SPATIAL VARIABILITY OF SOIL PROPERTIES IN SOILS OLIVE GROWING IN SULAIMANYAH IRAQ

Tavan Kamil AHMED

Master Thesis

Department of Soil Science and Plant Nutrition

Supervisor: Assoc. prof. Dr. Abdulkadir SÜRÜCÜ

2017

REPUBLIC OF TURKEY
BINGOL UNIVERSITY
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This thesis was unanimously approved by the following jury on 16/01/2017

Assoc.Prof. Dr. Abdulkadir SÜRÜCÜ	Prof. Dr. Recep GÜNDOĞAN	Prof. Dr. Alaaddin yuksel
President of the Jury	**Member**	**Member**

I confirm the results above

prof. Dr. İbrahim Y. ERDOĞAN

Director of the institute

PREFACE

First and foremost, I thank God for giving me the oppertunity and allowing me to go so far in this wonderful journey.Then, my sincere gratitude goes to my supervisor, Prof. Dr. Abdulkadir SÜRÜCÜ for his unwavering encouragement, support and mentorship, which have been invaluable to me through out the entire journey of my research. I appreciate Bingol University for funding my research project BPA-ZF 2016.00.001. I am grateful to the faculty of Agriculture, especially Assoc. Prof. Dr. Ali Riza DEMIRKIRAN and Prof. Dr. AlaaddinYUKSEL. I also direct a special thanks to Assist. Prof. Dr. Veysel TURAN for his comments and corrections. Also to Assist. Prof. Dr. Yasin DEMIR and Kadriye ATAŞ, for their willingness to help me during my stay in the department. I would love to thank Assist. Prof. Dr. Nurullah ACİR for designing the mapping and Prof. Dr. Akram O. ESMAIL from Salahaddin University, Erbil, for allhis help and assistance. My sincere thanks goes to the ministry of agriculture, general director agriculture - plant protection department for all their help and support. In addition, I would like thank my dear friends, Bakhtyr and Sarkawt TAHA, for their help in collecting soil sample; and all of my other friends for their kindness, help, supporte during my masters degree. Finally, I would like to thank my amazing family for their continuous encouragement and support throughout my study. I dedicate this work to the soul of my mother. I all so dedicate this to my parents and my sister Tarza Kamil. This thsesis project was funded by BAP- ZF 2016.00.001.

Tavan kamil AHMED
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LIST OF SYMBOLS

SYMBOL	: DESCRIPTION
D.W	: Distilled water
pH	: Potential of Hydrogen
EC	: Electrical Conductivity
OM	: Organic Matter
$CaCO_3$	: Calcium Carbonate
P_2O_5	: Penta Oxide of phosphorus
EDTA	: Ethylene Diamine Tetra Acetic Acid
Na^+	: Exchangeable Sodium
K^+	: Potassium
Ca^{2+}	: Calcium
Mg^{2+}	: Magnesium
CEC	: Cation Exchange Capacity
DTPA	: Diethylenediamine Penta Acetic Acid
Fe	: Iron
Zn	: Zinc
Mn	: Manganese

Cu	: Copper
C_o	: Nugget
C_o+C	: Sill
M	: Meter
Cm	: Centimeter
Kg	: Kilogram
G	: Gram
Ha	: Hectare
meq	: Miliquivalent
Ppm	: Parts Per Million
Mm	: Milli meter
GPS	: Global Positioning System
%	: Percentage
°C	: Degree Celsius
$K_2Cr_2O_7$	: Potassium Dichromate
H_2SO_4	: Sulfuric Acid

IRAK SÜLEYMANIYE'DE ZEYTIN YETIŞTIRILEN TOPRAKLARDA TOPRAK ÖZELLIKLERININ MEKANSAL DEĞIŞKENLIĞI

ÖZET

Bu çalışma, Güneydoğu Süleymaniye bulunan Halepçe'deki zeytin bahçesi toprağının mekansal değişkenliğini belirlemek için 2016 yılında boyunca yürütülmüştür. Bu çalışmanın amacı, herhangi bir peyzajda toprak özelliklerinin mekansal değişkenliğinin, toprak özelliklerinin mekansal heterojenitesinin nasıl iyi kurulmuş olduğu gerçeğini araştırmaktır. Yanal ve dikey değişkenlik, toprak oluşum faktörlerinin, yani iklim, bitki örtüsü, topografik durum, ana materyalin ve zamanın etkisiyle ortaya çıkmaktadır. Çalışma alanı 100 hektardı, mekansal dağılım haritaları yapmak ve toprakların kimyasal ve fiziksel özelliklerini belirlenmesi için 116 toprak numunesi alındı. Dağılım örüntüleri, mekansal analizin incelenen toprak özellikleri için dağılım modelleri gösterdiğini gösterdi. Çalışılan toprak örneklerin çoğunun tekstürü, killi tın tekstürlü olan 5 numune haric, killidir. İncelenen toprak numunelerinin pH değeri 7.09 – 8.40 arasında değişirken, EC aralığı 132'den 966 mmhos / cm atasında olup tuzlude ğildir. Organik madde içeriği, $CaCO_3$ ve CEC değer aralığı % 0.88 -% 3.23, % 6.93 -% 20.82 ve 47.38 - 88.22 cmolc.kg – toprak idi. Çalışılan toprak numunesinin P içeriği 0.12 ile 12.80 kg / ha arasında değişirken, değişebilir Ca, Mg, K ve Na sırasıyla 26.07 ile 52.20, 1.86 ile 35.41, 9.90 ile 20.41 Ve 0,31 ile 6,74 meq / 100 gr topraktı. İncelenen toprak numunelerinin Fe, Zn, Mn and Cu içeriği sırasıyla 1.06-20.7, 0.33-1.74, 5.87-24.63 ve 0.56-1.23 ppm'dir.

Sonuçlar, jeoistatistiksel yöntemlerin küresel ve üstel değişkenogram modellerinin tüm bu zemin özelliklerine en iyi uyduğunu gösterdi. Haritalar, ölçülen değerlerin kriging ile enterpolasyonu yoluyla üretildi.

Anahtar Kelimeler: Mekansal değişkenlik, Halepçe, Jeostatitik, toprak özellikleri, ve zeytin.

SPATIAL VARIABILITY OF SOIL PROPERTIES IN SOILS OLIVE GROWING IN SULAIMANYAH IRAQ

ABSTRACT

This study was conducted during of 2016 to determine spatial variability of the olive orchard soil in Halabja, located in south-east Sulaymaniyah. The aim of this work was to investigate how the spatial variability of soil properties, spatial heterogeneity of soil properties in any given landscape is a fact that has become well established. The variability, laterally and vertically, results from the impact of the soil-forming factors, namely, climate, vegetation, topographic setting, parent material, and time. The area study was about 100 hectare, 116 soil samples were taken for determination of the main soil chemical and physical properties which were then used to prepare spatial distribution maps. The distribution patterns indicated that, spatial analysis showed patterns of distribution for the studied soil properties. The texture of most of the studied samples was clayey soil except for the texture of 5 samples which had clay loam texture. The pH value of the studied soil samples was ranged from 7.09 to 8.40. Tthe studied soil samples were non saline since the range EC of the studied soil sample was from 132 to 966 mmhos/cm .The range of organic matter content, $CaCO_3$ and CEC were 0.88% to 3.23%, 6.93% to 20.82% and 47.38 to 88.22cmolc.kg -1soil respectively. The P content of the studied soil sample was ranged from 0.12 to 12.80 kg/da, while the range of macro nutrients Ca^{2+}, Mg^{2+}, K^+, Na^+ were 26.07 to 52.20 , 1.86 to 35.41 , 9.90 to20.41 and 0.31 to 6.74 meq /100 g soil respectively. While the range of micro nutrients Fe, Zn, Mn, Cu for the studied soil samples were 1.06-20.7 , 0.33-1.74 , 5.87-24.63 and 0.56-1.23 ppm respectively.

The results indicated that geostatistical methods are spherical and exponential variogram models were best fitted to all these soil properties. Maps were generated through interpolation of measured values by kriging. Maintaining organic matter and plant nutrients of the soil without the practices might was due to the removal of plant nutrient by erosion. Furthermore, high-quality of organic matter and plant nutrients in the soil resulted in improving soil quality and increasing high agriculture production.

Key words: spatial variability, halabja, geostatsitics, goil properties, and olive.

1. INTRODUCTION

Human activities and geographical factors have a great impact on physical and chemical properties of soil, and the work has been analyzed by global positioning system (GPS) device to study the spatial variation and take samples from different areas (within studied area) to represent and describe the total area of the region. Spatial variation in soil occurs as a result of changes in geological, climate, topography, special moisturizing, and human factors in cultivated land by farms, so the soil needs planning system and good management (López-Granados et al. 2015).

The usage of geostatistical and spatial variation of soil and soil characteristics determines soil properties and methods of sampling and soil testing to measure the correlation between spatial variations (natural soil as if it is the case here) with the degree of spatial dependence (Turgut and Öztaş 2012).

Soil structure is composed of sand, clay and silt and organic matter particles and these particles consist of small blocks or aggregate the remains of plants and animals composed as a result of the impact of climatic and human factors. Soil texture can be identified in the laboratory are classified into three groups according to the ratio between sand, silt and clay the size of sand particles are larger than clay and silt that the percentage of sand, clay and silt identifies soil texture, using soil texture triangle (Cai et al. 2016).

Different spatial and temporal occurrence of natural processes and human activities affects the soil on the scope and leads to volatility in the soil. Soil composition variability associated with the effect of natural factors and that can be studied by the survey and mapping work, which is reflected by the maps that were prepared at various levels. Printable maps of soil base and the specific purposes of the survey reports by users in various fields to prepare maps from reviews and plan how to use the land for olive trees.

The geographic and human factors have an impact on soil composition, special chemical characteristics, and analyzing semivariance each model exponential, those characteristics helps to renew locations which held a spatial variation of soil tracts, the soil samples that has been taken for the study is representing the entire area.(L´opez-Granados et al. 2002).

The spatial variability and geographical incompatibility of physiochemical Characteristics soils are beneath physical and biological factors, impact topography, vegetation cover various grazing planning and rangeland management. Soil Characteristics variability in time and space continuously, heterogeneity may be occurred at widely or at cramped scale, even in the same type of soil despite the temporal and spatial changes of soil properties in small and large scales, awareness of how are these changes for increasing production and sustainable agriculture management, it is essential (Kavianpoor et al. 2012).

It is assumed that in the classical statistic, the selected dots are independent of each other and that the sample mean represents the population average at the best possible level. However, the points sampled close to each other may be more similar to each other. That is, the measured values are a function of the distance between the sampling points and cannot be considered independently from the distance. For this reason, it is necessary to determine the degree of spatial variability spatial dependence naturally found among the values of the properties examined. Geostatistical methods have been successfully applied with the determination of the local dependence (Addis et al. 2015).

Soil properties from a limited number of samples he methods of geostatistic the measured points of the soil feature to be investigated, the degree of natural dependence, is determined and the value of the feature investigated by the help of a further interpolation technique is estimated by estimating the values at unexamined points and areas. This problem is critical for delineating the areas for remedial treatments, delineating the contaminated areas, and determining the land suitability for specific crops Semivariograms are used to determine the degree of local dependence and Kriging analysis is widely used in the interpolation phase (Demiret et al. 2009).

When the series is defined by detailed soil maps and reports, it cannot be understood at what intervals the values obtained from the profiler to the soil properties change in the whole series and how this change is spatial. In recent scientific studies and in agricultural activities, most researchers and soil map users have increased the need for such data. For example, in precision farming, modeling and site-specific management studies, values derived from a profiling from the map unit series are not sufficient for studying and there is a need for data on the exchange of soil characteristics (statistical and spatial). In recent years, this deficiency has been frequently expressed and studies have been started in this direction (Fayisa 2014).

Deficiency of micro-element affects the spatial variability and soil properties like zinc (Zn), copper (Cu), manganese (Mn) and iron (Fe) in different soils has been reported world-wide . Deficiency of micronutrients in farms due to regular absorption of these nutrients through crop absorption the allocation of micro-element may vary in time and space across management units. In soils, spatial variability in micro-element availability is presumed to be high or low due to farms and different management (Shukla et al. 2016).

A lack of micro-element in the soil and plants affect agricultural production, zinc deficiency appears in calcareous soil and clayey soils and the addition of phosphorus, potassium, soil temperature and high pH value have a direct impact on the zinc and manganese availability. Olive live in rich and poor lands because the soil is exposed to the loss of nutrients and erosion due to climatic and geological conditions, the increase in the soil fertility by farmers the best management is necessary (Belliturk et al. 2010).

From spatial variability can determine the soil physical properties after harvesting crops and tillage, such as the soil texture the soil bulk density and penetration resistance and particle size distribution , water content and organic matter of other factors affect the physical properties of the soil and bulk density depending on soil depth (Özgöz et al. 2007).

The olive tree, a preliminary European, is an evergreen shrub or a citizen to the Mediterranean, Asia and Africa, the Mediterranean tree. All the great civilizations of the Mediterranean have played a role in the dissemination of olives in this region the Egyptians, Phoenicians, Greeks, and Romans (Loumou and Giourga 2003; Waterman and Lockwood 2007)

Cultivation of olive trees in northern Iraq as well as the spread in recent times, despite the circumstances of changes in temperature and rainfall during the seasons of year, especially in winter, the temperature drops and increased, rainfall in the summer rises and the rain stopped. Iraq's Kurdistan region in spite of the harsh conditions and the quality of the soil (especially the quality of clay soil in the Lands in Eneb quarter that implants olive tree) and fluctuations in temperature extremes ranging from (7-45) ^{0}C and minimal rainfall or under drip irrigation system based on supply of water underground in the province of Sulaymaniya. Varieties and most of the areas of the world rely on rainfall for olive cultivation can rain ratio between (300-500) mm (Ali et al. 2015).

Assessment spatial variability of olive orchard depends on geomorphic cause substantial changes in soil properties. system manage their fields and system of regardless of the possible existence of differences in soil characteristics influencing water and nutrients availability, $CaCO_3$ content in soil and pH, the neutral, slightly alkaline values to alkaline ones between 7 and 8.5, the $CaCO_3$ may reduce the olive tree vigor through its effect on the availability of P, Zn, Cu, Mn and Fe, Soil organic matter content enhances both olive tree productivity and soil structure, and helps the soil to maintain several nutrients in available forms for the roots (Gargouri et al. 2006).

Water management, such as irrigation and drainage methods affect the soil salinity and alkaline soils, as well as crop production (Demir et al. 2008).

The establishment of an olive grove in the poor lands, such as the soil is not suitable for the cultivation of field crops, as well as areas topography does not affect the productivity of olive that take nutrients and water from depth root zone, as well as also depends on the quantity and quality of the olives grown in that territory and the climatic factors and the characteristics of the physical and chemical, a type of the olive trees and the age of the trees and the height of the area above sea level (Belliturk et al. 2010).

Spatial analysis has become one of the most important branches of increasing statistics in recent years. All the places are related but the near ones are more related to each other. The rule is especially important when the social and physical elements are research subjects. In classical statistics, it is assumed that the selected dots are independent of each other and that the sampling average represents the population average best. In the analysis of spatial data, however, the assumptions of classical statistics are not obtained when neighboring data are considered to be related to each other. In other words, the points sampled close to each other are related and similar to each other. (Basbozkurt et al. 2013).

Agricultural area to limit the variability in farming to amelioration crop quality variable in needed economic issues to increase the productivity of crops in the land by using the technology needed to improve the content of the ground even given a high rate of agricultural production specifying a particular site to describe areas using a fully determine the spatial variation and sketch maps (Akbas 2014).

Since there are little or no studies about this subject the currenct study was selected in order to determine the spatial variability of soil properties in olive grove Eneb, Halabja located south-east of Sulaymaniyah, Iraq and to make physical and chemical analysis of the studied soil samples for olive orchards and the other crops planted, and map the data for the studied area by various statistical methods semivarigram, Kriging.

2. LITERATURE REVIEWS

Soils are the consequences of climatic, vegetation and time effects on geological structure and vary in many physical and chemical properties in the field of research. In this respect, classical statistical methods are insufficient to show this variability that the soil shows spatially. Besides, organic matter content is quite different in terms of color, structure, texture, pH, base saturation, cation exchange capacity, volume weight, water retention capacity and some other physical and chemical properties. Sampling and analysis for collecting soil information is not easy and economical. For this reason, low-cost methods are needed before assessing whether soil variability exists to a considerable extent and investing for more detailed investigations. Spatial analysis methods are one of the most important methods used frequently in the analysis of soil variability (Mulla and Mc Bratney, 2000; Basbozkurt et al. 2013).

Spatial variability of the soil occurs as a result of different interactions that hold the soil through human and environmental factors, as well as good management practices, and that the parent material biologic factors are the main factors to regulate nutrient content especially from the parent material, many scientists and studied the spatial variation of the characteristics of the soil in different geological level fields is between the sample and the distance scale geological. It is verily significant to keep in mind that there is no spatial scale but multiple spatial scales contribute to volatility in the soil. This plays a tremendous role in the evaluation of the spatial variation of the characteristics of the soil as well as in the evaluation of the effects of soil variability (Phefadu and Kutu 2016).

Climate and topography are other important factors contributing to soil variability. Temperatures and precipitation, especially two important factors of climate, contribute to the variability in the soil at the regional level. Differences in topography also cause land differences. The physical and chemical processes in the soil system cause vertical and horizontal variability.

Biological events occurring in the soil also increase local variability. Another factor that increases soil variability is the applied management. Soils included in the same series can have quite different properties due to different management systems applied. In addition to this, although there are different levels, there are some lands which resemble their characteristics under the same arrangement. Agricultural land has additional sources of variation due to animal waste, fertilizer, irrigation water addition and soil treatment. Plow processing results in variability in land reclamation, subsurface processing, channeling structure and water arrangement (Akbas 2004).

The soil pH and EC an essential role in soil formation soil analysis of elements present in the soil for a way to take the elements in the soil and determine the outcome depends on the existence of the elements of a macro and micro in the soil samples (Lastincova et al. 1998).

The degree of soil reaction is a measure of the soil solution pH is the negative logarithm of the hydrogen ion (H^+) and (OH^-) The value of the logarithm of the hydrogen determines alkaline and acidic and neutral soil, their pH value from 0 to14 and the neutral 7 (pure water), less than of 7 is acidic and greater than 7 is alkaline. The provision of positively charged cations or dissolved, such as aluminum (Al^{3+}), and iron (Fe^{2+} , Fe^{3+}) and acidic soil are either positively charged cations such as calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (k^+) and sodium (Na^+) suggest to the base soil. Rely providing plant nutrients on the degree of soil interaction excepting phosphorus content is the most available from pH 6 to 7, and the nutrients Nitrogen, calcium, magnesium, potassium and sulfur more available from pH 6.5 to 8. Iron, boron, copper, manganese, nickel and zinc more available in the degree of amino from 5 to 7 (McCauley et al. 2009).

