

**THE IMPACT OF THE GREAT MAN MADE RIVER PROJECT ON  
LIBYA'S AGRICULTURAL ACTIVITIES AND THE ENVIRONMENT**

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This project report is dedicated to my beloved  
Parents

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## ABSTRACT

Libya is a dry country with very limited water resources. As the population of Libya increases, so does its demand for water. The search for oil in the 1950s and 60s led to the discovery of vast amount of 'fossil' water in aquifers underneath Libya's southern deserts. In 1984, the Libyan government started the largest civil engineering project ever undertaken in the world that was scheduled to complete within twenty years. The project, popularly known as the Great Man Made River Project (GMMRP), when fully completed can supply a total of 6,500,000m<sup>3</sup> of freshwater per day to most northern Libya cities bordering the Mediterranean Sea. Eighty percent of this water is allocated for agricultural activities while the remaining is for municipal and industrial purposes. The impact of the availability of this water on the agriculture activities is tremendous and so is the projected consequences on the environment. In light of this, this study, through a questionnaire survey, tries to identify such impact on the agriculture town of Abu Sheiba. Findings from the questionery survey indicate that while the impact of the GMMRP project on agriculture activities are very significant so are the concern of the people on its environmental impacts.



## ABSTRAK

Libya merupakan sebuah negara padang pasir yang mempunyai sumber air yang terhad. Selari dengan peningkatan bilangan penduduk, permintann air juga meningkat. Aktiviti carigali minyak dalam dekad 50an dan 60an telah membawa kepada penemuan sumber air bawah tanah yang banyak di bawah padang pasir di selatan Libya. Dalam tahun 1984, kerajaan Libya telah memulakan satu projek kejuruteraan awam yang terbesar pernah dilakukan yang dijangkan berlanjutan selama dua puluh tahun. Project yang dikenali sebagai *The Great Man Made River Project (GMMRP)* ini bertujuan untuk membekalkan air bawah tanah dari selatan ke utara Libya. Ia berkemampuan untuk membekalkan sebanyak 6,500,000m<sup>3</sup> air per hari kepada bandar-bandar utama Libya yang bersempadan dengan Laut Mediterranean. Lapan puluh peratus daripada air ini adalah untuk tujuan pertanian manakala selebihnya untuk tujuan munisipal dan perindustrian. Kesan bekalan air baru ini ke atas aktiviti pertanian adalah besar dan begitu juga kesan jangkaan keatas alam sekitar. Dalam perspektif ini, kajian ini dilaksanakan untuk mengenalpasti kesan-kesan ini keatas kegiatan pertanian dan alam sekitar di Bandar Abu Sheiba, sebuah kawasan pertanian di utara Libya. Penemuan-penemuan daripada hasil solasesidik menunjukkan kesan GMMRP keatas akativiti pertanian di situ adalah besar dan begitu juga kebimbangan penduduk tentang kesan lanjutan keatas alam sekitarnya.

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**LIST OF ABBREVIATION**

GMMRP	-	Great Man Made River Project
SPSS	-	Statistical Package for the Social Sciences
IHP	-	International Hydrological Programme
UNESCO	-	United Nations Educational, Scientific and Cultural Organization



## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background of the Study**

Increasing populations and industrial and agricultural development worldwide are placing much greater demand on groundwater supplies (Robert and Albert, 1989). Because it has practically no renewable water resources, Libya is one of the countries that rely heavily on groundwater to satisfy its ever-increasing water needs with minor contributions from springs, wades, and surface runoff (Abu fayed and El-Ghuel, 2001). Over 80% of Libya's population resides along a thin strip of its 1900-km-long Mediterranean coast, which also contains most of the country's agricultural farms and major industrial units. In recent years a rapid increase in population and water consumption rates for domestic, industrial and agricultural purposes have had a significant impact on the country's water resources — mostly ground aquifers — which suffered serious depletion and deterioration.

The above situation combined with severe droughts and uneven population distribution has prompted a search for new and unconventional sources of water (Bandar and Walid, 2000). Different options were considered to address this problem, which include the use of each option, importing water by ships, desalination of seawater, or laying a pipeline from Europe. As a result of this, the Libyan's authorities has paid a major attention to the idea of transferring water from the huge aquifers at the south to the north residential areas, which is known latter as the Great Man-Made River Project.

This research is an academic endeavour intending to investigate the environmental impact of the Great Man Made River project. The aim of this study is then to examine related problems that provide a basis for this research. For the purpose of this study, therefore, an agriculture town of Abu Shieba has been selected as a study area. The impact of the GMMRP on the agricultural activities of the town and the consequence environmental impacts of these agricultural activities are the focus of this study.

