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GEOGRAPHIES OF AQUACULTURE PROJECTS AND RURAL DEVELOPMENT IN ERBIL GOVERNORATE, IRAQI KURDISTAN

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Анотація

Основна мета цього дослідження – зрозуміти вплив реалізації проектів аквакультури на розвиток сільських територій у провінції Ербіль, Іракський Курдистан. Для досягнення цієї мети охарактеризовано загальні особливості провінції Ербіль, її природне середовище, а також виявлено просторові відмінності у поширенні проектів аквакультури та рибальства у провінції Ербіль в розрізі районів.

Роботу виконано англійською мовою. Анотації наприкінці наведено англійською та курдською мовами.

Дане дослідження включає вступ, чотири розділи, висновки та рекомендації. Розділи магістерської роботи присвячено таким питанням.

Перший розділ містить огляд фахової літератури, зокрема розкриття сутності географії аквакультури, концепту розвитку та поняття розвитку сільської місцевості, у тому числі у зв'язку з розвитком проектів аквакультури.

Другий розділ присвячено оцінці природних та людських ресурсів провінції Ербіль, зокрема, розглядаються географічне положення досліджуваної території, забезпеченість різними складовими природних ресурсів та потенціал людських ресурсів з точки зору розвитку проектів аквакультури.

Третій розділ присвячено просторовому аналізу поширення проектів аквакультури та рибальства у провінції Ербіль, зокрема охарактеризовано географічний розподіл проектів аквакультури у розрізі районів, а також особливості та форми реалізації цих проектів.

Четвертий розділ містить аналіз даних, зібраних в процесі інтерв'ювання місцевих фермерів та оброблених за допомогою програми SPSS з метою оцінки культурних та економічних наслідків реалізації проектів аквакультури у сільській місцевості провінції Ербіль.

Дослідження завершується висновками та рекомендаціями.

CONTENTS

INTRODUCTION

Aquaculture is one of the most important agricultural activities. Due to rapid population growth and increasing demands on animal portions worldwide, the aquaculture gains an important role in supplying these demands and in national food security. Aquaculture projects attract the attention of inhabitants of rural areas. The same condition could be applied in Erbil governorate rural areas. In addition to that, because of geographic condition of the area and because of lacking sea access, aquaculture becomes an important economic opportunity for rural areas of Erbil governorate. Moreover, the aquaculture products are relatively cheaper than red meat, and the aquaculture project is developing very fast in the area under study. The fishery projects in this area does not have a very far historical roots, it emerged in the second half of 20th century and grows in the beginning in this century due to the availability of water resources and increasing demands of aquaculture products. In addition to availability of water resources, the climate, raining seasons, and human resources, are crucial elements that aid the growth of this industry. This study provides a characteristic of Erbil governorate area which is employed for aquaculture projects, the influence of these projects on enhancing the quality of rural developments plans, and the peculiarities and features of the area that might potentially help in growth of this industry. The economic and cultural aspects of aquaculture projects will also be visited. Moreover, the main obstacles in front of the growth of these projects in Erbil governorate will be discussed.

Research questions. Aquaculture and the area under study are two board topics, therefore, the current research is restricted to answering following questions:

- Economically, can aquaculture help rural development plans?
- Culturally, can aquaculture help rural development plans?

Hypothesis. The research is argue following points:

- Erbil governorate has characteristics required for aquaculture projects.
- The characteristics required for aquaculture projects differ from one district to another.
- Aquaculture projects can help developing rural areas economically.
- Aquaculture projects can help developing rural areas culturally.

The aims of the research:

- to illustrate the importance of aquaculture projects in developing rural areas economically and culturally;
- to assess the resources required for established aquaculture projects in Erbil governorate;
- to consider the features of conducting aquaculture projects in Erbil governorate;
- to discuss the obstacles and the problems which farmers face with aquaculture projects in studied area.

Current research (Geographies of aquaculture projects and rural development in Erbil governorate, Iraqi Kurdistan) is important for following reasons:

- Erbil governorate is important for Iraq and Kurdistan region;
- the importance of aquaculture projects on global and local levels and their impact on local villagers;
- the lack of any systematic study of the questions and aspects mention earlier;
- the author of the research is enthusiastic about aquaculture, agriculture and development in general.

Methodology. The current research adopts quantitative and qualitative approaches to address the question raised by the research. In addition to that, the research benefits from the site survey to enhance its arguments. The maps and illustrations by different governmental bodies are also used for analytic purposes. Moreover, site surveys are also used for understanding the situation of villagers who are running aquaculture projects.

The structure of the current research is consist of an introduction, four chapters, and conclusions and recommendation, in addition to translated of abstract in Kurdish and Arabic. The first chapter consists of three sections which are dedicated to introduce the research topic, defining aquaculture projects, developments and rural development. While the second chapter is dedicated to showing the characteristics of the resources of Erbil governorate, and its possible impact on aquaculture projects, in particular following aspects of Erbil governorate will be visited: land, relief, climate, water resources, and population. Chapter three is dedicated to illustrating general characteristics of aquaculture projects in Erbil governorate and their locations and analysis of the results of site survey conducted for the sake of this research. Moreover, in chapter four, impact of Aquaculture on rural development in Erbil governorate , enhanced by analysis of site survey. Then the research is concluded by conclusions and the list of recommendation based on the finding of the research.

Research problems. Conducting this research was challenging; scarcity of sufficient and relevant data was one of the challenges the research had to deal with, the quality of available data was not accurate and lacked the important details, in addition to that, researcher faced difficulty in conducting a survey because of lack of local people and governmental bodies cooperation. Another unprecedented issue that the research had to deal with was the outbreak of COVID 19, caused government announcement of curfew, and it was impossible to make required site visits.

CHAPTER ONE
INTRODUCING RESEARCH TOPIC:
AQUACULTURE AND RURAL DEVELOPMENT

The purpose of this introductory section is to delve into the subject of the study, which consists of three sections which include geography of aquaculture, concept of development, and rural development and aquaculture projects.

1.1. Geography of Aquaculture

Aquaculture is inclusive and very important human practice worldwide. In order to reach a comprehensive and apprehended definition, a review of definitions will be cited as below:

FAO organization: Aquaculture is the farming of aquatic organisms, including fish, Molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated (FAO, 1998).

NOAA: Aquaculture is the breeding, rearing, and harvesting of fish, shellfish, algae, and other organisms in all types of water environments (NOAA, 2011).

Aquaculture is the farming of freshwater and marine organisms, the culture or husbandry of aquatic animals or plants by private industry for commercial purposes or by public agencies for augmenting natural stocks (World aquaculture, 2017).

OECD: Aquaculture production is defined as the cultivated fish and crustaceans taken from marine and inland waters and sea tanks. Aquaculture is seen as playing a key role in many emerging economies, by virtue of its potential to contribute to

increased food production while helping reduce pressure on fish resources (OCED, 2010).

Economic Geography of Aquaculture: Aquaculture is defined as the farming of aquatic organisms for the purpose of food under controlled conditions, either in inland freshwater bodies or offshore saltwater bodies (Bardach & Ryther, 1972).

According to definitions above, we can argue that aquaculture is a new form of fishing and farming by cultivating freshwater and salty water under controlled conditions, or stages that involve breeding fish and plantation for maintaining the demands of human consumption. Aquaculture plays a vital role in the economy and supply chain in many countries.

The history of aquaculture is debatable. Some scholars believe that aquaculture as a way to cultivate fishing and plantations go back as far as ancient Egyptian 2500 BC, new evidences also confirm that around 2000 BC, aquaculture was popular in China for cultivating Chinese carb fish, in addition to that aquaculture was popular form of farming in central east Asia in countries such as Malaysia, Indonesia, Taiwan, Thailand, Vietnam (Arabic organization, 1997). In Europe, historical records show that during Roma empire, aquaculture was popular in and it was common practice of fishing for centuries, it was particularly vital in fishery during the middle centuries. When the demand of salmon rises in Europe, Aquaculture plays a crucial role in breeding this fish in European farms (Arabic organization, 1997)

On the other hand, aquaculture is also very popular in the North America continent. In the Northern sphere aquaculture is mainly used to cultivate salmon fish. After the Second World War, due to rapid growth of population aquaculture was introduced to large areas in the South American continent and in the Middle East to sustain huge demand on livestock protein and food. Therefore the techniques of aquaculture were developed to grow the cultivation. Concerning aquaculture adoption in Iraq, in 1955 several aquaculture farms were established to cultivate carb fish and cyprinids. he value for Aquaculture production (metric tons) in Iraq was 28,835.00 as

of 2016. As the graph below shows, over the past 56 years this indicator reached a maximum value of 28,835.00 in 2016 and a minimum value of 0.00 in 1960 (Fig. 1.1).

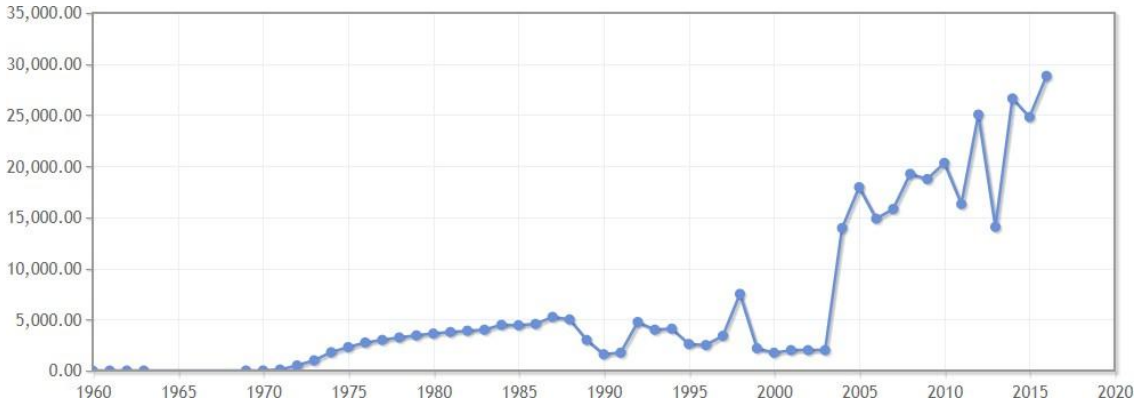

Fig. 1.1. Fish production growth in Iraq in 2006-2016 (metric tons)

Source: FAO, 2017. Total fisheries production in Iraq.

There are three main methods of fishery;

1. Soil (Pond) fishery: this fishery method is popular in areas close to rivers or places where plenty underground water is available. Basically, this method involves creating a pond of a ditch with a water escape that is maintained, filling it with water and certain types of fish, usually crab or salmon, and breeding them. This method is cheap and the product is highly harvested (Rahim et al., 2013).

2. Cage Fishery: this method of fishery involves creating metal cages and placing them in seas and open waters where the fishes inside the cage are protected from escaping while they can feed on riches of open waters. As it is a low cost and highly profitable industry, this type of fishery plays a very crucial role in gross domestic products . (Rahim et al., 2013).

3. Coastal fishponds: this method is used in coastal sites where a large net is used to captivate the fish while they roam the space between net and coast and constantly feed. The method is also relatively cheap and productive (Rahim et al., 2013).

Fishery is a worldwide industry. It sustains the supply chains and highly demands on animal protein. On the other hand, it highly contributes to gross domestic products. While aquaculture helps to maintain fishery, it can also help in breeding decorative and rare fishes. Due to rapid growth of world population, the methods of fishery are under scrutiny to help it to reach a level in which they can sustain the global demand of fish. Finishing wild fishes in open seas proves that cannot provide enough supply to meet the increasing demand of fish, therefore and as a result, human controlled fishery is an urgent necessity.

1.2. Concept of Development

Development is a post Second World War term. During previous centuries, many terms have been used to refer development conditions, such as “material progress”, “economic progress”, “modernization” and “industrialization” (Tryzna, 1995). Until the 1960s, development was used to refer the gross domestic products that contributed to enhancing national economic power and development of infrastructure of newly emerging nations (al-Dulaimi & Musa, 2009). The main aim of development is to provide basic and necessary services and products for citizens and raise their income by employing national resources and treasure in a way that creates equal opportunity without discrimination. In the 1970s, development acquired a more inclusive meaning, it refers to all aspects in certain geographical area, such as education quality, quality of medical services, quality of infrastructure, national economic growth and other economic, political and sociological aspects, but not only gross domestic products (Brown, 1988). As a result, development becomes a measurement to classifying the world countries into:

1. Developing Countries: these countries were newly gained their independence and relatively under development.

2. Developed countries: these countries were well developed and lived in prosperous lifestyle (Ghoneim & Zant, 2007)

Politically and economically the term “development” sparks endless debates. Each scholar defines it in his or her own perspective. In addition, the goal or aim of development highly determines the way we define this term. If an institution is concerned with sociological, economic, political or infrastructural goals of development, it would reflect the way they define development. Therefore, there are countless ways of defining development. Below a short review of the way this term is defined by different bodies is presented (Romano, 2004).

The International Bank defines development as follows: Development in any given country is measured as enhancing the quality of life in certain geographical area, by enhancing quality of life; it refers to reforming economic, cultural, health, environmental, political and sociological sectors, and to paving the way to creating job opportunities and freedom of speech as well (World Bank, 2019).

Kleeman, on the other hand, asserts that development targets fighting poverty. Moreover, he suggests that development could be carried out in different aspects of governance. Therefore, both public and private sectors established could be developed according to necessities (Kieeman, 2000)

Al-Naqshbandi is another scholar who discussed this phenomenon. He thinks that development in any form or sector indicates a change. It is a pre-planned agenda that targets reforming or restructuring an aspect of multi-aspect of a body or institution. Development involves many stages, such as analyzing the data, planning, discussing the implementation of the planning, observation and assessing the data of achievements. He also believes that in order to stop wasting energy and resources all aspects of the development plans must go under strict scrutiny. Al-Naqshbandi also asserts that the main aim of development is to achieve maximum possible reformation and enhancing the quality of the services and products necessary for human life (Al-Naqshbandi, 2004).

Salim suggests that development involves all and any steps and procedures that are carried out to reform in any sector for certain goals. He also asserts that development is modernization of different aspects of a nation or a country. It is concerned with development of economical, administrative, political and sociological aspects respectively that help the manpower of that nation to renew and establish their activities on modern and sufficient bases. Therefore, he stresses that development is a self-realizing act and it is a goal itself (Salim, 1978).

Al-Mtulosi is another scholar who studied development aspects. In "Geography dictionary" he defines development as a radical process that builds up modern infrastructures, modernizing and upgrading economical, sociological and cultural aspects that are caused by reforming economical reformation (Al-Mtulosi, 2004)

In another definition, he stresses that development aims at creating economic opportunities (Ausald, 1997)

Ibrahim thinks that development is a long circle between people and public space, an inclusive and radical process or chain of processes that aims at developing and enforcing many aspect of well-being of life of citizens. It involves many phases, but the results of final phase leads to perfection of citizens' lifestyle. He thinks that development is pre-planned and discusses a roadmap that targets many sectors such as economical, political, sociological and cultural and ultimately aims at developing communities (Ibrahim, 2009).

He also believes that development targets increasing the annual income of individuals in addition to generating enough job opportunities that leads to keeping unemployment low rates. Despite the fact that development is mainly concerned with internal sectors in certain country, but, he stresses that it is not immune from global circumstances and crises (Ibrahim, 2009).

Al-Mowmin is another scholar who investigates development who argues that development is a dynamic, flexible and inclusive roadmap that aims at eliminating all

financial and cultural obstacles in front of progress and globalization. He points the main goals of developments;

1) economic growth;
2) social growth;
3) elimination of poverty (Al-Mowmin,1991).

Moreover, he believes that all sorts of developments explicitly target to raise the annual income of citizens and to familiarize technological equipment and devices to the country and its inhabitants. Achieving these targets will help in building up a skillful labor and industrial ground for any potential future project.