Spatial variability of organic matter, which has a role on the soil and organic material difference in the soil from the remains of plant and animal waste out of the rights that have not decomposed or degraded by bacteria or fungi, and organic materials important role in improving the physical and chemical properties of the soil organic matter plays an important role in regulate the acidity level of the soil and water conservation and soil building. Acidic and alkaline soils activities the affect micro-organisms have a role in the disintegration of the remains of plants and animals (Pettit 2004).

The amount of calcium carbonate control the pH of the soil and thus controls the chemical reactions as well as providing nutrients to the plants in the soil group, most of the Iraqi soil composed of calcium carbonate represent 90% to 95% of total carbonate (Maulood et al. 2012).

Demonstrated organic matter animal waste and plants the role that differing soil properties may produce on soil thickness through primitive transactions of soil use and landscape expansion. By admission initial randomness and irregularities in the form of bedrock that weathers at different rates, mess or instability is introduced into the system leading to non-united soil thickness (Tye et al. 2011).

Providing phosphorus depends on soil properties such as minerals from the parent material, the soil texture and provide phosphorus in the soil in the forms of organic and inorganic, phosphorus organic form humus organic materials involving living organisms in the soil and in the form of inorganic with various forms of the base, iron consists, magnesium, calcium and other elements, phosphorus is one of the most basic elements of plants that help many vital functions that occur within plants such as photosynthesis and respiration and energy transfer and cell division. The Iraqi soils, particularly the north area contain high amount of calcium carbonate and alkaline pH (Amin 2010 and Esmail 2012).

The measurements cations substitution soil analyzes, such as calcium, magnesium, potassium, sodium has a significant impact on soil structure in a neutral soil alkalinity exchange of cations group cations exchange is equal to the first three elements has a big role on special soil structure soil neutral and alkaline, said the group cations exchange equal to the total exchange of cations, either in acidic soil acidity include exchange of measuring the exchange of cations use solutions PH soil (Dawes 2006).

The cation exchange capacity is the key measure of soil that determines the quality of clay minerals in the soil content, as well as assesses the fertility of the soil and keeps the food materials on the spill and environmental factors. Chemical reactions depends on the exchange of cations from the soil, the quantity of clay and organic material in the soil both direction counterproductive, either individually or collectively constitute

Such as clay and humus have the ability to retain the positively charged ions, either in the sandy soil and organic matter the ratio of cation is high (Fayisa 2014).

Plants need rock elements in small quantities in the growth of the necessary elements for normal growth of plants stage is copper (Cu), iron (Fe), manganese (Mn), zinc (Zn), boron (B), molybdenum (Mo), chlorine (Cl), nickel (Ni), the lack of these elements in the soil reduces the yield and quality of crops, is measured in the crop through the chemical and physical properties may be important for marketing products from the crop as well as the food content of the soil instrumental. Soil variability caused by climate and terrain mother, plants, art, time and administrative practices used Geostatic system is more a way to analyze the spatial variation of the characteristics of the soil, the amount of rock elements from the parent material varies by soil weathering process quality affects the amount of rock elements and contents of the soil (Behic et al. 2011).

Soil survey and mapping studies result in soil maps generated and associated charts creating soil database for users. This database is used in the modeling of environmental effects, engineering and Geographic Information System applications. Spatial soil data is usually obtained by digitizing soil maps and creating layers for the desired data. The accuracy of the reports, the richness of the details and the additional information they contain, ensures that the results are valid for their use for this purpose (Rogowski 1996).

In addition to knowing of soil properties, geostatistical techniques are required if it is desired to know the spatial structure of the studied feature. Geostatistics is a field of applied statistics and is used to predict the spatial dependence and spatial structure of observed features and to predict the values at unexplored points using the modeled spatial structure. These operations are performed in two steps, spatial modeling variogram and spatial interpolation kriging (Rogowski 1996).

Soil contains seventeen of the key nutrients that absorbed dissolved by plants in the soil solution some food be available in the benthic soil some substances soluble in alkaline soil or neutral. The study results and tests pH of the soil general soil is alkaline in precedent studies. The EC depends on the navigator ratio in the soil solution, that concentration percentage of salts in acidophilus soil more from the basal soil, this affects indirectly to lower productivity and growth of plant if they addition fertilizer such as

(Ca^{2+}, Mg^{2+}, K^{+}) of positively charged ions into the soil does not cause an increase in concentration of salts dissolved in the soil if the appropriate amount according to the amount of soil foodstuffs (Cavins 2000).

The soil pH value depends on the amount of calcium carbonate has an effect on soil chemical properties and nutrient content of the soil depending on the spatial variability of the soil in general the value of soil pH of calcareous soil was between 7.5 to 8.2. Since most of agricultural soils in our region are calcareous to severe calcareous and most of the soils contains more than 10 % of $CaCO_3$, which has great effect on soil pH and many of the chemical reactions and this affects the amount of available nutrients to the plants and the movement of nutrients in the soil. In Iraqi soils the amount of calcium carbonate is high which affects the chemical and physical properties of the soil, such as the provision of food materials and install the phosphorus (Maulood et al. 2012).

Changes happening to the soil as a result of various factors that take place in the soil as well as soil management with soil spatial dependence, spatial variability of soil physical properties affected in soil management practices (Huber 2013).

The basic characteristics of the soil, such as soil texture and substance of the mother and the acidity of the soil, the contents of organic matter and carbonate calcium instrumental to the strength of the soil, as well as an environmental and characteristics of the physical and chemical factors, the soil texture made up a high proportion of clay (Aziz and Karim 2016).

Soil structure is defined as the set of soil particles in which the power contracts the particles together. The aggregation is formed by some processes like physiochemical and biological forces which are mainly responsible for their constancy. The formation of totals are affected by some factors that are climate, environmental, these processes are able to fetch soil particles close together that the physical and chemical forces between them contract the particles The soil totals stability occurs due to the existence of quality and quantity of organic and inorganic materials (Aziz et al. 2016).

Structure raise supply new rock material for physiochemical weathering and could be a limiting factor in the weathering of rocks in analyzes soil density, tectonics can influence the physiochemical weathering process through the raise and fracturing of rock (Tye et al. 2011).

Parent soil material containing a quantity of elements potassium, where the ions of potassium are the third key element of the soil and with nitrogen and phosphorus which determine the productivity of plants, as well as considered in the primarily by exchange of cations and metals properties minute. Spatial variation in the distribution of potassium depends on the mineral elements and soil management any land use. Managements such as intensive farming and material origin and climatic conditions. A high percentage of clay in the soil increases potassium either in the soil acidity decreases potassium, saving the physical properties of chemicals has a major role on the percentage of clay, the amount of organic material and the movement of water, air permeability melting and low calcium and magnesium and sodium and the composition and activities of microorganisms and soil fertility (Fayisa 2014).

3. MATERIALS AND METHODS

3.1.Material

3.1.1 Introducing of Study Area

The study was conducted at Eneb, which is located in the south of Halabja, Sulaymaniyah governorate Kurdistan region in Iraq, with GPS reading of North (35° 0 12°) and East (45° 0 58°) and the height is 690m above sea level. Geographically, Halabja lies within 35° 0422.5" and 35°20'29.7" latitudes and 45°37'39.4" and 46°07'10.2"E longitudes (Figure.3.1). Topographically, it lies in southeastern Sharazur plain, surrounded by Hawraman and Balambo mountains to the north and south respectively. Despite this, much of the region is fertile area covered with forest vegetation and with the historical antecedent of exported grain and livestock. Moreover, the mountainous region with cold climate gets annual precipitation that is suitable to keep up temperate forests and shrubs (Al-doski et al. 2013).

The plain and fertile fields of this sector are entirely producible and changeable area which could be taken into consideration by anyone who tends to develop the process of heading farming sector to a developed one. There is one trouble of spatial variability of soil property of this researched area which is the impact of Saddam’s former chemical attack on the city, that you have already known the consequences, which caused a huge massacre in case of human kinds. On the other hand and relevant to our main points of the fertile land, the open-plains became a pool to all the chemical substances and gasses which mostly gathered in the south of Halabja. Despite of these considerable point of views, the mentioned are is still one of the most of the productive lands around the whole governorate (Al-doski et al. 2013).

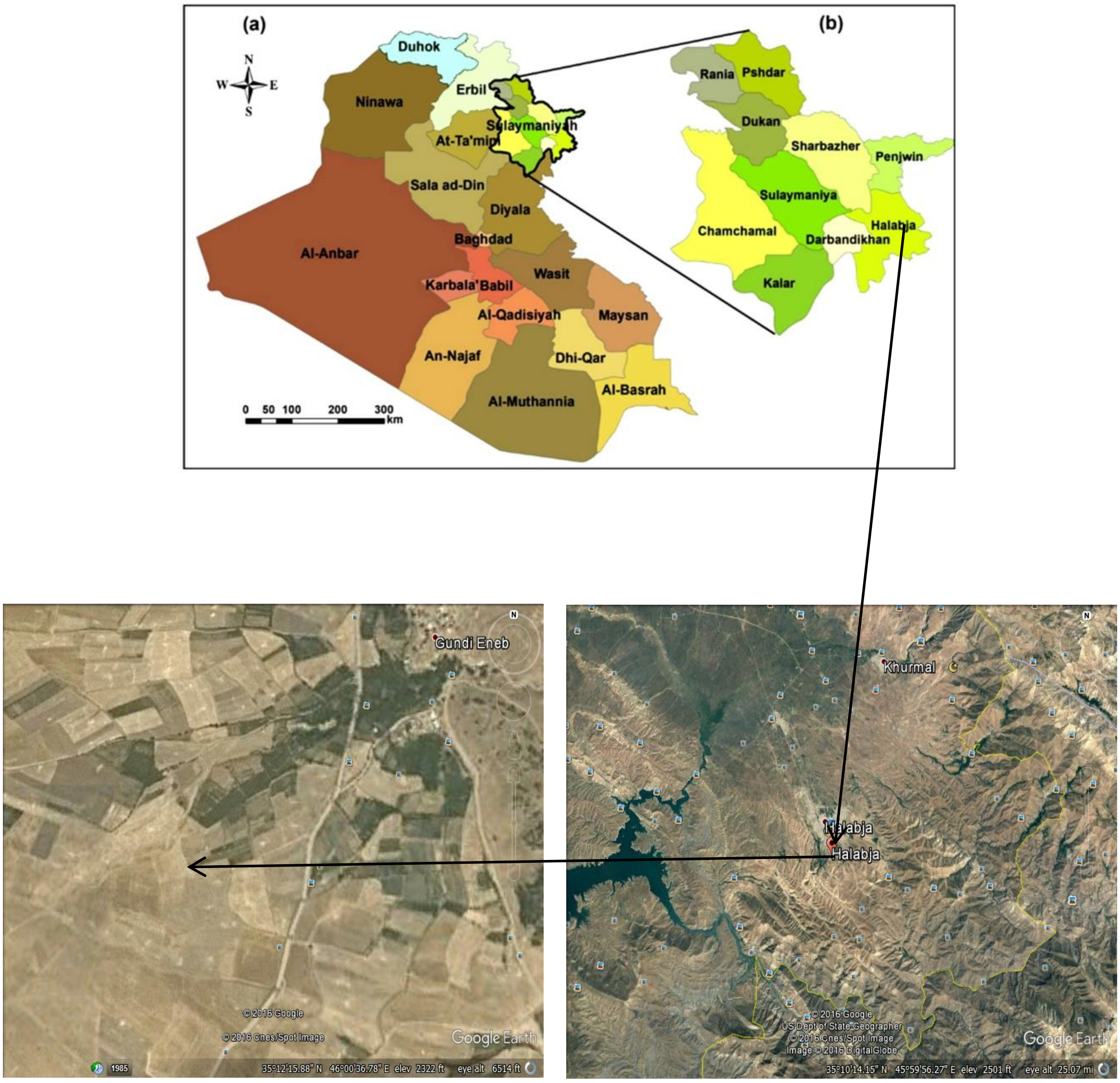

Figure 3.1. Shows the study area in Iraq, Sulaymaniyah , Halabja and Eneb

3.1.2. Climate

In the studied area, Halabja, the climate in general is warm in the summer and temperate. In winter, there is more rainfall. This type climate is classified as an agro-meteorological department climate. The medium temperature in the summer is hot, where temperatures range from 15 °C to 35 ˚C and sometimes up to 40 ˚C or more in some of the chapters in the winter will be cold, rainy and be moderate in the last annual season. Precipitation In a year, ranges from 300 to 700 mm. (Aziz and Karim, 2016; and Al-doski et al. 2013).

A year of climate and weather condition of Halabja are shown. Table 3.1. The total amount of rain and the range of average maximum and minimum temperature of air were measured (Figure 3.2) for years (2004 - 2016) and soil temperature from a depth of 20 cm were taken (Figure 3.3) for years (2004 – 2013). This information was taken from Kurdistan regional general Directorate of agricultural - Sulaimani (Government Agro-meteorological department).

Table 3.1. Climate data for the Halabja (2004-20016) (Agro-meteorological department)

Month	**Rain Total**	**Soil Temperature ˚C in the depth 20 cm**			**Air Temperature ˚C**		
		Avg	**Max**	**Min**	**Avg**	**Max**	**Min**
Jan	98.06	8.86	16.55	65.98	8.01	16.81	-2.45
Feb	121.13	9.69	18.13	6.85	9.09	20.03	-0.98
Mar	86.00	12.96	16.42	10.1	13.61	25.64	2.85
Apr	78.44	17.88	21.83	14.34	18.36	31.80	6.32
May	30.75	24.31	30.1	18.89	23.95	38.92	11.06
Jun	0.78	32.40	36.52	28.14	31.73	43.94	20.23
Jul	0.00	35.75	37.61	33.75	35.01	46.71	23.45
Aug	0.03	36.04	37.38	33.92	35.28	46.10	24.25
Sep	2.20	32.24	34.89	29.09	30.13	42.74	17.49
Oct	45.80	26.02	30.21	19.95	21.56	33.68	9.74
Nov	84.68	16.41	21.06	12.66	13.02	21.07	3.80
Dec	83.66	10.63	13.59	7.71	8.50	18.04	-0.24

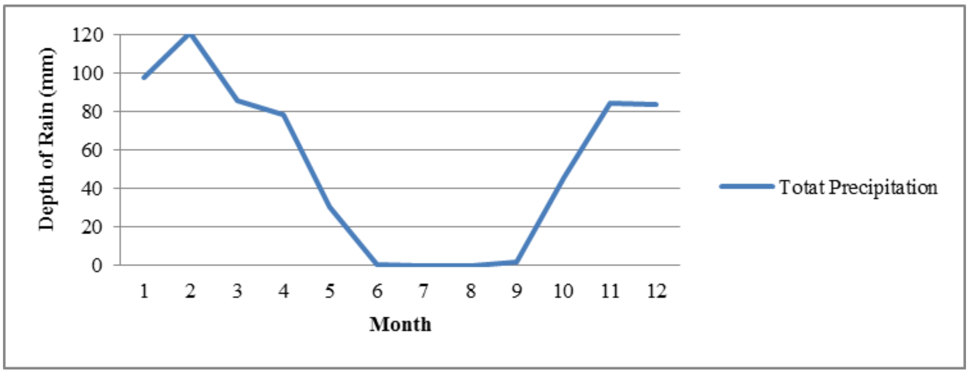

Figure 3.2. . The depth of rainfall mm (2004 – 2016)

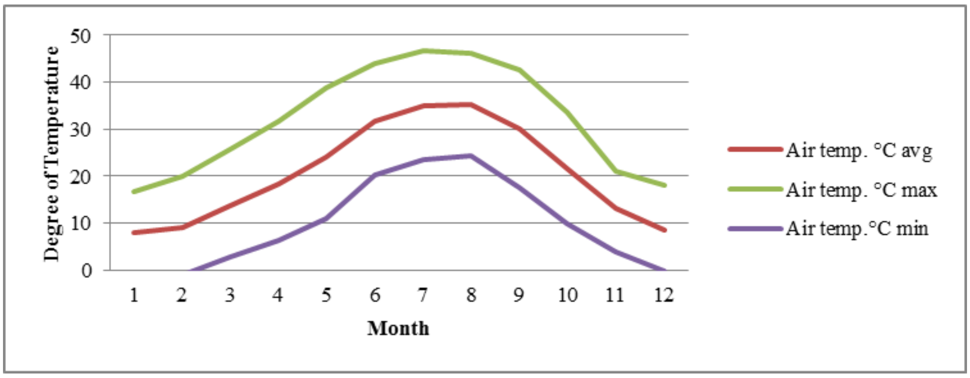

Figure 3.3. . The air temperature ˚C (2004 – 2016)

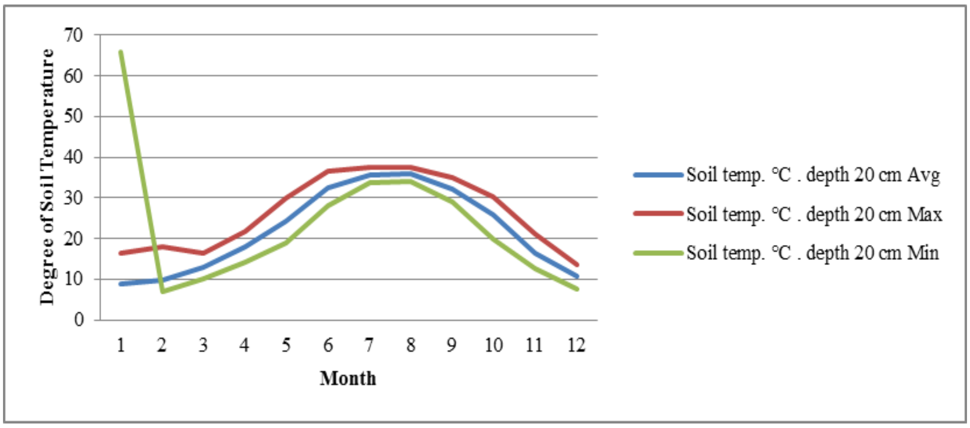

Figure 3.4. The mean of soil temperature ˚C at 20 cm depth (2004 – 2013)

3.1.3. Mapping Units in Study Area

Halabja is a city in northern Iraq, Kurdistan region. It is located 35˚ 0 12˚ N and 45˚ 0 58˚ E and it is approximately 241 km northeast of Baghdad, the capital of Iraq, and about 80 kilometers from southeastern of Sulaymaniyah city. Halabja is also about 14 km from the Iranian border range of precipitation site than 300 mm in Eneb shows (Figure 3. 5)

Figure 3.5. The studied olive orchard Halabja, Eneb

3.2. Methods

3.2.1. Soil Sampling

The area that was studies was 100 hectare, which was divided into 100 × 100 m^2 grid. Soil samples were taken at 0-20 cm depth. One sample was taken from each corner of the grid and also the mid-part of the grid. Also, 16 samples were collected on the line of the squares (Figure 3.6). First sample 5 m away from the corner, 50 m on the line from north to south, taken 8 sample of corner distance; second sample 10 m and 40 m taken sample of corner distance from east to west taken 8 sample. A total of 116 sample were collected of the area soil (Figure 3.1) and the type of cops were identified in each portion of the studies area (Figure 3.7).

