Review Article
Published: 14 Sep, 2020

SF Journal of Environmental and Earth Science

Soil Salinity and Its Management Options in Ethiopia, Review

Wudu A[1] and Mahider W[2]*

[1]Amhara Agricultural Research Institute, Sirinka Agricultural Research Center, Woldia, Ethiopia

[2]College of Agriculture and Environmental Science, Woldia University, Ethiopia

Abstract

Soil salinity is one of the chemical soil degradation problems which affect soil productivity in the Ethiopian low lands. This paper tries to put together soil salinity concept, causes, extent and management practices. Soil salinity is the problem of agricultural activities in Ethiopian low lands (cultivated lands) and is getting an increase. Farmers require simple and sustainable techniques to amend acid saline and improve yields of crops of their choices. Recommendations on reclamation of saline soils need to change with new developments, such as Gypsum, use of salt-tolerant crop varieties, integrated soil fertility management, and using of organic fertilizers. Gypsum has played an important role in reducing soil salinity and enhancing crop productivity. In Ethiopia, the gap between potential and actual yield is very wide because of soil salinity and associated nutrient availability. Saline soils are not responsive to the application of inorganic fertilizers without amendments-it is simply wastage of resources. Thus, developing effective and efficient saline soil management practices is indispensable for enhancing crop productivity and thereby sustaining yield gains. This review focuses on the extent, causes and managements of soil salinity and its subsequent effect on soil fertility and crop yield. It also provides important information on management options to amend soil salinity and improve the entire fertility of soils, and other organic amendments that can be applied to remedy soil salinity to the desired Electronic conductivity level and improve soil quality. Integrated saline soil management enhances the stability of yields and maximizes nutrient use efficiency.

Keywords: Gypsum; Salinity; Management

Introduction

Soil salinity is a major issue influencing crop generation all over the world: 20% of cultivated land within the world, and 33% of irrigated land, are salt-affected and degraded [1]. Soil Salinity could be a serious hindrance to the sustainable management of over 800 million hectares arable land range globally; particularly in flooded arid and semiarid regions [2].

Soil saltiness may be a major land degradation issue in numerous portions of the world. The advancement of salt influenced soils and related issues are most articulated in dry and semi-dry districts, which offer significant guarantee for improvement as major nourishment creating locales, since of their visit potential for numerous editing. The water system, dissipation of dampness from the surface or shallow depths inside the profile, and the inadequately yearly rainfall to filter down salts from the plant establishing zone support the intemperate accumulation of solvent salts in soils of bone-dry and semi bone-dry locales, rendering such lands to have been utilized by human creatures with as it were negligible success since the approach of farming.

Soil salinity could be a major restricting factor that imperils the capacity of agricultural crops to sustain the developing human population. It is characterized by a high concentration of solvent salts that significantly decreases the yield of most crops [3].

Soil salinization is one of the major limitations in accomplishing nourishment security and natural degradation in Ethiopia. The rebuilding of salt-affected lands into profitable lands and assurance of recently created ranges from the spread of saltiness is subsequently of foremost significance. In high saltiness ranges where specialized arrangements to soil recovery are costly and time expending and development of ordinary field crops is limited, utilization of bioremediation strategies counting planting halophytic scrounges seems to bring these soils back into generation [4].

OPEN ACCESS

***Correspondence:**
Wudu Abiye, Amhara Agricultural Research Institute, Sirinka Agricultural Research Center, Woldia, Ethiopia.
Tel: *+251913123417*
E-mail: *wuduabiye@gmail.com*
Received Date: *19 Jun 2020*
Accepted Date: *10 Sep 2020*
Published Date: *14 Sep 2020*
Citation: *Wudu A, Mahider W. Soil Salinity and Its Management Options in Ethiopia, Review. SF J Environ Earth Sci. 2020; 3(2): 1042.*
ISSN 2643-8070

Table 1: Characteristics of salt-affected soils [13].

Characteristics	Saline soils	Sodic soils
Content in soil	Excess of neutral salts	Excess of sodium salts
pH	<8.5	>8.5
EC (dS m^{-1})	>4	<4
Exchangeable sodium percentage (%)	<15	>15
Physical condition of soil	Flocculated	Defflocculated
Color	White	Black
Organic matter	Slightly less than normal soils	Low
SAR	<13	>13
Total soluble salt contents (%)	>0.1	<0.1

Saltiness issue in Ethiopia has shown to the extent that farmers are encountering huge crop losses whereas numerous ranches have gone out of generation over the final decade. The saltiness issues are presently spread over a run of scenes, inundated lands, rain-fed cultivating regions, and rangelands within the nation [5].

As of now, soil saltiness is recognized as the foremost vital issue within the dry and semi-arid marsh regions of the nation coming about in diminished crop yields, low cultivation livelihoods, and expanded rural poverty [6].

