Sudan University of Science and Technology

College of Graduate Studies

Study the Effect of Physical, Chemical Parameters and Pesticides Residue on Drinking Water in Elmanagil Area

دراسة تأثير المتغيرات الفيزيائية والكيميائية وبقايا المبيدات على مياة الشرب في منطقة المناقل

A Thesis Submitted in the Fulfillment for the Requirements of the Degree of Doctor of Philosophy in Chemistry

By

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استهلال

بسم الله الرحمن الرحيم

قال تعالى:

(أَوَ لَمۡ يَرَ ٱلَّذِينَ كَفَرُوٓاْ أَنَّ ٱلسَّمَٰوَٰتِ وَٱلۡأَرۡضَ كَانَتَا رَتۡقٗا فَفَتَقۡنَٰهُمَاۖ
وَجَعَلۡنَا مِنَ ٱلۡمَآءِ كُلَّ شَيۡءٍ حَيٍّۚ أَفَلَا يُؤۡمِنُونَ)

صدق الله العظيم

سورة الانبياء(30)

Dedication

To My family and beloved Land ….

To everyone who helps…

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Abstract

This study was undertaken to evaluate the effect of some physical parameters , chemical parameters and pesticides residual of drinking water in El-Managil area. Ninety nine samples were collected from middle El-Managil town and different villages around El-Managil, town. The samples were collected in July 2013 from zeer supplied by *Turaa*, zeer supplied by tank and tank supplied by Well. Water samples were analyzed for physical parameters variants such as Water Temperature (WT), total dissolved solids (TDS), total suspended solids (TSS) and Turbidity (using turbidity meter), pH, (using pH meter), chemical parameters such as Chlorides, Nitrates, Carbonate and Bicarbonate (measured by titration method),Calcium,Cadmium,Copper,Iron, Potassium, Sodium, lead, zinc (measured by Atomic Absorption Spectrophotometer), Phosphorus (using Spectrophotometer) and pesticides suchas (Sevin,) (measured by High Performance Liquid Chromatography),Malathionand,Cypermethrin (using Gas Chromatography). The results showed that the temperature readings ranged between (26.3 and 29 ° C). The pH values ranged between (7.1 and 8.2) were within the limits allowed by WHO. The water samples of Turaa showed the highest values of TSS ranged from (3.00 to 9.873 mg / l). For TDS all water sample values were below the WHO limits, the highest value(673.653mg/l) which recorded in north El-Managil, (Altiquia), the water source was a tank supplied from well. The conductivity values ranged from (0.2 to 70.805) all values were below the WHO limits The turbidity values in most of the samples were higher than the WHO limit and ranged from (130.33 to 1618NTU), the highest value was recorded in west El-Managil,(Wad Al Amin),the source was Turaa water , water quality is untreated water. The concentration of minerals varied for the calcium, copper, potassium, sodium and zinc, all readings

were below the WHO limit. The concentration of phosphorus was higher than the limit of the WHO the highest reading (57.00 mg / l) in El-Krimit (water source is *Turaa)*. Cadmium concentrations were higher than WHO limit in some areas, and the highest concentration value (0,009mg/l) found in El-Managel town (middle) for untreated water (the source hole filled from Turaa*)* and Umtalha South El-Managil the source is Turaa. As for the iron the concentrations in some areas exceeded the limit of the WHO ,the highest value was recorded in northern El-Managil, Shasha, source of water is zeer filled from the tank ,The concentration was (1.57mg/l). For the lead element., in some areas, the concentration was (0.7 mg/l) exceeded the WHO limit in El-Kirimit, the source is *zeer* filled from *Turaa*. Chlorides, Nitrates, Carbonate, and Bicarbonate readings were below WHO permissible limit except Nitrates (NO_3^-), the concentration values were higher than the WHO permissible limit in El-Managil town (middle) water source Zeer filled from tank (treated water), concentration was (14.56 mg / l). The results showed that treated and untreated water samples show some concentrations values for pesticide residues; for malathion residue concentrations values were higher than WHO permissible limit. The highest value was (0.0032 ppm) recorded in Wad Alamin, water source Zeer filled from Turaa, , Cypermethrin concentrations values were higher than the WHO permissible limit with value (0.032 ppm) recorded in Abood for the source Zeer filled from tank, Sevin residue concentrations values were below than WHO permissible limit. In the area north El-Managil, no concentrations values for pesticide residues were found to untreated water samples. The study gave an overview that the water of the Turaa was the most common source of pollution for pesticide residues. As for the chemical and physical variables, the pollution included the water of the canals and the water of the tank.

المستخلص

أجريت هذه الدراسة بغرض تقييم تأثير بعض المتغيرات الفيزيائية , المتغيرات الكيميائية والمبيدات المتبقية في مياه الشرب في منطقة المناقل . تم جمع تسع وتسعين عينة مياه تمثل مساحات كبيرة من شمال المناقل ، وجنوب المناقل ، وشرق المناقل ، وغرب المناقل ، ومدينة المناقل وسط. تم جمع العينات في يوليو 2013 ، وكانت مصادر المياه إمدادات زير من الترعة، وإمدادات زير من الخزان، وإمدادات خزان من البئر. تم تحليل عينات المياه وقياس المتغيرات الفيزيائية وهي درجة الحرارة ، مجموع المواد الصلبة الذائبة (TDS)، إجمالي المواد الصلبة العالقة (TSS) ، العكورة (باستخدام جهازTurbidity meter) درجة الحموضة (pH) (باستخدام جهاز pH meter)، الكلوريدات ، النترات ، الكربونات وبيكربونات (تم القياس بواسطة المعايرة) ، الكالسيوم ، الكادميوم ، النحاس ، الحديد ، البوتاسيوم، الصوديوم ، الرصاص ، الزنك (تم قياسها بواسطة جهاز الامتصاص الذري Atomic Absorption spectrophotometer)، والفوسفور (باستخدام جهاز spectrophotometer) ومبيدات الملاثيون والسيبرمثرين (تم القياس بواسطة كروماتوجرافيا الغاز Gas chromatography) مبيد السيفين (تم القياس بواسطة جهاز High Performance Liquid Chromatography). أوضحت النتائج أن قراءات درجات الحرارة لجميع عينات المياه تراوحت ما بين (26.3 إلى 29 درجة مئوية). وتراوحت قيم الأس الهيدروجيني لجميع العينات من (7.1 إلى 8.2) وهي ضمن الحدود المسموح بها لمنظمة الصحة العالمية (6.5 – 8.5). اوضحت عينات مياه الترعة أعلى قيم للمواد الصلبة العالقة حيث تراوحت ما بين (0.3 إلى 9.873 ملجرام/ لتر). أما بالنسبة لمجموع المواد الصلبة الذائبة كانت جميع قيم عينات المياه أقل من الحدود المسموح بها لمنظمة الصحة العالمية ، حيث تراوحت القيم ما بين (122.4 إلى 673.653 مليجرام / لتر) ، أما بالنسبة للايصالية كانت جميع قيم عينات المياه أقل من الحدود المسموح بها لمنظمة الصحة العالمية ، حيث تراوحت القيم من (0.2 إلى 70.805مليجرام / لتر) ، قيم العكورة في عينات المياه التي تم اختبارها في الغالبية كانت أعلى من الحد المسموح به لمنظمة الصحة العالمية وتراوحت ما بين (130.33 إلى 1618.7NTU) واعلى قيمة (1618.7NTU) سجلت غرب المناقل قرية ود الأمين، مصدر المياه الترعة، نوعية المياه غير معالجة . كان تركيز المعادن في عينات المياه التي تم اختبارها متباين وفقًا لنوعية ومصادر المياه لكل من الكالسيوم والنحاس والبوتاسيوم والصوديوم والزنك، حيث كانت كل القراءات أقل من الحد المسموح به لمنظمة الصحة العالمية. في حين أن تراكيز الفسفور كانت أعلى من الحد المسموح به لمنظمة الصحة العالمية لبعض

المناطق وسجلت اعلى قراءة (57.00مليجرام / الليتر) في غرب المناقل منطقة الكريمت، مصدر المياه الترعة. اما بالنسبة لعنصر الكادميوم كانت قيم التراكيز اعلى من الحد المسموح به لمنظمة الصحة العالمية لبعض المناطق واعلى قيمة للتركيز كانت (0.009 مليجرام /ليتر) ورصدت في وسط المناقل في المياه الغير معالجة، المصدر الحفرة مملؤة من الترعة، وفي قرية ام طلحة جنوب المناقل المصدر الترعة. أما بالنسبة لعنصر الحديد فقد فاقت التراكيز لبعض المناطق الحد المسموح به لمنظمة الصحة العالمية ، وأعلى قيمة سجلت في منطقة شمال المناقل في قرية شاشا، مصدر المياه الزير مملوء من الصهريج , وقد بلغت نسبة التركيز (1.57 مليجرام /ليتر). بالنسبة لعنصر الرصاص نجد في بعض المناطق أن التركيز فاق الحد المسموح به لمنظمة الصحة العالمية في منطقة غرب المناقل قرية الكريمت، مصدر المياه الزير مملوء من الترعة، وقد بلغ التركيز (0.073 مليجرام/الليتر). الكلورريدات , النترات , الكربونات والبيكربونات كانت قراءتها أقل من الحد المسموح به لمنظمة الصحة العالمية , في ماعدا النترات (NO_3^-) فقد بلغت قيمة التركيز أعلى من الحد المسموح به لمنظمة الصحة العالمية لمياه الشرب في منطقة وسط المناقل، مصدر المياه زير مملوء من الصهريج (المياه معالجة) وبلغت قيمة التركيز(14.56 مليجرام / الليتر). بالنسبة لمتبقيات المبيدات أظهرت نتائج التحليل أن عينات المياه المعالجة وغير المعالجة أظهرت ارتفاع في تركيز مبيد الملاثيون المتبقية اقل من الحد المسموح به لمنظمة الصحة العالمية في بعض المواقع وأعلى قيمة للتركيز فاقت الحد المسموح به لمنظمة الصحة العالمية سجلت في قرية ود الأمين غرب المناقل، مصدر المياه زير مملوء من الترعة، فقد بلغت قيمة التركيز (0.0032جزء من المليون) وكانت قيم تركيزات متبقيات مبيد الثيبرومثرين في بعض المواقع أقل من الحد المسموح به لمنظمة الصحة العالمية وأعلى قيمة سجلت في منطقة شرق المناقل قرية عبود، مصدر المياه زير مملوء من الصهريج، وبلغت قيمة التركيز (0.032 جزء من المليون) وهذه القيمة أعلى من الحد المسموح به كما وضعته منظمة الصحة العالمية. أما بالنسبة لمبيد (السيفين) في بعض المواقع التركيز كان أقل من الحد المسموح به لمنظمة الصحة العالمية. أما بالنسبة لمنطقة شمال المناقل لم تعطي اي تراكيز لمتبقيات المبيدات لعينات المياه الغير معالجة. أعطت الدراسة نظرة عامة أن مياه الترع اكثر مصادر للتلوث بمتبقيات المبيدات أما بالنسبة للمتغيرات الكيميائية والفيزيائية فإن التلوث شمل مياه الترع ومياه الصهريج .

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List of Abbreviations

ANOVA	Analysis of variance
CDC	Center Disease Control
CWSs	Community Water Systems
DDT	Dichloro Difenil Trichloroetan
DNA	Deoxyribo Nucleic Acid
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
GC	Gas Chromatography
HCH	Hex Chloro Cycholo Hexan
IMP	Integrated Pest Management
IUPAC	International Union of Pure and Applied Chemistry
LOQ	Limit of Quantification
MCL	Maximum Contamination Level
NDR	No Detectable Residues
NHL	National Health laboratory
OCs	Organo Chlorines
ppb	Part per billion
PPD	Plant protection Directorate
ppm	Part per million
POPs	Persistent Organic Pollutants
SDWA	Safe Drinking Water Act of Sweden
SPSS	Statistical Packages Social Sciences
SSMO	Sudanese Standard and Metrology Organization
TDS	Total Dissolved Solid
TSS	Total Suspended Solid
UNESCO	United Nation Education Sciences and Culture Organization
WHO	World Health Organization
µS/cm	Micro Seimens per centimeter

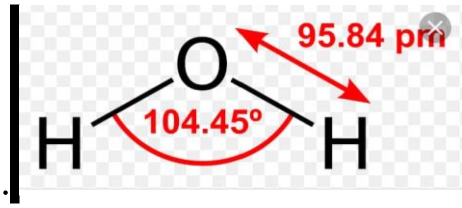
CHAPTER ONE

Introduction and Literature Review

1. Introduction

1.1 Background

Water is the common name applied to the liquid form (state) of the hydrogen and oxygen compound H_2O. Pure water is an odorless, tasteless, clear liquid. Water is considered an economic good, therefore each unit of it should be used efficiently, equitably and soundly. Perhaps the most unique characteristic of water is that it occurs on earth as solid, liquid and gas within the range of climatic conditions commonly encountered.71% of the Earth is covered with water, so it appears plentiful and as if there is an unlimited supply. However, 97% of this water is salty ocean water, which we can not drink, so only 3% of it can be used for drinking. Water that can be used for drinking is called Fresh water (Cosgrove and Rijsberman; 2000). Water is essential for human existence. Public water should be palatable and wholesome, attractive to senses (taste and smell) and hygienically safe. Water, even in its natural state, contains variety of chemicals. If the concentration of such chemicals exceeds the desirable limits for human consumption, their removal becomes necessary. Different types of water can be affected by different factors whether in the source, or in the different passages . Water is dependent upon for human life, as with all animal and plant life on the planet. Water is not only needed to grow plant, our food, generate our power and run our industries, but we need it as a basic part of our daily lives. "Basic needs" go beyond what we need to drink or ingest through our food for daily survival (about 5 litres per person per day (Gleick, 1999). It includes the need for water to maintain a basic standard of personal and domestic hygiene sufficient to maintain health. It is not sufficient merely to have access to water in adequate quantities, the water also needs to be of adequate quality to maintain health and it must be free of harmful biological and chemical contamination. Water gathered from unprotected sources often does not meet these criteria and places the users at risk. Often water which is of a sufficiently high quality at the point of collection is contaminated before it is used because it has to be carried and stored before use or because of unhygienic practices. Water provision cannot be separated from two other inter-related factors - sanitation and health. This is because one of the primary causes of contamination of water is the improper disposal of human and animal excreta (WHO, 2005). Water that looks drinkable can contain harmful elements, which could cause illness and death if ingested. Today people are concerned about the quality of the water they drink, it is necessary for the digestion and absorption of food: helps maintain proper muscle tone, supplies oxygen and nutrients to the cells, protoplasm is a solution of water and fats, carbohydrates, proteins, and salt. The human search for pure water supplies have begun in pre historic time 20% of the world population dose not have access to clean water, half of this figure do not have adequate means of water purification. Pollution from water contamination and the lack of appropriate water proccssing facilities lead to loss of human life annually. It has been estimated that over 90% of death from the developing world today occur among children under 5 years old is caused by inadequate supplies of safe water and inadequate sanitation facilities and lack of hygienene behavior by the mother (WHO, 2005).



Chemical structure of water

1.1.2 Water Sources

Drinking water comes from two main sources: surface water and ground water. In urban areas, water from these sources is frequently pumped to water treatment plants and then to buildings. Drinking water in rural or agricultural areas often comes from individual wells drilled into aquifers. The water from these wells is usually not treated. Human activity depletes drinking water sources, which must be restored by rain and snow (USEPA, 1991).]

Although Sudan is the second largest country in Africa and lies mostly in the arid region where water is scarce commodity, it is considered to be rich in water resources. Most of population and the majority of live stock live around the Nile areas. However, the recent drought, with civil war have led to migrations to urban centers resulting in over use of available and limited urban facilities including water and sanitation systems. The available water resources are Nile system, rain water and ground water. The main Nile and its tributaries provide perennial fresh water of good chemical composition. Only 20 % of the total populations live along the Nile where they make use of its water either by collecting water directly from the Nile or pumping it from irrigation canals e.g. in New Halfa and Gezira, especially in the western side where water is treated with slow sand filters and distributed to the households. The remaining 80% live away from the Nile depending on the rain water and ground water (Ginawi, 1994).

1.1.3 Water quality

According to the definition of the (WHO, 2004), water must be suitable for human consumption and for all usual domestic purposes including personal hygiene, however water of higher quality may be required for some special purposes such as renal dialysis. When guideline value is exceeded the cause should be investigated and corrective action be taken. Drinking water therefore concerns both the quantity and quality of the water required to meet the needs of human being in an efficient and economical manner (Mahgoub, 1984). It is necessary to determine the physical, chemical and biological parameters that affect the quality of waters. A drinking-water quality guideline value represents the concentration of a constituent that does not result in any significant health risk to the consumer over a lifetime of consumption (WHO, 1996). Drinking-water should be suitable for human consumption and for all usual domestic purposes. The amount by which, and for how long, any guideline value can be exceeded without endangering human health depends on the specific substance involved. In drawing up national standards for drinking-water quality, it will be necessary to take into account various local, geographical, socioeconomic and cultural factors. As a result, national standards may differ appreciably from the guideline values. There may be a need for interim standards to provide a medium-term goal as a step towards the achievement of guideline values in the longer term. There is no objection to such a stepwise approach provided that the relevant authorities in each country, especially the ministry of health or its equivalent, are consulted and approve it. There are dangers in leaving such matters entirely to the agencies responsible for water supply because of the conflict of interests that may arise. While supplies that fail to meet ideal criteria should be neither considerd nor ignored, interim standards permit resources to be directed first towards those communities with the greatest problems. They provide incentives to upgrade rather than blame for failure, this is particularly important in countries subject to severe economic constraints. The use of categories of bacteriological contamination of small-community supplies is useful. In some countries health authorities have adopted interim standards for intractable natural contaminants such as fluoride, pending the development of appropriate treatments for their removal from community supplies. No attempt is made here to establish guideline values for service indicators other than drinking-water quality, such as those for the coverage, continuity, and cost of community water supplies. It is for national authorities to establish medium- and long-term targets for such factors. This should be done on amulti sectoral basis, since the setting of these targets will have a number of social and economic implications. Nevertheless, because of the importance to public health of adequate access to safe water, the adoption of standards in this area is strongly recommended (WHO, 1993).

1.1.3.1 Standards for water quality

Drinking water standards around the world are in a continuous state of evaluation as more information becomes available and is evaluated. WHO (2005) developed guidelines to be used as a basis for developing standards for drinking water in all countries, particularly those countries that lack the resources to perform the basic information gathering and assessment tasks involved (WHO, 1996). These guidelines have undergone various revisions through years, (Droste, 1997). No single standard for drinking water quality suffices for all countries but there is a considerable degree of agreement on contaminants and their allowable concentrations (Droste, 1997). In many countries water quality criteria are incorporated in their regulations. Standards for drinking water quality are generally established on the following:

a/ Established or ongoing practices: Practices that have been used for many years without noticeable harmful effects are used as bases to set water quality criteria.

b/ Experiments with animals: It is most desirable to use animals with physiological response as similar as possible to humans e.g; rats to find exposure levels that produce harmful effects (Droste, 1997).

1.1.4 Water crisis

Water is essential to life, yet 844 million people in the world (1 in 9 - lack access to it). According to a report by the World Economic Forum, the water crisis is the global risk in terms of impact to society. 844 million people are living without access to safe water, and 159 million depend on surface water to meet their basic needs.there is agrowingworldwideconcern about water resources and the so-called (water crisis). Total water used in the world has quadrupled during the last fifty years (Clark, 1991).

1.1.5 Water borne diseases

Water borne diseases are among one of the major public health problems in developing countries like Ethiopia. They are the leading causes of morbidity and mortality in all age groups particularly in children under 5 years of age. According to the World Health Organization (WHO) 3 million deaths occur every year from diarrheal diseases worldwide (WHO, 1996). The problem of water borne diseases is especially prevalent where general hygiene and environmental sanitation are poor and where there is a shortage of protected water supply (Abram, 1995; WHO, 1996). It is believed that 80% of all diseases in the world are caused by inadequate sanitation, polluted water or unavailability of water. Poverty, illiteracy, over crowding and low health services are contributing factors that directly or indirectly affect the prevalence of water born diseases. Therefore, an integrated prevention and curative approach with community participation is required in order to tackle this prevalent public health problem. In the United States the Centers for Disease Control and Prevention estimates that 76 million people become ill with food borne disease resulting in about 325,000 hospitalizations and 5000 deaths each year (Abram, 1995). From 1997 to 1998 the Centers for Disease Control and Prevention reported 4,166 illnesses from contaminated drinking water and recreational water exposure in the United States (WHO, 2004). Ground and surface water are exposed to chemical and physical pollutant such as heavy metals (lead, cadmium, iron, phosphorus) and pestisides. Lead is one of the most abundant heavy metals and its toxic effects cause environmental and health problems because of its stability in contaminated site and complexity of mechanism in biological toxicity, particularly dangerous for children leading to mental retardation when exist with abnormal concentration in body fluid. The chronic exposure to Cadmium produces a wide variety of acute and chronic effects in humans. Cadmium accumulates in the human body, especially in the kidneys, resulting in kidney damage (renal tubular damage), which is a critical health effect. Other effects of Cadmium exposure are disturbances in calcium metabolism, hypercalciuria and the formation of kidney stones. High exposure to can Cadmium lead to lung cancer and prostate cancer. Humans have changed the natural phosphate supply radically by addition of phosphate-rich manures to the soil and by the use of phosphate-containing detergents. Too much phosphate can cause health problems, such as kidney damage and osteoporosis. Phosphate shortages can also occur. These are caused by extensive use of medicine, noting that the most from water that is high in iron is that the water may taste metallic. The water may be discolored and appear brownish, and it may even contain sediment. Iron will leave red or orange rust stains in the sink, toilet and bathtub or shower. It can build up in your dishwasher and discolor ceramic dishes. It can also enter into the water heater and can get into the laundry equipment and cause stains on clothing. The EPA cautions that although iron in drinking water is safe to ingest, the iron sediments may contain trace impurities or harbor bacteria that can be harmful. Iron bacteria are naturally occurring organisms that can dissolve iron and some other minerals. These bacteria also form a brown slime that can build up in water pipes. Iron bacteria are most commonly problematic in wells, where water has not been chlorinated **(**Tiwari and Tripathi; 2012).

1.1.6 Water pollution

Water pollution can be defined as any chemical, physical or biological change in the quality of water that has a harmful effect on any living organism that drinks or uses or lives in it .Water pollution could be caused by human activities including sewage disposal, fertilizers for agricultural crops containing nutrients such as nitrates and phosphate, also growth of plants and algae might clog water pipes and increase growth of organisms. Another pollution by agricultural activities might be commercial live stock and poultry farming as sources of many organic and inorganic pollutants in surface and ground water. In addition, industrial pollution discharge through pipe lines or sewage into the surface water, organic chemicals such as pesticides, inorganic minerals and chemicals compounds could all be considered as major water pollutants. Furthermore, pollution could come from many sources including untreated sewage, industrial discharges, leakage from oil storage tanks, mine draining and leaking from mine waste and drainage from the residues of agricultural fertilizers and pesticides (Krantz and kifferstein; 1996).