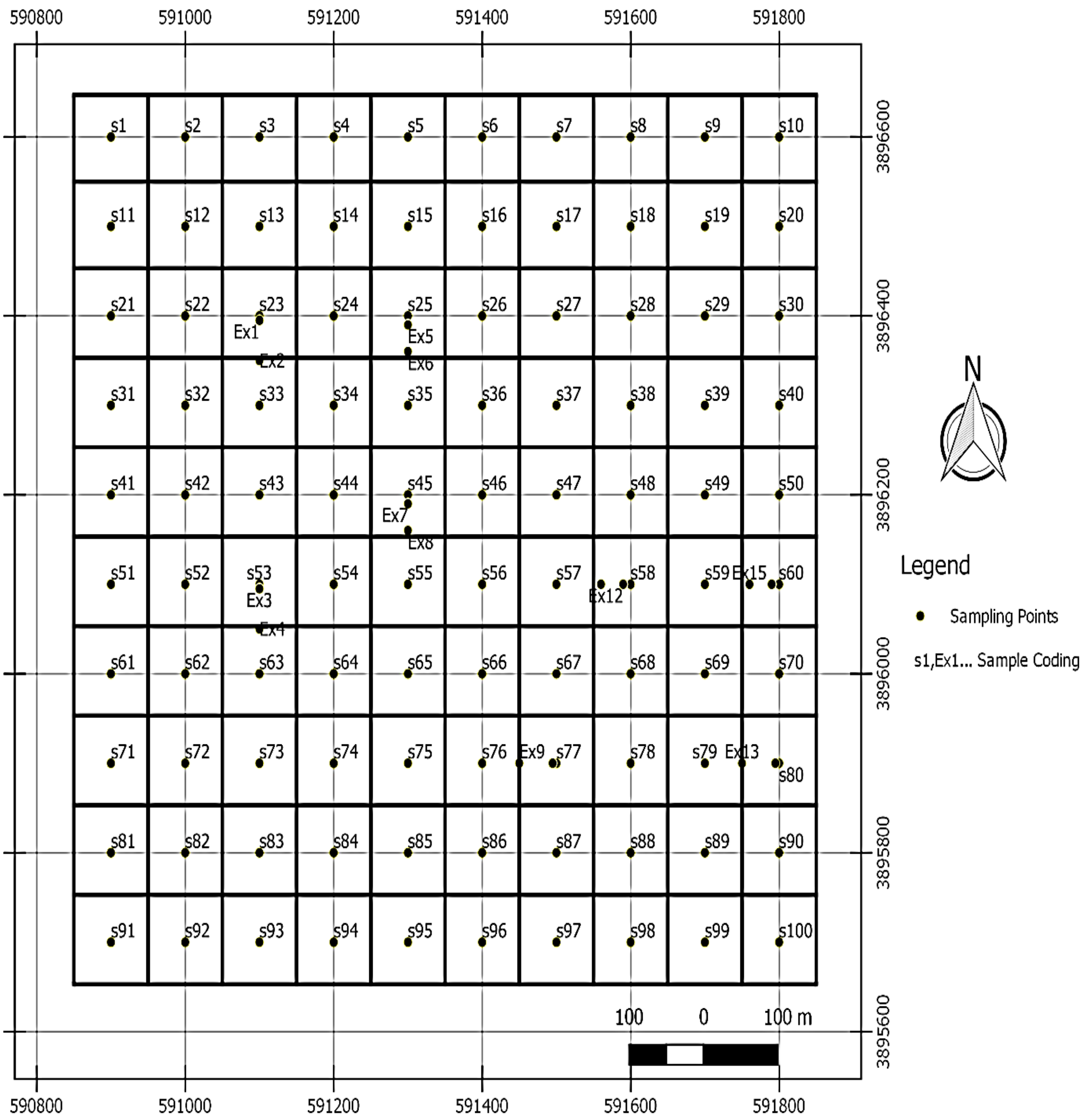

Figure 3.6. Sampling design based on the 100 x 100 grid

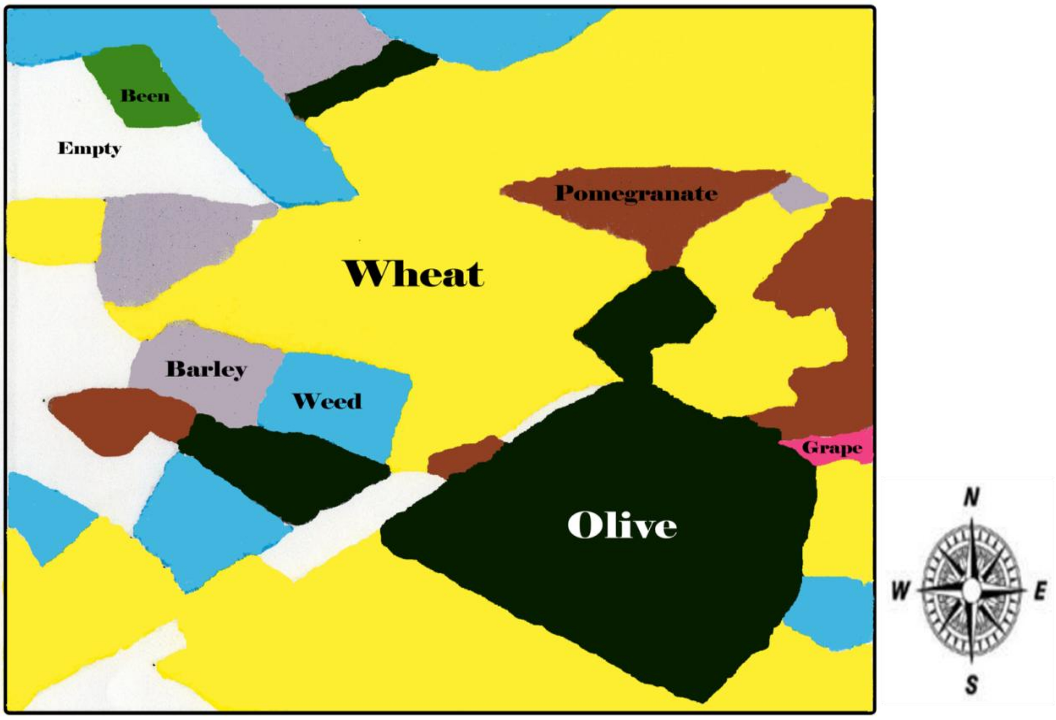

Figure 3.7. Plant patterns in the experimental field

3.2.2. Laboratory Analysis Methods.

The soil samples were taken from the study area then translocated to the laboratory in plastic bags. After that the soil was dried at room temperature first and then gently crushed and sieved by 2 mm sieves using stainless-steel sieves to avoid any contamination. The characteristics of the soil used in most high-R^2 and / or squares semi-variance separate model using "Kriging" method of use of evaluation for each 100 m in the study area. These estimates were used in neighboring dots to estimate semi-variance in the maps of geographic positioning system analysis pH, EC, organic matter, Calcium carbonate, phosphorus, textures, Ca, Mg, K and Na, CEC, Fe, Mn, Cu and Zn were analyzed in soil samples.

Soil pH and EC:

Determined. 1: 1 soil: water value was used for soil pH measurement, was used for soil EC measurement conductance meter (Richards 1954)

Organic Matter:

The modified (Nelson and Sommers 1982) organic matter determination.

Calcium Carbonate:

Determined with Schepler Calcimetry (Gülçur 1974).

Phosphorus:

Analysis was done according to (Olsen 1954) estimation of available phosphorus in soils by extraction with sodium bicarbonate reading by spectrophotometer (Figure 3.8).

Soil Texture:

Determined with (Boyoucous 1962) hydrometer method.

Macroelement:

Determined with Ca^{2+}, Mg^{2+}, K^{+}, Na^{+} in soil, using ammonium acetate 1N. An estimate of calcium, magnesium using the titration method of (EDTA), reading potassium, sodium in soil extracts by (Flame photometer).

Microelement:

Determined with Fe^{2+} ,Zn^{2+}, Mn^{+}, Cu^{+} were measured using DTPA reading by the atomic spectrofoto matter reading by AAS Figure 3.8. (Lindsay and Norvel 1978)

Figure 3.8. .AtomicAbsorption Spectrophotometer and spectrophotometer

3.2.3. Statistical Analysis Methods

Descriptive statistics fitted to the semivariograms spherical or exponential models were, and their selections were based on visual best fit and the corresponding coefficient of determination, i.e., R^2. The parameters of the model – nugget semivariance, range, and sill, or total semivariance – were calculated. Nugget semivariance is the variance at zero distance and represents field and experimental variability, or random variability, which is undetectable at the sampling scale. Sill is the lag between measurements at which one value for a variable does not influence neighboring values (Bohling 2005).

The experimental semivariogram was conducted on chemical and physical soil properties using geostatistical analyzes; estimating mapping to describe the soil that did not take the samples was determined properties using SPSS 20. 0 software data analysis of pH, EC,OM, $CaCO_3$, phosphorus, clay, sand, silt, Ca^{2+}, Mg^{2+}, K^+, Na^+ and CEC, and some microelement (Fe, Mn, Cu, Zn) exploratory data analysis was made calculating standard deviation.

Figure 3.9 using Semavrigram Isotropic variogram models Exponential, spherical to study the degree of continuity of the spatial properties of the soil between the data points. Range or A is calculated from A_0 as noted in the model descriptions, above nugget variance (C_o) the y-intercept of the model sill or (C_o+ C), model regression coefficient R^2 and variable RSS (Residual Sum of Squares). The neighboring points used in making these estimates (Bohling 2005).

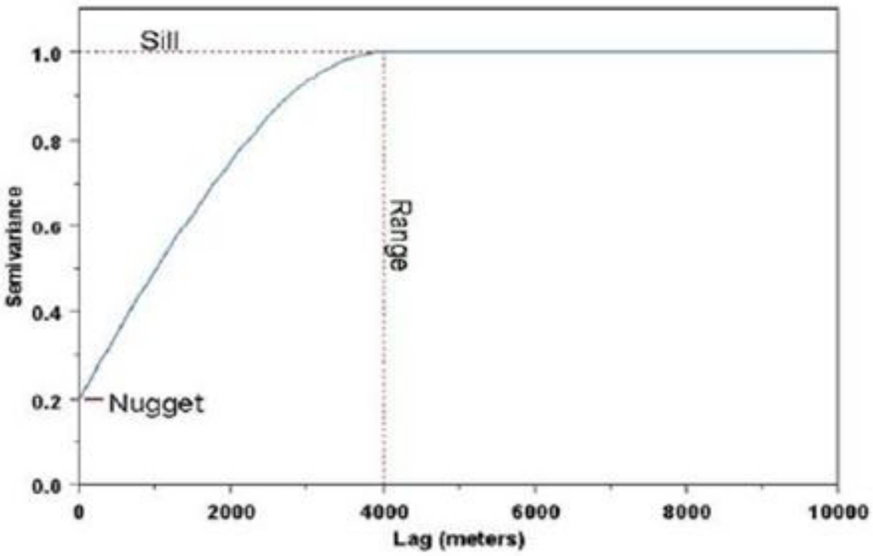

Figure 3.9. Parameters for a typical semivaryograge (Bohling, 2005)

Semivaryans: $\Upsilon(\mathrm{h}) = \frac{1}{2N(h)} + \sum_{i=1}^{N(h)} [\mathrm{z(Xi + h) - z(Xi)}]^2$

Nugget: g(h) = $\begin{cases} 0 \text{ eğer h} = 0 \\ 0 \text{ eğer h} \neq 0 \end{cases}$

Speherical: g(h) = $\begin{cases} c.\left[1{,}5\left(\frac{h}{c}\right) - 0{,}5\left(\frac{h}{a}\right)^3\right] eğer\ h \leq a \\ c\ h \neq 0 \end{cases}$

Exponential: g(h) = $c.\left(1-\exp\left(-\frac{3h}{a}\right)\right)$ (2.4)

Of the study area as part of the preliminary statistical draw in separate maps per unit area of study and give the results Table 4.2 in the present study to determine the properties of the soil by soil survey and take advantage of it to make contributions to the decision soil management and improve the quality of crops (Krasilnikov et al. 2008).

Choose a model semivariance of soil properties, to investigate soil properties properties (only the distance between sample pairs additives) or anisotropic (as well as the distance between sample pairs), depending on movements in the four value semivariance experimental depends on the specific distance sampling, spherical, linear, gaussion are not emboldened in the value of the threshold for the low increase to determine the distance as well as increases and decreases so semivariance model most suitable for calculations to describe the entire region (Bohling 2005).

4. RESULT AND DISSCUTION

4.1. Isotropic Variogram Model

In this study, descriptive statistical analyses were applied to evaluate spatial variability of 15 soil properties in 116 soils samples taken at a depth of (0-20 cm) in a cultivated field by olive plants and other plant in Eneb, Halabja- Sulaymaniyah. The results isotropic semivariogram spherical or exponential models provided the best fit for the semivariograms (Active Lag, nugget, sill, range, R^2, RSS, Neighbors) of all soil physiochemical analyses properties used in this study of the are showed in Table 4.1.

Using geostatistical system of complete data sets means identifying the extreme values of the data set the variogram is a graph of semivariance vs. separation distance. The modeling applied soil sample in the orchard olive and different crops in Eneb, Halabja from surface (0-20) cm. Where autocorrelation is present, semivariance is lower at smaller separation distances (autocorrelation is greater). Isotropic variogram models are provided in GS+ Exponential, each model can be described using the terms above % nugget variance (C_o) the y-intercept of the model sill (C_o+C) the model asymptote and range (A) the separation distance over which spatial dependence is apparent. In some texts this is called the effective range in order to distinguish range A from a model range parameter A_o, model R^2 and variable RSS (Residual Sum of Squares).

Directionally dependent semivariograms were calculated for four different directions (north, south, east, west) to determine whether the change in investigated soil properties within the study area is isotropic. The semivariogram models and model parameters determined for the examined samples are given.

Parameters models in Table 4.1 were selected from fitted models to soil properties because had less residual sum of squares and better structure. Suitable model for soil properties was isotropic. Results showed that pH had highest effective range with 1248 meter sodium with 114 meter had minimum effective range between the studied characteristics of soils.

Table 4. 1. The best fitted semivariance of models and parameters for the studied soil properties

Variable	Active Lag	Uniform İnterval	Model	Nugget	Sill	Range	R^2	RSS	Neighbors
pH	800	69	Exp.	0.00565	0.0208	1248	0.866	2.205E-05	16
OM	1200	77	Sph.	0.015	0.517	1087	0.987	4.841E-03	12
$CaCO_3$	520	55	Exp.	1.35	7.207	102	0.676	1.83	20
P_2O_5	1000	106	Exp.	1.41	7.139	492	0.973	0.279	20
Clay	807	110	Exp.	4.98	16.3	261	0.731	4.23	18
Silt	510	55	Exp.	3.11	21.79	156	0.945	4.80	18
Sand	450	30	Sph.	6.61	25.38	286.7	0.895	61.9	18
Ca	606	101	Sph.	2.17	24.93	139	0.933	0.717	14
Mg	700	105	Sph.	0.1	40.2	195	0.865	42.5	12
K	600	101	Exp.	1.53	7.97	189	0.598	1.01	12
Na	600	101	Exp.	0.051	0.533	114	0.583	9.181E-04	16
CEC	700	105	Sph.	6.5	69.1	154	0.735	54.3	14
Fe	700	105	Sph.	7.49	22	372	0.971	2.13	12
Zn	800	101	Sph.	0.0184	0.0899	496	0.996	1.081E-05	12
Mn	850	101	Exp.	1.95	15.57	387	0.989	0.425	12

4.2. Geostatistical Evaluation

In this study, the use of both theoretical and practical methods were used to collect data for determining the spatial variation of the area (Eneb - Halabja) the results of the statistical analysis of for the study soil characteristics like pH, organic matter,calcium carbonate content, phosphorus, clay, silt, sand, macro elements and some micro elements of the normal distribution.

The research has studied soil properties of spatial change of different directions (north, southeast and southwest and north, east and west, and south-east and north-west), the soil samples were analyzed and calculated for each characteristics of models and model semi-variance information as shown in Table 4.1. It is calculated as these values are examined soil properties for defined theoretical models, spatial structural characteristics show that effectively reflects Figure 3.9.

Spatial variations of some physical properties and chemical properties of the soil have been demonstrated all in Tables 4.1 faced with the soil data and distribution of the data set, and the test data as well as to a normal life using Semivariance test. Thus, the forms of distributions Kriging composition maps system.

Soil property was developed to quantify the spatial variation of soil characteristics. The semivariogram for pH exponential model content shows Table 4.1 nugget value 0.00565 the range 1248 m the zero nugget effect value indicates spatial continuity between neighbouring points. Shown in (Figs 4.1 - 4.15) spatial distribution maps of soil properties of pH based on block kriging, as has been already reported in the studies, pH of the soil properties has variable range 889.10 (Jeloudar et al. 2012) pH of the soil properties has variable range 39.1 (Bijanzadeh et al. 2015).

The measured organic matter spherical model content nugget values 0.015 the range of 1087 m the zero nugget effect value indicates spatial continuity between neighbouring points. Shown in (Figs 4.1 - 4.17) spatial distribution maps of soil properties of organic matter based on block kriging as has been already reported in the studies, OM of the soil properties has variable range 411.88 (Gargouri et al. 2006).

The measured of $CaCO_3$ exponential model content nugget values 1.35 the range 102 m the zero nugget effect value indicates spatial continuity between neighbouring points. Shown in (Figs 4.1 - 4.18) spatial distribution maps of soil properties of organic matter based on block kriging as has been already reported in the studies, $CaCO_3$ spherical model of the soil properties has variable range 910.90 (Jeloudar et al. 2012).

