2018-11-01

ASSESSMENT OF IRRIGATION WATER QUALITY OF RIBB DAM FOUND IN SOUTH GONDAR, ETHIOPIA

ABEBA, AYALEW

BAHIR DAR UNIVERSITY

COLLEGE OF SCIENCE

DEPARTMENT OF CHEMISTRY

ASSESSMENT OF IRRIGATION WATER QUALITY OF RIBB DAM FOUND IN SOUTH GONDAR, ETHIOPIA

BY: - ABEBA AYALEW

Thesis submitted to the fulfillment of the requirement for
Master of Sciences in Chemistry under analytical chemistry stream

August, 2018 G.C

Bahir Dar, Ethiopia

ASSESSMENT OF IRRIGATION WATER QUALITY OF RIBB DAM FOUND IN SOUTH GONDAR, ETHIOPIA

BY: - ABEBA AYALEW

Thesis submitted to the fulfillment of the requirement for Master of Sciences in Chemistry under analytical chemistry stream

Supervisor:

Mr. ZEBASIL TASSEW MENGESHA

(Assistant professor of Analytical Chemistry, BDU)

August, 2018 G.C

Bahir Dar, Ethiopia

Thesis

The thesis with the title **"ASSESSMENT OF IRRIGATION WATER QUALITY OF RIBB DAM FOUND IN SOUTH GONDAR, ETHIOPIA"**

By: AbebaAyalew

Approved for Master of Sciences in Chemistry under analytical chemistry stream

Board of Examiners

	Name	Signature	Date
Advisor:	Mr.ZebasilTassew (Assi. Prof.)	______________	______________
External Examiner:	______________________	______________	______________
Internal Examiner:	______________________	______________	______________
Chair Person:	____________________________	______________	______________

August, 2018 G.C

Bahir Dar, Ethiopia

Declaration

I, the undersigned, declare that the work described in this thesis is original work undertaken by myself for the Master of Science in chemistry, at the college of science, Bahir Dar University. All sources of materials used for the thesis have been referenced and duly acknowledged.

Mrs. Abeba Ayalew:____________________

Signature

Date of submission:___________________________

August, 2018G.C

Bahir Dar, Ethiopia

ACKNOWLEDGEMENT

First of all, I thank to the Almighty of GOD for giving me health and strength to start and complete my study. I would like to thank to my advisor Zebasil Tasew (Asst. prof.) for his skillful contribution to accomplish this thesis and close follow up in my study. It was too difficult to accomplish this study without his advice and support.

I am alsograteful to ministry of education of Ethiopia and Bahir Dar University (BDU), college of Science thatprovide me the opportunity to study and forfinancial support of the research work.

I extend my sincer tanks to department of chemistry in Bahir Dar University for supporting in all activities and equipment that have been used during for the programm.

I also extend my great appreciation to Ribb dam manager Ato Sintayehu Endewagaw and his friends at Ribb dam for the information gave me about the dam and their assistance during field work.

I would also like to thank Ato Temsgen Tigabu,Ato Eshetu Wale Ato Tadesse Misganaw for their material support duringthis study.

I also take this opportunity to extend my special thanks to Ato Kidanemariam Teklay chemical analyst at the chemistry Laboratory of BDUwho kindly assisted me in laboratory work.

My heartfelt thanks to the Libo–Kemkem woreda agricultural and developmental office staff members for their unlimited contribution of the field work.

At the end but not least, my hasband Ato Mekonnen Mamo, my sister Serkadis Ayalew and friends, Berhe Negash (Msc) ,Kibur Tadele, Muhamed Oumer and Tsehaynesh Negash deserve special thanks for their valuable contributions and encouragement.

Table of Contents

Content **Page**

LIST OF TABLE

Table **Page**

List of figures

Figure **Page**

LIST OF ABBRIVATION

TDS	Total Dissolved Solid
SAR	Sodium Absorption Ratio
WHO	World Health Organization
FAO	Food Association Organization
USEPA	United States Environmental Protection Agency
EC	Electrical Conductivity
ICP-OES	Inductively Coupled Plasma –optical emission spectrometry
AAS	Atomic Absorption Spectroscopy
Ppm	Parts Per million
TH	Total Hardnes
UNESCO	United Nations Educational Scientific and Cultural Organization
MDL	Method Detection Limit

Abstract

Water is a major environmental constraint for agricultural practices in developing countries. As a result of lack of water storage, infrastructure, large spatial and temporal variations in rain fall and less or no availabilityof enough water farmers do not produce more than one crop per year.To relive from such constraints irrigation schemes are commonly used, but lack of sufficient and effective irrigation in agriculture contributes to low agriculture yields.

Recently, Ethiopian government starts to construct irrigation schemes, as irrigation increases the yieldof cultivated land, allowsgreater productivityand improve Ethiopian economy. Among irrigation schemes under construction Ribb dam is one in south Gonder Zone at Ebenat district. Thus the main objective of this study was assessing the irrigation Water quality of Ribb dam by analyzing the physicochemical parameters like pH, TDS ,EC, TH(total hardness) PO_4^{3-},SO_4^{2-},NO_3^-,Cl^-*, and metals Pb, Mg ,Ca, Zn and Cd. Those parameters were analyzed in four sampling site of the study area with dry and wet season by using ICP-OES, Flame Photometer and multimeter (pH meter, conductometer).*

The result of physicochemical parameter during dry and wet season the minimum and maximum valuewasobtainedpH(7.32,7.53),TDS(54.8mg/L,129.9mg/L),EC(108.3µs/cm,271.3µs/cm),TH(56. 62mg/L,73.3mg/L),Cl^-*(0.6mg/L,8.93mg/L),*NO_3^-*(1.2mg/L,3.93mg/L),*$SO4^{-2}$*(1mg/L,4.3mg/L),*PO_4^{-3}

(0.19mg/L,1.35mg/L)respectively.AndmetalsCa(1.99mg/L,2.99mg/L),Mg(0.373mg/L,0.66mg/L),Z (0.0142mg/L,0.187mg/L).These studies confirm that value of most parameter were found under permissible limit of WHO, but Pd and Cd were not detected.

Key words: *irrigation, water quality, Ribb dam, physicochemical properties, and ICP-OES.*

1. INTRODUCTION

Ethiopia is the second most populous country in Africa; Ethiopia's population is now surpassing 100 million with 85 percent being rural inhabitant and dependent of agriculture with a low level of productivity. In most developing countries, water is a major environmental constraint for agricultural practices. This constraint is most acute in arid and semi-arid areas, which constitute over one-third of the entire land surface of the Earth[1]. However, Ethiopia has about 12 river basins with an annual runoff volume of 122 billion m^3 of water and an estimated 2.6 - 6.5 billion m^3 of ground water potential, which makes an average of 1575 m^3 of physically available water per person per year, a relatively large volume[2]. As a result of lack of water storage infrastructure and large spatial and temporal variations in rainfall, there is not enough water for most farmers to produce more than one crop per year. Therefore, it is evident that the promotion of both small and large-scales irrigation provide an opportunity to improve the productivity of land and increase production volumes. Lack of sufficient and effective irrigation in agriculture contributes to low agricultural yields, and is a significant constraint to economic growth. Irrigation increases the yield of cultivated lands, and allows for the extension of cultivated areas. Greater productivity would have a positive impact on rural income, food security, agricultural exports, and, ultimately, on the overall Ethiopian economy [3].Thus the Ethiopian government has prioritized the development of irrigation schemes as a central component of its poverty reduction strategy. For that Abay basin is considered as one of potential growth corridors and suitable site for irrigation schemes.

1.1. Background

The Abay basin is located in the northwestern part of Ethiopia. It is one of the major basins among the basins in Ethiopia known as Abay (upper Blue Nile) basin with estimated irrigation potential of over 1 million hectares[3].The study site Ribb dams an irrigation schemes, located within the Abay basin along with other schemes, Megech and Angerereb irrigation schemes, is under construction on the Ribb River flowing to Lake Tana (Fig. 1).

The basic characteristics of Ribb dam irrigation scheme is shown in Table 1, based on the Ribb irrigation scheme project proposal document for sourced from Castalia Willingness to Pay Surveys, BCEOM Pre-Feasibility Study, World Bank Project Appraisal Document (2007).

Table 1: Basic characteristics of Ribb dam irrigation scheme

Parameters	Characteristics
Project Area	17,700 ha
Irrigable Area	14,460 ha
No. ofKebeles	8 Kebeles within and 8 Kebeles partly within project area
No. of Woredas	Project within 2 Woredas
Source of water	Ribb and mello rivers
Type of System	Dam on Ribb River and open channels
Peak Demand	9,300 m^3/ha/year
Capitalcost(2008)	ETB 984 million

The Ribb Irrigation and Watershed Management Project develop to supply a command area Medeb Gubda kebele of 20,000ha with irrigation fed farming (Ministry of water resource, 2010). Since, the Ribb dam would have various agricultural activities to be practiced by farmers like fish production, crop irrigation; it was necessary to accessed good quality of the water in Ribb irrigation project for plantation of different crops and required to check the level of chemicals in the dam closed to with the standard of international level of water quality.

Agricultural practiced by irrigation was dependent on an adequate water supply of usable quality. Water quality concerned have often been neglected because good quality water supplied have been readily available, but this situation is now changed in many areas for various reasons such as during the last century application of fertilizer, land degradation had been widely applied to collected wood for fuel and land for cropping and grazing caused major soil erosion during the rainy periods which in turn increased the sedimentation rate in the reservoirs and the amount of particles in the water[4].Moreover, intensive use of nearly all good quality supplies on new and old irrigation projects, seeking new or supplemental supplied rely on lower quality and less desirable sources. To avoid problems when using these poor quality water supplies, there must be sound planning to ensured that the quality of water available is put to the best use [5].The water quality referred to the characteristics of a water supply that would influence its suitability for a specific use, i.e. how well the quality meets the needs of the user. In irrigation water evaluation, the quality emphasis is placed on the chemical and physical characteristics of the water andrarely other factors considered important.

Although the Ribb irrigation scheme was newly constructed and ready for the work the quality of the water in the canals and the storage reservoirs were important factors to secured harvest and food production. Moreover, there had been no previous research report on quality analysis of the Ribb dam water. It is also important to monitor the quality of the water to insure the success of the Ribb Irrigation project as an effective means of improving crop production.

