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Status of the Salt and Alkalinity Intrusion from the Lake Abaya to Agricultural Lands

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Abstract

Salinity and alkalinity intrusion from the lake to agricultural land of shore is one of the major environmental issues throughout the world. This research was conduct to assess the intrusion effect of Lake Abaya to the agricultural land. To analysis status of soil salinity and alkaline due to Lake Abaya intrusions, one hundred soil samples were collect by Auguring method at the 30cm depth of soil along the field. Those soil chemical properties were analysis in Arba Minch university water supply and sanitary laboratory according different standards. The average soil pH value, electric conductivity, organic matter and organic carbon were 8.06, 1.04ds/m, 1.45% and 0.84%, respectively. The average cation concentration of sodium, magnesium, calcium and potassium were 17.64mg/l, 6.94mg/l, 5.5mg/l and 5.4mg/l, respectively. Generally the the intrusion of soil salinity and alkalinity from the the lake abaya to agricultural land was too high that show the land need soil reclamation in order to decrease soil PH and electric conductivity.

Key words: Lake Abaya, Soil pH, Soil Electric Conductivity, Soil Macronutrients

INTRODUCTION

Salinity and alkalinity intrusion from the lake to agricultural land of shore is one of the major environmental issues throughout the world (S. Dasgupta, et al., 2015). Saline soils mainly contain soluble salt components including cation such as calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}), (Dubey, 2018) and anion such as chloride (Cl^{-}), bicarbonate (HCO^{3}), or sulfate (SO_4^{2-}) (Hasegawa et al., 2000) and high salinity in the soils usually causes the phenomenon of sodicization that contains a high accumulation of salt hinders crops growth.

Saline soils with high salt concentration also lead to unfavorable physical, chemical, and biological properties (Abrol et al., 1988) and saline soils contain high levels of Na^{+} ions in the soil's absorption complex, causing disturbance and imbalance in the uptake of water and nutrients for crops and disadvantages in soil physical properties (Ağar , 2011).