Saltiness has been related to irrigated farming since its early beginnings. One reason is that the water system frequently compounds the impacts of saltiness, which happens normally since of weathering of saline parent fabric determined from ocean water stores or other sources. Saltiness has in this way been connected with the rise of groundwater tables coming about from an abundance of water system and poor drainage in large-scale, lasting irrigation frameworks. The coming about shallow water tables bring salts to the upper layers of the soil profile [7]. Saline soils contain sufficient solvent salts to unfavorably influence the development of most plants. The lower restrain of the saturation extract electrical conductivity of such soils is helpfully set at 4 dS/m (at 25^{0}c). Sensitive plants are influenced at half this saltiness and profoundly tolerant ones at approximately twice this saltiness. Saltiness decreases development rates and yields and, in serious cases, causes add up to edit disappointment [7].

Salt influenced soils have been detailed to happen at most parts within the Rift Valley Zone of Ethiopia [8].

Soil salinization is complexly interrelated with soil characteristics, the sum and composition of salts within the soil, the amount and quality of water system water connected, and the water system strategies utilized [9].

Soil Saltiness unfavorably influences the environment, agro-ecosystems, and agricultural efficiency of arid and semi-arid locales around the world. The soil salinity happens due to common, human or both activities on the dynamic soil framework [6].

The impressive range of land is getting to be useless each year since of salinity in the Lowlands of Ethiopia. For sound land utilization and water system water administration, it may be a foremost critical to know the salinity status of soils and water system water quality [10]. Therefore the objective of this review is to review on Soil Salinity and its Management Options.

Soil Salinity Concept, Extent, Cause and Management Options

Concepts of soil salinity

Several agencies have given distinctive definitions for soil salinity. The foremost broadly acknowledged definition of salt-affected soils is as characterized by the United States Department of Agriculture, (USDA) [11]. The definition is based on ECe (electrical conductivity of the immersion extricates of soil, DSM-1), pHs (pH of the soaked soil glue), and ESP (exchangeable sodium rate of the soil).These soils have used more than 4 DSM-1 at 25^{0}C, pHs less than 8.2, and ESP less than 15.

Soil salinity may be a degree of the minerals and salts that can be broken down in the water. In most cases, the taking after mineral particles is found in soil-water extricate recorded in arrange of importance. Expanded soil saltiness has dynamic and regularly significant impacts on the structure, water development, and microbial and plant differing qualities of soils. Soil salinity is measured by utilizing Electrical Conductivity (EC) estimations of a water-saturated soil paste extract.

All soils contain a few water-soluble salts, but when these salts happen in sums that are harmful for the germination of seeds and plant development, they are called saline [12].

Soil salinity may be a major constraining calculates that imperils

Table 2: Extent of saline soils globally [14].

Regions	Total area	Saline soils	Percent (%)	Sodic soils	Percent (%)
Africa	1899.1	38.7	2.0	33.5	1.8
Asia and the pacific and Australia	3107.2	195.1	6.3	248.6	8.0
Europe	2010.8	6.7	0.3	72.7	3.6
Latin America	2038.6	60.5	3.0	50.9	2.5
Near East	1801.9	91.5	5.1	14.1	0.8
North America	1923.7	4.6	0.2	14.5	0.8
Total	12781.3	397.1	3.1%	434.3	3.4%

the capacity of crops to support the developing human population. It is characterized by a high concentration of solvent salts that altogether diminish the yield of most crops Soils with an Electrical Conductivity (EC) of the immersion soil extricate of more than 4 dS m^{-1} at 25°C are called saline soils, which are proportionate to around 40 mM NaCl and produce an osmotic weight of approximately 0.2 MPa. Salts generally found in saline soils incorporate chloride and sulfates of Na, Ca, Mg, and K. Calcium and magnesium salts are at a tall sufficient concentration to balance the negative soil impacts of sodium salts. The pH of saline soils is for the most part underneath 8.5. The typical desired range is 6.0-7.0 [3] (Table 1).

The extent of soil salinity

Several authors have endeavored to assess the degree of salt-affected soils within the final 30 a long time, FAO assessed that universally the entire region of saline soils was 397 million ha which of sodic soils 434 million ha. Of the at that point 230 million ha of flooded land, 45 million ha (19.5 percent) were salt-affected soils; and of the almost 1500 million ha of dry land agriculture, 32 million (2.1 percent) were salt-affected soils as demonstrated within the Table 2 and 3.

The outline of salt influenced soils inferred from experimental demonstrate revealed four classes of salinity levels with different extents of a zone *via* non-saline, slightly saline, moderately saline, and strongly saline soils. Non-saline soil area was the largest in extent (3692.7 ha), which was 54.7% of the total area (Table 4). Strongly saline soil secured 2.0%, which was basically within the central portion of the study region. Spatially, it coincided with those inferred from supervised classification and NDSI classification except the variety within the range scope. The show revealed some modern inconsistent zones of solid saltiness within the northern and western edges of the ponder zone. Slightly saline and moderately saline soils secured 32.6% and 10.6%, separately, and found scattered throughout the study range [14].