1.2. Statement of the Problem

One of the major problems within the water quality management field was a lack of common understanding of water quality-related terminology relative to regulatory requirements and appropriate evaluation of water quality. Due to this, the Ribb dam new anew dam, around this dam there are various agricultural activities practiced by farmers, so this study would assessed the quality of the water in Ribb irrigation project for plantation of different crops and checked the level of chemicals in the dam close to with the standard of international level of water quality.

1.3. Objectives of the study

1.3.1.General Objectives

The general objective of the study was to assess the irrigation water quality of Ribb dam found in south Gondar, Amhara regional state, Ethiopia by analyzing some of its physical and chemical properties.

1.3.2. Specific Objectives

❖ To assess physical quality of irrigation water quality of Ribb dam irrigation water sample taken from the inlet and outlet of the reservoir.

❖ To determine the level of selected essential and suspected toxic trace metallic elements in the irrigation water.

❖ To compare the obtained irrigation water of quality with international water quality standards.

1.4. Significance of the study

To ensure sustainable agriculture and to improve food quality among the farming communities water is the most important resource for irrigation. The study is vital because the problem relating to water quality is affected the livelihood of the farmers. Due to this the dam serves for irrigation, fish production, consumption of livestock and for such activities.

The study result may serve to provide information for other researchers who desire to make future studies on similar aspect of the study, it provides the true nature of irrigation water management practices in the Ribb dam irrigation area, and the major challenges that the irrigation water resource potential faces leading to social conflict in the short run and over exploitation and depletion of the main aquifer in the long run. Moreover, the outcome of the research may also shed lights on effective irrigation water regulating mechanisms and management practices which will be implemented by the communities. It also gives an important in puts to administrative managers, and decision and policy makers.

2. LITERATURE REVIEW

2.1.Water for Irrigation

Irrigation institutions are defined as the collective arrangements at scheme level for water control and use which include water distribution, construction of infrastructure, maintenance and rehabilitation [6].Water is derived from streams, dam, river, diversion or groundwater, then allocated and distributed. Identification of factors that facilitate the establishment and effectiveness of collective action for irrigation development would help identify where collective action can easily be established and be effective, and where concerted effort is needed for the establishment and effectiveness of collective action. Key research issues regarding collective action for irrigation management include how people organize themselves with respect to irrigation water, what consistent and detectable influences of policies and other instruments can be deployed to modify stakeholder behavior, and how experience in participatory research and extension and common property management be used to facilitate local organizations for water management. The best starting point perhaps is to learn from the success of traditional irrigation systems, especially from the institutional and legal aspect of water administration and management. Understanding the evolution, development and functioning of traditional water uses associations should give important insights as to how to organize and develop modern irrigation associations[7].

2.2.Water and water quality

Salt-affected soils develop from a wide ranges including: soil type, field slope and drainage, irrigation system type and management, fertilizer and maturing practices, and other soil and water management practices. The most critical factor in predicting, managing, and reducing salt-affected soils is the quality of irrigation water being used. Besides affecting crop yield and soil physical conditions, irrigation water quality can affect fertility needs, irrigation system performance and longevity and how the water can be applied. Therefore, knowledge of irrigation water quality is critical to understanding what management changes are necessary for long-term productivity[8]. Soil scientists use the following categories to describe irrigation water effects on crop production and soil quality [9]:

- ✓ Salinity hazard - total soluble salt content

- ✓ Sodium hazard - relative proportion of sodium to calcium and magnesium ions
- ✓ pH - acid or basic
- ✓ Alkalinity - carbonate and bicarbonate
- ✓ Specific ions: chloride, sulfates, boron, and nitrate.

Another potential irrigation water quality impairment that may affect suitability for cropping systems is microbial pathogens. The Ribb Irrigation and Watershed ManagementProjectwas developed to supply a command area of 20,000 ha with irrigation fed farming (Ministry of Water Resources, 2010). This large scale irrigation project is mainly thought to remove the previously used rain fed and subsistence farming techniques. The projection is that the system will yield two crop cycles during a year instead of one and an increased amount of high value crops. In order to achieve these goals the Ethiopian government's expertise and farmers preferences have developed a three step model with different cropping patterns[10].The growth of high value crops will render higher income for the farmers. Estimates are that even the first step in the model will increase farmer's income threefold. This will not only improve their livelihoods, but also enable them to pay back for the construction of the irrigation system which is meant to start after four years of irrigation usage. This is expected to render full cost recovery of the project (Ministry of Water Resources, 2010).In order to supply tail end users with adequate water and meet crops water demand, water management must be carefully planned. Farmers must optimize the use of water to avoid excessive water loss and maximize crop growth efficiency.

Water used for irrigation always contains measurable quantities of dissolved substances which as a general collective term are called salts. These include relatively small but important amounts of dissolved solids originating from dissolution or weathering of the rocks and soil and dissolving of lime, gypsum and other salt sources as water passes over or percolates through them. The suitability of water for irrigation will be determined by the amount and kind of salts present. With poor water quality, various soil and cropping problems can be expected to develop. Special management practices may then be required to maintain full crop productivity.With good quality water there should be very infrequent or no problems affecting productivity [5].The problems that result from using poor quality water will vary both as to kind and degree but the most common ones are:

2.3.The Irrigation system, the dams and the reservoir and the farming area

Irrigated farming may be sustainable if the basicprinciples of water management and salinity controlare recognized and implemented. Unfortunately, the productivity of many existing irrigated areas is in decline as a result of a combination of technical, economic, and institutional factors. Probably thegreatest technical cause of declining agricultural production on irrigated land is water logging andStalinization of soil in arid and semi-arid area[11].

2.4 .Water quality in the reservoir

Water quality should be assessed based on the characteristics of the water relative to the beneficial uses of the water. Water quality is not, as frequently used, a list of chemical constituent concentrations. In order to reliably assess whether concentration of a constituent impairs the water quality beneficial uses of a water body, it is necessary to evaluate on a site-specific basis whether the constituent is present in toxic/available forms at a critical concentration for a sufficient duration to be significantly adverse to aquatic life that is important to the beneficial uses of the water body[12].Irrigation water quality and quantity have direct and indirect impact on soil characteristics (physical, biological and chemical) especially in arid and semi-arid regions that unfortunately depend on irrigation[13].The quality and quantities of the water used on each scheme are as variable as the environmental and geo-logical characteristics in each of the schemes. Water quality and quantity also vary between different seasons and between years as affected by different factors[14].The variation in water quantity is directly related to productivity inirrigation schemes in the short term while water quality affects productivity in the long term[15].A water quality assessment is an evaluation of the beneficial use impairment that is occurring, or could potentially occur, due to the presence of a particular chemical(s) or other constituent. It is not an assessment of the frequency of exceedance of a water quality standard. Pathogens, organic compounds, synthetic chemicals, micro-plastics, nutrients and heavy metals are some elements that pollute fresh water. Unregulated discharge of wastewater undermines biological diversity, natural resilience and the capacity of the planet to provide fundamental ecosystem services.

2.5. Importance of water quality

Ethiopian water resource policy clearly recognizes water as an economic good that requires proper protection, conservation and management. The strategy also indicates the management and conservation activities lined at basin scale while the developmental issues are completely owned by regional level. Beside this, Ethiopia clearly set on the SDG, ambient water quality as one goal to achieve the three basic goals: end poverty reduction, protect the planet and ensure prosperity for allpeople while, ensuring the health of water bodies is essential for maintaining viable, abundance and diverse communities of organisms in aquatic ecosystems. People have specific water quality requirements for their drinking, recreation, irrigation and other purposes, however the requirements are vary based on their usage. Deterioration of water quality affect the availabilities of water for consumption human as well as ecosystems, increase treatment cost, increase prevalence of disease and others. These aquatic ecosystem changes could be linked with basic water quality parameters like nutrient load, temperature changes, DO level fluctuation, E.C, pH and Sediment load[12].Human being has been responsible for a number of drastic changes and events observed in the terrestrial and aquatic environments. The major consequences of human`s activities on the environment are habitat degradation, water pollution, air pollution and the resultant deterioration of the aquatic ecosystem. Different anthropogenic activities are the major water pollution problem in our world[16]. This water pollution occurs when the pollutants/contaminants are discharged directly or indirectly into water body without adequate treatment.

2.6. Water quality guidelines for maximum crop production

Traditionally, irrigation water is grouped into various quality classes in order to guide the user to the potential advantages as well as problems associated with its use and to achieve optimum crop production. The water quality classifications are only indicative guidelines and their application will have to be adjusted to conditions that prevail in the field. This is so because the conditions of water use in irrigation are very complex and difficult to predict. The suitability of water for irrigation will greatly depend on the climatic conditions, physical and chemical properties of the soil, the salt tolerance of the crop grown and the management practices.

Table 2.1.Guideline for interpretation of water quality for irrigation[44]

Potential irrigation problem	Unit	Degree of restriction on use		
		None	**Moderate**	**Sever**
Salinity(affects crop water availability)EC_W	ds/m	<0.7	0.7 – 3.0	> 3.0
TDS	mg/l	<0.450	450 – 2000	>2000
Permeability (affects infiltration rate of water into the soil. Evaluate using ECw and SAR or $adjR_{Na}$ together)[b] or $adjR_{Na}$ = 0 – 3	0-3	ECw ≥ 0.7	0.7 – 0.2	< 0.2
	3-6	ECw≥1.2	1.2 – 0.3	<0.3
	6-12	ECw ≥1.9	1.9 – 0.5	<0.5
	12-20	ECw ≥ 2.9	2.9 – 1.3	<1.3
	20-40	ECw≥5.0	5.0 – 2.9	<2.9
Specific ion toxicity (affect sensitive crops) Sodium (Na)				
Surface irrigation SAR	mg/l	<3	3 – 9	>9
Sprinkler irrigation	mg/l	<70	>70	
Surface irrigation	mg/l	<140	140 – 350	>350
Sprinkler irrigation	Mg/l	<100	>100	
Boron (B)	mg/l	<0.7	0.7 – 3.0	>3.0
Nitrogen (total-N)	mg/l	<5	5 – 30	>30
Bicarbonate (HCO_3) (overhead Sprinkling only)	mg/l	<90	90 – 500	>500
pH (Normal range)			6.5 – 8.4	

Thus, classification of water for irrigation will always be general in nature and applicable under average use conditions. Many schemes of classification for irrigation water have been proposed. Ayers and D. W. Westcot, classified irrigation water into three groups based on salinity, sodicity, toxicity and miscellaneous hazards, as shown in Table 2.1. These general water quality classification guidelines help to identify potential crop production problems associated with the use of conventional water sources. The guidelines are equally applicable to evaluate wastewaters for irrigation purposes in terms of their chemical constituents, such as dissolved salts, relative sodium content and toxic ions. Several basic assumptions were used to define the range of values in the guidelines and more detailed information is reported [5].The effect of sodium ions in irrigation water in reducing infiltration rate and soil permeability is dependent on the sodium ion concentration relative to the concentration of calcium and magnesium ions (as indicated by SAR) and the total salt concentration, as shown in table 2. The guideline which clearly indicates that, for a given SAR value, an increase in total salt concentration is likely to increase soil permeability and, for a given total salt concentration, an increase in SAR will decrease soil permeability. This illustrates the fact that soil permeability (including infiltration rate and surface crusting) hazards caused by sodium in irrigation water cannot be predicted independently of the dissolved salt content of the irrigation water or that of the surface layer of the soil.