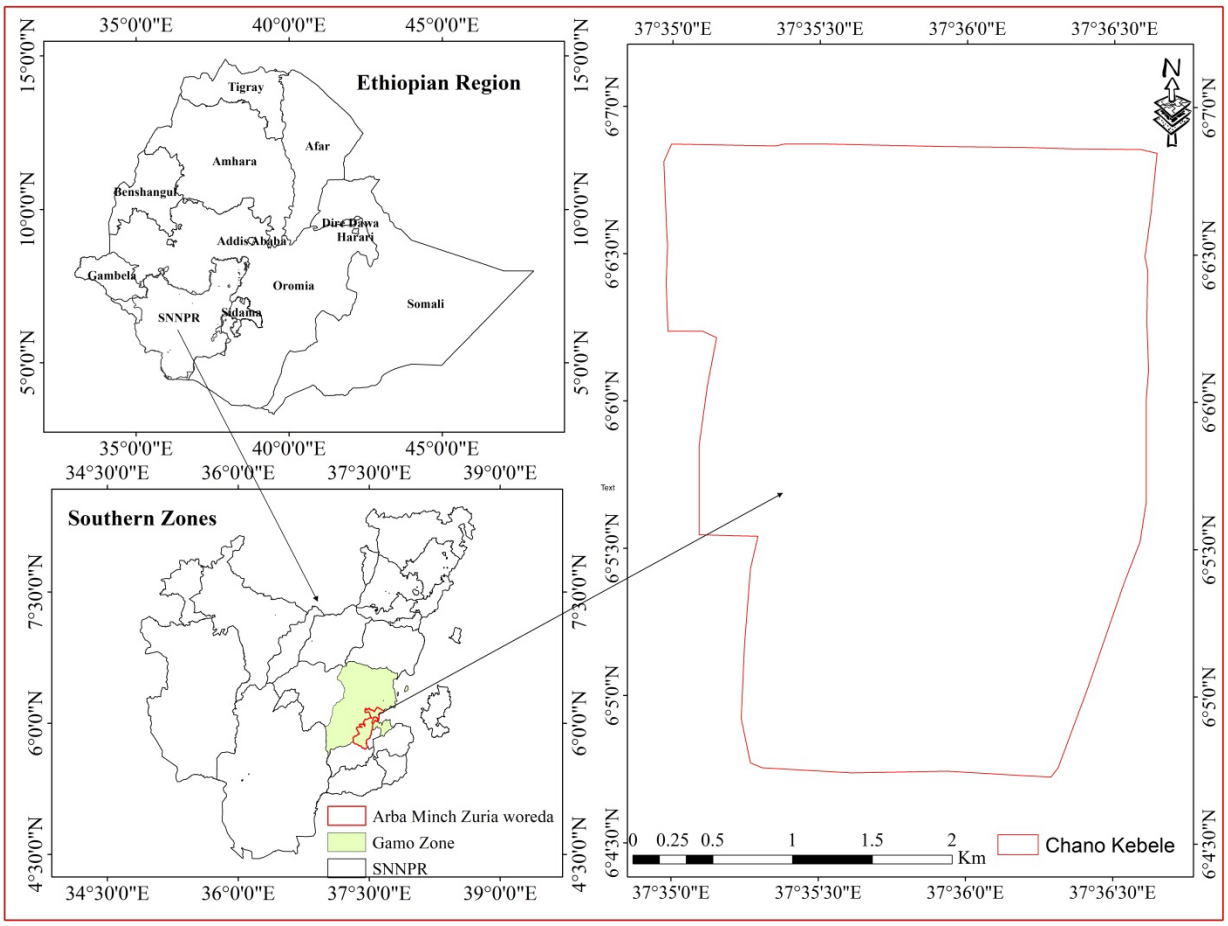
Soil alkalinity (sodicity) and salinization is a major hazard for land degradation, having an impact on a number of soils functions, in particular, a direct negative effect on soil biology and organic matter dynamics, and an indirect effect leading to loss of soil stability through changes in soil structure (Daliakopoulos, et al., 2016).

Soil quality degradation due to salinity and alkalinity accumulation are the major problem in Ethiopia has demonstrated to the extent that farmers are experiencing huge crop losses while many farms lands have gone out of production over the last decade (Asad et al., 2019). The salinity problems are now spread over a range of landscapes, irrigated lands, rain-fed farming areas and rangelands in the country (Qureshi, 2017). Similarly large amount of agricultural land near the Lake Abaya was out of production and land productivity decrease rapidly years to years. Additional crop wilting and yellowish color of plant leaf was observed in the area. Therefore this research will conduct to assess salinity and alkalinity intrusion from the lake to the agricultural land s of coastal area and to suggest possible mitigation measure.

MATERIAL AND METHODOLOGY

Description of the Study Area

Chano kebele is located between 6° 3' 18" north latitude and 37° 54'40" east longitudes of Gamo zone, south nation, nationality, and people's regional state, Ethiopia. The average elevation of the scheme is 1200m above the mean sea level.



Sampling techniques

Representative sampling techniques was used to select representative site on a field. A chemical property of soil has been computed through the laboratory and used to show the levels of salinity and alkalinity intrusion to agricultural lands on soil fertility by relating to the optimum level of each parameter. Soil samples were collected at agricultural areas that found near the Lake Abaya. Collected soil sample were dry at the shadow area without sunlight to minimize losses of soil nutrients. After drying of this soil sample it was sieved in soil mechanics laboratory by 2mm sieve size. Soil was sampling by composite sampling techniques to analyze soil within the average value. Soil was collected at all corners and middle of the plot and that sample was mixed.

Soil PH value

The PH value of the soil is used to show the acidity and alkalinity of soil on the research area because the nutrient availability of soil is governed by this soil PH value of soil. To determine this value 10g of distilling water and 25 gm of sieved soil was mixed and digital PH meter was calibrated with buffer solution. Then after PH value of soil was measured at the ratio 1:1.25 distill water to the sieved soil from Arba Minch university chemistry laboratory.