## **1.2 Statement of the Problem**

The background of the study has provided an overview to the problem of our interest. In recognizing that, there is an obvious need for a study on the impact of the GMMRP on the agriculture activities and the environment. Thus, the central problem statement of this study is to realize a better understanding of the total environmental impact of the Great Man Made River Project through expansion of agriculture activities.

## **1.3 Purpose of the Study**

The purpose of this study is to understand the impact of the GMMRP on the agriculture activities at a small town in Libya and also to understand its eventual impact on the environment. By understanding how the project has changed the agricultural sector of the town in terms of its size, fertilizer and pesticide uses, etc, it is hoped that the environmental impact of environmental by these agricultural activities will be better understood.

#### **1.4 Objectives of the study**

The following objectives have been identified in the effort to achieve the purpose of this study.

1. To quantify the impact of the GMMR project on the agricultural sector of the study area.
2. To study the changes those take place within the agricultural practice at the study area.
3. To access the environmental impact that is a consequence to these changes.

#### **1.5 Research Questions**

The primary purpose of this study is to understand the Great Man Made River project and the underlying dimensions central to its agricultural environmental impact. In this inquiry the research questions have to serve two purposes. The first is to focus the study by showing the relationship of the research questions to the study's purpose. The second purpose is to guide the examination in how to conduct a qualitative and quantitative study by revealing the relationships to research methodology. The research methodology that will be chosen to address the research questions is the case study approach based on questionnaire instruments as primary data source. This will supported by company documents from relevant governmental authorities and a review of project literature as a secondary data

Given that this study aims to examine the agriculture environmental impact of the Great Man Made River project; the answers to the following question were sought to illustrate this interest:

1. What is the environmental impact of the Great Man Made River project as the consequences of its impact on agricultural activities?

## **1.6 Significance of the Study**

This study is significant because it proposes a research on one aspect at environmental impact of great man made river project. Impacts from the GMMR project are many and come in various form. This study however, is significant for its attempt to look at the environmental impacts of changes in towns agricultural activities as a result of the GMMR project. Knowing the environmental impacts of these changes would offer some ideas on how to minimize or mitigate them.

## **1.7 Scope of the Study**

Environmental impacts of the changes to the agricultural activities brought about by the project can be numerous and wide ranging. This study however, focuses only on the following;

1. The impacts of the project on the scale of the agricultural activities of a selected town, i. e the study area at Abu Sheiba.
2. The impacts of the changes on the availability and prices of agricultural products.
3. The impacts of the projects on the practices of water usage and fertilizer and pesticides application within the study area.

## CHAPTER 2

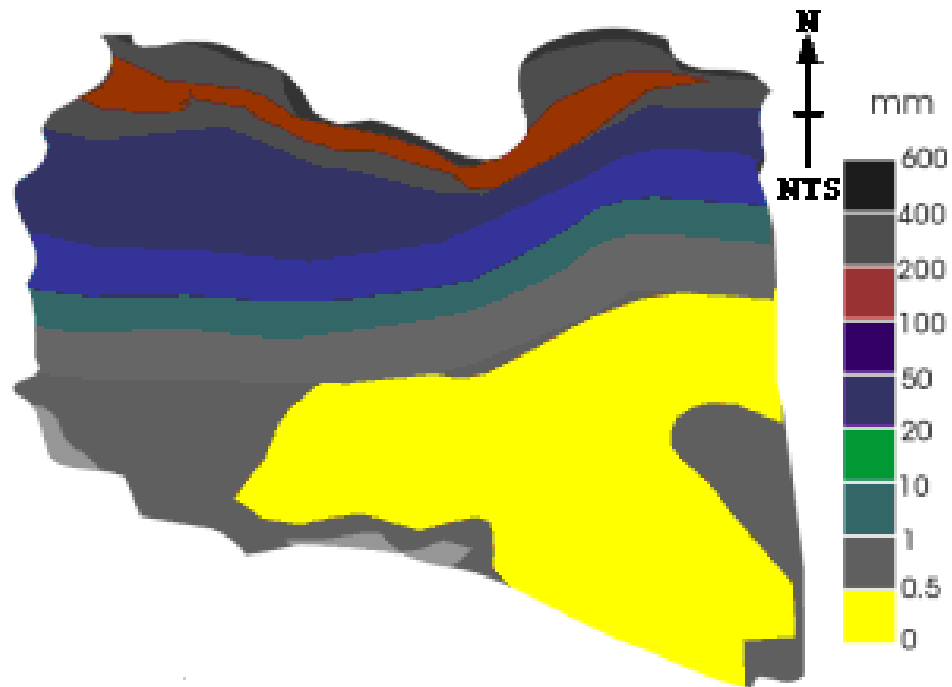
### LITERATURE REVIEW

#### 2.1 Introduction

Today the role of water as a vital and precious substance, a stimulating force in socio- economic development and a key factor in water ecosystem conservation is obvious and clear. In many countries, inappropriate water abstraction from groundwater has led to over-consumption and has caused negative consequences, seriously threatening sustainable development. However, according to the International Hydrological Programme (IHP) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) 2005, our water management problems and challenges are not confined to the natural shortage of water resources. Inappropriate methods of water management along with incremental deterioration of water quality have been additional stressors. Unfortunately, despite these consequences, the non-structural aspects of water management and demand management are not sufficiently taken into account.