2.7 The physical and Chemical Characteristics

The physical and chemical characteristics of the irrigation water are of particular importance where extreme of temperature and low humidity results in high rate of evapotranspiration. Water used for irrigation can vary greatly in quality depending upon type and dissolved salts. The consequence of evapotranspiration is salt deposition from the applied water, which tends to accumulate in the soil profile. The physical and mechanical properties of the soil, such as degree of dispersion of the soil particles, stability of aggregates, soil structure and permeability are sensitive to the types of exchangeable ions present in the irrigation water[17].

2.7.1 pH and Alkalinity

The acidity or basicity of irrigation water is expressed as pH (< 7.0 acidic; > 7.0 basic). The normal pH range for irrigation water is from 6.5 to 8.4.Low pH’sbelow 6.4 are caused accelerated irrigation system corrosion where they occur. High pH’s above 8.5 are often caused by high bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) concentrations, known as alkalinity. High carbonates cause calcium and magnesium ions to form insoluble minerals leaving sodium as the dominant ion in solution[18]. The higher the activity of hydrogen ion, the more acid is the solution, and the lower activity of hydrogen ion it is more basic. The pH value of water can have effect on plant growth, irrigation equipment and the drinking quality[19].

2.7.2. Electrical conductivity

Salts, together with other dissolved substances are what constitute Total Dissolved Solids (TDS) in water. Salts are chemical compounds of carbonates, chlorides, sulfates, nitrates, potassium, magnesium, calcium and sodium[20].Measuring the salinity is a time consuming process. It is easier to measure the water’s electrical conductivity (ECw). The ability of water to conduct an electrical current is directly proportional to the amount of solids in the solution. Salt water has many solids (charged particles) in solution and is therefore a good conductor of electrical currents, while freshwater is a poor conductor [18].

Generally,conductance is also of great importance in case of water quality assessment for different purpose. Municipal, agricultural, and industrial discharges can contribute ions to receiving waters or can contain substances that are poor conductors (organic compounds) changing the conductivity of the receiving waters. Thus, conductance can also be used to detect pollution sources[21].The ionic composition of surface waters is usually considered to be relatively stable and insensitive to biological processes occurring within a body of water[22].

2.7.3. Calcium

It has not effect on human health in water but, it can cause hardness problem risk and directly related to hardness [23]. The permissiblelimit for drinking and irrigation water set by WHO was given as (75mg/l).High concentration of calcium may leads to antagonism and resulting deficiency in phosphorus or magnesium also leads to clogged irrigation equipment due to scale formation and other components[49].

2.7.4. Magnesium

It is the most abundant element in nature and it is significant member water hardness. It gives an unpleasant taste to water[24]. Magnesium and calcium ion dissolved in water is most common minerals that make water hard. The degree of hardness becomes greater as calcium and magnesium content increase. The prescribed guide line value for irrigation and drinking water set by WHO was (150mg/L)[39]

2.7.5. Sulfate

The sulfate ion is a major contributor to salinity in many irrigation waters. As with boron, sulfate in irrigation water has fertility benefits for maximum production for most crops. Exceptions are sandy fields with <1 percent organic matter and <10 ppm SO4-S in irrigation water [18

2.7.6 .Nitrate

The nitrate ion often occurs at higher concentrations than ammonium in irrigation water. Waters high in N can cause quality problems in crops such as barley and sugar beets and excessive vegetative growth in some vegetables. However, these problems can usually be overcome by good fertilizer and irrigation management. Regardless of the crop, nitrate should be credited toward the fertilizer rate especially when the concentration exceeds 10 ppm NO_3-N (45 ppm NO_3)[18]

In aquatic systems, nitrogen is the nutrient that most commonly limit maximum biomass of algae and aquatic plants (primary producers), which occurs when concentrations in the surrounding environment are below requirements for optimal growth of algae, plants and bacteria[25], Compounds of nitrogen (N) are major cellular components of organisms. Since the availability of this element is often less than biological demand, environmental sources can regulate or limit the productivity of organisms in aquatic ecosystems. Productivity of aquatic ecosystems can, thus, be managed by regulating direct or indirect inputs of nitrogen with the aim of either reducing or increasing primary production.

Nitrogen occurs in water in a variety of inorganic and organic forms and the concentration of each form is primarily mediated by biological activity. Nitrogen fixation, performed by cyanobacteria (blue green algae) and certain bacteria, converts dissolved molecular N_2 to ammonium (NH_4^+).Aerobic bacteria convert (NH_4^+) to nitrite (NO_2^{-1}) and nitrate (NO_3^{-1}) through nitrification, and anaerobic and facultative bacteria convert nitrite (NO_2^{-1}) and nitrate (NO_3^{-1}) - to N2 gas through gentrification. Primary producers assimilate inorganic Nitrogen as ammonium ion (NH_4^{+1}) and nitrate (NO_3^{-1}) and organic N is returned to the inorganic nutrient pool through bacterial decomposition and excretion of NH_4^{+1} and amino acids by living organisms [26].

2.7.7. Chloride

Chloride is essential to plants in very low amounts (below 70 ppm). It can cause toxicity to sensitive crops at high concentrations. Like sodium, high chloride concentrations cause more problems (above 70 ppm). Leaf burn under sprinkler from both sodium and chloride can be reduced by night time irrigation or application on cool, cloudy days [27].

2.7.8 .Phosphate (PO_4^{3-})

Inorganic phosphorus, as orthophosphate (PO_4^{3-}), is biologically available to primary producers that rely on phosphorus for production and has been demonstrated to be an important nutrient limiting maximum biomass of these organisms in many inland systems [28] Phosphorus in water is usually measured as total phosphorus, total dissolved phosphorus (i.e., all P that passes through a 0.45cm pore-size filter), and soluble reactive or orthophosphorus.

2.7.9.Zinc

It is an essential element in human diet. High level of zinc in water causes change of tasteand color. Zinc is found in nature as the sulfide associated with other metals like (Pd, Cu, Cd and Fe).Without enough zinc in the diet people may be experience loss of appetite, decrease sense of taste and smell. Shortage of Zn can cause birth defects. Hardness, temperature and other environmental factors increase toxicity of zinc in aquatic life. EPA recommended maximum contamination level is 5mg/L [29].

2.7.10. Cadmium

Cadmium is a very toxic metal. All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Cadmium has many uses, including batteries, pigments, metal coatings, and plastics. It is used extensively in electroplating.Cadmium and cadmium compounds are known humancarcinogens. Smokers get exposed to significantly highercadmium levels than non-smokers. Severe damage tothe lungs may occur through breathing high levels ofcadmium. Long-term exposure to lower levels leads to a buildupin the kidneys[30].and possible kidney disease, lung damageand fragile bones).The permissible limit for irrigation and drinking water set by WHO is 0.0003mg/L[39]

2.7.11.Lead

As a result of human activities, such as fossil fuel burning, mining, and manufacturing, lead and lead compounds can be found in all parts of our environment. This includes air, soil, and water. Lead is used in many different ways. It is used to produce batteries, metal products like solder and pipes, and X-ray shielding devices. Lead is a highly toxic metal and its use in several products like gasoline, paints, and pipe solder, has been drastically reduced in recent years. Today, the most common sources of lead exposure in the United States are lead-based paint and possibly water pipes in older homes, contaminated soil, household dust, drinking water, lead crystal, lead in certain cosmetics and toys, and lead-glazed pottery.Environmental Protection Agency (EPA)has determined that lead is a probable human carcinogen. Lead can affect every organ and system in the body. Long-term exposure of adults can resultin decreased performance in some tests that measurefunctions of the nervous system; weakness infingers, wrists, or ankles; small increases in blood pressure; and anemia.Exposure to high lead levels can severely damage thebrain and kidneys and ultimately cause death. In pregnant women, high levels of exposure to leadmay cause miscarriage. High level exposure in men can damage the organs responsible for sperm production[31]. The permissible limit for irrigation and drinking water 0.01that set by WHO [39]

2.8. Physical parameters

2.8.1. Turbidity

Turbidity and Suspended Solids are other important water quality parameters. Turbidity refers to water clarity. The greater the amount of suspended solids in the water, the murkier it appears, and the higher the measured turbidity. The major source of turbidity in the open water zone of most rivers are typically clays and silts from erosion, resuspended bottom sediments, and organic detritus from stream and/or water discharges.The source of these sediments includes natural and anthropogenic (human) activities in the watershed, such as natural or excessive soil erosion from agriculture, forestry or construction, urban runoff, industrial effluents, or excess phytoplankton growth[32].

Turbidity is also defined as a measure of the transparency of water. Suspended particles (in the range of 0.004–1.0 mm) make it harder for light to pass through the medium, thus it also affects the color of the water [11].According to Yiasoumi the more suspended particles the higher the turbidity. A higher turbidity causes the temperature to increase since there are more particles which absorb heat. This in turn reduces the amount of dissolved oxygen. Since a higher turbidity causes less light to move through the water there is a decrease in photosynthetic activity, a decrease which decreases the amount of dissolved oxygen. Suspended particles in water provide ideal attachments for heavy metals and other organic compounds as well as microorganisms. Drinking water with a high turbidity cause gastrointestinal diseases since the water probably house toxins as well as waterborne diseases. Additionally, turbidity may decrease the infiltration rate in soils. It also has the ability to prevent the establishment of certain crops, like rice [11]. According to the WHO, the desirable threshold for drinking water is set to 5 NTU (Nephelometric Turbidity Units). This threshold is based on the aesthetics, not on health risks. A turbidity >3 can be visually seen[34].