Othman: also evaluates development term. She argues that development is a pre-planned agenda aimed at reforming countries vital sectors such as economy, cultural, sociological, political and scientific sectors; and the duration of the implementation of the development plan is relatively short (Othman, 2013).

Fisher argues that development is a set of plans that aim at reforming political, sociological structures for enhancing citizens' lifestyle (Fisher, 1995).

Al Dlimi and Mousa assert that there three basic components of development without which no result will be achieved:

1. The capacity of the state to provide a high quality education, provide enough residential units for citizens and supply their basic needs, such as cloth, food, etc.
2. Political independence, which means that no political unit can perform any sort of the development if they are politically under supervision of another power, in other words, any state or people who desire to perform any development, first, need to be politically and economically independent.
3. Providing election rights, freedom of speech, eliminating corruption and poverty (al-Dulaimi & Musa, 2009).

According to the survey of the way development term is defined, we can argue that development is a term that refers to a set of plans that aim at reforming and

developing certain sectors, such as economic, political, cultural, in certain regions or states in the long term. The plan is carried out by employing the human resources to achieve pre-planned goals.

1.3. Rural development and aquaculture projects

Rural development is considered one of the most important aspects of nation-building and domestic growth planning. Rural areas are territories where small human colonies are living, the main occupation in such areas are agricultural and livestock projects. The annual income of such places is relatively lower and population density is less that in urban areas. What distinguishes rural sites is the fact the cultural and heritage values remain intact for a very long time (Fadel, 2011).

Recently the term rural or village has been used extensively in researches that aim to address issues that are related to 'brain migration' and migration of villagers to urban sites. The massive wave of villagers' migration to cities pushes governments and researchers alike to question the motivation behind such massive and rapid migration waves. In order to understand the scope of the issue and rural development aspects a short review of definitions is provided below.

IFAD: Rural development is the process of improving the opportunities and well-being of rural population; the process of change in the characteristics of rural societies. In addition to agricultural development it involves human development and social and environment objectives as opposed to just economic ones. Therefore rural development encompasses health, education and other social services. It also uses a multi-sectoral approach for promoting agriculture, mining, tourism, recreation and niche manufacturing. (IFAD, 2016)

World Bank: Rural development is a strategy designed to improve the economic and social life of a specific group of people – the rural poor. It involves

extending the benefits of development to the poorest among those who seek a livelihood in the rural areas (World Bank, 2010).

Malcolm: Rural development is the process of improving the quality of life and economic well-being of people living in rural areas, often relatively isolated and sparsely populated areas (Malcolm, 2003).

Madu: Rural development is the improvement of the spatial and socioeconomic environment of rural space which leads to the enhancement of the individual's ability to care for and sustain his/her well-being. (Madu, 2003)

According to definitions above we can conclude that rural development is a comprehensive and inclusive process of developing rural areas to help to increase the annual income of the local inhabitants through using natural and human resources and put an end to the exploitation of resources. Because the rural areas are the 'food baskets' of countries, the government pays serious attention to keeping people operating in these areas and protecting their habitat. The rural development plans are strategic plan that involves the main pillars:

- proper use and employment of the natural resources of rural areas;
- enabling inhabitants of rural areas to get benefits from the landscape that they are working on and live in;
- employing the skills of inhabitants of rural areas in developing the country;
- implementation of non-central legislation and decision making (Ahmed & Heiba, 2015).

Muhamd Jawhar in his research titled "Training need of fish farmers in Erbil governorate and it relationship some variables" (2013) illustrates the importance of fishery projects and the relationship between these projects and some related changes in local community. To achieve this goal, he adopts different measurements and approaches and also conducts a site survey to understand the needs of the farmers (Jawhar, 2013).

Bahra raza Othman in the paper “Spatial variation of Agricultural development in the Governorate of Erbil Study in the geographical development” (2013) highlights the spatial variability of agricultural development in the governorate of Erbil depending on the agricultural developments standards and identifies the causal actors of the spatial variation of the agriculture development. Alongside with spatial variation he proposes to use other meaningful concepts, such as development, agricultural development, and sustainable agricultural development. He identified natural and human potentials for agricultural development in the study area. On the one hand, he emphasizes the role of different natural characteristics, such as terrain, climate, water resources, soil and natural vegetation, and underlines the indifference of human in the agricultural development in terms of population, technological capabilities, irrigation projects, transportation routes, and agricultural market policies, on the other hand (Othman, 2013)

Balsam Jameel behind and Salam niama Muhammad Ali “Fish wealth in Iraq, reality and future prospects” determine fish stocks in Iraq and eatimate the future of fish sector. They revealed the low level of the fishery production and rate of per capita consumption caused by the weakness of investment, lack of the government support, a significant decline in the quantities of water, the high proportion of salinity and water pollution, the use of primitive fishing means and methods, weak legislation, and the policy of dumping markets imported products. Despite all of this constrains, this research has shown that investment opportunities in this sector is high because of the size of the market and the absorptive capacity, and the growth of per capita income and cultural changes as well (Behand &Ali, 2008).

Bushra Ramadan Yassin recently (“Rural Development Problems in Al-Zubair District in Basra Iraq”, 2018) explores the situation of rural development in Al-Zubair district and identifies the most important natural and human troubles that it faces. The results show that studied area suffer from the low level of services provided by the state, and local community needs such services as health care, education,

infrastructure, etc. Also this district lacks tourism and industrial development as well as surpassing the lands that are agrarian (Yassin 2018).

CHAPTER TWO
NATURAL AND HUMAN RESOURCES OF ERBIL GOVERNORATE

In this chapter natural and human resources of the Erbil governorate are presented. In particular, location, administrative division, size, geological features, climate, water resources, and the soil directly impacting on the aquaculture development in studied area will be discussed. At the same time, demographic characteristics of Erbil governorate will be considered.

2.1. Location factors

Erbil governorate is located at northwest of Iraq and it is located at the heart of Kurdistan. Erbil in north neighboring Turkey, while in northeast is neighboring Iran. Sulaymaniyah governorate in east is neighboring Erbil, while lower Zab river separates Erbil and Kirkuk governorate is at southeast of Erbil. In addition to that, Erbil governorate is neighboring Dohuk at northeast and north. While Ninawa governorate is located at southeast parts of Erbil governorate where the great Zab river separates two governorates as it is shown in map number one.(*Annual Statistical Abstract 1988* (1989). Erbil governorate, the area under study, is located at the center of Kurdistan region of Iraq and Ninawa governorate. Moreover, it is neighboring Turkey and Iran, therefore, Erbil governorate is connecting an international trade route between Iraq, Iran and Turkey, and the interconnected routes help to facilitate transportation of good between neighboring countries which positively affect the low cost production. Concerning the lat-long coordinates of Erbil governorate, it is located at north of latitude (35.30) and (37.17) and eastern parts of longitude (43.22) and (45.05), the province is located at south of the upper half of the Earth (Ali Zarari, 2013)

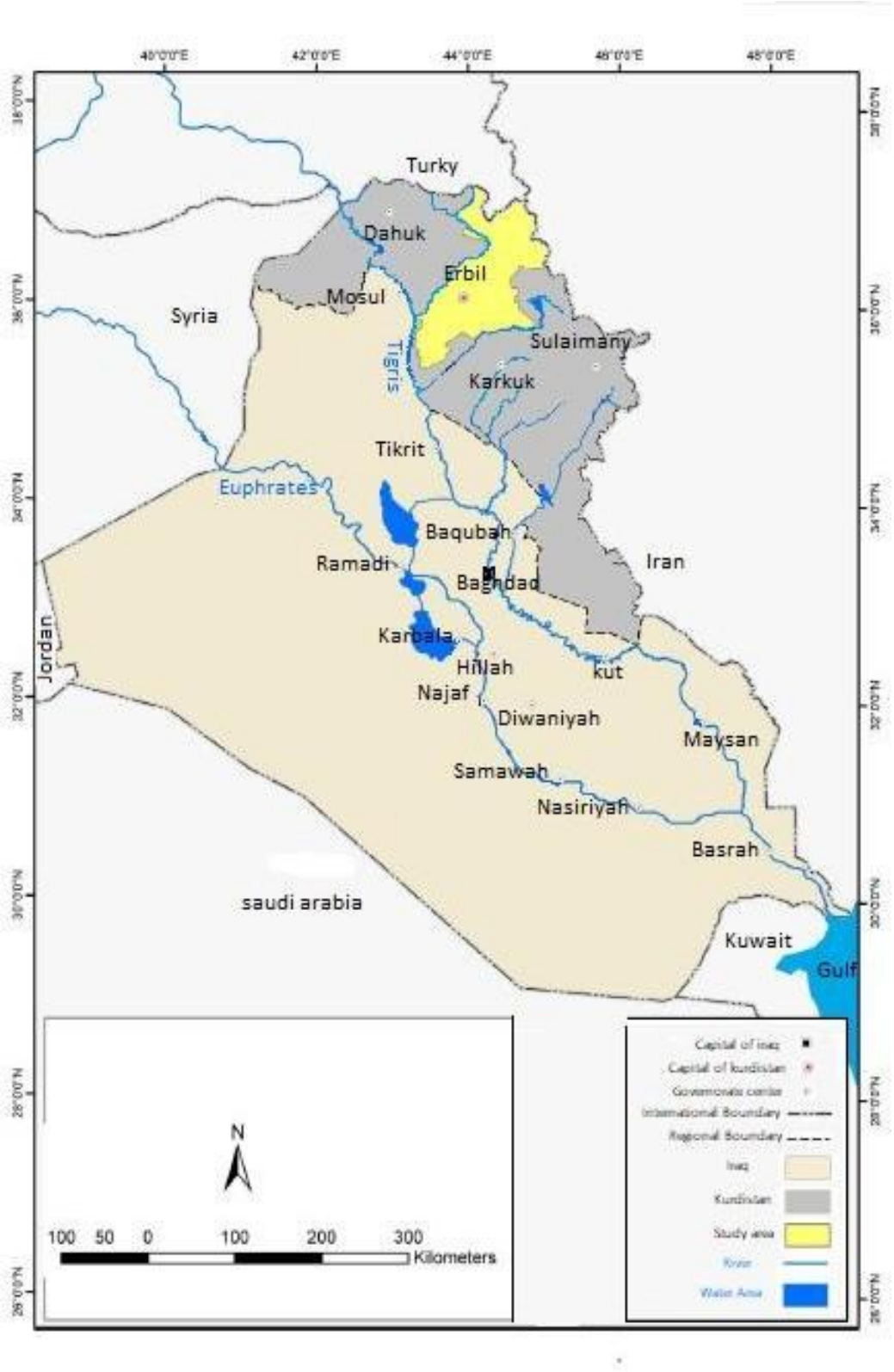

Fig. 2.1. Location of Erbil governorate in relation to Iraq and Kurdistan

The total area of Erbil governorate is 14,869 km^2, which is about of 17% of Iraqi Kurdistan region total area (which is estimated to be 87,317 km^2). Moreover, according to data of Iraqi Ministry of Planning, the area of Erbil governorate is about 3.4% of the total area of Iraq (which is 438,317 km^2) (Mohammad, 1998)

The area under study is divided into ten administrative unties: Central Erbil district, Erbil plains district, Koya district, Shqllawa district, Soran district, Khabat district, Rowandz district, Choman district, Maghmor district, Mirgasor district (Fig. 2.2). The area of land of administrative unites of Erbil governorate varies in space. The largest district is Maghmor with 2689 wm^2 and contributes to overall Erbil governorate by 18%. On the other hand, the smallest district of Erbil is Rowandz which area does not exceed 528 km^2 and contribute to Erbil total area by 3.5 % as it is shown in table 1.

Table 2.1. Variation of Erbil governorate districts by area

District	**Area, km^2**	**Area, Dunam***	**Share in total area of the Erbil governorate, %**
Central Erbil district	1131	452400	7.6
Rowandz district	528	211200	3.5
Koya district	2051	820400	13.8
Choman district	890	356000	5.8
Khabat district	695	278000	4.6
Erbil plains district	1307	522800	8.7
Soran district	2129	851600	14.3
Shqllawa district	1473	589200	9.9
Mirgasor district	1976	790400	13.3
Maghmor district	2689	1075600	18.0
Total	14869	5947600	100

Source: Ministry of Planning, Director of Regional Statistic Office, 2020.

The area is the main and vital element of any economical or industrial human activity, virtually, almost all sorts of economical, industrial and agricultural human

* A dunum of land area was used in the Ottoman Empire ,in Iraq :A dunum is equivalent to 2500 square meters.

activity depends on the availability of mass land. In the Erbil governorate, 43.6 % of this province's total area are suitable for agricultural and fishery industries. The data shows that 2,593,481 Dunam (equivalent to 2500 m) are suitable for agricultural and fishery activities.

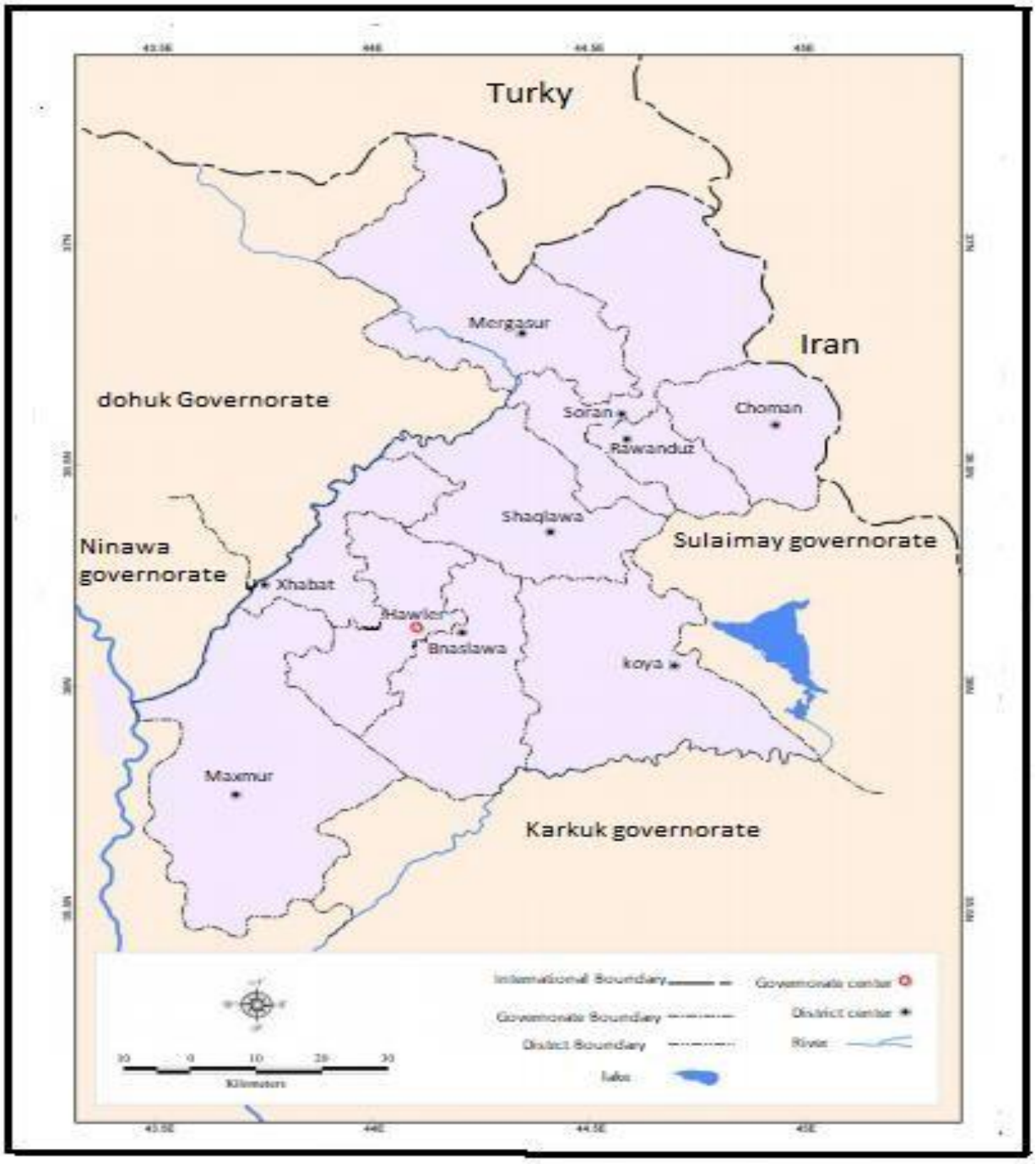

Fig. 2.2. Administrative division of Erbil governorate

2.2. Natural resources

Topography is a board term used to indicate the natural and physical formation of the land, the river, mountains, hills, valleys and plains are the main topics which are of concern of topography. Topography could be interpreted as the natural study of the land surface formation. The topography of any land is the result of long and historical geological elements and formations, including world tectonic plate movements, erosion, wind factor and rain force. In addition to that, the elevation of the land is considered as crucial natural elements that play important role in agricultural activities and breeding livestock (Al-Tamimi, 2002).