1.1.6.1 Chemical parameters

(i) Heavy metals

Heavy metals concentrations have been estimated in surfacial sediments by (Moussa, 1984; Abdel-Moati, 1997 ; Abdelbagy *et al*., 1998). Pollution of the aquatic environment by inorganic chemicals has been considered a major threat to the aquatic organisms including fish. The most anthropogenic sources of metals are industrial, petroleum contamination and sewage disposal (Santos *et al*., 2005). Metal ions can be incorporated into food chains and concentrated in aquatic organisms to alevel that affects their physiological state. Of the effective pollutants are the heavy metals which have drastic environmental impact on all organisms. Trace metals such as Zn, Cu and Fe play a biochemical role in the life processes of all aquatic plants and animals, therefore, they are essential in the aquatic environment in trace amounts (Elghobashy *et al*., 2001). In the Egyptian irrigation system, the main source of Cu and Pb are industrial wastes. Lake sediments are normally the final pathway of both natural and anthropogenic components produced or derived to the environment. Sediment quality is a good indicator of pollution in water column, where it tends to concentrate the heavy metals and other organic pollutants. The drainage water transports considerable amounts of autochthonous sediments to the Nile northern delta Lakes, which are distributed by currents and water movements throughout most of the Lakes. These sediments are deposited on the bottom and constitute with autochthonous deposits the total sediments of the Lakes. The present work aimed to investigate the pollutants levels including the accumulation of some heavy metals (Iron, Zinc, Copper, Manganese, Cadmium and Lead) (Farag, 2002).

(ii) Chloride

Chlorine is a naturally occurring element that is common in most natural waters and is most often found as a component of salt (sodium chloride) Chloride in drinking water is not harmful, and most concerns are related to the frequent association of high chloride levels with elevated sodium levels. There is no health-based drinking water guideline for chloride, however, the guidelines for Canadian Drinking Water Quality recommend and aesthetic objective for chloride levels of 250 mg/L, based on the potential for undesirable tastes at concentrations above this level, and the increased risk of corrosion of pipes (Koshy and Nayar; 1999)**.**

(iii) Nitrate

Nitrates (NO_3^-) are an essential source of nitrogen (N) for plants. When nitrogen fertilizers are used to enrich soils, nitrates may be carried by rain, irrigation and other surface waters through the soil into ground water. Human and animal wastes can also contribute to nitrate contamination of ground water. In Benton and Franklin Counties, agricultural practices have been linked to elevated levels of nitrates in drinking water. Although any well can become contaminated by nitrates, shallow, poorly constructed, or improperly located wells are more susceptible to contamination **(**Bureau of Indian Standard, 1991**)**.

(vi) Phosphorus

Phosphorus is common constituent of agricultural fertilizers, manure, and organic wastes in sewage and industrial effluent. It is an essential element for plant life, but when there is too much of it in water, it can speed up reduction in dissolved oxygen in water bodies caused by an increase of mineral and organic nutrients of rivers and lakes. (Koshy and Nayar; 1999).

1.1.6.2 Physiochemical parametars

(i) pH

In chemistry, Phisa logarithmicscale usedtospecifythe acidity or basicity ofan a queous. Solutions with a pH less than 7 are acidic and solutions with a pH greater than 7 are basic. The neutral value of the pH depends on temperature, being lower than 7 if the temperature increases. Pure water is neutral pH 7 at (25 °C), being neither an acid nor a base. Contrary to popular belief, the pH value can be less than 0 or greater than 14 for very strong acids and bases respectively. Measurements of pH are important in agronomy, medicine, chemistry, water treatment, and many other applications (USEPA, 1990).

(ii) Turbidity

Suspended matter such as clay, silt finely divided organic and inorganic matter, soluble colored organic compounds and other organisms can cause turbidity in water. Turbidity is the measure of relative clarity of a liquid (EPA, 2012).

(iii) Electerical conductivity

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water (EPA, 2012).

(iv) Total dissolved solids (TDS)

It is combination of the sum of all ion particles that are smaller than 2 microns (0.0002 cm). This includes all of the disassociated electrolytes that make up salinity concentrations, as well as other compounds such as dissolved organic matter. In "clean" water, TDS is approximately equal to salinity. In wastewater or polluted areas, TDS can include organic solutes (such as hydrocarbons and urea) in addition to the salt ions (Atekwanaa *et al*., 2004).

(v) Total suspended solids (TSS)

Total dissolved solids are another parameter acquired through a separate analysis which is also used to determine water quality based on the total substances that are fully dissolved within the water, rather than undissolved suspended particles (ASTM, 2000).

1.1.6.3 Pesticides

a.General background

pesticide is a chemical that is used to control a pest. A pest can be an insect, weed, bacteria, fungus, rodent, fish or any other troublesome organism.

Pesticide manufacturers develop most pesticides, although some occur naturally in the environment (USEPA, 1990). Pesticides control one or more specific pests around homes, in agricultural areas and on public land. One of the most important problems experienced across the globe is environmental pollution due to industrialization and climate changes and to the reduction of farmland and the decrease in productivity gains compared with the increasing population. This fact shows us that nutrition needs are not fulfilled. Existing agricultural fields are evaluated in the best possible way to find a method to increase the productivity. Chemical control method is one of the most preferred methods for this. Today if production is done without the use of pesticides 65% of the products quantity will be lost. The use of chemical pesticides, ensures high quality and quantity of products, offers easy application, gives the result in a short time, can be applied to large areas and is relatively low cost. In addition to these advantages, however, the negative effects of pesticide residues in the environment should not be unnoticed. Unconscious use of pesticide can ruin the natural balance, can cause soil water and air pollution, leave residue in foods and create resistance of pests. When pesticides remain active in the environment for long along time, bioaccumulation trends and their impact on non-target species pose a great danger for ecosystem health. For this reason, pesticides require monitoring and surveillance in foods and environment for health protection, environmental assessment and pollution. The diagnosis, identification and concentration measurement of pollutants are not only important in pollution content and their effects but are also important for understanding new pollution control precaution activities (USEPA, 1990).

b. Classification of pesticides

Due to the large amount of chemicals and pesticides combinations of compounds have been classified for use in insecticides, miticides, herbicides, nematicides, fungicides, molluscicides and rodenticides. The World Health Organization proposed classification based on their health risk, based on their toxic behavior in rats and other laboratory animals by administering oral and dermal and estimating the median lethal dose (LD 50) that produces death in 50% of exposed animals (WHO, 1993). This ranking order from lowest to highest toxicity in numbers I through IV, being extremely toxic, highly toxic, moderately toxic, slightly toxic, respectively. Another definition of this classification based on its chemical structure, pesticides are classified into different families, ranging from organochlorine and organ phosphorus compounds to inorganic compounds (WHO, 2004).

(i) Organochlorine

Stable compounds are too persistent in the environment and tend to accumulate in fatty tissue (Waliszewski *et al.,* 2003). Its main use is in the eradication of disease vectors such as dengue and malaria. They are also used in cultivation of grapes, lettuce, tomato, alfalfa, corn, rice, sorghum, cotton and wood, for preservation. Its way of exposure is mainly on insects by contact or by ingestion (Ferrer, 1993). In humans these substances or their metabolites act primarily at the level of central nervous system altering the electrophysiological properties and enzymatic neuronal membranes, causing alterations in the kinetics of the flow of Na^+ and K^+ through the membrane of the nerve cell (Narahashi, 1992), resulting in the spread of multiple action potentials for each stimulus causing symptoms such as seizures and acute poisoning death from respiratory arrest (Kamrin, 1997).

(ii) Organophosphates

They are esters derived from phosphoric acid. In man act on the central nervous system by inhibiting acetyl cholinesterase, an enzyme that modulates the amount and levels of the neurotransmitter acetylcholine, disrupting the nerve impulse by serine hosphorylation of the hydroxyl group in the active site of the enzyme (Correia *et al*., 2000). The symptoms are causing loss of reflexes, headache, dizziness, nausea, convulsions, coma and even death (Sulbatos, 1994). Organophosphorus compounds are most commonly used in agriculture, most are insecticides and miticides, their way of joining these organizations is by ingestion and contact. They are used in vegetable crops, fruit trees, grains, cotton, and sugarcane, among many others. Maltion was considered one of important of organophosphates depravities as shown below (AMAP, 1998).

***Malathion:**

Molecular formula: $C_{10}H_{19}O_6PS_2$.The chemical name of malathion is S-[1, 2-di (ethoxycarbonyl) ethyl] dimethyl phosphorothiolothionate. Its chemical structure is shown below:

Physio Chemical properties **(**WHO, 2008**)**

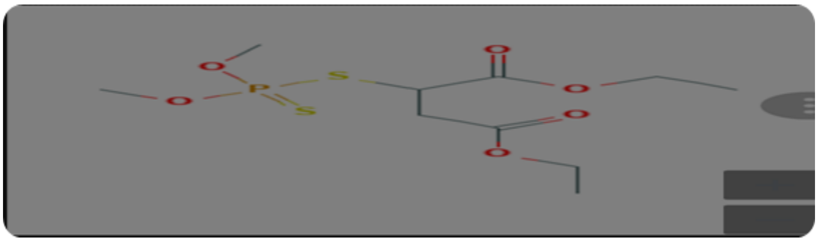
Appearance clear, light, amber – coloured liquid.

Boiling point 60 °C (decomposes).

Vapour pressure 5 × 10-3Pa at 30 °C.

Log n-octanol–water partition coefficient2.36–2.89.

Solubility in water 145 mg/litre at 25 °C.



Chemical structure of Malathion

Malathion is commonly used to control mosquitos and a variety of insects that attack fruits, vegetables, landscaping plants and shrubs. It can also be found in other pesticide products used indoors and on pets to control ticks and insects, such as flces and ants. It is also used to control human head and body lice. Health Canda (1989).

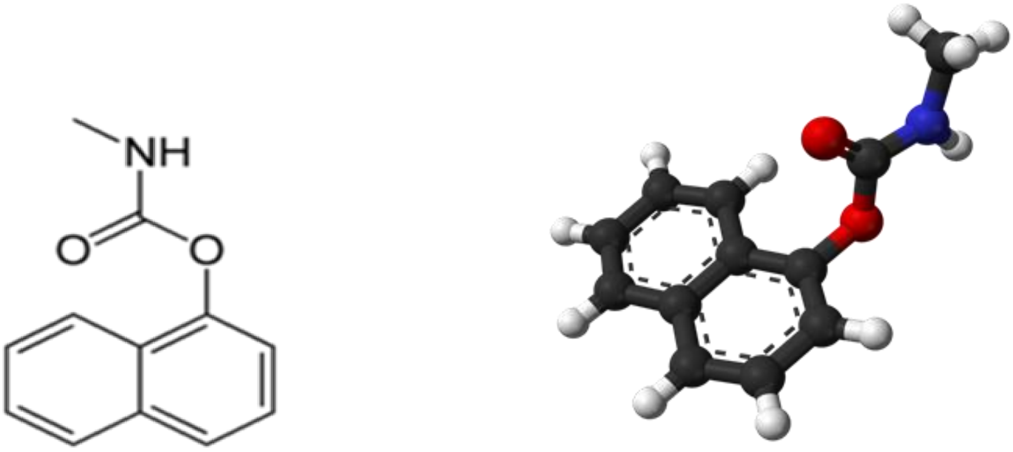
(iii) Carbamate Family (Carbaryle) (Sevin):

IUPAC name *1-nap*hthyl methylcarbamate

Chemical formula $C_{12}H_{11}NO_2$

Molar mass 201.23 g·mol^{-1}

Appearance	Colorless crystalline solid
Density	1.2 g/cm^3
Melting point	12 °C (288 °F; 415 K)
Boiling point	decomposes
Solubility in water	very low (0.01% at 20°C)[1]



Chemical structure of Carbaryle (Sevin)

Carbaryl (1-naphthyl methylcarbamate) is a chemical in the carbamate family used chiefly as an insecticide. It is a white crystalline solid commonly sold under the brand name Sevin, a trademark of the Bayer Company. Union Carbide discovered carbaryl and introduced it commercially in 1958. Bayer purchased Aventis CropScience in 2002, a company that included Union Carbide pesticide operations. It remains the third-most-used insecticide in the United States for home gardens, commercial agriculture, and forestry and rangeland protection. About 11 million kilograms were applied to U.S. farm crops in 1976 (Thomas, 1996**).**

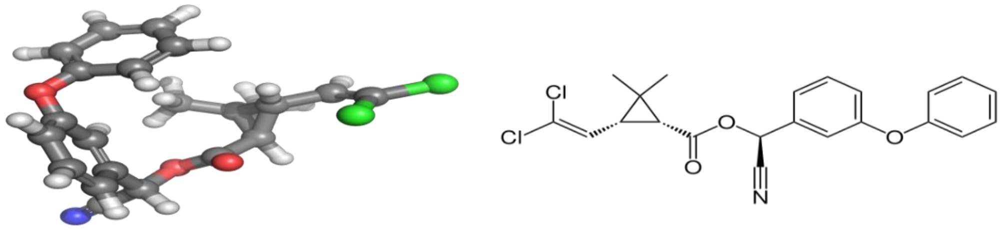
(iv) Pyrephroids (Cypromathryn):

Cypermethrin is a synthetic pyrethroid used as an insecticide in large-scale commercial agricultural applications as well as in consumer products for domestic purposes. It behaves as a fast-acting neurotoxin in insects.

Formula: $C_{22}H_{19}Cl_2NO_3$

Molar mass: 416.3 g/mol

Boiling point: 428°F (220°C)



Chemical structure of Cypromathryn

It is moderately toxic through skin contact or ingestion. It may cause irritation to the skin and eyes. Symptoms of dermal exposure include numbness, tingling, itching, burning sensation, loss of bladder control, incoordination, seizures and possible death. Pyrethroids may adversely affect the central nervous system. Human volunteers given dermal doses of 130 µg/cm^2 on the earlobe experienced local tingling and burning sensations. One man died after eating a meal cooked in a 10% cypermethrin concentrate that was mistakenly used for cooking oil (Ecobichon, 1993). Shortly after the meal, the victim experienced nausea, prolonged vomiting, stomach pains, and diarrhea which progressed to convulsions, unconsciousness and coma. Other family members exhibited milder symptoms and survived after hospital treatment. Cypermethrin is not a skin or eye irritant, but it may cause allergic skin reactions. Excessive exposure can cause nausea, headache, muscle weakness, salivation, shortness of breath and seizures. In humans, cypermethrin is deactivated by enzymatic hydrolysis to several carboxylic acid metabolites, which are eliminated in the urine. Worker exposure to the chemical can be monitored by measurement of the urinary metabolites, while severe overdosage may be confirmed by quantitation of cypermethrin in blood or plasma (Ecobichon, 1993).

C. Pesticide use in Sudan

(i) Background

Trials for use of pesticides in Sudan started with the introduction of Bordeaux mixture in 1941 followed by the chlorinated hydrocarbon DDT for the control of cotton *Jacobiasca lubica berg* in Gezira scheme in 1949. The success of the trial, which started with a single application against a single major pest, initiated the interest for expansion of the treated area and opened the way for subsequent introduction of other related compounds. The early 1950s witnessed the introduction of the organophosphate compounds, namely parathion. In the same decade and due to the outstanding increase in cotton prices during the Korean War, many products were tested and released for commercial use. Early in the sixties organophosphates became a reliable partner to the organochlorines for the control of the chewing and sucking insect pests, when dimethoate was first used in 1960/61 season. The same decade witnessed the discovery of a new generation of insecticides, the carbamates, as well as an intensive screening effort to select the most suitable products from many brands and formulations available in the market. The period from early sixties to late seventies witnessed progressive intensification and expansion in the cropped areas with subsequent increase in pest complexity and damage. This necessitates increase in chemical treatment with negative impact on human health and the environment. The number of applications during the season has also risen to an average of 9 -11. Organochlorines were the major group of pesticides, which flourished during this period favored by their high potency against wide range of agricultural and public health pests, cheapness and environmental persistence (Abdelbagi, 2006). The problems arising from the increased use of pesticides coupled with the drastic change in the cotton pest complex led in the early 80s to the introduction of synthetic pyrethroids in order to replace DDT and the insecticides mixtures containing DDT which were then banned (Abdelbagi, 2006). Early in the 1990s Sudan Government declared integrated pest management (1PM) programmed as its crop protection strategy and many attempts were made to reduce the use of pesticides and rely more on non-chemical means of crop protection. Nevertheless, the use of pesticides remains an important component of crop production policy, especially after the introduction of a new generation of pesticides, which is claimed to have better biological efficiency, less negative impact on the environment and more cost-effective performance, thus complying with 1PM objectives. Among these new products are the BT toxins, neonicotinoid imdacloprid, and phenylpyrazole, fibronil. Currently there are over 600 products being registered for commercial use in the Sudan. However, only limited number of the registered compounds dominates the local import despite the huge number of registered products. The desirability of certain products may be attributed to their superior efficacy under local conditions, safety and cheapness. The recent advancement in agrochemical industry with the tremendous efforts currently focused on the use of genetically modified crops is a new challenge facing crop protection policy in the Sudan which still stands fairly in the opposition of such technology for many logical reasons (Abdelbagi, 2006).

(ii) Pattern of pesticide use in Sudan

Man constantly fights against insects, weeds, rodents, plant, diseases and disease vectors like mosquitoes, sand flies... etc. The most important tools to control all of these pests and diseases are pesticides. Pesticides occupy a rather unique position among many chemicals that man encounters regularly. They added to the environment for the purpose of killing or injuring some forms of life. Ideally their injurious action must be highly specific for undesirable target organisms and not injurious to desirable, non target organisms. Most of the chemicals that are used as pesticides are not highly selective but instead are generally toxic to many non-target species including man and other desirable forms of life that co-inhabit the environment. Although hazards of pesticides usually accompany their misuse and handling, yet, significant ecological implications were noted even during ideal uses. These implications motivated many researchers in various continents to investigate the environmental impact of pesticides use on the whole ecosystem. In the Sudan the use of pesticides has been known since the beginning of the 20 th century when arsenate of soda was used against desert locust. In 1949 DDT was tested against cotton pests in the Gezira Scheme. The significant success of DDT in combating cotton pests encouraged the introduction of other halogenated pesticides such as HCH, aidrin, dieldrin, heptachlor, endrin, toxaphene etc... in Sudan. Other classes of insecticides (organophosphorus, carbamates, pyrethroids and others) were introduced during the subsequent three decades. The expansion in agricultural land and intensification of the existing cropping systems led to the appearance of new insect pests. Coupling this with over reliance on few pest control compounds at that time, many environmental management problems such as insect resistance, destruction of natural enemies and beneficial insects, outbreak of secondary pests etc. emerged out. Consequently, the number of sprays per season increased from one spray (with one compound) in 1950s to over ten sprays per season (with more than one compound) in early eighties. This in turn led to a significant increase in the quantities of imported pesticides (Abdelbagi, 2006).

(iii) Organic farming

The ideas behind organic farming have been around since the 1920s. They have evolved considerably and continued to evolve as new scientific research becomes available, while retaining the fundamental philosophical perspective of working with, not dominating, natural systems and paying respect for the environment which sustains us. Organic farming a production system which avoids or largely excludes the use of synthetic compounds such as fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent feasible, organic farming systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, and aspects of biological pest control, to maintain soil productivity and to supply plant nutrients and to control insects, weeds and other pets. The principles of organic farming have been concisely expressed in the standard document of the

International Federation of Organic Agriculture Movements (IFOAM) (Lampkin, 1990)

as:

- to produce food of high nutritional quality in sufficient quantity;
- to avoid all forms of pollution that may result from agricultural techniques;
- to maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats

1.2 Literature Review

1.2.1 Water as a basic need for life

Water is a renewable resource but it is often not available in the right amounts at the right time or the right place and the right quality (Moghraby, 1999). water lies in human survival, and the entire history of mankind can be written in terms of its need for water. The importance of water can be further amplified by the fact that the Greek philosopher, Impedances of Argumentum considered water to be one of the four primary elements from which all the materials of the world were constituted. The other basic elements, air, fire and earth. Only earth is characterized by a hydrosphere with abundant liquid water. Some major planets are known to contain solid phase of water (ice) in large quantities. Water constitute 2/3 of cell protoplasm, any changes could lead to the organism's death. Water demand differs according to species, stage of life cycle, and body water content. Water is described to be a universal solvent because it dissolves so many substances as well as functioning as a media of ionization, for that reason it acts as a suitable media for chemical reactions in and outside the body living organism. Moreover, all chemicals and products of reactions are transported inside and outside the body as an aquatic solution. Water also regulates the body temperature and facilitates digestion and assimilation of food. Water keeps the flexibility of tissues and the excretion of urine and feaces and acts as an environment to aquatic organisms (Clark *et al*; 2000).

1.2.2 Contamination of water

1.2.2.1 Contamination of ground water

Similar to soil surface and compartments, there is no regular monitoring of POPs in ground water. Drinking water may be contaminated by different contaminants which have an impact on the health and economic status of the consumers. Contaminants such as bacteria, viruses, heavy metals, nitrates and salt have found their way into water supplies due to inadequate treatment and disposal of waste (human and livestock), industrial discharges, and over-use of limited water resources. (TWAS, 2002). However sporadic studies were done for personal interest or following specific event (Abdelbagi, 2005). The survey done by the National Chemical Laboratory (NCL) in the BNHP area in 1982 exammed water samples from five bore holes in the Gezira area. The detectable levels of any POP pesticides were found (Alhindi, 1982; Elzorgani, *et al*., 1993; UNESCO National Commission report, 2000). Elzorgani, *et al*., (1993) reported ground water samples in Gash basin were almost free from detectable levels of pesticide residues, also reported traces of gamma HCT-1 and also found traces of DDT (0.1-5.5 ppb) in all extracts from wells near Qurashi pesticide store 7 years after the dumping incident. Babiker (1998) investigated pesticide residues in four drinking wells near Qurashi pesticide store 11 years after the dumping incident and found measurable levels of heptachlor in three wells at a range of 0.003-0.065 ppm, gamma HCH in two wells at a range of 0.0 1-0.028 ppm and no detectable levels of DDD.