Soil salinity

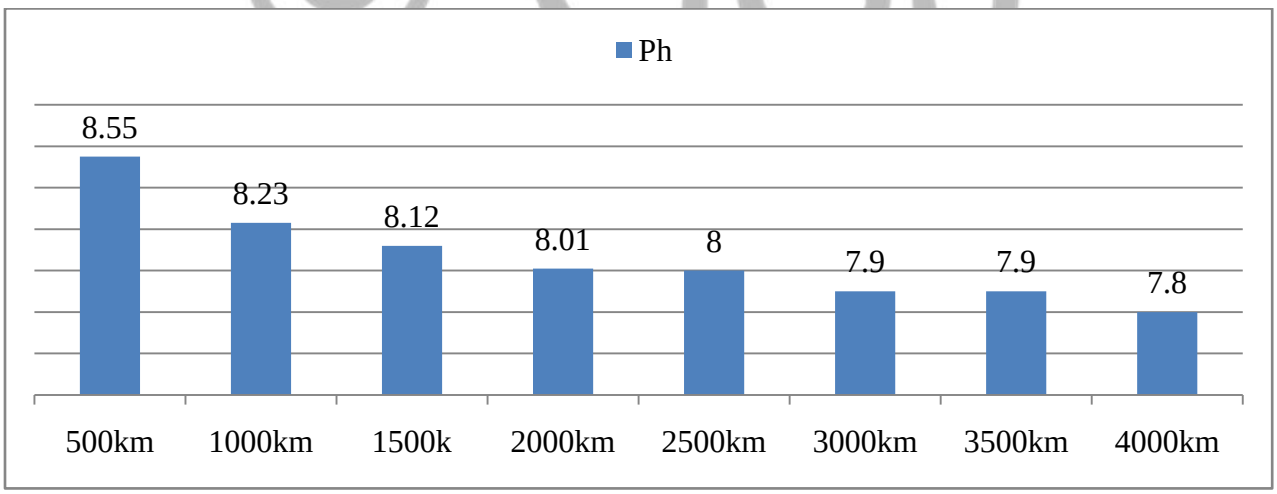
To evaluate electrical conductivity of the soil 10gm of distilling water mixed with 50 gm of sieved soil. The digital EC meter was calibrated with a buffer solution at a constant temperature of 28℃. Then EC of soil was measured at the ratio 1:5 distill water to the sieved soil from Arba Minch university chemistry laboratory.

Soil macronutrient

Based on (Cheng and Bray, 1951) (Cheng & Bray,1951) as cited in (Motsara and R.N. Roy, 2008) exchangeable cations were determined in a neutral normal ammonium acetate extract of soil. Extraction was carried out by shaking the soil-extractant mixture, followed by filtration or centrifugation. Potassium and sodium were determined by flame photometer and calcium and magnesium also determined by the EDTA titration method after the removal of ammonium acetate and OM. That availability macronutrient of soil such as (Mg^{+}, Na^{+}, $K^{+,}$ and Ca^{+}) were extracted from Arba Minch university chemistry laboratory. Magnesium ion cannot estimate separately in the laboratory but it can estimate with calcium ion.

