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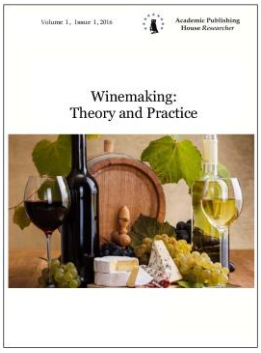

Articles and Statements

UDC 574

Research on the Salinity Level of Alazani Valley Soils and Their Impact on Agrobiodiversity of the Region

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Abstract

The research reviews the dynamics of change of the saline soils of the Alazani valley (village Dzveli Anaga) and the salinity level of vineyard and grassy soils. In 2016, the amount of dry sediment in vineyard soils was ranging between 0.185-1.180, in 2017 between 0.200-0.688 %. At one-meter depth, the vineyard soil is more saline in lower horizons and belongs to the moderately saline category. The grassy soil belongs to the category of moderately saline and strongly saline in deeper layers. In 2016, the dry sediment was ranging between 0.284-1.065, in 2017 between- 0.548-1.044 %. SO_4^{-2} ions are dominating which means that the soil is sulphate saline. Then come Na^+, Ca^{+2}, Mg^{+2}, HCO_3^- and Cl ions. The amount of Na and Ca exceeds the amount of Mg ions which is a sufficient condition to contain Na_2SO_4 and $CaSO_4$ in these soils.

Based on the research data, recommendations can be given to the trial plots to decrease the salinity level, increase the soil fertility and maintain biodiversity.

Keywords: the Alazani Valley, degradation, saline soils, dry sediment.

1. Introduction

Global climate changes have important influence on the development of Agriculture in Georgia-intensified natural disasters (floods and torrents) affect the biodiversity and fertility of soil, cause soil degradation.

East Georgian landscapes are sensitive to climate changes and on most of its area, the average annual temperature has increased by 0,6°; droughts are increased. Rainfall in those area does not exceed 200-250 mm, which is only 50-200mm of the productive soil moisture supply in 1m deep soil.Due to the intensified droughts, caused by the global warming, the natural landscapes have undergone transformation (Elizbarashvili et al., 2013; Elizbarashvili, Elizbarashvili, 2005). 3000 m2 territory in the South-East Georgia, situated in semi-desert area, is constantly being destroyed by droughts and wind erosion and turns it into desert landscape. Examples of

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desertification are Kiziki and several regions in outward Kakheti and Kvemo Kartli – 120 000 ha land in Dedoplistskharo and 47 000 ha in Signagi and Sagarejo municipalities each.

2. Materials and Methods

Seasonally, in 2016-2017, we took samples of soil from the area of village Dzveli Anaga, Signagi municipality. The samples were taken from two spots at the left bank of Kvemo Alazani irrigation canal, within the distance of 500 and 1500 meters. The plot №1 – was an irrigated vinery with drainage and plot №2 – a grassy area. The samples were taken once in a quarter at the depth of 0-20 cm, 20-40 cm, 40-60 cm, 60-80 cm, 80-100 cm and once a year at the depth of 0-100 cm.

The samples of soil were processed in the lab of Ecology at the Institute of Hydrometeorology of the Georgian Technical University. The samples were dried, all the contaminants were removed, grinded, sifted through 1mm mesh sieve and weighed to prepare water extract. The water extract was tested to define the following indices: pH, Na^{+}, K^{+}, Ca^{+2}, Mg^{+2}, CL^{-}, SO_4^{-2}, CO_3^{-2} HCO_3^{-} and dry sediment (Shavliashvili et al., 2014).

The test methods of the International Standards Organization (ISO) were applied to define the above mentioned parameters. To assess the soil salinity level, we refer to V.Chkhikvishvili gradation scale (Gogoberidze, 1984).

3. Results and discussion

Signagi municipality is situated in Kakheti, East Georgia. It covers the slopes of Gombori mountain ringe and Alazani plain. The area is characterized by intense droughts, rare rainfalls and high temperature which reduce the soil moisture and create unfavorable conditions for the plants. The area is poor with water resources and atmosphere precipitation. The average temperature in summer is 35^{o}-40^{o}C which leads to droughts if it maintains for a long period. The global warming increases draught in dry areas, intensifies evaporation, soil salinity, quick mineralization and the lost of arable land (Fomin, Fomin, 2001). Saline and alkali soils occurring on Alazani Valley (Sauth-East part), are examples of degraded soils. Their total area comprises more than 205 thousand hectares of Georgia and 54 000 hectares of Signai municipality (Gogoberidze, 1984, Chkhikvishvili, 1960).

