

Evaluation and Characterization of Soil Salinity Status at Small-Scale Irrigation Farms at Bora and Lume Districts of East Showa Zone, Oromia, Ethiopia

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Abstract: For sound land use and water management in irrigated area, knowledge of the chemical composition of soil and water condition before action are crucial for sustainability of irrigation projects. The study aimed to evaluate and characterize the physicochemical properties of soils with the intention to soil salinity status at small scale irrigation schemes with reference to standard suitability classes. With regard to this, a study was conducted in Bora and Lume districts of small scale irrigation in East showa, Ethiopia. Before soil sampling the area was purposively classified as the land irrigated with ground water and river for more than 5 years. Accordingly, Soil samples were collected from the land irrigated with ground water and river to the depth of 90cm that was re-classified in to three different sampling depths (0-30cm, 31-60cm and 61-90cm). Both land irrigated with ground water and river were replicated three times in each district. Soil samples were also collected from rein fed agriculture in both districts for comparison. Analysis of soil samples showed that average soil pH>8.5, EC<4ds/m, and ESP>15 were observed at the land irrigated using ground water in both districts. This analysis reveals the existence of potential sodicity in the soil. Ground water analysis also indicated high sodicity in the irrigation water. To sustain productivity of soil in this small scale irrigation site, the study underlines the need for immediate soil salinity management by using appropriate soil sodicity reclamation techniques especially at the farmers who are using ground water for irrigation.

Keywords: Soil Salinity, Irrigation, Soil and Water Analysis

1. Background and Justifications

In many areas of the world, salinity is one of the principal environmental causes of soil degradation, and consequently, a source of reduction in the biomass (André *et al.*, 2004; Tejedor *et al.*, 2003; Warrick 2004). According to certain estimates, approximately 7% of soils all over the world suffer from this phenomenon (Ziad *et al.*, 2004, Jassogne *et al.*, 2006). These types of soils appear mainly in arid and semi-arid areas where precipitations are insufficient to drain the soluble salts contained in the soil profile (Caitlin 2003) and most of the developing countries are located in these two areas (Ziad *et al.*, 2004).

Perennial irrigation invariably raises the water table. Dissolved salts are transported by capillary action into the

root zone, deposited on the soil surface and left behind when water evaporates. Excess salt inhibits plant growth by disturbing osmotic relations in the root zone, causing declines in crop productivity. More specifically, salinity affects agricultural soils by destabilizing their structure, affecting microbial life with consequent declines in porosity. It affects plants by decreasing the available water for plant growth, deregulating mineral uptake and causing physiological stress. Water is absorbed into plants because of a gradient that exists between the soil solution and the cell sap of the interior root cells. High concentration of neutral salts in the soil solution tends to narrow the gap between the soils (external) and plant cell (internal) water potentials (BPMC 1996). This means that salts increase the energy with which water is held in the soil. Then the soil water potential

become more negative, making water movement to the root cells more difficult. If the soil solution potential becomes negative enough, water may actually migrate out of the plant cells and into soil solution (Norton, 2000 & Joe Silvertooth, 2002).

Salinity is thought to affect more than a third of the world's irrigated agricultural lands. (El-Ashry, 1980, as quoted in Tillman, 1981) for irrigated lands in arid and semi-arid regions, where salinity problems are most common, even good quality irrigation water (200 ppm soluble salts) can add 0.2 tons/hectare of salts with a normal water application of 10, 000 m³/hectare/year. In this case salt developed gradually as the duration of irrigation increased.

According to Sissay (1995), salt-affected flatlands have increased from 6% to 16% of the total land area of Ethiopia in recent years. It was reported that in Ethiopia there is over 11 million hectares of unproductive naturally salt affected wastelands (Tadelle 1993). Tamir (1994) has revealed that 44 million ha (36% of the country's total land areas) are potentially susceptible to salinity problems. The naturally salt affected areas are normally found in the arid and semiarid lowlands particularly in rift valley and other areas that are characterized by higher evapo-transpiration rates in relation to precipitation (PGRC 1996).