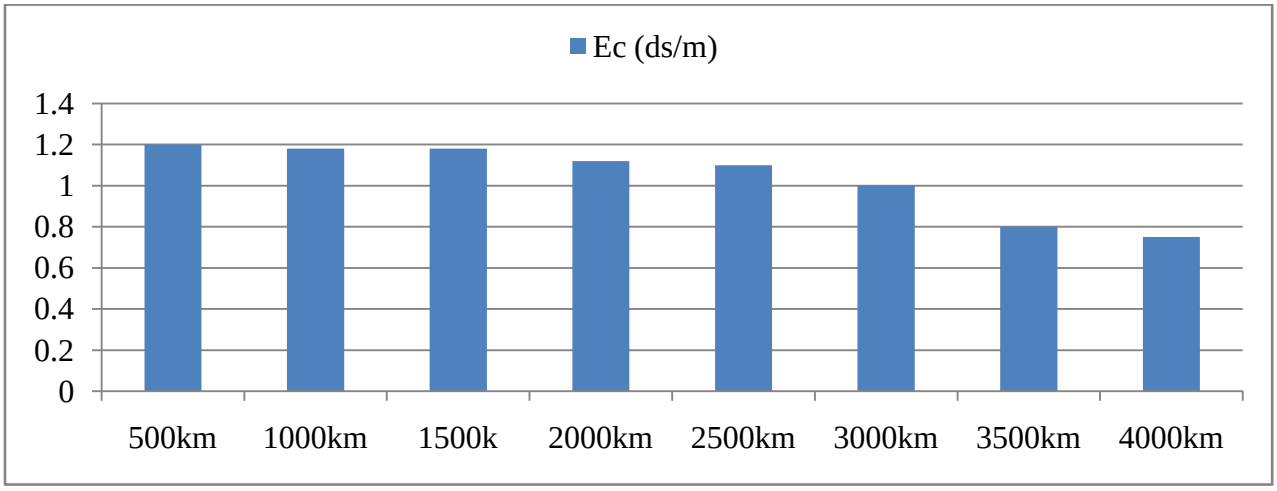
RESULT AND DISCUSION

Soil pH value increase toward the Lake Abaya and decrease away from the lake that inducts intrusion of alkaline elements from the lake to agricultural land are too much and this high value pH value shows accumulation of alkaline elements.



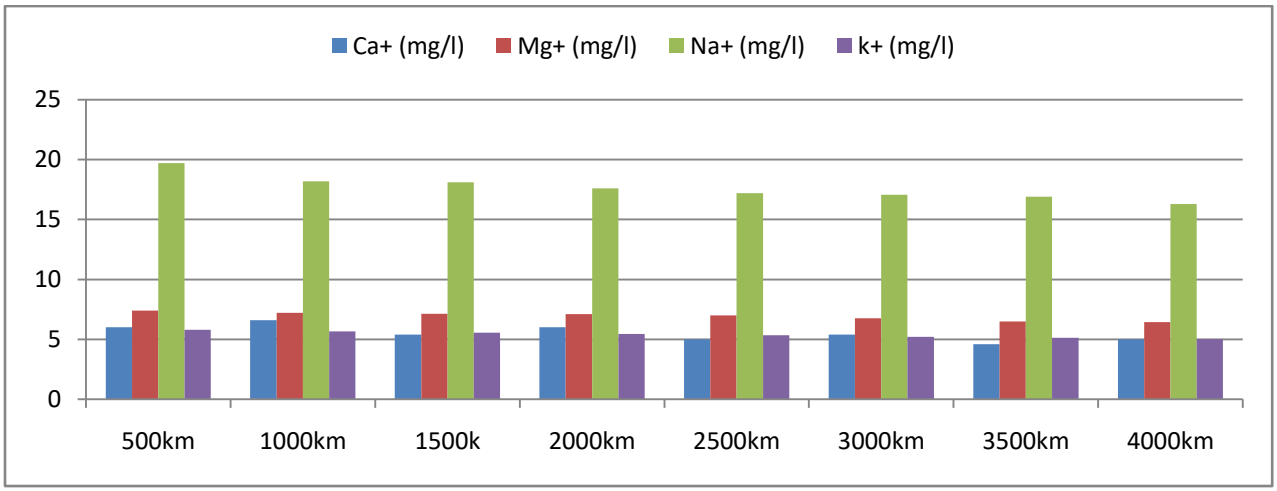
Soil electric conductivity

Salinity content of the soil also increases toward the Lake and decrease away from the lake and this high content of soil salinity decrease crop production and soil fertility quality.