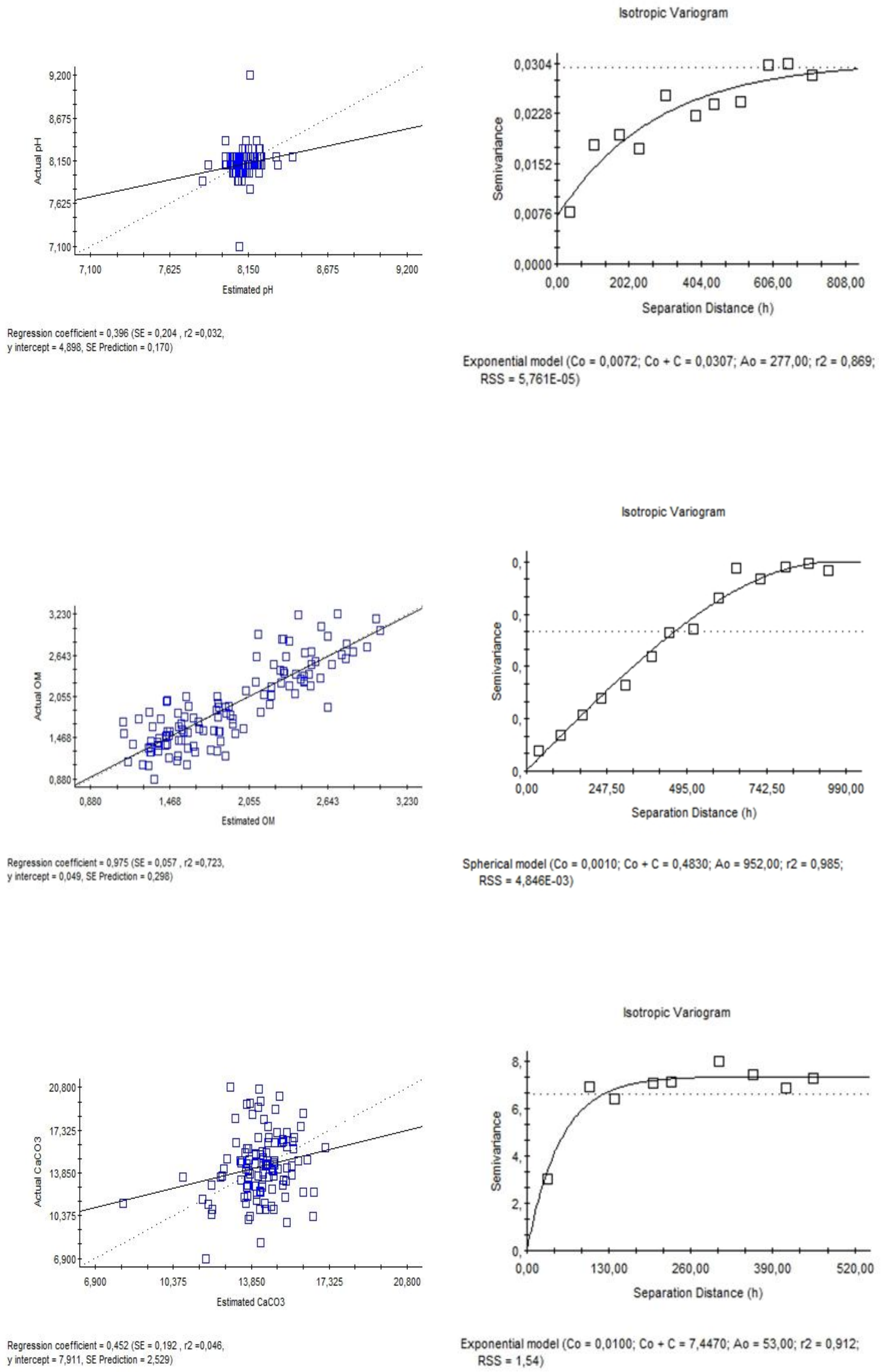

Figure 4.1. Experimental semivariograms of soil properties 0-20 cm (pH, OM and $CaCo_3$)

The measure of P_2O_5 exponential model content nugget values regression 1.41 the range 492 m the zero nugget effect value indicates spatial continuity between neighbouring points Shown in (Figs 4.2 - 4.19) spatial distribution maps of soil properties P_2O_5 based on block kriging as has been already reported in the studies, P_2O_5 spherical model of the soil properties has variable range 43.5 (Tekin et al. 2011).

The measure of clay exponential model content nugget values 4.98 the range of 261m the zero nugget effect value indicates spatial continuity between neighbouring points. Clay content at soil 0-20cm varied from 37.2% to 59.8% shown in (Figs 4.2 - 4.20) spatial distribution maps of soil properties of clay based on block kriging as has been already reported in the studies, clay of soil properties has variable range 157 (Jeloudar et al. 2012).

The measure of silt exponential model content nugget values 3.11 the range 159 m in zero nugget effect value indicates spatial continuity between neighbouring points. Silt content at soil 0-20 cm varied from 2.10% to 39.2% shown in (Figs 4.2 - 4.21) Spatial distribution maps of soil properties of silt based on block kriging as has been already reported in the studies, silt of soil properties spherical model has variable range 688.30 (Jeloudar et al. 2012; Trangmar et al. 1986)

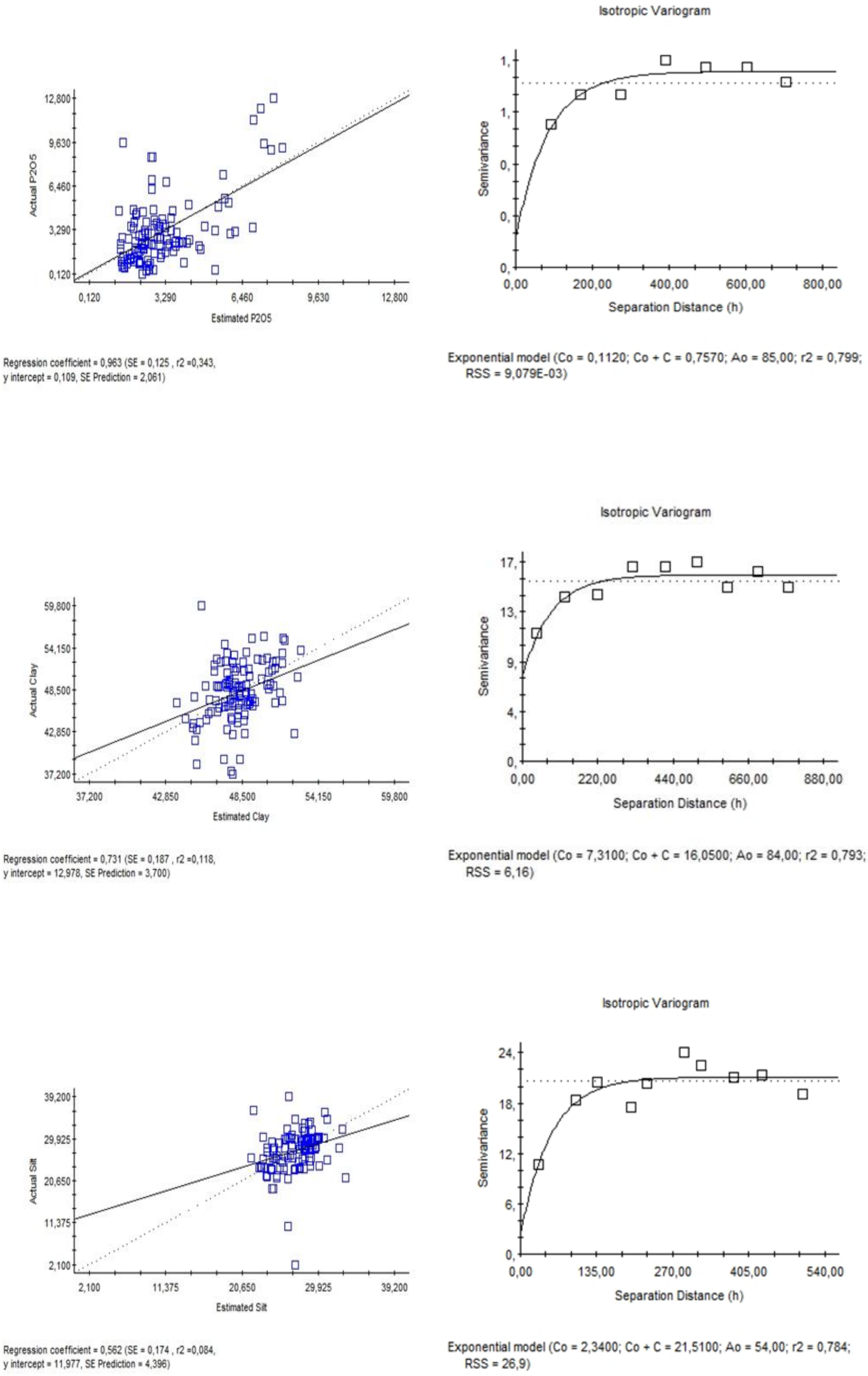

Figure 4.2. Experimental semivariograms of soil properties 0-20 cm (P_2O_5, Clay and Silt)

The measure of sand spherical model content nugget values 6.61 the range 286.7m in zero nugget effect value indicates spatial continuity between neighbouring points. Sand content at soil 0-20cm varied from 16.5% to 38.0% it's shown (Figs 4.3 - 4. 22) spatial distribution maps of soil properties of sand based on block kriging as has been already reported in the studies, sand of soil properties has variable range 279.9 (Surucu 2013).

The measure of calcium (spherical spatial) content nugget values 2.17 the range 139 m in zero nugget effect value indicates spatial continuity between neighbouring points. In this result the amount of Ca^{2+} exchangeable was higher proportion it's shown (Figs 4.3 - 4.23) spatial distribution maps of soil properties of calcium based on block kriging as has been already reported in the studies, calcium of soil properties has variable range 562 (Jeloudar et al. 2012).

According to magnesium exponential model content nugget values 0.1 the range 195 m in zero nugget effect value indicates spatial continuity between neighbouring points. In this result the amount of Mg^{2+} was higher proportion it's shown (Figs 4.3 - 4.24) spatial distribution maps of soil properties of magnesium based on block kriging as has been already reported in the studies, magnesium of soil properties Gaussian model has variable range 910.90 (Jeloudar et al. 2012; Wani et al. 2016).

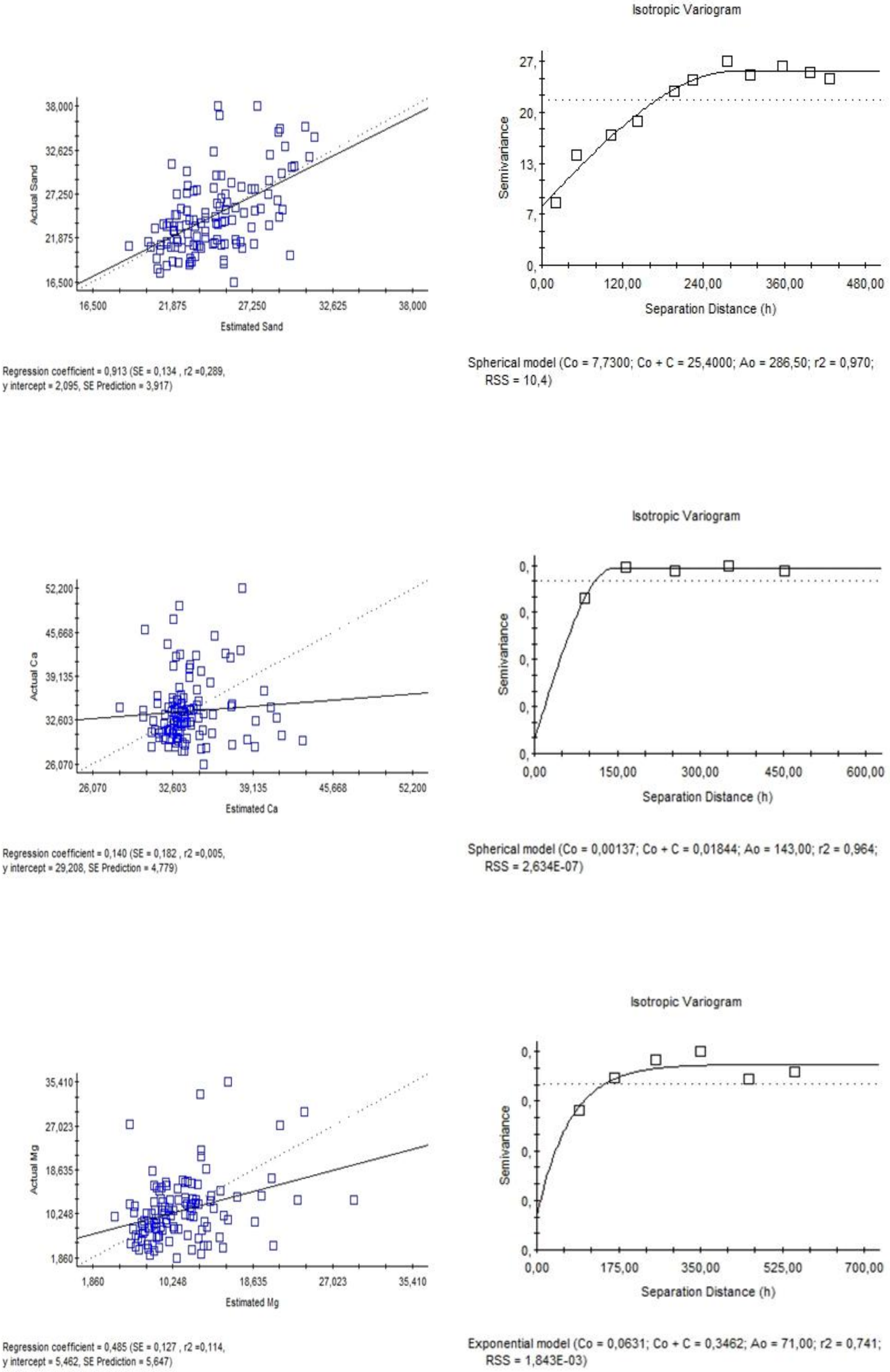

Figure 4.3. Experimental semivariograms of soil properties 0-20 cm (Sand, Ca^{2+} and Mg^{2+})

The measure of potassium exponential model content nugget values 1.53 the range 189m in zero nugget effect value indicates spatial continuity between neighbouring points. In this result the amount of K^+ was lowers it's shown (Figs 4.4 - 4.25) spatial distribution maps of soil properties of potassium based on block kriging as has been already reported in the studies, potassium of soil properties has variable range 96 (Bijanzadeh et al. 2015; Aşkın et al. 2012).

The measure of sodium spherical model content nugget values 0.051 the range 114m in zero nugget effect value indicates spatial continuity between neighbouring points. in this result the amount of Na+ was lowers it's shown (Figs 4.4 - 4.26) spatial distribution maps of soil properties of sodium based on block kriging as has been already reported in the studies, sodium of soil properties has variable range 910.90 (Jeloudar et al. 2012; Aşkın et al. 2012).

According of cation exchangeable capacity exponential model nugget values 6.5 the range 154 m in zero nugget effect value indicates spatial continuity between neighbouring points. In this result the amount of CEC was 47.4 to 88.2 cmolc /kg soil it's shown (Figs 4.4 - 4.27) spatial distribution maps of soil properties of cation exchangeable capacity based on block kriging as has been already reported in the studies, CEC of soil properties spherical model has variable range 742.8 (Tekin et al. 2011; Aşkın et al. 2012).

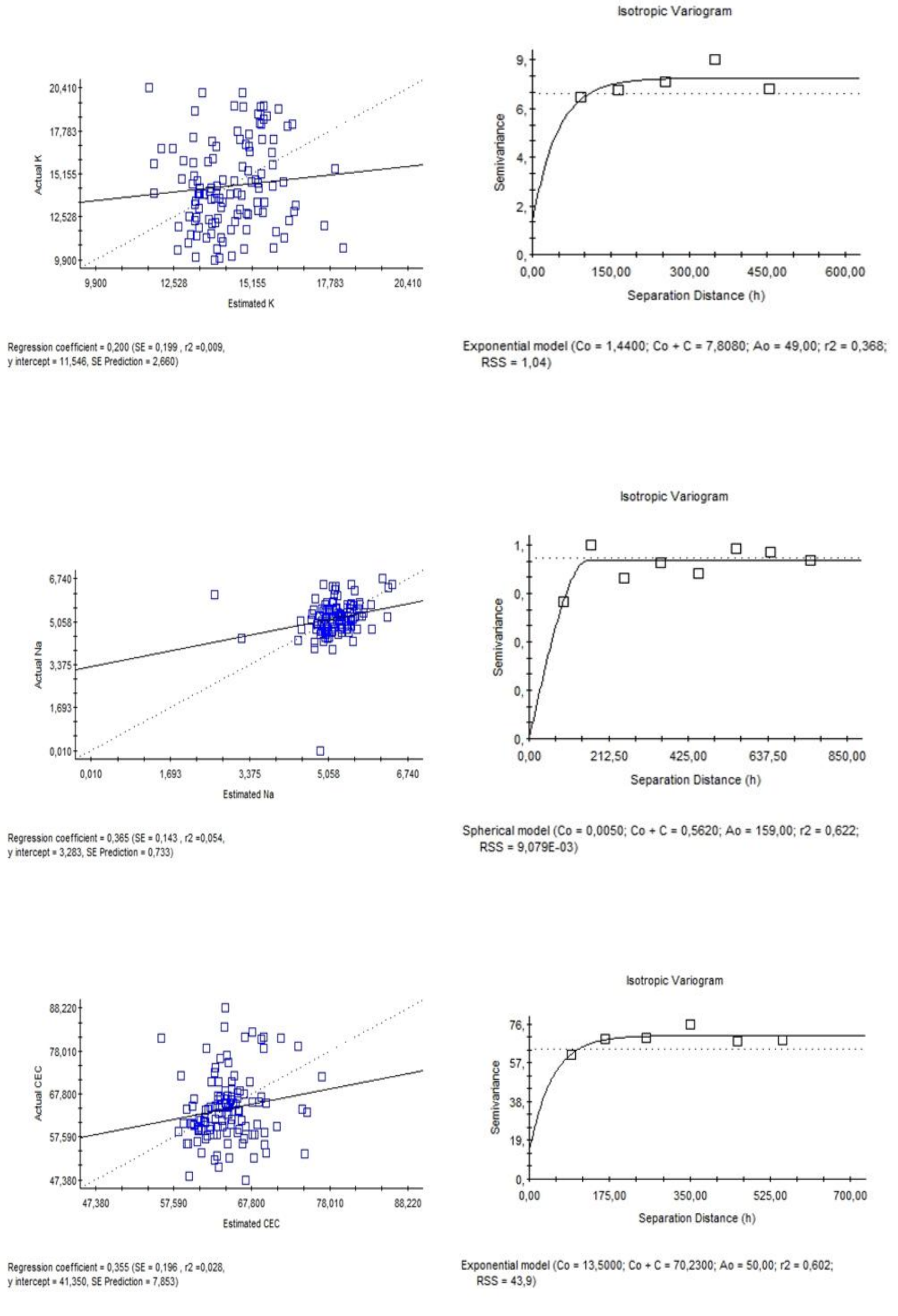

Figure 4.4. Experimental semivariograms of soil properties 0-20 cm (K^+ , Na^+ and CEC)

The measure of iron spherical model nugget values 7.49 the range 372 m in zero nugget effect value indicates spatial continuity between neighbouring points. in this result Fe^{2+} was above critical level it's shown (Figs 4.5 - 4.28) spatial distribution maps of soil properties of iron based on block kriging as has been already reported in the studies, iron of soil properties has variable range 243 (Akbas et al. 2009).