Salinity of soils affect the regions biodiversity and endemic species. We considered it important to study the dynamics of changeability of the chemical composition in the saline soils in Alazani Valley and the salinity level in 2016-2017.

The tests were done in the irrigated vineyards with drainage (plot №1) and grassy area (plot №2) in village Dzveli Anaga, Signagi region. We studied the total amount of dry sediment – easily soluble salts to the depth of 0-100 cm on both plots. The test results are given in drawing 1, 2. According to them, the pH of the soil in plot №1 is neutral and ranges between 7.10 – 7.20. The soil in plot №2 tends to be more alkaline and ranges between 7.40-7.80.

According to the test results (figure 1), the soil in plot №1, which is vineyard soil, belongs to the category of non saline soils though with certain salt content at the depth of 60-80 cm. The amount of dry sediment ranged between 0.185-1.180 in the year 2016 and ranges between 0.200 – 0.688 % in 2017. Salinity increases at a depth of about one meter in the vineyard soils and it is washed down to the lower horizons. These horizons belong to the category of moderately saline soils. We think, that the increase of the dry sediment in the soil is conditioned by the atmospheric precipitates, salt solubility and migration to the deeper layers of the soils. The analyses of the graphs show that the amount of the dry sediment in Dzveli Anaga vineyard soils in 2017, is reduced compared to the year 2016.

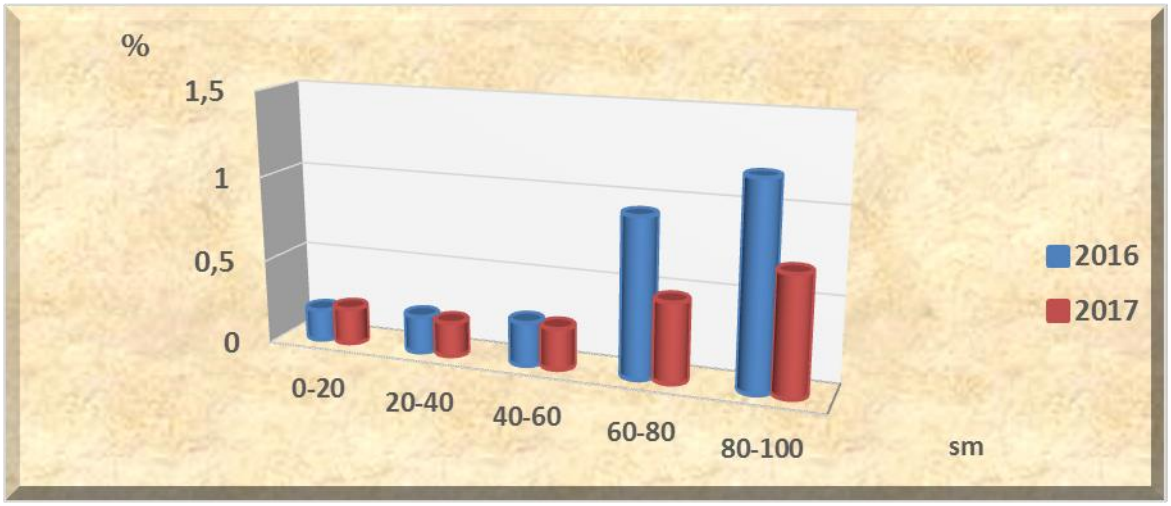

Fig. 1. Dry sediment. Vineyard

There is a different picture on the second plot, where the soil is covered by grass and is used as pasture (figure 2). The soils belong to the category of moderately saline and strongly saline in the depth. In 2016, the dry sediment was ranging between 0.284 – 1.065 and in 2017 between 0.548 – 1.044 %. In 2016, the amount of dry sediment in the grassy soil, increased at the depth of 60-80 cm. It can be said that in 2016 and 2017, its amount in the depth was more or less the same. These soils undergo influence of hydrometeorological factors, especially precipitation and evaporation. Due to their high salinity, they are not influenced by Agricultural activities (farming, irrigation, etc).