The dry and semi-arid agro-ecologies which account for about 50% of the countries arrive region are respected as marginal situations for crop production basically due to soil and water saltiness. Low levels of yearly rainfall and high daily temperatures have driven to high water vanishing rates and subsequently contributed to tall concentrations of solvent salts in these swamp ranges [13].

In Ethiopia, approximately 44 million ha (36% of the whole arrive area) is potentially susceptible to saltiness issues of which 11 million ha have as of now been influenced by different levels of saltiness and primarily concentrated within the Rift valley. Ethiopia ranked as 7th within the world in terms of rate of the full arrive region influenced by saltiness [4] (Table 5).

According [10] the profoundly saline soils were found on the ranges underlain by the lacustrine sediments and shallow groundwater level. The low lying topography and poor vegetation cover enormously improved the salinization. The degree zones of each course of the saltiness have appeared. The tall and direct soil saltiness classes cover roughly 11% and 40% of the total area, separately. The non and slightly saline soil classes together accounted for over 49% of the whole range. It is clear that the regions highly defenseless to salinization enormously related to the groundwater level that ordinarily happened on the lacustrine silt close to lake Beseka (Table 6).

Table 3: Worldwide distribution of salt-affected areas (Million ha).

Area	Saline soils	Sodic soils	Total	Percent
Australasia	17.6	340.0	357.6	38.4
Asia	194.7	121.9	316.5	33.9
America	77.6	69.3	146.9	15.8
Africa	53.5	26.9	80.4	8.60
Europe	7.8	22.9	30.8	3.30
World	**351.2**	**581.0**	**932.2**	**100**

Source: [15], in FAO Soil Bulletin 39; Summary of data for Europe (Szabolcs 1974) and other continents (Massoud 1977).

Major saline soil

Cambisols and Fluvisols soils are the main soil classes dominated by soil salinity [14]. These soils have used more than 4 DSM-1 at 25⁰c, pHs less than 8.2, and ESP less than 15. The recognizing characteristic of saline soils from the agricultural standpoint is that they contain adequate neutral dissoluble salts to adversely influence the development of most crop plants. For purposes of definition, saline soils are those which have an electrical conductivity of the saturation soil extract of more than 4 dS/m at 25°C [11] (Table 7).

Causes of soil salinity

Within the saline lands of Ethiopia, agricultural production is progressively confronted with natural imperatives coming about in decreased crop efficiency. The variation in crop production completely different salinity prone ranges is connected to the changes in nearby natural, socio-economic, and edaphic conditions. Major components causing saltiness advancement in Ethiopia are summarized below [4].

Water deficiency for irrigation: Salt-affected lands in Ethiopia are located in parched, semi-arid, and lowland dry ranges (60% of add up to the land zone of the nation), where precipitation is not one or the other adequate nor solid for economical crop production. In these zones, the water system is essential for stabilizing the agricultural generation. In numerous zones, farmers used to develop flood-based cultivating frameworks, also called a spate water system. The spate water system is advantageous in mountain catchment border swamps, where agriculturists can make utilize of brief-term surges. In any case, as water comes regularly either long sometime recently or late after the cropping season, crop efficiency is seriously influenced.

Declining irrigation water quality: The expanding request of water for residential and mechanical employments has put enormous pressure on the farming sector to diminish its share of great quality water utilization. The hot and dry climates of saline regions require that the water system water does not contain solvent salts in sums that are destructive to the plants or have an unfavorable impact on the soil properties.

Water logging: Soil Salinity issues are expanding within the flooded areas of parched and semi-arid lowlands of Ethiopia, which is causing huge social (that's, movement and maladies) and financial issues (decrease in crop production and increase in poverty) for the nation. Farmers are progressively abandoning a portion of their farms

Table 4: Area Extent of Soil Salinity Level Derived at Sego Irrigation Farm, South Ethiopia [14].

Salinity level (mS/cm)	Salinity extent	Area(ha)	Area (%)
2.05–4	Non saline	3692.7	54.7
4-8	Slightly saline	2202.0	32.6
8-15	Moderately saline	715.0	10.6
>15	Strong Saline	13.69	2.0

Table 5: Temporal changes in the area affected by soil salinity at Dubai/Tendaho state farm. Salinity [4].

Salinity level	1972		1994		2014	
	Area (ha)	Change (%)	Area (ha)	Change (%)	Area (ha)	Change (%)
Normal soil	3783	35	2930	27	2189	20
Saline-Sodic	2178	20	2423	23	3154	29
Saline	4035	37	4138	38	2929	27
Sodic	797	8	1302	12	2521	24
Total	10793	100	10793	100	10793	100

Table 6: Extent of areas of various salinity levels derived from overly salinity model at metehara sugarcane state [4].

Item	Salinity Extent	Area (ha)	Area in %
1	Non-saline	2816.957	23
2	Slightly saline	3229.28	26
3	Moderately saline	4999.84	40
4	Highly saline	1378.99	11

in water system plans due to rising salinity issues. This issue is more intense in dry and semi-arid districts, where saltiness unequivocally limits crop improvement. In numerous parts of the nation, tall saltiness and sodicity levels from expanding groundwater levels are debilitating the sustainability of irrigated agriculture.