According of zinc spherical model nugget values 0,0184 the range 496 m in zero nugget effect value indicates spatial continuity between neighbouring points. In this result most of the studied samples contains low amount of available Zinc it's shown (Figs 4.5 - 4.29) spatial distribution maps of soil properties of zinc based on block kriging as has been already reported in the studies, zinc of soil properties has variable range 105 (Akbas et al. 2009).

The measure of magnesium exponential model nugget values 1.95 the range 387m in zero nugget effect value indicates spatial continuity between neighbouring points it means that the concentration of available Mn is adequate for plant growth at the studied area it's shown (Figs 4.5 - 4.30) as has been already reported in the studies, magnesium of soil properties has variable range 379.8 (Tekin et al. 2011; Yeşilırmak et al. 2011).

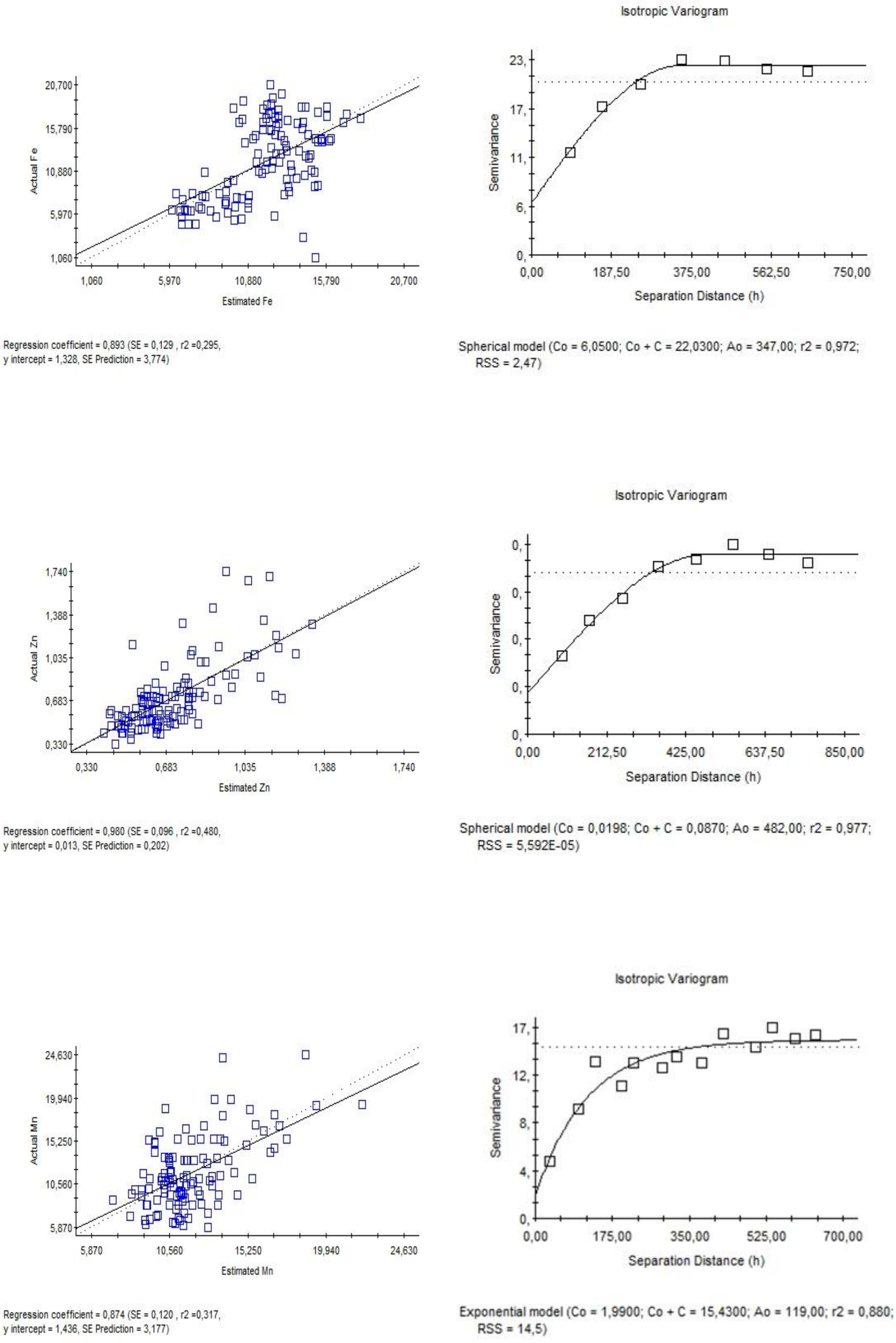

Figure 4.5. Experimental semivariograms of soil properties 0-20 cm (Fe, Zn and Mn)

4.3. Kriging Maps

Kriging is expression of geostatistical approach rating which is also described as areas that did not take samples these methods of geostatistical and configure semivariogram maps and a statement differences in soil characteristics studied for the entire study area by maps using semivariogram,Somakram used the system was set up in a way ordinary map squareness. In the study area we took 116 samples to describe the region as a whole, placed pH and electrical conductivity of soil texture and organic materials phosphorus, macronutrient and cation exchange capacity and microelements and be the subject of irregularly depending on the quality of cultivated crops to estimate the acidity of the soil from the highest level to the average content and less as taken from different the area directions (Budak 2012).

The degree of soil interaction means that the diagnosis of basal soil or acidic or mild, in the alkaline soil is ion (OH^-) larger than ion (H^{2+}) This leads to bacterial organisms and activities for it to be more active than the acidic soil. Units mapping shows that soil acidity content is higher alkalinity of the south and west line and the content of soil pH medium alkaline in the north line and Central regions of the north, west, south and east of these areas the ratio of soil pH less alkaline, the nearest of the equalizer, especially in the north line to the west. To reach the electric in the study area on the line north to the west of electrical conductivity content is high because the soil acidity in these lower regions Hgrbmodah any closer to a moderate, while in the central regions of the north line and the east, west and south directions of less because the soil pH is higher in these areas but on the south and east of a line.

The pH value of the studied soil ranged from neutral to alkaline 7.09 to 8.40 but the soil of most of the studied area was slightly alkaline 7 to 8, moderately alkaline 8 to 9 (Dimeglio et al. 1995). While the pH of small area was alkaline (pH equal or more than 8.5) as shown from (Figure 4.6). The significant correlation was recorded between actual and estimated pH there is no change explained Produced crushing map of soil pH.

Electrical conductivity is one of the chemical properties of the soil that determines the concentration of soluble cations and anions (soluble salts), such as calcium, magnesium, potassium, sodium, chloride bicarbonate, and sulfate, the type of ions affects on soil properties for example sodium salts or ions causes decrease in soil permeability , bad aireation as due to clay dispersion which causes decrease in soil macro pores. (Figure 4.7) shows that the EC of studied area was ranged from 132 to 646.9 µmhose/cm or 0.132 to 0.646 dS.m[1], it means the soil samples were non-saline since the EC in less than 4000 µmoles/cm or 4 dS/m (Richards 1954).

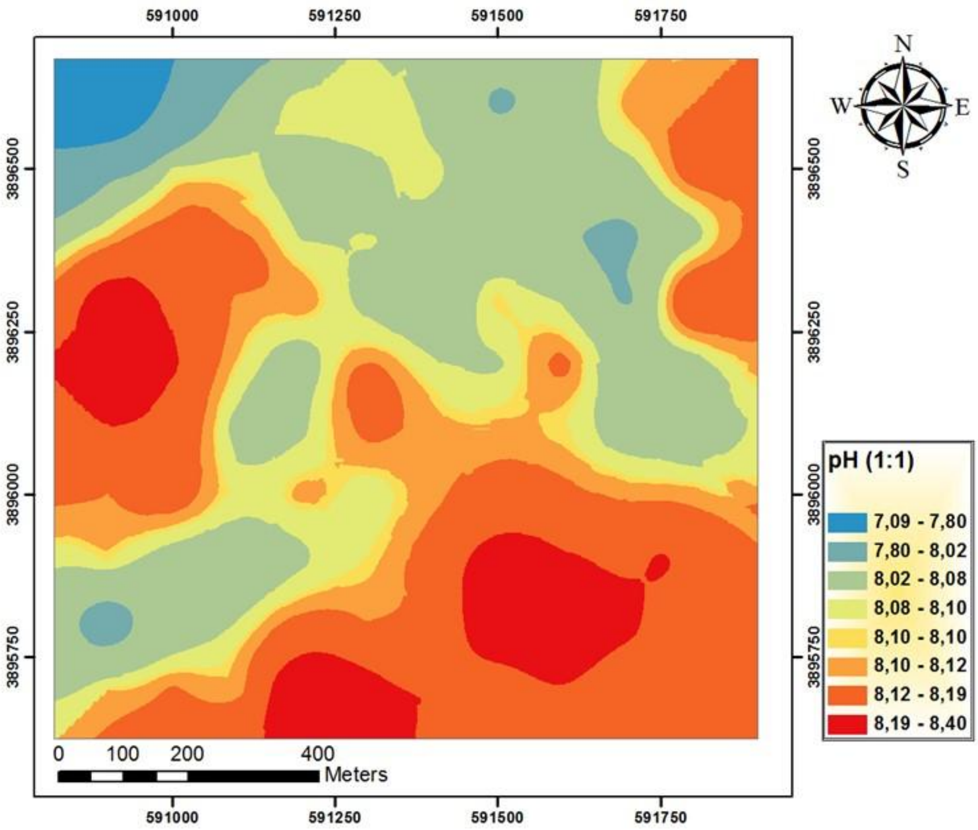

Figure 4.6. Distribution map of the soil pH in the study area

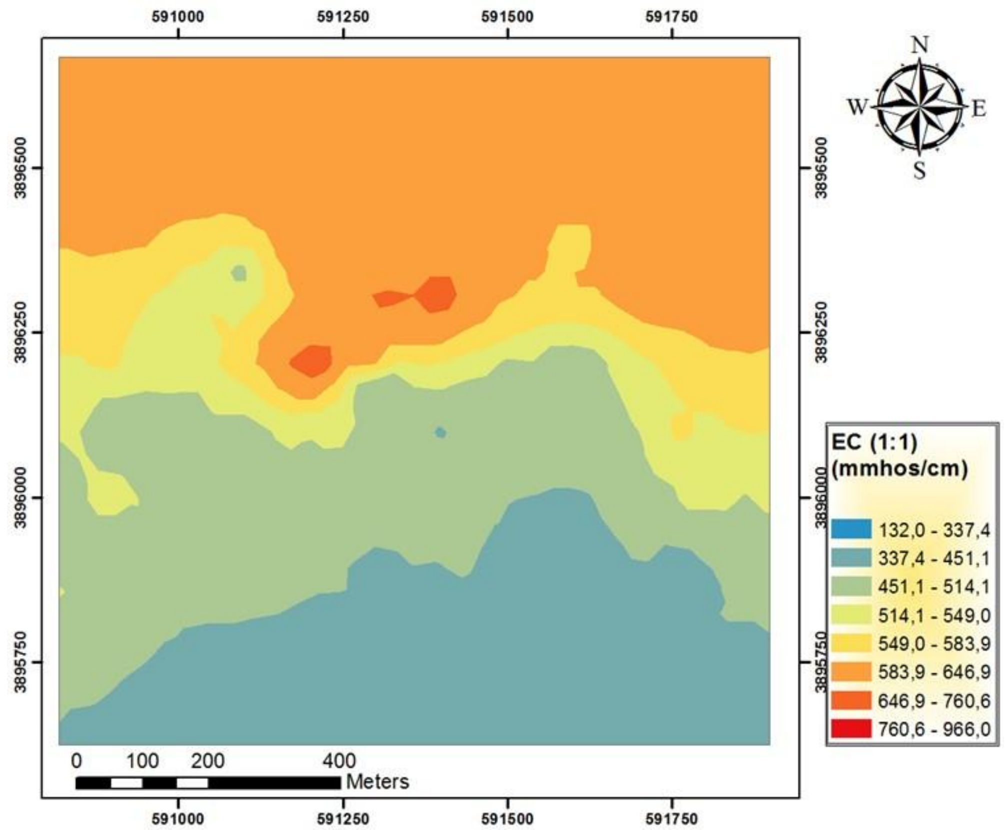

Figure 4.7. Distribution map of the soil EC in the study area

Figure 4.8 explains that the organic matter content of the studied area was ranged from 0.88% to 3.23% , it means most of the studied area have the O.M% more than 1%, which intern means that the organic matter content for the studied area ranged from medium to high. Since the soil contains more than 1.29% it means the organic matter is high (Walkley Black 1934), but if it contains less than 0.85% it means that it contains low organic matter content Table 4.1. The significant correlation coefficient was recorded between estimated and actual O.M% of the studied soil samples. İt is in agreement with (Aziz and Karem 2016) results, they are in same range.

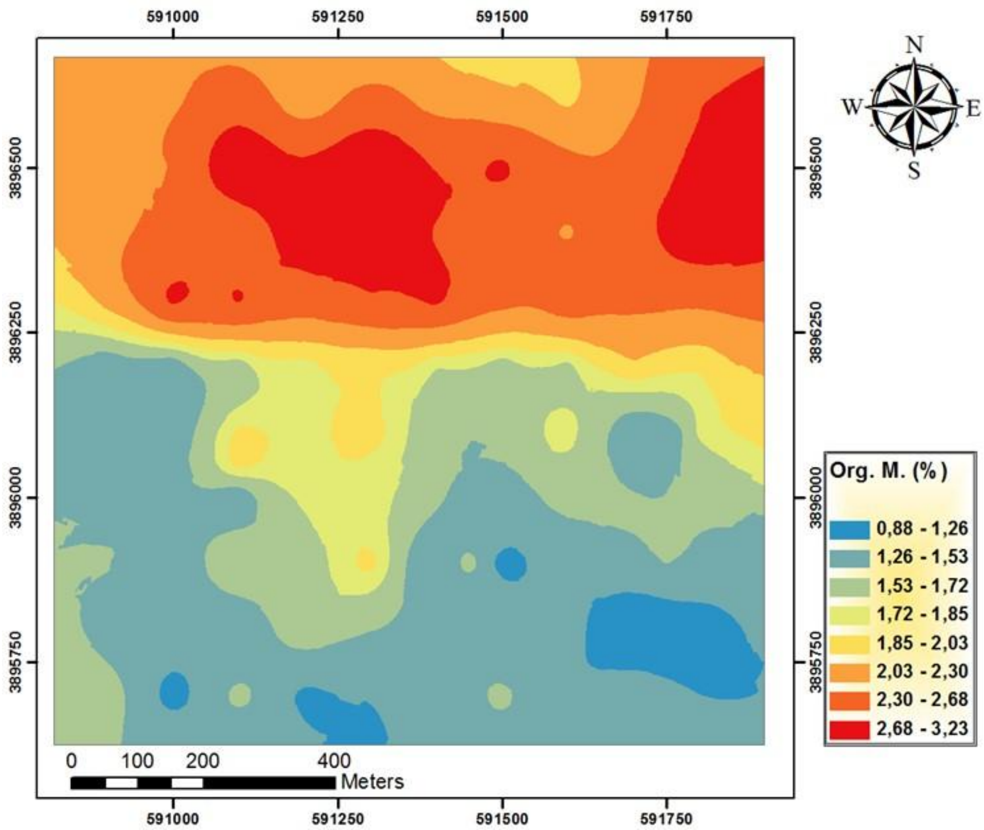

Figure 4.8. Distribution map of organic mater in soil

Iraqi agricultural soils, mostly calcareous to extensive calcareous that the percentage of calcium carbonate in the soil has a significant impact on the chemical reactions and the availability of nutrients to the plants and the acidity of the soil. The percentage of calcium carbonate represents 90% - 95% of the total carbonate minerals. The increase in the calcium carbonate leads to increased in the soil pH value (Maulood et al., 2012). The results of spatial variation in the study sites on the chemical properties of the soil and stakeholders indicate a change in the value of overall stability, in general, refers to $CaCO_3$% of the studied area which varied from 6.9% to 20.8% (Figure 4.9). It means most of the studied area was extensive calcareous since the $CaCO_3$% of them was more than 10% (Hodgson and Fridovich 1975). İt is agree with (Aziz and Karem 2016) result theye are in same range.

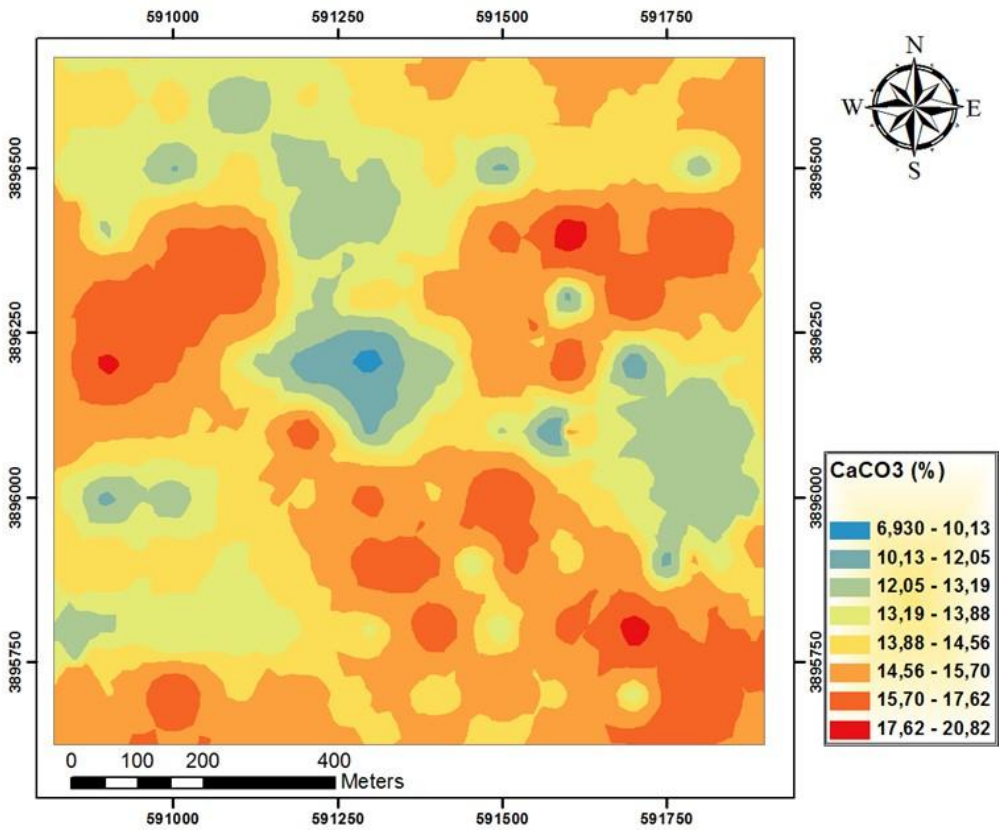

Figure 4.9. Destribution map of the soil $CaCO_3$ in study area

Geostatistical data results show that the readiness of phosphorus in the studied soil area ranged from 0.12 to 12.8 $mg.kg^{-1}$ soil. In general the concentration of phosphorus in most of the studied soils was less than the critical level (5 mg.kg-1 soil),it means concentration of phosphorus in blue,green and yellow sites of the map is less than phosphorus critical value mentioned by (Black 1965).Since depending on (Black 1965) the critical value of phosphorus in the soil is (5 $mg.kg^{-1}$ soil) on the other hand the phosphorus critical level in Iraqi soil was (7 $mg.kg^{-1}$ soil) as mentioned by (Hassan et al. 1975).While the phosphorus critical level for Erbil governorate soils was (3.5 mg.kg-1 soil) as recorded by (SheakhBzayni 2005).On the other hand depending on local study (SheakhBzayni 2005) the concentration of the phosphorus for most of the studied soil samples was more than critical value yellow, red and brown colours of (Figure 4.10).