In this respect, Libya is one of the countries located in the arid and semi-arid regions of the world and is suffering also from intensive water shortage and poor water management. The north coastal strip, on the other hand, is situated within a semi-Mediterranean climate and receives winter rainfalls ranging from 200 to 400 mm/yr with moderate temperatures and high relative humidity (Figure 2.1). There are both surface and groundwater resources in Libya (Salem, 2005). Surface water is rather limited and contributes to less than 3 per cent of the total water use for the different activities. In order to better control these resources, sixteen dams and

several reservoirs were constructed for the collection of over 60 million m<sup>3</sup> per year. Natural springs of low to medium discharge provide water for different uses in the Jabal Akhdar(east Libya), Jabal Nefusa(west Libya) and the central zone.



Source: [www.gmmra.org](http://www.gmmra.org)

Figure 2.1: Yearly rain fall average of Libya

Groundwater represents the main source of water supply in the Libya. It is extracted through wells ranging from few metres to more than 1,000 m in depth. Groundwater aquifers are either renewable or non-renewable. The renewable aquifers are those located in the northern zones and fall within areas under high precipitation rates. They range in age from Quaternary to Cretaceous and contribute more than 2,400 million m<sup>3</sup> per year against an annual recharge of less than 6.5 million meter cube per year. This imbalance has provoked a continuous lowering of groundwater levels accompanied by deterioration in water quality due to seawater intrusion and invasion of saline water from adjacent aquifers (Salem, 2005)

This situation combined with severe droughts and uneven population distribution has prompted a search for new and unconventional sources of water (Bandar and Walid, 2000). Different options were considered to address this problem, which included importing water by ships, desalination of seawater, or laying a pipeline from Europe.

As a result of this problem, the Libyan authorities have paid major attention to the idea of transferring water from the huge aquifers at the south, along to the north residential areas, which known latter by the Great Man-Made River Project. This chapter therefore, is designed particularly to review most of the related literature that provides a basis to a better understand of this project.

## **2.2 Libya**

### **2.2.1 Geography**

Libya extends over 1,759,540 square kilometers (679,182 sq. mi), making it the 17th largest nation in the world by size. Libya is somewhat smaller than Indonesia, and roughly the size of the US state of Alaska. Libya is a country in North Africa, bound to the north by the Mediterranean Sea, the west by Tunisia and Algeria, the southwest by Niger, and the south by Chad and Sudan and to the east by Egypt. At 1770 kilometers (1100 miles), Libya's coastline is the longest of any African country bordering the Mediterranean. Geographic coordinates: Latitude 25°00 'North of the Equator Longitude: 17°00 'East of Greenwich (Figure 2.2).



Source: [www.printablemapstore.com](http://www.printablemapstore.com)

Figure 2.2: Map of Africa showing Libya

### 2.2.2 History of Libya

Archaeological evidence indicates that from as early as the 8th millennium BC, Libya's coastal plain was inhabited by a Neolithic people who were skilled in the domestication of cattle and the cultivation of crops. This culture flourished for thousands of years in the region, until they were displaced or absorbed by the Berbers.



The area known in modern times as Libya was later occupied by a series of peoples, with the Phoenicians, Carthaginians, Greeks, Romans, Vandals and Byzantines ruling all or part of the area. Although the Greeks and Romans left ruins at Cyrene, Leptis Magna and Sabratha, little other evidence remains of these ancient cultures. By the 5th century BC, Carthage, the greatest of the Phoenician colonies, had extended its hegemony across much of North Africa, where a distinctive civilization, known as Punic, came into being. Punic settlements on the Libyan coast included Oea (Tripoli), Labdah (Leptis Magna) and Sabratha (Figure 2.3). All these were in an area that was later called Tripolis, or "Three Cities". Libya's current-day capital Tripoli takes its name from this. The Greeks conquered Eastern Libya when, according to tradition, emigrants from the crowded island of Thera were commanded by the oracle at Delphi to seek a new home in North Africa. In 631 BC, they founded the city of Cyrene. Within 200 years, four more important Greek cities were established in the area: Barce Euesperides, Teuchira and Apollonia (Susah), the port of Cyrene. Together with Cyrene, they were known as the Pentapolis (Five Cities).