Salinization may be a preparation that comes about in an expanded concentration of salts in soil and water. Of these salts, sodium chloride is the foremost common. With an increment in concentration of solvent salts, it gets to be more difficult for plants to extract water from the soil. Higher salt concentrations can be made by poor soil drainage, improper water system, water system water with tall levels of salts, and excessive use of fertilizer or compost as fertilizer [3].

Crop fertilization is one of the sources of salinization of soils. To decrease this negative effect, the fertilizer characteristics, the strategy of fertilizer application, irrigation water quality, and fertilization planning, etc., must be considered. Excessive nutrient applications must be maintained a strategic distance from, and high-purity, chloride-free, low-saline fertilizers ought to be selected [1].

Most of the saline-sodic soils are developed due to natural geological, hydrological, and pedagogical forms. A few of the parent materials of those soils incorporate middle igneous rocks such as phenolytes, essential volcanic rocks such as basalt, undifferentiated volcanic rocks, sandstones, alluvium, and lagoonal deposits [16].

According to the findings of [17] the cause of soil salinity is listed below.

Characteristic soil salinity (weathering of rocks, parent material).

Brackish and saline water system water.

Ocean water intrusion into coastal lands as well as into the aquifer due to over-extraction and abuse of new water.

Limited seepage and a rising water-table.

Surface evaporation and plant transpiration.

Ocean water splashes, condensed vapors which drop onto the soil as rainfall.

Windborne salts yielding saline fields.

Overuse of fertilizers (chemical and cultivate manures).

Utilize soil alterations (lime and gypsum).

Utilize of sewage slime and/or treated sewage effluent.

Dumping of industrial brine onto the soil.

All salts found in soils and waters started from parent rock material that has experienced geochemical weathering. Over geologic time, essential minerals have responded with water, O_2, and CO_2 to make secondary minerals and salts that were transported by water to seas or depressions within the landscape. Immersion of huge arrive masses by saline oceans stored sedimentary materials that have become the major source of salt in arid districts [18].

Low precipitation and high evapotranspiration as a consequence of extremely hot and dry conditions are another major reason for soil saltiness in these parts of the nation. The human-induced

Table 7: Soil salinity Distribution with respected to soil type [14].

Soil type	Soil salinity classes and extents (ha)								Total
	Non-saline		Slightly saline		Moderately saline		Strongly saline		
	Area	Area (%)	Area	Area (%)	Area	Area (%)	Area	Area (%)	Area
Cambisols	611.6	9.1	1223	18.1	1693.1	25.1	155.6	2.3	3683.3
Fluvisols	3.8	0.1	741.8	11	865	12.8	37.7	0.6	1648.2
Gleysols	0	0	9.5	0.1	37.2	0.6	0.9	0	47.5
Luvisols	86.4	1.3	355.3	5.3	231.4	3.4	0.3	0	673.3
Solonchaks	0	0	5.7	0.1	160.1	2.4	0.5	0	166.4
Solonetz	0	0	48.3	0.7	127	1.9	4.7	0.1	180
Vertisols	0	0	22.1	0.3	37.9	0.6	0	0	60.1
Leptosols	52.7	0.8	199.1	3	34.8	0.5	0.7	0	287.3
Total	754.6	11.2	2604.9	38.6	3186.6	47.2	200.5	3	6746.5

Table 8: Cause of Soil Salinity with Rank and Farmers Perception [5].

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	2	3.1	3	6.7
Medium	28	41.8	13	37.1	28	32	10	15.4	16	35.6
High	23	34.3	15	42.9	31	35	18	27.7	13	28.9
Very high	6	8.9	3	8.6	22	25	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	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

Table 9: Various remedial options and interventions [7].

Category	Options
Engineering	Construct additional storage facilities for water (dams and reservoirs) and salts (evaporation ponds).
	Improve maintenance of irrigation infrastructure.
	Conserve water in catchment, and rain in irrigated areas.
	Construct drainage facilities.
	Improve maintenance of existing (including natural) drains.
	Reuse waste and drain water, and find alternate ways to dispose drainage effluent, and industrial and municipal waste water.
	Prevent or reduce canal seepage, i.e., through lining.
Agronomic	Grow different crops or introduce different crop rotations, i.e., less-water demanding crops, more drought- and salt-tolerant ones.
	Irrigate according to reliable crop water requirement estimates (yield response functions) and leaching requirement calculations.
	Reduce irrigated area (use more water per unit land).
	On-farm watercourse improvement and precision land leveling.
	Apply soil amendments, such as gypsum.
Policy	Introduce water and power pricing to make water more expensive.
	Introduce transferable water entitlements.
	Set limits for allowable groundwater recharge (amount and quality) and introduce penalties for exceeding these limits.
	Provide incentives for land reclamation, i.e., subsidizing gypsum.
Management	Improve the operation of existing irrigation and drainage infrastructure through introduction of management information systems, etc.

salinization has occurred mostly in special topographic conditions of semi-closed to closed intermountain basins where irrigation has been honed for centuries. The factors which have contributed to the event of secondary salinization incorporate (i) utilize of saline water for irrigation without satisfactory administration hones in areas of extraordinary water shortage; (ii) inadequately and inappropriate waste offices for the transfer of saline seepage water produced by irrigated agriculture. Most of the waste ventures were constructed 40-50 a long time back. Due to age and poor maintenance, most of them are deserted or non-functional [19].