Small-scale irrigation activities are very common in mid rift valley areas for addressing chronic food security vulnerability in the rural communities to which they have been providing relief assistance for decades. However, In the this areas, an expansion of irrigated agriculture is greatly contributing to the build up and spread of salinity problems (Tenalem, 1998). The arid like climate of mid rift valley irrigated area allow limited leaching by favoring concentration and accumulation of soluble salts in the soil. Poor water management practices (excess application of irrigation water through flooding) and lack of adequate drainage facilities in the farm contributed to the conversion of large productive lands in to an unproductive waste land in a short period of time (Tadelle 1993).

For appropriate land use and water management in irrigated area, the chemical composition of the soil characteristics and irrigation water should be evaluated and known before implementation of any soil salinity management interventions (Al-Ghobari, 2011). With regards to soil studies, a number of surveys have been carried out for different purposes at different times by different institutions. However, the scale and purpose of the studies allow only planning for development undertakings. A very detailed survey is necessary to characterize soils as well as water to identify the salinity hazard and level of nutrients (major or minor) at each irrigation sites for the proper understanding of the hazard and appropriate mitigation measures. Therefore, Proper management procedures, combined with periodic soil and water quality tests are needed to give early warning before its critical stage and to prolong the productivity of salt-affected soils.

2. Objectives

- 1) To evaluate and characterize soil salinity and water quality status for irrigation at different small scale irrigation farms in the study area
- 2) To generate information on soil salinity hazard and water quality status of different water resources for irrigation
- 3) To suggest appropriate soil salinity management interventions for salt affected small scale irrigated farm

3. Materials and Methods

3.1. Description of the Study Area

The study will be conducted at small scale irrigation farms in Bora and Lume districts in the East Shoa Zone. The area is characterized by dry low_ land agro-climate with the altitude ranging from 1576-1750 m.a.s.l. It has bi-modal rainfall pattern with erratic condition and insignificant mean monthly precipitation. The area is also characterized by the agro pastoral land use system. The potential evapo-transpiration is higher than the precipitation in the area.

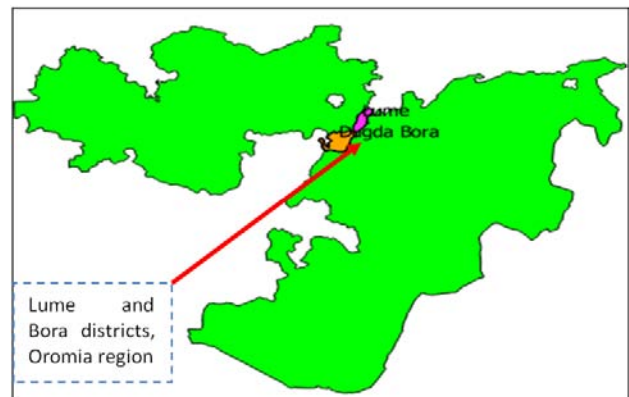


Figure 1. Geographical location of Bora and Lume district.

In Bora and Lume Districts of East Shoa Zone, Irrigation has been highly practiced for more than 30 years and is currently the most important source of income for many farmers in these districts. However, soil salinity is a major problem in reducing production and productivity of irrigated land in this district. Poor irrigation management, high evapotranspiration, ground water recharge and longer irrigation period are supposed to be the main causes for the development of soil salinity in the area

3.2. Soil and Water Sampling Techniques and Data Collection

Before soil and water sampling, quick assessment was done to identify the source of water for irrigation, potential of irrigation farm and soil salinity problem in both districts. Accordingly, it was identified that 75% of the farmers are using ground water for irrigation. The rest 25 percent of the farmers are using river water particularly Awash and Modjo rivers in Bora and Lume districts respectively. Depending on source of water for irrigation, the sites were classified in to two (Irrigation using ground water and river). Farmers

practicing irrigation for more than 5 years using both ground water and river were purposively selected. For soil and water sampling, three sites from farmers who are using ground water for irrigation and other three sites from farmers who are using river water as source of irrigation were purposively selected from each district.

The pits were dug at each selected sites to the depth of 90cm. This depth is most commonly used by different authors to collect soil samples for soil salinity assessment Gonzalez *et al.*, (2004), Qadir & Schubert (2002). Soil samples were taken from three different sites varied depending on source of water for irrigation at three depth intervals (0-30cm, 31-60cm, and 61-90 cm). Based on the soil profile of the area, the first 30cm represent the A-horizon, 31-60cm is B-horizon and 61-90cm represents the C-horizon. Accordingly, in both districts, 18 soil samples were collected from irrigated land using ground water and 18 soil samples from irrigated land using river. 18 Soil samples were also collected from none irrigated or rain fed agricultural land as a control. 3 ground and 3 river water samples were collected from each district to evaluate the quality of water for irrigation.