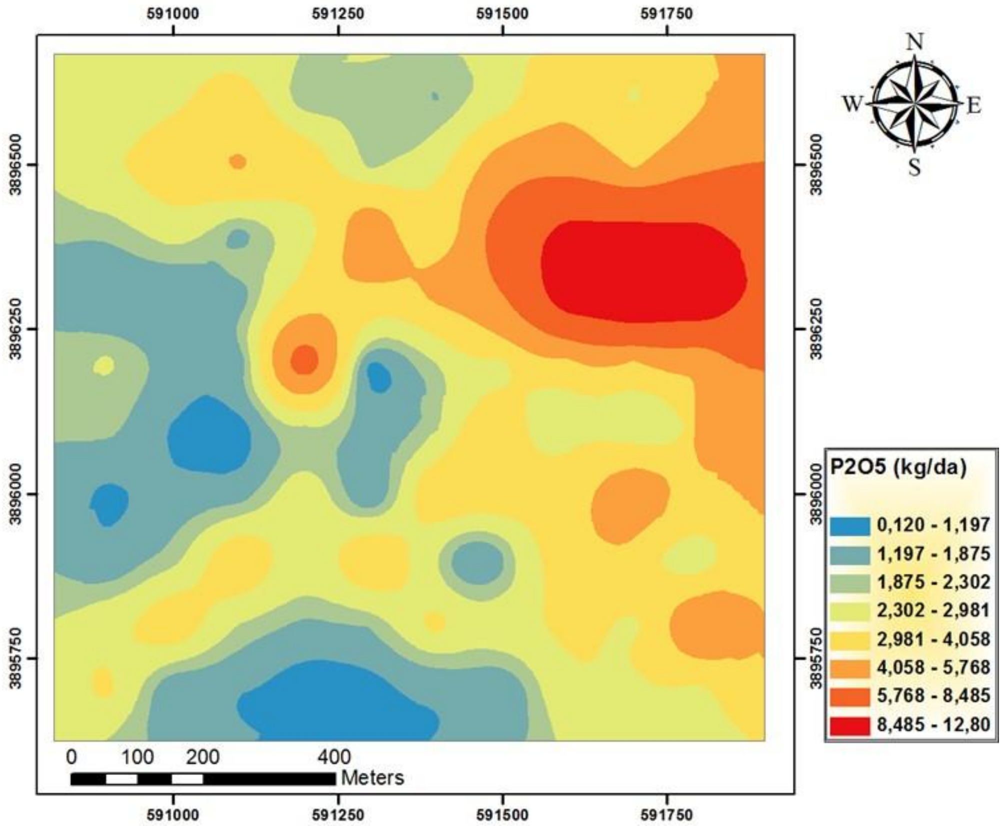

Figure 4.10. Distribution map of the soil P_2O_5 in the study area

Spatial characteristics of the soil examination autocorrelation have been shown by the distance from the clay and silt, sand content. It has made him subject for study examined group changing soil properties 100 meters above similar accounts geyer and the same distance from a group to examine all the properties of the soil distance (100 m) from the borders of change they are less valuable with this issue spatial distributions of soil properties designation In this study, each mazhalnmozj determine the optimal the way people look and using every 100 square meters (10m × 10m) such as estimates are made for girls. nature of the land.

Figures (4.11 – 4.12 – 4.13) shown particle size distribution of the studied soil samples The range of clay, silt and sand particles were (37.2 - 59.8)%, (2.10- 39.2)% and (16.5 – 38.0)% respectively. This wide range of the clay particle size creates different soil textures in the studuied area. It is in agreement with (Aziz and Karem 2016) results.

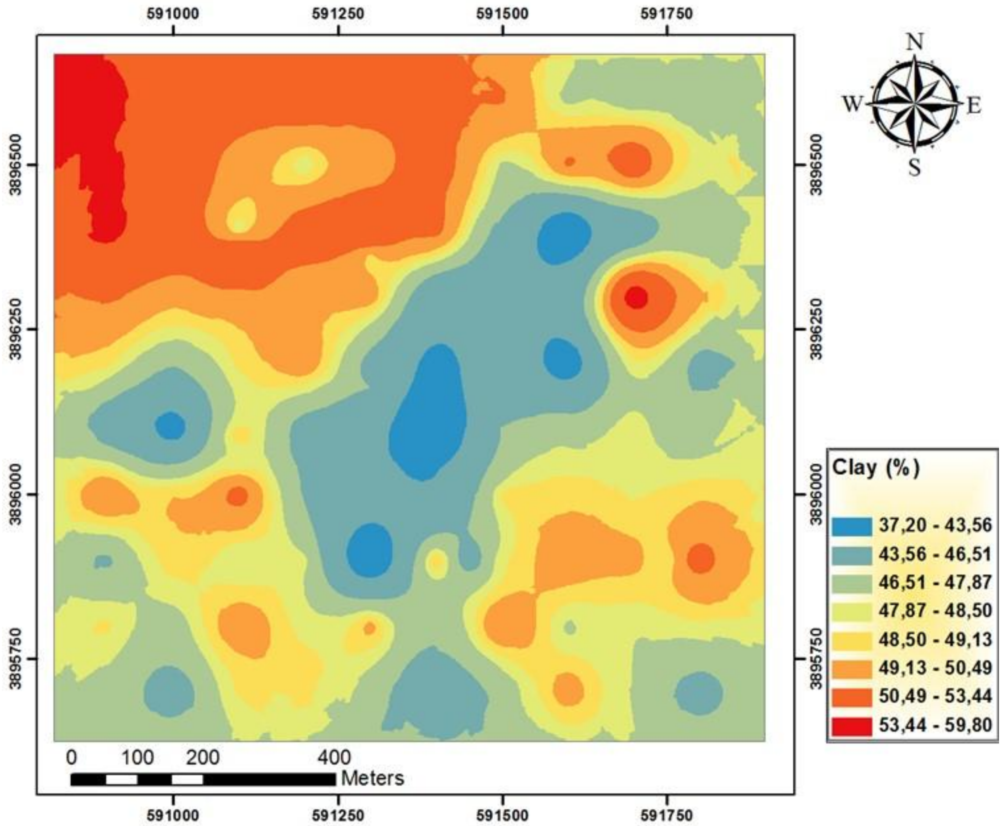

Figure 4.11. Distribution map of the soil Clay in the study area

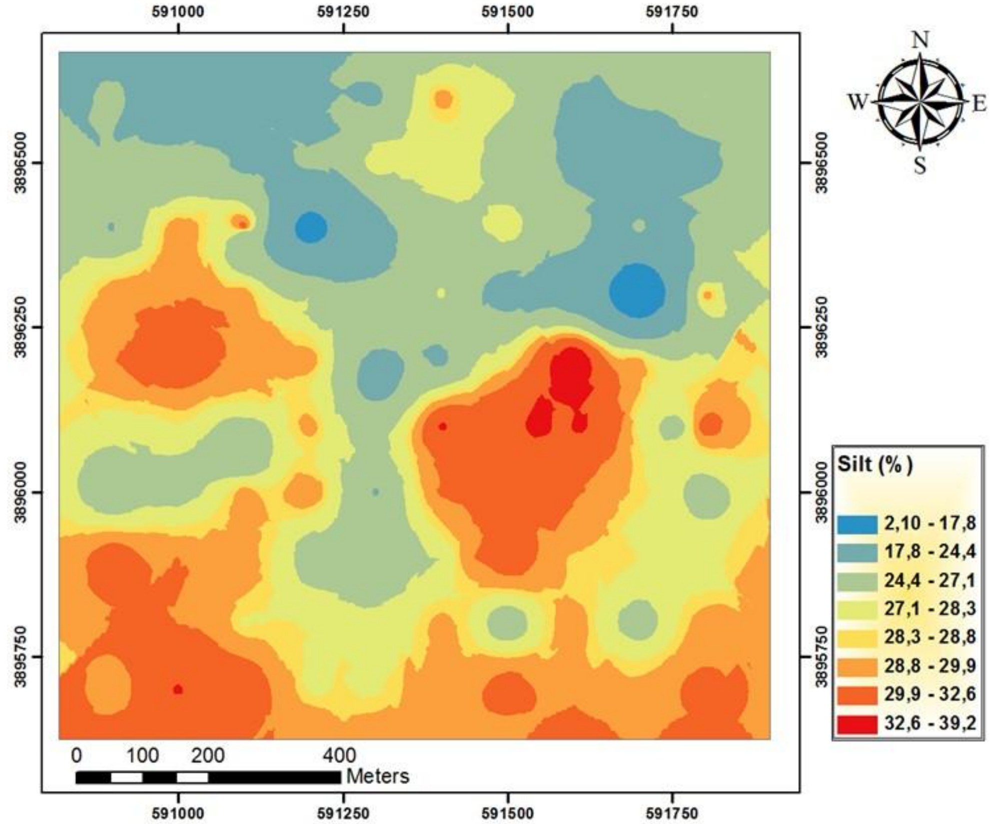

Figure 4.12.. Distribution map of the soil Silt in the study area

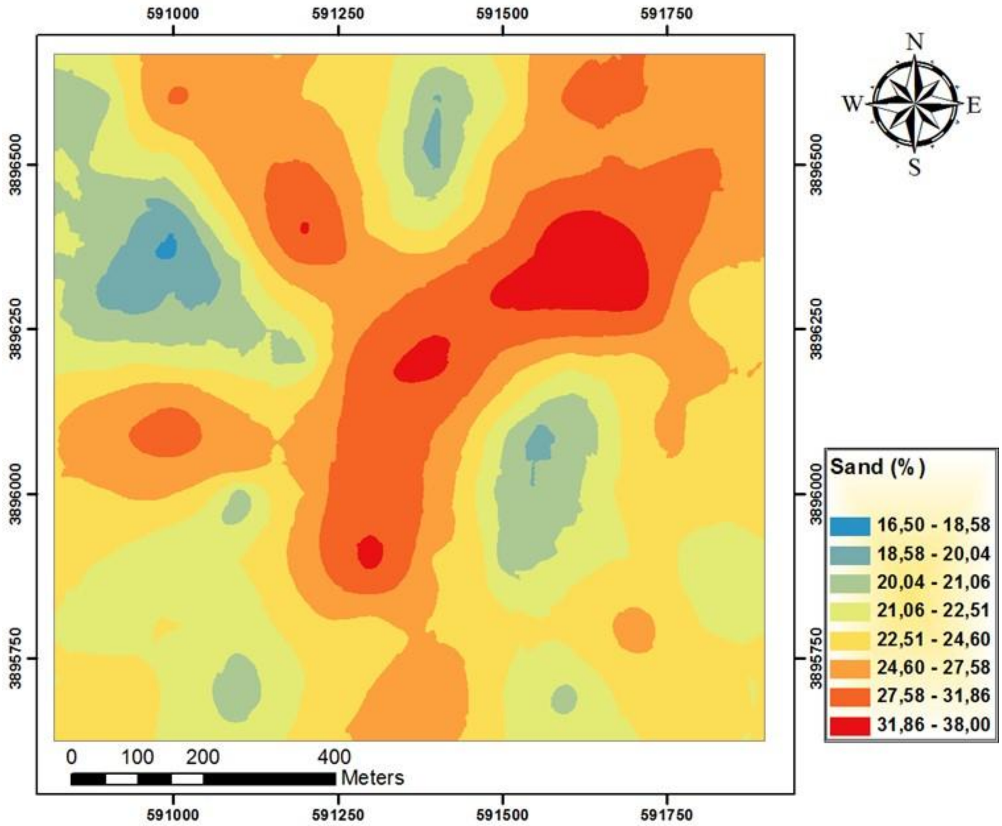

Figure 4.13. Distribution map of thye soil Sand in the study area

The value of exchangeable Ca^{2+} ranged from 26.1 to 52.2 meq/100g soil. This high value of exchangeable Ca^{2+} may be due to high $CaCO_3$ content of the studied area as mentioned before, since $CaCO_3$ regards as a source for Ca^{2+} (Figure 4.14). The amount of exchangeable calcium is differing among the studied samples or sites of the studied area. Dis agrees with (Aziz and Karem 2016) result theye are in same range.

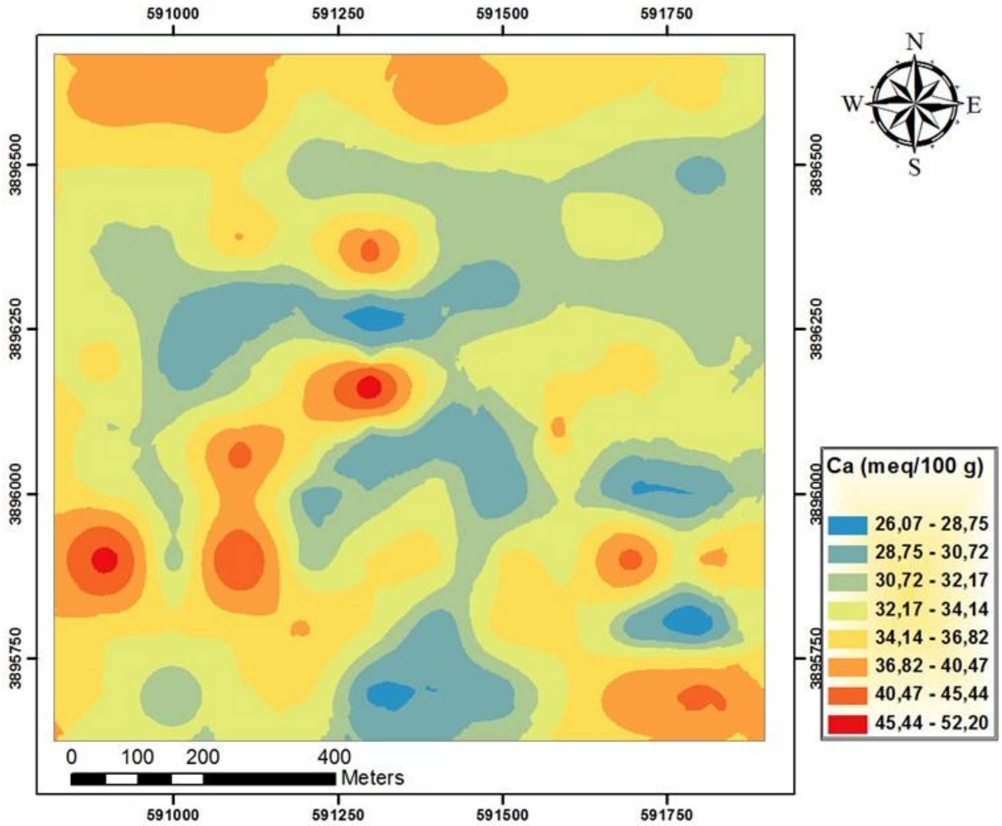

Figure 4.14. Distribution map of the soil Ca^{2+} in the study area

Figure 4.15 explains the range for exchangeable magnesium at the studied area, which was from 1.86 to 35.4 meq /100 g soil. The main source of Mg in dolomite mineral [Ca,Mg, $(CO_3)_2$], the spatial distribution of magnesium for the studied area, shows the variation in its value among the studied samples and directions from east to west and north to south. Dis agrees with (Aziz and Karem 2016) result they are in same range.

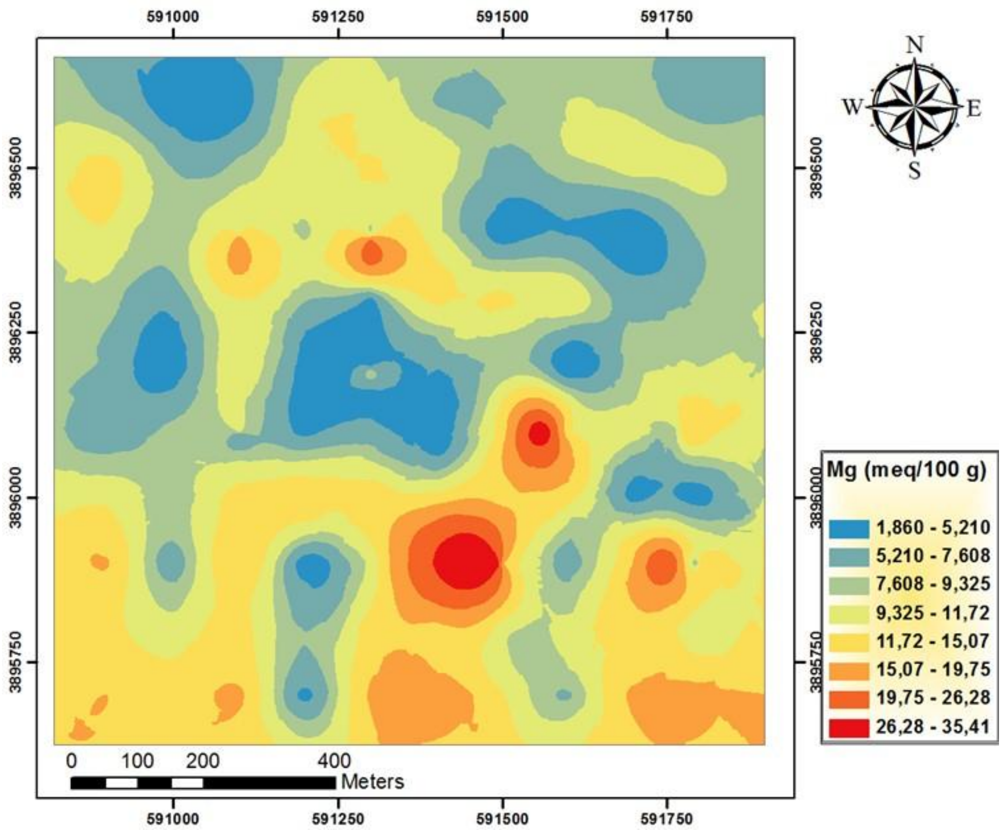

Figure 4.15. Distribution maps of the soil Mg^{2+} the study area

Map of K^+ distribution in the study area, content the Potassium ranged from 9.90 to 20.4 meq/100g soil while the critical value for available K^+ in Iraqi soil is (180ppm). It means the K concentration in the studied location is more than critical level recorded (Hassan et al. 1975).The Sodium content of the studied soil as shown from (Figure 4.16) is less than other cations in the studied area, this may be due to the geological composition of the studied area or due to non-saline soil of this area or location krigk and seimavrince.