2.8.2. Temperature

Temperature of water is a very important physical parameter to assess thermal pollution and associated effects on aquatic biota. This is because abnormal water temperature alters chemical reactions, reaction rates and solubility of gases. Temperature affects the growth and Temperature reproduction of aquatic organisms. If the temperature gets too high or too low, the local population of a species decreases. Temperature also affects water chemistry, which in turn affects biological activity. A sudden change temperature of river water can lead to a higher rate of mortality of aquatic biota[35].

2.8.3. Dissolved oxygen (DO)

Oxygen is one of several dissolved gases important to aquatic life. It is a primary and comprehensive indicator of water quality in surface water. Primary sources of oxygen in surface water are photosynthesis of aquatic plants, algae and diffusion of atmospheric oxygen across the air water interface[36].The dissolved oxygen content of natural water varies with temperature, photosynthesis activities and respiration of plants and animals[37]. Dissolved oxygen declines have serious implication for the health of aquatic system for low DO or hypoxic condition reduces or eliminates sensitive fishes and invertebrate species. For example game fish requires at least 4 to 5 mg/L DO and either die off or migrate when DO falls below 2 mg/L. Any water body that maintains aquatic life should contain 5 mg/L of DO for at least 16 hours of the day and during the other 8 hrs it should not drop below 3 mg/L[38]. The concentration of DO in natural water reduce (depleted) as a result of biodegradation of carbonaceous and nitrogenous wastes discharged into the water bodies deposited in the sediment and the point or non-point input of plant limiting nutrients which leads to eutrophication[39].

The amount of dissolved oxygen, photosynthesis activity, rate of chemical reactions, aquatic organisms sensitivity to pollution as well as their metabolic rate are some examples of how temperature affects the water. Growth and decomposition of organic matter and microbial growth increases with an increased temperature.

Anthropogenic impacts that includes, industrial discharges, domestic sewage, nonpoint source runoff and atmospheric precipitation are the main sources of toxic heavy metals that enter aquatic systems[3]. However, metals also occur in small amounts naturally and enter aquatic systems through ore-bearing rocks, windblown dust, forest fires and vegetation[40].

2.9. Salinity and salinity problem in agriculture

A salt is a combination of positively charged elements (Cations) and negatively charged elements (anions). Cations include calcium, magnesium, sodium, and potassium. Anions that will dissolve in water include carbonate, bicarbonate, nitrate, sulfate, chloride, and boron. Salts accumulate in soil when inputs exceed outputs. Salts are supplied to soil by irrigation water, geologic sources (soil parent material), fertilizers, manures, composts, or any other amendment. Salts are removed by leaching and crop removal. When irrigation water is high in salt, leaching is the only effective way to remove salt[39].

After much successive irrigation, the salt accumulation in the soil will approach some equilibrium concentration based on the salinity of the applied water and the leaching fraction. A high leaching fraction (LF = 0.5) results in less salt accumulation than a lower leaching fraction (LF = 0.1). If the water salinity (ECw) and the leaching fraction (LF) are known or can be estimated, both the salinity of the drainage water that percolates below the rooting depth and the average root zone salinity can be estimated. The salinity of the drainage water can be estimated from the equation:

Excess salts affect crop production and soil quality. Salt has the following effects on crop yield and quality. Soluble salts (those that dissolve in water) damage plants through an osmotic effect; water moves from the area of lower salt concentration (the plant root) to an area of higher salt concentration (the soil). This causes plants to be stressed for water and wilt even though the soil may be wet. Soluble salts in irrigation water can desiccate (burn) leaf tissue when applied to foliage.Salts deposited on crops can cause leaf and fruit discoloration, reducing market value.

Irrigation water that supplies nitrogen in excess of crop need may reduce yield and/or quality [39].

Total quantity of salts in the irrigation water is high enough that salts accumulate in the crop root zone to the extent that yields are affected. If excessive quantities of soluble salts accumulate in the root zone, the crop has extra difficulty in extracting enough water from the salty soil solution. This reduced water uptake by the plant can result in slow or reduced growth and may also be shown by symptoms similar in appearance to those of drought such as early wilting. Some plants exhibit a bluish-green color and heavier deposits of wax on the leaves. These effects of salinity may vary with the growth stage and in some cases may go entirely unnoticed due to a uniform reduction in yield or growth across an entire field. This mechanism of water uptake has been studied extensively and it now appears the plant takes most of its water from and responds more critically to salinity in the upper part of the root zone than to the salinity level in its lower depths when using normal irrigation practices [38]. Thus, managing this critical upper root zone may be as important as providing adequate leaching to prevent salt accumulation in the total root zone.

2.10. Permeability

A permeability problem related to water quality occurs when the rate of water infiltration into and through the soil is reduced by the effect of specific salts or lack of salts in the water to such an extent that the crop is not adequately supplied with water and yield is reduced. The poor soil permeability makes it more difficult to supply the crop with water and may greatly add to cropping difficulties through crusting of seed beds, water logging of surface soil and accompanying disease, salinity, weed, oxygen and nutritional problems. It is evaluated firstly, from total sales in the water since low salt water can result in poor soil permeability due to the tremendous capacity of pure water to dissolve and remove calcium and other soluble in the soil and, secondly, from a comparison of the relative content of sodium to calcium and magnesium in the water. Furthermore,carbonates and bicarbonates can also affect soil permeability and must be evaluated. The adverse influence of sodium on soil permeability has been recognized for many years. But in many cases the evaluation of the sodium influence alone has proven to be in error basically because the interaction of three factors determines water’s long term influence on soil permeability. These factors are sodium content relative to calcium and magnesium, bicarbonate and carbonate content, and the total sail concentration of the water. A simultaneous analysis of these has been applied to soils before but only recently has been applied to estimating the permeability hazard of irrigation waters to soils[39].

2.11. Toxicity

If the decline of crop growth is due to excessive concentration of specific ions, rather than osmotic effects alone, it is referred to as "specific ion toxicity". The ions of most concern in wastewater are sodium, chloride, and boron. The most prevalent toxicity room the use of wastewater is from boron. The source of boron is usually household detergents or discharges from industrial plants. The quantities of chloride and sodium also increase as a result of domestic usage especially where water softeners are used. The suggested maximum trace element concentrations for irrigation water are reported in table 2.2. In severe cases these elements tend to accumulate in plants and the soil, which could result in human and animal health hazard or cause phytotoxicity in plats [5].A toxicity problem occurs when certain constituents in the water are taken up by the crop and accumulate in amounts that result in a reduced yield. This is usually related to one or more specific ions in the water namely boron, chloride and sodium.

Table 2.2. The suggested maximum trace element concentrations for irrigation water [44].

Element	**RecommendedMaximum Concentration (mg/l)**	**Remark**
Cd (cadmium)	0.010	Toxic to beans, beets, and turnips at concentrations as low as 0.1 mg/l in nutrient solutions. Conservative limits recommended because of its potential for accumulation in plants and soils to concentrations that may be harmful to humans.
Co (cobalt)	0.050	toxic to tomato plants at 0.1 mg/l in nutrient Solution tends to be inactivated by neutral and Alkaline soils
Pd (lead)	5.0	can inhibit plant cell growth at very high Concentrations
Zn (zinc	2.0	Toxic too many plants at widely varying Concentrations; Reduced toxicity at pH >6.0 and in fine textured organic Soils.
Fe (Iron) not	5.0	Toxic to plants in aerate soils but can Contribute to soil acidification and loss of Reduced availability of essential phosphorus and molybdenum. Overhead sprinkling may Result in unsightly deposit on plants, Equipment And buildings

2.12. miscellaneous

Various other problems related to irrigation water quality occur with sufficient frequency that they should be specifically noted. These include excessive vegetative growth, lodging and delayed crop maturity resulting from excessive nitrogen in the water supply, white deposits on fruit or leaves due to sprinkler irrigation with high bicarbonate water and suspected abnormalities indicated by an unusual pH of the water.

3. EXPERIMENTAL

3.1. Descriptions of the study area

The study area Ribb dam is located at Amhara National Regional State, south Gondar zone at the eastern side of Lake Tana at the command area of Medeb Gubda kebele in Farta district. Fogera Woreda is one of the 106 Woredas of the Amhara Regional State and found in South Gondar Zone. It is situated at 11^{o} 58 N latitude and 37^{o} 41 E longitude. Woreta is the capital of the Woreda and is found 625 km from Addis Ababa and 55 km from the Regional capital, Bahir Dar. The woreda is bordered by Libo Kemkem Woreda in the North, Dera Woreda in the South, Lake Tana in the West and Farta Woreda in the East. The Woreda is divided into 29 rural kebeles and 5 urban Kebeles (RDBOA, 2007/8). The command area is located at the vicinity of Fogera woreda near Woreta town and north east Ebnat and south east Farta