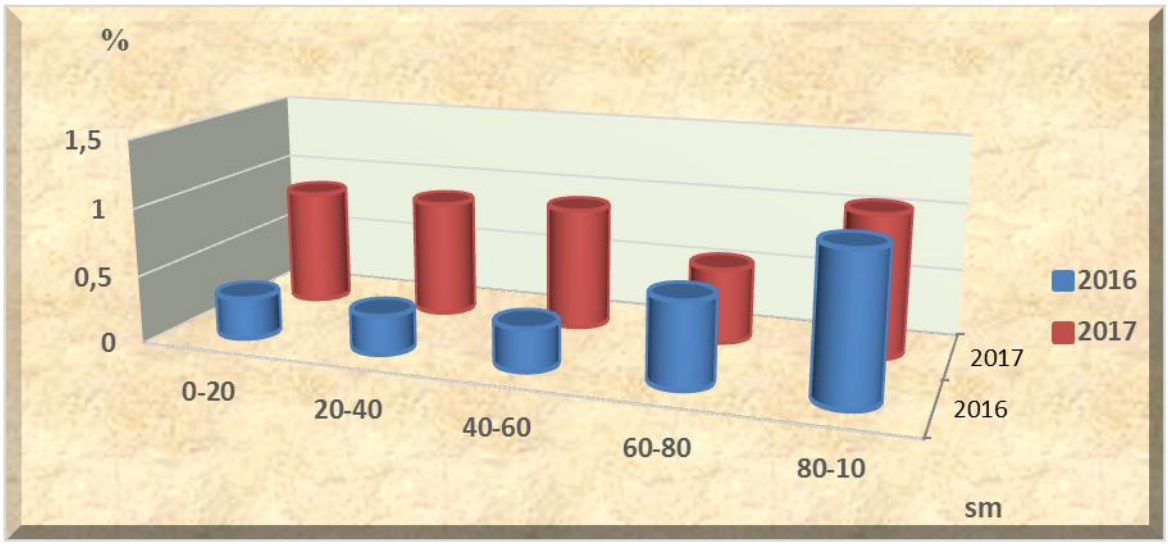

Fig. 2. Dry sediment, Grass

The figures 3-6 are for the graphs showing the composition of anion/cation (90-100 cm deep) in vineyard and grassy soils in Dzveli Anaga for the month of March, 2016-2017. Based on the analysis of the graphs, SO_4^{-2} ions are dominating everywhere which means that salinity is sulphate type. Then come Na^+, Ca^{+2}, Mg^{+2}, HCO_3^-, Cl^- ions. The amount of Sodium and Calcium exceed the amount of Magnesium ions which causes composition of Sodium (Na_2SO_4) and Calcium ($CaSO_4$) sulphates in these soils. The soil profile contains almost equal amount of Calcium and Sodium ions. The least was the amount of Chlorine ions.

