

Hydrogeology and Hydrochemistry of Shaqlawa Area, Erbil Governorate - Northern Iraq

PhD Research Proposal by

Shwan Omar Ismail

Assistant Lecturer at Department of Soil and Water

MSc in Geology Science (Hydrogeology)

Manager of GIS Unit - Salahaddin University/Erbil

Date of Birth: March 01, 1975

Iraqi Citizenship

Telephone: +964 750 4487884

Email: shwanom2003@yahoo.com

Address: Hamreen Qr. 415, Alley 19, House no. 2, Erbil, Iraq

Table of Contents

Table of Contents	2
Introduction	3
Objectives	3
Location and Morphology.....	3
Hydrology	5
Geology	5
Methodology	7
Software Application	9
Bibliography	9
Timetable	9

Introduction

The increase of inhabitation and the establishment of agricultural and industrial projects, the groundwater utilization became more important for Erbil plain. In addition, the drought climatic condition has affected the amount of the recharged water to the aquifers of the basin, which in term shows a risk in exploitation of groundwater by its present quantities.

The largest available source of fresh water lies underground. The main recharge source of groundwater is precipitation. A portion of rain falling on the earth's surface infiltrates into ground, travels down and when checked by impervious layer to travel further down, forms groundwater.

The study of chemical characteristics of groundwater is very important for municipal, commercial, industrial, agriculture, and drinking water supplies. Development provides opportunities for pollution of groundwater and consideration must be given to the protection of quality.

The chemical composition of water is based primarily on the minerals which have dissolved in it. In addition, the chemical composition of water is modified by ion-exchange equilibrium. There are some environmental conditions affecting on the water chemistry such as type of rock, climate, relief, vegetation and time.

Objectives

The main aims of this PhD Thesis are to:

- 1- Determine the water surplus and water deficit of the sub-basin and related parameters such as runoff, recharge and other parameters of water balance.
- 2- Studying hydromorphometric analysis and its effect on hydrogeological conditions on the area.
- 3- Studying the groundwater fluctuation of some wells in the study area.
- 4- Evaluating the type, extent, and potentiality of the aquifers.
- 5- Studying groundwater quality of Shaqlawa area including physical and chemical properties, water type, hypothetical salts, origin of water and hydrochemical indicators.
- 6- Determine the optimum policy to develop and investment of groundwater resources in the area.

Location and Geomorphology:

The area located about 60 km NE of Erbil and is bounded several mountains. The elevation ranges from 700-1500 m above sea level. Shaqlawa basin lies within the high folded zone according to Buday and Jassim (1987), Safin anticline border the sites from south and Mirawa anticline from north, Safin anticline is large asymmetrical, double plunging anticline (Figure 1). Pliocene and Quaternary deposit iron flat Questa-Hogback, ride, cliff and badland are the most dominant geomorphological erosion features, which mainly control by structural and lithological properties, parallel type of drainage pattern are very common.