Therefore, there were five treatments classified based on source of water for irrigation. The treatments were replicated three times in each district.

1. Irrigated land using ground water in Lume district
2. Irrigated land using ground water in Bora district
3. Irrigated land using river water in Bora (Awash river)
4. Irrigated land using river in Lume (Modjo river)

3.3. Data Collection

The extent of salinity in the study area was categorized based on four main parameters such as EC (electrical conductivity), pH, ESP (exchangeable sodium percentage), SAR (sodium adsorption ratio) because these values are used in the guidelines for classification of salt affected soil (Gonzalez *et al.*, 2004; Qadir & Schubert 2002). Both soil and water samples were analyzed for the following characteristics using standard procedure

1. PH
2. Electrical conductivity (EC) in ds/m at 25°C
3. Soluble cations such as Calcium, Magnesium, Sodium, and Potassium in me/l, CEC
4. SAR and ESP, Na^+ , Ca^{+2} , Mg^{+2} , P, Total N, K and SOC

In order to evaluate the sodium hazard, SAR (Sodium absorption ratio) and exchangeable sodium percentage the following formula will be used:

$$\text{SAR} = (\text{Na}^+ / (\text{Ca}^{2+} + \text{Mg}^{2+})^{0.5}) \text{ in me/100g soil}$$

$$\text{ESP} = (\text{Na}^+ / \text{CEC}) \times 100$$

3.4. Parameters for Classifications of Soil Salinity

3.4.1. Saline Soil

Saline soils are often recognized by the presence of white crusts of salts on the soil surface called “White alkali” (soluble salts) and irregular plant growth. Electrical conductivity of these soils when a solution extracted from

saturated soil is greater than or equal to 4.0 mmhos/cm at 250C. The pH is generally less than 8.5, sodium makes up less than 15 percent of the exchangeable cations and the sodium adsorption ratio (SAR) is less than 13 (Conway 2001; Jim 2002; Michael & Paul 2002).

3.4.2. Saline-Sodic Soils

Saline Sodic soils contain large amounts of total soluble salts and exchangeable sodium (BPMC 1996). It is characterized by EC greater than 4 mmhos/cm at 250C, pH less than 8.5, EC more than 15 percent and the sodium adsorption ratio greater than 13 (Conway 2001; Jim 2002).

3.4.3. Sodic Soils

Sodic soils are low in soluble salts than saline or saline-sodic soils but high in exchangeable sodium (Jim 2002; Pam 2002). Generally, this is characterized by exchangeable sodium percentages of more than 15. This means that sodium occupies more than 15 percent of the soil cation exchange capacity (CEC) and the sodium adsorption ratio (SAR) is greater than 13. In Sodic soils, the electrical conductivity is less than 4 ds/m at 25°C and the pH readings are usually range between 8.5 and 10. The soils were classified into different salt affected soils according to the standard guidelines by FAO (1985), Abrol *et al.*, (1988); Gonzalez *et al.*, (2004); Qadir & Schubert (2002),

Table 1. Guidelines for classification of salt affected soil (FAO, 1988).

Soil classification	EC DS/m	SAR	ESP	PH
Sodic	<4	>13	>15	>8.5
Saline	>4	<13	<15	<8.5
Saline sodic	>4	>13	>15	<8.5

3.5. Data Analysis

Soil and water samples were analyzed at Ziway soil research center. Data was interred into Excel spread sheet. SAS 9.0 version was used to analyze the data. Tukey's least significance difference at 0.05 was used for mean separation.

4. Result and Discussion

Soil physiochemical characteristic was analyzed to characterize and determine the status of soil salinity hazard at small scale irrigation farm.

4.1. Soil Textural Class Analyses

Soil texture is the relative proportion of sand, silt and clay in the soil. Soil texture is one of the most important soil physical properties that affect the amount of water and nutrient supply to the plant. After the relative proportion of sand, silt and clay was identified in the laboratory, texture triangle is used to determine the textural class. Soil textural classes of the sites are described as follows:

The texture is not significantly different ($p < 0.05$) at different sampling points and soil depth. However the proportion of % sand and silt are relatively high and Clay has the lowest percentage from the soil particles at all

experimental sites (table 2).