Poor drainage is another factor that usually contributes to the salinization of soils, it is the most common cause, and it may include the nearness of a tall ground-water table or low porousness of the soil. The high ground-water table is frequently related to topography. Therefore, there are drainage basins that have no outlet to changeless streams. The drainage of salt-bearing waters absent from the higher lands of the basin may raise the ground-water level to the soil surface on the lower lands, which may cause temporary flooding [20].

A majority of saline soils have risen due to normal causes such as the collection of salts over long periods in dry and semiarid zones. Typically since of the reality that the parent shake from which it shaped contains salts, mainly chlorides of sodium, calcium, and magnesium, and to a few degrees, too contains sulfates and carbonates. Seawater is another source of salts in low-lying ranges along the coast. Other than common salinity, a significant extent of developed arrive has ended up saline due to arrive clearing or irrigation [21].

As indicated in Table 8 the major cause of soil salinity in irrigation water quality 88.1% at amibara, 82.9% at bubti, 86.4% at

Raya alamata,44.6% at Ziway-Dugda and 31.1% at Kewet.

Effects of soil salinity on nutrient availability and crop growth and yield

Excessive use of ground water (basically on the off chance that near to the ocean), increasing use of low-quality water in the water system, and enormous presentation of water system related to intensive farming. Over the top soil saltiness diminishes the efficiency of numerous agrarian crops, including most vegetables, which are especially delicate all through the ontogeny of the plant. The salinity threshold (ECt) of the lion's share of vegetable crops is moo (extending from 1 to 2.5 dS m^{-1} in immersed soil extracts) and vegetable salt resilience diminishes when saline water is utilized for water system [1].

The foremost common whole-plant response to salt stress could be a common hindering of development. As salt concentrations increment over a limit level, both the development rate and extreme measure of crop plants continuously diminish [18].

Vegetable crop production requires a high input of fertilizers and water, each conceivably expanding soil salinity. Fertilization and water system administration procedures must consider the impacts of saltiness on vegetable growth, crop salt resilience, soil decencies, and impacts on water utilization productivity and soil salinity [1].

The major nutritional impacts of saltiness are those related to cation nutrition. Although imbalances in cation nutrition tend to be adjusted when blended salts are displayed, lopsided characteristics in some cases do happen [22]. Soil Salinity caused a reduction in water substance of all tissues (clears out, stems, taproots, and horizontal roots) that come about in inner water shortage to plants. Expanding salt stretch disabled juicy include of tap roots [23].

Saltiness unfavorably influences cell physiology and the digestion system in several ways. The cell-specific occasions, which influence key metabolic pathways and cause harm in salt focused plants, incorporate cell film harm due to electrolyte spillage (EL) and Lipid Peroxidation (LP), oxidation push caused by the free oxygen radicals, disabled water relations, changed gas trade characteristics, and particle toxicities [2].

The capability of natural product tree and vine crops to endure soil saltiness is profoundly subordinate upon the rootstocks. Their resilience appears to be related essentially to the capability of diverse rootstocks to control the take-up of Na^{*} and/or Cl [18].

Strong salt influenced soils can influence plant development both physically (osmotic impact) and chemically (nutrition impact and/or harmfulness). Due to these plant development and yield is diminished, and the quality or esteem of rural generation is lowered. The adverse impact of high soil salt content on vegetative development is due to three primary reasons [12].

1. Prevention of soil water take-up into the plant because of the osmotic effect;

2. Particular particle toxicity, which can disturb the nutritional processes of the plant; and

3. Modification of the soil structure and permeability

The crop productivity losses due to soil salinization in the study regions extended from a total loss to less than 10% loss. The majority of the respondents (54.3%) in Dubti Locale detailed 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 efficiency misfortunes of 25% were detailed in Amibara (35.8%) and Dubti (25.7%) districts. Nearly 15% of the respondents in Amibara Area detailed a complete loss of their crop production in numerous cropping seasons. Be that as it may, in other four areas, complete production misfortunes were less than 10%. High productivity losses in Amibara and Dubti areas are reasonable given the dry, hot and saline environment of the area [5].

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% [5].

Salt accumulation in the root zone causes the development of osmotic stress and disrupts cell ion homeostasis by inducing both the inhibition in uptake of essential elements such as K^{+}, Ca^{2+}, and NO_3^{-} and the accumulation of Na^{+} and Cl^{-} [1].