Erbil governorate elevation differs from a place to another; some parts of the province are very high and mountainous areas. The altitude and size of the mountains vary, as some mountains are extensive, rocky, and difficult to climb. However, several other peaks are relatively low and accessible. In addition to mountains places, there are several places which are hilly. Generally, as we move towards southwest from northeast, turns and climbing steep increases which makes harder to climb (Omer,1999). The lowest sea level reaches 200 m in Qaraj plains of Maghmor district. As we move towards south and southwest from north, the peaks and elevation will increase in interconnected, twisted and steeped mountains where the highest is reaching 2000 m above sea level, as the case in Halgurd crest which is 3607 m above sea level and located in Choman district. Between these peaks, several valleys are formed and they are mostly 1000 m above sea level (Othman, 2013). The different elevation rates are highly affecting the suitability of land for any agricultural activities.

The area under study is divided into three different zones according to their elevation levels, as follow (Fig. 2.3):

A. Unleveled-steep peaks areas: in this areas, there are different elevation steep degrees; they are mainly located at northern and

northeast parts of Erbil governorate. This area is roughly about 5,011.3 km^2, which contribute by 33.8 of the total province's area. The curved crests are very common in this area, such as in Zagros mountain range (Hamad, 2008). It is subordinate to administrative units such as Mirgasor district, Choman district, Rowandz district and Soran district. The elevation of the peaks of these mountain ranges are not leveled; different degree of steep could be located. Their elevation ranges between 2000-3600 meters above sea level, therefore, this area are not suitable for agricultural activities. However, between these peaks there are several plains and flat areas are formed due to erosion over time, such as Diyana, Barazgird, Balakaity valley, Khalifan(Allana) plains (Ahmad, 2003) this plains are highly inhibited by people and gradually many agricultural and fishery projects were established inhabitants of these plains.

B. Relatively leveled-steep peak areas: their area is 2185 km^2, which contribute to the total province area by 14.7 %. It was less affected by tectonic plate movements, therefore the elevation of their peak comparatively is lower as the elevation degrees ranges between 1000-2000 meter above sea level and they are mainly located at the northwest and southeast parts of the governorate and they are neighboring unleveled-steep peaks areas in the south (Khasabak, 1973). The peaks of this area are mainly formed out of the clay, therefore, seasonal raining and wind play very vital role in erosion and creating deep valleys and plains around this areas, as a result, many they generate serious obstacles when transportation routes are created in these areas, which ultimately negatively have impact on the growth of agricultural and fishery projects. The peaks of this area are Bani Harir peak (1343 m), Pirmam peak (1180 m), Safin peak (1975 m), Haibat Sultan peak (1260 m), Bawaji peak (1273 m), Awa Gird peak (1470 m), Bna Bawi peak (1320 m). Between these mountains several plains are formed, such as Harir, Smaquli, Mirawa, River bank plains (Saeed, 2008). The climate and geological formation of this area are suitable for fishery and agricultural projects; in addition to that, development of infrastructure project is cheaper in compare to the first area.

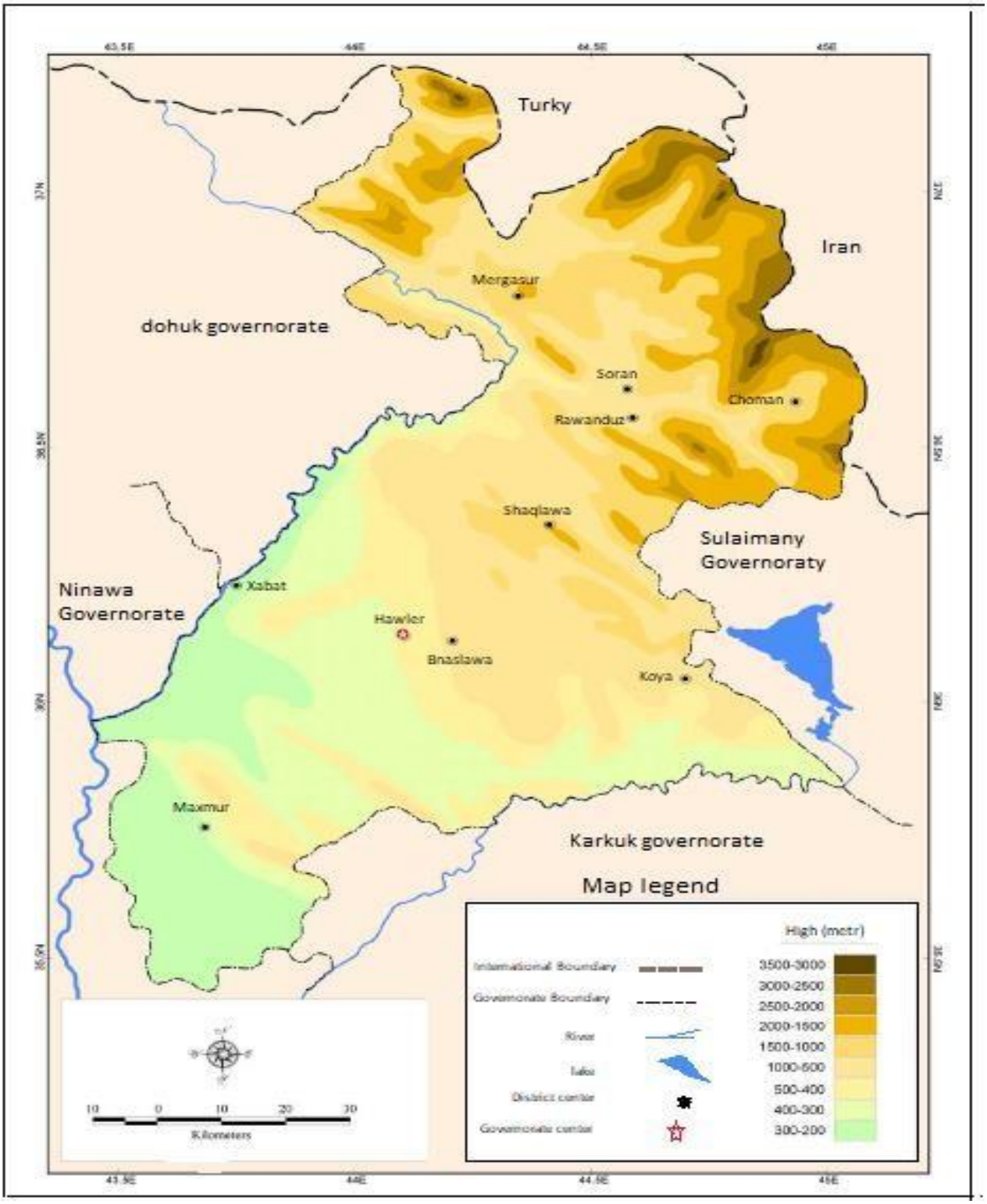

Fig. 2.3. Topographic map of Erbil governorate

C. Plain areas: the flat area in Erbil governorate. Majority of lands of these areas consists of flat area by 51.5 %, which totally is 7672.4 km^2. It is located at south and southwest parts of the governorate. If from the south of this area we move towards the northeast the elevation will increase. The dense of population in this area is higher than the other ones; the administrative units are Central district of Erbil, Erbil plain district, Koya district, Maghmor district and Khabat district (Haddad & Mahmoud, 2011). The average elevation of these areas is ranging from 200 to 500 m above the sea level. However, several mountains could be observed in this area, such as Zirga Zor and Qarachogh (821 m) in Maghmor district, Damir Dagh (510 m) in Khabat district. This area are mostly plain and in the east parts lower Zab flows, which are contributing to creation of highly cultivated plains, such as Koya, Gomspan, Kandinawa, Qaraj, Dibaga, Erbil plains (Kahraman, 2004). This area is considered as the most important areas in Erbil governorate economically, industrially and agriculturally. Because of its flat land surface, road construction is cheaper, and the availability of water resources help established agricultural projects and fishery, and it is easier to market the harvested products.

Climate is one of the natural elements that directly or indirectly effects on the human movements and activities. Climate may refer to one of the followings: temperature, sun light, erosion, precipitation,wind, and humidity, but this research is concerned with two important climate elements, temperature and precipitation, because they are vital in fishery development.

Precipitation – raining, snowing and hail – are all considered different precipitation forms. Each element affects the average water resources, both underground and surface. Hail is rare in the area under study. It occasionally happens in spring, and has little effect on the fishery industry. While raining and snowing are playing important role in the fishery.

Raining support different species on the land and plays vital role in surface formation and geomorphological aspects of the land (Ismail, 2005). The raining

average in the area mainly depends on the clouds that are coming from Mediterranean Sea. The season and the precipitation are highly depending on these clouds. The average raining varies across Erbil governorate. The raining precipitation is higher in the northern and northeast parts of the province. Moreover, it varies according to seasons, as it is shown in table 2.2. The average annual raining ranges between 260-730 ml which changes from a year to year depending on the arriving Mediterranean clouds. Some years because of lacking enough clouds which carry raining drops, the area suffers from drought. Comparatively, the annual raining in the north and northeast area is higher than in the south and southwest areas of the province. In addition to that, the season of raining in the north and northeast areas are longer than those of south and southwest area.

Table 2.2. The annual and monthly average raining in Erbil governorate in 2000-2019

Year	**Month**												**Annual average**
	Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
2000-2011	111.4	118	94.3	82.5	21.8	0.9	0.3	0.0	4.3	38.2	59.6	107.3	638.6
2012	56.1	31.5	72.1	14.5	26.8	0.0	0.0	0.0	0.2	23.4	45.9	95.9	366.4
2013	174	55.8	17.7	37.4	40.6	0.0	0.0	00	0.03	0.2	19.1	86.6	432
2014	74.9	8.2	93.4	14.7	2.5	0.0	0.0	1.0	0.0	68.7	69.2	56.0	389
2015	37.4	44.3	56.8	17.3	5.4	0.0	0.0	0.0	4.5	36.4	104.4	115.8	422
2016	45.6	33.0	103.5	46.4	6.4	2.5	0.0	0.0	0.0	0.03	22.3	116.1	376
2017	37.9	23.4	77.8	55.8	3.7	0.02	0.0	0.0	0.0	0.2	37.6	24.9	266
2018	44.0	164.4	8.0	77.9	74.6	1.7	0.0	0.0	0.0	42.3	132.9	188.0	733.6
2019	119.1	64.2	220.1	123.5	5.4	0.7	0.0	0.2	0.0	19.3	3.9	45.8	602.2

Source: General Directorate of Agriculture, Kurdistan Region of Iraq, unpublished data.

The temperature play an important role in fishery ponds in the area, because hot seasons helps fish to grow better. Farmers in hot seasons pour fingerlings into the ponds, while in cold seasons they extract fishes from ponds because the coldness is not helping the growth of the fishes (Shehadeh, 2009). The temperature of the area

varies across the months (table 2.3). In January the temperature rarely exceed 9°, while in July temperature degrees will exceed 34.9°, which shows that the dramatic rise of temperature between January and July by 25°. In addition to that, the temperature degrees varies across the governorate, as we move from southwest towards north and northeast parts of province the temperature degrees decline due to different geological formation of these areas and getting away from equator.

Table 2.3. Annual and monthly average temperature in Erbil governorate in 2000-2019

Year	Month												Annual average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
-2000 2011	5.9	7.6	11.5	16.9	23.1	29.3	32.9	32.4	27.9	21.8	13.1	8.1	19.2
2012	8.2	9.5	11.2	21.9	27.1	.332	35.9	.352	30.8	24.4	.172	6.0	21.2
2013	7.4	12.5	14.9	.204	25.3	31.4	34.3	34.5	28.8	23.2	17.4	9.6	21.6
2014	10.6	11.5	15.8	20.6	27.3	31.8	35	35.3	29.6	22.8	14.6	11.7	22.2
2015	9.5	11	14.2	19.2	27.4	31.5	.362	35.4	32.2	24.6	15.1	9.9	22.1
2016	7.9	.122	17.6	19.6	26.1	32.5	35.4	.362	29.5	24.5	15.6	8.7	22.1
2017	11.6	10.8	17.2	28.2	29.5	34.2	36.5	34.3	27.3	23.6	16.8	13.8	23.6
2018	10.6	12.4	18.3	20.2	25.8	31.8	35.4	34.5	31.8	25.7	15.9	11.5	22.8
2019	9.5	10.8	12.4	15.7	26.2	33.0	33.1	34.8	.302	25.4	16.6	12.2	21.6
Average	9	10.9	14.7	20.2	26.4	.321	34.9	34.7	30.3	24	15.8	10.1	21.8

Source: Kurdistan Region of Iraq, General Directorate of Agriculture, mass land of Erbil governorate, unpublished data

Water resources. Water is essential component of life, as God says ((Al-Quran Al-Karim)وجعلنا من الماء كل شيء حي), we have created every living thing from water. All agricultural human activities highly depend on water resources. The area under study is considered as a rich area with water resources. They come from three different sources: underground, surface and precipitation waters. Because the precipitation has been discussed previously, in this section the research concentrates on underground and surface water resources.

Surface water resources. All streams, rivers, ponds, and dams are contributing to surface water in the area under study. As it is mention, Erbil governorate is rich with these resources. The surface water resources vary annually and mainly determined by precipitation. If raining and snowing precipitation is relatively high, then the rivers flow harder and faster, but if the amount of raining and snowing decline, the area will suffer from drought. Additionally to two rivers and many streams, several dams have been built in the area.

The Great Zab is the largest river that flows across Erbil governorate. The source of the river is Van Lake which springs from Hakari mountainous area in Turkey and Urmia Lake in Iran. The length of the river is estimated to be 341 km. It flows at 341m^3/second, the overall watershed of the river is 26473 km^2, but the watershed in the area under study is around 9530 km^2 (Saeed, 2014)

The Lower Zab river crosses the southeast parts of Erbil governorate. It is one of the most important rivers in this province, and it establishes the governorate borders with Sulaymaniyah and Kirkuk governorates. The source of this river is springing from Lajan Mountains near Mahabad governorate in Iran and it immediately enters Iraqi. The annual average flow of this river is seven billion m^3. The river plays an important role in watering agricultural fields organized at the river banks (Saeed, 2014). In addition to that, dozens of pond fishery projects are established alongside the river bank.

The geological formations of the surface of Erbil governorate is suitable for creating dams which are play an important role in watering the farmlands and pond fishery projects. Because of the seasonal character of the raining, establishing dams are important for drought seasons. In Erbil governorate several dams were established, such as: Hamamok, Smaqoli, Digala, Bani Talaban, Jali, Razgadwin, Aqwyan dams. These dams are not large in scale, but they play important role in increasing water supply.

