. The salinity problems are now spread over a range of landscapes, irrigated lands, rain-fed farming areas and rangelands in the country (Qureshi, 2017). Currently, soil salinity is recognized as the most important problem in the arid and semi-arid lowland areas of the country resulting in reduced crop yields, low farm incomes and increased rural poverty (Gebremeskel et al., 2018). Among others, farmers' poor knowledge about the processes of salinity development and suitable coping strategies is considered as the major reason for rapidly increasing salinity problems in the country. This situation has forced farmers to switch to salt-tolerant legume and forage crops instead of cultivating traditional cereal crops, which has consequences for the household food security (Qureshi et al*.,* 2018).

Salinity management at the farm level depends on the farmer's knowledge of the causes of salinity development and the farming practices they should use to overcome this problem. Understanding farmers' perceptions of salinity and adaptive strategies to cope with this problem could be a good entry point to suggest interventions that can help them tackle this problem (Wickham et al*.*, 2006). Farmers' response strategies are usually based on the timing and severity of the problem perceived and their ability to properly interpret available information to develop the right response for a given situation (Meze-Hausken, 2000; Kassa et al*.*, 2013). For instance, farmers having knowledge of salinity might decide to employ local mitigation and adaptation practices such as improved land and water management practices, planting salt-tolerant crops, diversify cropping patterns and change their investment decisions (Mamba et al*.*, 2015).

In Ethiopia, very limited literature is available on the sources of salts, extent of soil salinization and its spatial distributions. This study was conducted to establish farmers' perceptions of the soil salinity and its impact on agricultural production and household food security. The study has also documented strategies adapted by farmers to cope with the salinity problems. It is anticipated that the information generated through this study will help policy makers, farmers and researchers in formulating appropriate policies and suggesting suitable interventions for the mitigation of salinity problems and improve food security in the salt-affected areas of the country.

Description of the study area

The study was conducted in five districts of Ethiopia. These include Amibara, Dubti, Raya-Alamata, Ziway-Dugda and Kewet districts from the Afar, Tigray, Oromia and Amahara regions, respectively. These areas were selected based on the presence of large tracts of salt-affected soils in the irrigated areas and the demonstrated potential of crop production. General characteristics of the selected districts are given in Table 1.

In Amibara District, about 33% of the total area is saline. In Dubti District, more than 80% of the area is affected by salinity and sodicity. The major reasons of this salinity development are poor irrigation water management practices and lack of drainage facility (Frew, 2012). The Raya-Alamata District of the Tigray Region is characterized by the shallow groundwater levels, which is the main cause of salinity development. In Ziway-Dugda and Kewet districts, soils are sodic in nature. This problem has deleterious impact on soil fertility which, in turn, reduces crop yields and farm income (Farifteh et al*.,* 2006). The location map of the selected districts is given in Figure 1.

METHODOLOGY OF DATA COLLECTION AND ANALYSIS

The survey data were collected from a total of 300 respondents from five districts of Ethiopia, which were selected from a household

Table 1. Characterization of the selected districts.

Districts	Climate	Mean annual rainfall (mm)	Temperature range (°C)	Main crops grown	Salinity problems
Amibara	Semi-arid	570	19-34	Cotton, wheat, maize, vegetables	Wide-spread salinity in irrigated areas
Dubti	Hot and dry	220	23-49	Wheat, sorghum, vegetables	High water table, high salinity in farms
Raya-Alamata	Semi-arid	660	15-28	*teff,* sorghum, cereals, vegetables	Shallow water table, low to medium salinity
Ziway-Dugda	Arid	760	16-25	Fodder, cereals	Shortage of water, wide-spread salinity
Kewet	Hot and humid	1000	17-32	*teff,* maize, tobacco and vegetables	High water table, high salinity, low yields