1.2.2.2 Contamination of surface water

Environmental scientists are increasingly alarmed by the fact that the Nile may suffer from contamination as a result of rapid increase of population coupled with the enormous rate of industrialization and increasing agriculture activities and a wide scale of urbanization (El Hassan, 1984). Fresh water contaminates by chemicals containing Zn, Cu, Pb, As, Ba, Cr, Hg, Ni. Se and Th cause damage to internal organs of human body (Kidney, liver and brain) (WHO, 2004). Early civilization grew along major rivers with agriculture as the focal point. Agriculture is still responsible for about 70% of the water use in the world and it is by far the largest water consumer in Sudan. Most of agriculture such as in Sudan were located close to major rivers with their drainage system discharge directly or indirectly into the Nile course, therefore contamination of the Nile water might occur as a result of direct drift during active spray season, windblown contaminated dust, contaminated run off or leaching soil particles (Moghraby, 1999). In Sudan most of the factories are located along the bank of the River Nile and its tributaries, for ease of process and water abstraction, cooling water supply, and disposal of treated effluents. This opened the door for misuse of water bodies since they are used mainly as dumping sites rather than for their intended reasons. It can be forecasted that before long the nation will be facing an insoluble problem that will not only endanger the fresh water resources and productive land, but also will exhaust them and reduce the capabilities in remedying actions (Honda *et al*., 1991). All the wastes from most of the factories in the Sudan are discharged into the atmosphere, water bodies and land with different levels of treatments and in most cases without treatments. In spite of the regulations, there is evidence of domestic and industrial effluent reaching the Nile in the Khartoum rural area, and also other surface water sources (Dirar, 1987). Surface water sources are contaminated and bear heavy loads of suspended silt. Sudanese studies on the physical and chemical characteristics of the Nile began as early as 1904, on the chemical and physical characteristics of the two Niles. White Nile is not free from suspended matter while the Blue Nile carries enormous amounts of solid during flood and later becomes almost clear. It is of a common understanding among Sudanese that the Blue Nile is much cleaner and therefore safer than the White Nile. However precious data presented came as a surprise, revealing facts contrary to the long-standing belief that “the Blue Nile is facing more contamination than the White Nile”.(Dirar, 1987) presented a quantative and qualitative record on the seasonal succession of the plankton in relation to the hydrological physical, chemical characteristics of the Blue Nile. Generally, not much work has been published on zooplankton as indicators of water pollution in Africa. Moghraby, (1999) observed that the density and number of species of zooplankton of the Blue Nile after the completion of Roseiris and Sennar Dam increased. In Sudan Dirar (1986) reported that a particular point source of pollution of the White Nile at Khartoum was due to the continuously flowing stream of partially treated sewage coming from the city's sewage treatment plant and surroundings .The movement of animal wastes into the surface water is often cited as major factor contributing to the pollution of available water in many rural areas.

1.2.2.3 Contaminants of water

a. Chemical parameters

(i) Heavy Metals

Elhag (2004) found that the amount of lead in tap water was in the range 0.004 mg/l to 0.016mg/l. Nurrain (1998) found that the calcium level of water from well, canal and tap water were 19.7, 18.1 and 24 mg/l respectively. (Hagar 2009) found that in the drinking water at the Gezira state the amount of micro elements zinc ranged from 0.0014 mg/l to 0.02mg/l in ground water , while surface water was free of zinc copper was higher in surface water than in ground water. The levels of cadmium and lead were found in ground water , while surface water was free of lead. Nurrain (1998) found that the amount of chloride in canal and wellwater is 9.8 and 120 mg/L respectively. Elhag (2004) found that the amount of zinc in well water was in the range 0.012 to 0.17 mg/L. Elhag (2004) found that the amount of lead in tap water was in the range 0.004 to 0.016 mg/l. Lead could enter drinking water from the corrosion of pipes distribution systems. Elhag (2004) found that the amount of zinc in well water was in the range 0.012 to 0.17 mg/l.

(ii) Chloride

Nurrain (1998) found that the amount of chloride in canal and well water was 9.8mg/l and 120 mg/l respectively in the Gezira area, WHO (1986) reported that chloride content in water is an indicator of sewage pollution. The permissible level is 200 mg /l to 600 mg /l that is unlikely to be harmful to consumer health. Excessive chloride concentration increases rates of corrosion of metals in the distribution system depending on the alkalinity of the water this can lead to increased concentration of metals in the supply and give rise to detectable taste in water.

(iii) Nitrate

Nitrate levels in drinking water can also be an indicator of overall water quality. Elevated nitrate levels may suggest the possible presence of other contaminants such as disease-causing organisms, pesticides, or other inorganic and organic compounds that could cause health problems. The Environmental Protection Agency (EPA) has set the Maximum Contaminant Level (MCL) of nitrate as nitrogen (NO_3^-N) at 10 mg/l (or 10 parts per million) for the safety of drinking water. Nitrate levels at or above this level have been known to cause a potentially fatal blood disorder in infants under six months of age called methemoglobinemia or "blue-baby" syndrome, in which there is a reduction in the oxygen-carrying capacity of blood. The symptoms of blue-baby syndrome can be subtle and often confused with other illnesses. An infant with mild to moderate blue-baby syndrome may have diarrhea, vomiting, and/or be lethargic. In more serious cases, infants will start to show obvious symptoms of cyanosis: the skin, lips or nailbeds may develop a slate-gray or bluish color and the infant could have trouble breathing. A sample of the infant’s blood can easily confirm a diagnosis of blue-baby syndrome. It is difficult to determine the true incidence of blue-baby syndrome in Washington State because it is not a reportable disease **(**Bureau of Indian Standard, 1991**)**.

(vi) Phosphorus

Phosphorus is a common constituent of agricultural fertilizers, manure, and organic wastes in sewage and industrial effluent. It is an essential element for plant life, but when there is too much of it in water, it can speed up eutrophication (a reduction in dissolved oxygen in water bodies caused by an increase of mineral and organic nutrients) of rivers and lakes. Soil erosion is a major contributor of phosphorus to streams. Bank erosion occurring during floods can transport a lot of phosphorous from the river banks and adjacent land into a stream, (Koshy and Nayar; 1999).

b. Physical parameters of water

(i) pH

pH value represents the concentration of hydrogen ions present in water. The neutral value of the pH depends on the temperature, being lower than 7 if the temperature increases. Pure water is neutral, pH 7 at (25 °C), being neither an acid nor a base. Contrary to popular belief, the pH value can be less than 0 or greater than 14 for very strong acids and bases respectively (Lim and Kieran; 2006). Measurements of pH are important in agronomy, medicine, chemistry, water treatment, and many other applications. The pH scale is traceable to a set of standard solutions whose pH is established by international agreement. Mahgoub, (1984) found that the pH value from the three Niles ranged from 7.5 to 8.5. And pH values for the tap and canal water ranged from (7.9 to 8.8).

(ii) Turbidity

The quality of drinking water in the Gezira state is affected by the turbidity level in ground water that ranged 0.3 to 0.95 NTU, while that in surface water ranged 5.5to 197 NTU, thus being higher than the maximum acceptable level stated by WHO standard as 5 NTU (Hagar 2009). Abdelmagid et al (1986) found that the turbidity of Nile ranged from 0.05 to 0.07 O. D, for wells water it ranged from 0.01 to 0.56 O. D, and for tap water it was 0.01 O. D.

(iii) Electrical conductivity

Conductivity, in particular specific conductance, is one of the most useful and commonly measured water quality parameters. A sudden increase or decrease in conductivity in a body of water can indicate pollution. Agricultural runoff or a sewage leak will increase conductivity due to the additional chloride, phosphate and nitrate ions. EC is measured in micro siemens per centimeter µs/c (Hagar 2009). (Abdelmagid *et al*., 1986) found EC for tap water to be 0.17 µs /cm.

(iv) Total dissolved solids (TDS)

TDS can include organic solutes (such as hydrocarbons and urea) in addition to the salt ions (Atekwanaa *et al*., 2004). Nurain (1998) found that the TDS varied widely for well and canal being174 and 495 mg/l respectively. TDS have an important effect on the taste of drinking water. According to WHO (1993) the palatability of water with a TDS level of less than 600 mg/l would be considered as good, but drinking water would become increasingly unpalatable at TDS levels greater than 1200 mg/l, however water with extremely low concentration of TDS might be unacceptable because of its flat taste.

(v) Total suspended solids (TSS)

Total dissolved solids is another parameter acquired through a separate analysis which is also used to determine water quality based on the total substances that are fully dissolved within the water, rather than undissolved suspended particles (ASTM, 2000).

c. Pesticides residues

i. Residues in soil

Soil represents the final depot for most of the environmental contaminants including pesticides. This topic was extensively reviewed for POPs pesticides by Abdelbagi (2005). According to his review several studies were conducted to investigate the soil residue levels of organochlorine pesticides in the Sudan in shallow soil. Abdelbagi *et al* (2003) conducted systematic comparative investigation of organochlorine residues in areas of limited and intensive pesticide use in the Sudan. In their first study they collected fifty soil samples from different locations (the irrigated riverain region of Northern State, mechanized and traditional rain-fed areas in eastern and western Sudan and the semi-desert area northwest Khartoum) representing areas of limited or no pesticide use in the Sudan. Heptachlor (as epoxide) was detected in almost all soil samples examined. Dieldrin was found in five locations, mechanized rain-fed area (Gadaref), traditional rain-fed area (Megenis and Umrawaba) and irrigated riverain area (Dongola and Elgolid). Aidrin was detected in soils of Dongola only, while gamma HCH was only detected in Gedarif soils. No detectable level of DDT was found. In their second investigation (Abdelbagi *et al*., 2003) collected 40 soil samples from different locations representing areas of intensive pesticide use (irrigated cotton and sugarcane soils). Their results indicated that DDT, heptachlor epoxide and dieldrin were the major soil contaminants of irrigated cotton soils and their levels were relatively higher in the Gezira than in Rahad. Soils of sugarcane schemes showed some levels of dieldrin and heptachlor L epoxide. Generally, the level of residues detected in the soil was not high, the total average concentration of the studied organochlorines was 1.484, 0.272, 0.83 and 0.297 ppm in Gezira, Rahad, Guneid and Kinana respectively. Direct application (areas of intensive use), drifts during active spray season and winds blown dusts were among the anticipated means of residue transport. The fact that levels detected were not high even in the areas of intensive pesticide use. The capability of Sudanese micro flora for cleaning highly polluted soils and dump sites were recently investigated with encouraging results (Elsayid, 2006).

ii. Residues in Food

There is no regular monitoring of pesticides residues in the Sudanese food crops. However, sporadic studies were done for personal interest or following specific event (Abdelbagi, 2005).

Kim and Kim (2003) investigated consumers' awareness and information about food hygiene with focus on pesticide residues and food borne illness in Korea. The data were collected from 350 adults living in Daegu and Busan, Korea by a self- administered questionnaire. Frequency and chi-square tests were conducted by SPSS. The results of the survey were as follows: The consumers' concerned about food hygiene were higher about three-fourth of the respondents answered that they were 'somewhat' or 'highly' concerned about pesticide residues and food borne illnesses. Women and the elder persons showed more concerns than men and the youngers. The respondents were also worried about eating vegetables, fruits and grains because of pesticide residues, and did not trust the results from food hygiene tests given by the Government. Three-fourth of the respondents claimed to wash food stuff with water several times for cleaning off pesticide residues. Finally, the respondents expressed their interest to get more information about the harmfulness of pesticide residues in foods.

iii. Residues in sediments

No study had been carried out to examine the presence of pesticide residues in fresh water sediments in the Sudan (Abdelbagi, 2005). On the other hand, sea sediments were reported to contain measurable levels of the four pesticides (ATSDR, 2000).

iv. Residues in water

There are many ways in which pesticides can reach water: (i) They may be directly applied as aerial sprays or granules to control water inhabiting pests, (ii) They may fall onto the surface of water, when agricultural land is sprayed from the air, (iii) Spray drift from normal agricultural practices, (iv) Residues may reach water as surface runoff from treated soil, (v) insecticides may be discharged into rivers through factory or sewage effluents; industrial and domestic discharge, and (vi) Recycling of domestic residues by falling rain or dust. The wide spread use of pesticides and other agrochemicals necessitated numerous studies concerning their fate and initiated an increased interest in their transformation in the environment, pesticide fate is described by how and where it enters the environment, How a pesticide enters the environment is the first step determining the fate (George, 2004). The initial distribution is determined by many factors such as the method of application, amount, timing, frequency and placement of application, weather conditions, and proximity to water bodies, soil properties, topography, and depth of water table. Pesticides entering the environment may be subject to:

1/ Movement (within or off the site) and/or.

2/ Alteration. The two processes (movement and alteration) may occur simultaneously and occasionally pesticides at various stages of degradation can move within and/or off the site of deposition and in many instances the two processes determine the dissipation at the point measurement (Abdelbagi and Mohamed; 2006). Pesticides may move for a short distance by diffusion in solution or gas phases before they swept away by moving water or air. A pesticide tendency to move in air or water is determined by how much is retained by the surface on which it was deposited (attached or sorbet to soil, vegetation or other surfaces). Another factor determining short-range transport is volatilization, which is determined by vapor pressure.The latter is dependent on the physical properties of the substance and the media, temperature and other factors. Also, co-distillation with water vapor is known for DDT and other compounds. Dust storms can carry pesticides for surprisingly long distance (USEPA, 1990). Cohen and Pinkerton (1996) found large amounts of organophosphorus and organochlorine pesticides in dust rains falling on Cincinnati, Ohio: These dusts originated from Texas, Oklahoma-New Mexico area. Major rivers and ocean current can also cause long-range movement of pesticides. About 10000 Kg of pesticides are discharged by Mississippi River system into the Gulf of Mexico every year (excluding the amount adhered to the leached soil particles (USEPA, 1991). Nilsson (2002) studied the reduction of pesticide transport to surface water- catchment within the pesticide monitoring proramme of Sweden. In 1990, a catchment in the southern most part of Sweden was selected for intensive monitoring of pesticide concentrations in surface water. A total of 44 pesticides (34 herbicides, 5 fungicides, 5 insecticides) and 5 herbicide metabolites have been detected in stream water samples collected during the 12-year period. Commonly detected pesticides were: atrazine, bentazone, dichiorprop, isoproturon, MCPA, mecoprop, metazachior and tçrbuthylazine. Monitoring results obtained during the first years revealed elevated pesticide concentrations (up to 200 µ.g/l for single pesticide) and also elevated pesticide residues entering the stream without preceding rainfall. These findings were argued by the authors to be due to accidental spillage. However, during the following years there has been considerable reduction in levels of all pesticides in the stream with concentration down by more than 90%. The decreasing levels of pesticides in stream water from the catchment area was attributed to the increased awareness among farmers on better practices for the correct handling of spraying equipment and application procedures (including the practice of total weed killing on farmyards). Kreuger and Nilsson; (2002). studied the effectiveness of buffalo grass Buchloe dactyloides filter strips in removing dissolved atrazine and metabolites from surface runoff. The atrazine and atrazine metabolites differ substantially in desorption and adsorption behavior suggesting that retention differences among compounds within vegetative filter strips (VFS) relikely. A micro-watershed runoff study was conducted to compare the simultaneous partitioning of atrazine, di-ethylatrazine, dii sopropylatrazine, diamioatrazine, and hydroxyatrazine within a buffalo grass filter strip. The total atrazine mass retained within the filter strip (35%) was significantly greater than the metabolite mass retained (32%). The mean infiltration mass retained for all compounds was approximately 23% and was not significantly different among compounds. Atrazine mass retained by adsorption to the grass that soil surface (13%) was significantly greater than the metabolite mass adsorbed (9%). Buffalo grass filter strips appear to preferentially retain atrazine as compared with the atrazine metabolites due to differences in the partitioning of the compounds among the solution, soil, and thatch. According to Hamilton, *et al* (2003), the IUPAC Commission on Agrochemicals and the Environment has completed a project on Regulatory Limits for Pesticide Residues in Water. The project examined the methods for setting pesticide residue limits in water in countries around the world and concluded with 12 recommendations. The basis for limits and guideline values issued by WHO, Australia, USA, New Zealand, Japan, Canada, European Union and Taiwan were examined. Limits have been most commonly developed for drinking water, but values have also been proposed for environmental waters, effluent waters, irrigation waters and livestock drinking waters. The contamination of ground water is of concern because it may be used as drinking water and it may act as source of contamination for surface waters. Most commonly, drinking water standards have been applied to ground water. Regulatory limits for pesticide residues in waters should have the following characteristics: definition of the type of water, definition of the residue, a suitable analytical method for the residues and explanation for the basis for each limit. Limits may be derived by applying a safety factor to a no-effect level, or from levels occurring when good practices are followed and a safety assessment is passed, or from the detection limit of an analytical method, or directly by legislative decision. Different approaches will lead to different maximum limits being set. Aklilul and Jagath, (2005), studied that "although pesticide residues in drinking water can vary significantly from day to day, however, water quality monitoring is usually performed at limited frequency". For example, the Safe Drinking Water Act of Sweden (SDWA) necessities sampling of the community water systems (CWSs) to four data points per year over a few years. Due to this limited sampling, likely maximum residues may be underestimated in risk assessment. In this work, a statistical methodology was proposed to study two types of uncertainties in observed samples and their propagated effect in risk estimates. The methodology was demonstrated using data from 16 CWSs that have three independent data bases of atrazine residue to estimate the uncertainty of risk to infants and children The results showed that in 85% of the CWSs, chronic risks predicted with the proposed approach may be two- to four folds higher than that predicted with the current approach, whereas intermediate risks may be two-to three-folds higher in 50% of the CWSs. In 12% of the CWS, however, the proposed methodology showed a lower intermediate risk. A closed-form solution of propagated uncertainty was developed to demonstrate the number of years (seasons) of data and sampling frequency needed to reduce the uncertainty of risk estimates. In general, this methodology provided good insight into the importance of addressing uncertainty of observed water quality data and the need to predict the likely maximum residues in risk assessment. This finding Adopted by Matsumura (1985) who indicated that almost 60 % of the positive samples in White Nile water were found in Juba, , cypermethrin, was detected Malathion was not detected. Gebreel (2007) found that the results of residue analysis for organophosphorus, chlorpyriphos and malathion bout (33%) of the samples collected from Khartoum (Elgreef) were found to contain profenophos with average concentration of 0.00061m/l and ranged of (ND-0.00183 mg/l), cypermethrin residues were detected in(33.3%) of the water samples collected from Sinnar with an average of (0.00085 mg/l) and range of (ND - 0.00256 mg/l) and from, Dongla, the main Nile with an average of (0.00005 mg/l) and arrange of (ND-0.00015mg/l),malathion residue was not detected in White Nile water samples collected from Gabelawlia.

1.3 Statement of the problem

It is well known that water is the most important element of life. Despite this vital importanse, the citizens of the town and the settlement villages in the study area (El managile) have been suffering from scarcity of suitable drinking water. The problems fasing the citizens in the area:

1- lack of clean hygienic water for drinking and other purposes.
2- lack of sufficient amount of water.

El managile town has awater station for treatment ,distribution system and it lak of the following ;

1- laboratoryry for analysis befor and after treatment .
2- materials for treatmen .
3- because of the increasing population the station is incapable to cover the need of all people .

1.4 Hypothesis of the Study

The thesis is based on the following hypothesis:

1- Many sources of water may cause water pollution according to human activities.
2- Some of physiochemical parameters and pesticides residual may exceed WHO permissible limit.
3- Streams are the most sources expected for the pollution.

1.5 Objectives of the study

The objectives of this study can be summarized as follows:

1. To estimate some physiochemical parameters and pesticides residual in drinking water in El-Managil area.
2. To compare the drinking water quality to the international standards adopted by WHO for drinking water.
3. To determine any variation of water quality according to locations, water kinds and sources.

CHAPTER TOW

Materials and Methods

2.1 Materials

2.1.1 Description of the Study area

El-Managil is atown in central Gezira state in Sudan, it is about 412 meters (1351 feet) above sea level, 156 kilometers (96.9 miles) far away from Khartoum and 62 kilometers (38.5 miles) from Wad Madani. It is one of the largest industrial cities in Sudan. The climate is characterized by higher temperature ranged (15 to 40˚C). Sources of water are acted in Wells and *turaa*... The main transportation channel, which began operation in 1957, was completed in 1964. A design card of 16 million meters was constructed for irrigating 379 feddans for the extension of transport. It was the title of life for many cities and villages starting from Kilo Zero to the kilo 57). Dozens of years in the island project, where the silt covers (7) million cubic meters of canal, which became like the schedule Abu twenty. Drilling of wells did not work for the salinity of the water or the limited life of the well, which does not exceed the year, and then dry water completely, because of the occurrence of the area on the rock Almatori. The water in its present state appears to be unfit for drinking, but the citizen has no alternative, so they resort to it **(**World Bank, 2000) (Fig 1)

2.1.2 Samples

Ninety nine water samples were collected representing large areas from Middle of El-Managil, North El-Managil: the villages of (Wad Hallawy, Al-Tiquia, Shasha), East El-Managil: the villages of (Maktab 84, wad Mahamood, Abood, Maktab Alnasih), South El-Managil: the villages of (Umm-Talha, Kambo 26), and West El-Managil: the villages of (Wad El -Ameen, Alkrimt), as shown in Table (2.1.2).They were collected in July 2013 into cleaned plastic bottles, the sources of water, tap water (Net (turaa + well)),(3 samples), Zeer supply from tap water (3 samples), Hall (3 samples), Tank (turaa+ well), (3 samples), Tank(24 samples), Turaa(21 samples), Zeer supply from Turaa(18 samples), Zeer supply from Tank(24 samples) , Fig(2), each water sample was identified and stored for later laboratory analysis.

Table 2.1.2 .1 Sampling sites, direction, Sources and kind of waters used in the study

Sites	Direction	Sources	Kind of water
El-Managil	Middle	Tap water (Net (turaa+ well))and Zeer,Hall,Tank	Treated
Altiquia	North El-Managil	Turaa, Tank and Zeer	Untreated
Wad- Halawy			
Umm-Talha	South El-Managil	Turaa, Tank and Zeer	
Kambo 26			
Maktab84	East El-Managil	Turaa, Tank and Zeer	
Abood			
Wad Mahmood			
Maktab Elnasih			
El-Krimit	West El-Managil	Turaa, Tank and Zeer	
WadAlameen			

2.1.3 Reagents

Potassium Chromate ($K_2Cr_2O_4$), Silver Nitrite ($AgNO_3$), boric acid, methyl red, gmbromocresoi green, Alcohol, Sodium Hydroxide (NaOH), Devardas (50Cu:5Al:5Zn),Sulphuric acid (H_2SO_4), phenolphthalein and methyl orange, ascorbic ammonium molybdate potassium antimony tartrate, anhydrous Potassium phosphorus (KH_2PO_4), Acetone, Hexane (C_6H_{14}), Ethyl acetate, isooctane, Acetonitrile, anhydrous Sodium sulphate, n-Heptane, petroleum Ether. Deionized distilled water, Potassium chloride Standard (99%pure) of the organophosphorus (malathion), peroxide compounds (cyperomathrin) and carparayle (siven).

2.1.4 Equipments

The equipments used in the research are listed as follows:

Turbidity meter model LH- TB02. (Fig 6).Hand glass thermometer scale 0-100 ^{0}C. model Temperature by (Wagner *et al*, 2006).pH meter HANNA pH 209 (Fig 8). Conductivity meter Model 4510.(Fig 9)Burettes (50ml), Stands, peppet, Separating funnels Filter papers, Measuring flask,Beaker (250ml),Conical flask(50,100,250 ml),Measuring cylinders(50,100,250). Sensitive balance, Glass thermometer. Electronic micro-balance(Sortorious, Berlin, Germany).

2.1.5 Instruments

2.1.5.1 Flame Atomic Absorption Spectrophotometer (FAAS)

Flame Atomic absorption spectrophotometer(double-beam) (210VGP Buck Scientific) manufactured by United States of America (2005). This technique is usually used for the determination of metal elements. It features a high accuracy and precision of trace elements determination on conditions that analyze sample adequately prepared.

(AAS, 1994) (Fig 3).