Underground water resources. Erbil governorate is rich with the underground water resources. People and government alike get benefit of these resources by digging wells to provide water demands. As we move from south towards north, the underground water resources increase. Generally Erbil governorate is divided into two zones in terms of water resources provision as follow (Talabani, 2003).

The first zone is *the mountain ponds:* which located at north and northeast of Erbil governorate at neighboring with Turkey and Iran areas till it reaches mountain ranges of Haibat Sultan, Bawaji, Bna bawi, Pirmam and Baba Jik peaks. These mountains are located at far south of this area. This area is about 8178 km^2 and it contributes to total area of Erbil governorate by 55 %. The quality of the water ponds in this area is rich and fresh (Omer, 2013). It could be used supplying the increasing water demands, and in some places these water resources spring naturally and create small streams. The richness and freshness of these water resources is in the outcome of heavy and long raining and snowing seasons. The main ponds are Banaman, Pirmam, Kori, Mawan, Houjran, Safin, Shaqllawa, Harir, Bradost (Omer, 2000).

The second zone is the vast plains ponds: which consists of 45 % of Erbil governorate (6691 km^2) (Omer, 2013). The quality and quantity of the underground water resources of this area are relatively different in compare with mountainous areas. Because of the raining seasons the underground water resources of the northern parts of this area extends its in southern parts. The main ponds located in this area are Koya, Ashti, Erbil, Dibaga, Maghmor plains ponds. The inhabitants of this zone rely heavily on the underground water resources for their daily activities. In some parts the quality of underground water is not suitable because of dissolve metals and salt. This frequently occurs in southern parts of the area, especially in Maghmor plains ponds.

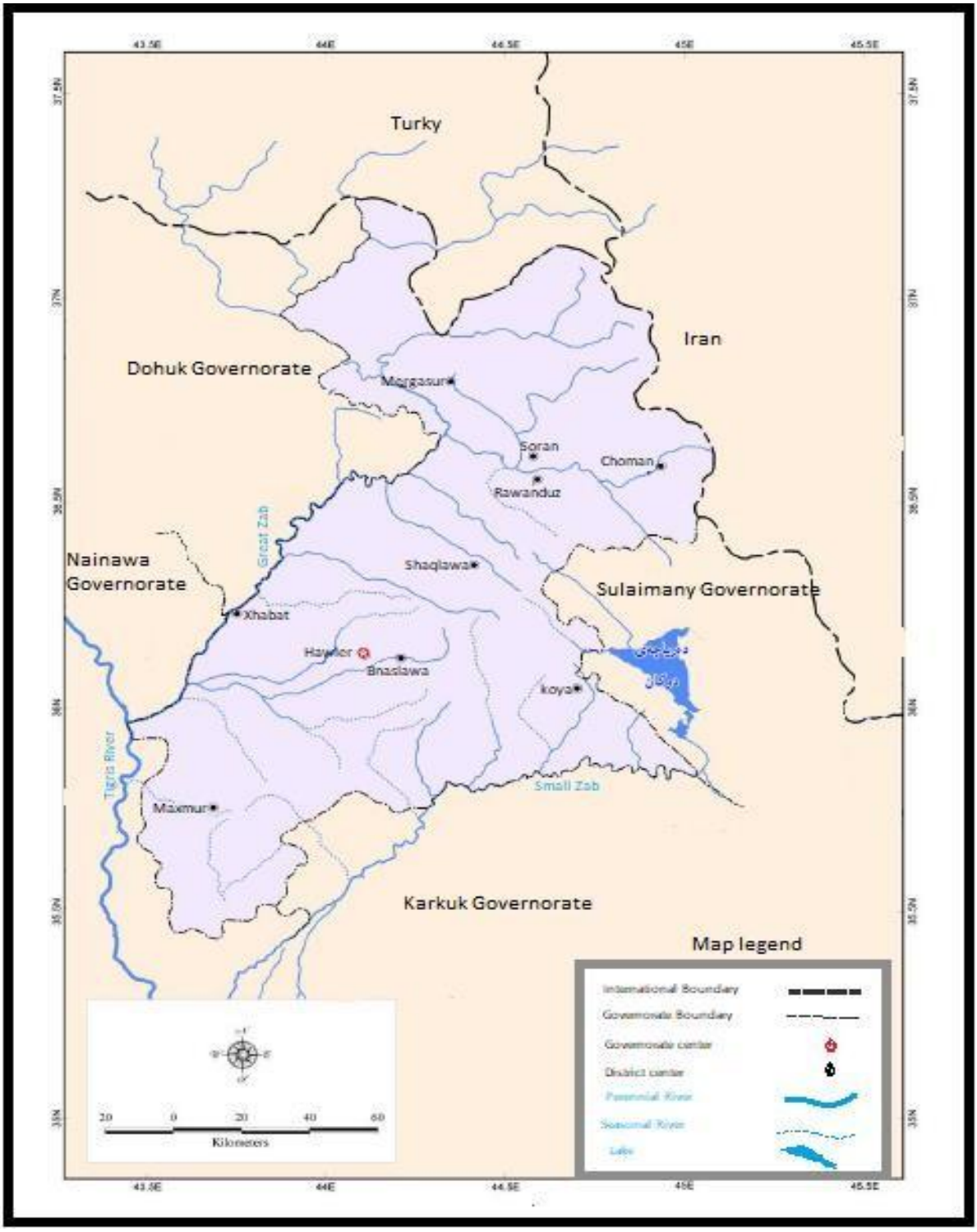

Fig. 2.4. Surface water distribution in Erbil governorate

2.3. Human resources

The human resources are considered as the first and foremost pillar of any civilizations; human can employ natural resources to produce products and market it and sell it to other humans. Therefore, the quantity of human resources plays a vital role in the growth of agricultural and fishery projects. In addition to taking care of safe transportation of harvest and stopping any potential disease that can negatively affect the agricultural projects (Hussein, 2003)As the inhabitants of any area increases, it will positively effect on the quantity and availability of labor which is an urgent necessity for any industry. In addition to that, the rapid growth of population helps the creation of a good market where harvest could be traded.

Concerning ***population dynamics*** in Erbil governorate, the statistics shown in table 2.4 shows that there is a rapid growth of population.

Table 2.4. Population dynamics in Erbil governorate in 1987-2018

Year	**Total population number**	**Urban**		**Rural**	
		number	**share, %**	**number**	**share, %**
1987	770439	596118	77.4	174321	22.6
2002	1220447	975342	79.9	245105	20.1
2009	1717286	1372404	79.9	344882	.201
2018	2162509	1632694	82.9	529815	17.1

Sources: Ministry of Planning of the Federal Republic of Iraq, Central Institution of Statistics (Table 14, p. 29); Director of Regional Statistic Office (the estimation of population number, unpublished data)

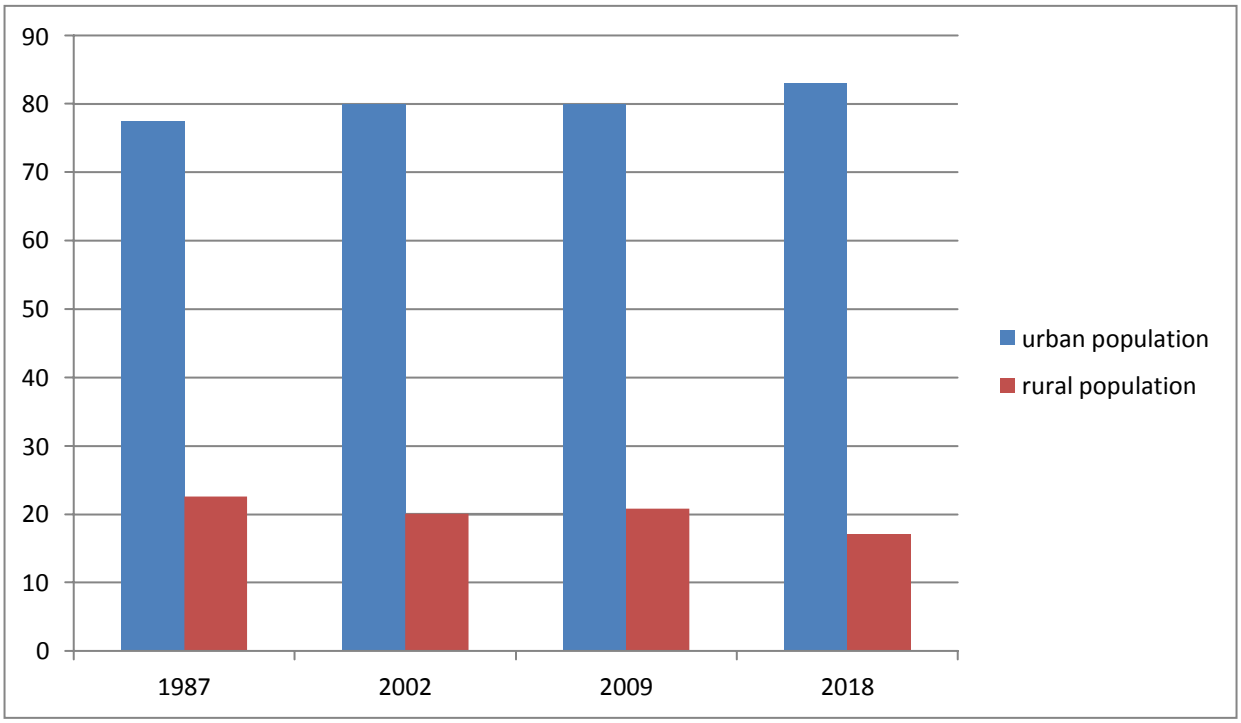

Fig. 2.5. Urbanization dynamics in Erbil governorate in 1987-2018

Source: Table 2.4

The table above shows that the population of Erbil governorate has changed drastically. The population number of the governorate in 1987 was consist of 770439 persons, while in 2018 it reaches 2162509 persons.

The number of rural population in Erbil governorate is increasing, as in 1987 it was 22.6 % of the total population of the governorate while 24% in 2018. This is result of government planning and development strategy. But the share of rural population in Erbil governorate is declining (Fig. 2.5). For example, 83 % of Maghmor district inhabitants are residing in rural areas, while the rural inhabitants of Central Erbil district is lowest as it is 8.8 % as it is shown in the Table 2.5 and Fig. 2.5.

Table 2.5. The population structure of the districts in Erbil governorate

District	Total population number	Urban		Rural	
		number	share, %	number	share, %
Central Erbil district (Hawler)	1001163	913060	91.2	88103	8.8
Rowandz district	26887	13793	51.3	13094	48.7
Koya district	118394	90689	76.6	27705	23.4
Choman district	33087	16344	49.4	16743	50.6
Khabat district	116712	84149	72.1	32563	27.9
Erbil plains district (Bnaslawa)	234141	197849	84.5	36292	15.5
Soran district	196895	152002	77.2	44893	22.8
Shqllawa district	158418	109783	69.3	48635	30.7
Mirgasor district	220665	35747	16.2	184918	83.8
Maxmur district	56147	13531	24.1	42616	75.9

Source: Ministry of Planning, Director of Regional Statistic Office (the estimation of Erbil governorate population, unpublished data)

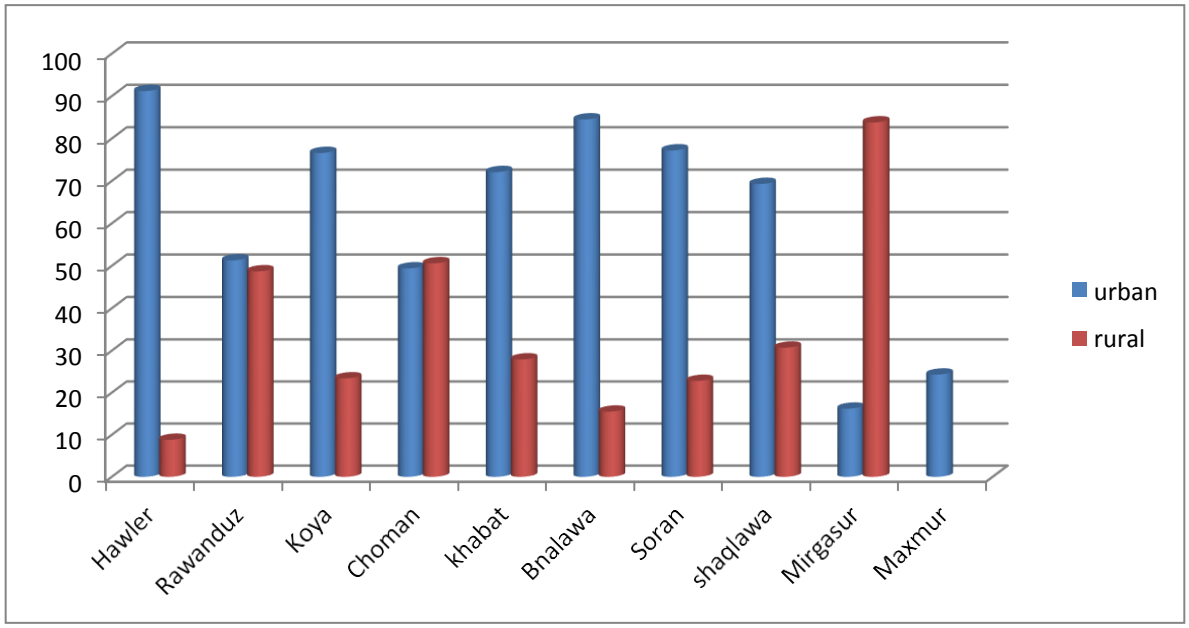

Fig. 2.6. The share of urban population in Erbil governorate by districts, 2018

Moreover, concerning the ***population density*** in Erbil governorate, it is consists of 145.4 persons per one square kilometer, however the average population density by districts is varies essentially, as it shown in table 2.6:

Table 2.6. The population density in Erbil governorate by districts

District	**Population number, persons**	**Mass land, km^2**	**Population density, person/km^2**
Central Erbil district	1001163	1131	885.2
Rowandz district	26887	528	50.9
Koya district	118394	2051	57.7
Choman district	33087	890	37.1
Khabat district	116712	695	167.9
Erbil plains district	234141	1307	179.1
Soran district	196895	2129	92.4
Shqllawa district	158418	1473	107.5
Mirgasor district	56147	1976	28.4
Maghmor district	220665	2689	82
Erbil governorate	2162509	14869	145.4

Source: Ministry of Planning, Director of Regional Statistic Office (the estimation of Erbil governorate population, unpublished data); Kurdistan Region of Iraq, General Directorate of Agriculture (area of Erbil governorate, unpublished data)

The table above shows that the population density in Central Erbil district is the highest as it records 885,2 persons per square kilometer. The reason behind this high number is the high aspiration level of people to live here. On the other side, the lowest population density is recorded in Mirgasor district which is 28.4 persons per square kilometer. This lower density is caused by the topography of the district which is hilly and mountainous, therefore, road construction and services are very hard to be provided in these remote areas which make it very hard for establishing new settlements in these areas.

Age and gender population structure in Erbil governorate. Two aspects of the population are important, gender and age. Through these aspects we can trace the changes in population in any area (shwany ,2006). In addition to that, the importance of knowing the status of these two aspects of the population helps governmental bodies to set the right development plans and this could help us to understand the manpower capacity of this area. The gender composition of the Erbil population is ideal: there is a balance between male and female population in this area – 50.2% male and 49.8 female. The under 20-year-old people are contributing to the overall population of Erbil governorate by 40%. The average age of this province's people is between 20-65 years old. 56% of the Erbil govarnorate population is the eligible workforce. The desperate age, over 65 years old, incontributing by 4% to Erbil governorate which is a small fraction.