The Romans unified both regions of Libya, and for more than 400 years Tripolitania and Cyrenaica became prosperous Roman provinces. Roman ruins, such as those of Leptis Magna, attest to the vitality of the region, where populous cities and even small towns enjoyed the amenities of urban life. Merchants and artisans from many parts of the Roman world established themselves in North Africa, but the character of the cities of Tripolitania remained decidedly Punic and, in Cyrenaica, Greek. Arabs conquered Libya in the 7th century CE. In the following centuries, many of the indigenous peoples adopted Islam, and also the Arabic language and culture. The Ottoman Turks conquered the country in the mid-16th century, and the three States or "Wilayat" of Tripolitania, Cyrenaica and Fezzan (which make up Libya) remained part of their empire with the exception of the virtual autonomy of the Karamanlis who ruled from 1711 until 1835 mainly in Tripolitania but had influence in Cyrenaica and Fezzan as well, 1911 when Italy simultaneously turned the three regions into colonies. In 1934, Italy adopted the name "Libya" (used by the Greeks for all of North Africa, except Egypt) as the official name of the colony (made up of the three Provinces of Cyrenaica, Tripolitania and Fezzan).



Source: from <http://flickr.com/photos/duimdog>

Figure 2.3: Theatre sabratha Libya.

### 2.2.3 Climate

The climate is mostly dry and desert-like in nature. However, the northern regions enjoy a milder Mediterranean climate. Natural hazards come in the form of hot, dry, dust-laden sirocco. This is a southern wind blowing from one to four days in spring and autumn. There are also dust storms and sandstorms. Oases can also be found scattered throughout Libya, the most important of which are Ghadames and Kufra as well as others.

#### **2.2.4 Demographics**

The main language spoken in Libya is Arabic, which is also the official language. Tamazight, which do not have official status, are spoken by Libyan Berbers. Berber speakers live above all in the Jebel Nafusa region, the town of Zuwarah on the coast, and the city-oases of Ghadames, Ghat and Awjila. In addition, Tuaregs speak Tamahaq, the only known Northern Tamasheq language. Italian and English are sometimes spoken in the big cities, although Italian speakers are mainly among the older generation.

By far the predominant religion in Libya is Islam with 100% of the population associating with the faith. The vast majority of Libyan Muslims adhere to Sunni Islam, which provides both a spiritual guide for individuals and a keystone for government policy. Family life is important for Libyan families, the majority of which live in apartment blocks and other independent housing units, with precise modes of housing depending on their income and wealth. Although the Libyan Arabs traditionally lived nomadic lifestyles in tents, they have now settled in various towns and cities. Because of this, their old ways of life are gradually fading out. An unknown small number of Libyans still live in the desert as their families have done for centuries. Most of the population has occupations in industry and services, and a small percentage is in agriculture.

#### **2.2.5 Libyan Desert**

The Libyan Desert, which covers much of eastern Libya, is one of the most arid places on earth. In places, decades may pass without rain, and even in the highlands rainfall happens erratically, once every 5-10 years. At Uweinat, the last recorded rainfall was in September 1998. There is a large depression, the Qattara Depression, just to the south of the northernmost scarp, with Siwa oasis at its western extremity. The depression continues in a shallower form west, to the oases of Jaghbub and Jalo.

Likewise, the temperature in the Libyan desert can be extreme; in 1922, the town of Al 'Aziziyah, which is located west of Tripoli, recorded an air temperature of 57.8 °C (136.0 °F), generally accepted as the highest recorded naturally occurring air temperature reached on Earth.

There are a few scattered uninhabited small oases, usually linked to the major depressions, where water can be found by digging to a few feet in depth. In the west there is a widely dispersed group of oases in unconnected shallow depressions, the Kufra group, consisting of Tazerbo, Rebiana and Kufra. Aside from the scarps, the general flatness is only interrupted by a series of plateaus and massifs near the centre of the Libyan Desert, around the convergence of the Egyptian-Sudanese-Libyan Borders.

### **2.2.6 Economy**

The Libyan economy depends primarily upon revenues from the oil sector, which constitute practically all export earnings and about one-quarter of gross domestic product (GDP). These oil revenues and a small population give Libya one of the highest GDPs per person in Africa and have allowed the Libyan state to provide an extensive and impressive level of social security, particularly in the fields of housing and education. The non-oil manufacturing and construction sectors, which account for about 20% of GDP, have expanded from processing mostly agricultural products to include the production of petrochemicals, iron, steel and aluminum. Climatic conditions and poor soils severely limit agricultural output.