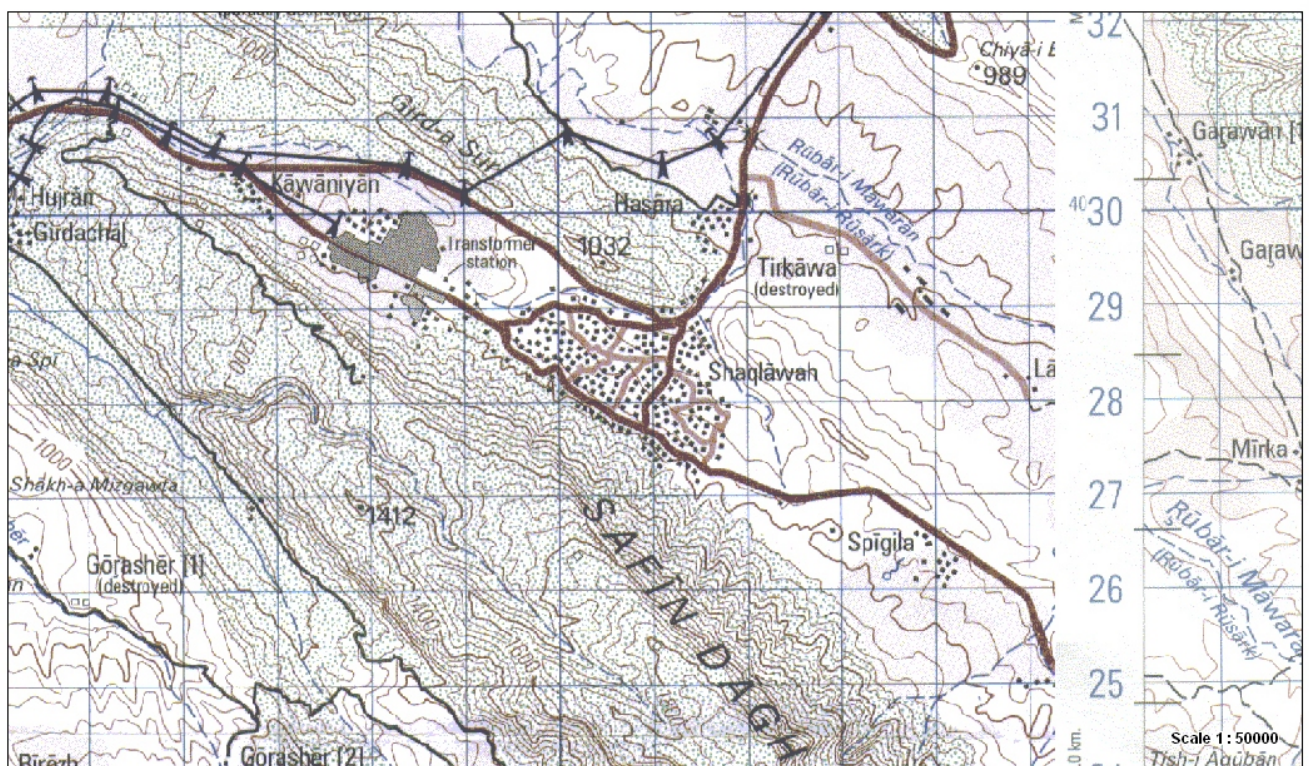


Figure 1: Topographic Map of the Study area

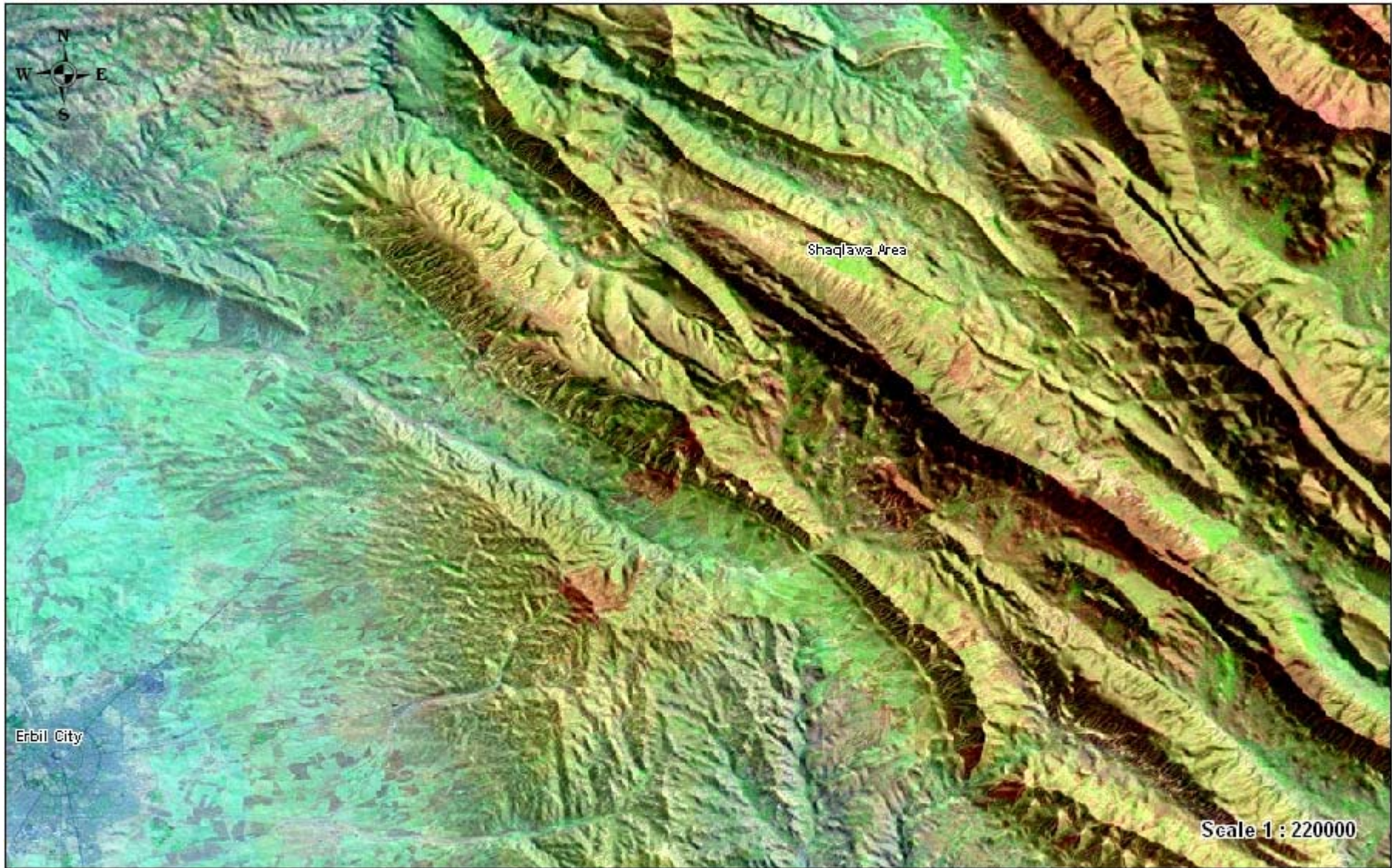


Figure 2: Satellite Image of the Study area

Hydrology

The main hydrogeological characteristics are resembled by annual precipitation range between 800-1000 mm/year, many springs are flowing in studied area, these springs are flow from Aqra-Bekhe and Pila Spi Formations. The main source for these springs are related to aquifers fissured, fissured-karstified rocks.

Geology

The following formations are exposed in the studied area:

1- Aqra-Bekhme Formation (Campanian-Maastrichtian)

This formation exposed at the body of Safin anticline core, its characterized by reefal limestone, fore-reef, shoal limestone and associated facies.

The formation consist mainly of limestone and dolomite beds at lower part, the limestone are grey and grayish brown in color, hard to very hard, well bedded to massive, the thickness of massive limestone exceed 30 m the middle part of the formation, but the thickness of layer in well bedded limestone are range from (0.5-1.5 m).

The dolomite is light yellowish brown and grayish brown color, very hard, very fine grained and rarely medium to coarse grain. The depositional environment of Aqra-Bekhme formation is shallow tropical marine reefal and fore reef.

2- Shiranish Formation (Maastrichtian)

This formation exposed at the foot of the Safin mountain around the area, the formation consist of two part, the lower is limestone frequently marly or clayey, with gray color and well bedded. This limestone is partly fossiliferous, while other are micritic. Some joints and fractures are commonly seen, sometime filled by clayey or calcareous materials.

The upper part is composed of blue, gray marl and shale of papery structure. Their lithotypes are rather soft, thus the upper part shows more weathering than the lower part.

The thickness of the formation is about 100 m, the lower contact with Aqra-Bekhme Formation is conformable, at field the contact defined by the first appearance of white limestone of Shiranish Formation.

3- Tanjero Formation (Late Maastrichtian)

The formation exposed at the trough of the syncline, the formation consist of clastic which dominate dark yellowish green and olive green colors. Lithologically the formation is composed of sandstone, claystone, shale and conglomerate, the sandstone that the main constituent is either in form of beds or large concretion ball within claystone and shale, the grain size of the sandstone is medium to coarse.

Conglomerate are as lenses consist of fine to coarse pebbles of silica carbonate. The contact of the formation with underlying formation is gradual and conformable.