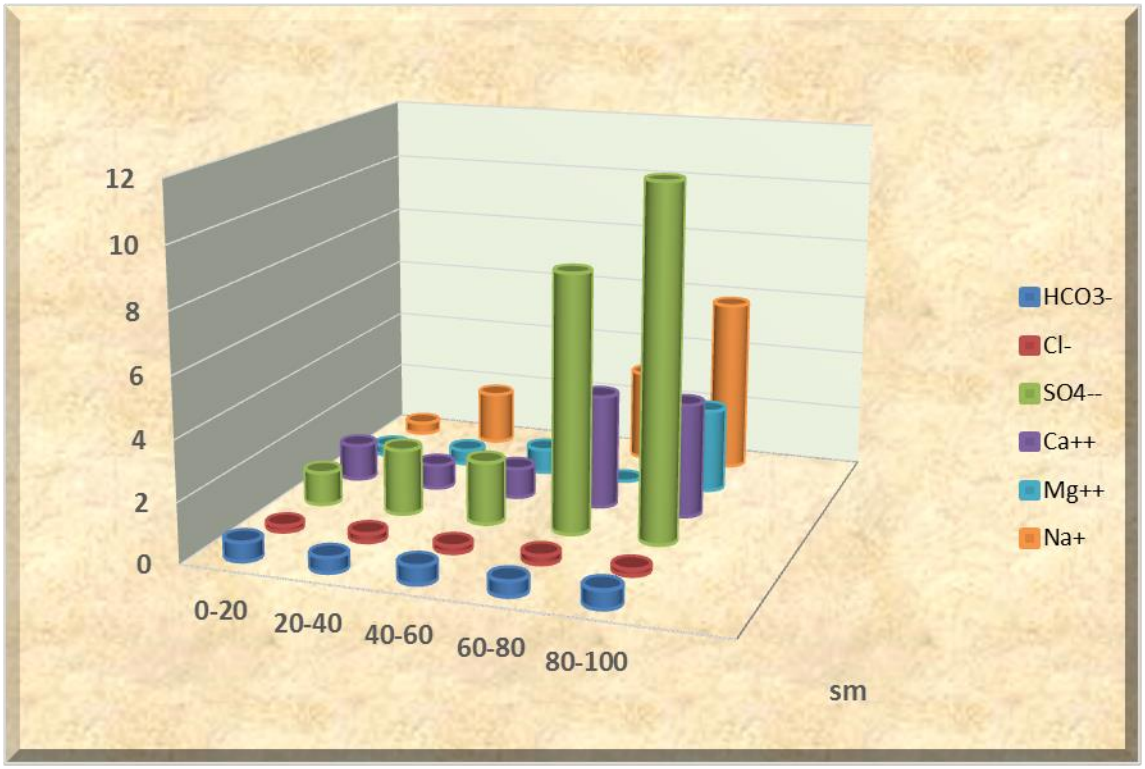

Fig. 3. Ion composition (Dzveli Anaga, vineyard) 03.2016

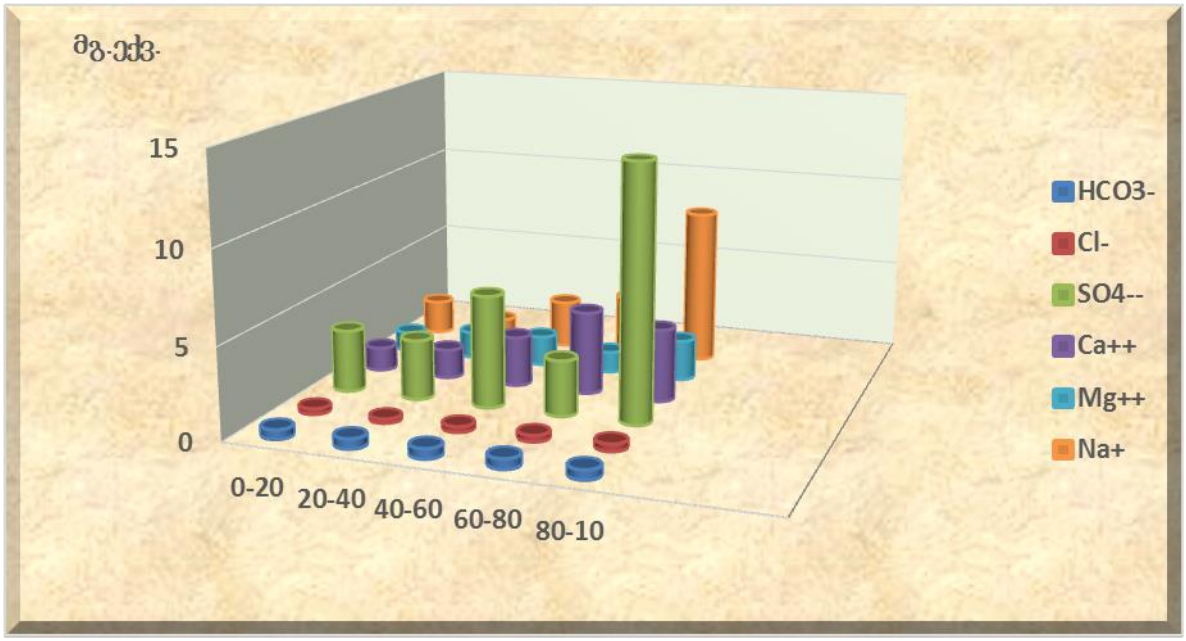

Fig 4. Ion composition (Dzveli Anaga, grass) 03. 2016

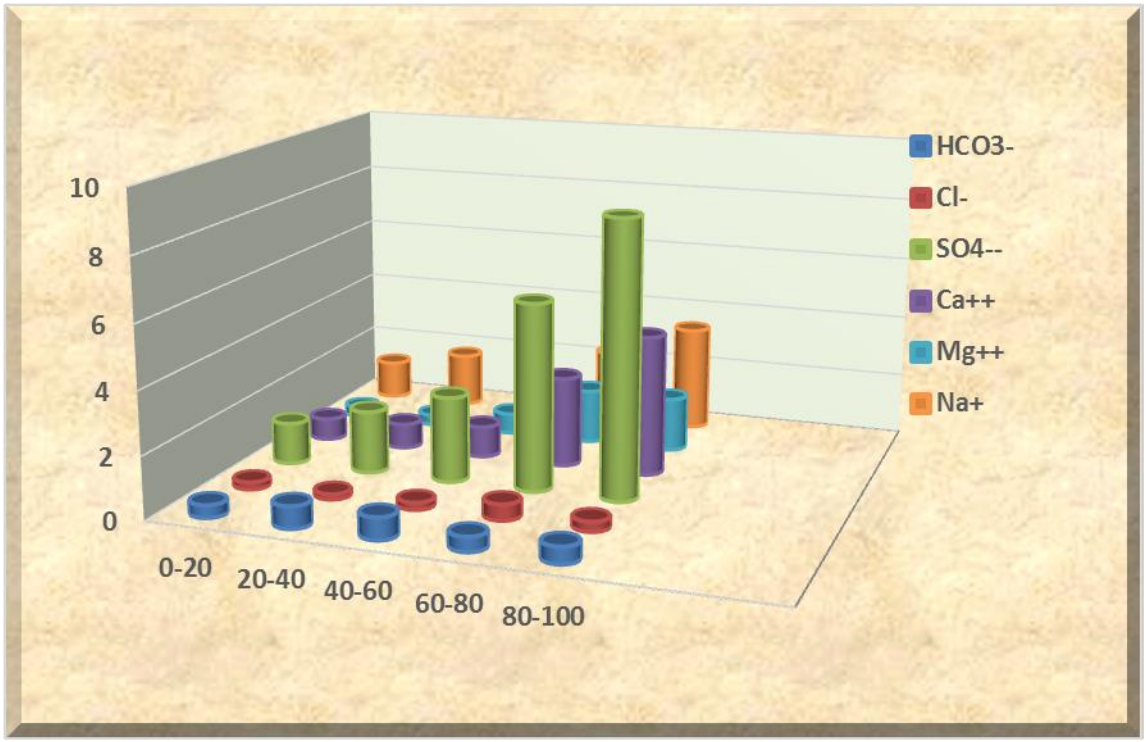

Fig. 5. Ion composition (Dzveli Anaga, vineyard) 03. 2017

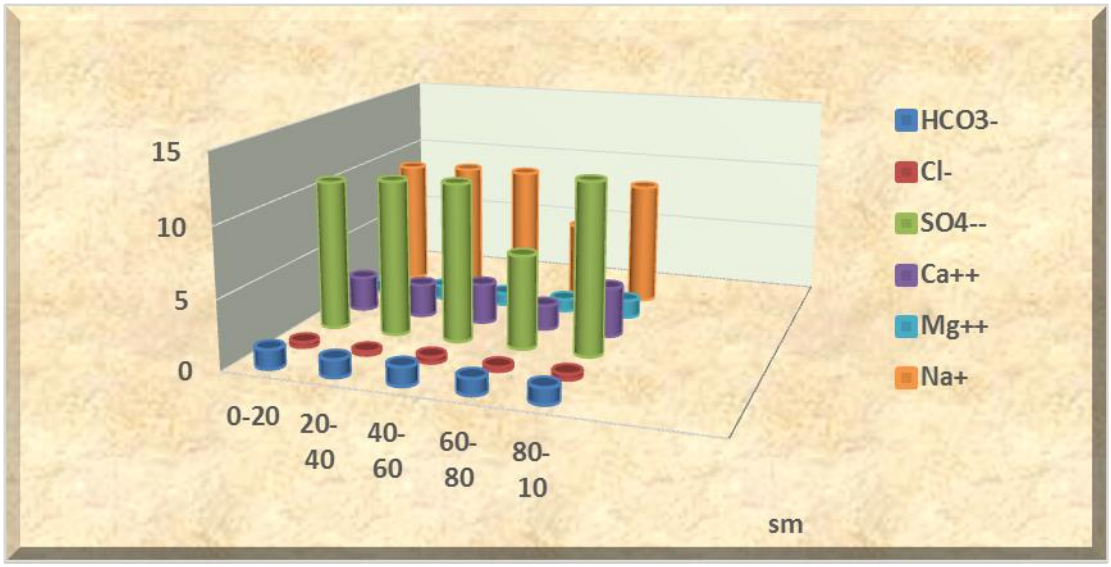

Fig. 6. Ion composition (Dzveli Anaga, grass) 03. 2017

It is known that saline soils are less fertile. High concentration of soluble salts in soil solution blocks flow of water to the plants which leads to their devastation. The crops growing on saline soils have metabolic disorder, nutrient deficiency problems, delay in normal growth, especially at the early stage, photosynthesis becomes limited and it leads to the loss of the plants' reproductive capacity (table 1). The level of toxicity of salts is measured by their composition and solubility. The greater the solubility of salts, the higher is their toxicity. The toxicity level varies from sulphate to saline sodic.

Table 1. Levels of Soil Salinity and Conditions of Agricultural Crops

Levels of soil salinity	Condition of moderate salinity resistant plans
Practically non-saline soils (or slightly saline)	Good growth and development (normal yield)
Slightly saline	Slight suppression (decrease in yield by 10-20%)
Moderately saline	Moderate suppression (decrease in yield by 20-50%)
Strongly saline	Strong suppression (decrease in yield by 50-80%)