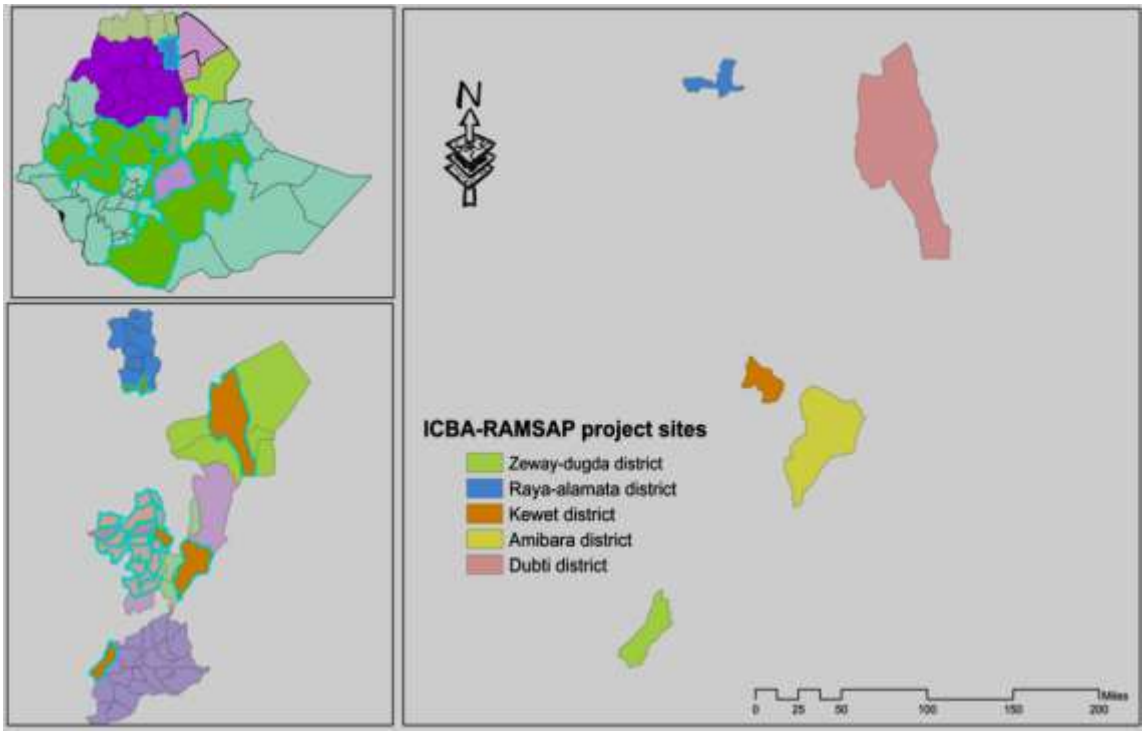

Figure 1. Location of the selected study areas in Ethiopia.

list using multistage random sampling technique. These include 67 respondents from Amibara, 35 from Dubti, 88 from Raya-Alamata, 45 from Kewet and 65 from Ziway-Dugda. The survey was conducted at regional and household levels. The variation in the number of respondents from each district is due to population size of that district. Data were collected using a semi-structured questionnaire. Semi-structured interviews are considered a better strategy to understand farmers' response and coping strategies and practices for the management of salt-affected soils. The questionnaire was pre-tested in the field by trained enumerators and necessary corrections were made based on the obtained feedback. Focus Group Discussions were also conducted with farmers in each district to record their collective views on the causes and extent of soil salinity, its impacts on their well-being and their adaptive strategies.

The selected districts have mixed crop-livestock system therefore the livelihood of most of the respondents is based on both farming and livestock rearing. In addition to survey data, data from secondary sources regarding groundwater quality and levels, soil maps and information on the status of salinity/sodicity were also collected. Secondary data are essential to get baseline information of the selected areas. During the survey, information on farmers' perceptions about the causes and severity of salinity on their fields was collected. Farmers were also asked about the limitations and

constraints faced by them in the adoption of innovative technologies and approaches for managing saline soils and improving agricultural productivity. The data collected through household survey, interviews and focus group discussions were used to perform descriptive and econometric analyses using mean, %age, frequency and ANOVA. SPSS Version 20 software was used to carry out statistical analysis. The Chi square test was conducted to verify the significance level of association between farmers' perceptions and their determinants.

RESULTS AND DISCUSSION

Demographic and socio-economic characteristics of respondents

The demographic and socio-economic characteristics of respondents include gender, family size, marital status, education level, land holding and livestock ownership. Table 2 shows that 86.7% of the respondents were males and 13% females. The highest number of female respondents belongs to Raya-Alamata District and the lowest to Kewet District. More than 85% of the respondents were married. About 42% of the respondents have formal education, 17% are educated up to secondary school level whereas the rest 41% were illiterate. The highest number of illiterate respondents was from Raya-Alamata District followed by Amibara and Dubti districts. The average landholding per household is 2.2 ha (with a standard deviation of 1.2 ha) with lowest in Amibara (1.2 ha) and highest in Kewet (4.2 ha).