### **2.2.7 Culture**

Libya is culturally similar to its neighboring Arab states. While the primary language of the country is a local colloquial form of Arabic, the Libyan people

consider themselves very much a part of a wider Arab community. Libyan Arabs have a heritage in the traditions of the nomadic Bedouin and associate themselves with a particular Bedouin tribe.

As with some other countries in the Arab world, Libya boasts few theatres or art galleries. Public entertainment is almost nonexistent, even in the big cities. Recently however, there has been a revival of the arts in Libya, especially painting: private galleries are springing up to provide a showcase for new talent. Conversely, for many years there have been no public theatres, and only a few cinemas showing foreign films. The tradition of folk culture is still alive and well, with troupes performing music and dance at frequent festivals, both in Libya and abroad. The main output of Libyan television is devoted to showing various styles of traditional Libyan music. Tuareg music and dance are popular in Ghadames and the south. Libyan television programmes are mostly in Arabic with a 30-minute news broadcast each evening in English and French. The government maintains strict control over all media outlets. A new analysis by the Committee to Protect Journalists has found Libya's media the most tightly controlled in the Arab world. To combat this, the government plans to introduce private media, an initiative intended to bring the country's media in from the cold.

Many Libyans frequent the country's beaches. They also visit Libya's beautifully-preserved archaeological sites—especially Leptis Magna, which is widely considered to be one of the best preserved Roman archaeological sites in the world. The nation's capital, Tripoli, boasts many good museums and archives; these include the Government Library, the Ethnographic Museum, the Archaeological Museum, the National Archives, the Epigraphy Museum and the Islamic Museum. The Jamahiriya Museum, built in consultation with UNESCO, may be the country's most famous. It houses one of the finest collections of classical art in the Mediterranean.

### **2.2.8 Politics**

There are two branches of government in Libya. The "revolutionary sector" comprises Revolutionary Leader Gaddafi, the Revolutionary Committees and the remaining members of the 12-person Revolutionary Command Council, which was established in 1969. The historical revolutionary leadership is not elected and cannot be voted out of office; they are in power by virtue of their involvement in the revolution. The revolutionary sector dictates the decision-making power of the second sector, the "Jamahiriya Sector".

Constituting the legislative branch of government, this sector comprises Local People's Congresses in each of the 1,500 urban wards, 32 Sha'biyat People's Congresses for the regions, and the National General People's Congress. These legislative bodies are represented by corresponding executive bodies (Local People's Committees, Sha'biyat People's Committees and the National General People's Committee/Cabinet).

Every four years, the membership of the Local People's Congresses elects their own leaders and the secretaries for the People's Committees, sometimes after many debates and a critical vote. The leadership of the Local People's Congress represents the local congress at the People's Congress of the next level. The members of the National General People's Congress elect the members of the National General People's Committee at their annual meeting.

## **2.3 The Great Man Made River Project (GMMRP)**

### **2.3.1 Historical Background**

Libya's Great Man-Made River Project is one of the greatest civil engineering schemes currently being carried out in the world. This project is

undertaken to supply Libya's needs by drawing water from aquifers beneath the Sahara and conveying it along a network of huge underground pipes for use (predominantly for irrigation) in Libya's northern coastal belt.

In the 1950s and 1960s the search for new oilfields in the deserts of southern Libya led to the discovery not only of significant oil reserves, but also of aquifers containing vast quantities of fresh groundwater Loucks,(2004). Most of this 'fossil' water was collected over 35,000 years ago. The demand for fresh water in the mostly desert country of Libya to sustain its economy, especially its agriculture sector, exceeds its traditional supplies. Hence soon after this discovery of fresh groundwater reserves a plan was conceived to pump and transport water from these aquifers in the desert to Libya's Mediterranean coast where most of its 4 million people live and where the water can be used. This project is called the Great Man-made River. The work on the project began in 1984 and will take an estimated 25 years to complete. The project was designed in four phases and recently work has commenced on the 4th phase. When completed, irrigation water from the GMMRP will enable about 155,000ha of land to be cultivated. According to (Loucks, 2004) the total cost of the project is expected to reach 25 billion US dollars. Figure 2.4 illustrates in one view the total project design.

Back to project background, first conceived in the late 1960s, the initial feasibility studies were conducted in 1974 and work began ten years later. The project, which still has an estimated 5 years to run, was designed in five phases. Each one is largely separated in its design but will eventually combine to form an integrated system.