2.1.5.2 Spectrophotometer

Spectrophotometer model 630 JENWAY manufactured by UK. **(**Fig 4)

2.1.5.3 High performance liquid chromatography (HPLC)

HPLC was formed of liquid chromatography, where separation occurs between a mobile phase (the solvent) and a stationary phase (the column packing) it is ability with which the sample components will distribute themselves between the two phases that will affect the separation (Balinova, 1996) HPLC uses small-particle columns through which the mobile phases pumped at high pressure (Gerber and Frederic, 2004) (Fig 5).

2.1.5.4 Gas Chromatography

Gas chromatography includes three basic operational steps. They are injecttion, separation, and detection. (AOAC , 2005) (Fig 6).

2.2 Methods

2.2.1 Sampling(collection, conserved)

Samples were collected in one-liter plastic bottles after washing, and cleaning with tap and distilled water, concerning turaa the bottles immersing closed and then opened at approximately (30cm) in depth and then were closed inside the water directly after filling. Water samples were conserved at $4C^{o}$ and for later laboratories analysis (APHA, 2005).

2. 2.2 Analytical methods

2.2. 2.1 Physiochemical analysis

(I) Determination of Electrical Conductivity

The conductivity cell was rinsed first with distilled water and then rinsed with standard KCl solution. The conductivity of the standard KCL was measured and adjusted to 1.4 1 µs/cm. Then the conductivity of the 15 ml of water sample was measured and recorded (Petersen and Hansen 1996).

(II) Determination of turbidity

This parameter was estimated by using turbidity meter. (WHO, 1993)

(III) Determination of pH

For measuring the pH value, the electrode was first rinsed by the buffer solutions before adjusting for pH 4.0 and 7.0 each separately. Then rinsed with distilled water and with the water sample for measuring each sample. The electrode bulb was immersed well in the water sample and pH was measured at room temp. (APHA, 1998).

(IV) Total Dissolved Solids (TDS)

This parameter was estimated gravimetrically a known volume of the sample (v ml) after being filtered was transferred to weigh watch glass (w_1 mg) and evaporated in an oven at 180c. The watch glass was then reweighed until it came to constant weight ($w_2$mg) equipment used water bath crucible oven.

Total dissolved solids = $((w_2-w_1) / v)$ 1000. (ASTM, 2000).

(V) Total Suspended Solids (T.S.S)

This parameter was estimated gravimetrically a known volume of the sample (v ml) was filtered through a weighed whattman filter paper (w_1 mg), the filter paper was dried in an oven at 105c. The filter paper was then reweighed to constant weight ($w_2$mg).

Total Suspended solids = (w_2-w_1) / v) 1000. (ASTM, 2000 & WHO 1993).

(VI) Temperature

The Temperature of the tested samples was measured in suitable volume (30 ml) using a hand glass thermometer, scale 0-100c. (Wagner *et al*, 2006).

2.2.2.2 Chemical analysis

(A) Determination of chloride

(ii) procedure:

5 ml of sample was taken in a clean 100 ml beaker and diluted to about 25ml with distilled water. After adding 5 – 6 drops of potassium chromate ($K_2Cr_2O_4$) indicator (making it dark yellow), it was titrated against the standard $AgNO_3$ (0.1N) solution with continuous stirring till the first brick red tinge appeared (ISO, 1990). Calculate Cl concentration of unknown water samples from the equation below:

$$Cl\ (mg/l) = \frac{AgNO_3\ molarity \times vol.\ AgNO_3\ used \times equiv.\ wt.\ of\ Cl}{Sample\ (ml)}$$

(B) Determination of nitrate

(i) parepration of indicator

mixed indicator dissolved 0.066 gm methyl red and 0.099 gmbromocresoi green in 100ml of alcohol.

(ii) **procedure**

50 ml of sample was pipette into the conical flask and add10 ml of NaOH. 20 ml of boric acid solution added with mixed indicator in 150 ml conical flask and put beneath the condenser. Stopper the flask and steam distill the ammonia into the boric acid solution remove the stopper of flask after NH_3 distillation,

and 0.2gm Devardas alloy putted if sufficient aliquot (40—50 ml) was left, rapidly replaced the stopper and distill ammonia into fresh boric acid (with mixed indicator). Titrate this distillate with 0.02N H_2SO_4, till the pinkish color reappears. Blank should also be carried out simultaneously (Tandon, 1993).

Calculation:

$$NO_3 \text{ , mg/l} = \frac{(A - B) \times 280}{\text{ml aliquot}}$$

A= Volume of H_2SO_4 used for sample, ml

B= Volume of H_2SO_4 used for blank, ml

(C) Determination of carbonate and bicarbonate

(i) parepration of standard H_2SO_4 (0.05N). solutions

Added 2.7 ml of conc. H_2SO_4 slowly by touching out let point of measuring cylinder to the inner neck of the flask, add distilled water slowly and dilute to one liter.

(ii) procedure

Carbonate and bicarbonate in the samples of water determined by titrating it against standard sulphuric acid (H_2SO_4) used phenolphthalein and methyl orange as indicators (ISO, 1990). Take a known volume (10ml) of water sample in 100 ml conical flask and diluted to about 25ml with distilled water. After adding 2 – 3 drops of phenolphthalein indicator, when red colour appeared it was titrated against the standard H_2SO_4 (0.05N) solution with continuous stirring till red colour disappears. added (2-3) drops of methyl orange in 10 ml of original sample and again it was titrated against the standard H_2SO_4 (0.05N) solution with continuous stirring till the yellow color changed into rosy red. Recorded the volume of H_2SO_4 consumed each time (ISO, 1990). Calculate Carbonates and Bicarbonates concentration of unknown water samples from the equations below:

$$\text{Carbonates (mg/l)} = \frac{(PR \times 2) \times H_2SO_4 \text{normality} \times 1000}{\text{Sample (ml)}}$$

Bicarbonates (mg/l) = $\frac{(MR-2PR)\times H_2SO_4 normality \times 1000}{Sample (ml)}$

PR= the burette reading (ml of H_2SO_4) after phenolphthalein was neutralized

MR= final burette (total volume of H_2SO_4) after methyl orange

(D) Determination of metals and heavy metals

For the analysis, the Atomic Absorption Spectrophotometer was calibrated with standard solutions and the samples were directly analyzed for the presence and concentrations of the elements; Ca, Cd, Cu, Fe, K, Na, Pb and zn at their respective detection wavelengths, the different parameters and operating conditions were listed in table 2.2.2.2 below.

Table 2.2.2.2 Atomic Absorption parameters and operating conditions

Metal	**Wavelength (nm)**	**Slit (nm)**	**Detection limit(mgl^{-1})**	**Sense Check(mgl^{-1})**	**Linear Range(mgl^{-1})**	**Flame Type Color**
Ca	422.7	0.7	0.01	3.50	5	A-A
Cd	228.9	0.7	0.01	0.75	2.0	A-A
Cu	324.8	0.7	0.005	2.00	5.0	A-A
Fe	248.3	0.2	0.050	2.50	5.0	A-A
K	766.5	0.7	0.01	0.75	3.0	A-A
Na	589.0	0.2	0.005	0.25	2.00	A-A
Pb	283.3	0.7	0.08	10	6.0	A-A
Zn	213.9	0.7	0.005	0.50	2.50	A-A

(E) Determination of phosphorus

(I) preparation of reagents

Reagent A (1.0 g ammonium molybdate and 0.2 g of potassium antimony tartrate in 1000 ml measuring flask, add 16 ml of conc. H_2SO_4 slowly by touching out let point of measuring cylinder to the inner neck of the flask, add distilled water slowly, dissolved the contents by shaking and make up to the mark.

Reagent B (0.88gm of ascorbic acid dissolved in one liter of solution A)

(ii) preparation of standard P solutions

standard phosphate solution Dissolved 0.2195g. anhydrous KH_2PO_4 in distilled water and dilute to one liter. This is 50 ppm solution. Prepare a series of standard solution containing 0,2,4,6,8 and 10 µgp/ml by pipetting equal volume of stock solution into 50 ml conical flask and making to its mark with by distilled water.

(iii) procedure

10 ml of sample was pipetted and 10 ml of reagents (B+A) added, made the volume to 50 ml with distilled water and let the blue colour developed for 30 minutes. The absorbance was measured at the wavelength (450 nm). The blank with distilled water was prepared and adjusted 100% transmittance before reading the sample. Three graphs of the standard P solutions (was drawn (P µg/ml v/s absorbance) and plot the straight-line relationship Read P concentration of unknown water samples from the graph in µg/ml: (ISO, 1990).

Calculation

$$P, mg/l = \frac{mgP\ (in\ 50ml)\ x1000}{ml\ sample}$$

2.2.2.3 Pesticides resdue Analysis

(A) standard solution

(I) prapration of standard solution

stock solutions were prepared of concentration 1mg/mL individually by accurately weighing 10mg of each standard dissolving separately in 10 ml inAcetonitrile.The mixture of standard solution 10,5,2,1,0.5, 0.2,0.1, 0.05,0.02, 0.01,0.005,0.002,and 0.001µg/ml were taken in competedto 10ml volume. The standard solutions were stored at−20°C until analysis

(B) Determination of malathion residues

(I) preparation of Sample

Twenty five ml of water was transferred to 250 ml separating funnel, the malathion residue was extracted in 50 ml (30ml Acetone(C_3H_6O), (20 ml

Hexane (C_6H_{14})), respectively shaking the separating funnel vigorously for 10 minutes, the extract was allowed to separate in two phases (layers). The organic layer was collected and concentrated by using Rotary Evaporator to near dryness; residue was recovered in 15% ethyl acetate ($C_4H_8O_2$) in isooctane (C_8H_{18}) and blown down with Nitrogen to 1ml and analyzed by Gas chromatography (GC).

(II) Procedure (Gas Chromatography Analysis)

Gas Chromatography in operated at the following condition:

Column (Bonde phase) fused slica jel: polydimethile silicoxan 5% phenyl Detector: ECD (Electron Capture Detector), Injection temperature: 90 º C

Column temperature: (100- 285 º C), I min Hold then programmed at 7 / min finally hold at 15 min, Detector Temperature:(240- 320 º C).

The sample was injected through the injector inside the device Gas Chromatography and heated to be converted to gas immediately and the Gas chromatography (GC) pumped inert gas so as not to interact with the components of the sample, the inert gas was carried components of the sample into the column (long tube with a certain diameter). As a compound reaches the end of the column, it is sensed by a detector, which sends an electronic signal either to a strip recorder where the signal is recorded as a peak on the strip chart or to a computer data station where the signal is captured electronically. The area under a given peak was proportional to the amount of the compound that causes the signal. The Gas Chromatography was evaluated by measuring the peak area of the sample and comparing with that obtained from the standard solution (AOAC. 2005).

(C) Determination of Cypermethrin residues

(I) Preparation of Sample

25 ml of sample was transferred to 250 ml separating funnel, the Cypermethrin residue was extracted with 40 ml of Acetonitrile (CH_3CN), 15 ml of Acetone (C_3H_6O), 5g of anhydrous Sodium sulphate (Na_2SO_4) keep them together for 10

minutes with vigorously shaking the extracted was filtered, residue washed with 2x10 ml acetone (C_3H_6O). The Cypermethrin was concentrated near dryness and reconcentrated in about 10 ml n-Heptane (C_7H_{16}) + 5g anhydrousNa_2SO_4 concentrated again to dryness and then added 1ml Acetone (C_3H_6O) and analyzed by Gas chromatography(GC) .

(II) Procedure (Gas Chromatography Analysis)

Gas Chromatography operated at the following condition: Column: slica jel, Detector: ECD (Electron Capture Detector), Injection temperature 200 ^{0}C , Column temperature 178 ^{0}C. The sample was injected through the injector inside the device Gas Chromatography and heated to be converted to gas and immediately and the Gas chromatography (GC) pumped inert gas so as not to interact with the components of the sample,the inert gas was carried components of the sample into the column (long tube with a certain diameter) As a compound reaches the end of the column, it is sensed by a detector, which sends an electronic signal either to a strip recorder where the signal is recorded as a peak on the strip chart or to a computer data station where the signal is captured electronically. The area under a given peak was proportional to the amount of the compound that causes the signal. The Gas Chromatography was evaluated by measuring the peak area of the sample and comparing with that obtained from the standard solution. The residue in ppm Cypermethrin was calculated applying the following equation:

Cypermethrin % = (R/R*) X (W*/W) X P

Where R and R*=average peak area ratios for test and standard solution s, respectively; W*=g Cypermethrin in standard solution; W=g portion extracted for analysis; and p= percent purity of standard (AOAC, 2005).

(D) Determination of Carbaryle (Sevin) residues

(I) Preparation of Sample

25 ml of water residue was transferred to 250 ml separating funnel, Carbaryle residues was extracted in petroleum ether (2x75) ml by shaking the separating

funnel vigorously for 5 minutes, the phases were allowed to separated. The organic layer was collected and concentrated by using Rotary Evaporator to near dryness; residue was recovered in acetone (C_3H_6O) and analyzed by HPLC.

(II) Procedure (High-performance liquid chromatography Analysis)

The aliquot solution was injected into the High-performance liquid chromatography (HPLC) and operated according to the following condition: Colum: C18(Octaaesyl group), Wave length: 280nm, Mobile phase: methanol, Detector: photo diode array. The HPLC was evaluated by measuring the peak area of the sample and comparing it with that area obtained for the standard solution of sample. Equal volumes of the extract solution and the standard solution should be injected. The residue in ppm Sevin was calculated by applying the following equation:

Residue in ppm= A_1CV_1/ A_2WV_2

A1= Area of sample, A2= Area of standard

V1= total volume of sample, V2= injected volume

C= concentration of standard

W=weight of standard

Rf= %mean recovery factor

(AOAC, 2005).

2.2.2.4 Statistical analysis

Data was analyzed as complete randomized design. Analysis of variance (ANOVA) was performed According to procedure described by Gomez and Gomez (1984). Means were separated by Using least significant difference (LSD) and T test.

Fig (1): El-Managil map

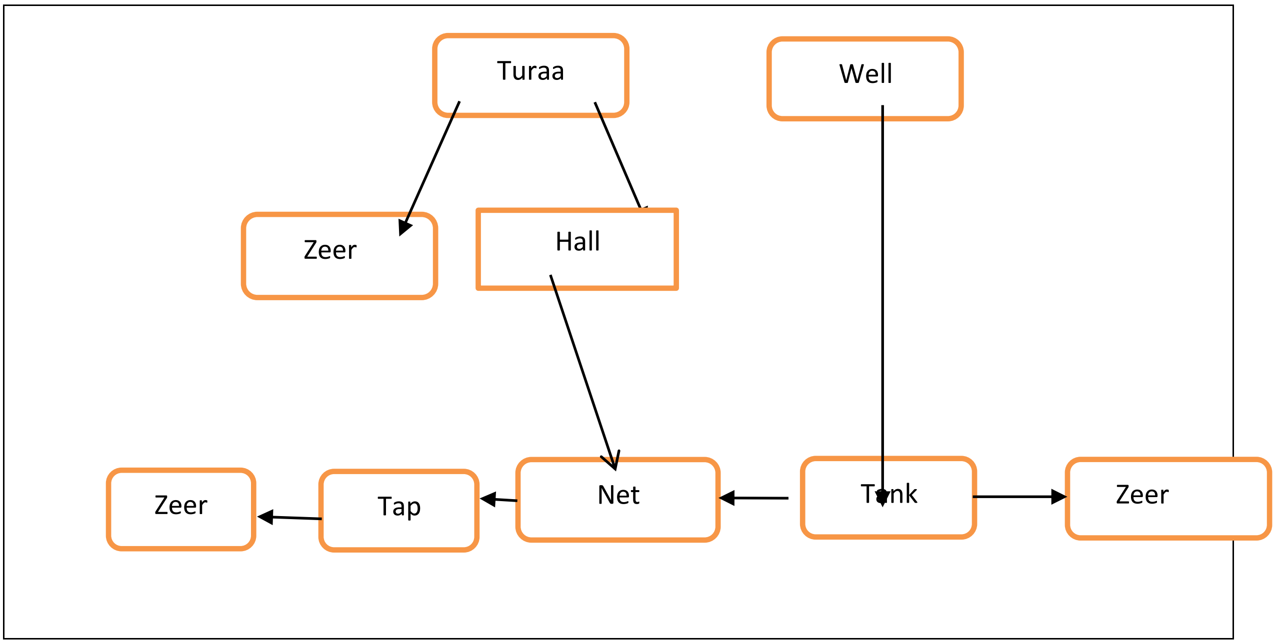


Fig (2): Sources of water samples

Fig (3): Atomic Absorption Spectrophotometer

Fig 4: Spectrophotometer

Fig (5): High Performance Liquid Chromatography (HPLC)

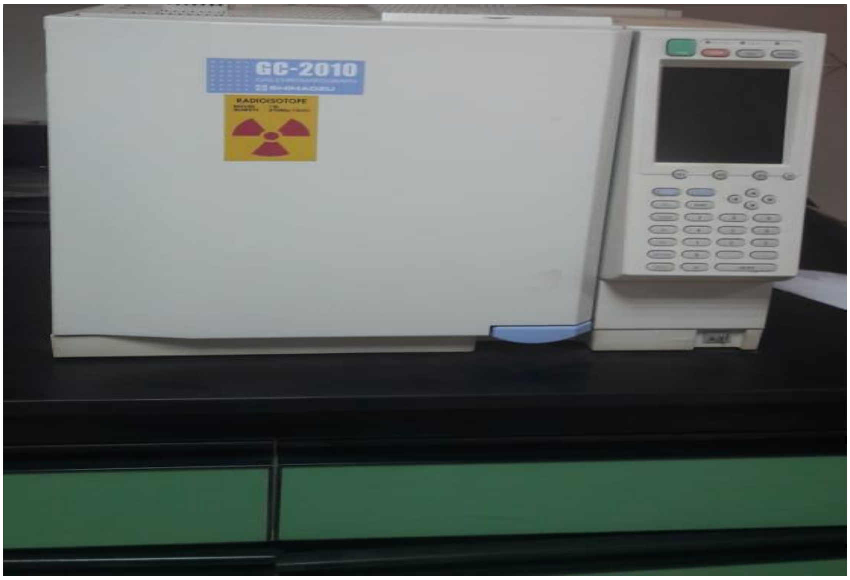


Fig (6): Gas Chromatography (GC)

Fig (7): Turbidity meter

Fig (8): pH meter

Fig (9): Conductivity meter

CHAPTER THREE

Results, discussion , Conclusion and recommendations

3.1 Results and discussion

For convenience, the results were accessible into three groups:

Group A:

(Physical Parameters), Water Temperature (WT), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and Turbidity.

Group B:

(Chemical Parameters) pH, Chlorides (Cl^-), Nitrates ($NO3^-$), Carbonate (CO_3^{--}) and Bicarbonate (HCO_3^-), Calcium (Ca), Cadmium (Cd), Copper (Cu), Iron (Fe), Potassium (K), Sodium (Na), Phosphorus (P), Lead (Pb) and Zinc (Zn)

Group C:

Pesticides (Malathion), (cypermethrin) and (Carbaryl(sevin))

3.1.1Physiochemical parameters, chemical parameters and Pesticides residue of studied water samples

3.1.1.1 El-Managil town

Water samples used in this study varied widely in their properties as shown in Table (3.1.1.1 a) for El-Managil town, data (pH, total dissolved solids (TDS), (Conductivity and Turbidity) showed significant differences in the values but the data (temperature and total suspended solids (TSS) showed non-significant differences in the values. Temperature was an important environmental factor, the minimum temperature recorded (28 °C) and maximum temperature (28.66C°). During the study period, highest mean value of pH (8.177) was found in *zeer* supply from tank(*turaa*+ well) treated water while the lowest one (7.577) was found in tap water (Net (*turaa* +well)) treated water, the values obtained were slightly lower than those reported by Nurain (1998) who found that the pH of the tap and canal water were (7.9 and 8.8) respectively. All the pH readings fall within the acceptable level of WHO (1993) standards (6.5 - 8.5), Mahgoub, (1984) found that the pH value from the three Niles ranged from (7.5 to 8.5). And pH values for the tap and canal water ranged from (7.9 to8.8). Total suspended solids (T.S.S) ranged (0.003 to 3.723 mg/l) for tap water (Net (*turaa* +well)) and hole supply from *turra* respectively, the value of total dissolved solids (TDS) ranged (123.95 to 589. 65 mg/l) the higher values (589.65mg/l) for total dissolved solids (TDS) in treated water the source tap water (Net (*turaa* +well)), may be due to uncorrected treatment, this finding agrees with Nurain (1998) who found that the TDS varied widely for well and canal being (174 and 495 mg/l) respectively. The value of Conductivity ranged (0.194 to 0.921 cm/mS), the higher values (0.921mg/l) for Conductivity in treated water the source tap water (Net (*turaa* +well)). Turbidity in water is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms, in this study turbidity values ranged between (0.00 t0 130.33 NTU). Treated samples show the highest turbidity values than the untreated one and this may be due to the presence of suspended matter such as clay, silt. This finding agrees with Paul, (2011) who found high values for turbidity in natural water (20.9 – 617.9 NTU), in table (3.1.1.1b). The results showed that chlorides are the good indicator of pollution, chloride values in water samples of El-Managil town found ranged between (2.133 to 4.267 mg/l) of which maximum value (4.267mg/l) was recorded in *zeer* supply from tap water (Net (*turaa* +well) and the minimum value (2.133 mg/l) in hole supply from *turra*. These levels can be related to those reported by Nurain (1998) who found that the amount of chloride in canal and well water was (9.8 and 120 mg/l) respectively. All these readings fall below the maximum acceptable level of WHO (1993) standards (250mg/l) when chloride values above (200 mg/l) the water is unsuitable for human consumption. The nitrate values varied from (1.86 to 14.56 mg/l) in treated water which show highly significant difference ($p \leq 0.01$) between the different sources of water. However, the levels of nitrates in studied water samples were within the range of permissible limit (10 mg/l) given by WHO

(2004) except in treated water *zeer* supply from tank (turaa + well), the value was (14.56 mg/l). While Abdel Magid and Elhassan (1986) stated that the acceptable level was 45 mg/l and at higher concentration a health hazard particularly on children might occur for e.g. Blue Babies disease. Carbonate and bicarbonate in water samples for all sources varied from (0.53 to 0.80 mg/l, 2.66 to 6.40 mg/l) respectively, they show significant difference ($p \leq 0.01$), carbonates become a significant factor as the water pH increases beyond (8.0) and are a dominant factor when the pH exceeds about (10.3). The carbonate content of water is considered in conjunction with bicarbonates for several important evaluations such as alkalinity generally, water that contains appreciable carbonates will have already exceeded desirable bicarbonate level.