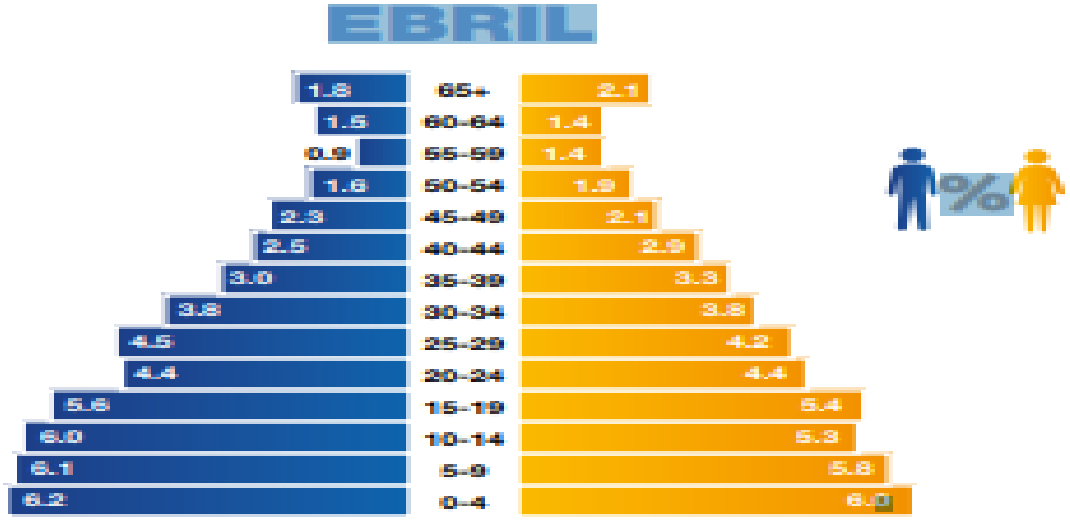

Fig. 2.7. : Population Pyramid of Erbil province population

Literacy rates among the population of Erbil governorate. The rate of literacy in any area shows the quality of the education system and access to these services among people. Depending of age, the literacy rates vary. The literacy rate among people 0-14 years old reaches 78.2%. The reason behind this low date is the fact that

children start school when they reach 6 years old, therefore, all people who are under 6 years old are considered as illiterates as it is shown in the table below. The literacy rates among people who are 65+ years old are also relatively low because of the political situation and economic crises they had to endure. The rate of literacy between urban and rural areas are different: while the literacy rate in urban sites is 80.9%, this rate in rural areas reaches 71.8%. The low literacy rates in villages is caused by lack of education services in these areas.

Table 2.7. Literacy rates among the population of Erbil governorate

Age	**Literacy Rate, %**
0-14	78.2
15 – 17	95.3
18 – 24	93.9
25 – 34	84.0
35 – 44	75.0
45 - 54	68.3
55 - 64	44.9
65+	28.3
Total rural	71.8
Total urban	80.9

Source: the International Organization for Migration (IOM) and the United Nations Population Fund (UNFPA).(2018) DEMOGRAPHIC SURVEY of Kurdistan region of Iraq,p 35, published

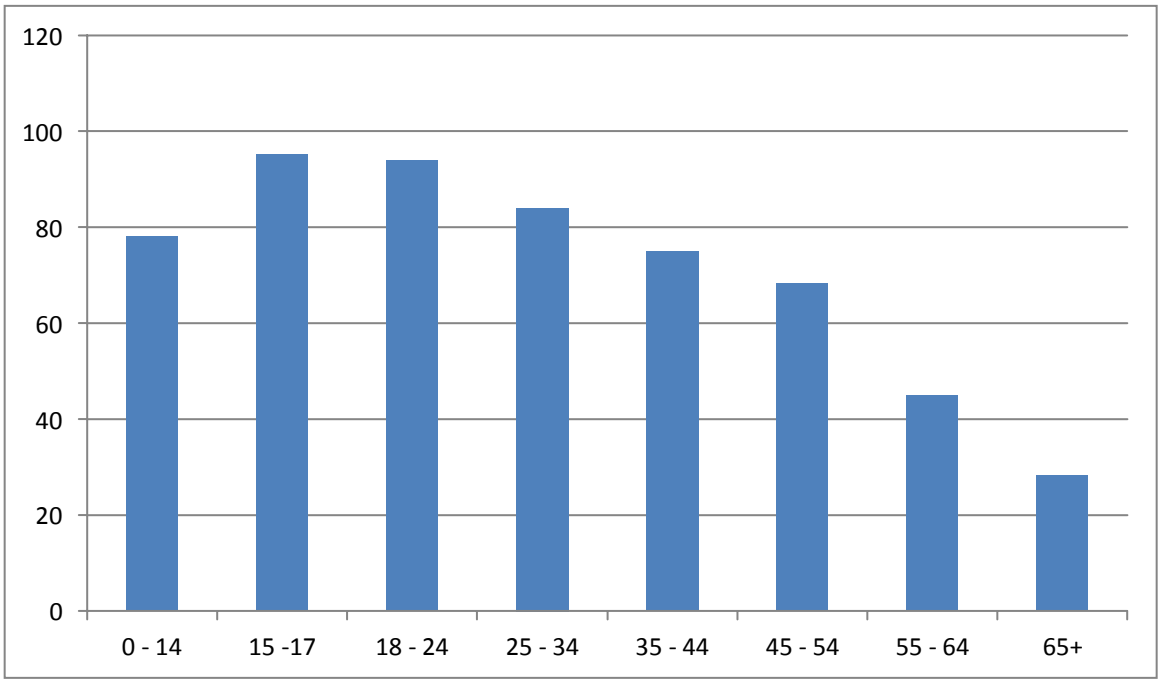

Fig 2.8**.** Literacy rates among the population of Erbil governorate

The occupational structure. The type and the rate of occupation is an important element in government plans. These statistics also show the rate of joblessness in the area. The population of Erbil province could be categorized into 6 types of occupations, as it is shown in the table below. The majority of the population of this area is government employees and serves in different public services sectors. According to age, gender and settings, numbers of government employees are different. In urban settings 50% of the population serves in public sectors, while in rural settings this number falls to 44%. The second type of occupation is small business projects, the rates of people who are working or owning small business projects are also different. While in villages, the small projects owner are about 20% which mainly are agricultural projects, this number is slightly lower in cities where reaches 18%, which are small retailing shops and other private services. The smallest rate of villager population is owning big business projects, while the smallest fraction of people in cities are working on unpaid family work, as it is shown in the table 2.8.

Table 2.8. The occupational structure in Erbil governorate

Age	Unpaid family worker	Daily wage worker	Self-employed	employer	Employee private sector	Employee public sector
15-17	25.2	50.4	15.6	1.1	8.0	0.6
18-24	9.5	38.2	17.0	1.8	13.0	20.4
25-34	2.1	18.5	15.4	2.5	9.6	56.7
35-44	1.5	15.2	18.0	3.7	5.8	55.8
45-54	1.8	10.6	23.6	4.2	4.9	54.9
55-64	3.6	10.0	24.9	6.0	4.7	50.8
Total rural	10.8	17.5	20.0	2.3	5.2	44.3
Total urban	1.6	18.4	18.0	3.4	8.2	50.0

Source: International Organization for Migration (IOM) and the United Nations Population Fund (UNFPA), 2018. Demographic Survey of Kurdistan region of Iraq, p 41.

CHAPTER THREE
FISHERY PROJECTS IN ERBIL GOVERNORATE

3.1 General characteristics of fishery projects in Erbil governorate

The early fishery projects were small family projects. Such ponds were relatively small and the area of the project rarely would exceed 500 m^2. The harvest was used to supply fish to families and relatives and the small remaining potation was sold in local markets. It helped family to gain from this business and gradually the income of farmers started to improve, which ultimately lead to expansion of the fishery projects and implementing several precaution technique to improve the quantity of seasonal and annual harvest. As a result, industrial fishery projects were emerged (Ayyat, 2006).

Aquaculture projects in Erbil governorate start to emerge at the ends of the 1990s and the beginning of 21^{st} century. The huge animal protein appetite, rapid population growth and lack of access to seas and oceans, enhance the growth of aquaculture projects in Erbil governorate (Abish,1978). Despite the fact that two large rivers flow onto Erbil governorate, yet the fish harvest of the two rivers are not enough to meet the huge demands of fish in the area. Therefore, many fish farms were established in the area. The harvest of these farms is consumed by people as there is no fish canning factory in the area. The statistics show that there are 116 fishery farms in the area. The size of these projects varies from a district to another as it is shown in Table 3.1.

The date in the table 3.1 shows several aspects of fishery projects in Erbil governorate, such as the area of the projects, geographical distribution of fish farms. The total area used in fishery projects in Erbil governorate is about 258.28 dunams (645700 m^2). Further, the popular forms and pond types of fishery projects in this area will be discussed.

Table 3.1. The number of fish projects, pounds, projects area, and type of fishes in Erbil governorate by districts

District	Number of projects	Number of ponds	Projects area, dunum*	Breed type	Project type
Central Erbil (Hawler)	16	27	33.4	carp	pond
Erbil plains (Bnalawa)	27	64	62.94	carp	pond
Koya	13	35	32.36	carp	pond
Shqllawa	4	25	39.58	carp	pond
Soran	5	16	10	carp	pond
Maghmor	25	60	64.6	Carp	pond
Mirgasor	6	18	23.12	carp & salmon	pond
Rowandz	4	7	6.9	carp	pond
Choman	2	21	55.56	carp & salmon	pond
Khabat	14	36	29.82	carp	pond & cage
Total	116	309	358.28	carp & salmon	pond & cage

Source: General directorate of agriculture and water resources of Erbil governorate, unpublished data, 2018

Forms of fishery projects according to land availability. There are not universally acknowledge forms of area for fishery projects in the world. Each farmer establishes the fishery farms according to the available capacity; however, researches tend to divide fishery projects into three main forms by the density and area, as follow:

– *Expanded form*: this form of fishery projects is natural form of fish breeding. In such fishery farms natural barrier block water from escaping and a natural pond is forming. It is old form of fishery farms where little food and equipment are required to breed fish. Instead, the fish depend on available natural resources to grow and little

manpower is required. However, the harvest of such pond is little and commonly its harvest is used for farmer's daily consumption rather than trading. This form of fish farms is rare in Erbil governorate (Arab Organization for Agricultural Development, 2008).

– *Dense fishery projects*: this form of fishery project is common in dust fish farms. The area of such farms highly depends on the availability of water resources. In such form of fishery projects, skilled labor is required to implement the essential harvest growth techniques. In addition to that, the constant fodder supply is important to feed fishes and quicken the growth of fishes. This form of fishery is commercial, therefore, it is organized and the natural elements interventions are almost blocked. It is extremely popular in Erbil governorate (Arab Organization for Agricultural Development, 2008)

– *Extremely dense form*: this form of fishery project aims at harvesting maximum fish product possible in the smallest area available. This commercial fishery project highly depends of equipment and manpower to feed and monitor the rapid growth of the fishes. Moreover, sophisticated equipment is used to generate enough oxygen to compensate its shortage. Such form of fishery projects require huge investment, however in return, the harvest is also extremely productive. In Erbil governorate there are couple of projects that adopt this form of fishery, they heavily depend of equipment and huge supply of fodder to raise harvesting capacity to its peak (Salim & Al-Rawi, 2012).

There are two main types of fishery projects

– *soil pond fish culture.* Pond fishery project is extremely popular type of the fishery in the world to produce animal protein. There are two kinds of fish farm pond: clay pond and cement pond. When such pond is established, the engineers pay special attention to the places where water pours and escapes gate. However, in some ponds

water pumps are used to inject water and fill the pond. In addition to that, a special mechanism is adopted to distribute the fodder equally inside the pond.

There are advantages and disadvantages of such types of fish project ponds. The main advantages could be summed up in followings: low cost, high harvest and that it is not at risk that could be imposed by natural elements. On the other hand, establishing of such ponds is costly, skilled labor, generating constant oxygen, cleaning the pond from algae and grass in the bed of the pond, and adaptation of sophisticated equipment are required. They all could be labeled as disadvantages of such type of fishery project (Salman, 2013). This type of fishery pond is pervasive in Erbil governorate. Most of the ponds in this area are clay ponds. However, several cements ponds are also established in this area.

Fig. 3.1. Soil pond fish culture

- *Cage fishery projects type* of fishery projects are also very common. However, special climate is required to establish such farms. It is common in places where they have access to open seas. In addition to that, the water where such projects are established must be inland or open sea. However the waves of the water must be

very smooth and mild; and the cages must be built out of light but hard metals. The largeness of such projects are not determined, it depends of the farmers managements and plans (Ismaeel).

This type of fishery projects has advantages and disadvantages. The advantages are possible controlling the equal distribution of fishes over the cage, easiness of feeding the fishes, protections of the breeding fish from predators. Harvesting is also easy. On the other hand, the disadvantages are: the high cost of cages construction, the maximum usage of the cages is not exceed 5 years, only special fish breeds could be raised in the cages, the changes of water could be fatal for fishes inside the cages (Ismaeel). Because the rivers in the area under study are turbulent and helical flows, and the high cost of establishing such fishery projects, cage fishery project in Erbil governorate is rare. However there is couple of cage fishery projects in Khabat district realized, which are established along the banks of the Great Zab River.

Fig. 3.2. Cage fish culture

The most common *types of the fishes* are carp and salmon.

- *Carp fish*: is most popular and common fish. Breeding this fish is growing in relatively hot waters, especially in waters above 20°. In addition to that, this breed does not require deep ponds; the depth of ponds must range between 1 to 2 meters. The high concentration of oxygen is also not required to farm this fish. It could survive in waters where oxygen concentration is between 5-7 mg/liter. If the temperature degree is between 20 to 28°, the growth of carp fish will eat quickly and move less. Because of these suitable features of carp fish and compatibility of the area to farm this fish (Farag, 2014), carp is most popular in Erbil governorate and 95 % of fishery projects here are farming carp fish. Huge appetite for this fish also motivates farmers to farm carps. The farmers in Erbil governorate pour carp fingerlings into pond at the beginning of hot season, and harvest starts at the beginning of cold season. The standard weight of carp fish is from 2 to 3 kilograms. This weight standard is achieved in 6-8 months, however, in cold season, because of low temperature, it required more time to grow carp fish.

- *Salmon fish*: is another common fish breeding because it's delicious taste and look. It is consumed worldwide. Salmon fish is differs from carp fish and has its own unique characteristics. This type of fish prefers mild and low temperature. It grows under 23° degree and prefers the deep ponds, and also less tolerant to low oxygen concentration. Because of low temperature (U.S. Bureau of Land Management, 2009) this type of fish is farmed in northern parts of Erbil governorate, especially in Choman and Mirgasor districts. In Erbil governorate, there are only four Salmon breeding projects, which are not able to meet the increasing demands of this fish here. The main obstacles in front of establishing more salmon fishery projects are the unique climate required to farm and high cost of breeding this fish.

3.2. Spatial distribution of fishery projects in Erbil governorate

The types of fish farming and the forms of fishery projects in Erbil governorate are vary depending on the districts and the capacity of the farmers. Every of 10 administrative units of Erbil governorate has different and unique characteristics for farming fishes. Therefore, two aspects are adopted to divide the districts.

Distribution of fishery projects by the number of fishery projects in the area is following. The fishery projects are distributed in the administrative units unequally, while there are lots of fishery projects in some districts, in other districts there only few fishery projects as it shown in Table 3.2 and Fig. 3.1.