The *t-test* analysis showed that there is a significant difference ($P < 0.01$) in farmland size among households of different districts. Households at Dubti District have larger farmland than households of Amibara, Raya-Alamata and Ziway-Dugda districts. The farmland size in Kewet District is the highest among all districts. Similarly, the number of land parcels per household differs significantly ($P< 0.1$) between districts with a combined mean of 1.25 and a minimum and maximum of 1 and 3 parcels, respectively. In Dubti, land parcel per household is 1.37 compared to 1.19 parcels in Amibara district.

The livestock ownership is considered a proxy for wealth in rural areas of Ethiopia. Number and type of livestock holding determine the wealth of a household. This is particularly true in Amibara and Dubti districts because livestock is a major source of food, income and security in times of hardship for the pastoral communities of these areas. In this study, the livestock asset of separate households was estimated by tropical livestock unit (TLU) (Storck et al., 1991). The TLU provides a common unit for comparison because households own different species of livestock (cattle, goat, camel, sheep etc.). The average livestock holding per household was found to be 10.4 TLU with highest livestock holding in Amibara District and the lowest in Ziway-Dugda and Kewet districts. The highest livestock holding in Amibara, Dubti and Raya-Alamata districts can be attributed to the presence of pastoral communities. The 3.7 TLU value in Ziway-Dugda and Kewet districts is lower than the minimum threshold value of 4.5 TLU, which is generally considered necessary to sustain traditional pastoral households in East Africa (Davies and Bennett, 2007). This means that the households in these two districts are less dependent on livestock and need off-farm jobs to supplement their incomes. The households in these districts adopt different strategies to earn their livings. These include livestock herding, crop cultivation, off-farm wage employment, petty trade, permanent employment, food aid, and others.

Sources of households' income

The agricultural production system of the selected districts is a mixed farming system in which farmers practice both livestock and crop production. However, farmers give more emphasis to crop production to secure food supply and satisfy cash needs of their families. The different sources of income reported by the sample households include livestock herding, crop cultivation, off-farm wage employment, petty trade, permanent employment, food aid, and others. The survey results show that 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 also contributed significantly to the incomes of the respondents.

Table 3 shows that except in Ziway-Dugda, the share of crop sale was the largest in household incomes followed by livestock. In Ziway-Dugda, the largest contribution in household income comes from livestock farming and less from agriculture. Due to intensive agro-business activities, opportunities for off-farm wages and permanent employment are significant in Amibara and Dubti districts. This makes households of these districts less dependent on food aid programs. Household incomes from permanent employment are substantial (20%) in Ziway-Dugda district. However, in Raya-Alamata, Ziway-Dugda and Kewet districts, chances of off-farm wages and permanent employment are the lowest and more people are dependent on petty trade and food aid programs of national and international organizations. This clearly shows that households of salt-affected areas in these districts cannot rely solely on farming and need to engage themselves in multiple activities to earn their living and meet their daily food requirements. The survey results indicate that to reduce production cost and increase farm income, household in salt-affected areas perform most of the farm activities by themselves. Farm labor activities such as land clearing, ploughing and irrigating are mainly performed by men whereas women contribute more in winnowing and harvesting activities. Other activities such as sowing weeding, bagging, and transporting are largely shared among male and female members of the household (Figure 2).

Table 2. Demographic and socio-economic characteristics of the respondents.

Parameter	Amibara (N = 67)	Dubti (N = 35)	Raya-Alamata (N = 88)	Ziway-Dugda (N = 65)	Kewet (N = 45)	Average (N = 300)	SD
Male (%)	92	88.5	70.4	87.7	95.0	86.7	9.6
Female (%)	8.0	11.5	29.6	12.3	5.0	13.3	9.6
Single (%)	8.4	17.0	27.6	37.0	2.2	18.4	14.1
Married (%)	91.4	83.0	72.4	63.0	97.8	81.5	14.1
Illiterate (%)	50.8	48.6	51.4	16.9	35.6	41.0	14.8
Formal school (%)	33.2	42.9	42.8	50.8	40.8	42.0	6.3
SSC school (%)	16.0	8.5	5.5	32.3	23.4	17.0	11.0
Landholding (ha)	1.2	2.0	2.0	1.6	4.2	2.2	1.2
Livestock (TLU)	15.3	15.0	14.6	3.70	3.70	10.4	6.2

Table 3. Sources of households' income.