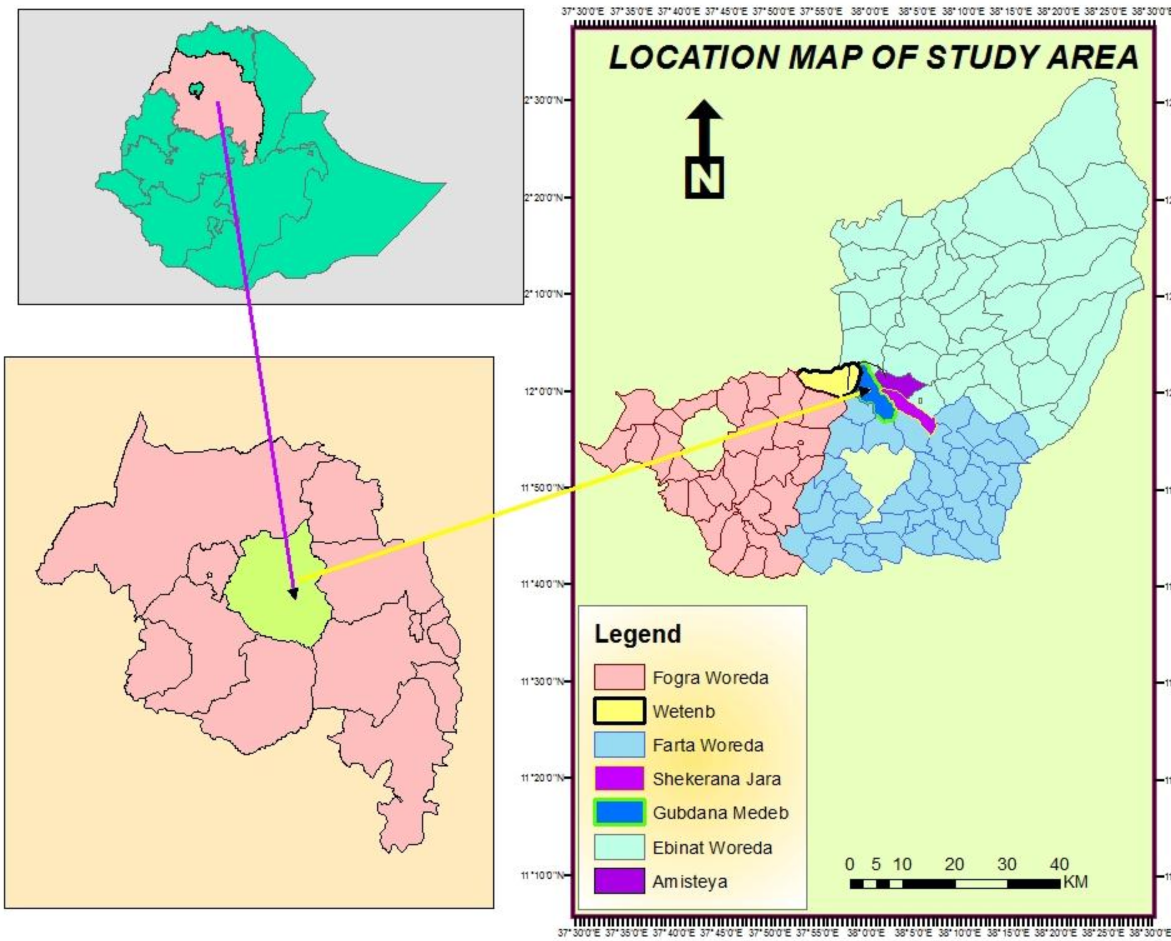


Figure3.2: map of the study area

3.2. Climate

The climatic condition of the study area is generally tipped moist mid-highland with the annual average rain fall amount of 900-1400 mm. Most of this rain received during mid-June to September. Agro-ecologically the climate is woyna-dega (78%) and dega (22%). It stands/serves to harness the flow of Ribb River to irrigate an area of about 20,000 hectares in Fogera plain (ministry of water resource, 2010).The area has reddish soil type (woreda agriculture development office, 2010).

3.3 Sampling (sample collection technique)

Sampling of Ribb water was taken twice,that isboth in the dry and wet season. So the results in this study could be regarded as seasonal. The first sampling session was before rainy season during the dry season on the 15^{th} of April 2018. The second sampling session was after rainfall during the wet season on the 15th of June 2018. It was rainy and an air temperature of 20.4°C.Sampling was carried out starting downstream to be sure that “the same” water wouldn’t be collected more than once. Two points were carefully chosen to get representative water from the different canals and at places where water enters to the dam and reserved (reservoir) and water leaves out from the dam (outlet). Samples were collected by prewashed with distilled water one liter plastic bottle (polyethylene), which were rinsed twice before the true sample was taken. The samples were labeledor designated a letter and number as A1 for thereservoirandA2 for the outlet of the dry season; similarly, B1forreservoirand B2 for the outlet of wetseason.

3.4. Chemicals, Instrument and apparatus

Plastic bottles (polyethylene) were used to collect the samples; and other materials, like beaker, conical flasks, filter paper, funnel, volumetric flask, micro pipette, hotplate hood. Instruments were pH meter, conductometer (HachHQ4od) ,inductively coupled plasma(8000,perkin Elmer, Germany), Waqtech flame photometry 8000 was used to conduct experiments in the study. Chemicals like nitric acid, perchloricacid, calcium nitrate, lead nitrate, and others required chemicals were used.

3.5. Methods

3.5.1. Quantitative Determination of water quality analysis

According to UNESCO (United Nations Educational, Scientific, and Cultural Organization) a majority of the Ethiopian river waters had a decent quality regarding salinity and chemical pollution.The irrigation water quality parameters included in this study was, electrical conductivity (EC), pH, total dissolved solid (TDS), toxic and essential elements such as calcium ,magnesium, zinc, lead, cadmium, nitrate, phosphate, sulfate, chlorides, total hardness and so on, which would be explained in detail according to world health organization standard [39,40]. For few physical analyses pH meter, conductometer was used, whereas ICP-OES for detection and quantification of metals and radicals were analyzed by using flame photometer. The data analysis was conducted by using statistical tool software MS-Excel and Origin.

3.5.2. Sample Preparation water quality analysis Procedure

The method of analysis was split into sections describing the conditions and performance of the field, lab-work and presents the equipment used [8].Though some parameters (pH,TDS,EC) were determined at the field based on the accessibility of field measuring analytical devices and no need sample preparation. The water sample were prepared for chemical parameter (metals andessential nutrients), in which 50 mL of each sample werepipette out to a100 mL conical flasks. Then 5 mL of conc. HNO_3 (68%) were added to each sample and watch glass were used to cover the flasks, and kept in hood to avoid contamination. Then the samples were digested on a hot plate to a temperature of 80 ºC-95 ºC without boiling until it reaches 20ml for 2 hrs [32]. After clear solution was obtained, all samples were taken away and cooled at room temperature. Then each sample was transferred to a separate 50 mL volumetric flask and diluted up to the mark using distilled water. The digested samples were stored in a refrigerator to minimize volatilization, contamination and biodegradation between sampling and analysis time[38].The digested samplewas analyzed by using ICP-OESto be determined for its concentration of metals in water. For nitrates and phosphate, the water sample was filtered by using a0.45μm filter paper then treated by photometry.

3.5.3. Standard preparation and calibration of the instrument

Standard solutions of metal ions are necessary to standardize and calibrate the instrument. Moreover, the preparation of standards is also an important and crucial part of analysis and it requires much attention. The intermediate and working standards were prepared freshly using dilution formula form the 1000 ppm standard stock solution of each target metal.Working stock solution from the 1000 ppm stock solutions of each target metal, (i.e .calcium, magnesium, lead, cadmium and zinc), 10 mL of the stock solution was transferred to a 100 mL standard volumetric flask, and diluted up to the mark usingdistilled water. A concentration of Ca, Mg, Pb, Cd, and Zn metals were prepared by this serial dilution procedure.[32]

A concentration of 10 ppm of each metal (i.e. Ca,Mg, Pb, Cd, , and Zn) were prepared from the 100 ppm secondary stock solution one by transferring 1 mL of the solution to a 100 mL standard volumetric flask using micropipette followed by dilution up to the mark with distilled water[36]. Using the same procedure, a series of calibration standard solutions and standard solutions for spiking of each target metal were prepared. That is, for metals Ca and Mg series of concentrations 0.1, 0.3,0.9,2.7,8.1 ppm, and for metals Pb, Cd, and Zn series of concentrations 0.01,0.039, 0.152,0.593,2.3 ppm, respectivelywere prepared.

4. RESULT AND DISCURSION

4.1Analyzingof physicochemical parameter of water

The physicochemical parameter such as pH,total dissolved salt (TDS),total hardness (TH), electrical conductivity (EC) chloride, phosphate, nitrate and suliphate were analyzed for the water sample collected from Ribb dam. Duringthe analysis photometry was used to evaluate the physicochemical parameter of Ribb irrigation water In addition to this, ICP-OES used for the determination of metals. All parameters with the mean value of the data with standard deviation were calculated as shown in table below;

Table4.1. Distribution of physicochemical parameters in study area at dry and wet season

Parameter	**Dry season**		**Wet season**		Gr.Mean±Std.
	A1	**A2**	**B1**	**B2**	**A1,A2, B1** and**B2**
pH	7.32±0.01	7.32±0.022	7.36±0.02	7.53±0.01	7.38±0.03
EC	108.3±0.54	134.00±0.22	114.7±0.08	271.0±1.4	157.0±1.28
TDS	64.9±0.65	63.93±0.10	54.8±0.05	129.67±0.40	78.33±0.99
TH	73.3±2.36	56.62±2.36	56.67±2.36	70±0	64.13±3.67
Cl^-	8.93±0.15	0.667±0.094	0.80±0.08	0.60±0.08	2.73±0.21
PO_4^{3-}	1.35±0	0.365±0.004	0.22±0.05	0.19±0.04	0.53±0.05
SO_4^{2-}	1±0	1.90±0.14	4.30±0.47	1.167±0.24	2.09±0.49
NO_3^-	1.2±0	2.0±0.16	3.93±0.09	2.43±0.17	2.39±0.22

Note; All parameters was given in mg/L exceptEC=µs/cm

A1=reservoirsample,B1=reservoir sample,A2=outlet sample and B2=outlet sample

From **Table 4.1** most physicochemical parameters are found to be comparable with WHO guide-line.The pH of the Ribb irrigation dam water in all sample sites of study area (A1,A2,B1&B2)were obtained to be 7.32, 7.32, 7.36 and 7.52, respectively, whichare all within limit of 6.5-8.5 standard set by the WHO. The pH value of water in wet season was shown a small variation than dry season; because of floods and rainrunoff in which some dissolved alkaline salts may be enter to the dam.