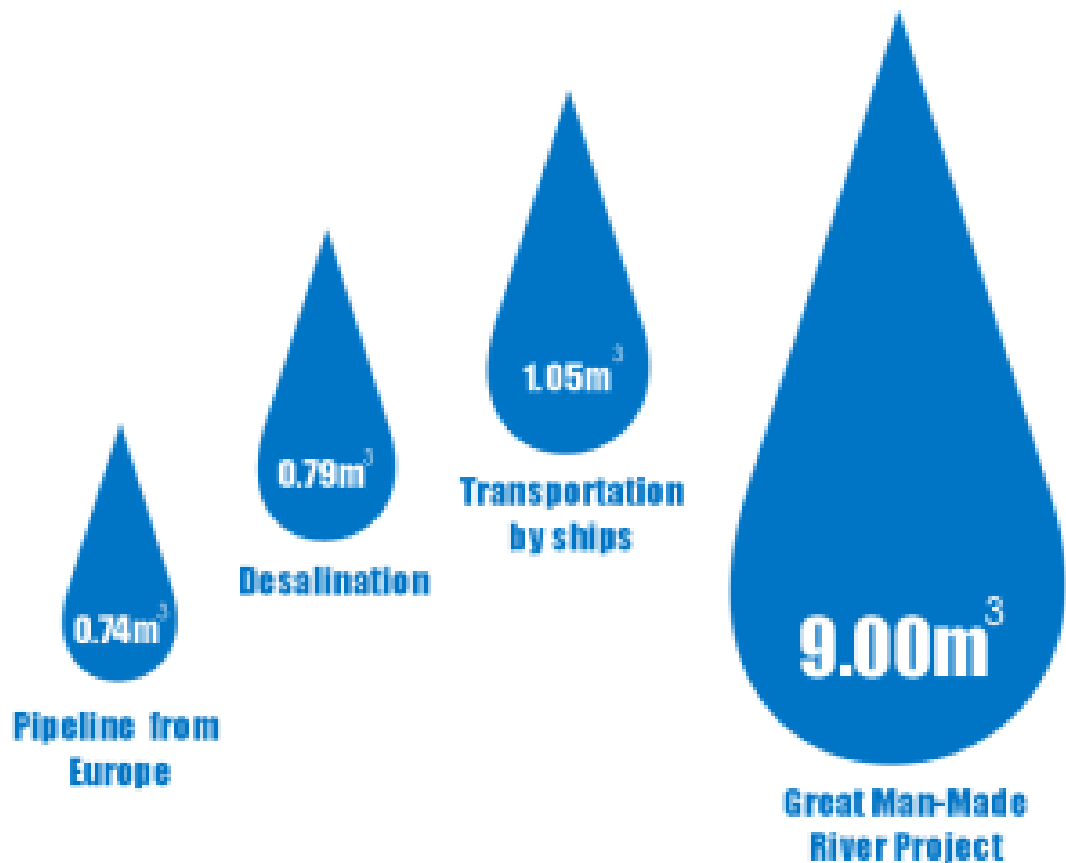
Source: [www.gmmra.org](http://www.gmmra.org)

Figure 2.4: The whole GMMRP network.

### 2.3.2 Project Initiative and Economic Feasibility

Upon the feasibility study, the initial idea of starting the Great Man-Made River was mooted at the General People's Congress on 3<sup>rd</sup> October 1983. This followed geological revelations that up to 120,000 cubic kilometers of water lay beneath the Sahara Desert dating 14-38,000 years. It emerged that within a given budget, the Great Man-Made River Project would be five times more water cost effective than the other three options combined (i.e. importing water by ships, desalination of seawater, or laying a pipeline from Europe)(Figure 2.5).





Source: [www.gmmra.org](http://www.gmmra.org)

**Figure 2.5: Cost water from different resources**

In October 1983, the Great Man-Made River Authority was created and invested with the responsibility of taking water from the aquifers in the south, and conveying it by the most economical and practical means for use, predominantly for irrigation, in the Libyan coastal belt.