Table 2. Soil textural analysis at different irrigation land.

Source of water for irrigation	Soil depth (cm)	% Sand	%Silt	%Clay	Soil textural Class
Awash River in Bora	0-30	37.0	43.7	19.3	Sandy loam
	31-60	32.3	45.0	22.7	Sandy loam
	61-90	34.3	44.3	21.3	Sandy loam
Ground water in Bora	0-30	32.3	41.7	26.0	Clay loam
	31-60	43.0	33.7	23.3	loam
	61-90	29.7	39.0	31.3	Clay loam
Modjo River in Lume	0-30	43.7	42.3	14.0	loam
	31-60	47.7	39.0	13.3	Sandy loam
	61-90	49.9	37.7	12.6	Sandy loam
Ground water in Lume	0-30	36.3	42.3	21.3	loam
	31-60	32.3	48.3	19.3	loam
	61-90	33.7	46.3	20.0	loam
CV %		22.4	15	26	-
LSD _{0.05}		14.24	10.61	13.79	-
F- value		1.3	1.28	1.30	-
P-value		0.09	0.30	0.28	-

The textural class of the soil type was sandy loam, which indicates the presence of high sand percentage than the other soil particles. The presence of high sand particles as compared with silt and clay can let the salt react in the soil mixture and then leaching can be easier (Ziad *et al.*, 2004; Qadir *et al.*, 2003).

The chemical characteristics of the soil are used as an

indicators or measurement of soil fertility and soil salinity status. The most commonly used chemical parameters for soil salinity characterization are: soil pH, Electrical conductivity (EC), exchangeable sodium percentage (ESP) and Sodium adsorption ratio (SAR). The chemical properties of the soil for characterizing soil salinity hazard was analyzed and indicated in the following table 3.

Table 3. Mean values of soil salinity parameters.

Source of water for irrigation	Soil Depth (cm)	EC (ds/m)	pH	CEC meq/100g soil	ESP (%)	SAR
Awash River in Bora	0-30	0.41 ^c	6.98 ^d	32.37	8.49 ^c	0.52 ^d
	31-60	0.26 ^c	7.23 ^{cd}	22.85	8.1 ^c	0.49 ^d
	61-90	0.27 ^c	7.23 ^{cd}	29.56	5.29 ^c	0.41 ^d
Ground water in Bora	0-30	3.4 ^b	8.54 ^a	32.35	52.25 ^a	4.2 ^a
	31-60	2.3 ^{cd}	8.21 ^a	33.71	47.62 ^a	3.8 ^{ab}
	61-90	2.1 ^d	8.04 ^a	31.11	38.02 ^{ab}	3.41 ^{abc}
Modjo River in Lume	0-30	0.36 ^c	7.9 ^{ab}	36.52	14.88 ^c	1.33 ^{cd}
	31-60	0.32 ^c	8.07 ^a	33.54	14.59 ^c	0.99 ^d
	61-90	0.32 ^c	7.91 ^{abc}	34.91	10.64 ^c	0.72 ^d
Ground water in Lume	0-30	4.1 ^a	8.18 ^a	31.44	37.5 ^{ab}	4.41 ^a
	31-60	3.1 ^b	8.10 ^a	31.75	31.99 ^b	1.69 ^{bcd}
	61-90	2.8 ^{bc}	8.09 ^a	30.55	31.13 ^b	3.80 ^{ab}
LSD _{0.05}		0.64	0.74	7.84	15.06	2.26
CV%		23	5.59	14.67	29.65	38.78
F-value		32.2	3.43	1.59	23.2	4.24
P		<0.0001	0.005	0.160	<0.0001	0.015

Electrical conductivity of the soil describes the amount of electrical current conducted by extracting the solution from a saturated soil sample at a fixed temperature (Joe, 2002). EC is a measure of the total salt content of the soil. The greater the concentration of ions or soluble salts in the saturation extract, the more electricity the solution will conduct, the greater the EC reading, and the greater the toxicity to plants. This test does not distinguish between one type of salt and another; it simply provides an overall measure of water-

soluble salts.