Alkali soils	Only certain plants survive (no crop)

The global climate changes made it urgent for every country to work out an adaptation strategy and implement it for maintaining biodiversity. From this point, it is very important to improve irrigation systems in research regions, introduce biotechnologies (drought-resistant and slat-resistant species), create windbreak zones, make scientific reasearches in Agriculture and other. All these will have a positive impact on the process of maintaining biodiversity.

4. Conclusion

Based on the research results, we can conclude that the chemical composition and salinity level of saline soils in Dzveli Anaga, Alazani valley, vary in vineyard and grassy soils. The amount of dry sediment in vineyard soil was higher in 2016 than in 2017. In a one-meter thick vineyard soil, the salinity is increasing in lower horizons and in the deep, they are moderately saline. The grassy soils belong to the category of moderate salinity and strong and very strong salinity in the depth. A study, made on composition of ions, showed that SO_4^{-2} ions dominate everywhere which means that the salinity is of sulphate type.

Salinization and alkalization processes decrease the soil fertility of the Alazani Valley area (village Dzveli Anaga). The soil salinization process might be connected to the erosion of salt rocks, mineralized groundwater and other factors. All these have negative impact on the local agrobiodiversity.

The research findings give opportunity to give proper recommendations to trial plots to reduce the soil salinity and increase the soil fertility for maintaining the biodiversity.

References

Chkhikvishvili, 1960 – *Chkhikvishvili V.* (1960). Saline Soils of East Georgia and their Agricultural Characteristics. “Soviet Georgia”, Tbilisi, p. 117.

Elizbarashvili et al., 2013 – *Elizbarashvili E.S., Tatishvili M.R., Elizbarashvili M.E., Elizbarashvili S.E., Meskhia R.S.* (2013). Tendencies of Changes of Air Temperature due to the Global warming. Meteorology and Hidrology, № 4, pp. 29-36.

Elizbarashvili, Elizbarashvili, 2005 – *Elizbarashvili E.S., Elizbarashvili M.E.* (2005). Possible Transformation of Natural Landscapes in Caucasus due to the Global Warming. Meteorology and Hidrology, № 10, pp. 53-57.

Fomin, Fomin, 2001 – *Fomin G.C., Fomin A.G.* (2001). Internation Standards of Soil, Quality Control and Ecological Safety. Moscow, RSRI standards. p. 300.

Gedevanishvili, Talakhadze, 1981 – *Gedevanishvili D., Talakhadze G.* (1981). A Course of Soil Science. Tbilisi, p. 370.

Gogoberidze, 1984 – *Gogoberidze I.* (1984). Saline Soils of East Georgia. “Tsodna”, Tbilisi. p. 24.

Shavliashvili et al., 2014 – *Shavliashvili L., Kordzakhia G., Elizbarashvili E., Kutchava G., Tughushi N.* (2014). Degradation of Alazani Valley Saline Soils Due to Climate Changes (monography). Publishing house "Universal", Tbilisi, p. 182.