Soil macronutrient

The alkaline or macronutrient very high especially concentration of sodium ion too high compare with other ions. These excess alkaline ion accumulations are reduced quality of soil fertility by increasing sodium absorption ration or exchangeable sodium ratio.



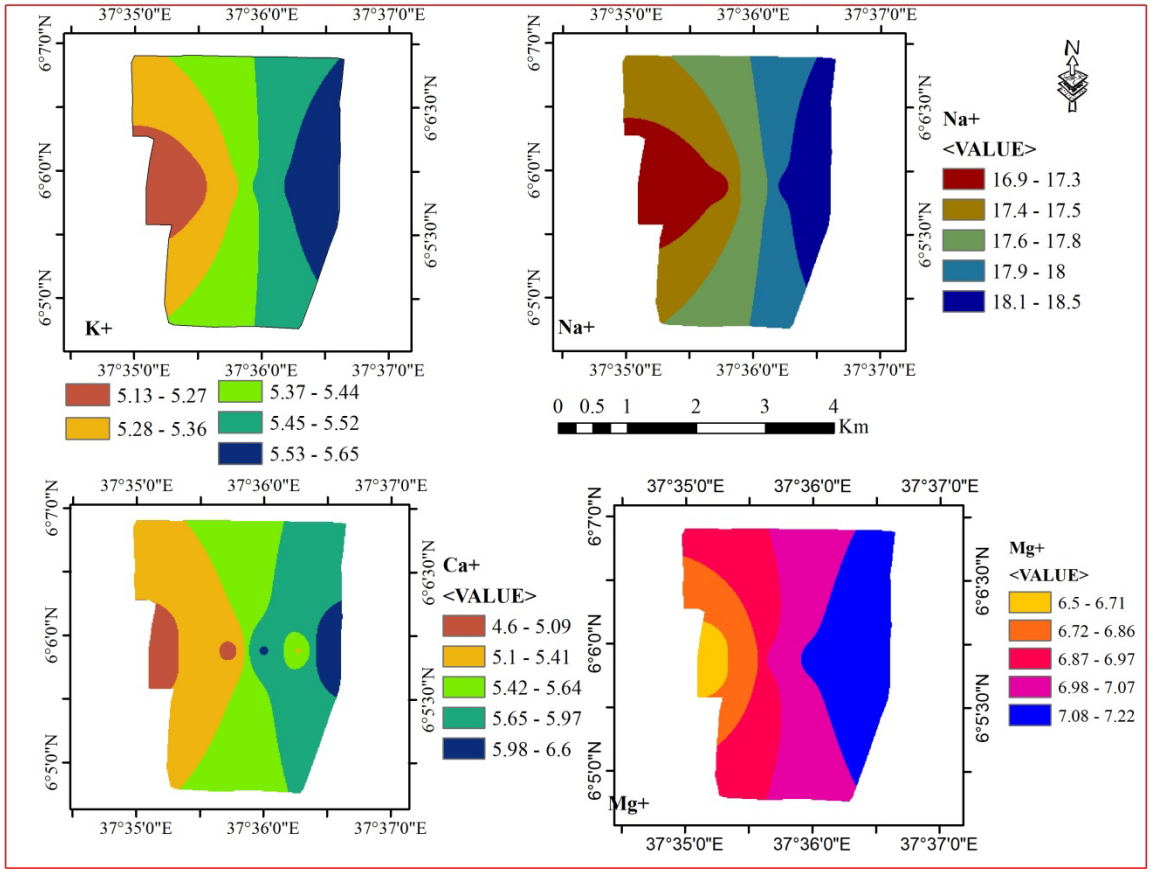
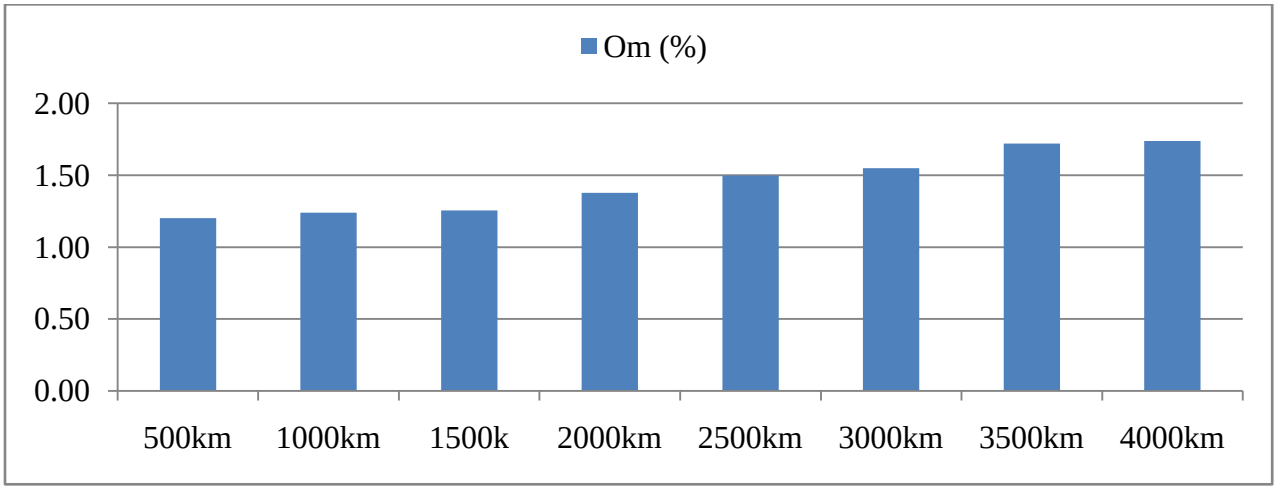