4.2. Soil Chemical Characteristic

4.2.1. Soil Electrical Conductivity (EC)

EC values are highly significantly different at ($p < 0.05$) among irrigated land using ground water in both districts and it is not significantly different for the irrigated land using river across different soil depth intervals (table 3). In addition, EC value showed a decreasing trend with the soil depth at all

sampling sites with depth (figure 2). This result is strongly agreed with the study report by (W. Al-Jassem *et al*, 2008) who clearly indicated that soil electrical conductivity decrease with the soil depth. This is mainly due to the fact that salinity accumulated on the plough layer due to low leaching of saline soil to the sub surface and sodic soil characteristics that can reduces soil water infiltration. However, this situation is not practical especially where concentrated or saline ground water recharge is the cause for soil salinity problem. In this case, soil salinity in general and EC values in particular increase with the soil depth.

Poor water infiltration can lead to poor drainage, waterlogging, and increased EC on the surface and sub-surface soil. The EC value of irrigated land using ground water is very high in both districts indicating that there is high anion and cation concentration in ground water solution as compared with the land irrigated with rivers. Its value is ranging from 2.1-4.1ds/m and 0.26-0.41 ds/m at the land irrigated with the ground water and river respectively. According to the study by (Al Sherif, A. E. 2008), many plants suffer restricted growth when the EC is greater than 4 dS/m. An EC of below 2 dS/m is non-saline, 2-4 dS/m is weakly saline, 4-8 dS/m is moderately saline and 8-16 dS/m is severely saline. Therefore, EC values at the land irrigated using ground water is in the range of moderately saline that have still a potential to restrict plant growth and crop yield.

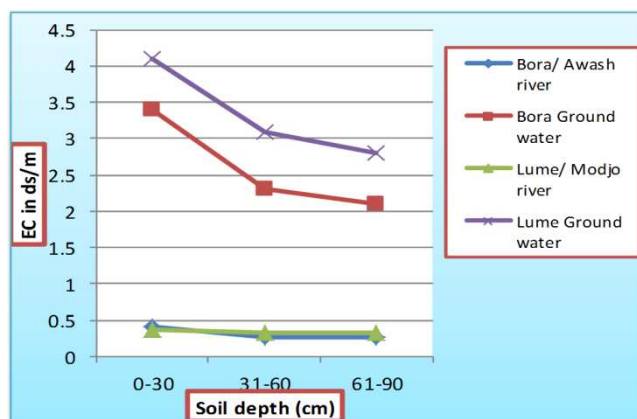


Figure 2. EC value across soil depth.

4.2.2. Soil pH

Soil pH is a measure of the hydrogen ion concentration in soil solution. It is also important to indicate the chemical status of the soil. Soil pH level affects soluble salts and availability of major plant nutrients (Conway 2001; Joe 2002).

Soil pH at irrigated land using Awash River is significantly different at ($p < 0.05$) between the land irrigated using ground water and Modjo river. It is above 8 for the land irrigated with ground water in both districts. On the other hand, soil pH ranges from 6-7.5 for the land irrigated with river in both districts. However the pH of the soil irrigated using Awash River in Bora district is in the neutral range (6.9-7.3). This result clearly showed that there is higher ionic concentration in soil solution of irrigated land using

ground water than in river based irrigated land (table 3 & figure 3). According to FAO soil salinity guideline report in 1988, Sodic soils contain a high exchangeable sodium percentage ($>15\%$) and also have a high pH value (mostly in the range of 8.0 to 10). These soils seriously affect plant growth in a number of ways. Sodium ions have an adverse effect on plant metabolism and nutrition. Most plants cannot tolerate the high pH associated with sodic soils. The high pH leads to low micronutrient availability and decreases the availability of macronutrients such as calcium, magnesium and phosphorus (Tesfai *et al*, 2002). Accumulation of elements such as sodium, molybdenum and boron in plants can result in direct toxicity and may lead to plant injury or reduced growth and eventually death in more sensitive plants.