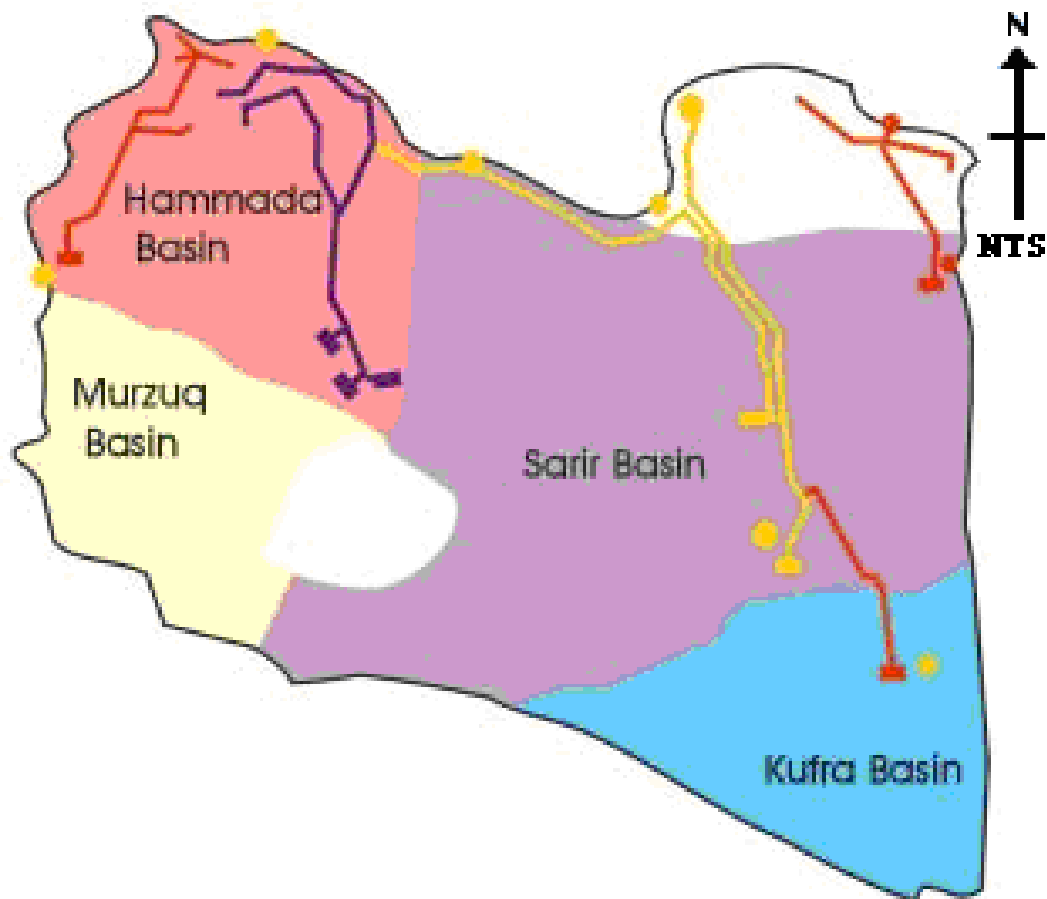
### 2.3.3 Project Technical Features

According to the Wikipedia free encyclopedia (2006) the Great Man-made River Project (GMMRP) is a network of pipes that supplies water from the Sahara Desert in Libya from a fossil aquifer. Some sources cite it as the largest engineering project ever undertaken. It consists of more than 1300 wells, more than 500 m deep,

and supplies 6,500,000 m<sup>3</sup> of freshwater per day to the cities of Tripoli, Benghazi, and elsewhere. It is the largest single development effort has been established by Libyan government,(Dirk, 1999). It is a multi-billion dollar project designed to facilitate irrigation for agricultural production along the Libyan coastline.

#### **2.3.4 The Groundwater Resources of the Great Man Made River Project**

In term of the water resources, there are four major underground basins (Figure 2.6). The Kufra basin, lying in the south east, near the Egyptian border, covers an area of 350,000km<sup>2</sup>, forming an aquifer layer over 2,000m deep, with an estimated capacity of 20,000km<sup>2</sup> in the Libyan sector. The 600m-deep aquifer in the Sirt basin is estimated to hold over 10,000km<sup>2</sup> of water, while the 450,000km<sup>2</sup> Murzuk basins, south of Jabal Fezzan, is estimated to hold 4,800km<sup>3</sup>. Further water lies in the Hamadah and Jufrah (west of Libya) basins, which extend from the Qargaf (southern east of Libya) Arch and Jabal Sawda (south of Libya) to the coast.