4- Kolosh Formation (Paleocene-Early Eocene)

This formation exposed at NW and northern part of Shaqlawa, consist of clastic rocks which are dark gray to black in color, some rare brown or violet horizons also may occur. Lithologically the formation is composed of shale, claystone, sandstone and siltstone.

The shale and claystone are soft papery and fragmented, the mainly thick black or gray clayey soil. The sandstone are dark in color fairly hard to friable, medium to coarse grained. The contact with the underlying formation is unconformable (angular unconformity).

5- Khurmala Formation (Paleocene-Early Eocene)

Khormala Formation consist of limestone and marly limestone, the limestone in yellow colored, hard, partly dolomitized well bedded and lower part in some place are bituminouse, which gives the dark color to limestone, the thickness of individual bed ranges between (0.5-2 m) because they are overlain and underlain by soft materials the always form ridges, the thickness of the formation is about 25 m.

6- Gercus Formation (Middle Late Eocene)

The formation consist of red clastic rock, which are mainly of claystone, siltstone and sandstone, with a different layer of conglomerate at upper part. The main rock type of this formation is the claystone which is ridish brown, brown in color, soft and fragmentede to small chipses, occasionally the claystone is silty and very rarely sand grains could be seen.

The sandstone are less abundant than the claystone and occur at thin beds. The thickness of the formation is varies along Shaqlawa area, at Sork mountain is about 110 m.

7- Pila Spi Formation (Late Eocene)

The formation forms continuous high ridges with very common flat iron morphology, the formation consist mainly of limestone, which are crystalline, dolomitic and clayey or chalky, the color is white creamy, light gray and yellowish white, well bedded, the thickness of the individual bed ranges from less than 0.4 m to 1.5 m, hard to very hard occasionally the limestone is fossiliferous. Fossils are mainly Foraminifera and Gastropods. The thickness of the formation is about 90 m, the lower contact is unconformable with Gercus Formation.

Methodology

The study of natural and contaminated ground-water systems by PHAST program (simulates multi-component, reactive solute transport in three-dimensional saturated ground-water flow systems. PHAST is a versatile ground-water flow and transport simulator with capabilities to model a wide range of equilibrium and kinetic geochemical reactions), and simulating chemical reactions and transport processes in natural or polluted water by PHREEQC program (based on equilibrium chemistry of aqueous solutions interacting with minerals, gases, solid solutions,

exchangers, and sorption surfaces, but also includes the capability to model kinetic reactions with rate equations that are completely user-specified in the form of Basic statements).

Groundwater samples will be taken from drilled wells for detailed chemical analysis in two periods, the minimum recharge period (drought) and maximum recharge period. In some wells more than one sample will be taken for determination of accuracy of the analyzed data. Bartram and Balance (1996).

The temperature, electric conductivity, and pH of the water samples will be record at the site by the pH meter, Ec meter, and thermometer instruments. The coordination of the wells will be record by GPS instrument.

Determination the Infiltration rate of different lithology in the study area by using the double ring method. The boundaries between the formations will be indicate in the study area by studying the lithological properties and the sedimentary environments to find out the geological setting of study area.

All data from field and laboratory processes to create tabular and graphics data such as geological data, GPS data drawing map, simulation laboratory data on graph, drawing relationships between different parameter to determine the origin of water, hydrogeochemical formula, statical analysis to determine accuracy of the chemical analysis. Preparation the Hydrological data of the wells and projected on the map. Employed some specialized software such as GIS (Arc GIS, Arc info, Arc catalog), MapInfo, Aquifer Test, SPSS, Graph Ground water, AutoCAD, Surfer and Grapher.

Software Application

- 1- GIS and Remote Sensing: in hydrogeological modeling (predicts water levels in rivers/lakes, rain water runoff, ground water availability and better manage water levels) by using high resolution satellite images of the study area.
- 2- Modflow program
- 3- Aquifer Test program
- 4- AutoCAD program

Bibliography

- Bartram, J., and Balance, R., 1996. Water Quality Monitoring. UNEP and WHOE and FN Spon. London, UK.371p.
- Buday, T. Jassim, S. Z., 1987. The Regional Geology of Iraq (Stratigraphy and Paleogeography). Vol. 2, 352 P.

Timetable

The scheduled time for the proposed PhD research is 3 years.