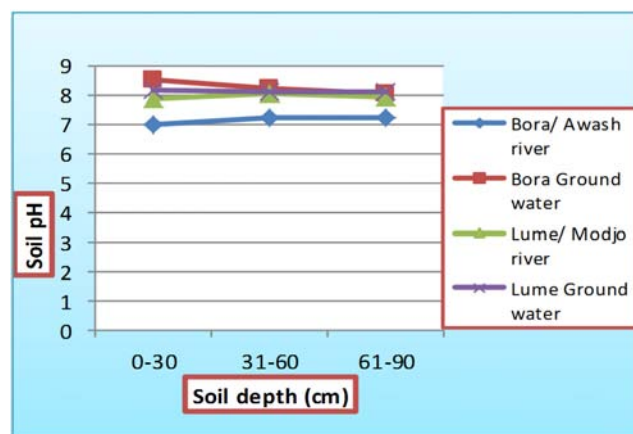


Figure 3. Soil pH across soil depth at different irrigated land.

4.2.3. Exchangeable Sodium Percentage (ESP) and Sodium Adsorption Ratio (SAR)

The exchangeable sodium percentage (ESP) is a measure of the amount of exchangeable Na relative to the total cation exchange capacity of calcium and Magnesium. As the ESP goes up, more exchangeable Na is available, and the greater the potential to be toxic to plants and soil. The Sodium Adsorption Ratio (SAR) describes the ratio of the concentration of soluble sodium ion in the soil solution to the square root of the dissolved calcium and magnesium ion concentration that moderate the adverse effects of sodium (Joe 2002). The greater the SAR, the more Na relative to Ca and Mg, the greater the toxicity to plants and indicates a sodic soil. Both ESP and SAR are highly significantly different at ($p < 0.05$) across soil depth at all selected irrigated land. In addition, ESP and SAR value showed a decreasing trend with the soil depth at all sites (figure 4). This indicated that the concentration of exchangeable sodium is lower in sub soil layers (30-90cm) as compared with surface layer (0-30cm). This result is strongly agreed with the study by (FAO, 1988) that indicated Salinity is a common problem in arid and semi-arid areas due to the fact that as water evaporates from the soil surface the salts remain in the soil and accumulates over time. Both ESP and SAR values are above the normal range of soil quality for irrigation. ESP of soil at irrigated land using ground water ranges from 31-52% indicating that soil sodicity is extremely high in this area as

compared with soil quality standard reported by (Zhang *et al.*, 2005). According to the soil salinity classification standard by FAO, 1988, Hogg and Henry, 1984 and Zhang *et al.*, 2005,

ESP above 15%, CEC below 4 ds/m and pH above 8 are categorized under sodic soil (figure 5).

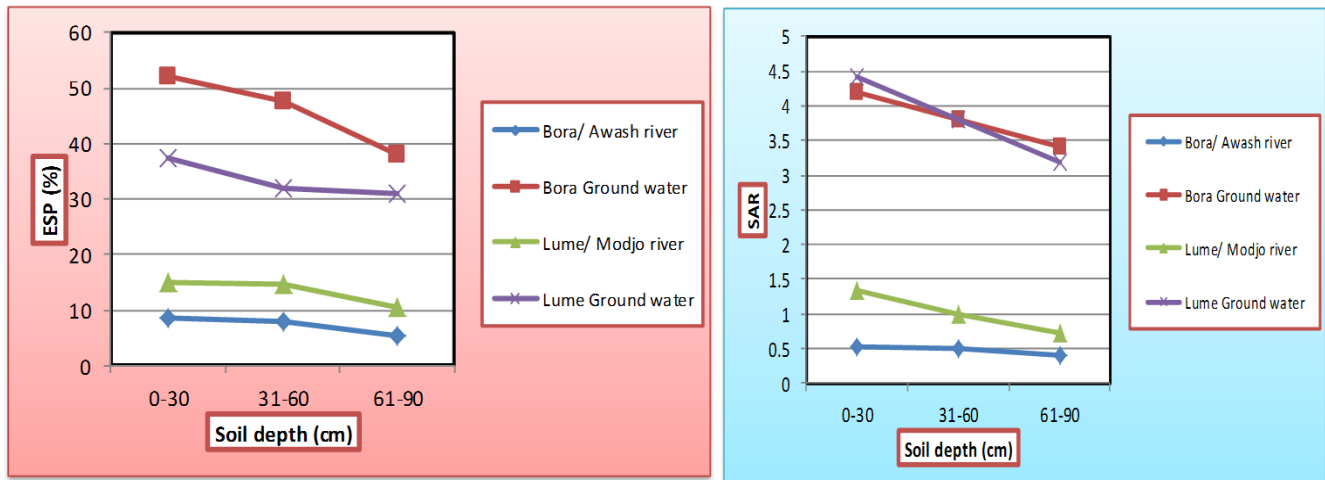


Figure 4. ESP and SAR of soil across depth at different Irrigation land.