Soil salinity may contrarily influence plant development and survival by decreasing soil water accessibility. As the salt substance in soil increments, the sum of water accessible for plant take-up diminishes. High concentrations of particular salts may too cause disturbance within the take-up and utilization of other minerals required by the plants. Besides plant development, saltiness may too decrease seed germination, in this manner influencing the capacity to re vegetate these sites. As the salt concentration increments, the capacity of the seed to assimilate the moisture fundamental for germination is diminished. In addition, high salt concentration may promote the entry of ions into the seed unit at toxic levels [12].

Management options of soil salinity

Leaching: To ensure long-term land utilize with irrigated vegetable crops, it is vital to do a maintenance leaching. The volume of water connected with irrigation must incorporate a water sum that channels down the root zone, which is in expansion to the sum required for normal irrigation. This extra water is characterized as the Leaching Fraction (LF) [24].

Soil reclamation: Soil salinity and sodicity are issues as well difficult to overcome, requiring salt removal from the root zone (reclamation). Usually perhaps the most viable and long-lasting way to play down or indeed eliminate negative impacts of salinity [1].

In case soil drainage is poor and the water table is shallow, an manufactured seepage framework must be introduced. Subsequently, it isn't continuously possible or feasible to carry out a "true reclamation" method. The recovery of sodic soils may, in expansion to filtering, require the application of amendments to extend soil permeability and decrease the exchangeable sodium levels. Sodic soils recovery includes substituting sodium within the soil with calcium particles, through applying large amounts of gypsum ($CaSO_4$). The discharged sodium particles are at that point filtered profound beyond the root zone utilizing overabundance water and at last moved out of the field through seepage. Gypsum, when gradually blended with water, discharges calcium particles, which supplant sodium particles from the soil into the descending moving water [1].

The recovery of a saline soil is finished by filtering the salts from the soil. To achieve this, adequate moisture must be accessible and the soil must have great inside drainage. To improve the porousness, the incorporation of expansive sums of organic matter is suggested. Organic matter may be within the form of clean straw, native prairie feed, sawdust, wood chips, or fertilizer. Typically especially imperative where over the top soil loss has happened. The natural matter improves soil structure, penetration and permeation of dampness, subsequently improving the salt leaching [12].

Before severely salt-affected soils can be cropped, they usually must be reclaimed by applying water to leach excess salts out of the soil [22].

Fertilization: Crop fertilization is one of the sources of salinization of soils. To decrease this negative effect, the fertilizer characteristics, the strategy of fertilizer application, water system water quality, and fertilization planning, etc., must be considered. Excessive nutrient applications must be avoided, and high-purity, chloride-free, low-saline fertilizers should be chosen. In irrigated vegetable crops the crop dietary prerequisites must be provided by the soil, fertilization, and the supplement substance within the irrigation water. The application of fertilizers through water system water (fertigation) can diminish soil salinization and mitigate salt stress impacts since it moves forward the productivity of fertilizer use, increments supplement accessibility and timing of application, and the concentration of fertilizers are effectively controlled. Fertigation permits visit applications of exceptionally low fertilizer rates which adjusts nutrient supply to plant prerequisites. Supplement supply rate must take under consideration the rates of supplement uptake and of evapotranspiration and irrigation water quality [1] (Table 9).

Crop selection: Salinity or sodicity cannot be completely killed when the as it were available irrigation waters are saline, or when soil properties are marginal. In such circumstances, as it were those crops that can endure the resultant saltiness or sodicity ought to be developed. During the afterward stages of recovery, tolerant crops may be developed to yield a few financial return. Tolerant grasses and vegetables tend to progress soil structure in part recovered soils through the advantageous activity of roots, or through their incorporation into the soil as green fertilizers. Salt tolerance information are valuable in selecting reasonable crops for such conditions [22].

Planting methods: Salt transport is particularly articulated in furrow-irrigated soils. In a single post planting water system, water moving into the planting bed concentrates the salts close the surface at the center of the bed to 5-10 times the saltiness of the soil some time recently water system. Seeds planted in this area as often as possible come up short to sprout indeed when the soil saltiness earlier to water system was very low. Saltiness diminishes from the center to the shoulders of the beds so that double-row plantings close the bed shoulders are at approximately the same saltiness as the first soil some time recently water system. Slanting seed beds with seeds planted one third of the way underneath the crest of the bed allow great germination indeed beneath greatly tall beginning soil saltiness, since water moving into the bed clears salts past the plant push into the top of the bed. Sprinkler water system is presently as often as possible utilized to begin push crops such as lettuce, since sprinkling washes salts down underneath the seed profundity [22].

Diverse planting procedures have been described for raising tree plantations in salt-affected lands lying barren and useless. Depending upon the sodicity levels, geology, and assets, one of the taking after methods can be effectively utilized for tree plantation [22].

Pit method (refilled with recovered soluble base soil or ordinary soil:

Auger hole method.

Combination of pit and auger hole strategy;

Ridge plantation;

Trench plantation.

The Soil Salinity affect may be decreased in case the planting of seeds/seedlings is done at suitable positions on the edges. Depending upon the irrigation system, the furrows, edges, and planting of seed/seedlings can be arranged. In common, planting ought to be done on the stand of the edge instead of on the best or center, whereas water system is connected through furrows on both sides of the edge since evaporation will cause aggregation of more salts at the edge beat or center. On the other hand, in case water system is connected in substitute furrows, at that point plant as it were on one bear of the edge, closer to the flooded furrow [3].