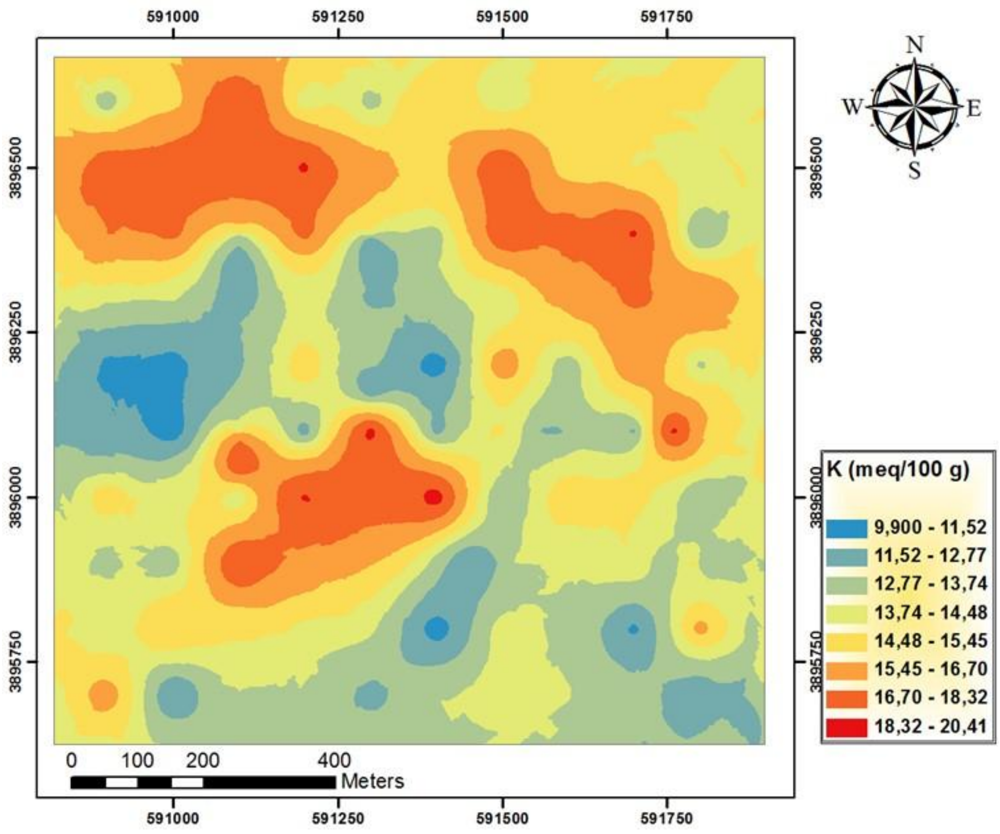

Figure 4.16. Distribution map of the soil K^+ in the study area

Sodium is one of the positive ions in the soil to increase the ratio of sodium in the soil cause alkaline soil for it raises the degree of interaction of soil, and is one of the weak ions cohesion of the soil it loses through the water The sodium content of the studied soil as shown from (Figure 4.17), was range from 0.31 to 6.74 meq/100 is less than other cations in the studied area, this may be due to the geological composition of the studied area or due to non saline soil of this area or location. The results of the study of spatial variation of sodium show mapping semivariance the ratio of sodium in all directions, especially high in the direction of the north and south as well as east and west line, and the central regions are a small percentage of potassium or medium. It is in agreement with (Aziz and Karem 2016) result, they are in the same range.

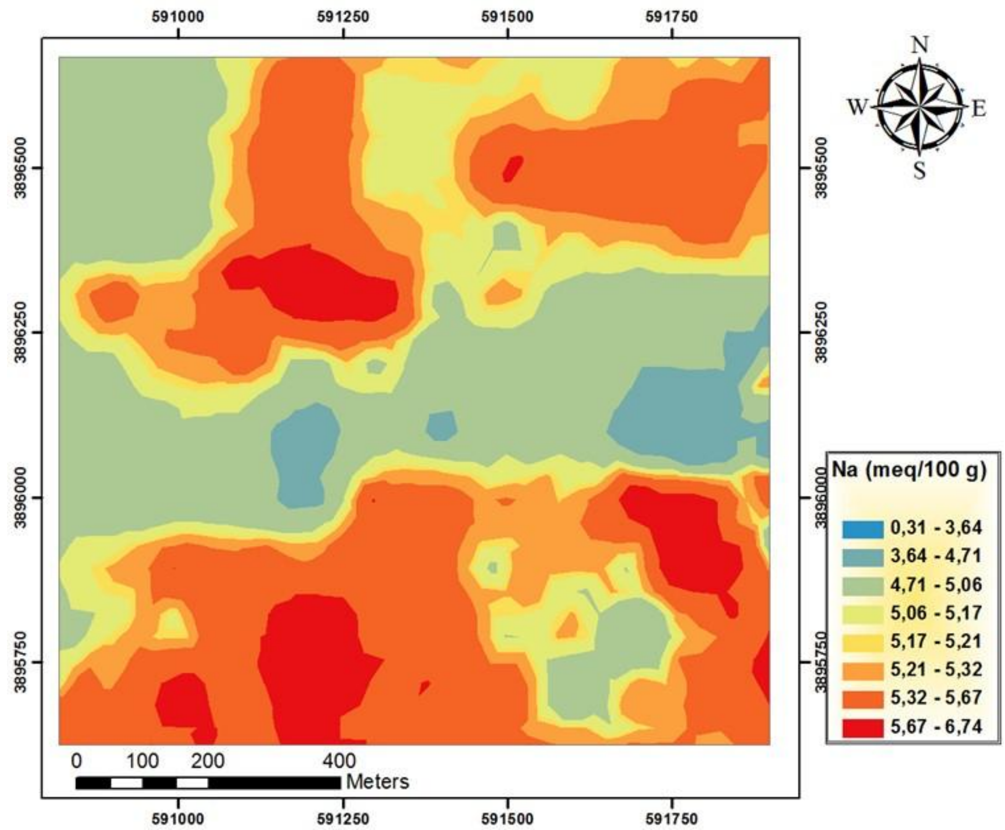

Figure 4.17. Distribution map of the soil Na^{+} in the study area

Cation exchange capacity is a measure of a soil is capacity to retain and release elements such as Ca^{2+}, Mg^{2+}, K^{+} and Na^{+}. Soils with high clay and organic matter content high (Horneck.et al. 2011). Cation exchange capacity is often estimated by summing the major exchangeable cations (Ca^{2+}, Mg^{2+}, K^{+} and Na^{+}) using units of cmolc /kg. (Figure 4.18) the range of Cation exchange capacity is often estimated by summing the major exchangeable cations (Ca^{2+}, Mg^{2+}, K^{+} and Na^{+}) using units of cmolc /kg. cation exchange capacity of the studied soil samples was 47.4 to 88.2 cmolc /kg soil. It means the CEC is high or the soil is fertile since increase in soil CEC means increase in soil fertility. Results of the study area show that the proportion of cations few positive ions because the rate of a few cation exchangeable capacity also appeared map kriking, as explained in the mapping on the line south of the direction of the highest as well as the north top-line to an average of either the central areas are the proportion of ions slim to average.

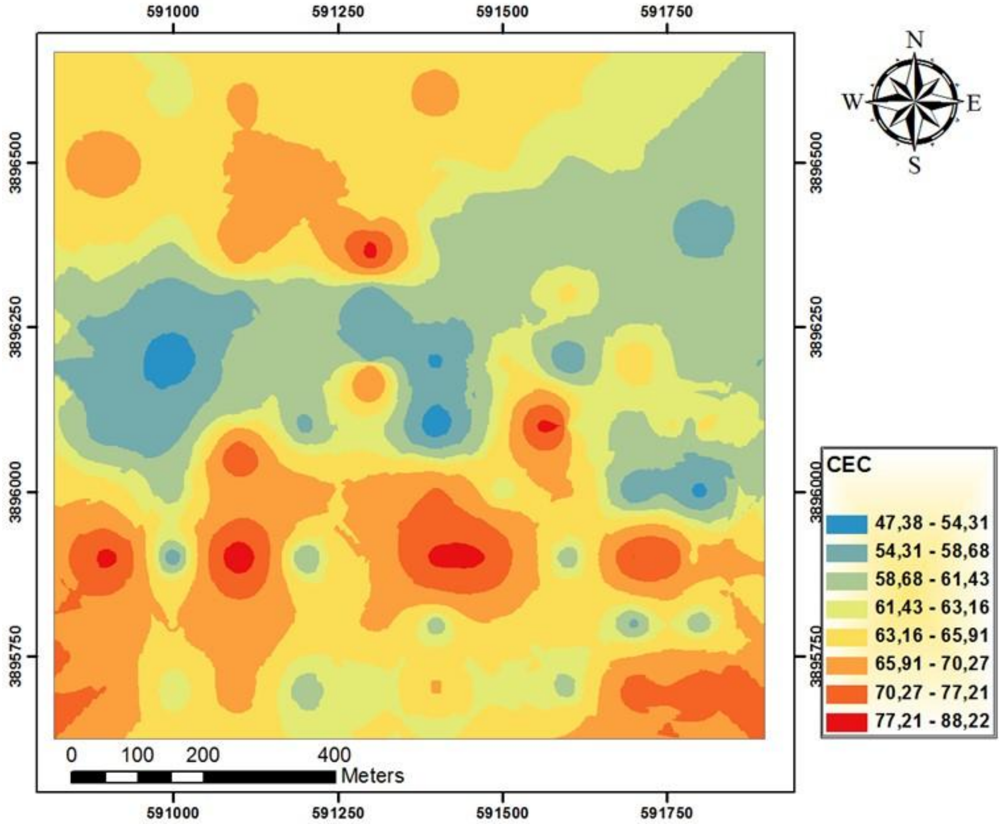

Figure 4.18. Distribution map of the soil CEC in the study area

The Fe concentration ranged from 1.06 to 20.7 ppm in the studied soil (Figure 4.19). Which means that most of the studied soils at this area contains adequate amount of iron, since the critical level for available ron is 2.50 ppm, the iron content for most of the studied samples was above critical level except few location at (locations drawn by blue colure).

The results of the study show that the Zn concentration ranged from 0.33 to 1.74 ppm (Figure 4.20). That means that most of the studied samples contains low amount of available Zn (less than 1ppm) except some locations which are containing adequate amount of available Zn (the locations having brown and red colure in the map).

Mapping of manganese form one of Kriging Manganese as shown in (Figure 4.21) indicated that the range of Mn was from 5.87 to 24.5 ppm. It means that the concentration of available Mn is adequate for plant growth at the studied area, but it is differing from location to other as shown from (Figure 30).

Results of the study of the available copper concentration (Figure 4.22) showed that the concentration of Cu was from 0.56 to 1.23 ppm. It appears from the map, that the concentration of Cu increases from the north to south in the studied area.