Table 3.2. Distribution of fishery projects in Erbil governorate

Districts	**Number of projects**	**Number of ponds**	**Share in governorate projects, %**
Central Erbil (Hawler)	16	27	13.7
Erbil plains (Bnslawa)	27	64	23.2
Koya	13	35	11.2
Shqllawa	4	25	3.4
Soran	5	16	4.3
Maghmor	25	60	21.2
Mirgasor	6	18	5.1
Rowandz	4	7	3.4
Choman	2	21	1.7
Khabat	14	36	12.8
Total	*116*	*309*	*100*

Source: Research survey, supported by table (3-2)

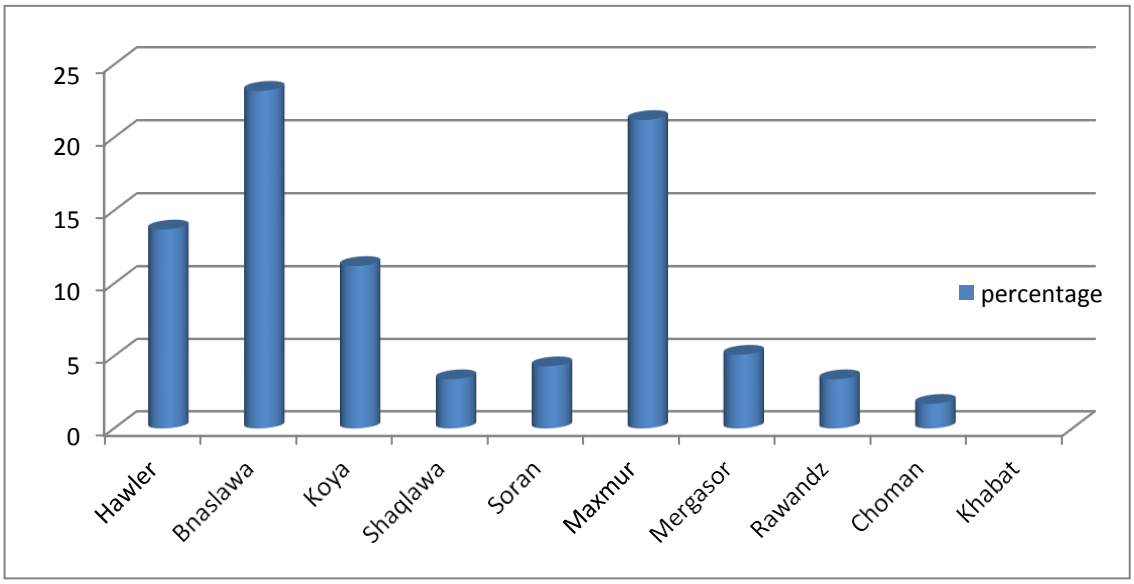

Fig. 3.5. Distribution of fishery projects in Erbil governorate by districts

In the Table 3.2 the number of ponds does not show their area because there is no regulation of land size that could be applied. In addition to that, the data shows that the most areas dedicated to fishery projects are located in Maghmor district, which reach 161500 m^2 (18.1 % of Erbil governorate area). On the other hand, the least used for fishery farms areas are located in Rowandz district, which consists of 17250 $m^{2,}$ (1.9%).

There are several elements that directly or indirectly ***affect fishery projects*** in the area under study. The main ones are listed below.

Temperature: is a natural energy coming from the sun through the light, and it is one of the climate elements influencing almost all human aspects from washing, clothes, housing, food production and all human occupations (). Temperature is influencing other natural and climate elements such as wind formation and its direction (Shahadeh, 2009). Fish, like other species, to survive and grow needs sun light. The amount of required sun light depends on the types of fish. In addition to that, it can help human begins to locate different fishes by measuring temperature.

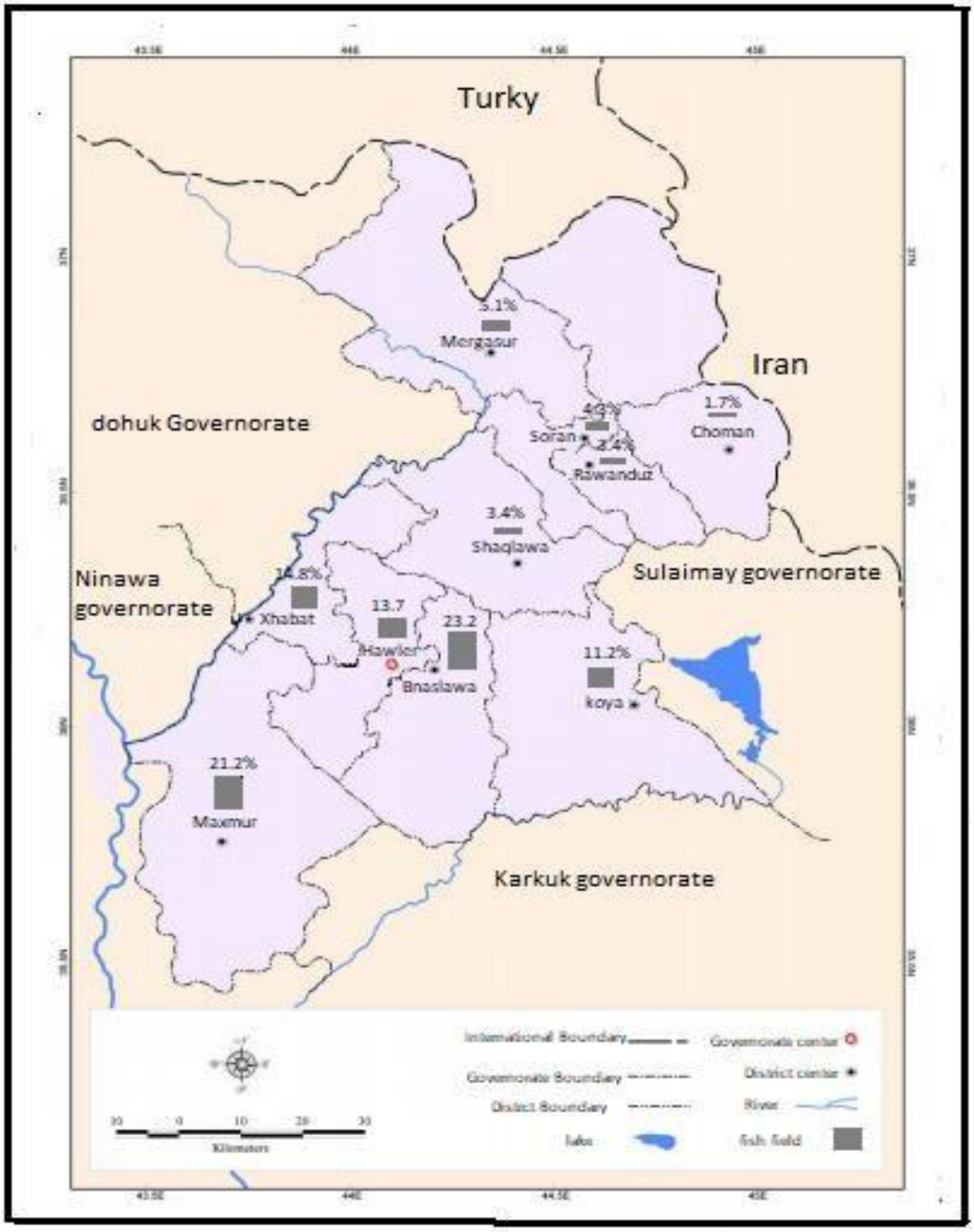

Fig. 3.6. Distribution of fishery projects in Erbil governorate by districts

As it was illustrated previously, the temperature of the area under study is warm and hot, and the average value reaches 21.8, which is ideal temperature of fishery projects. However, as we move towards north the temperature drops. As a result, salmon farming is popular in northern parts of governorate, while in southern parts where temperature is higher, carp farming is common.

Water resources: is a natural resources that in dry areas determine the population density and supports different live forms, such as animal, plant, etc. (Al-Ziyadi & Jaber, 2013). For fishery projects, water is the first and much needed resource because fishes can only survive in water; without water there will be no fishery projects. Underground and surface water resources are in plenty in Erbil governorate, however, the fishery projects are mostly located at the banks of the rivers.

Capital: Any human activity requires sufficient money capital. The fishery farming is no exception and requires a huge capital at different stages of construction, monitoring and harvesting. In addition to that, there are other post-harvest costs, such as transportation and tax. Therefore, the quantity of capital essentially determines the capacity and type of fishery project (Interview with Aram Ali).

Manpower: The agricultural projects generally and aquaculture specifically requires a skilled and extensive labor in different stages of these activities (Interview with Mohammad Abdula). Concerning fish farms, manpower is required in construction, monitoring, harvesting, transportation and marketing the harvest. Therefore, labor is needed in any part of Erbil governorate when fishery project is operated.

Trading and marketing: The main aim of any trading or industry is financial gains. To gain finically form business, a compatible market is required. In addition to that, a proper handling of marketing is also important. The distance between fishery project and selling markets plays an important role in the growth of fishery projects in any area. Therefore, because Maghmor Erbil plains are located between three

different provinces, the data shows that density of fishery projects in Maghmor Erbil plains are higher comparing to the other districts where their product cannot be delivered as fast.

Veterinary Clinic Services: Fishes, like other species, get sick; therefore when a sickness strikes a pond of farmed fishes an urgent medical caring is important to reduce the rate of fatality of various sicknesses. In Erbil governorate, there are 30 veterinary clinics and they are distributed across the province unequally as it is shown in Table 3.3.

Table 3.3. Spatial distribution of veterinary clinics in Erbil governorate

District	Number, units	Share, %
Central Erbil	4	13,3
Bnaslawa	3	10,0
Soran	2	6,7
Shqllawa	5	16,7
Choman	2	6,7
Koya	5	16,7
Mirgasor	4	13,3
Khabat	3	10,0
Rowandz	1	3,3
Maghmor	1	3,3
Total	30	100,0

Source: Kurdistan Government Region, Ministry of Agriculture and Water Resources, General Directorate of Erbil Agriculture, unpublished data, 2018

Table 3.3 shows that veterinary clinics are not distributed across Erbil governorate equally. While there is huge density of fishery projects in Maghmor district, but only one veterinary clinic is operating in this area. If potential sickness strikes fishery ponds in this district, there is a huge chance that is will be catastrophic.

CHAPTER FOUR
IMPACT OF AQUACULTURE ON RURAL DEVELOPMENT IN ERBIL GOVERNORATE

The study was conducted in 10 districts that are located across Erbil governorate, Iraqi Kurdistan and a total of 44 questionnaires were successfully retrieved from the farmers. This equated to a response rate of 100% and data analysis was conducted based on the collected 44 responses. Hence, this chapter laid an important part of formulating the necessary strategies and policies needed to promote aquaculture and rural development plans.

4.1. Spatial variation of aquaculture activities in Erbil governorate

Distribution of ponds by districts. The initial focus of the study was to determine the distribution of ponds by districts across Erbil governorate. Insights revealed by the collected data that the ponds were mainly located in 5 out of the 10 districts that were placed under examinations. As such, the highest number of ponds was established to be in Koya district with a total of 16 ponds. Deste Hawler district (Bnaslawa) has the second highest number of ponds totaling 13. Erbil district was discovered to be having 11 ponds while Xabat and Soran districts have 3 and 1 ponds respectively as depicted by Fig. 4.1.

Independent t-test was used to test the hypothesis that the characteristics required for aquaculture projects do not differ from one district to the other. It was revealed that there is a significant difference in variation in the number of ponds by district (see Table 4.1). This therefore revealed that there is a difference in the distribution of ponds across districts in Erbil governorate.

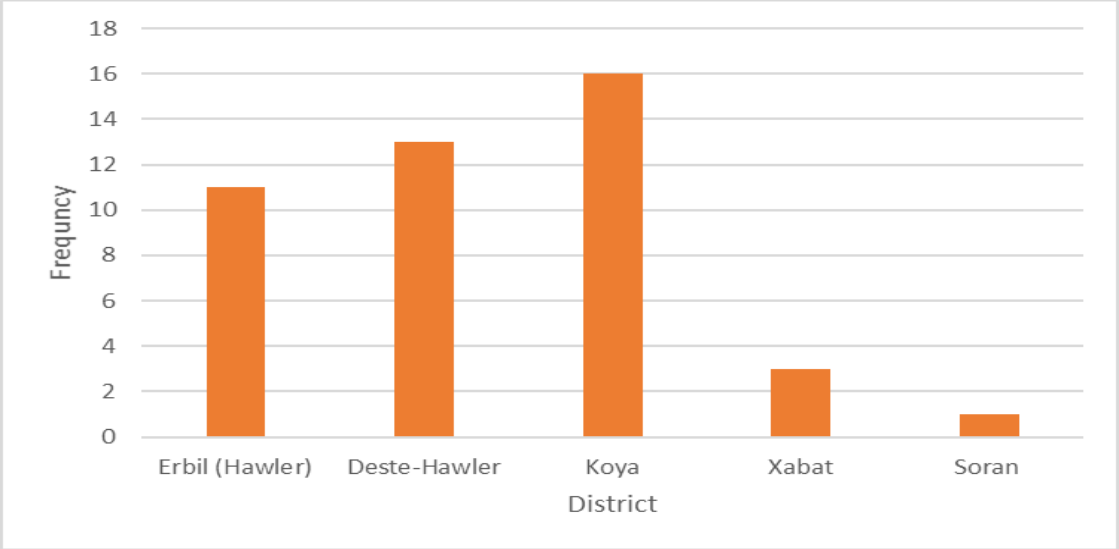

Fig. 4.1. Number of ponds by district

In addition, this possibly suggested that there are certain geographical factors that influence the location of ponds in Erbil governorate. Furthermore, this is important for devising measures to promote aqua agriculture across Erbil governorate as efforts might be stepped up to increase awareness about the potential benefits of aquaculture across Erbil governorate.

Table 4.1. Independent t-test results

t	**Df**	**Sig.**	**Mean difference**
12.572	43	0.000	2.432

The findings also showed that the ownership of ponds by the farmers also varied from one farmer to another. That is, certain farmers have more ponds than others and 16 farmers owned a total of 3 ponds each. 13 farmers owned a total of 2 ponds each, 11 farmers owned a total of 3 ponds each, and 3 farmers owned a total of 4 ponds each (Fig. 4.2).

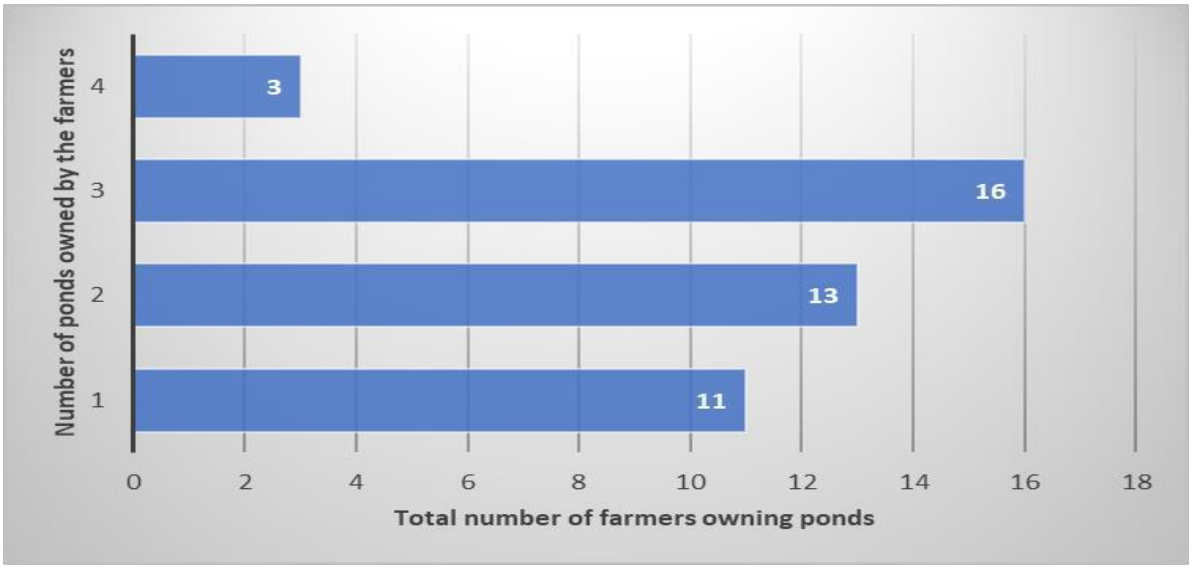

Fig. 4.2. Number of ponds owned by farmers in Erbil governorate

Thus, ownership of ponds can be said to vary according to social aspects such as family and income. This provided an indication of how social status and popularirty influence aquaculture in Erbil governorate.