Reclamation through gypsum: The recovery handle is started by appropriate arrive leveling giving solid bunds on all sides of the cultivate to control entrance of water from the connecting un-reclaimed ranges. The on-farm improvement works including cultivate format with water system and seepage channels ought to be completed by early summer some time recently the on-set of downpours. In spite of the fact that the sum of revision to be connected, is based on soil examination, as a thumb run the show, 12-15 t gypsum ha^{-1} (50% of gypsum necessity of 0-15 cm soil as per soil investigation) is adequate sufficient to recover upper 15 cm soil layer of a exceedingly disintegrated soil (pH as tall as 10.7) for effectively developing rice-wheat crops in a turn. The dosage can be decreased to half, on the off chance that 10-15 t FYM ha^{-1} is connected at the side gypsum or salt-tolerant rice and wheat assortments are utilized within the to begin with 3 a long time of development. The revision is consistently spread within the entirety field and altogether blended inside 10 cm best soil layer, taken after by ponding of irrigation rain water for around [25].

Reclamation through organics: Impact of green manuring on soil wellbeing and supplement accessibility is well acknowledged. Comes about of long-term try started in 2005 at Indore middle appeared positive impact of natural/ green manuring on soil properties and trim abdicate on an antacid (sodic) Vertisol. control, 10 t FYM ha^{-1}, sunhemp and dhaincha as green manuring crops were tried at four soil ESP levels (25,35,45 and 50±2) accomplished through one time gypsum application. The most reduced normal ESP values (23.54 in 2016-17 and 22.62 in 2017-18) were recorded within the plots accepting joining of dhaincha taken after by sunhemp (26.70 in 2016-17 and 25.90 in 2017-18). The greatest abdicate of paddy (3.71 & 3.96 t ha^{-1}) and wheat (3.47 & 3.68 t ha^{-1}) was recorded at soil ESP of 25; be that as it may, the most reduced yields were recorded at soil ESP of 50. Among different medicines joining of dhaincha gave the most elevated abdicate and most reduced was watched in control plot for both the crops. Green manuring made a difference in reducing soil ESP and moving forward [25].

Mulching: Mulching with crop residues makes a difference in decreasing evaporation from the soil surface. This, intern, diminishes the upward development of salts and reduces the aggregation of salts. Inorganic mulches coordinates with the drip water system framework successfully decrease salt concentration. Subsurface trickle water system pushes salts to the edge of the soil wetting front, diminishing harmful impacts on seedlings and plant roots [3].

Deep tillage: In saline soils, accumulation of salts is near to the surface. Profound culturing would blend the salts show within the surface zone and would decrease the concentration of the salts near the surface. Within the impervious difficult pan soils, salt leaching prepare does not happen. Chiseling would be viable to progress water penetration and descending development of salts [3].

Adequate drainage: Salt issues frequently happen in soils with poor inside seepage. Low-permeability soil layers may limit the stream of water from more profound layers much slower than evapotranspiration (ET) from the soil surface. In such circumstances, select those crops like sharp gourd and cinder gourd that can endure salinity without much reduction in yield. Artificial channels can moreover be given to permit the removal of filtering water and salts from soils [3].

Conclusion

Sustainable soil management practices and the maintenance of soil quality are central issues to agricultural sustainability. Soil salinity problems are increasing in the lowland areas of Ethiopia. Soil salinity and associated low nutrient availability are among the major constraints to crop production. Soil reaction is one of the physiological characteristics of the soil solution expressed in terms of Ec which indicates whether the soil is saline, saline sodic, or sodic. It exercises significant on many soil properties including nutrient availability, biological activity, and soil physical condition.

The practice of leaching saline soils to mitigate soil salinty and reduce phytotoxic levels of Na has been recognized as necessary for optimal crop production in saline soil. However, application of Gypsum should be considered as an approach to improve soil salinty to optimize nutrient availability for optimum plant growth and yield, otherwise, it is not an end goal by itself to achieve potential yield. Gypsum should be coupled with the applications of optimum rates of inorganic and organic fertilizers, particularly P and K fertilizers. Moreover, there is a need for identifying areas where gypsum application brings significant change and benefit in crop yield. Overall, gypsum should be considered as a soil amendment to raise soil electric conductivity to the level that is suitable for maximum nutrient availability, plant growth, and crop yield.

In general, the integrated use of all the available resources including salt tolerant crops and crop species, which improve and sustain soil and agricultural productivity, is of great practical significance. Overall, saline soil management needs to emphasize strategic research, integrating soil and water management with improved crop varieties to generate prototype and environmentally benign technologies for sustained food production within a framework of appropriate socio-economic and policy considerations. Gypsum and inorganic phosphate fertilizers are used to remedy these problems. However, due to increasing costs and unavailability when needed, their use among our farmers in our country is not widespread. Thus the government should give an attention to the supply of gypsum where it is prudently needed.