Parameter	Amibara (N = 67)		Dubti (N = 35)		Raya-Alamata (N = 88)		Ziway-Dugda (N = 65)		Kewet (N = 45)	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Livestock	56	83.6	28	80.0	19	21.6	37	56.9	29	64.4
Farming (crop sale)	67	100	31	88.5	53	60.2	14	21.5	30	66.7
Off-farm wage	31	46.3	7	20.0	4	4.5	4	6.2	2	4.4
Permanent employment	19	28.4	9	25.7	1	1.2	13	20.0	1	2.2
Petty trade	2	3.0	3	8.57	3	3.4	9	13.8	4	8.9
Food aid	2	3.0	0	0.00	10	11.4	3	4.6	6	13.3

Figure 2. Contributions of men and women in performing different farm activities.

Farmers' perception about the existence and causes of salinity

During this survey, farmers were asked about the indicators they use to identify salinity in their farmlands. According to survey results, 36% of the respondents use white crust on the soil surface, 22% consider dark brown color of the soil whereas 42% use both white crust and

Table 4. Farmers' classification of farmland salinity.

Parameter	Amibara (N = 67)		Dubti (N = 35)		Raya-Alamata (N = 88)		Ziway-Dugda (N = 65)		Kewet (N = 45)	
	N	%	N	%	N	%	N	%	N	%
Classification of farmland salinity										
Low	10	14.9	4	11.4	7	8.0	2	3.1	3	6.7
Medium	28	41.8	13	37.1	28	32.0	10	15.4	16	35.6
High	23	34.3	15	42.9	31	35.0	18	27.7	13	28.9
Very high	6	8.9	3	8.6	22	25.0	29	44.6	6	13.3
Causes of salinity development										
Parent material	12	17.9	17	42.9	10	11.4	58	89.7	30	66.7
Irrigation water quality	59	88.1	29	82.9	76	86.4	29	44.6	14	31.1
Irrigation methods	23	34.3	23	65.7	37	42.0	4	6.2	8	17.8
Climatic conditions	5	7.5	9	25.7	16	18.2	6	9.2	3	5.3
Land leveling problem	32	47.8	15	42.9	8	9.1	7	10.8	6	13.3
Irrigation frequency	5	7.5	4	11.4	40	45.5	4	6.2	4	8.8
Irrigation water quantity	14	20.9	11	31.4	39	44.3	12	18.5	13	28.9
Drainage problem	34	50.8	18	51.4	53	60.2	58	89.2	37	82.2

dark brown color of the soil as an indicator to identify salinity in their fields. Based on these indicators, farmers were asked to classify salinity in their farmlands on a scale of low, medium, high and very high and the results are presented in Table 4.

The results presented in Table 4 shows that most of the farmers believe that salinity levels in their farmlands ranged from medium to high. A considerable percentage of respondents in Raya-Almata (25%) and Ziway-Dugda (44.6) rated salinity levels in their fields as 'very high'. The high salinity levels in Amibara and Dubti districts are attributed to dry and hot weather conditions along with low availability of irrigation water. The presence of parent salts and the addition of excessive salts due to the use of poor quality groundwater for irrigation are also major causes of high salinity in these areas. Furthermore, drainage problems are also more severe in Amibara and Dubti districts where poor irrigation management practices and absence of complimentary drainage system have resulted in rapid rise of groundwater levels leading to soil salinization. In Dubti and Raya-Almata districts, farmers also believe that salinity development is linked to climate changes as the length of dry periods have increased whereas the amount of rainfall has reduced. However, in other three districts, climate change is not considered as the major concern.

The fertility status of farmlands in the 5 districts differs significantly due to various reasons. During this survey, respondents were also asked to categorize fertility status of their farmlands using three indicators, that is, poor (infertile), average and good (fertile). The consolidated results of the survey revealed that majority of the farmlands possessed by respondents of these areas are poor in terms of fertility. About 43% of the respondents consider their farmland poor (infertile), 51% rated their farmland as average and about 6% termed the fertility of their farmland as good (fertile).