Prevalence of aquaculture activities. Further observations made from the study showed that there were notable variations in the number of ponds developed in Erbil governorate since 2002 (Fig. 4.3). Thus, the period from 2002 to 2019 was noted to have been associated with variations in the developed of ponds in Erbil governorate. The 2016 year was marked with notable increase in the number of ponds developed in Erbil governorate. This possibly coincided with efforts made by the Erbil governorate to promote agricultural activities. In addition the period 2008 to 2009 was marked with a huge decrease in the number of ponds developed in Erbil governorate. This is possibly because of the 2008-20098 financial crisis whose effects spread across nations and sectors. However, improvements in aquaculture can be noted to have started increasing from the year 2018 as measures were put by the government to promote all forms of agricultural activities in Erbil governorate.

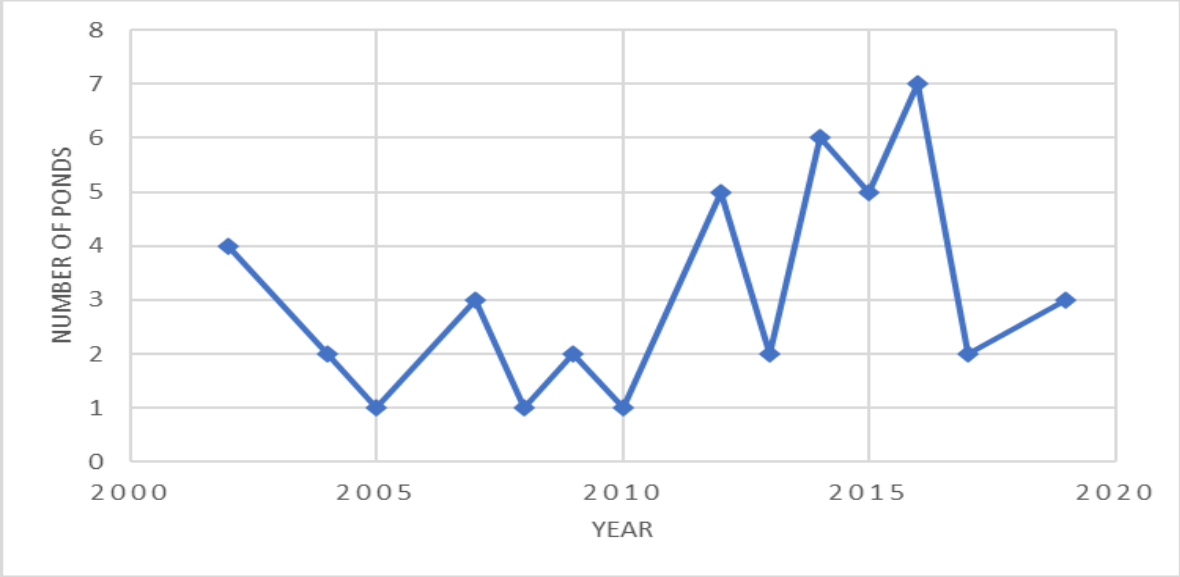

Fig. 4.3. The development of ponds in Erbil governorate in 2002-2019

4.2. Factor analysis

The study also placed considerable effort in determining if there were considerable differences in characteristics required for aquaculture projects differ from a district to another. Individually, it was noted that the characteristics required for aquaculture projects differ from one district to another. The factors differed with respect to study area are the number of fish, water source, depth of the pond and duration to change water. This entails that each district in Erbil uses specific aqua-culture methods that suites among others, feasibility, socio- and economic status, and its geographical location. The test results are shown in the Table 4.2.

Table 4.2. Characteristics required for aquaculture projects

Factor		Frequency	Percentage	T statistics and Sig.
Field area	1500-5000	15	34.9	11.451 (0.000)
	5000-10000	18	40.09	
	10000-15000	9	20.45	
	15000-20000	4	9.09	
	20000 and above	1	2.27	
	Total	**44**	**100**	
Number of fish	1000 and less	2	4.54	11.505 (0.000)
	2000 and less	8	18.18	
	5000 and less	20	45.45	
	8000 and less	12	27.27	
	10 000 and above	2	4.45	
	Total	**44**	**100**	
Water source	River	8	18.2	30.912 (0.000)
	Well	36	81.8	
	Total	**44**	**100**	
Depth of the pond	Less than 1M	15	34.1	22 952 (0.000)
	1-2M	29	29	
	Total	**44**	**100**	
Duration to change water	Continuing	18	40.9	14.408 (0.000)
	One week	14	31.8	
	One week to one month	11	25.0	
	Over one month	1	2.3	
	Total	**44**	**100**	

Factors that influence aqua-culture activities in Erbil governorate. Further examination of the obtained results showed that there were considerable differences in factors that influence aquaculture activities in Erbil governorate. This was done using independent t-test. Thus, it was revealed that factors that influence aquaculture in Erbil governorate were totally different from one district to another (Table 4.3).

This shows that certain parts of Erbil made it possible for aqua cultural activities to use a fewer number of employees than other districts.

Table 4.3. Factors that influence aqua-culture activities in Erbil governorate

Factor	Description	Frequency	Percentage	T statistic and Sig.
Staff members	1 person	4	9.1	
	2 people	12	27.3	
	3 people	10	22.7	16.595
	4 people	13	29.5	(0.000)
	5 people	4	9.1	
	6 people and above	1	2.3	
	Total	**44**	**100**	
Duration to produce fish	3-6 month	30	68.2	
	6-9 month	14	31.8	14.408
		44	100	(0.000)
Standard weight of a fish (Kg)	1-2kgs	17	38.6	
	2-3kgs	27	61.4	35.199
	Total	44	100	(0.000)
Farmer education	Primary	9	20.5	
	High school	19	43.2	19.216
	College	16	36.4	(0.000)
	Total	**44**	**100**	

Farmer experience	Medium	43	97.7	
	Expert	1	2.3	89.000
	Total	**44**	**100**	(0.000)
Selling location	In field	16	40.9	
	In cities	29	59.1	21.218
	Total	**44**	**100**	(0.000)
Needed costs to produce fish ($)	1-3	2	4.5%	
	3-5	30	68.2	40.992
	Over $5	12	27.3%	(0.000)
	Total	**44**	**100**	

In addition, the duration to produce the fish was also noted to be different. And this varies according to individual preferences which varied from 1-2 kg to 2-3 kg. Hence, certain individuals can prefer to wait longer until the fish grows to a certain weight while others may prefer to sell it at a tender age. Hence, certain districts were found to be producing fish for shorter periods ranging from 3 to 6 weeks while other required at least 1 month to produce the fish.

Farmer experience was also another important factor that influenced variations in fish production between the regions. An independent t-test statistic of 19.216 was obtained and this was significant at 1%. Similar results were also obtained in connection to farmer experience which was also significant at 1% with an independent t-test statistic of 89. This is relatively true and in line with findings established which showed that aqua-culture is most likely to vary with farmer education and experience.

The results of the study further exhibit that huge variations in fish production were inevitable and varied with respect of selling location and costs needed to produce the fish. This entails that the marketing activities of the farmers influenced their production locations. Hence, this is why we found that fish production is higher

in some districts of Erbil governorate as opposed to others. A study by Miller (2004) concurs with this idea and contends that marketing and distribution activities are vital for the production of agricultural products and other commodities.

4.3. Social and economic benefits and problems of aquaculture development in rural areas

The computed descriptive statistics showed that there were ***major social and economic effects of aquaculture in rural areas*** of Erbil governorate. As such, the findings showed that the respondents agreed to a large extent that fish production has posed a lot or economic benefits to rural residents of Erbil governorate as noted by a mean value of 2.45. Similar deductions were made with the residents confirming that fish production has created a lot of opportunities and filled demand as evidenced by a mean value of 2.36. However, a fewer number of people indicated that fish farming has not risen to a common level in the rural areas of Erbil governorate and to become a main course in their daily meals as noted by respective mean values of 1.89 and 1.91.

The findings also showed that fish production has affected the alternative job activities residence can resort to and this is poses huge positive economic and social implication. However, there were also concerns that fish production has been imposing effects on agricultural land as noted by a mean value of 2.20. This also represents major variations in fish production as noted by a high standard deviation of 1.212. Thus, more benefits and huge negative effects were observable in relation to improvements or degradation of agricultural land.

Table 4.4. Social and economic effects of aquaculture in rural areas

	Mean	**Standard deviation**
To what extent fish farming are common this region?	1.89	0.841
To what extent fish projects offer work opportunities?	2.36	0.718
To what extent fish projects have effects on people economic situation?	2.45	0.627
To what extent workers like to work in fish projects ?	2.36	0.838
To what extent fish- farming are alternative to other types of work in this place?	2.27	0.899
To what extent consuming fish become a main course in the daily meals in your region?	1.91	0.741
To what extent fish producing in your region filled the demand of people for fishes in the market?	2.36	0.810
To what extent fish projects are making problem for agricultural lands?	2.20	1.212

Problems affecting aquaculture in Erbil governorate. It is worthy to note that fish production also poses a series of problems which if remain unaddressed can causes a lot of undesired effects. Water pollution was discovered to be a major problem associated with fish production (3.36±0.917). This shows that fish production results in negative effects on the environment. Other issues were related to lack of water resources in this region (3.59±0.045) and unavailability of loans to expand and set up projects (3.48±1.292). Moreover, concerns were raised that are aquatic plants growing in fish ponds (2.64±1.123) (Table 4.5).

The above listed problems are an indication that fish production has negative and positive effects on rural people. Thus, rural people stands to gain economically and socially when fish production results in an increase in income level and an improvement in social status or ranking. However, environmental problems and

inherent fish production problems are key challenges undermining fish production in rural areas. Hence, recommendations were made with respect to this observation.

Table 4.5. Problems affecting aqua-culture in Erbil governorate

	Mean	**Standard deviation**
High prices of the fish feed?	1.43	0.818
Difficulty of getting fingerling (codlin fish) ?	2.34	0.713
The ratio of fish diseases and pests?	1.68	0.674
The type of water sources available in this area?	2.36	0.844
Lack of water resources in this region?	3.59	0.045
Unavailability of loans to expand and set up projects?	3.48	1.292
lack necessary experiences and skills for fish farming and project management?	2.23	0.731
Some traders monopolize fish production?	2.98	1.064
Lack of trained workers to carry out fish farming in farms?	2.95	.0776
Low prices while marketing fish?	1.80	0.734
The difficulty of transporting fish from farms to market places?	2.57	0.759
Water pollution used in fish farming?	3.36	0.917
Are aquatic plants growing in fish ponds?	2.64	1.123
The lack of factories to manufacture fish products?	1.,77	0.985
Lack of veterinary services and expert of fish in the region?	1.41	0.622

Ranking of the problems. It is imperative to note that the existence of various problems does not entail that the problems are of the same magnitude and effect. This can be supported by the established results which revealed that 68.2% of the farmers indicated that high prices of fish feed are a major problem affecting fish aqua-culture. This problem is exacerbated by low prices that prevail when marketing fish. This is

because 38.6% of the farmers expressed that this is a very huge problem affecting fish projects in Kurdistan of Iraq. The second concern was observed to be linked to factories as 47.7% of the farmers gave their concern and outlined that the lack of factories to manufacture fish products is also a very huge problem hampering aqua-culture in Kurdistan of Iraq (see Appendix A).

Concerns raised by the farmers showed that 65.9% of the farmers agreed that lack of veterinary services and expert of fish in the region is a major challenge undermining their fish projects. On the other hand, 11.4% of the farmers the major problem affecting their fish projects is the difficulty of transporting fish from farms to market places.

With regards to resources and the environment, there was a high agreement among the fish farmers that the notable issue affecting fish production is the high ratio of fish diseases and pests. 40.9% of the farmers were in support of this argument and considered this to be of significantly very high effect (see Appendix A). 22.7% of the farmers highlighted that aquatic plants growing in fish ponds are very high and that this is a major obstacle to sustainable and profitable fish production. On a relative scale of 1 to 5, the farmers depicted that the lack necessary experiences and skills for fish farming and project management and trained workers to carry out fish farming in farms are of moderate to fish production in Kurdistan of Iraq. 47.7% and 54.5% were in support of this argument respectively.

Scale and quality effects. There are high contentions among the farmers that the less stuff number, the more important problem of the lack of trained workers (Appendix B.1). In overall, having 1 person was considered to be low and resulting in the lack of skilled fish farmers. The same was observed with farmers who had 2, 3, 4 and 5 employees with 12, 10, 13 and 4 farmers respectively supporting this idea (Appendix B.1).

It was noted that 15.91% farmers expressed concerns that production levels from as high as 5000 fish were necessary for reducing the high prices while 11.36%

of the farmers recommended that production levels of 9000 fish were necessary to address the problem of high fish prices. Hence, it can be said that the more number of fish, the less important problem of high prices for the fish feed (less than 7000 – 100%, more than 7000 – 80%) (see Appendix B.2).

It is of no argument that there is a general level of educational level that is required to enhance experience needed to undertake certain operational activities. 43.18% of the farmers highlighted that at high school qualifications are needed to run a fish project while 36.36% expressed concern towards having a college qualification (Appendix B.3).

Market orientation. Market orientation has a problem of necessitating producers to sell fish at high prices and this problem is influenced by the selling location (markets). This can be supported by the established findings which revealed that monopolistic activities are high in the cities. That is, 59.09% of the farmers exhibited that high prices of fish are charged in cities whereas 40.91% of the farmers expressed that this problem is also prevalent in fish fields. This is because 7 farmers indicated that price related problem are of high significance for those in fields while 5 individuals contended that it is also a problem in cities as well. 37.5 indicated that this problem is on a moderate level (Appendix B.4).

Water issue. Insights from the established findings revealed that water problems are highly prevalent among residents using well water. 90% of the respondents indicated that using wells to draw water undermines fishing projects. In addition, these problems were highly prevalent in district 3, 2 and 1 with supporting responses of 40%, 32.5% and 27.5% respectively (Appendix B.5).

CONCLUSIONS

Fish production and/or aquaculture have huge positive effects on the society. As such, people in a society are able to benefit from fish production and suffer from the negative effects of fish production. Apart from that, the initial findings have thus led to the conclusion that the there is a significant diffrence in variation in the number of ponds by district. In other words, there is a difference in the spatial distribution of ponds in Erbil governorate.

The study contends that ownership of ponds can be said to vary according to social aspects such as family and income and this influences how social status and popularirty influence aquaculture in Erbil governorate. If fish production in Erbil governorate increases then there is a greater need to promote awareness about fish production programs across the entire region of Erbil governorate. Governments need to put measures that prevent or limit the effects of economic catastrophes on fish production. This is because were notable variations in the number of ponds developed in Erbil governorate since the year 2002. Thus, the period from 2002 to 2019 was noted to have been associated with variations in the development of ponds in Erbil governorate. Efforts made by the Erbil authorities to promote agricultural activities as noted by the surge in fish production activities in 2016. But the period 2008 to 2009 was marked with a huge decrease in the number of ponds developed in Erbil governorate, and this was as a result of the 2008-20098 financial crisis.

Inferences were also made that there were considerable differences in characteristics required for aquaculture projects differ from a district to another with regards to study area, number of fish, water source, depth of the pond and duration to change water. Hence, each district in Erbil governorate uses specific aquaculture methods that suites among others, feasibility, socio- and economic status, and its geographical location. As a result, it can be concluded that factors influenced aqua-culture in Erbil governorate were totally spatially different. This is mainly because the

study showed that certain parts of Erbil governorate made it possible for aqua cultural activities to use a fewer number of employees than other districts.