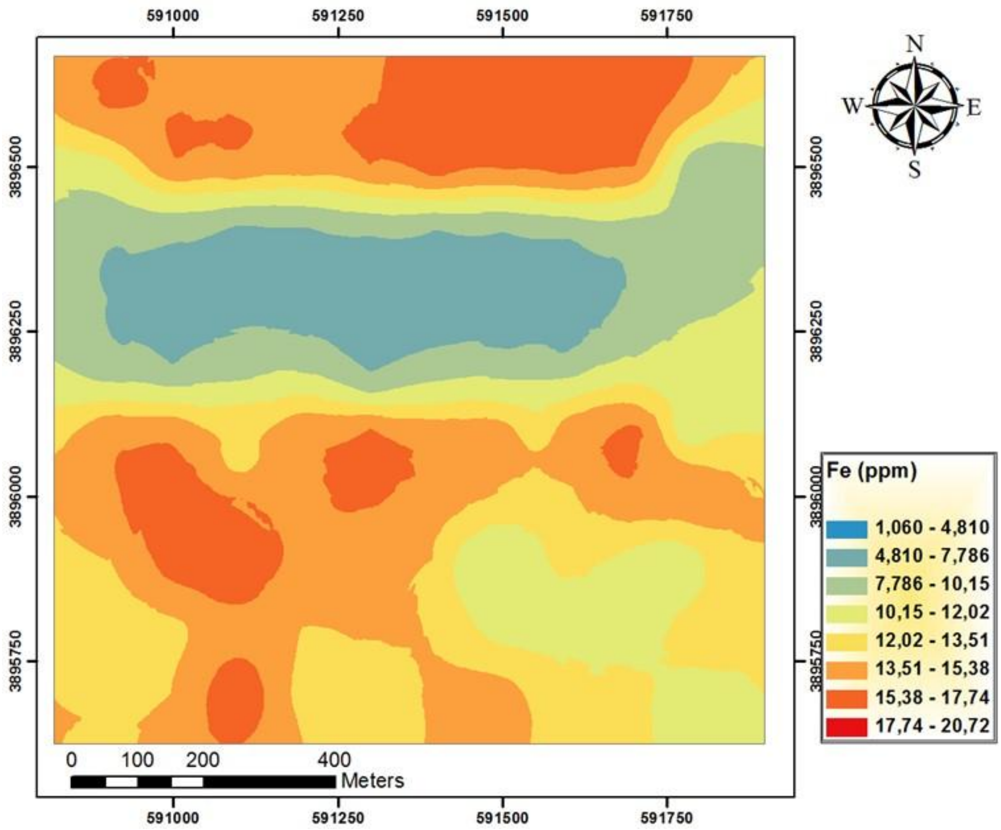

Figure 4.19. Distribution map of the soil Fe in the study area

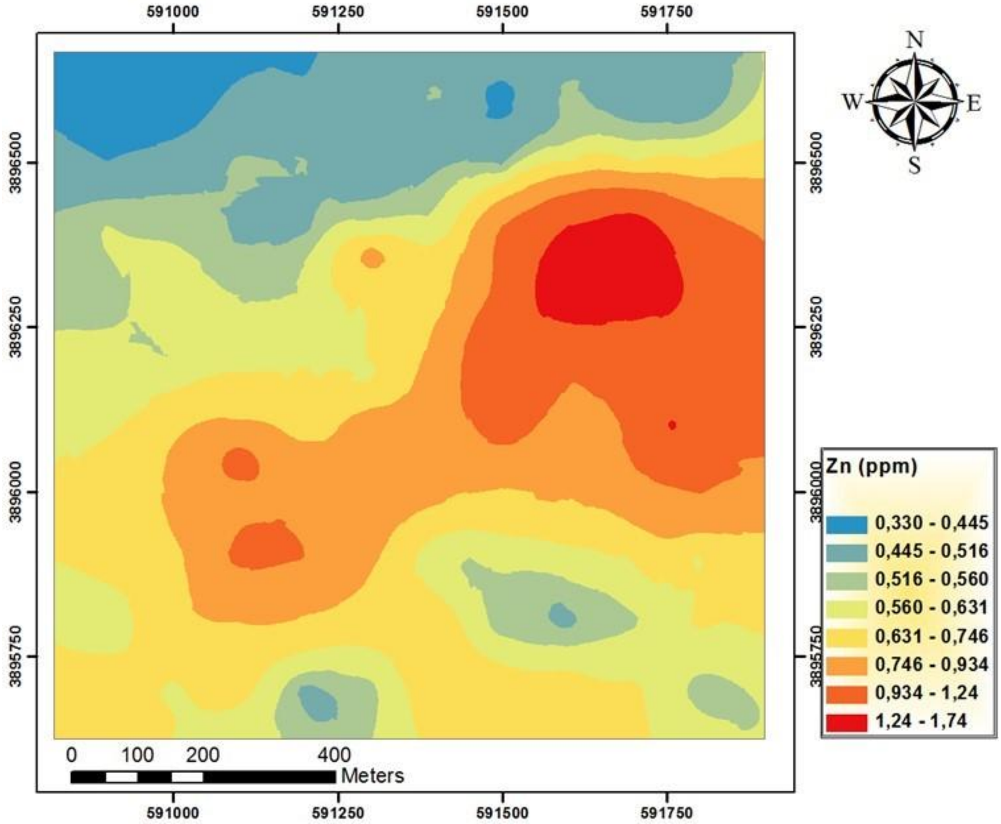

Figure 4.20. Distribution map of the soil Zn in the study area

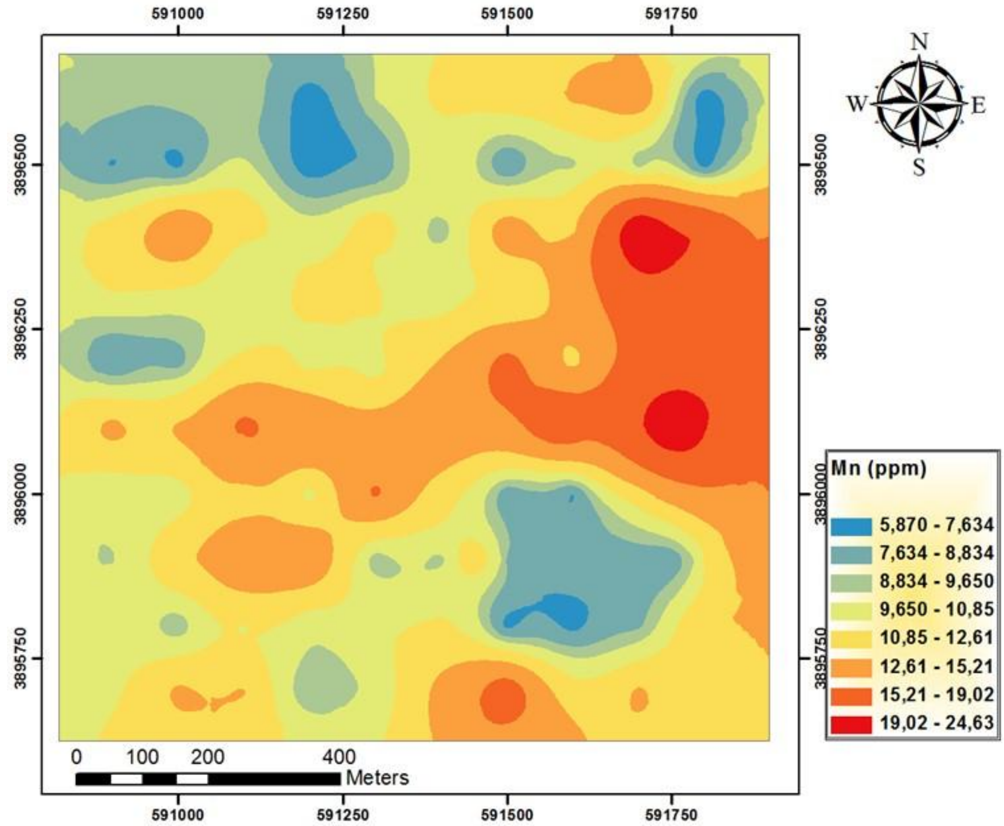

Figure 4.21. Distribution map of the soil Mn of the study area

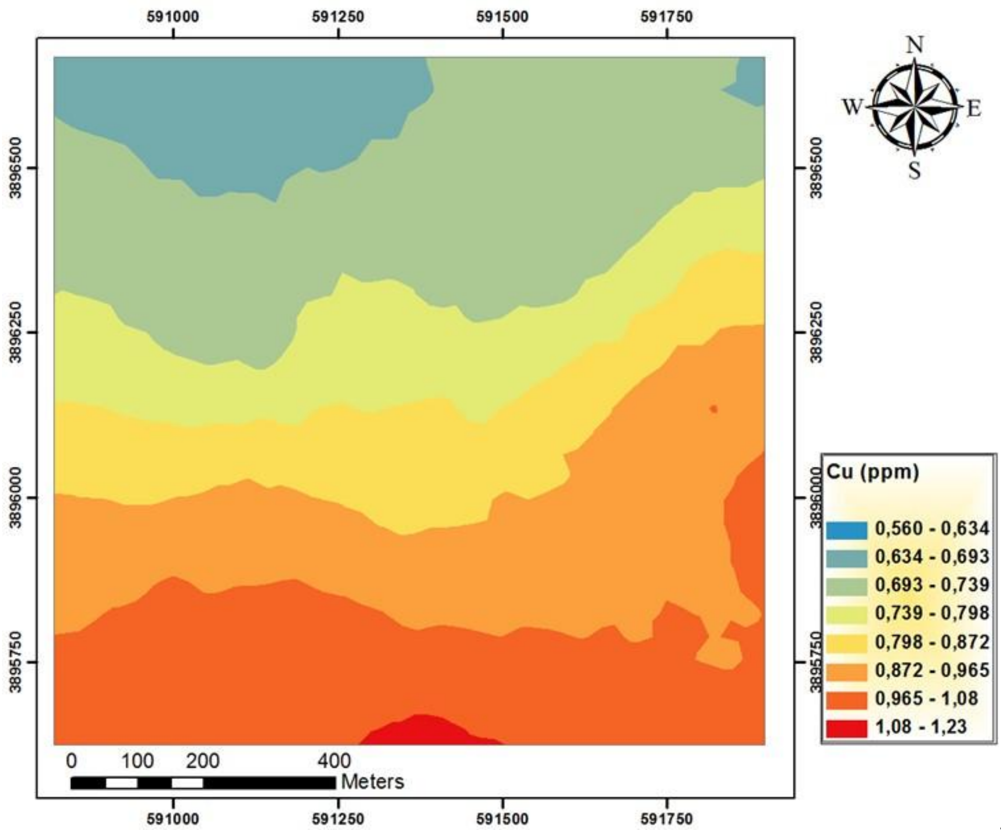

Figure 4.22. Distribution map of the soil Cu in the study area

CONCLUSION

Spatial variation in Halabja Eneb's area location with GPS reading of North (35^0 0^0 12^0) and East (45^0 0^0 58^0) and the height of 690 m above sea level, can help in the analysis of the factors and processes to study the soil properties and availability of nutrients for plants. The objectives of this study was to analyze the spatial variability of the soil pH ,EC, CEC, organic matter, calcium carbonate, some macro and micro nutrients and availability such as P, K, Mg, Ca, Na, Fe, Zn, Mn and Cu to the olive growth and patterns of different crops 100 hectares Map plants using geostatistical methods by semi-variogram, Kriging maps and assessment of the factors and processes controlling contrast.

Geostatistical, and a total 116 samples from depth (0-20 cm) and show the following results. The 75% of pH of the studied samples moderately alkaline and 24.1% of were slightly alkaline 0.86 % strongly alkaline. All the studied samples were non saline, the conductivity of 52%, Organic matter ratio of 19.1% of the studied area ranged from 0.88 to 3.23%, it means most of the studied area have the O.M%. The proportion of calcium carbonates Phosphorus 315%. The proportion of clay 4.82%, silt 2.72% and 2.45% the proportion of sand so that the high percentage of clay loam. The ability of the cations 6.43% and the feel of the soil are clay soil and the proportion of calcium 3.39%, Mg 1.08%, potassium 1.43%, sodium 518%. The proportion of cation exchangeable capacity 6.43%.Iron 1.20%, zinc 71.43%, manganese 1.18% and copper 82.93.

The range of organic matter content, $CaCO_3$ and CEC were 0.88% to 3.23%, 9.6% to 20.80% and 47.40 to 88.20 cmolc.kg^{-1} soil respectively. The P content of the studied soil sample was ranged from 0.12 to 12.8 kg/da, while the range of macro nutrients Ca^{2+}, Mg^{2+}, K^+, Na^+ were 26.1 to 52.2 , 1.86 to 35.4 , 4.04 to20.4 and 0.31 to 6.74 meq /100 g soil respectively. While the range of micro nutrients Fe, Zn, Mn, Cu for the studied soil samples were (1.06 to 20.7 , 0.33 to 1.74), 5.87 to 24.6 and 0.56 to 1.23 ppm respectively.

There is not any work to accomplish without hard working and endeavoring as much as you can to achieve what you verily want to cope.

REFERENCES

Addis HK, Klik A, Strohmeier S (2015) Spatial variability of selected soil attributes under agricultural land use system in a mountainous watershed, Ethiopia. International Journal of Geosciences, 6(6): 605

Akbas F (2004) Entisol ordosuna aitbirarazi toprak ozelliklerinin degisiminin geleneksel ve jeoistatistiksel yontemlerle belirlenmesi. Gaziosmanpaşa Üniversitesi

Akbas F (2014) Spatial variability of soil color parameters and soil properties in an alluvial soil. African Journal of Agricultural Research, 9(12): 1025-1035

Akbas F, Günal H, Gökmen F, Gezgın S, Ersahın S (2009) Spatial variation of micronutrients in topsoil and subsoil of Vertic Haplustepts. Agrochimica, 53(2): 101-116

Akter F (2012) Inorganic phosphorous fractionation in some soils of ganges meander floodplain. Khulna University

Al-doski J, Mansor SB, Shafri HZM (2013) Monitoring Land Cover Changes in Halabja City, Iraq. International Journal of Sensor and Related Networks (IJSRN) Volume, 1

Ali JJM, Amin SH, Rashed SO, Noori IM (2015) Utilizing the olive trees for developing green area in Kurdistan. Vol. 6, No. 4, pp: 92-99

Andrade JM, Kubista M, Carlosena A, Prada D (2007) 3-Way characterization of soils by Procrustes rotation, matrix-augmented principal components analysis and parallel factor analysis. Analytica chimica acta, 603(1): .20-29

Aşkın T, Kızılkaya R, Yılmaz R, Olekhov V, Mudrykh N, Samofalova I (2012) Soil exchangeable cations: A geostatistical study from Russia. EURASIAN JOURNAL OF SOIL SCIENCE (EJSS), 1(1): 34-39

Aziz SA, Karim SM (2016) The Effect of Some Soil Physical and Chemical Properties on Soil Aggregate Stability in Different Locations in Sulaimani and Halabja Governorate. Open Journal of Soil Science, 6(04): 81

Basbozkurt H, Öztas T, Karaibrahimoglu A, Gundogan R, Aşır GENÇ (2013) Toprak Özelliklerinin Mekânsal Değişim Desenlerinin Jeoistatistiksel Yöntemlerle Belirlenmesi. Journal of the Faculty of Agriculture, 44(2): 169-181

Belliturk K, Saglam C, Akdemir B, Sisman CB (2010) Determination of Spatial Variability in Olive Production. Part I-Soil. Bulgarian Journal of Agricultural Sciences, Bulgaria, 16(4): 468-475

Bijanzadeh E, Mokarram M, Naderi R (2015) applying spatial geostatistical analysis models for evaluating variability of soil properties in eastern Shiraz, Iran. Iran Agricultural Research, 33(2): 35-46

Bohling G (2005). Introduction to geostatistics and variogram analysis. Kansas geological survey, pp: 1-20.

Bouyoucos G.J, 1962. Hydrometer method improved for making particle size analyses of soils. Agronomy journal, 54(5): 464 -465.

Cai A, Feng W, Zhang W, Xu M (2016) Climate, soil texture, and soil types affect the contributions of fine-fraction-stabilized carbon to total soil organic carbon in different land uses across China. Journal of environmental management, 172, 2-9

Cavins TJ, Gibson JL, Whipker BE, Fonteno WC (2000) pH and EC meters-tools for substrate analysis. Floriculture research, North Caw. 1ina State University, pp: 1-4

Dawes LA (2006) Role of soil physical and chemical characteristics and landscape factors in defining soil behaviour under long term wastewater dispersal

Demir Y, Erşahin S, Güler M, Cemek B, Günal H, Arslan H (2009) Spatial variability of depth and salinity of groundwater under irrigated ustifluvents in the Middle Black Sea Region of Turkey. Environmental Monitoring and Assessment, 158(1-4): 279-294

Dimeglio A, Bensahel H, Souchet PH, Mazeau PH, Bonnet F (1995) Classification of clubfoot. Journal of Pediatric Orthopaedics B, 4(2): 129-136

Esmail AO (2012) Effect of Soil Phosphorus Chemical Equilibrium on P-availability for Wheat using Solubility Diagram and (DRIS-Chart) Methods. Journal of Kirkuk University for Agricultural Sciences Vol, 3(2)

FAO (2014) Strengthening the enabling environment for food security and nutrition. E-ISBN 978-92-5-108543-1

Fayisa MC (2014) Assessment of Soil Physical and Chemical Properties as Affected by Different Land Use Types in Warandhab Area of Wollega Zone, Oromia Regional State. Haramaya University

Ferreira V, Panagopoulos T, Andrade R, Guerrero C, Loures L(2015) Spatial variability of soil properties and soil erodibility in the alqueva reservoir watershed. soild earth 6, 383- 392

Gargouri K, Sarbeji M, Barone E (2006) Assessment of soil fertility variation in an olive orchard and its influence on olive tree nutrition. In Proceedings of the Second International Seminar Biotechnology and Quality of Olive Tree Products Around the Mediterranean Basin November

Gülçur F (1974) Topragın Fiziksel ve Kimyasal Analiz Metodları. İstanbulÜniversitesi Orman Fakültesi Yayınları, İÜ. Yayın No, OF. Yayın No: 201, Kutulmuş Matbaası, İstanbul, 1970

Hassan NAK, Aziz F, Raban E, Asker S, Al-Timimi T (1975) Limits of phosphorus availability in representative Iraqisoil as measured by crop response and soil values. 2nd scientific conference, Baghdad, Iraq

Hodgson EK, Fridovich I (1975) Interaction of bovine erythrocyte superoxide dismutase with hydrogen peroxide. Inactivation of the enzyme. Biochemistry, 14(24): 5294-5299

Horneck DA, Sullivan DM, Owen JS, Hart JM (2011) Soil test interpretation guide. [Corvallis, Or.]: Oregon State University, Extension Service

Huber M (2013) Soil variability and its consequences in geotechnical engineering. Inst. f. Geote chnik

Huber M, Moellmann A, Bárdossy A, Vermeer PA (2009 November) Contributions to probabilistic soil modeling. In Proceedings of the 7th International Probabilistic Workshop, Delft pp: 1-12

Jeloudar ZJ, Kavianpoor H, Ouri AE, Kavian A (2012) Spatial Variability of Some Soil Properties in Mountain Rangelands of Northern Iran. World Academy of Science, Engineering and Technology, International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering, 6(8): 631-635

Jones C, Jacobsen, J (2005)Plant nutrition and soil fertility. Nutrient management module, (2): 11

Kavianpoor H, Ouri AE, Jeloudar ZJ, Kavian A (2012) Spatial variability of some chemical and physical soil properties in Nesho Mountainous Rangelands. American Journal of Environmental Engineering, 2(1): 34-44

Kilic K, Kilic S, Kocyigit R (2012) Assessment of spatial variability of soil properties in areas underdifferent land use. Bulg. J. Agric. Sci., 18: 722-732

Krasilnikov P, Carre F, Montanarella L (2008) Soil geography and geostatistics.

Concepts and Applications. JRC Scientific and Technical Reports. EUR 23390 EN

L´opez-Granados F, Exp´osito MJ, Atenciano S, Garc´ıa-Ferrer A, de la Orden MS, Torres LG (2002) Spatial variability of agricultural soil parameters in southern Spain. Plant and soil 246: 97-105

Laštincová J, Vanovčan J, Oktavec D, Kaderova E (1999) Multielemental determination of Cu, Zn, Mo, Mn, V in soils by ICP-AES method after microwave digestion. Chemical Papers, 53(5): 288-294

Lindsay WL, Norvell WA (1978) Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil science society of America journal, 42(3): 421-428

Loumou A, Giourga C (2003) Olive groves:The life and identity of the Mediterranean. Agriculture and Human Values, 20(1): 87-95

Maulood PM, Esmail AO, Dohuki MS, Darwesh DA (2012) Comparison between Calcimetric and Titrimetric Methods for Calcium Carbonate Determination. Open Journal of Soil Science, 2(03): 263

McCauley A, Jones C, Jacobsen J (2009) Soil pH and organic matter. Nutrient management module, 8, pp: 1-12

Mulla DJ, McBratney AB (2000) Soil spatial variability. P: A321–A352. MK Summer (ed.) Handbook of soil science

Nelson DW, Sommers L (1982) Total carbon, organic carbon, and organic matter. Methods of soil analysis. Part 2. Chemical and microbiological properties, (methodsofsoilan2), pp: 539-579

Olsen SR (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate

Özgöz E, Akbş F, Çetin M, Erşahin S, Günal H (2007) Spatial variability of soil physical properties as affected by different tillage systems. New Zealand journal of crop and horticultural science, 35(1): 1-13

Pettit RE (2004) Organic matter, humus, humate, humic acid, fulvic acid and humin: Their importance in soil fertility and plant health. CTI Research

Phefadu KC, Kutu FR (2016) Evaluation of Spatial Variability of Soil Physico-Chemical Characteristics on Rhodic Ferralsol at the Syferkuil Experimental Farm of University of Limpopo, South Africa. Journal of Agricultural Science, 8(10): 92

Richards LA (1954) Diagnosis and improvement of saline and alkali soils. Soil

Science, 78(2):154

Richter MG, Massen IM (1973) Total organic carbon and oxidizable organic carbon by the Walkey-Black procedure in some soils of the Argentine Pampa. Agrochimica. Total de registros: 1 BD BIBUN Ayuda MegaBase Agropecuaria Alianza SIDALC

Rogowski AS (1996) Quantifying soil variability in GIS applications: II Spatial distribution of soil properties. International Journal of Geographical Information Systems, 10(4): 455-475

Sánchez T, Jaiver D, Ligarreto M, Gustavo A, Leiva FR (2011) Spatial variability of soil chemical properties and its effect on crop yields: a case study in maize (Zea mays L) on the Bogota Plateau. Agronomía Colombiana, 29(2): 456-466

Sarmadian F, Keshavarzi A, Rooien A, Iqbal M (2011) Continuous mapping of topsoil calcium carbonate using geostatistical techniques in a semi-arid region. [AJCS 4(8):603-608]

Sheakh Bzayni ITA (2005) The cirtical level of phosphorus for wheat in Arbil plain soils.MSc thesis University of Salahaddin, College of agriculture

Shukla AK, Behera SK, Lenka NK, Tiwari PK, Prakash C, Malik RS, Sinha NK, Singh VK, Patra AK, Chaudhary SK (2016) Spatial variability of soil micronutrients in the intensively cultivated Trans-Gangetic Plains of India. Soil and Tillage Research, 163, pp: 282-289

Surucu A, Günal H, Acir N (2013) Importance of spatial distribution in reclamation of boron toxic soils from central Anatolia of Turkey. Fresenius environmental bulletin, 22(11): 3111-3122

Tekin AB, Gunal H, Sindir K, Balci Y (2011) Spatial structure of available micronutrient contents and their relationships with other soil characteristics and corn yield. Fresenius Environmental Bulletin, 20(3a): 783-792

Thomas GW (1982) Exchangeable cations. Methods of soil analysis. Part 2. Chemical and microbiological properties methodsofsoilan2: 159-165

Trangmar BB, Yost RS, Uehara G (1986) Aplication of Geostatistics to Spatial Studies of Soil Properties. Advances in Argon, 38: 45-94

Turgut B, Öztasb T (2012) Penetrasyon Direncini Etkileyen Bazı Toprak Özelliklerinin Yersel Değişiminin Belirlenmesi. Ziraat Dergisi 7(2): 10-22

Tye AM, Lawley RL, Ellis MA, Rawlins BG (2011) The spatial variation of weathering and soil depth across a Triassic sandstone outcrop. Earth Surface Processes and Landforms, 36(5): 569-581

Walkley A, Black IA (1934) An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. Soil science, 37(1): 29-38

Wani MA, Shaista N, Wani ZM Spatial Variability of Some Chemical and Physical Soil Properties in Bandipora District of Lesser Himalayas. Journal of the Indian Society of Remote Sensing, pp: 1-10

Waterman E, Pharm M, Lockwood B, Pharm B, PhD Pharms MR (2007) Active Components and Clinical Applications of Olive Oil. Altern Med Rev 2007;12(4): 331-342

Yeşilırmak E, Atatanır L, Yorulmaz A, Aydın G, Turgut C (2011) Spatial variability of Fe, Mn, Zn and Cu in soils of büyük menderes delta in western Turkey. Fresenius Environmental Bulletin, 20(2): 310-316

Zhang JG, Chen HS, Su YR, Kong XL, Zhang W, Shi1 Y, Liang HB, Shen GM (2011) Spatial variability and patterns of surface soil moisturein a field plot of karst area in southwest China. Plant soil environ. 57(9): 409–417

CURRICULUM VITAE

Personal Identity

Name, Surname	: Tavan Kamil Ahmed
Nationality	: Iraqi
Date and place of birth	: 10 Aug, 1973 Sulaymaniyah, Iraq
Marital Status	: Single
Telephone	: (+90) 534 722 36 12 - (+964)770 192 05 09
E-mail	: Tavan74ahmad@Gmail.Com

Educational Background

Degree	Place of Education	Date ofGraduate
Master Degree	BİNGÖL ÜNİVERSİTESİ Faculty of Agriculture Department of Soil science and plant Nutrition	2017
Bachelor's Degree	Sulamaniya University College of Agriculture Department of Soil and Water Sci	1996

Work Experience Year	Place	Position
1998-1999	Minstry of Ariculture General Directorate of Antiquities	As. Engineering
1999- now	Ministry of Agricultur General Director of Agriculture in Plant Protection Sulaimanyah	As. Engineering

Language Skills

Language	Reading	writting	Speaking
Kurdish	Ecellent	Ecellent	Ecellent
Abrabic	Ecellent	Ecellent	Ecellent
English	Good	Good	Good
Turkish	Medium	Medium	Medium