From the Soil sample analysis it was realized that salinity levels i.e. electrical conductivity (ECe) <4 dS m⁻¹, soils pH >8.5 and ESP>31 are indicating the soils have high sodium content, which has led to structural degradation and poor drainage of applied irrigation water. A high amount of exchangeable sodium relative to calcium and magnesium at high pH (greater than 8) causes soil crumbs to disperse or break apart. Soil particles that are dispersed are much smaller than well-aggregated or clumped soil and cause the destruction of soil structure (Rhoades *et al.*, 1992).

The soil surface usually forms a crust, and pore spaces become clogged with tiny, dispersed soil particles that prevent water movement into and through the soil. High levels of salts in soils reduce plant growth and crop yield in a number of ways. There may be direct toxic effects, especially from elements such as sodium, chlorine or boron. Ionic

imbalances may also be created in plants. Plants may also suffer from physiological drought as water availability to plants is lowered due to the high osmotic potential of salty water in the soil solution (FAO-UNESCO, 1988).

In sodic soils, plants suffer from oxygen deficiency as sodium disperses clays and organic matter leading to structural breakdown of the soil particles and consequent low porosity (FAO, 1988). Dispersed organic matter may accumulate at the surface of poorly drained areas and impart a black color; hence the common name 'black alkali soils'. Moreover, these properties reduce water infiltration and aeration in the soils and hinder the growth of roots, which may eventually lead to loss of arable land unless appropriate ameliorative measures are taken for the reclamation of the soils.

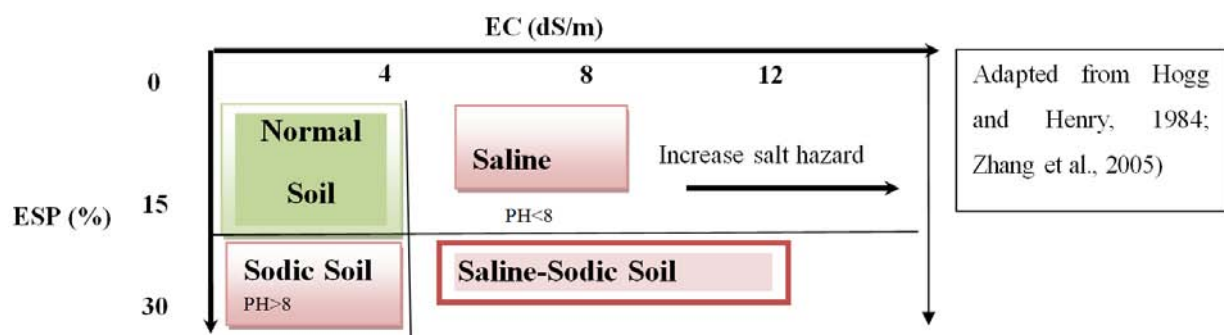


Figure 5. The relationship between EC, pH and ESP on determining the type of soil salinity.

4.2.4. Anions and Exchangeable Cations

It was identified that the concentration of exchangeable calcium, magnesium and sodium are significantly different at $p < 0.05$ between irrigated sites using ground and river water but They are not significantly different between sites that are

using ground water for irrigation and there is also no significance difference in this cation concentration between sites who are using rivers for irrigation. Total nitrogen, SOC, calcium carbonate and available phosphorous are not significantly different at $p > 0.05$ at all sampling sites (table 4)

Table 4. Anions and Exchangeable cations concentration at different irrigation sites.