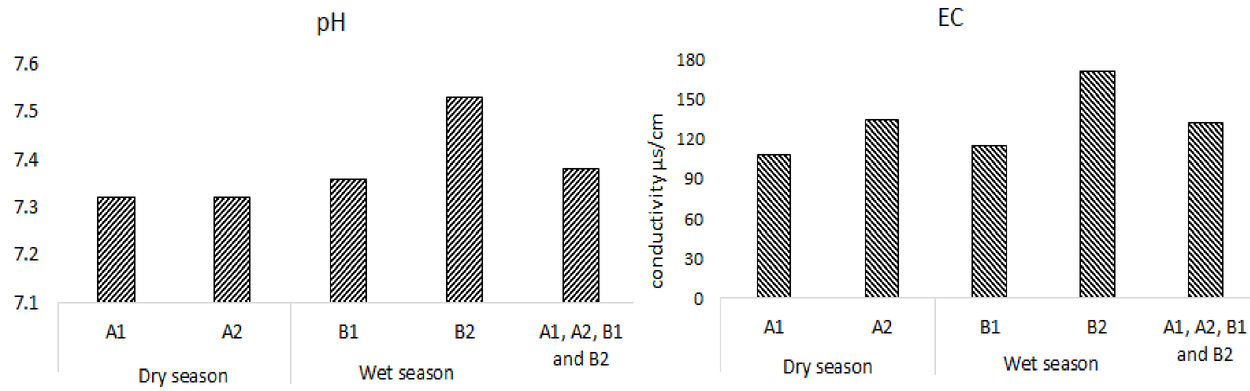
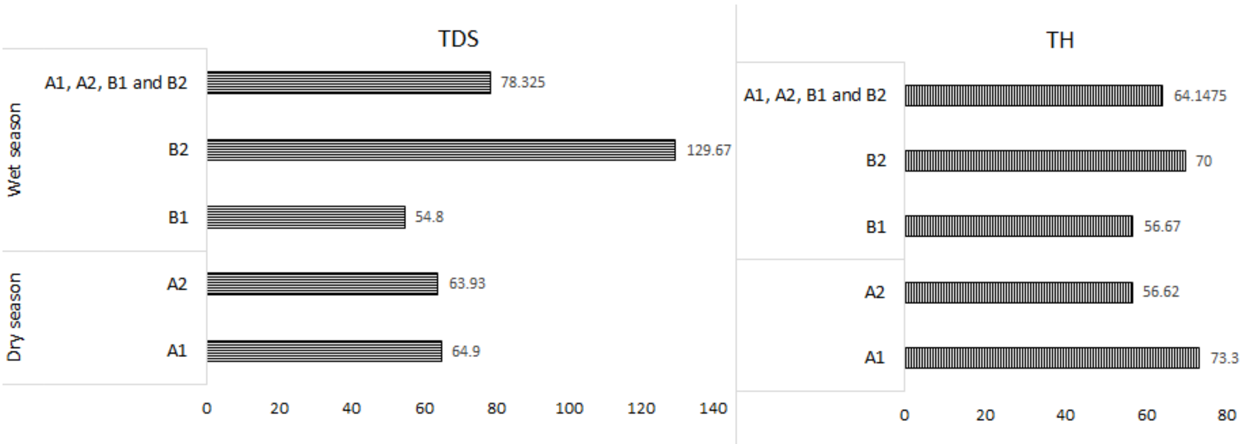


Fig.4.1.1ThepH and EC of the four sampling sites (A1, A2, B1, B2) and their rmean value.

Electrical conductivity is a measure of the ability of aqueous solution to carry anions.ECthat depends on total concentrationof ion and their mobility value on the temperature.It also the valuable measure of the amount of metal ions dissolved in water.Hence the value of EC in all sampling sites of Ribb dam A1, A2,B1 and B2obtained value were 108.3µs/cm, 1343µs/cm, 114.73µs/cm and 2713µs/cmrespectively.Conductivity is one of the most important parameters affecting crop growth. The value obtained in all sampling site were within allowable/permissive ranges for irrigation uses of water that set by [44] But small variation was recorded between dry and wet season which is EC value of sample site B2 was 271µs/cm it was greater value from other sampling site this may be due to rainy season more electrolyte substances were be present in the dam.

Total dissolved solid (TDS) affects the aesthetic value of the water by increasing turbidity.High concentration of TDS water sample elevates the density of water, limits the suitability of water as drinking source andirrigation supply, influenceosmoregulation of freshwater organismsand reduces the solubility of gases.In the present study the concentration of TDS in all sampling siteA1,A2 ,B1 and B2 were 63.9 mg/L, 63.93 mg/L, 54.8 mg/Land 129.67 mg/L respectively. These values were below the standard limits that set by WHO (500mg/l)[39]. The low level of TDS contents of irrigation water allows the water for drinking and domestic uses.

Total hardness of water mainly depends upon the amount of calcium and magnesium salts or both.The value obtained from the analysis of total hardness of water in water sampling site of study area A1, A2,B1 and B2 was 73.3mg/L,56.62mg/L,56.67mg/Land70.0mg/L respectively. This value is below the limits of the WHO (500mg/l)[39] it might be indicates that water in all sampling site were not contaminated from disposal wastage water in detergents, fertilizer and others .High alkalinity tends to be problematic because it can leads to elevate the pH of the growth media which can cause varies nutrient problem (Fe& Mn)[49].



.

Fig4.1.2. TheTDSand TH of the four sampling sites (A1, A2, B1, B2) and their mean value.

The result obtained from the analysis of nitrate in water at sampling sites of the studying area A1,A2, B1 andB2 were 1.2mg/l,2mg/l,3.93mg/land2.43mg/l, respectively as presented in Table 4.1. The value is below limit of WHO (50mg/l)[39] standard. It might be indicate that the lack of oxidation that can convert ammonia to nitrite (absence of nitrogen fixing bacteria). According to Fig.4.1.3 nitrate in the dry sampling season was less than that of the wet sampling season samples. Whereas the reservoir nitrate concentration slightly increased when it reached at the outlet in dry season, this may be there were the intermixing opportunity of reservoir water at outlet position of the dam and cause to increasing concentration of nitrate on the other hand, in wet season the reservoir nitrate concentration decreased when it reached at the outlet, this could be due to decreasing oftemperature and forming of turbid water the oxidation activity of bacteria decrease

The phosphate analysis value obtained from sampling site ofA1, A2, B1and B2 were 1.35mg/L,0.365mg/L,0.22mg/L and0.192mg/L, respectively. Thevalue indicates that the level of phosphate contamination at Ribb dam was relatively insignificant disposal of phosphate from domestic and phosphate fertilizers very less in amount.

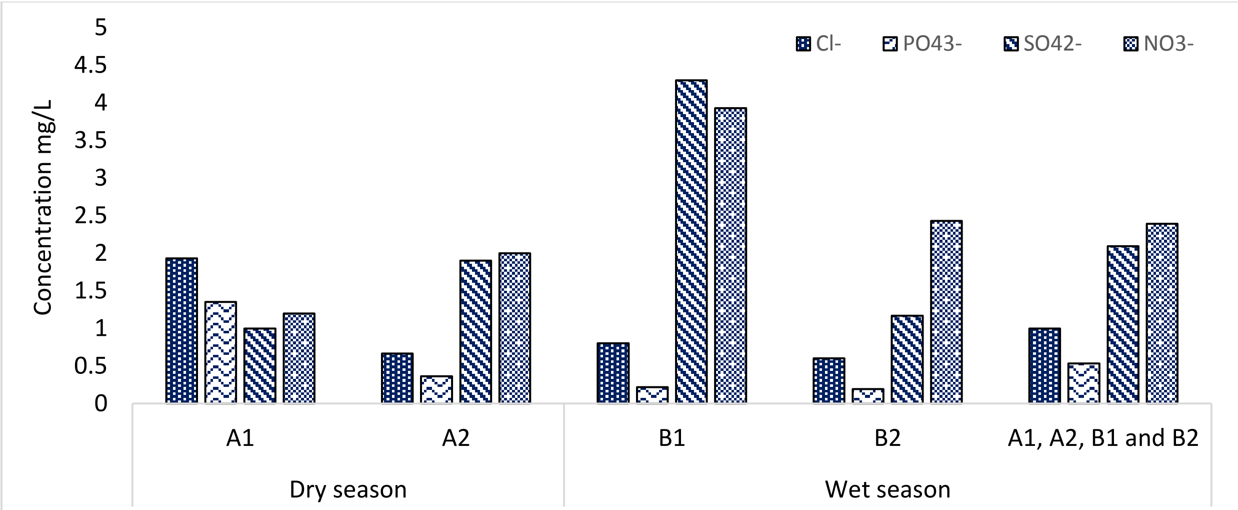


Fig4.1.3. The level of radical ions in water collected from Ribb irrigation dam

Chloride is essential nutrientsin very low amount, but it causes toxicity at very high amount.In present study thechloride ion concentrationinallcollected water sample were 8.93mg/L,0.667mg/L,0.8mg/Land0.6mg/L the value were below the permissible value that set by WHO (250mg/l).It indicates that water may not be toxic.

The sulfate ion is a major contributor to salinity in many irrigation waters. Sulfate in irrigation water has fertility benefits for maximum production for most crops. Discharge of industrial wastes anddomestic study sewage tends to increase its concentration. For present study the levels of sulphate in all sampling sites A1,A2,B1,B2 were 1mg/L, 1.90mg/L,4.30MG/L,1.167mg/L respectively .And these measured results were more less within the standard value of WHO which is250mg/L(Table4,4). This might be indicate that around Ribb dam there was no industrial wastage materials and domestic sewage.

4.2. Analyses of metals

4.2.1 Validation of experimental procedures

The validation of experimental procedures help to know the efficiency of the experimental analysis,which is proved by some parameters. Before the determination of the level of some selected trace metals in the water samples of Ribb irrigation dam, some of experimental procedures validation were seen such as method detection limit (MDL), recovery test (% recovery), coefficient of variation using standard deviation of triplicate sample analysis (CV), linear range, and plotting calibration curve with their coefficient of determination (R^2)for the analysis of five selected trace metals in water samples of Ribb irrigation dam as presented in [37] Table 4.2.

Table4.2 methoddetection limit for the selected five metals..

Metals	MDL	R^2	Equation	%Recovery
Ca	0.0015	0.996	Y=41666x+29206	94.5
Mg	0.0012	0.993	Y=2E+06x+54222	96
Pb	0.0006	0.999	Y=37362x-585	100.2
Cd	0.0003	0.999	Y=42397x-15514	104.5
Zn	0.0015	0.999	Y=16153x-3038	92.5

I. **Method detection limit(MDL)**of the analyte in the sample means the lowest concentration of the analyte that can be detected. This value was obtained by multiplied the standarddeviation of the blank by three (3)[33].

MDL = 3*STD (standard deviation)/mean

According to this formula, the MDL of the method of analysis using ICP-OES for each of the five element is determined, and the MDL results for Ca, Mg, Pb, Cd and Zn were determined to be 1.5 µg/L, 1.2 µg/L, 0.6 µg/L, 0.3 µg/L and 1.5 µg/L, respectively. All the detection limits obtained are significantly above the quantification limit that is going to be determined in water sample collected from Ribb irrigation dam.