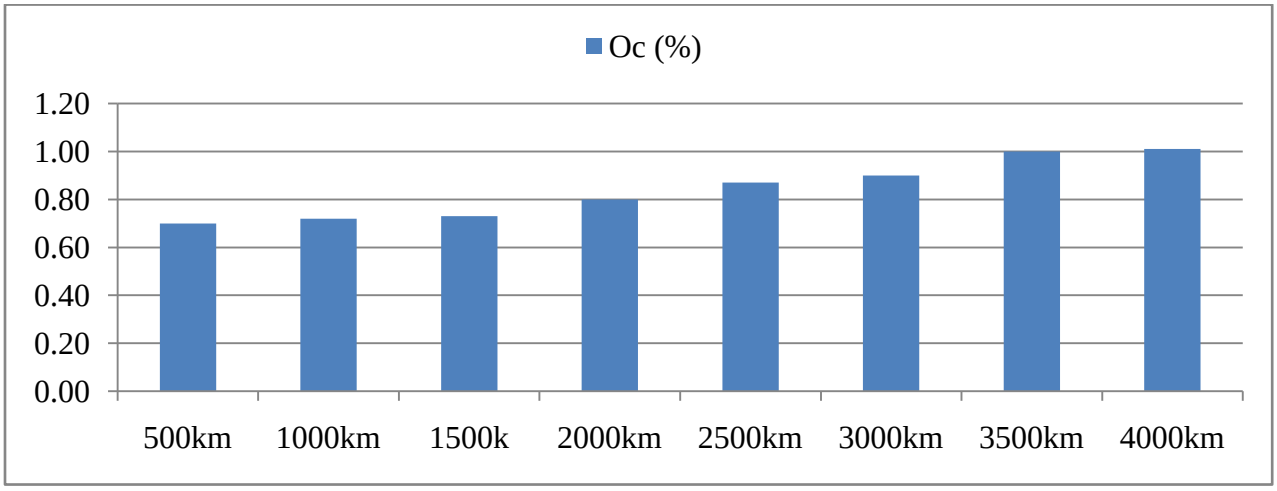


Figure 1 Soil Macronutrient

Soil organic matter and carbon

As discussed in the following figure soil organic matter and organic carbon increase away from the lake and increase toward the lakes because excess alkaline element such as sodium decrease content of organic matter and carbon.