References

1. Machado RMA, Serralheiro RP. Soil salinity: Effect on vegetable crop growth. Management practices to prevent and mitigate soil salinization. Horticulture. 2017.
2. Singh A, Sharma DK, Kumar R, Kumar A, Yadav RK, Gupta SK. Soil Salinity Management in Fruit Crops: A Review of Options and Challenges. CRC Press. 2018.
3. Sharma A, Rana C, Singh S, Katoch V. Soil Salinity Causes, Effects, and Management in Cucurbits. CRC Press. 2016.
4. Asad SQ, Tesfaye E, Melese M. Prospects of alternative copping systems for salt-affected soils in Ethiopia. J Soil Sci Environ Manag. 2018; 9: 98-107.
5. Qureshi AS, Mohammed M, Daba AW, Hailu B, Belay G, Tesfaye A, et al. Improving agricultural productivity on salt-affected soils in Ethiopia: Farmers perceptions and proposals. African Journal of Agricultural Research. 2019; 14: 897-906.
6. Gebremeskel G, Gebremicael TG, Kifle M, Meresa E, Gebremedhin T, Girmay A. Salinization pattern and its spatial distribution in the irrigated agriculture of Northern Ethiopia: An integrated approach of quantitative and spatial analysis. Agricultural Water Management. 2018; 206: 147-157.
7. Kijne JW, Wopereis MC, Prathapar S, Sahrawat KL. How to Manage Salinity in Irrigated Lands: A Selective Review with Particular Reference to Irrigation in Developing Countries. 1982.
8. Haile LM. Soil Salinity and Irrigation Water Quality Status in selected areas of Awash River Basin of Ethiopia. Greener J Soil Sci Plant Nutr. 2019; 6: 25-32.
9. Endo T, Yamamoto S, Larrinaga JA, Fujiyama H, Honna T. Status and Causes of Soil Salinization of Irrigated Agricultural Lands in Southern Baja California, Mexico. Appl Environ Soil Sci. 2011.
10. Adhanom OG. Salinity and sodicity hazard characterization in major irrigated areas and irrigation water sources, Northern Ethiopia. Cogent Food & Agriculture. 2019; 5: 1-15.
11. McGeorge WT. Diagnosis and Improvement of Saline and Alkaline Soils. Soil Science Society of America Journal. 1954; 18: 348.
12. Conway T. Plant Materials Technical Note 26. 2001; 26: 1-7.
13. Worku AM. Analysis and Mapping of Soil Salinity levels in Metehara Sugarcane Estate Irrigation Farm using Different Models. 2015.
14. Zewdu S, Suryabhagavan KV, Balakrishnan M. Geo-spatial approach for soil salinity mapping in Sego Irrigation Farm, South Ethiopia. Journal of the Saudi Society of Agricultural Sciences. 2017; 16: 16-24.
15. Abrol IP, Yadav JSP, Massoud FI. Salt-affected soils and their management. FAO Soils Bulletin. 1988.
16. Wang BY, Nii N. Changes in chlorophyll, ribulose bisphosphate carboxylase-oxygenase, glycine betaine content, photosynthesis and transpiration in Amaranthus tricolor leaves during salt stress. The Journal of Horticultural Science and Biotechnology. 2015.
17. Zaman M, Shahid SA, Heng L. Guideline for Salinity Assessment, Mitigation and Adaptation Using Nuclear and Related Techniques. 2018.
18. Maas EV, Grattan SR. Crop Yields as Affected by Salinity. 2015; 38: 55-108.
19. Qureshi AS, Al-falahi AA. Extent, Characterization and Causes of Soil Salinity in Central and Southern Iraq and Possible Reclamation Strategies. Int. J Engineer Res Appl. 2015; 5: 84-94.
20. Meron N. Characterization of salt affected soils in the Central Rift Valley and assessing salt tolerance of different plants: A case study at the southwestern shore of Lake Zeway. 2007.
21. Munns R, Tester M. Mechanisms of Salinity Tolerance. Annual Review of Plant Biology. 2008; 59: 651-681.
22. Bernstein L. Effects of Salinity and Sodicity on Plant Growth. Ann Rev Phytopathol. 1975; 13: 295-312.
23. Hirpara KD, Ramoliya PJ, Patel AD, Pandey AN. Effect of salinisation of soil on growth and macro- and micro-nutrient accumulation in seedlings of Butea monosperma (Fabaceae). Anales de Biología. 2005; 27: 3-14.

24. Letey J, Hoffman GJ, Hopmans JW, Grattan SR, Suarez D, Corwin DL, et al. Evaluation of soil salinity leaching requirement guidelines. Agricultural Water Management. 2011; 98: 502-506.

25. Kaledhonkar MJ, Meena B, Sharma PC. Reclamation and Nutrient Management for Salt-affected Soils Reclamation and Nutrient Management for Salt-affected Soils. Indian Journal of Fertilisers. 2019; 15: 566-575.