II. **Coefficient of determinationor regression(R^2)**: is used to infer the linearity of an analyticalmethod only when standard solutions, based on which the calibration curve is determined. It is very important to determine a suitable dependence and the “visual”analysis of the obtained graph[.As shown in Table 4.2,all thecoefficient of determinations of the six trace metals are above 0.99, whichis deemed a good fit to the linearity of calibration curve potted analytical methods.

A calibration curve is used to determine the unknown concentration of element [37].Individual calibration curve of each metal was obtained from the instrument by using series of solution of known concentration. The plots of calibration curves of some the metal and the linear regression equation is given below.For instance, the calibration curve for the determination of calcium and zinc in water sample collected from Ribb irrigation dam is plotted as shown in Fig 4.4.

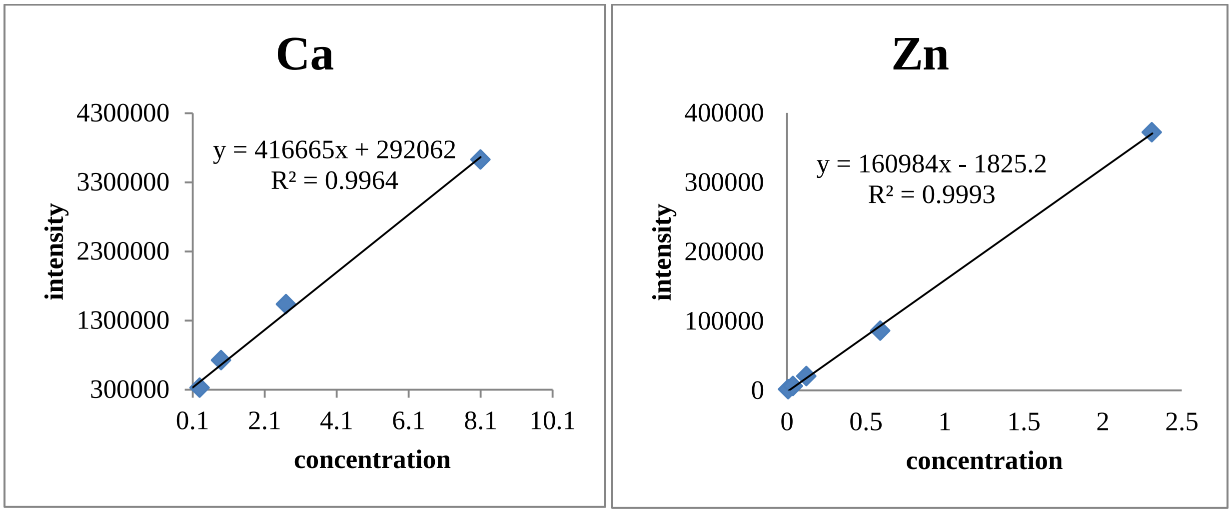


Figure 4.4 Calibration curve for Calcium and Zinc analysis using ICP-OES .

III. **Recovery (%)**:denotes the recovery of an analyte for a given analytical procedure. The efficiency and accuracy of the optimized method was evaluated by analyzing the digests of spiked samples. For metals Ca, Mg, Pb, Cd and Zn percent recoveries were determined as presented in Table 4.2. The present spike recovery was calculated by the standard formula.

$$\% \textbf{ Recovery} = \frac{C_{spiked\ sample} - C_{unspiked\ sampe}}{C_{added}} \times \mathbf{100}\%$$

Accordingly, the recoveries of metals in the spiked samples were obtained in the range from 92.5% to 104.5 %, which confirms that the method of analysis for each metal has acceptable good recovery value.

IV. **Coefficient of variation (CV)**: is one of the measure of precisionmeasurement of analysis, which is determined by the percentage value of ratio of standard deviation of replica measurement to the mean value of the measurements.If the CV value is calculated by using any of the mean value of the triplicate measurements and their standard measurementin Table 4.1, most of the CV values are less than 5%, which confirms that the measurement was good in precision.

4.2.2Concentration of the metals analyzed using ICP-OES

Metals calcium, magnesium, zinc ,lead and cadmium were analyzed in all of the sample collected from sampling site of study area. Concentration of Ca ,g and Zn were detected whereas Cd and Pb were found below the detection limit in allsampleanalyzed. The mean value and standard deviation thatobtainedfromanalysis of metals by using ICP OESwere given in table 4.3. The grand mean value obtained for the detected metal is almost negligible compared with the allowable limit of irrigation water as observed in Table 4.3, which confirms the softness of the irrigationwater. However, zinc need to be high in concentration as it is essential cation for crop production.

Table. 4.3 Distribution of metals in sampling site at dry and wet season

Metals	A1	A2	B1	B2	Gr.Mean±Std.
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Ca	2.95 ±0.164	1.99 ±0.1.43	2.82 ±0.114	2.23 ±0.171	2.498 ±1.45
Mg	0.52 ±0.033	0.373 ±0.0234	0.543±0.0278	0.66±0.0394	0.524±0.24
Zn	0.187 ±0.044	0.184±0.0166	0.0142±0.009	0.0668±0.00235	0.113±0.022
Pb	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND

Note: ND=note detected

Table 4.4. International Guidelines of physicochemical for irrigation water

Metals	WHO[39]	FAO[38]	USEPA[46]
Ca	200mg/l	---	-----
Mg	150mg/l	----	-----
Zn	3mg/l	2mg/l	5mg/l
Cd	0.003mg/l	0.01mg/l	0.015mg/l
Pd	0.01mg/l	5mg/l	0.003mg/l
TDS	1000mg/l		500mg/l
TH	500mg/l		
EC	1200µs/cm		
PH	6.5-8.5		6.5-8.5
NO_3^-	250mg/l		
SO_4^{-2}	250mg/l		
PO_4^{-3}	0.1mg/l		
Cl^-	250mg/l		250mg/l

4.3. Comparisons of results of metals from four sampling site

Among the five metals intended to be determined three of them were detected and presented in Table 4.3. The comparison of these metal concentration (Ca, Mg and Zn)is shown in figure4.6 below:

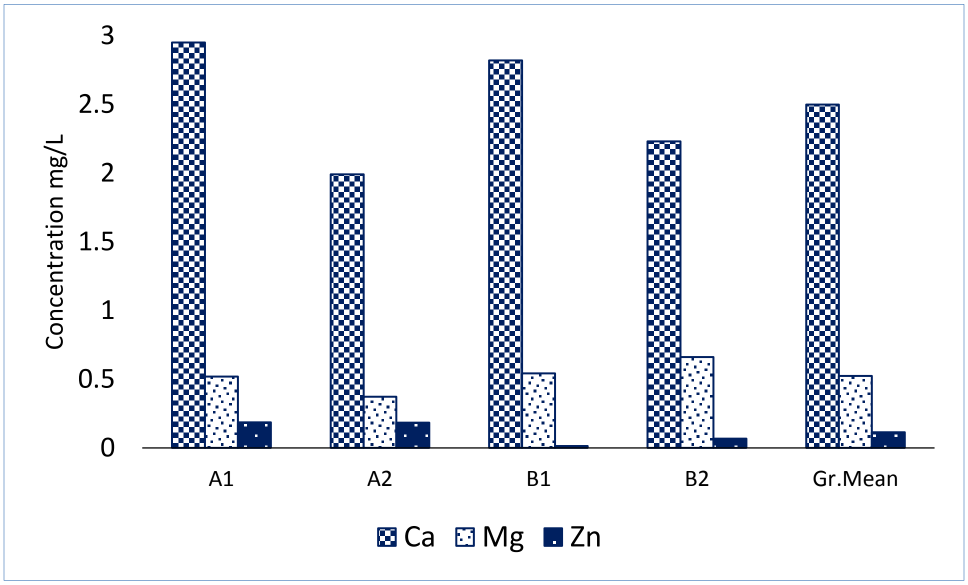


Figure 4.5. Comparison ofCalcium, Magnesium and Zinc from sampling site.

Based on the bar chart it is clearly observed that calcium concentration is greater than that of magnesium and zinc. The calcium concentration in the reservoir samples obtained is slightly greater than that of the outlet samples.The concentration of Calcium in sampling siteA1, A2,B1 and B2 were a 2.95mg/L,1.99mg/L,2.82mg/Land2.23mg/L, respectively.These may indicate that the level of hardness of water in all sampling site is insignificant andthe recorded value of calcium was below permissible guide line value set by WHO (200mg/l).

Zinc is an essential element in human diet. Zinc with a low concentration and high concentration cancause health problem .High level of zinc in water change taste and color of water. The recorded value of zinc in all sampling site as figure 4.6 was 0.187mg/L, 0.184mg/L,0.142mg/L land 0.066mg/L.The value is below the permissible value of the guideline set byWHO(5mg/L). But there was a significant variation of between dry and wet season.It might indicate that water contamination level by concentration of zincshouldbe reduced

Magnesium is the most abundant element in nature and it is significant member ofwater hardness. It gives an unpleasant taste to water[24].The concentration of magnesium ion increases the degree of hardness become greater.The prescribed guide line value for irrigation and drinking water set by WHO was (150mg/L).In this study the recorded value of magnesium was0.52mg/L, that was below the permissible limit set by WHO .The result might be indicate that less concentration of magnesium leads to less hardness of water available in Ribb dam.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Agricultural practiced by irrigation was dependent on an adequate water supply and water quality. The study was tried to be assessed the physicochemical parameters irrigation water quality of Ribb dam found in south Gander. Four samples were collected from two sampling sites (that is water reservoir and outlet of the irrigation water dam) and in two seasons, namely dry and wet season.The levels of selected physicochemical parameters like pH, TH, TDS & EC were treated by using pH meter, conductometer, flame photometer. Moreover, NO_3^-,PO_4^{3-},SO_4^{2-} ,&Cl^- using photometry; and some selected metals Ca ,Mg, Pb, Zn& Cd were be assessed by using ICP-OES and standard procedures and methods.. The result of most physicochemical parameters were within theguideline limit set by WHO and there was no significant difference between physical parameters in all sampling site.But among chemical parameters Ca, Mg ,Zn, Cd and Pb the concentration of Ca that obtained from four sampling site was greater from others (Mg ,Zn, Pb& Cd) .Where as Pb and Cd were below detection limit in all samples of the sampling site.