Source of water For irrigation	Soil depth (cm)	TN %	OC (%)	C:N	Ava.P in ppm	Ca ⁺² mel/100g	Mg ⁺² mel/100g	Ex. Na ⁺ mel/100g	Ex.k ⁺ mel/100g	Caco ₃ me/100g
Ground water in Bora	0-30	0.13	2.14	17.59	16.80 ^{ab}	9.47 ^{bc}	3.14 ^{bcd}	13.08 ^a	4.28	5.89
	31-60	0.11	2.64	23.13	10.91 ^{bc}	9.73 ^{bc}	2.71 ^{cd}	12.18 ^{ab}	4.68	3.78
	61-90	0.12	1.60	12.63	5.20 ^{bc}	9.01 ^{bc}	2.92 ^{bcd}	8.95 ^b	3.55	4.05
Awash River in Bora	0-30	0.14	2.26	17.37	27.53 ^a	12.54 ^{abc}	6.06 ^a	1.65 ^d	3.53	3.56
	31-60	0.11	1.53	15.37	16.93 ^{ab}	10.12 ^{bc}	5.15 ^{ab}	1.77 ^d	4.09	3.09
	61-90	0.10	1.42	12.14	16.87 ^{ab}	10.70 ^{abc}	4.99 ^{abc}	2.05 ^d	5.23	4.79
Ground water in Lume	0-30	0.14	2.20	15.79	6.28 ^{bc}	7.80 ^c	2.89 ^{cde}	13.35 ^a	4.16	3.41
	31-60	0.12	2.64	17.10	3.54 ^c	12.69 ^{ab}	2.25 ^c	11.74 ^{ab}	3.70	4.88
	61-90	0.11	2.79	21.79	3.45 ^c	10.16 ^{bc}	2.93 ^{bcd}	8.83 ^{bc}	3.56	8.79
Modjo river in Lume	0-30	0.12	2.13	17.88	11.60 ^{bc}	15.17 ^a	3.44 ^{bcd}	3.91 ^d	2.90	7.47
	31-60	0.14	2.56	18.87	7.05 ^{bc}	14.99 ^a	3.91 ^{abcd}	4.62 ^d	2.60	6.55
	61-90	0.11	2.34	19.85	6.09 ^{bc}	14.98 ^a	4.86 ^{abcd}	2.05 ^d	2.55	9.55
CV (%)		31.24	30	27	30	24	35	32	30	26
LSD _{0.05}		0.06	1.83	14.43	13.12	4.80	2.23	4.02	3.13	4.44
F-value		0.44	0.50	0.44	2.63	2.4	2.48	11.18	0.51	2.05
P-value		0.92	0.88	0.92	0.023	0.035	0.030	<0.0001	0.87	0.068

Carbon to nitrogen ratio is one of important parameter for soil quality evaluation. The mean C:N varies from 20:1 at farmers using river water to 15:1 at farmers who are using ground water. According to Kirsten (2005), the two extremely important chemical elements in organic matter, proportional relationship is the carbon-nitrogen ratio. When the ratio was between than 10:1-15:1, it is optimum for plant growth, even though the proportions of C/N ratio differ for different type of organic matter. In salt-affected degraded areas, SOC (soil organic carbon) levels are likely to be affected by declining vegetation health and hence, decreasing biomass inputs and concomitant lower levels of organic matter accumulation. Moreover, potential SOC losses can be higher from dispersed aggregates due to Sodicity (Vanessa *et al.*, 2006).

5. Conclusion

For sound land use and water management in irrigated area, knowledge of the chemical composition of soils and water condition before action are crucial for sustainability of irrigation projects. The study aimed to evaluate and characterize the physicochemical properties of soils with the intention to soil salinity status at small scale irrigation schemes with reference to classification standards. With regard to this, a study was conducted in Bora and Lume districts of small scale irrigation in East showa, Ethiopia.

Before soil sampling preliminary survey was done to identify the major source of water for irrigation and farmers' view on soil salinity. The preliminary survey showed that about 75% of the respondents use ground water as source for irrigation water. 25% of the farmers use river (Modjo and Awash River) for irrigation. Soil salinity is major problem for the farmers using ground water for irrigation. Soil samples were collected from the land irrigated with ground water and river to the depth of 90cm at different sampling depths (0-30cm, 31-60cm and 61-90cm). Both land irrigated

with ground water and river were replicated three times in each district. Analysis of soil samples showed that average soil pH>8.2, EC<4ds/m, and ESP>31 were observed at the land irrigated using ground water in both districts. This analysis reveals the existence of potential sodicity in the soil.

Recommendations

To sustain productivity of soil in this small scale irrigation site, the study underlines the need for immediate soil salinity management by using appropriate soil salinity reclamation techniques especially at the farmers who are using ground water for irrigation in both districts.

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