Table (3.1.1.1a) Physiochemical properties of studied water samples El-Managil town (middle)

Kind of water	Sources	Temperature (^{0}C)	pH	TSS (mg/l)	TDS (mg/l)	Conductivity (cm/mS)	Turbidity (NTU)
Maximum Permissible Limit WHO (2004)		**≤15**	**6.5-8.5**	**NS**	**≤1000**	**≤250**	**0.1-5.0**
Treated	**tap water (Net (*turaa* +well))**	28.000[a]	7.577[c]	0.593[a]	589.65[c]	0.921[a]	0.00[c]
Treated	**Zeer supply from tap water (Net (*turaa* +well))**	28.667[a]	8.177[a]	0.007[a]	534.19[d]	0.835[b]	130.33[a]
Un treated	**Hall supply from *turaa***	28.333[a]	7.853[b]	3.723[a]	123.95[b]	0.194[d]	113.66[ab]
Treated	***Zeer* supply from tank (*turaa* +well))**	28.333[a]	8.050[a]	0.003[a]	131.84[a]	0.206[c]	63.13[b]
Sig		**Ns**	******	**Ns**	******	******	******
LSD 0.05		**0.94**	**0.24**	**3.07**	**6.43**	**0.10**	**57.85**

Note: values with different characters are :

* significantly different by means of the LSD (p<0.05)

** significantly different by means of the LSD (p<0.01)

Table (3.1.1.1 b) Concentration(mg/l) of Chemical parameters of studied water samples of El-Managil Town (Middle)

Site	Kind of water	Sources	Cl^-	NO_3^-	CO_3^{--}	HCO_3^-
Maximum Permissibe Limit WHO (2004)			**≤250**	**≤10**	**≤500**	**≤150**
El-Managil town (Middle)	Treated	Net (*turaa* +well) tap water	4.067[a]	9.89[b]	0.00[b]	6.400[a]
		Zeer supply from Net (*turaa* +well) tap water	4.267[a]	1.86[c]	0.80[a]	6.133[a]
		Hall supply from *turra*	2.133[a]	6.34[d]	0.00[b]	2.667[b]
		Zeer supply from tank (turaa +well)	2.200[a]	14.56[a]	0.53[a]	2.667[b]
Sig			**Ns**	**	**	*
LSD 0.05			1.92	5.91	0.43	3.28

Note: values with different characters are :

* significantly different by means of the LSD ($p<0.05$)

****** significantly different by means of the LSD ($p<0.01$)

Minerals in table (3.1.1.1c) show trends of calcium, cadmium, copper, iron, potassium, sodium, phosphorus, lead and zinc. Calcium, cadmium and potassium show significant difference ($p \leq 0.01$) for different sources of water (treated, untreated) water, tap water (Net (*turaa* +well), *Zeer* supply from tap water (Net (*turaa* +well)),Hall supply from *turra* and *Zeer* supply from tank(*turaa* +well) ranged from (1.875 to 2.745, 0.004 to 0.009, and 0.159 to 0.454 mg/l) respectively, while copper, iron, sodium, phosphorus, lead and zinc show non-significant difference values ranged (0.012to 0.023mg/l, 0.033 to 0.754, 0.921to 3.423, 0.593 to 1.000, 0.015 to 0.020 mg/l and 0.011 to 0.016) respectively.Calcium, copper, potassium, sodium, and zinc values obtained were within the maximum WHO (2008) permissible limits, but (0.009 mg/l) value of cadmium for untreated sample in hall supply from turra was over WHO permissible limit (0.005 mg/l) and lead values(0.020 mg/l ,0.021 mg/l) for the water sources *zeer* supply from tap water (Net (turaa + well)) and zeer supply from tank respectively over the maximum WHO (2008) permissible limits (0.01 mg/l) That value was higher than the finding of Elhag (2004) who found that the lead concentration in well water was in the range (0.004 to 0. 016 mg/l). All these amounts were less than the maximum acceptable level of WHO (2008) standards (0.01 mg/l). value of iron for untreated sample in hall supply from turra was value (0.754 mg /l) over WHO permissible limit (0.3 mg/l), Hager (2009) found in water from 24Elgorashi the higher value of iron 0.83mg/L which was higher than the level allowed by WHO (2008) of (0.3mg/l). Table (3.1.d) shows some commonly used pesticides belonging to the organo phosphorous (malathion), carbamate family (Sevin) and pyrethroids (cypermethrin) in El-Managil town, Sevin, malathion and cypermethrin were not detected in treated water samples except zeer supply from tank (turaa +well) the values (0.0009 mg/l), (0.00112 mg/l), (0.0031 mg/l) respectively which were less than the level allowed by WHO (2008) except the malathion was above than the level allowed by WHO (0.002 ppm), (0.0001), (0.01ppm) for untreated sample in hall supply from turra wear value (0.000487 ppm), (0.0048 ppm), (0.0053 ppm) respectively less WHO permissible limit except malathion over WHO permissible limit (0.0001 ppm). The level of studied pesticides in water samples for both (Sources and kind of water) mentioned Figure (10-15), and this may be due to the intensive use of pesticide in irrigated Gezira scheme, as well as any possible impact from sub stream sources. This finding Adopted by Matsumura (1985) who indicated that almost 60 % of the positive samples in White Nile water were found in Juba, cypermethrin, was detected Malathion was not detected. Gebreel Abdellatif (2007) found that the result of residue analysis for organophosphorus, chlorpyriphos and malathion about (33%) of the samples collected from Khartoum (Elgreef) were found to contain profenophos with average concentration of 0.00061m/l and ranged of (ND- 0.00183 mg/l), cypermethrin residues were detected in(33.3%) of the water samples collected from Sinnar with an average of (0.00085 mg/l) and range of(ND-0.00256 mg/l) and from, Dongla, the main Nile with an average of (0.00005 mg/l) and arrange of (ND-0.00015 mg/l), malathion residue was not detected in White Nile water samples collected from Gabelawlia.

Table (3.1.1.1 c) Mean concentration of minerals (mg/l) of studied water samples El-Managil town (Middle)

Sites	Kind of	Sources	Ca	Cd	Cu	Fe	K	Na	P	Pb	Zn
Maximum PermissibleLimit WHO (2004) ((2004)			≤200	0.005	2.0	≤0.30	5-25	≤200	≤ 2	0.01	≤5.0
El-Managil twon (Middle)	Treated	tap water (Net (p *turaa* (+well)	2.745[a]	0.004[b]	0.012[a]	0.033[a]	0.394[b]	3.423[a]	0.593[a]	0.015[a]	0.010[a]
		Zeer supply from Net *(turaa +well) tap water*	1.875[c]	0.005[b]	0.016[a]	0.076[a]	0.454[a]	2.644[a]	1.000[a]	0.020[a]	0.011[a]
	Un treated	Hall supply from *turra*	2.307[b]	0.009[a]	0.019[a]	0.754[a]	0.169[c]	0.921[a]	1.000[a]	0.016[a]	0.016[a]
		Zeer supply from tank (*turaa* +well)	2.503[a]	0.005[b]	0.023[a]	0.064[a]	0.159[c]	1.630[a]	0.000[a]	0.021[a]	0.016[a]
Significant			**	**	**Ns**	**Ns**	**	**Ns**	**ns**	**Ns**	**ns**
LSD 0.05			0.40	0.003	0.014	0.96	0.057	2.23	1.701	0.018	0.007

Note: values with different characters are significantly different by means of the LSD ($p < 0.05$).

Table (3.1.1.1d) Mean concentration of pesticides (ppm) in studied water samples El-Managil town (middle)

Site	Kind of water	Sources	Sevin	Malathion	Cypermet hrin
Maximum Permissible Limit WHO (2004)			0.002mg/l	0.0001mg/l	0.01mg/l
El-Managil town (middle)	Treated	(Net(turaa+well)) tap water	Nd	Nd	Nd
		Zeer supply from (Net(*tera*) +well)tap water	Nd	Nd	Nd
		*Zee*r supply from tank (*Tura* +well)	0.00086	0.00112	0.0031
	Un treated	Hall supply from *turra*	0.00048	0.0004	0.0053

3.1.1.2 North El-Managil

Table (3.1.1.2a) shows some physiochemical properties of water samples for northern El-Managil villages (Wad halawy, Altiquia and Sasha) which varied widely according to sources (*Turaa*, *Zeer* supply from *Turaa*, Tank supply from well and *Zeer* supply from Tank) and kind of water (untreated). The data(total dissolved solids (TDS), Conductivity and Turbidity) were showed significant differences in the values but the data (T temperature, pH and total suspended solids (TSS) were showed non-significant differences in the values for the untreated water in different sources, observed in Altiquia village.The data (total dissolved solids (TDS), Conductivity and Turbidity temperature, total suspended solids (TSS)) were showed significant differences in the values except (pH)was showed non-significant differences in the values for the untreated water in different sources, observed in wad Hallawy village. The data (Physical parameters) showed non-significant differences in the values for the untreated water in different sources, observed in Shasha village. Temperature was an important 0environmental factor, the minimum temperature recorded 27 ^{o}C and maximum temperature 29C^{o} During the study period.. The study revealed that the pH value of the water ranged from (7.6 to 8) was slightly alkaline and within WHO (2008) permissible limit **(**6.5-8.5**).** Mahgoub, (1984) found that the pH value from the three Niles ranged from (7.5 to 8.5), and pH values for the tap and canal water ranged from (7.9 to 8.8). The mean values for total suspended solids (TSS) observed ranged between (0.000 to 1.474mg/l) for the untreated water in different sources, the value (1.474 mg/l) observed in Altiquia villages in *turaa* water may due to saltation, deterioration and heavy precipitation, this finding adopted by Raut *et. al*. (2011) of Ravivar Peth Lake at Ambajogai, the TSS values were below the desirable limit of WHO standard, therefore, water was recommended for drinking and bathing purposes. In the present result total dissolved solids (TDS) ranged from (131.2 to 673.653 mg/l) where the value (673.653 mg/l) was observed in Altiquia village for untreated water (*Zeer* supply from Tank). The mean values for total conductivity observed ranged between (0.214 to 0.898 mg/l) for the untreated water in different sources, the value (0.898 mg/l) observed in Altiquia villages in tank supply from well, turbidity in water is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms. Turbidity was ranged (0.000 to 254.333 NTU), the highest value (254.333 NTU) was observed in *zeer* supply from *turaa* source for Altiquia village and this may be due to suspended matter such as clay, silt this value exceeding Nema (1999) standards effluent discharge of (300 NTU).

Table (3.1.1.2 c) shows trends of chloride, nitrates, carbonates and bicarbonates at Wad Hallawy village for untreated water samples for different sources (*Turaa*, *Zeer* supply from *Turaa*, Tank supply from well and *Zeer* supply from Tank) were varied significantly ($p \leq 0.01$), while in Altiquia village chloride and carbonates varied significantly, nitrates and carbonates show non- significant differences for different sources, more over in Shasha village chloride varied significantly while nitrates, carbonates and bicarbonates show non-significant differences for all sources mentioned above. The results are in agreement with Hager (2009) she found that the concentration of chloride in the six water samples and the highest mean value (86.87 mg/l) was detected in ground water from Tabat water station, while the lowest mean value (3.23 mg/l) was detected in surface water from 24 Elgorshi water station. There are significant differences among samples and agreement with Nurain (1998) who found that the amount of chloride in canal and well water were (9.8 and 120 mg/l) respectively. All these readings fall below the maximum acceptable level of WHO (1993) standard (250 mg/l). Water is free from chloride hazard at this area (North El-Managil) hence it can be used for human consumption and agricultural purposes, while the levels of nitrates in north El-Managil water were within the range of permissible limit given by WHO (10 mg/l) for human consumption and agriculture purposes.

Table (3.1.1.2 a) Physiochemical properties of studied water samples north El-Managil

Site	Kind of water	Sources	Temperature (^{0}C)	pH	TSS mg/l	TDS mg/l	Conductivity cm/mS	Turbidity NTU
Maximum Permissible Limit WHO (2004)			≤15	6.5-8.5	**NS**	≤1000	≤ 250	0.1-5.0
Wad Hallawy	**Untreated**	***Turaa***	28.67[a]	7.803[a]	0.305[b]	137.17[c]	0.214[c]	238.233[a]
	Untreated	***Zeer* supply from *Turaa***	27.33[b]	7.697[a]	0.003[b]	174.08[b]	0.272[d]	28.037[b]
	Untreated	**Tank supply from well**	28.00[a]	7.85[a]	0.000[b]	449.92[a]	0.703[a]	0.000[b]
	Untreated	***Zeer* supply from Tank**	27.00[b]	7.856[a]	0.839[a]	445.86[a]	0.697[b]	1.457[b]
Sig			**	**Ns**	**	**	**	*
LSD 0.05			**0.78**	**0.47**	**0.49**	**5.83**	**0.009**	**154.17**
Altiquia	**Untreated**	***Turaa***	29.00[a]	7.830[a]	1.474[a]	131.200[b]	0.205[b]	252.000[a]
	Untreated	***Zeer* supply from *Turaa***	28.00[a]	7.840[a]	0.667[a]	170.027[b]	0.266[b]	254.333[a]
	Untreated	**Tank supply from well**	29.00[a]	7.637[a]	0.000[a]	574.933[a]	0.898[a]	0.000[b]
	Untreated	***Zeer* supply from Tank**	29.00[a]	7.637[a]	0.000[a]	673.653[a]	0.896[a]	0.000[b]

Sig			**Ns**	**Ns**	**Ns**	******	******	******
LSD 0.05			**0.00**	**0.194**	**2.43**	**169.07**	**0.081**	**78.17**
Shasha	**Untreated**	**Tank supply from well**	28.0[a]	8.0[a]	0.3[a]	504.3[a]	0.8[a]	0.0[a]
	Untreated	***Zeer* supply from Tank**	28.7[a]	7.9[a]	0.3[a]	506.0[a]	0.8[a]	0.0[a]
Sig			**Ns**	**Ns**	**Ns**	**ns**	**Ns**	**Ns**

Note: values with different characters are:

* significantly different by means of the LSD ($p<0.05$)

** significantly different by means of the LSD ($p < 0.01$)

Table (3.1.1.2 b) Chemical parameters of studied water samples (mg/l) north El-Managil

Site	Villages	Kind of water	Sources	Cl^-	NO_3^-	CO_3^{--}	HCO_3^-
Maximum Permissible Limit WHO (2004)				**≤ 250**	**≤10**	**≤500**	**≤150**
North El-Managil	Wad Hallawy	Untreated	*Turaa*	4.000[a]	0.000[b]	2.933[c]	28.67[a]
			Zeer supply from *Turaa*	2.000[b]	0.000[b]	4.267[b]	27.33[b]
			Tank supply from well	4.367[a]	0.000[b]	7.200[a]	28.00[a]
			Zeer supply from Tank	4.533[a]	0.800[a]	8.000[a]	27.00[b]
	Sig			*****	******	******	******
	LSD 0.05			**1.87**	**0.21**	**1.44**	**0.76**
	Altiquia	Untreated	*Turaa*	2.600[b]	4.940[a]	0.000[a]	2.667[b]
			Zeer supply from *Turaa*	3.133[a]	3.920[a]	0.000[a]	3.467[b]
			Tank supply from well	6.133[b]	3.547[a]	0.267[a]	5.867[a]
			Zeer supply from Tank	6.133[a]	3.547[a]	0.267[a]	5.867[a]
	Sig			******	ns	Ns	******
	LSD 0.05			0.84	4.77	0.61	0.86
	Shasha	Untreated	Tank supply from well	96.0[a]	3.0[a]	0.5[a]	8.3[a]
			Zeer supply from Tank	93.0[b]	3.2[a]	0.5[a]	7.2[a]
	Sig			*****	ns	Ns	Ns

Note: values with different characters are: * significantly different by means of the LSD ($p<0.05$) ** significantly different by means of the LSD ($p < 0.01$)

Minerals in table (3.1.1.2c) show trends of calcium, cadmium, copper, iron, potassium, sodium, phosphorus, lead and zinc. Calcium, cadmium, iron potassium, sodium and phosphorus show significant difference ($p \leq 0.01$) for untreated water samples in Wad Hallawy village for *turaa* water, *Zeer* supply from *turaa*, tank supply from well and *Zeer* supply from tank ranged from (3.616 to 5.181, 0.001 to 0.007, 0.002 to 0.174, 0.127 to 0.387, 0.581 to 3.563 and 1.667 to 30.00 mg/l) respectively, while copper, lead and zinc show non- significant difference values ranged (0.009 to 0.017, 0.007 to 0.023 and 0.004 to 0.012,mg/l) respectively. In Altiquia village untreated water samples show non- significant differences for cadmium, copper, iron, lead and zinc to the different sources above, while calcium, potassium, sodium and phosphorus show significant differences ($p \leq 0.01$) varied between (3.016 to 5.829, 0.168 to 0.841, 0.568 to 3.366 and 1.00 to 33.00mg/l) respectively. Untreated water samples for Shasha village show non-significant differences for cadmium, copper, iron, potassium, sodium, phosphorus and zinc, while calcium and lead show significant differences ($p \leq 0.05$) ranged 4.50 to 5.30, 0.006 to 0.017 mg/l. All metals tested in water samples were found below the maximum permissible limits by WHO except iron, lead, phosphorus, cadmium, concerning iron which exceed the permissible limits (0.3 mg/l) in Atiquia and Shasha villages, the high values (0.469 mg/l) source of untreated water from *turaa* and (1.57 mg/l) source of untreated water from *zeer* supply from tank respectively, this finding adopted with Hagar 2009 On surface water from 24 Elgorashi water station was found to contain iron as 0.83mg/l which was higher than the level allowed by SSMO (2002) of 0.3mg/L. The high values of phosphorus noticed in wad Hallawy (8.00 mg/l), (30.00 mg/l) and (29.67 mg/l) according to the sources of untreated water from *turaa,* tank supply from well and *zeer* supply from tank respectively and noticed in Shasha with values (23.3 mg/l) and (23.7 mg/l). according to the sources of untreated water from tank supply from well and *zeer* supply from tank which wear higher than the level allowed by WHO (2004) standard (2mg/l), concerning lead the high value recorded in wade Hallawy (0.023 mg/l) and (0.035) in Atiquia for (untreated water) for *turaa* and *zear* supply from *turaa* respectively and also the high value of lead recorded in Altiquia (0.035 mg/l), (0.029) and (0.029) kind of water untreated ,the sources *turaa*, tank supply from well and *zeer* supply from tank respectively, All these amounts were higher than the maximum acceptable level of WHO (2004) standard (0.01 mg/l), this values were higher than the finding of Elhag (2004) who found that the lead concentration in well water was in the range (0.004 to 0. 016 mg/l) and lower than finding of Hagar 2009 on ground water the level of lead in water collected from the six different sites. The highest mean value (0.258 mg/l) was detected in ground water from Elhasahisa water station, while no lead was detected in surface water. All these amounts were higher than the maximum acceptable level of SSMO (2002) standards (0.007 mg/l). the high value of recorded in Altiquia (0.035mg/l), (0.029) and (0.029) kind of water untreated, the sources turaa, tank supply from well and *zeer* supply from tank respectively. All these amounts were higher than the maximum acceptable level of WHO (2004) standard (0.01 mg/l). concerning cadmium, the high value recorded in wade Hallawy(0.007 mg/l) for (untreated water) for *zeer* supply from tank this amount was higher than the maximum acceptable level of WHO (2004) standard (0.005 mg/l). This level can be related to the reported by Hager (2009) who found that the highest value (0.062 mg/l) was detected in ground water collected from Elamara water station, while no cadmium was detected in surface water collected from Raselphil and 24 Elgorshi water station.There are significant differences among the samples. All detected values were higher than the

SSMO (2002) standards (0.003 mg/l). Fig (10-15) shows some commonly used pesticides belonging to the organophosphorus (malathion), carbamate (sevin) family and pyrethroids (cypermethrin) in villages belonging to North El-Managil town, sevin, malathion and cypermethrin were not detected in untreated water samples for all water sources mention above. This is because farmers do not use these types of pesticides and use other types. This finding Adopted by Matsumura (1985) who indicated that almost 60 % of the positive samples in White Nile water were found in Juba, cypermethrin, was detected Malathion was not detected. Gebreel Abdellatif (2007) found that the results of malathion residue were not detected in White Nile water samples collected from Gabelawlia.

Table (3.1.1.2 c) Mean concentration of minerals (mg/l) in studied water samples north El-Managil

Sites	Villages	Kind of	Sources	Ca	Cd	Cu	Fe	K	Na	P	Pb	Zn
Maximum Permissie Limit WHO (2004)				≤200	≤0.005	≤2.0	≤0.30	5-25	≤200	≤ 2	≤0.01	≤5.0
North El-Managil	Wad Hallawy	Untreated	*Turaa*	4.611^{a}	0.004^{b}	0.013^{a}	0.174^{a}	0.127^{b}	0.581^{c}	8.000^{b}	0.023^{a}	0.008^{a}
			Zeer supply from	5.181^{a}	0.005^{b}	0.017^{a}	0.043^{b}	0.343^{a}	1.400^{b}	1.667^{b}	0.020^{a}	0.012^{a}
			Tank supply from well	3.744^{b}	0.001^{c}	0.016^{a}	0.048^{b}	0.387^{a}	3.563^{a}	30.00^{a}	0.016^{a}	0.004^{a}
			Zeer supply from Tank	3.616^{b}	0.007^{a}	0.009^{a}	0.022^{b}	0.356^{a}	3.487^{a}	29.67^{a}	0.007^{a}	0.005^{a}
	Significate			**	**	Ns	*	**	**	**	Ns	ns
	LSD 0.05			0.082	0.002	0.008	0.097	0.082	0.160	9.013	0.019	0.006
	Altiquia	Untreated	*Turaa*	3.798^{b}	0.004	0.020	0.469	0.200^{b}	0.568^{b}	33.00^{a}	0.035^{a}	0.014^{a}
			Zeer supply from	3.016^{b}	0.004	0.014	0.169	0.168^{c}	0.600^{b}	30.00^{a}	0.014^{a}	0.009^{a}
			Tank supply from well	5.829^{a}	0.004	0.025	0.021	0.841^{a}	3.366^{a}	1.00^{b}	0.029^{a}	0.010^{a}
			Zeer supply from Tank	5.829^{a}	0.004	0.025	0.021	0.841^{a}	3.366^{a}	1.00^{b}	0.029^{a}	0.010^{a}
	Significant			*	Ns	Ns	Ns	**	**	**	Ns	ns
	LSD 0.05			2.25	0.006	0.011	0.584	0.265	0.129	15.92	0.037	0.004
	Shasha	Untreated	Tank supply from well	5.3^{a}	0.003^{a}	0.013^{a}	0.04^{a}	0.402^{a}	3.47^{a}	23.3^{a}	0.006^{b}	0.010^{a}
			Zeer supply from Tank	4.5^{b}	0.005^{a}	1.55^{a}	1.57^{a}	1.787^{a}	3.25^{a}	23.7^{a}	0.017^{a}	0.008^{a}
	Significant			*	Ns	Ns	Ns	ns	Ns	Ns	*	ns
	T calculated			4.599	0.353	0.998	1.000	0.977	2.157	0.301	4.063	0.693
	T table 0.05			2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776

Note: values with different characters are significantly different by means of the LSD ($p < 0.05$).