Table 4 illustrates that more than 80% of the respondents from Amibara, Dubti and Raya-Alamata districts consider poor irrigation water quality and inadequate drainage facilities as the main causes of salinity development in their farmlands, followed by irrigation methods and land leveling issues. Despite all the scientific progress and mounting water shortages, irrigation applications by farmers are not based on actual crop water demands. Fields are poorly leveled and farmers generally use basin/flooding methods of irrigation. This results in patches of low and high water application after each irrigation event leading to uneven crop growth and consequently low yields.

Farmers' perceptions about crop productivity losses due to salinity

The crop productivity losses due to soil salinization in the study areas ranged from a complete loss to less than 10% loss. The majority of the respondents (54.3%) in Dubti District reported 50% loss in their crop production followed by Amibara (38.8%), Ziway-Dugda (32.5%), Kewet (28.9%) and Raya-Alamata (20.8%). The highest crop productivity losses of 25% were reported in Amibara (35.8%) and Dubti (25.7%) districts (Figure 3). Nearly 15% of the respondents in Amibara District reported a complete loss of their crop production in multiple cropping seasons. However, in other four districts, complete production losses were less than 10%. High productivity losses in Amibara and Dubti districts are understandable

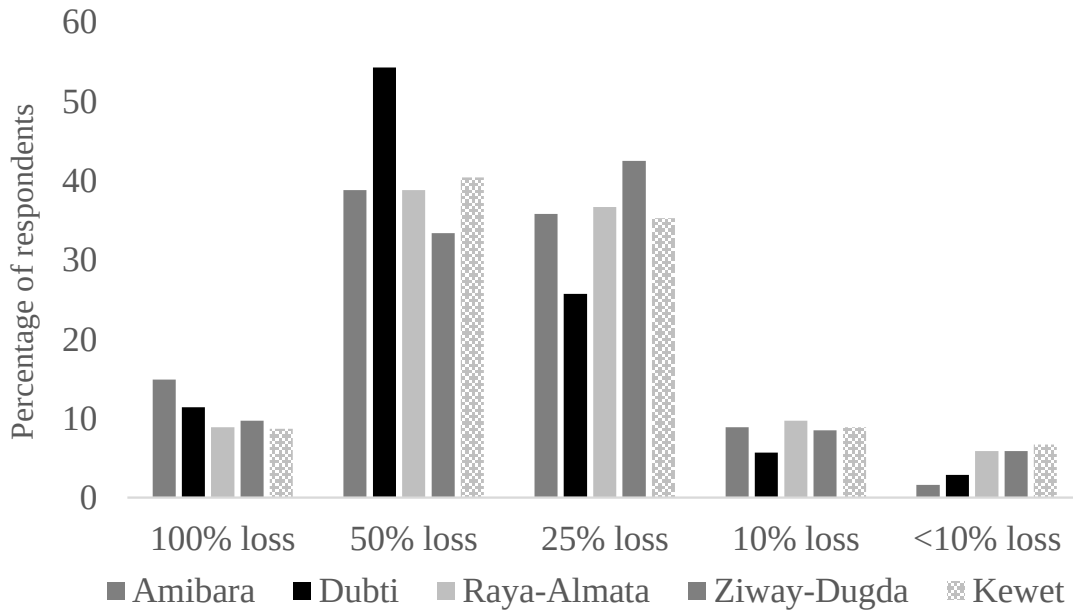

Figure 3. Production losses due to soil salinity in different districts.

given the dry, hot and saline environment of the area.

The low crop productivity in salt-affected areas has direct impact on the income and livelihood of households. In the highly saline areas of Amibara and Dubti, farmers are abandoning their lands and migrating to nearby cities and towns in search of off-farm jobs. Declining farm incomes has forced households to do extra work to earn cash to meet their daily needs, which has created serious health problems especially for women and children. Farmers complain about losing their livestock due to drought and diseases, which is making it impossible for them to nurture their families and we are entirely dependent on food aid programs for more than six months in a year. Due to low productivity in salt-affected areas, farmers send their animals to other areas in search of feed. This situation further increases their vulnerability.

Farmers' perception about production and marketing constraints

The information collected from secondary sources revealed that average crop productivities in the selected districts were consistently low. During this survey, farmers were asked about the major production and marketing constraints faced by them for improving their agricultural productivity. In Raya-Almata District, more than 95% of the respondents consider lack of agricultural inputs such as improved seed, fertilizer and farm machinery, shortage of arable land, lack of technical knowledge, shortage of irrigation water and increasing salinity as the major constraints for low productivity in their fields. In Dubti District, lack of agricultural inputs and technical knowhow, increasing soil salinity and invasion of weeds are reported as the major constraints.