Such aspects as the duration to produce fish, farmer experience and education, selling location and costs needed to produce the fish, must be taken into considerations by both the government and individuals if they are to sustain fish production in Erbil governorate. This ought to be supported by proper marketing and distribution activities and vital for the production of agricultural products and other commodities.

Social benefits such as employment, improvements in social levels and income also are inevitable benefits of fish production in rural areas. Hence, changing agricultural production methods and policies will go a long way in easing social limitations, unemployment's problems, political instability and heavy reliance on the government. But care should be placed in noticing the environmental effects of fish farming together with its undesired consequences.

The established problems affecting fish production in Kurdistan of Iraq are of different magnitude and effect. As such, high prices of fish feed and low prices that prevail when marketing fish are the main problem affecting fish aqua-culture in Kurdistan of Iraq. Economic problems are also a second major category of issues hampering the growth of fish projects in Kurdistan of Iraq. This is mainly because there are a few factories available to manufacture fish products. With the existence of service related problems such as the lack of veterinary services and expert of fish in the region, it is of great concern that these issues are posing major challenge undermining fish projects in Kurdistan of Iraq. These problems are also being made worse because of the difficulty of transporting fish from farms to market places. Problems regarding to resources and the environment, were mainly caused by the high ratio of fish diseases and pests and aquatic plants growing in fish ponds. As a result, these issues have a very high tendency of hindering sustainable and profitable fish production. Apart from this, the lack necessary experiences and skills for fish farming

and project management and trained workers to carry out fish farming in farms are of moderate concern to fish production. Concerns about the lack of veterinary services and expert of fish in the region cannot be ruled out.

Fish production levels from as high as 5000 fish are necessary if prices are to be reduced to affordable levels. However, a fish production level of 9000 is necessary to address the problem of high fish prices and maintain sustainable price levels. Hence, it can be said that the more number of fish, the less important problem of high prices for the fish feed. A relatively high number of stuff for operating fish projects is necessary for addressing problems associated with the lack of trained workers. Furthermore, a general level of educational level is required to enhance experience needed to undertake certain operational activities. Meanwhile, market orientation has a problem of high creating monopolistic activities in the cities as opposed to fish fields. Nevertheless, water problems are highly prevalent among residents using well water especially in Koya, Deste hawler and Erbil (Hawler) districts.

In light of the established findings which showed that fishing activities have inherent problems that affect their operational capacity, both negative effects on the environment and poses huge social and economic benefits, the following ***recommendations*** were made:

- Measures must be enacted to reduce the environmental effects of fish farming by introducing sustainable fish production methods and enacting laws that control environmentally unfriendly production methods and preserve the environment.
- Limit the formation of monopolistic structures by encouraging more individuals and companies to venture into fish production so as enhance the competitiveness of the fish industry.
- Teach farmers on sustainable methods of fish production.

- Introduce agricultural support mechanisms and schemes meant to support fish production industries.
- Agricultural officials need to engage in developmental activities that facilitate the easy distribution of fish produce from farmers to the intended markets.

This study has managed to provide detailed insights of aqua cultural activities in Erbil governorate on a district level. Other studies can specifically focus on some social aspects of fish production which is not being given due consideration. Future studies can also extend this one by investigation of other issues or aspects, such as political stability which is now a key factor in Erbil governorate.

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APPENDIXES

Appendix A. Effects of fish production levels on high prices of fish feed

Economic problems	**VH**	**H**	**M**	**L**	**VL**
High prices of the fish feed?	68.2	27.3	-	2.3	2.3
Unavailability of loans to expand and set up projects?	34.1	36.4	13.6	4.5	11.4
Some traders monopolize fish production?	18.2	27.3	34.1	18.2	2.3
Low prices while marketing fish?	38.6	43.2	18.2	-	-
The lack of factories to manufacture fish products?	47.7	36.4	11.4	-	4.5
Related services problems					
The difficulty of transporting fish from farms to market places?	11.4	25.0	59.1	4.5	-
Lack of veterinary services and expert of fish in the region?	65.9	27.3	6.8	-	-
Resources and environment					
Difficulty of getting fingerling (codlin fish) ?	9.1	52.3	34.1	4.5	-
The ratio of fish diseases and pests?	40.9	52.3	4.5	2.3	
The type of water sources available in this area?	-	4.5	50.0	27.3	18.2
Lack of water resources in this region?	6.8	52.3	-	20.5	20.5
Water pollution used in fish farming?	-	20.5	31.8	38.6	-
Are aquatic plants growing in fish ponds?	22.7	15.9	38.6	20.5	2.3
Labor market					
lack necessary experiences and skills for fish farming and project management?	-	27.3	47.7	25.0	-
Lack of trained workers to carry out fish farming in farms?	4.5	18.2	54.5	22.7	-

** VH=Very High, H=High, Medium, L=Low and VL=Very Low*

Figures are in percentages

Appendix B

Table B.1. Effects of fish production levels on high prices of fish feed

Staff number * Lack of trained workers to carry out fish farming in farms Crosstabulation						
		Lack of trained workers to carry out fish farming in farms				Total
		very high	high	medium	low	
Staff number	1 person	0	2	0	2	4
	2 persons	0	2	6	4	12
	3 persons	2	1	6	1	10
	4 persons	0	1	9	3	13
	5 persons	0	2	2	0	4
	6 and more	0	0	1	0	1
Total		2	8	24	10	44

Table B.2. Effects of number of fish on the prices of fish feed

Number of fish * High prices of the fish feed Crosstabulation						
		High prices of the fish feed				Total
		very high	high	low	very low	
Number of fish	700	0	1	0	0	1
	1000	0	1	0	0	1
	1500	2	0	0	0	2
	2000	4	0	0	0	4
	2500	2	1	0	0	3
	3000	2	1	0	0	3
	3500	3	1	0	0	4
	4000	5	0	0	0	5
	5000	4	3	0	0	7
	6000	2	0	0	0	2
	7000	0	2	0	0	2
	8000	4	1	1	0	6
	9000	1	0	0	1	2
	12000	0	1	0	0	1
	12500	1	0	0	0	1
Total		30	12	1	1	44

Table B.3. Effects of fish production levels on high prices of fish feed

Farmer education level * Lack of experience and skills in fish farming and project management Crosstabulation					
		Lack of experience and skills in fish farming and project management			
		high	medium	low	Total
Farmer education level	primary	3	4	2	9
	high school	6	10	3	19
	college	3	7	6	16
Total		12	21	11	44

Table B.4. Effects of selling location on monopolistic activities

Some traders monopolize fish production * Where selling products Crosstabulation				
		Where selling products		
		in field	in cites	Total
Some traders monopolize fish production	very high	4	4	8
	high	7	5	12
	medium	5	10	15
	low	2	6	8
	very low	0	1	1
Total		18	26	44

Table B.5. Classification of water problems by district

Water source * District Crosstabulation							
		District					
		1	2	3	5	7	Total
Water source	river	0	0	5	2	1	8
	well	11	13	11	1	0	36
Total		11	13	16	3	1	44

Appendix C

Fig. C.1. Carp fish cultivated in Erbil governorate farms

Fig. C.2. Salmon fish cultivated in Erbil governorate farms

Appendix C

The questionnaire form

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Faculty of Geography
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Farmer …… esteemed assalam u alaikum (hello)

The form in your hands contains a group of questions related to a research. The study is about geography of aquaculture and rural development with the case study of Erbil governorate, Iraqi Kurdistan. Please kindly answer the question objectively because your answer is used for the symptoms of scientific research, and your accurate and explicit answer about the recommendations mentioned will help you in the future for fish farming.

With thanks and appreciation for your cooperation with us

Awara Ali Mohammed
Master student

Part A: Introduction

1. Name of fish field …….. .

2. Fish project site? 1 - Erbil (hawler) ……. , 2 - Deste hawler ..... ,
3 - Koya …….. , 4 - Mexmur …….. , 5 – Xabat .....,
6 - Shaqlawa …….. , 7 - Soran …….. , 8 - Choman.....,
9 - Rawanduz …….. , 10 - Mergasor ……. .

3. The number of pond (pool) in the field …….. .

4. Date of creation of the field …….. .

5. Field area ..... meters.

6. Which types of fishes that you are producing in the field ?
1- carp ……. , 2-salomon …….. , 3- Tilapia …….. , 4- catfish ……. .

7. Number of fish that you are farming in the field ……. .

8. Pond (pool) water source ? 1- river …….. , 2- well …… 3-fount……. .

9. How much deep of pond ? 1- less one meter……. , 2 - one to two meters ..... ,
3- over two meters…… .

10. Time duration to change water of pond? 1- continuing ..... ,
2- One week ..... ,
3- One week to one month ..... ,
4- Over the month……. .

11. How getting fingerling (juvenile fish)? 1- Buying.....,
2 - Produce .....,
3 - Increment(growth)…… .

12. Which type of instrument are using to make oxygen for fishes ?
1- Electric …… 2-Gasoline…….. .

13. Which type of feed that you are using ? 1-chemical feed ..... ,
2- bovid feed, ...,
3-together …… .

14. How many persons are working in the field?

1- one person …….., 2 - two person ……., 3 - three person…..... ,

4 - four person……. 5 - five person…… , 6 - over five person….. .

15. How long time needed to produce the fish ?

1 - one to three months……, 2 - three to six months..... ,

3 - six to nine months …… 4 - over nine months…… .

16. Standard weight of a fish for selling ? 1- one kg, 2 - one to two kg,

3- two to three kg, 4-over three kg.

17. Farmer education level : 1- primary ……, 2- high school..... ,

3- college……, 4-expert…… .

18. Farmer experience in fish production : 1-primary .....,

2- medium .....,

3-expert…… .

19. Where selling products : 1- in the field ……, 2- in cites..... ,

3- export …… .

20. Needed cost n for produce each fishes? 1- less than $1, 2 - $1–3,

3 - $3–5, 4 - over $5

Part B: Effects

N	Question	The degree of effects				
		1- very high	2 - high	3 - medium	4 - low	5 - very low
1	To what extent fish farming are common this region?					
2	To what extent fish projects offer work opportunities?					
3	To what extent fish projects have effects on people economical situation?					
4	To what extent workers like to work in fish projects ?					
5	To what extent fish- farming are alternative to other types of work in this place?					
6	To what extent consuming fish become a main course in the daily meals in your region?					
7	To what extent fish producing in your region filled the demand of people for fishes in the market?					
8	To what extent fish projects are making problem for agricultural lands?					

Part C: Problems

N	Problems	The degree of the problems				
		1- very high	2 - high	3 - medium	4 - low	5 - very low
1	High prices of the fish feed?					
2	Difficulty of getting fingerling (codlin fish) ?					
3	The ratio of fish diseases and pests?					
4	The type of water sources available in this area?					
5	Lack of water resources in this region?					
6	Unavailability of loans to expand and set up projects?					
7	lack necessary experiences and skills for fish farming and project management?					
8	Some traders monopolize fish production?					
9	Lack of trained workers to carry out fish farming in farms?					
10	Low prices while marketing fish?					
11	The difficulty of transporting fish from farms to market places?					
12	Water pollution used in fish farming?					
13	Are aquatic plants growing in fish ponds?					
14	The lack of factories to manufacture fish products?					
15	Lack of veterinary services and expert of fish in the region?					

Abstract

The main aim of the current research is to understand the impact of establishing aquaculture projects on the development of rural landscapes in Erbil province. In order to achieve this point, Erbil province characteristics and natural elements are introduced, a map of Erbil province aquaculture and fishery projects according to districts are also illustrated. Current research is divided into an overview, four-chapter, conclusion, and recommendation and an abstract in Kurdish and Ukrainian languages are presented. The chapters are divided into several sections as follow:

Chapter one, an overview in which Aquaculture projects, development, and rural development are discussed.

Chapter two: this chapter is dedicated to discussing the natural and human resources of Erbil province, in this chapter, the geographical location of Erbil province, natural resources, and human resources are discussed.

Chapter three: this chapter is dedicated to showing the aquaculture and fishery projects in Erbil province, in this chapter, geographical distribution of fishery projects in Erbil province is presented, in addition to showing the features and forms of these projects.

Chapter four: this chapter is dedicated to discussing and analyzing the data collected through SPSS questionnaire form, to understand the cultural and economic impacts of aquaculture projects in Erbil province rural areas.

The research is concluding with a conclusion and a list of recommendations.

ئوخنةى ليَكؤلَينةوة

ئامانجى ئةم ليَكؤلَينةوة دةرخستنى كاريطةرى ضالاكى بةخ يَوكردنى ماسى لة سةر ئةرةنيَدانى طوندةكانى ئار يَزطاى هةول يَر لة ريَطةى ناساندن ضالاكى كشتوكالى ئاوى لة ناوضةكة و طرنطترين خاسيةت و ئابيةتمةنديةكانى ئةم ضالاكية لة ئاريَزطاى هةول يَر هةروةها دابةشبوونى كيَ َطةكانى بةخيَوكردنى ماسى بة سةر قةزاكانى ئاريَزطاكة بؤ ئةم مةبةستةش ئو يَذةر ل يَكؤ َلينةوةكةى دابةش كردووة بؤ ئيَشةكيةك و ضوار بةش

هةروةها لة كؤتاييدا دةرئةنجامى ليَكؤ َلينةوة و ئوخنةى ليَكؤ َلينةوةكة بة هةردوو زمانى كوردى و ئؤكرانى،

هةريةك لة بةشةكانى ليَكؤ َلينةوةش دابةش كراون بؤ ضةند باس يَك بةم شيَوازةى خوارةوة:

بةشى يةكةم : ناساندنى بابةتى ليَكؤ َلينةوة كة دابةش كراوة بؤ سآ باس كة هةر باسةو ناساندنى ضةمكيَكة لة

ضةمكةكانى)كشتوكالى ئاوى ، ئةرةنيَدان ، ئةرةنيَدانى طوند (

بةشى دووةم : خةسلَةتة سروشى و مرؤييةكانى ئار يَزطاى هةوليَر ، ئةم بةشةش ئيَكهاتووة لة سآ باس)باسى يةكةم شويَنى ئار يَزطاكة، باسى دووةم دةرامةتة سروشتيةكان ، باسى سيَيةم دةرامةتة مرؤييةكان(

بةشى سيَيةم :بةخيَوكردنى ماسى لة ئار يَزطاى هةول يَر ئةم بةشةش ئيَكهاتووة لة دوو باسى سةرةكى)باسى يةكةم ئابيةتمةنديةة شتيةكانى ئرؤذةكانى ماسى لة ئار يَزطاى هةوليَر ، باسى دووةم دابةش بوونى جوطرافى ئرؤذةكانى ماسى بةسةر ئاريَزطاى هةول يَر(

بةشى ضوارةم : كاريطةريةكانى بةخيَوكردنى ماسى لة سةر ئةرةنيَدانى طوندةكانى ئار يَزطاىهةول يَر بة ئ يَى نؤرمى رائرسى و شيكردنةوةى داتاكان بة ئيَ َى بةرنامةى(SPSS) كة خؤى لة كاريطةرية كلتورى و كاريطةرية ئابوريةكان بةسةر طوندنشينانى ئار يَزطاى هةول يَر.

لة كؤتايشدا لةبةر رؤشناي ئةم ليَكؤ َلينةوةية ضةند دةرئةنجاميك دةرهاتووة و باسى ليَوةكراوة ،هةروةها راسئاردةى طونجاويش ديارى كراوة بؤ مةبةستى ئةرةئ يَدانى طوندةكان بة هؤكارى ئةرةنيَدانى ضالاكى بةخ يَوكردنى ماسى لة ناوضةكةدا