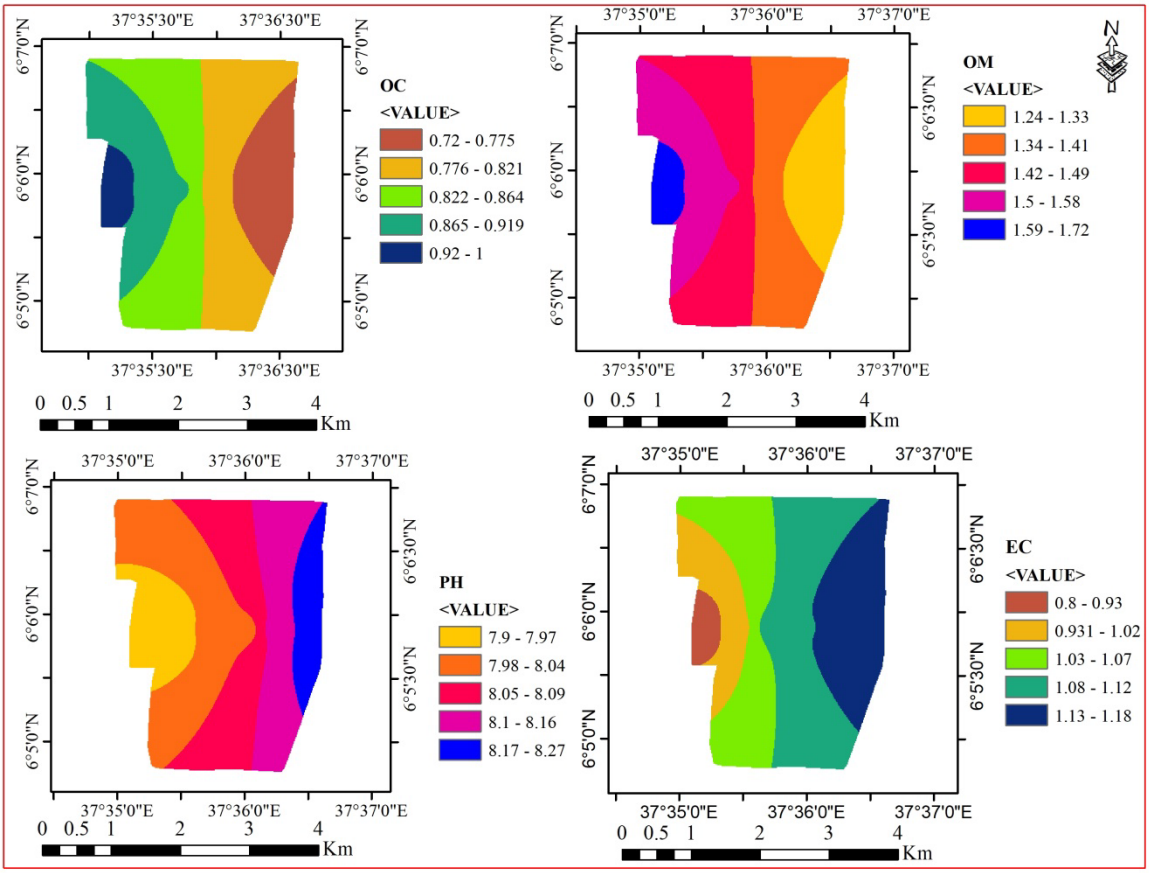


Figure 2 Soil Organic matter

CONCULSION AND RECOMMENDATION

Soil salinity, alkalinity, macronutrients and organic carbon were very high near the lake decrease away from the lake and organic matter also very low near the lake in increase away from the lake. This result shows the intrusion of salinity and alkalinity from the lake very high and the lake water have high content of alkaline nutrients. Therefore, to increase land productivity of the area that found near the abaya lake land reclamation to be important by decreasing soil pH value.

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