5.2. Recommendation

Further studies should be carried out in biological parameters and rest toxic metals in the dam to check the level of coli forms and toxic level of metals to check the suitability of Ribb dam water for domestic purpose for peoples around it.

REFERANCES

1. Thomas, D.S., 1997. Science and the desertification debate. *Journal of Arid Environments*, *37*(4), pp.599-608
2. Awulachew, S.B., Yilma, A.D., Loulseged, M., Loiskandl, W., Ayana, M. and Alamirew, T., 2007. *Water resources and irrigation development in Ethiopia* (Vol. 123).
3. PUMP, D.S.A.M., 2010. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE RIBB IRRIGATION AND DRAINAGE PROJECT.
4. Beyene, A., Sandström, E. and Hårsmar, M., 2016. Lake Tana: source of disputes or collaboration over the Blue Nile In*Land and Hydropolitics in the Nile River Basin* (pp. 205-226). Routledge.
5. Ayers, R.S. and Westcot, D.W., 1985. Water Quality for Agriculture. FAO Irrigation and Drainage Paper 29, rev. 1. Food and Agriculture Organization of the United Nations, Rome. 174 p.

6.Jagger, P., Pender, J. and Gebremedhin, B., 2003. *Woodlot devolution in Northern Ethiopia: Opportunities for empowerment, smallholder income diversification, and sustainable land management* (Vol. 107).

7. Wilde, F.D., Radtke, D.B., Gibs, J. and Iwatsubo, R.T., 1998. National field manual for the collection of water-quality data. *US Geological Survey Techniques in Water-Resources Investigations, Book, 9*.

8.Davis, J. G., et al. irigation water qaulity criteria. *irrigation water quality*. Colorado : Colorado State University, 2014.Myers, D., (2007). *TWRI Book 9.U.S. Geological Survey*. Pp FIB 5–73.

9.Lazarova, V. and Bahri, A. eds., 2004. *Water reuse for irrigation: agriculture, landscapes, and turf grass*. CRC Press.

10. Al-Momani, R. and Rasheed, M., 2016. Treated wastewater uses in irrigation con-serve water in the world’s second water-poorest country, jordan. *feb-fresenius environmental bulletin*, p.2225.
11. World Health Organization, 2009. Boron in drinking-water: Background document for development of WHO Guidelines for Drinking-water Quality. In *Boron in drinking-water: background document for development of WHO guidelines for drinking-water quality*.

12. Mahvi, A.H., Zazoli, M.A., Younecian, M., Nicpour, B. and Babapour, A., 2006. Survey of fluoride concentration in drinking water sources and prevalence of DMFT in the 12 years old students in Behshar City. *J Med Sci*, *6*(4), pp.658-61.

13. Rahimi, H., Pazira, E. and Tajik, F., 2000. Effect of soil organic matter, electrical conductivity and sodium adsorption ratio on tensile strength of aggregates. *Soil and Tillage Research*, *54*(3-4), pp.145-153.

14. Yidana, S.M., Sakyi, P.A. and Stamp, G., 2011. Analysis of the suitability of surface water for irrigation purposes: the Southwestern and Coastal River Systems in Ghana. *Journal of Water Resource and Protection*, *3*(10), p.695.

15. Almas, A.A. and Scholz, M., 2006. Agriculture and water resources crisis in Yemen: Need for sustainable agriculture. *Journal of Sustainable Agriculture*, *28*(3), pp.55-75.

16. Kiver, V.F. and Onopriyenko, D.M., 1998. Water-saving regimes of irrigation when growing maize. *VisnykAgrarnoyiNauky (Ukraine)*.

17. Mujere, N., Chazovachii, B., Chifodya, G. and Mushuku, A., 2011. Evaluating factors influencing the variation of irrigated wheat yields. A case study of Chinyamatumwa irrigation scheme in Zimbabwe. *Journal of sustainable development in Africa*, *13*(14), pp.177-188.

18. Welch, P., David, J., Clarke, W., Trinidade, A., Penner, D., Bernstein, S., McDougall, L. and Adesiyun, A.A., 2000. Microbial quality of water in rural communities of Trinidad. *RevistaPanamericana de SaludPública*, *8*, pp.172-180.

19. Ness, I. and Cope, Z., 2016. Country and Regional Analysis. In *The Palgrave Encyclopedia of Imperialism and Anti-Imperialism* (pp. 249-469). Palgrave Macmillan, London.

20. Dodds, W.K., Jones, J.R. and Welch, E.B., 1998. Suggested classification of stream trophic state: distributions of temperate stream types by chlorophyll, total nitrogen, and phosphorus. *Water Research*, *32*(5), pp.1455-1462.

21. Awofolu, O.R., Mbolekwa, Z., Mtshemla, V. and Fatoki, O.S., 2005. Levels of trace metals in water and sediment from Tyume River and its effects on an irrigated farmland. *Water Sa*, *31*(1), pp.87-94.

22. Khairiah, J., 2004. The uptake of heavy metals by fruit type vegetables grown inselected agricultural areas. *Pakistan Journal of Biological Sciences (Pakistan)*.

23. Villaescusa-Celaya, J.A., Gutiérrez-Galindo, E.A. and Flores-Muñoz, G., 2000. Heavy metals in the fine fraction of coastal sediments from Baja California (Mexico) and California (USA). *Environmental Pollution*, *108*(3), pp.453-462.
24. Fakayode, S.O., 2005. Impact of industrial effluents on water quality of the receiving Alaro River in Ibadan, Nigeria.
25. Burgman, M.A., 1999. Are Australian standards for risk analysis good enough?: conserving snails and managing genetically modified plants in fragmented landscapes.[Paper presented at the Joint Symposium of the Australian Institute of Biology and the Royal Melbourne Zoological Gardens (1999: Royal Melbourne Zoological Gardens, Melbourne)]. *Australian Biologist*, *12*(2), p.125.
26. Derbel, J., 1997. Water supply and sanitary engineering.
27. Gary, L.J. and Joseph, D.B., 1998. The basics of pond aeration. *Agriculture and natural resource*.
28. Tadesse, T., and Paulos W (2008). Water Quality and Treatment Laboratory Manual. Bahir Dar University Engineering Faculty Water Resources and EnvironmentalEngineering Department
29. Fipps, G.,(1999). Irrigation water quality standards and salinity management strategies. Agrilife extension, Texas A&M system.
30. Baron, J.S., Poff, N.L., Angermeier, P.L., Dahm, C.N., Gleick, P.H., Hairston, N.G., Jackson, R.B., Johnston, C.A., Richter, B.D. and Steinman, A.D., 2002. Meeting ecological and societal needs for freshwater. *Ecological Applications*, *12*(5), pp.1247-1260.
31. Marx, S., 2011. Large-scale irrigation in the Blue Nile Basin: Chances and obstacles in implementing farmers' self-management: A case study of the Koga irrigation and watershed management project in Amhara Region. *Ethiopia, IWMI, February*.
32. Hseu, Z.Y., 2004. Evaluating heavy metal contents in nine composts using four digestion methods. *Bioresource technology*, *95*(1), pp.53-59.
33. Shrivastava, A. and Gupta, V.B., 2011. Methods for the determination of limit of detection and limit of quantitation of the analytical methods. *Chronicles of Young Scientists*, *2*(1), p.21.

34. Chary, N.S., Kamala, C.T. and Raj, D.S.S., 2008. Assessing risk of heavy metals from consuming food grown on sewage irrigated soils and food chain transfer. *Ecotoxicology and environmental safety*, *69*(3), pp.513-524.

35. Lajunen, L., 2007. *Spectrochemical analysis by atomic absorption and emission*. Royal Society of Chemistry.

36. Smith, R., 1983. *A laboratory manual for the determination of metals in water and wastewater by atomic absorption spectrophotometry* (No. CSIR-K--63). Council for Scientific and Industrial Research.

37. Bruce, G.R. and Gill, P.S., 1999. Estimates of precision in a standard additions analysis. *Journal of chemical education*, *76*(6), p.805.

38. Turral, H., Burke, J.J. and Faurès, J.M., 2011. *Climate change, water and food security*. Rome, Italy: Food and Agriculture Organization of the United Nations.

39. World Health Organization, 2008. Guidelines for Drinking-water Quality [electronic resource]: incorporating 1st and 2nd addenda, Vol. 1, Recommendations.

40. Khan, S., Shahnaz, M., Jehan, N., Rehman, S., Shah, M.T. and Din, I., 2013. Drinking water quality and human health risk in Charsadda district, Pakistan. *Journal of cleaner production*, *60,* pp.93-101.

41. Mass, E.V., 1990. Crops salt tolerance, Agriculture Salinity Assessment and Managment. In *American Society Civil Engineers* (pp. 262-334).

42. Bhat, S.U., Pandit, A.K. and Mahathir, R., 2010.Limnological investigation of three freshwater springs of Pulwama district-Kashmir valley. *Recent Research in Science and Technology*, *2*(2).

43. Thompson, M., Ellison, S.L.R., and Wood, R., "Harmonized guidelines for single-laboratory validation of methods of analysis," *Pure Appl. Chem*., 74, 835–855, 2002 ochmindrvattenanläggningar. ISBN 9185482730.

44. Lindesberg.Bauder, T.A., Waskom, R.M., Davis J.G., (2009). Irrigation Water Quality Criteria.http://www.ext.colostate.edu/PUBS/crops/00506/.html(2 April, 2012

45. Wetzel R. G.anLikens G. E.,(2001)."Limnological Analysis," 3rEdition, Springer, New Delhi, 20

46. US EPA Ris, C., 2007 health assessment for diesel engine exhaust: a review. *Inhalation Toxicology*, **19**(**1**), pp. 229-2Rhoades, J. D., Kandiah, A. &Mashali, A. M. 1992 The

use of saline waters for crop production. Irrigation and drainage, 133 pp. Paper 28. Rome:

47. Food and Agriculture Organization .Ritchie, J. T. 1972 Model for predicting evaporation from a row crop with incomplete cover Water ResourRes 8,1204±121

48. Chapman, D. (1996). *Water quality assessments - A guide to use of biota, sediments and water in environmental monitoring*. 2nd ed. UNESCO/WHO/UNEP by E&FN Spon. London.

49. Will,,Elizabeth and James Faust,1999,irrigation water qulity for green house production,University of Tennessee.