Table (3.1.1.2 d) Mean concentration of pesticides (ppm) in studied water samples north El-Managil

Site	Villages	Kind of water	Sources	Sevin	Malathion	Cypermethrin
North El-Managil	Shasha	Untreated	Tank supply from well	ND	ND	ND
			Zeer supply from Tank	ND	ND	ND
	Wad Hallawy		*Turaa*	ND	ND	ND
			Zeer supply from *turaa*	ND	ND	ND
			Tank supply from well	ND	ND	ND
			Zeer supply from tank	ND	ND	ND
	Altiquia		*Turaa*	ND	ND	ND
			Zeer supply from *turaa*	ND	ND	ND
			Tank supply from well	ND	ND	ND
			Zeer supply from tank	ND	ND	ND

3.1.1.3 South El-Managil

Table (31.1.3 a) shows some physiochemical properties of water samples for south El-Managil villages (Ummtalha and Kambo 26) which varied widely according to different sources (*Turaa*, *Zeer* supply from *turaa*, Tank supply from well and *Zeer* supply from Tank) for untreated water. The data (Temperature, total suspended solids (TSS) total dissolved solids (TDS), Turbidity) were showed significant differences in the values but the data (,pH and Conductivity and) were showed non-significant differences in the values for the untreated water in different sources, observed in Kambo 26 village.The data(temperature, pH, total suspended solids (TSS). (conductivity and Turbidity) were showed non-significant differences in the values except (total dissolved solids (TDS) was showed significant differences in the values for the untreated water in different sources, observed in Ummtalha village. Temperature was important environmental factor, the minimum temperature recorded (26.33°C) and maximum temperature (28.67°C) during the study period. pH recorded (7.39) was found in tank supply from well source for Kambo 26 village and maximum pH (7.96) was found in *Turaa* source for Ummtalha village during the study period the study revealed that the pH value of the water is slightly alkaline and within WHO (2008) permissible limit (6.5- 8.5). Mahgoub, (1984) found that the pH value from the three Niles ranged from (7.5 to 8.5), and pH values for the tap and canal water ranged from (7.9 to 8.8). Total suspended solid (TSS) observed ranged between (0.000 to 9.837 mg/l,) where in some water samples for different sources total suspended solids were not detected. The highest value for total suspended solids (9.837 mg/l) in water sample for Kambo 26 (*turaa*) may be due to siltation, deterioration and heavy precipitation Raut *et. al*. (2011). Total dissolved solids ranged (133.76 to 409.81 mg/l), The highest value for total dissolved solids (409.81 mg/l) in water sample for Ummtalha village (Tank supply from well) which is considered below WHO permissible limit (1000 mg/l), and there for the water samples were suitable for human purposes. This result agrees with Hager (2009) how found that the TDS levels of the water collected from the six different sites**.** The highest mean value (757 mg /l) was found in ground water from Elamara water station, while the lowest one (152**.**33 mg/l) was found in surface water from 24 Elgorshi water station. Nurrain (1998) found that the TDS level for well and canal waters were (174 and 495 mg/l) respectively. There are significant differences among the samples. All the readings fall below the highest level of WHO (1993) standards (1000 mg/l)**.** Conductivity observed ranged between (0.222 to 70.805 cm/Sm,). The highest value for Conductivity (70.805 cm/Sm) in water sample for Kambo 26 village, sources (*turaa*) Turbidity was ranged (1.78 to 1596 NTU), the highest value (1596NTU) was observed in *turaa* source for Kambo 26 village and this may be due to suspended matter Another cause of human activities is water disturbance such as construction, which may lead to high levels of precipitation entering the water during rainstorms and turbidity of water. Also the high value of turbidity in the canal water can be due to the that fact canal becomes very shallow in summer and this caused difficulty in water pumping and contaminates the water with solids and soil particles thus turbidity values of surface water from Raselphil**,** 24 Elgorshi and 21 Elamancy water stations has highly exceed the acceptable level of WHO (1993) and SSMO (2002) standards (5NTU)**.** Table (3.1.1.3 b) the result shows that chloride, nitrates, carbonates and bicarbonates in water samples for Umtalha and Kambo 26 (different sources) show non-significant differences except bicarbonates which show significant differences ($p \leq 0.01$) in Umtalha villages ranged (2.267 to 2.733) (3.800 to 5.133), (4.480 to 10.080), (2.053 to 3.360), (0.000), (3.756 to 6.933) (4.000 t0 8.000 mg/l) respectively. These levels can be related to those reported by Nurain (1998) who found that the amount of chloride in canal and well water was 9.8 and 120 mg/l respectively Hager found that the level of Nitrate in the six different water samples. The highest mean value (11.82 mg/l) was found in ground water from Elhasahisa water station, while the lowest mean value (3.23 mg/l) was 37 found in surface water from 24 Elgorshi water station. The data showed significant differences among samples. All these levels were below the found by Abdelmagid and Elhassan (1986) who stated that the level was (45 mg/l).

Table (3.1.1.3 a) Physiochemical properties of studied water samples south El-Managil

Site	Kind of water	Sources	Temperature (^{0}C)	pH	TSS mg/l	TDS mg/l	Conductivity cm/mS	Turbidity
Maximum Permissible Limit WHO (2004)			**≤15**	**6.5-8.5**	**NS**	**≤1000**	**≤250**	**0.1-5.0 NTU**
Kambo 26	**Untreated**	***Turaa***	26.67^b	7.57^a	9.837^a	133.76^c	70.805^a	1596.667^a
	Untreated	***Zeer* supply from *Turaa***	27.00^b	7.45^a	0.347^b	142.09^c	0.222^a	81.000^b
	Untreated	**Tank supply from well**	28.67^a	7.43^a	0.031^b	324.92^a	0.508^a	18.520^b
	Untreated	***Zeer* supply from Tank**	28.33^a	7.39^a	0.001^b	245.97^b	0.384^a	20.187^b
Sig			**	**Ns**	**	**	**Ns**	**
LSD 0.05			**0.94**	**0.368**	**3.933**	**90.89**	**115.11**	**10.54**
Um talaha	**Untreated**	***Turaa***	26.33^a	7.96^a	0.00^a	152.53^b	0.372^a	128.67^a
	Untreated	**Tank supply from well**	26.33^a	7.68^a	0.00^a	409.81^a	0.630^a	1.89^a
	Untreated	***Zeer* supply from Tank**	27.00^a	7.94^a	0.00^a	388.24^a	0.416^a	1.78^a
Sig			**Ns**	**Ns**	**ns**	**	**Ns**	**Ns**
LSD 0.05			**1.48**	**0.45**	**0.0**	**21.89**	**0.487**	**128.57**

Note:values with different characters are significantly according to T test at ($p < 0.01$)

Table (3.1.1.3 b) Concentration(mg/l) of Chemical parameters of studied water sample South El-Managil

Site	Villages	Kind of water	Sources	Cl^-	NO_3^-	CO_3^{--}	HCO_3^-
Maximum Permissible limiteWHO (2004)				**≤250**	**≤10**	**≤500**	**≤150**
South El-Managil	Kambo 26	Untreatd	*Turaa*	2.467[a]	4.480[a]	0.00[a]	4.267[a]
			Zeer supply from *turaa*	2.733[a]	5.040[a]	0.00[a]	3.756[a]
			Tank supply from well	2.467[a]	10.080[a]	0.00[a]	6.933[a]
			Zeer supply from tank	2.267[a]	4.480[a]	0.00[a]	5.333[a]
	Sig			**Ns**	**Ns**	**Ns**	**Ns**
	LSD 0.05			2.29	5.4	0.00	3.60
	Umtalaha	Untreated	*Turaa*	5.133[a]	3.360[a]	0.000[a]	4.000[b]
			Tank supply from well	3.867[a]	2.613[a]	0.000[a]	8.000[a]
			Zeer supply from Tank	3.800[a]	2.053[a]	0.000[a]	7.200[a]
	Sig			**Ns**	**Ns**	**Ns**	**
	LSD 0.05			3.76	1.78	0.00	0.922

Note: values with different characters are significantly different by means of the LSD ($p < 0.01$).

Table (3.1.1.3 c) shows trends of calcium, cadmium, copper, iron, potassium, sodium, phosphorus, lead and zinc in untreated water samples of south El-Managil villages (Umtalha, Kambo26) for different sources such as *turra*, tank supply from well, zeer supply from *turra* and *zeer* supply from well where sodium show significant difference ($p \leq 0.01$) for different sources in two villages ranged from 2.342 to 3.688, 0.537 to 1769 mg/l beside iron which show significant difference ($p \leq 0.01$) for Kambo 26 water samples ranged 0.024 to 0.207 mg/l. Calcium, cadmium, copper, potassium, phosphorus, lead and zinc in untreated water samples for the different source Umtalha and Kambo 26 were show non-significant differences ranged (2.947 to 3.721, 3.339to 9. 970, 0.002 to 0.009, 0.003 to 0.006, 0.016 to 0.027,0.013 to 0.23, 0.034 to 0.135, 0.246 to 0.426, 0.125 to 0.323, 1.000 to 1.333, 0.667 to 9.333, 0.014 to 0.027, 0.010 to 0.22, 0.007 to 0.009, 0.005 to 0.014 mg/l) respectively. The concentration values for all the metals tested for South El-Managil water samples were below the permissible limit by WHO except cadmium, phosphorus, lead which slightly increased above WHO permissible limit. Elhag (2004) found that the amount of zinc in well water was 0.012 to 0.17 mg/l.The amount fall below the maximum acceptable level of SSMO (2002) standards (3 mg/l) while Hagar (2009) find that highest mean value (0.015 mg/l) for zinc was detected in ground water from Elamara water station, while zinc was not detectable in surface water from Raselphil, 24 Elgorshi and 21 Elmancy water stations and ground water from Elhasahisa water station. The data showed significant differences among the samples. Concerning cadmium the high values (0.009 mg/l) and (0.006) the sources *turaa* and *zeer* supply from well respectively the village Umtalha, this finding agree with finding of Hagar, the highest mean value (0.062 mg/l) for cadmium was detected in ground water collected from Elamara water station, while no cadmium was detected in surface water collected from Raselphil and 24 Elgorshi water station. There are significant differences among the samples. All detected values were higher than the SSMO (2002) standards (0.003 mg/l). Concerning lead the high values (0.026 mg/l) and (0.027 mg/l) the sources tank supply from well and *zeer* supply from tank respectively the village Umtalha, concerning the cadmium high value (0.006 mg/l) the sources tank supply from well the village Kambo26 concern phosphorus the high values (9.333 mg/l) and (4.000 mg/l) the sources *turaa* and *zeer* supply from *Turaa* respectively the village kambo 26, concerning lead the high values (0.020 mg/l) and (0.022 mg/l) the sources *turaa* and tank supply from well respectively the village Kambo26, finding of lead agree with Hagar (2009) the highest mean value (0.258 mg/l) for lead was detected in ground water from Elhasahisa water station, while no lead was detected in surface water. All these amounts were higher than the maximum acceptable level of SSMO (2002) standards (0.007 mg/l). While Elhag (2004) found that the lead concentration in well water was in the range 0.004 to 0. 016 mg/l. All these amounts were higher than the maximum acceptable level of SSMO (2002) standards (0.007 mg/l). The increased value of some metals in ground water may result from leaching of industrial and sewage water into the ground water (Mohamed *et al*., 1998). Table (3.1.1.3 d) shows the concentration values of sevin , malathion and cypermethrin for water samples in kambo 26 for *turaa* values (0.00065 mg/l), (0.0013 mg/l), (0.0144 mg/l) respectively which were over than the level allowed by WHO (2008)(0.002 mg/l), (0.0001), (0.01 mg/l) except sevin pesticide was less than the level allowed by WHO (2008) concern *zeer* supply from *turaa* the values (0.00060 mg/l), (0.0014 mg/l), (0.0053 mg/l) respectively which were less than the level allowed by WHO (2008) (0.002 mg/l), (0.0001 mg/l), (0.01 mg/l), except malathion pesticide was above than the level allowed by WHO (2008) these result may be due to the intensive use of pesticide in irrigated Gezira scheme, as well as any possible impact from sub stream sources, the mentioned pesticides were not detected in untreated water samples in Umtalha for both sources (*zeer* supply from well, *zeer* supply from tank. The level of studied pesticides in water samples for both (Sources and kind of water) mentioned Figure (10-15). This finding Adopted by Matsumura (1985) who indicated that almost 60 % of the positive samples in White Nile water were found in Juba, cypermethrin, was detected Malathion was not detected. Gebreel Abdellatif (2007) found that the result of residue analysis for organophosphorus, chlorpyriphos and malathion bout 33% of the samples collected from Khartoum (Elgreef) were found to contain profenophos with average concentration of 0.00061mg/l and ranged of ND- 0.00183 mg/l, cypermethrin residues were detected in 33.3% of the water samples collected from Sinnar with an average of 0.00085 mg/l and range of ND-0.00256 mg/l and from, Dongla, the main Nile with an average of 0.00005 mg/l and arrange of ND-0.00015 mg/l. malathion residue was not detected in White Nile water samples collected from Gabelawlia.

Table (3.1.1.3 c) Mean concentration of minerals (mg/l) in studied water samples south El-Managil

Sites	Villages	Kind of	Sources	Ca	Cd	Cu	Fe	K	Na	P	Pb	Zn
Maximum Permissible LimiWHO (2004)				≤ 200	≤0.005	≤2.0	≤0.30	5-25	≤200	≤ 2	≤0.01	≤5.0
south El-Managil	Umtalha	Untreated	*Turaa*	2.947[a]	0.009[a]	0.026[a]	0.135[a]	0.246[a]	2.342[c]	1.333[a]	0.014[a]	0.009[a]
			Tank supply from well	3.490[a]	0.006[a]	0.016[a]	0.034[a]	0.337[a]	3.112[b]	1.333[a]	0.026[a]	0.008[a]
			Zeer supply from Tank	3.721[a]	0.002[a]	0.027[a]	0.041[a]	0.426[a]	3.688[a]	1.000[a]	0.027[a]	0.007[a]
	Significant			**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**	**Ns**	**Ns**	**Ns**
	LSD 0.05			1.296	0.007	0.020	0.130	0.232	0.461	2.98	0.014	0.015
	Kambo 26	Untreated	*Turaa*	4.168[a]	0.004[a]	0.018[a]	0.207[a]	0.125[a]	0.537[b]	9.333[a]	0.020[a]	0.008[a]
			Zeer supply from *Turaa*	3.339[a]	0.004[a]	0.013[a]	0.064[b]	0.185[a]	0.691[b]	4.000[a]	0.010[a]	0.014[a]
			Tank supply from well	9.790[a]	0.006[a]	0.023[a]	0.024[b]	0.323[a]	2.348[a]	0.667[a]	0.022[a]	0.006[a]
			Zeer supply from Tank	6.022[a]	0.003[a]	0.017[a]	0.035[b]	0.267[a]	1.769[a]	1.000[a]	0.013[a]	0.005[a]
	Significant			**Ns**	**Ns**	**Ns**	**	**ns**	**	**Ns**	**ns**	**ns**
	LSD 0.05			7.17	0.007	0.010	0.084	0.175	0.98	15.11	0.014	0.015

Note: values with different characters are significantly different by means of the LSD ($p < 0.01$).

Table (3.1.1.3 d) means concentration of pesticides (ppm) in studied water samples south El-Managil

Site	Villages	Kindof water	Sources	Sevin	Malathion	Cypermethrin
Maximum Permissible Limit WHO (2004)				≤ 0.002ppm	≤0.0001 ppm	≤ 0.01ppm
south El-Managil	Kambo 26	Untreated	*Turaa*	0.00065	0.0013	0.0144
			Zeer supply from *turaa*	0.00060	0.0014	0.0053
	Umtalaha	Untreated	Tank supply from well	ND	ND	ND
			Zeer supply from tank	ND	ND	ND

3.1.1.4 West El-Managil

Table (3.1.1.4 a) shows some physiochemical properties of water samples for west El-Managil villages (El-krimit, Wad Alamin) which varied widely according to sources (*Turaa*, *Zeer* supply from *Turaa*) for (untreated water). The data (total dissolved solids (TDS), and Turbidity) showed significant differences in the values but the data (Temperature, pH and total suspended solids (TSS), Conductivity) showed non-significant differences in the values for the untreated water in different sources, observed in El-krimit village. The data (pH, Temperature, total dissolved solids (TDS), Conductivity and Turbidity, were showed non-significant differences in the values except (total suspended solids (TSS)) showed significant differences in the values for the untreated water in different sources, observed in Wad Alamin village. Temperature was important environmental factor, the minimum temperature recorded 28°C and maximum temperature 29ºC for the study period..The pH of water affects the solubility of many toxic and nutritive chemicals and it is a measure of acid balance of solution, it is ranged from (7.4 to 7.7). The study revealed that the pH value of the water is slightly alkaline and within WHO (2004) permissible limit. Total suspended solids (TSS) observed ranged between (0.00 to 6.00 mg/l) for the untreated water in different sources, the value (6.00 mg/l) observed in *turaa* water in Wad Alamin village.Total dissolved solids (TDS) ranged from (122.40 to 137.80 mg/l) where the value(137.80 mg/l) observed in Alkrimit village for *turaa* untreated water sample Nurrain (1998) found that the TDS level for well and canal waters were (174 and 495) mg/l respectively. The conductivity value for the all samples were(0.2 cm/mS). Turbidity in water is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms. Turbidity was ranged (115.2 to 1618.7 NTU), the highest value (1618.7 NTU) was observed in *turaa* source for Wad Alamin village and this may be due to suspended matter in Table (3.4.b) the result shows that Chloride, nitrates, carbonates and bicarbonates in water samples for El-krimit, Wad Alamin (different sources) non-significant differences values (1.9,2.5), (1.5, 1.5), (3.7,4.3) (4.3,1.9), (0.000), (2.1,4.8), (3.7, 4.7 mg/l) respectively. Nurain (1998) who found that the amount of chloride in canal and well water was 9.8 and 120 mg/l respectively.

Table (3.1.1.4 a) Physiochemical properties of studied water samples west El-Managil

Site	Kind of water	Sources	Temperature (^0C)	pH	TSS mg/l	TDS mg/l	Conductivity cm/Ms	Turbidity
Maximum Permissible Limit WHO (2004)			**≤15**	**6.5-8.5**	**Ns**	**≤1000**	**≤250**	**0.1-5.0 NTU**
El-krimit	**Untreated**	***Turaa***	28.0^a	7.3^a	0.0^a	137.8^a	0.2^a	115.2^b
	Untreated	***Zeer* supply from *Turaa***	28.7^a	7.7^a	0.5^a	129.3^b	0.2^a	1180.3^a
Sig			**Ns**	**Ns**	**Ns**	*	**Ns**	*
Wad Alamin	**Untreated**	***Turaa***	28.3^a	7.7^a	6.0^a	122.4^a	0.2^a	1618.7^a
	Untreated	***Zeer* supply from *Turaa***	29.0^a	7.4^a	0.1^b	124.6^a	0.2^a	894.3^a
Sig			**Ns**	**Ns**	*	**Ns**	**Ns**	**Ns**

Note: values with different characters are significantly different by means of the LSD ($p < 0.05$).

Table (3.1.1.4 b) Concentration(mg/l) of Chemical parametrs of studied water sample west El-Managil

Site	**Villages**	**Kind of water**	**Sources**	**Cl^-**	**NO_3^-**	**CO_3^{--}**	**HCO_3^-**
Maximum Permissible Limit WHO (2004)				**≤250**	**≤10**	**≤500**	**≤150**
WestEl-Managil	El-krimit	Untreated	*Turaa*	1.9[a]	3.7[a]	0.0[a]	2.1[a]
			Zeer supply from *Turaa*	2.5[a]	4.3[a]	0.0[a]	4.8[a]
	Sig			**Ns**	**Ns**	**Ns**	**Ns**
	Wad Ala min	Untreated	*Turaa*	1.5[a]	4.3[a]	0.0[a]	3.7[a]
			Zeer supply from *Turaa*	1.5[a]	1.9[a]	0.0[a]	4.0[a]
	Sig			**Ns**	**Ns**	**Ns**	**Ns**

Note: values with different characters are significantly according to T test at (p<0.05

Table (3.1.1.4c) show trends of calcium, cadmium, copper, iron, potassium, sodium, phosphorus, lead and zinc in untreated water samples of west El-Managil villages (El-krimit, Wad Alamin) for two different sources *turra* and *zeer* supply from *turra* where phosphorus show significant difference ($p \leq 0.05$) in El-krimit village ranged from(5.0 to 57.00 mg/l). Calcium, cadmium, copper, potassium, lead and zinc in untreated water samples for the two different sources El-krimit and Wad Alamin were show non-significant differences in values (2.908, 3.624), (2.773, 2.818), (0.005, 0.007), (0.004, 0.007), (0.016, 0.020), (0.014, 0.016), (0.043, 0.987), (0.148, 1.240), (0.207, 0.283), (0.138,0.176), (0.142, 0.129), (0.51, 0.61), (11.0, 15.3), (0.013, 0.73), (0.010, 0.013) and (0.288, 0.006), (0.15, 0.009) mg/l respectively. The concentration values for all metals tested for west El-Managil water samples were below the permissible limit by WHO except cadmium, lead, phosphorus and iron which show slightly increased above WHO permissible limit. Concerning cadmium the high values (0.007mg/l) the source *zeer* supply from *turaa* for Al-krimit and Wad Alamin villages which the WHO permissible limit (0.005 mg/l), the result for cadmium agree with finding of Hagar (2009) The highest mean value (0.062 mg/l) for cadmium was detected in ground water collected from Elamara water station, while no cadmium was detected in surface water collected from Raselphil and 24 Elgorshi water station. There are significant differences among the samples. concerning phosphorus the high values (5.006mg/l) and (57.00 mg/l) the sources *turaa* and *zeer* supply from *turaa* respectively the village El-krimit, concerning lead the high value (0.073mg/l) for *zeer* supply from *turaa* at El-krimit village which is considered higher than WHO permissible limit (0.01 mg/l) this finding in way with the finding of Elhag (2004) who found that the lead concentration in well water was in the range 0.004 to 0. 016 mg/l and lower than finding of Hagar (2009) on ground water the level of lead in water collected from the six different sites. The highest mean value (0.258 mg/l) was detected in ground water from Elhasahisa water station, while no lead was detected in surface water. All these amounts were higher than the maximum acceptable level of SSMO (2002) standards (0.007 mg/l). Concerning phosphorus, the high values (11.00 mg/l) and (15.30 mg/l) the sources *turaa* and *zeer* supply from *Turaa* respectively the village Wad Alamin. Zinc show lower values ranged (0.009 to 0.288 mg/l) which is considered lower than WHO permissible limit (5.0mg/l), the finding agree with Elhag (2004) who found that the amount of zinc in well water was 0.012 to 0.17mg/l while Hagar(2009) find that the highest mean value for zinc (0.015 mg/l) was detected in ground water from Elamara water station, while zinc was not detectable in surface water from Raselphil, 24 Elgorshi and 21 Elmancy water stations and ground water from Elhasahisa water station. The data showed significant differences among the samples. The amount fall below the maximum acceptable level of SSMO (2002) standards (3 mg/l) concerning iron which exceed the permissible limits (0.3 mg/l) in El-Krimit villages, the high value (0.987mg/l) source of untreated water from *turaa* The increased value of some metals in ground water samples may be result from leaching of industrial and sewage water into the ground water (Mohamed *et al*., 1998). Table (3.1.1.4 d) shows the concentration values of sevin, malathion and cypermethrin for water samples in El-krimit and Wad Alamin villages for *turaa* and *zeer* supply from *turaa* (0.00071 and 0.00078 mg/l), (0.00064 mg/l), (ND and 0.00085 mg/l), (ND and0.0058 mg/l) respectively. Malathion and cypermethrin were not detected in untreated water samples in both sources (*turaa* and *zeer* supply from *turaa*). concernWad Alamin villages for *turaa* and *zeer* supply from *turaa* (0.00014 and 0.00064 mg/l), (ND and 0.0032 mg/l), (ND and0.0032 mg/l), (0.0048 and 0.0045 mg/l) respectively which were less than the level allowed by WHO (2008) (0.002 mg/l), (0.0001 mg/l), (0.01mg/l) except malathion pesticide was over than the level allowed by WHO (2008) these result may be due to the intensive use of pesticide in irrigated Gezira scheme, as well as any possible impact from sub stream sources, The level of studied pesticides in water samples for both (Sources and kind of water) mentioned Figure (10-15). This finding adopted by Matsumura (1985) who indicated that almost 60 % of the positive samples in White Nile water were found in Juba, cypermethrin, was detected Malathion was not detected. Gebreel Abdellatif (2007) found that the result of residue analysis for organophosphorus, chlorpyriphos and malathion bout 33% of the samples collected from Khartoum (Elgreef) were found to contain profenophos with average concentration of 0.00061 mg/l and ranged of ND- 0.00183 mg/l, cypermethrin residues were detected in 33.3% of the water samples collected from Sinnar with an average of 0.00085 mg/l and range of ND-0.00256 mg/l and from, Dongla, the main Nile with an average of 0.00005mg/l and arrange of ND-0.00015 mg/l. malathion residue was not detected in White Nile water samples collected from Gabelawlia.