In Ziway-Dugda and Kewet districts, lack of agricultural inputs and shortage of arable land are not reported as the major issues. In these districts, shortage of water, increasing soil salinity are the major concerns followed by invasion of weeds. In all districts, low availability of pesticides results in the expansion of invasive weeds. The farmers of Amibara District were also concerned about the poor quality of surface water. They reported that the mixing of Lake *Beseka* and *Deho* hot spring water to Awash River has deteriorated the irrigation water quality over the last 5 years, which is causing salinity in their farmlands (Table 5).

Consistently lower land productivity in the study areas results in reduced farm incomes, food insecurity and sway in poverty. Due to the above-mentioned constraints, crop yields are generally low and after meeting domestic needs very little is left for sale in market to earn cash for other family needs. In addition to low produce, farmers are also facing many marketing constraints to get true value of their produce. During this survey, lack of market information and poor infrastructure were rated as the major marketing constraints by farmers in Amibara, Dubti and Raya-Almata districts. However this was not the case in Kewet District, where active involvement of brokers was reported as the top market constraint, followed by high transaction costs.

Household's food security in salt-affected areas

Salt-affected lands are directly and indirectly affecting livelihoods of the households. The direct effects of salinity

Table 5. Production and marketing constraints faced by farmers in Ethiopia.

Parameter	Amibara (N = 67)		Dubti (N = 35)		Raya-Alamata (N = 88)		Ziway-Dugda (N = 65)		Kewet (N = 45)	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Production constraints										
Lack of agricultural inputs	64	95.5	27	77.1	86	98.9	13	20	2.0	4.4
Shortage of arable land	50	74.6	15	42.9	86	98.9	1	1.5	1.0	2.2
Lack of tech. knowledge	51	76.1	25	71.4	85	97.7	32	49.2	14	31.1
Shortage of irrigation water	30	44.8	6	17.1	82	94.3	62	92.3	31	68.9
Increasing soil salinity	67	100	34	97.1	83	95.4	43	66.2	30	66.7
Growth of invasive weeds	52	77.6	25	71.4	70	80.5	22	33.8	18	40.0
Marketing constraints										
Lack of market information	53	79.1	29	82.8	77	88.5	4	6.2	3.0	6.7
Lack of infrastructures	38	56.7	19	54.3	32	36.8	32	49.2	5.0	11.1
Involvement of brokers	18	26.8	6	17.1	27	31.0	2	3.1	24	53.3
High transaction costs	35	53.3	19	54.3	43	49.4	5	7.7	7.0	15.6

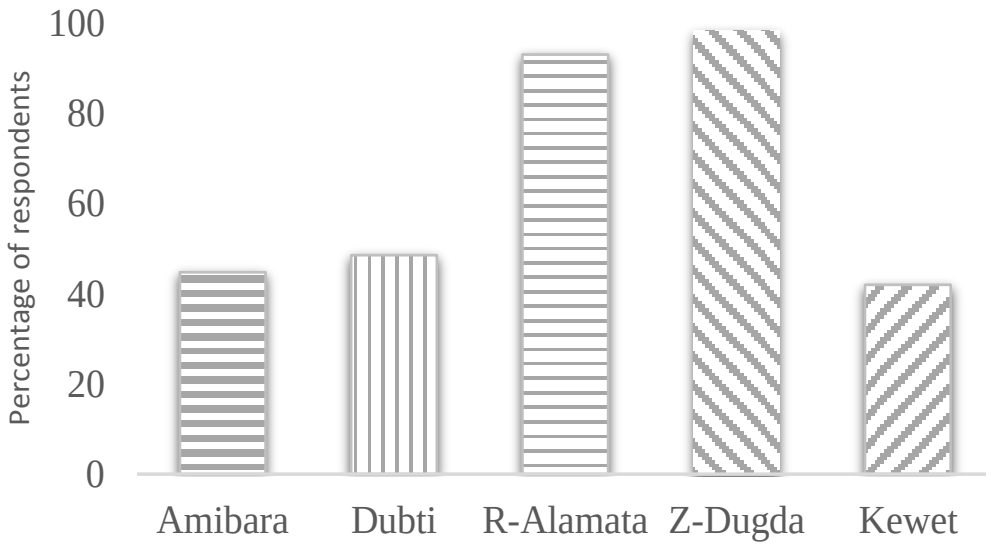

Figure 4. Food security in salt-affected areas of different districts.