Table (3.1.1.4 c) Mean concentration of minerals (mg/l) in studied water samples west El-Managil

Sites	Villages	Kind of water	Sources	Ca	Cd	Cu	Fe	K	Na	P	Pb	Zn
Maximum Permissible Limit WHO (2004)				≤200	≤0.005	≤2.0	≤0.30	5-25	≤200	≤ 2	≤0.01	≤5.0
West El-Managil	Al-kirimt	Untreated	*Turaa*	2.908[a]	0.005[a]	0.016[a]	0.043[a]	0.283[a]	1.42[a]	5.0[b]	0.013[a]	0.288[a]
			Zeer supply from *Turaa*	3.624[a]	0.007[a]	0.020[a]	0.987[a]	0.207[a]	1.29[a]	57.0[a]	0.073[a]	0.006[a]
	Significant			**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	*****	**Ns**	**Ns**
	T calculated			1.27	0.817	0.517	1.206	1.062	0.196	3.636	0.964	1.080
	T table 0.05			2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776
	Wad Alamin	Untreated	*Turaa*	2.773[a]	0.004[a]	0.014[a]	1.240[a]	0.176[a]	0.51[a]	11.0[a]	0.010[a]	0.015[a]
			Zeer supply from *Turaa*	2.818[a]	0.007[a]	0.016[a]	0.148[a]	0.138[a]	0.61[a]	15.3[a]	0.011[a]	0.009[a]
	Significant			**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**
	T calculated			0.283	1.521	0.353	1.330	0.687	1.106	0.271	0.424	1.034
	T table 0.05			2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776

Note: values with different characters are significantly different by means of the LSD ($p<0.05$).

Table (3.1.1.4 d) Mean concentration of pesticides (ppm) in studied water samples west El-Managil

Site	Villages	Kind of water	Sources	Sevin	Malathion	Cypermethrin
Maximum Permissible Limit WHO (2004)				≤0.002	≤0.0001	≤0.01
West El-Managil	Al-kirimit	Untreated	*Turaa*	0.00071	ND	ND
			Zeer supply from *Turaa*	0.00079	0.00085	0.0058
	Wad Alamin		*Turaa*	0.00014	ND	0.0048
			Zeer supply from *Turaa*	0.00064	0.0032	0.0045

3.1.1.5 East El- Managil

Table (3.1.1.5 a) shows some physiochemical properties of water samples for east El-Managil villages (Maktab 84, Wad Mahmood, Abood, Maktab Elnasih) show non-significant differences values according to water sources (Tura, *Zeer* supply from *Turaa*, Tank supply from well and *zeer* supply from tank) for (untreated water). The data (Physical parameters) were showed non-significant differences in the values for the untreated water in different sources, observed in the east El-Managil villages. Temperature was important environmental factor, the minimum temperature recorded 27 $^{\circ 0}$C and maximum temperature 29 ºC for the study area. Water pH affects the solubility of many toxic and nutritive chemicals and it is a measure of acid balance of solution, it is ranged from (7.1 to 8.2) The study revealed that the pH value of the water samples is slightly alkaline and within WHO (2004) permissible limit). the finding agrees with Mahgoub, (1984) found that the pH value from the three Niles ranged from (7.5 to 8.5) and pH values for the tap and canal water ranged from (7.9 to 8.8). Total suspended solids (TSS) ranged between (0.00 to 0.3 mg/l), TSS was not detected in 75% of water samples. Total dissolved solids (TDS) ranged from (161.7 to 442.2 mg/l) where the highest value (442.2 mg/l) in Abood sources water from tank supply from well which is considered lower than WHO permissible limit (1000 mg/l), Nurain (1998) found that the TDS varied widely for well and canal being 174 and 495 mg/l respectively .concern conductivity ranged from(0.3 to 0.7 mg/l) where the highest value (0.7mg/l) in Abood sources water from tank supply from well which is considered lower than WHO permissible limit (250 cm/ms). Turbidity ranged (0.00 to 842 NTU), the highest value (842 NTU) was seen in *turaa* water (Maktab 84) and this may be due to suspended matter which is considered over than WHO permissible limit (5.0 mg/l), the finding agree with Hager (2009) found that The turbidity level in ground water ranged from(0.3 to 0.95 NTU), while that in surface water ranged from (5.5to 197 NTU), thus being higher than the maximum acceptable level stated by WHO standard as (5NTU). Table (3.1.1.5.c) show that chloride, nitrates, carbonates and bicarbonates in water samples for east El-Managil villages (different sources) show non-significant differences values, in tank supply from well and *zeer* supply from tank (Abood, Maktab Elnasih) chloride, nitrates, and bicarbonates significant differences ($p \leq 0.05$) with values (4.1, 2.6) (3.7, 4.4), (8.8, 3.2) (8.8,7.2) mg/l respectively, Nurrain (1998) found that the amount of chloride in canal and well water is 9.8 and 120 mg/l respectively. Hager (2009) found that the highest mean value (11.82 mg/l) was found in ground water from Elhasahisa water station, while the lowest mean value (3.23mg/l) was37 found in surface water from 24 Elgorshi water station.

Table (3.1.1.5a) Physiochemical properties of studied water samples east El-Managil

Villages	Kind of water	Sources	Temperature (^{0}C)	pH	TSS mg/l	TDS mg/l	Conductivity cm/mS	Turbidity
Maximum Permissible Limit WHO (2004)			**≤15**	**6.5-8.5**	**NS**	**≤1000**	**≤250**	**0.1-5.0 NTU**
Maktab 84	**Untreated**	***Turaa***	27.0[a]	7.5[a]	0.0[a]	224.2[a]	0.4[a]	842.0[a]
	Untreated	***Zeer* supply from *tura***	27.3[a]	7.7[a]	0.0[a]	161.7[a]	0.3[a]	73.0[a]
Sig			**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**ns**
Wad Mahmoud	**Untreated**	**Tank supply from well**	28.3[a]	7.1[a]	0.0[a]	246.4[a]	0.4[a]	0.0[a]
	Untreated	***Zee* supply from tank**	29.0[a]	7.9[a]	0.0[a]	169.9[a]	0.4[a]	0.1[a]
Sig			**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**
Abood	**Untreated**	**Tank supply from well**	29.0[a]	7.3[a]	0.3[a]	442.2[a]	0.7[a]	0.0[a]
	Untreated	***Zeer* supply from tank**	28.0[a]	7.7[a]	0.0[a]	385.7[a]	0.6[a]	2.9[a]
Sig			**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**

Maktab Elnasih	**Untreated**	**Tank supply from well**	27.0^{a}	7.5^{a}	0.00^{a}	385.9^{a}	0.6^{a}	0.0^{a}
	Untreated	***Zeer* supply from Tank**	27.7^{a}	8.2^{a}	0.00^{a}	389.1^{a}	0.6^{a}	1.6^{a}
Sig			**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**

Note: values with different characters are significantly different by means of the LSD ($p<0.05$)

Table (3.1.1.5 b) Mean concentration of minerals (mg/l) in studied water samples east El-Managil

Sites	Villages	Kind of water	Sources	Ca	Cd	Cu	Fe	K	Na	P	Pb	Zn
Maximum Permissible Limit WHO (2004)				≤200	≤0.005	≤2.0	≤0.30	5-25	≤200	≤ 2	≤0.01	≤5.0
East El-Managil	Maktab 84	Untreated	*Turaa*	2.5[a]	0.006[a]	0.034[a]	0.434[a]	0.216[a]	0.75[a]	2.67[a]	0.015[a]	0.012[a]
			Zeer supply from *Turaa*	3.2[a]	0.005[a]	0.030[a]	0.028[a]	0.224[a]	0.82[a]	1.33[a]	0.024[a]	0.011[a]
	Significant			**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**
	T calculated			1.57	0.377	0.731	1.763	0.128	0.102	1.414	1.969	0.554
	T table 0.05			2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776
	Wad Mahmoud	Untreated	Tank supply from well	2.68[a]	0.002[a]	0.014[a]	0.012[a]	0.265[b]	3.89[a]	25.7[a]	0.013[a]	0.017[a]
			Zeer supply from Tank	2.62[a]	0.004[a]	0.012[a]	0.028[a]	0.354[a]	2.63[a]	1.0[b]	0.023[a]	0.009[a]
	Significant			**Ns**	**Ns**	**Ns**	**Ns**	*	**Ns**	*	**Ns**	**Ns**
	T calculated			1.000	0.944	0.904	2.280	5.954	2.57	37	1.145	1.21

	T table 0.05			2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776
	Abood	Untreated	Tank supply	3.9^{a}	0.004^{a}	0.007^{a}	0.032^{a}	0.357^{a}	3.21^{a}	23.3^{a}	0.016^{a}	0.010
			Zeer supply	2.2^{b}	0.005^{a}	0.019^{a}	0.028^{a}	0.356^{a}	3.28^{a}	0.7^{b}	0.008^{a}	0.011
	Significant			*	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	*	**Ns**	**Ns**
	T calculated			5.30	0.670	2.545	0.198	0.076	0.803	24.04	1.409	0.525
	Maktab Elnasih	Untreated	Tank supply from	2.8^{b}	0.003^{a}	0.011^{a}	0.02^{a}	0.247^{b}	3.37^{a}	32.0^{a}	0.012^{a}	0.017^{a}
			Zeer supply	3.3^{a}	0.004^{a}	0.019^{a}	0.038^{a}	0.322^{a}	3.02^{a}	0.7^{b}	0.018^{a}	0.012^{a}
	Significant			*	**Ns**	**Ns**	**Ns**	*	**Ns**	*	**Ns**	**Ns**
	T calculated			3.283	1.042	1.85	2.532	2.948	0.746	26.07	0.711	1.954
	T table 0.05			2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776	2.776

Note: values with different characters are significantly different by means of the LSD (p<0.05).

Table (3.1.1.5 c) Concentration(mg/l) of Chemical parameters of studied water samples (mg/l) east El-Managil

Site	Villages	Kind of water	Sources	Cl^-	NO_3^-	CO_3^{--}	HCO_3^-
Maximum Permissible Limit WHO (2004)				**≤250**	**≤10**	**≤500**	**≤150**
East El-Managil	Maktab 84	Untreated	*Turaa*	1.5[a]	4.3[a]	0.0[a]	3.7[a]
			Zeer supply from *Turaa*	1.5[a]	1.9[a]	0.0[a]	4.0[a]
	Sig			**Ns**	**Ns**	**Ns**	**Ns**
	Wad Mahmoud	Untreated	Tank supply from well	3.2[a]	8.6[a]	0.0[a]	5.3[a]
			Zeer supply from Tank	2.7[a]	1.9[a]	0.0[a]	5.3[a]
	Sig			**Ns**	**Ns**	**Ns**	**Ns**
	Abood	Untreated	Tank supply from well	4.1[a]	8.8[a]	0.0[a]	8.8[a]
			Zeer supply from Tank	2.6[b]	3.2[b]	0.0[a]	7.2[b]
	Sig			*	*	Ns	*
	Maktab Elnasih	Untreated	Tank supply from well	3.7[b]	7.3[a]	0.0[a]	7.7[a]
			Zeer supply from Tank	4.4[a]	3.4[a]	0.0[a]	7.2[a]
	Sig			*****	**Ns**	**Ns**	**Ns**

Note :values with different characters are significantly different according toT test at ($p < 0.05$).

Table (3.1.1.5 d) Mean concentration of pesticides (ppm) in studied water samples in east El-Managil

Site	Villages	Kind of water	Sources	Sevin	Malathion	Cypermethrin
Maximum Permissible Limit WHO (2004)				≤0.002	≤0.0001	≤0.01
East El-Managil	Maktab 84	Untreated	*Turaa*	0.0007	Nd	0.0031
			Zeer supply from *Turaa*	Nd	Nd	Nd
	Abood	Untreated	Tank supply from well	Nd	Nd	Nd
			Zeer supply from Tank	0.00096	Nd	0.032
	Wad Mahmoud	Untreated	Tank supply from well	Nd	Nd	Nd
			Zeer supply from Tank	Nd	Nd	Nd
	Maktab Elnasih	Untreated	Tank supply from well	Nd	Nd	Nd
			Zeer supply from Tank	Nd	Nd	Nd

Table (3.1.1.5 c) shows trends of calcium, cadmium, copper, iron, potassium, sodium, phosphorus, lead and zinc in untreated water samples of east El-Managil villages (Maktab 84, Wad Mahmood, Abood, Maktab Elnasih) and different water sources such as *Turaa*, *Zeer* supply from *Turaa*, Tank supply from well and *zeer* supply from tank. All the metals in different villages and sources show non-significant differences values except Calcium, potassium and phosphorus which show significant differences ($p \leq 0.05$) in (Abood, Maktab Elnasih) for Tank supply from well and *zeer* supply from tank with values (3.9,2.2) (2.8, 3.3) mg/l, (Wad Mahmoud, Maktab Elnasih) (0.265, 0.354) (0.247, 0.322) mg/l, (Wad Mahmood, Abood, Maktab Elnasih) with values (25.7, 1.0), (23.3, 0.7), (32.0, 0.07) mg/l respectively. The concentration values for all the metals tested in east El-Managil water samples were below the WHO permissible limit except, iron, phosphorus, lead, Concerning phosphorus the high value (25.7 mg/l), (32.0 mg/l) the source tank supply from well the village Wad Mahmoud, Maktab Elnasih, respectively, the high values (23.3.7 mg/l))the source tank supply from well the village Abood. Concerning lead the high value (0.023 mg/l) the source *zeer* supply from tank the village Wad Mahmoud. the high value (0.016 mg/l) the source tank supply from well the village Abood which is higher than WHO permissible limit (0.01 mg/l) this finding in way with the finding of Elhag (2004) who found that the lead concentration in well water was in the range 0.004 to 0. 016 mg/l and lower than finding of Hagar 2009 On ground water the level of lead in water collected from the six different sites. The highest mean value (0.258 mg/l) was detected in ground water from Elhasahisa water station, while no lead was detected in surface water, concerning phosphorus the high value (32.007 mg/l) the source tank supply from well the village Maktab Elnasih. Concerning lead the high value (0.0186 mg/l) the source *zeer* supply from tank the village Maktab Elnasih the increased value of some metals in ground water samples may be result from leaching of industrial and sewage water into the ground water (Mohamed *et al*., 1998)., finding of lead agree with Hagar(2009) the highest mean value (0.258 mg/l) for lead was detected in ground water from Elhasahisa water station, while no lead was detected in surface water. All these amounts were higher than the maximum acceptable level of SSMO (2002) standards (0.007 mg/l). This finding agree with finding of Hagar(2009) The highest mean value (0.062 mg/l) for cadmium was detected in ground water collected from Elamara water station, while no cadmium was detected in surface water collected from Raselphil and 24 Elgorshi water station and coincide with Muwanga and Barifaijo (2006) entitled ‘Impact of industrial activities on heavy metal loading and their physio-chemical effects on wetlands of Lake Victoria Basin’, recorded very low levels of Cadmium in Kinawata streams. The high value of lead may originate from the use of leaded fuel by Oxy-gas industry given the fact that downstream is about 50 meters from Oxy-gas industry, waste waters released by some industries into the streams have heavy metal concentrations above those recommended and this poses a risk to the environment. Muwanga and Barifaijo (2006). concerning iron which exceed the permissible limits (0.3 mg/l) in Maktab84 villages, the high value (0.434mg/l) source of untreated water from *turaa*. Hager (2009) found that only surface water from 24Elgorashi water station .was found to contain iron as 0.83mg/l which was higher than the level allowed by WHO (2008) of 0.3mg/l. The other water samples were found to contain no detectable iron concentration.

Table (3.1.1.5.d) shows the concentration values of sevin, malathion, and cypermethrin for untreated water samples in (Maktab 84, Abood) for *turaa*, values (0.0007 mg/l), (ND), (0.0031 mg/l) respectively, zeer supply from tank. (0.00096 mg/l) (ND), (0.032 mg/l) respectively. Malathion was not detected water samples. The level of studied pesticides in water samples for both (Sources and kind of water) mentioned Figure (10-15). The higher concentration values for pesticides mentioned were less than the permissible limit for (WHO, 2008), (0.002 mg/l), (0.0001mg/l), (0.01 mg/l) except the cypermethrin and this may be due to the intensive use of pesticide in irrigated Gezira scheme, as well as any possible impact from sub stream sources. This finding Adopted by Matsumura (1985) who indicated that almost 60 % of the positive samples in White Nile water were found in Juba, cypermethrin, was detected Malathion was not detected. Gebreel Abdellatif (2007) found that the result of residue analysis for organophosphorus, and malathion bout 33% of the samples collected from Khartoum (Elgreef) were found to contain profenophos with average concentration of 0.00061 mg/l and ranged of ND-0.00183 mg/l, cypermethrin residues were detected in 33.3% of the water samples collected from Sinnar with an average of 0.00085 mg/l and range of ND-0.00256 mg/l and from, Dongla, the main Nile with an average of 0.00005 mg/l and arrange of ND-0.00015 mg/l. malathion residue was not detected in White Nile water samples collected from Gabelawlia.

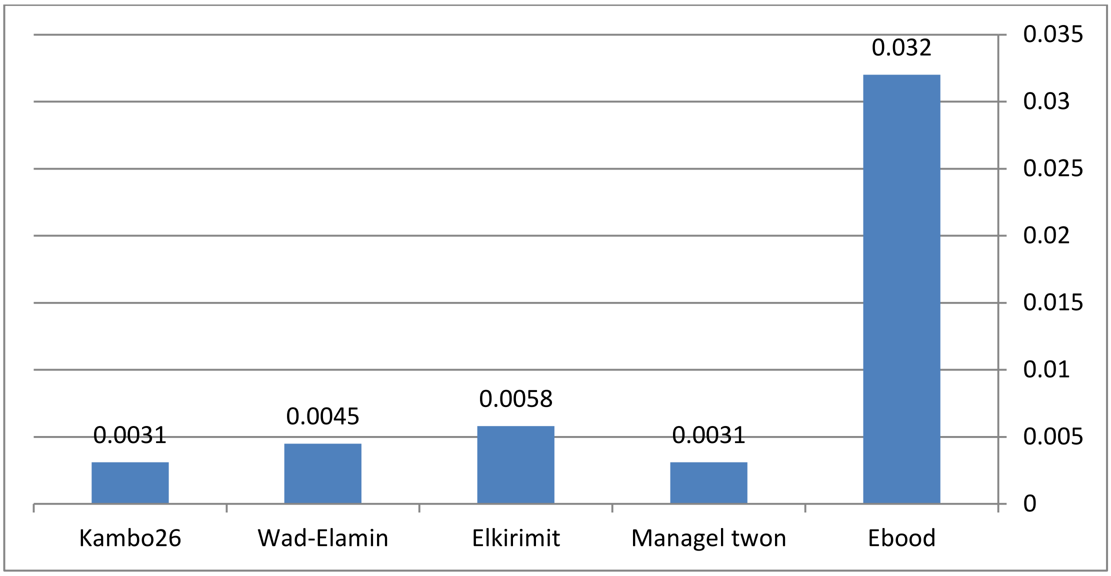


Fig. (10): Comparison of pesticides residual cypermethrin concentration (ppm) in studied water samples from *zeer*

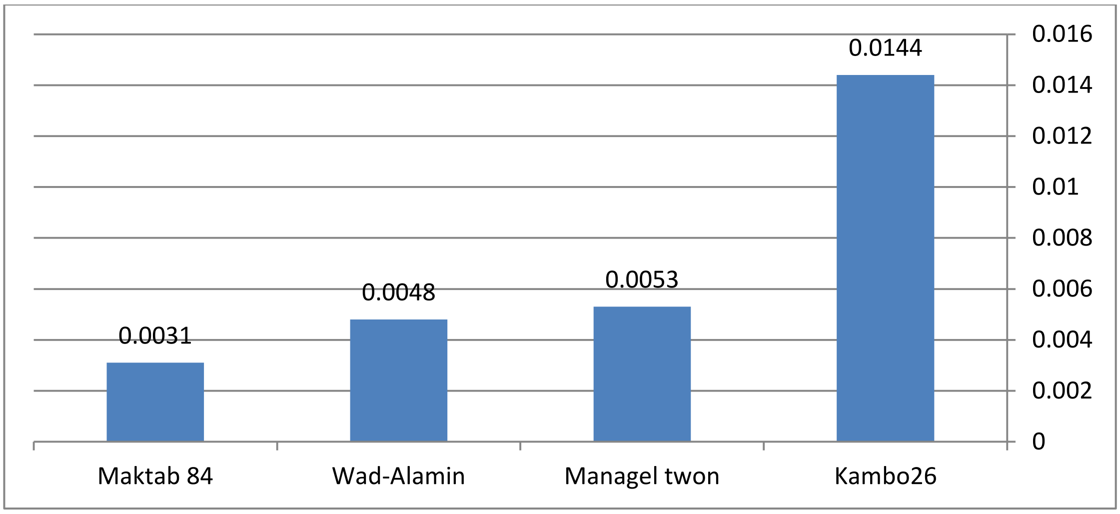


Fig. (11): Comparison of pesticides residual cypermethrin concentration (ppm) in studied water samples from *Turaa*

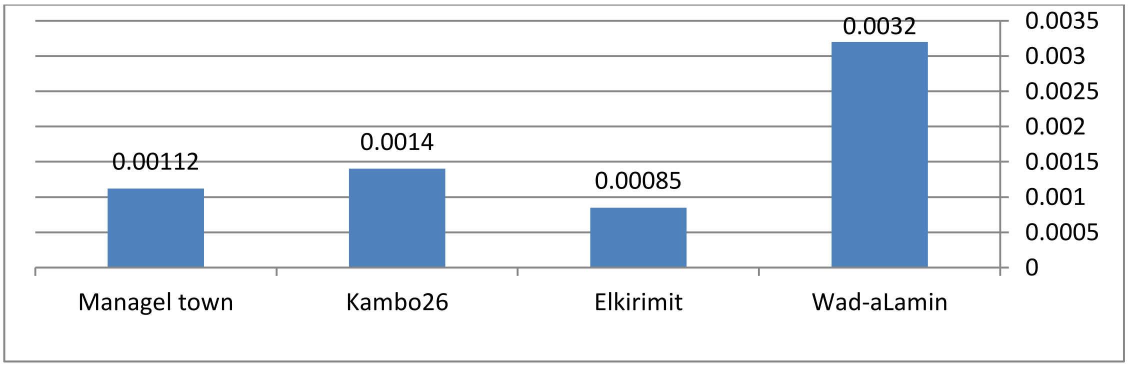


Fig. (12): Comparison of pesticides residual Malathion concentration (ppm) in studied water samples from *zeer*

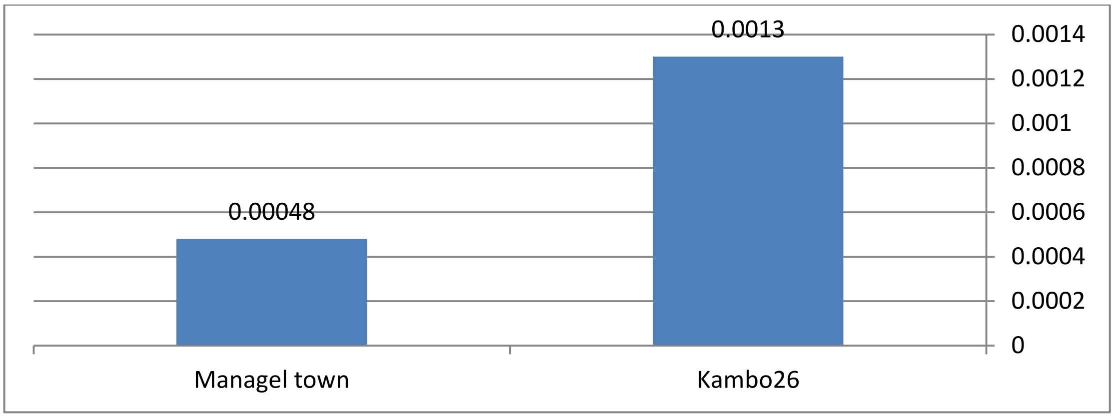


Fig. (13): Comparison of pesticides residual Malathion concentration (ppm) in studied water samples from *Turaa*

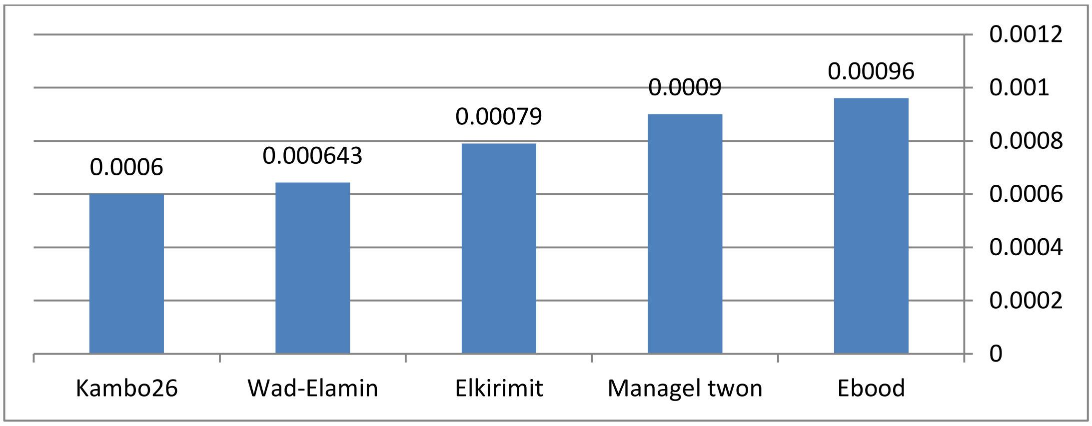


Fig. (14): Comparison of pesticides residual Sevin concentration (ppm) in studied water samples from *zeer*

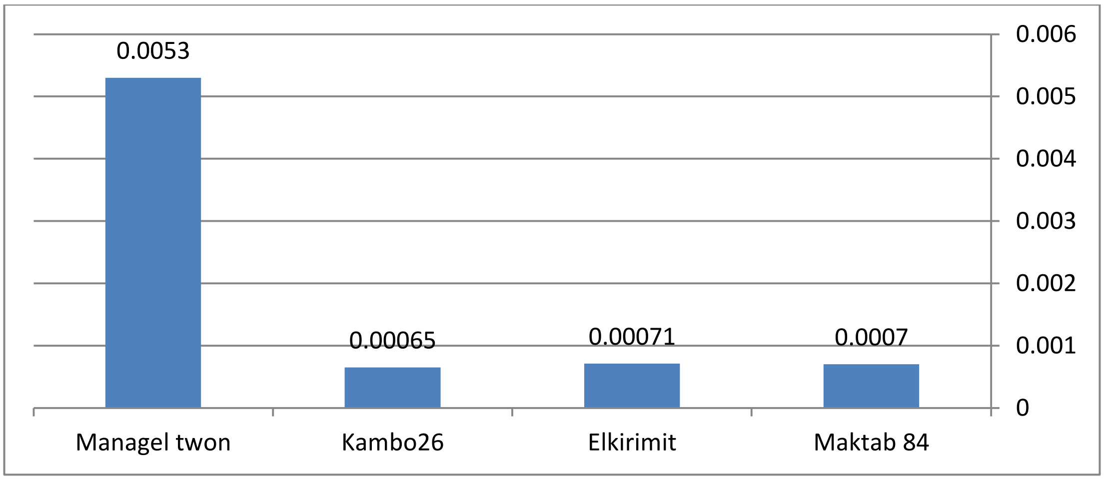


Fig. (15): Comparison of pesticides residual Sevin concentration (ppm) in studied water samples from *Turaa*

3.2 Conclusion

The huge challenge facing the world today is the water pollution. The pollutants are classified according to the quality of the water into solvent organic matter such as pesticides and solvent inorganic matter such as heavy and toxic metals such as Cadmium, Lead, Iron and phosphorus. Surface and ground water are also exposed to immense pollution due to the human activities when huge agriculture fertilizer are used such as phosphate and nitrates which are in taken by the plants. Part of these fertilizers leak into the ground water causing ground water pollution. Another pollutant is the elaborated use of detergents which contain phosphate. On the other hand, pesticides are used to eliminate agricultural pests and thus the pesticides residues transport to drinking water through soil and air, and heavy metals can be considered as pollutants for the water. The use of different types of water pipeline which contain cadmium, iron and lead when exposed to the acid rain turns into toxic metals that can be released into the water causing acute pollution. The polluted water can cause most of the diseases such as renal failure (increasing of Cadmium, lead and iron). The increase of lead also poses particular danger for children leading to mental retardation. Other effects of Cadmium exposure are disturbances in calcium metabolism, hypercalciuria and the formation of kidney stones. High exposure to Cadmium can lead to lung cancer and prostate cancer. Too much phosphate can cause health problems, such as kidney damage and osteoporosis, water that is high in iron may taste metallic. The water may be discolored and appear brownish, and it may even contain sediment. Iron will leave red or orange rust stains in the sink. The higher concentration of Nitrates can cause health hazard particularly on children and might cause for example Blue Babies disease. Concerning pesticides, if the concentration of the residues of the malathion and cypermethrin residue is greater than the permissible limit, it has serious and toxic effects on the human and animal, either in terms of the residues of the sevin causing cancer and distortions. Over all, the study has shown some physiochemical parameters such as Water Temperature (WT), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Turbidity, pH, Chlorides (Cl^-), Nitrates (NO_3^-), Carbonate (CO_3^{--}), Bicarbonate (HCO_3^-), Calcium (Ca), Cadmium (Cd), Copper (Cu), Iron (Fe), Potassium (K), Sodium (Na), Phosphorus (P), Lead (Pb), Zinc (Zn) and some Pesticides residual belonging to the organophosphorus (malathion), carbamate (sevin) family and pyrethroids(cypermethrin) in two types of drinking (treated, untreated) water according to sources (*turaa*, *zeer* supply from *turaa*, *zeer* supply from tank and tank supply from well) in El-Managil area. Middle of El-Managil Town, North El-Managil Town the villages (Wad Hallawy, Altiquia, Shasha), East El-Managil Town the villages (Maktab 84, wad mahamood, Ebood, maktab Alnasih), SouthEl-Managil Town the villages (Ummtalha, Kambo 26) and west El-Managil Town the villages (Wad Elameen, Alkrimt). The result of the study revealed the following facts:

1. Among the different physiochemical parameters, temperature readings for all (water types, sources and locations) were similar and ranged (26.3 to 29ºC).
2. pH values for all (water types, sources and locations) ranged (7.1 to 8.2) were within WHO permissible limit (6.5 - 8.5).
3. Total Suspended Solids in untreated water samples varied widely according to water sources and locations. *Turaa* waters samples shows the highest TSS values ranged (0.3 to 9.837 mg/l) and in order south El-Managil (Kambo 26)> west El-Managil (Wad Alamin)> El-Managil town > north El-Managil (Altiquia) > east El-Managil (Abood). The high value (9.837 mg/l) recorded in Kambo26 the site South El-Mnagil the source of water *turaa*.

4. For Total Dissolved solids all waters samples values were below WHO permissible limits regardless of water type, sources and locations. The values varied, the high value (673.653 mg/l), in order North El-Managil (Altiquia) tank supply from well > El-Managil town Net (*turaa* +well) > East El-Managil (Abood) tank supply from well > South El-Managil (Umtalha) tank supply from well > West El-Managil (El-krimit) *zeer* supply from *turaa*.it was noted that in the surface water the TDS were high at the tap this is dueto the non-washing and maintenance of the pipeline and it was considered stagnant water
5. Turbidity values in majority tested water samples were above WHO permissible limit, the highest Turbidity values ranged (130.33 to 1618.7 NTU). The variation was due to the source and in order *Turaa* > *Zeer* supply from *turaa* > *Zeer* supply from tank > tank supply from well. The high value (1618.7 NTU) noticed at Wad Alamin the site West El-Mnagil the source of water *turaa*. The surface water in the area of study were higher in level of turbidity. The ground water was low in turbidity.
6. Conductivity in untreated water samples varied widely according to water sources and locations. *Turaa* waters samples show the highest conductivity values ranging (0.2 to 70.805 cm/ms) and in order south El-Managil (Kambo 26) > El-Managil town west El-Managil > North El-Managil (Altiquia) > east El-Managil (Abood) > West El-Managil, The high value (70.805 cm/ms) recorded in Kambo26 the site South El-Managil the source of water *turaa*.
7. Minerals concentration in tested water samples show fluctuating readings according to water sources and locations Calcium, Copper, Potassium, Sodium and Zinc their readings were below WHO permissible limit. While cadmium, lead, iron and phosphorus show slightly increase compared to WHO permissible limit in samples of *turaa* and *zeer* supply from *turaa*. The high value (0.009mg/l) of the cadmium noticed at El-

Managil town middle, the source of water is Hall supply from *turaa*, and Umtalha the site South El-Managil the source of water *turaa*, the high value (0.073 mg/l) of the lead recorded in Alkirimt the site West El-Managil the source of water *zeer* supply from *turaa*, the high value(57.0mg/l) of the phosphorus observed in El-krimit the site West El-Managil the source of water *zeer* supply from *turaa*

8. Results of the samples for Chlorides (Cl^-), Carbonate (CO_3^{2-}), Bicarbonate (HCO_3^-), were lower than the maximum permissible level except the Nitrates (NO_3^-), was higher than the maximum permissible level it was recorded in El-Managil town middle the source of water *zeer* supply from tank (*turaa* + well).
9. Results of the samples for pesticides residual in treated and untreated water samples were detected. Pesticides residual in untreated water samples for north El-Managil were not detected, also malation was not detected in East El-Managil water samples.
10. The high value (0.0032 mg/l) of the Malathion recorded in Wad Alamin the site West El-Managil the source of water *zeer* supply from *turaa*, this value was above than the maximum Permissible level. the high values (0.032 mg/l), (0.00096 mg/l) of Cypermethrin and sevin respectively recorded in Abood the site East El-Managil the source of water *zeer* supply from tank, the Cypermethrin values was above than the maximum Permissible level.this attributed to the agricultural activities.
11. It was noticed that there was correlation between the increasing of malathion residues and existing of phosphorus.
12. Ther are many factors which affect the present of the contaminant in the water system in the study area.

(A) Effect of human activities;

The people living in thesttudy area in unnplamned houseKanabi play vital role in pollution the turaa water which are considerd the source of drinking water.

(B) Effect of the drinkingwater sources ;

The result illustrates that the surface water is the more contaminated than the ground water.

(C) Effect of non –treatment ;

The results indicated that water quality befor filtration (samples) which were taken from precipitation hall same in contamination in most of the sample this is attributed to the fact there no treatment of the water.

3.3. Recommendations:

The treatment of the water in study area is crucial for the survival of the life, therefore, the following recommendation must be observed:

1. Regular maintenance of water stations pipes is necessary to prevent leakages which cause contamination.
2. Cleaning canals from grass, mud and shrubs which restrict water movement.
3. Cleaning water sources (*Zeer*, Tank) to minimize contamination.
4. Using filters in water entrance to clean the water use for drinking.
5. Best training for using pesticides in agricultural purposes. In local water sources such as *zeer* it must be changed after 6 months.
6. The establishment of high-efficiency integrated plants with the importance of creating large storage pits and providing purification equipment.
7. Surface water in the area of study should be subjected to treatment before use for human consumption.
8. Regular inspection for the water station for chemical, and physical test should be conducted to determine suitability of water for drinking purpose.
9. Chlorine needs to be added in all water stations in the area of study.
10. Although the study did not cover all the areas of the project, and in view of the limited number of samples selected, it is necessary to conduct another systematic and detailed periodic surveys to monitor the residues of pesticides, chemical and physical variables in order to ensure that water is safe for drinking in El-Managil according to the standards specified by the WHO.

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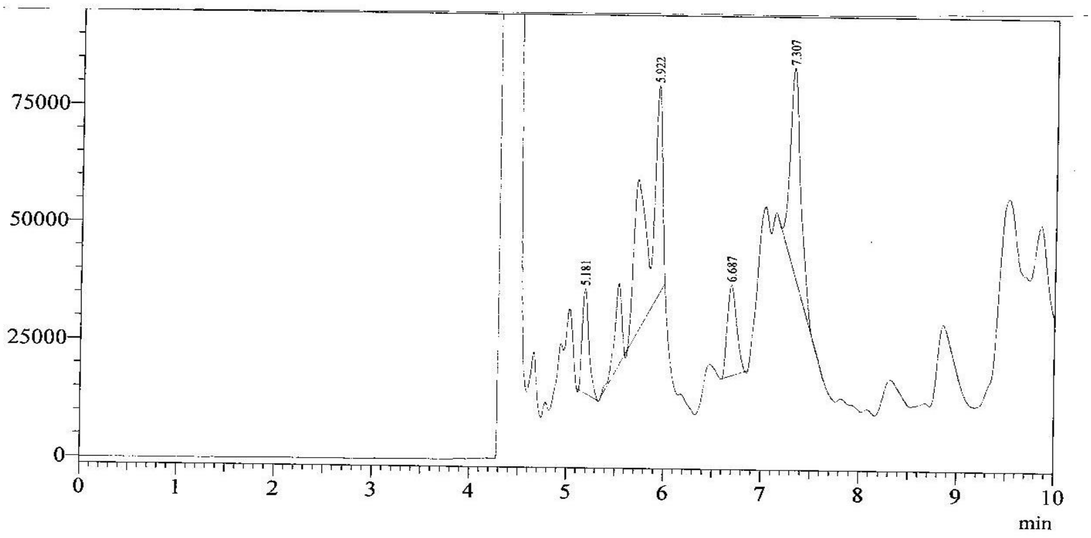
Appendicies

Appendix (1): Preparation of samples

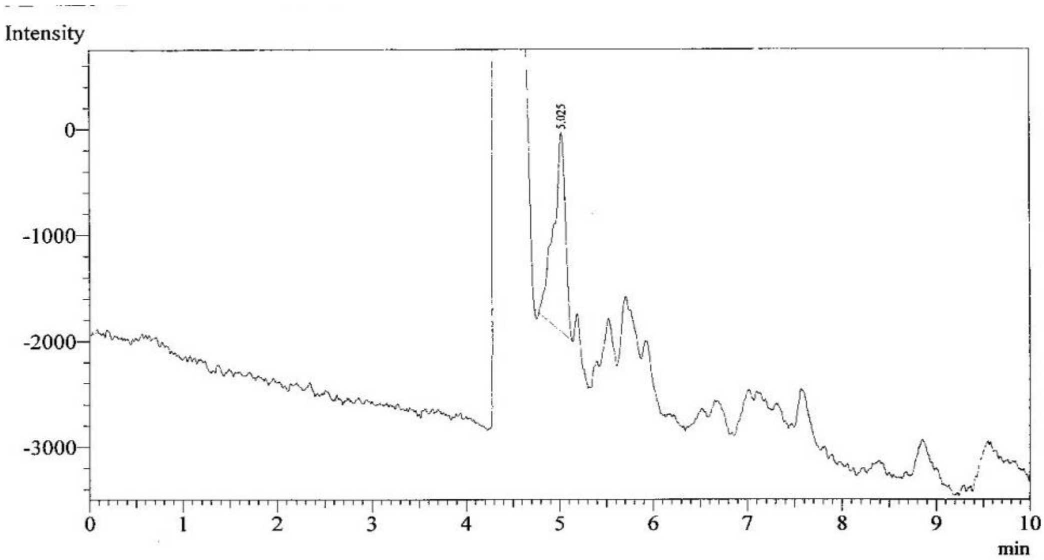
Appendix(2): Thousands of citizens suffer from lack of drinking water in El-Managil district



Quantitative Results - Channel 1

ID#	Name	Ret.Time	Area	Height
1	cyper a	5.181	106739	22065
2	cyperc	6.687	126787	19279
3	cyper d	7.307	327625	42916

Appendix (3) Typical HPLC Chromatogram of water samples



Quantitative Results - Channel 1

ID#	Name	Ret.Time	Area	Height
1	cyper a	5.025	16579	1874
2	cyperc	0.000	0	0
3	cyper d	0.000	0	0

Appendix (4): Typical GC Chromatogram of water samples

Sites	The values	P WHO ≤ 2	Villages	Source	Pb WHO 0.01	Villages	Soure	Zn WHO ≤5.0	Villages	Soure
East	**Higher**	32.0	Maktab Elnasih	Tank supply from well	0.024	Maktab 84	Zeer supply From Turaa	0.017	Maktab Elnasih	Tank supply from well
	lower									
West	**Higher**	1.33	Maktab 84	Zeer supply From Turaa	0.008	Abood	Zeer supply From tank	0.011	Abood	Zeer supply From tank
	lower									
South	**Higher**	57.00	El.krimit	Zeer supply From Turaa	0.073	El.krimit	Zeer supply from Turaa	0.288	El.krimit	Tura
	lower									
North	higher	5.00	El.krimit	Turaa	0.010	Wad Alamin	Turaa	0.006	El.krimit	Zeer supply from Turaa
	lower									
Midle of Almanagle	higher	9.333	Kambo 26	Turaa	0.027	UmTalaha	Zeer supply From tank	0.014	Kambo 26	Zeer supply From turaa
	lower									
Midle of Almanagle	higher	0.667	Kambo 26	Tank supply from well	0.010	Kambo 26	Zeer supply From Turaa	0.005	Kambo 26	Zeer supply From tank
	lower									
North	higher	30.00	Waad hallawy	Tank supply from wel	0.035	Altiquia	Turaa	0.014	Altiquia	Turaa
	lower									

North	higher	1.00	Altiquia	Zeer supplay from tank	0.006	shasha	Zeer supplay from well	0.004	Wad hallawy	Tank supply from wel
	lower									

Sites	The values	Cd WHO .005	Villages	Sources	Cu (WHO) 2.0	Villages	Sources	Fe (WHO) ≤0.30	Villages	Sources
East	**Higher**	0.006	Maktab(84)	turaa	0.034	Maktab(84)	Turaa	0.4340	Maktab 84	Turaa
	lower	0.002	Wad mahmoud	Tank supply from well	0.007	Abood	Tank supply from well	0.012	Wad mahmoud	tank supply from well
West	**Higher**	0.007	El.krimit	Zeer supply From Turaa	0.020	El.krimit	Zeer supply From Turaa	1.240	Wad Alamin	Turaa
	lower	0.004	Wad Alamin	Turaa	0.014	Wad Alamin	Turaa	0.043	El.krimit	Tura
South	**Higher**	0.009	UmTalaha	Turaa	0.027	UmTalaha	Zeer supply from Tank	0.207	Kambo26	Turaa
	lower	0.002	UmTalaha	Zeer supplay from	0.013	Kambo26	Turaa	0.024	Kambo26	tank supply From well
North	higher	0.007	Waad hallawy	Zeer supply from tank	1.55	Shasha	Zeer supply from tank	1.57	Shasha	Zeer supplay from tank
	lower	0.001	Waad hallawy	Tank supply from well	0.009	Waad hallway	Zeer supply from tank	0.021	Altiquia	Zeer supplay from tank

Midle of Almanagle	higher	0.009	Midle of Almanagle	turaa	0.023	Midle of Almanagle	Zeer supplay from tank	0.754	Midle of Almanagle	turaa
	lower	0.004	Midle of Almanagle	Tap water	0.012	Midle of Almanagle	Tap water	0.033	Midle of Almanagle	Tap water

Appendix (5) comparison of heavy metals concentration (mg/l) in studied water samples in El- Managil

Sites	**The values**	**Villages**	**Sources**	**TSS** Zero	**Villages**	**Sources**	**TDS (WHO)** ≤1000	Villages	**Sources**
East	**Higher**	MaktabEl.nasih	Zeer supply From Tank	0.30	Abood	Tank supply from well	442.20	Abood	Tank supply from well
	lower	Wad Mahmoud	Tank supply from well	0.00	Wad Mahmoud	Tanksupplyfromwell	161.70	Maktab(84)	Zeer supply From Turaa
West	**Higher**	Wad Alamin	Turaa	6.00	Wad Alamin	Turaa	137.80	El.krimit	Turaa
	lower	El.krimit	Turaa	0.00	El.krimit	Tura	122.40	Wad Alamin	Turaa
south	**Higher**	UmTalaha	Turaa	9.837	Kambo26	Turaa	409.81	UmTalaha	Tank supply from well
	lower	Kambo26	Zeer supply From tank	0.00	UmTalaha	Tank supply from well	133.76	Kambo26	Turaa

Appendix (6) Physiochemical properties of studied water samples in El- Managil