are related to decreased farm productivity and household income. The indirect effects are linked to food insecurity and increased dependency on donor aid programs. The survey results indicate that about 93% of the households in Raya-Alamata and 98.5% of the households in Ziway-Dugda are food insecure during different times of the year. In Kewet District, 42% of the households are food insecure for the whole year especially in the months of August and September. The remaining 58% of the households are food secure for most part of the year. About 44.8% of the households in Amibara and 48.6% in Dubti were reported as food insecure for different times of the year especially from March through June as these are the driest and hottest months. During these months, farmers usually shift their livestock to other areas where availability of fodder and water is guaranteed. Therefore households do not have access to milk and other dairy products, which makes it difficult for them to meet their food demands. In addition, crop production is at the lowest due to shortage of water and high temperatures (Figure 4).

Farmers' coping strategies

Households use different adaptive strategies to ensure

food security. Traditionally, mutual support system was the most commonly used strategy in pastoral and agro-pastoral communities used at the time of shocks and risks. However, with the weakening of the pastoral traditional system, this mutual support strategy system has broken down in the recent years. As a result, other copping strategies have been adopted by the communities either by themselves and/or with the support of internal and external bodies (governmental and non-governmental organizations). According to aggregate survey results, 42% of the food deficit households of all districts take part in "*food for work activities*" while 13% rely on food aid programs of national and international organizations. The remaining 45% food insecure households cope with this situation by doing off-farm income earning activities and even selling assets such as livestock and different household items.

CONCLUSION AND RECOMMENDATIONS

Understanding salinity status of soils plays a vital role for sustainable agricultural production. This study was initiated to evaluate the impacts of soil salinity on crop productivity, food security and socio-economic conditions of the farming communities in order to develop suitable management strategies for sustainable crop production in the salt-affected areas of Ethiopia. The study results indicate that farmers use different indicators to identify salinity in their lands. Observing white crust and dark brown color of the soil are the major indicators used by households for the identification of salinity in their farmlands. Majority of the households alleged that poor irrigation management and absence of drainage systems are the major causes of salinity development in their fields. Drainage systems are either non-existing or malfunctioning.

The agricultural farming followed by livestock are the major sources of household income in Ethiopia. Salinity affects directly or indirectly the livelihoods of the households. The direct impacts are related to abandoning of land, reduced crop production and declining farm incomes. The indirect impacts are linked to food insecurity and increased dependence on food aid programs. Farmers face number of production and marketing constraints, which include lack of farm inputs including fertilizer and machinery, shortage of irrigation water, lack of market information and heavy involvement of brokers (middleman). The declined household income is increasing poverty in salt-affected areas, which has forced male members of the household to migrate to nearby towns and cities in search of off-farm jobs. This has put an enormous pressure on female members as they have to carry extra burden of household activities.

In salt-affected areas, farmers are witnessing 10 to 70% production losses in different regions due to soil salinity, non-availability of agricultural inputs and management capacity of the farmers. The survey results indicate that majority of the food deficit households take part in "*food for work activities*" and at times depend on food aid programs of national and international organizations. Increasing dependence of farmers on food aid programs is declining the capacity of the food aid organizations, which is forcing farmers to sell their assets such as livestock and household items to buy food and other utilities for their families. Therefore, government needs to take immediate measures to improve situation in salt-affected areas to address food insecurity and poverty issues.

The households have made the following recommendations for raising agricultural productivity in salt-affected areas:

(i) A system of continuous assessment and monitoring should be established to keep an eye on the occurrence and increasing trend of soil salinity in the district.
(ii) Surface and subsurface drainage systems should be installed in the waterlogged areas since more farmlands are abandoned from time to time.
(iii) Crop varieties that have the capacity to grow under salinity and waterlogging conditions should be introduced.
(iv) Marketing mechanism for buying the agricultural products of smallholder farmers at their true value needs to be established. This will encourage farmers to increase crop production and improve their incomes.
(v) Effective extension program should be initiated to disseminate information on soil, water and salinity management practices to farmers. Farmers should also be linked with national research and extension organizations for developing intervention programs for solving increasing salinity problems.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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