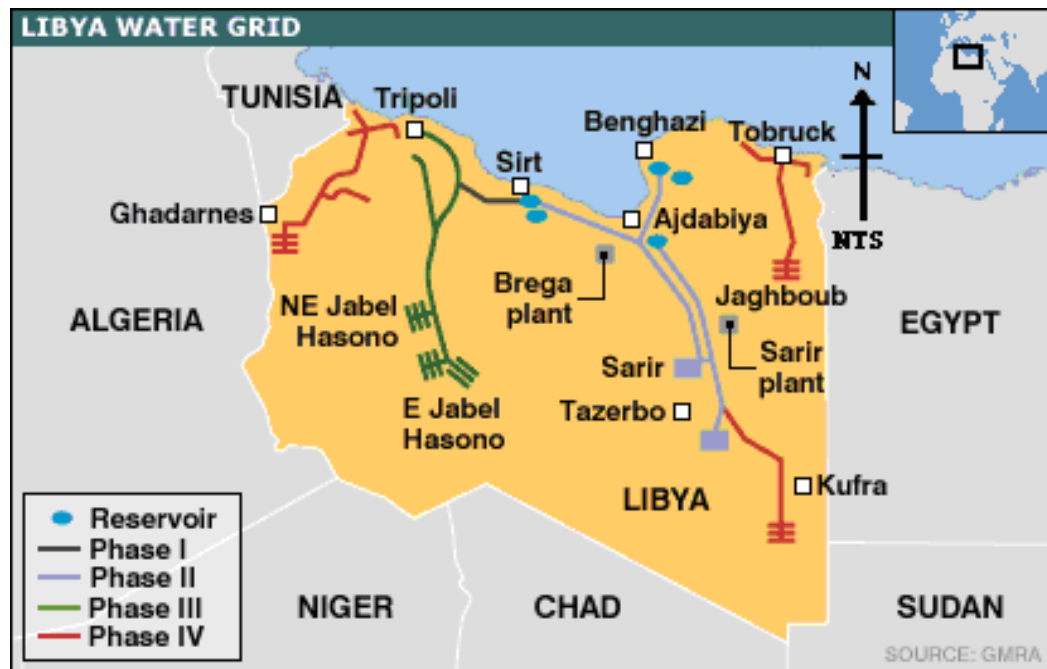
Source: [www.gmmra.org](http://www.gmmra.org)

**Figure 2.6: the main water source basin of great man made river**

Total mean annual runoff calculated or measured at the entrance of the wadis in the plains (or spreading zones) is roughly estimated at 200 million  $m^3$  per year, but a large part of it evaporates or recharges the underlying aquifers. Therefore, the regular renewable surface water resources are estimated at 100 million  $m^3$  per year. Currently there are 16 dams in operation with a crest higher than 10 meters. No new dams are under construction, but rehabilitation of the Wadi Qattara main dam and reconstruction of the secondary dam have just been started. A number of new dams are planned, but construction has not yet begun as a result of financial constraints. The total storage capacity of these dams is 385 million  $m^3$  with an average annual storage capacity of about 61 million  $m^3$ .

### 2.3.5 Phases of the Project

The first phase of the project was commissioned in 1990, and completed in November 1994 (Figure 2.7). The system is able to supply 2,000,000m<sup>3</sup> of water per day to Benghazi, the second-largest city in Libya. The second phase of the project finished in September 2000, completed the water supply section for the main city of Tripoli. It brings 2.5 million tones of water to Tripoli. The third phase will increase water flow in Phase I system by 1,680,000m<sup>3</sup> per day while Phase IV will provide 1,000,000m<sup>3</sup> per day of water through a pipeline to Tobruk. Phase IV will connect Phases I and II, and install two power stations to pump the 1,000,000m<sup>3</sup>/day of water.



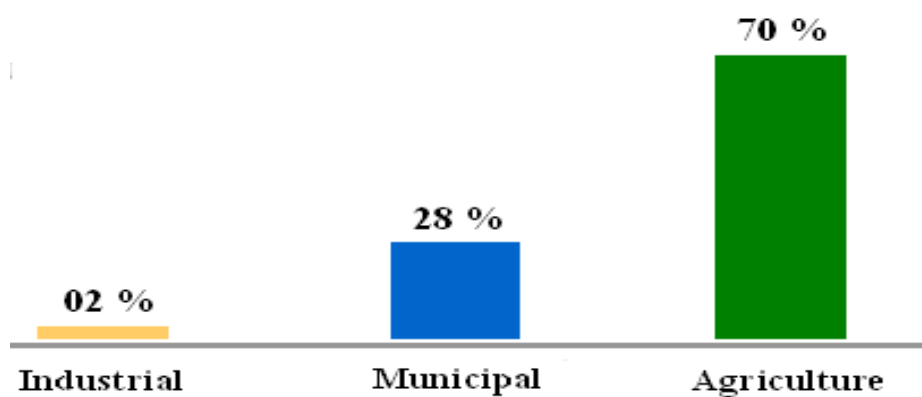
Source: [www.gmmra.org](http://www.gmmra.org)

Figure 2.7: The phases of the grate man made river.

### 2.3.6 The GMMRP Water Uses

The Great Manmade River Water Utilization Authority is responsible for the use for agricultural purposes of the water transported from the desert to the coast. The Secretariat of Municipalities takes care of the water demand of the urban settlements. At present, no water fees are imposed on users of water for irrigation purposes. From the total water withdrawal of 4.268 million m<sup>3</sup>, about 70 percent is demanded for agricultural purposes, 28 percent for domestic use and 2 percent for industrial use (Figure 2.8). More than 30 percent of the present domestic water demand is supplied by the GMRP. Most of the industrial water is used for the oil industry (injection, processing and some domestic use).

According to the assumptions made about water productivity in agriculture, the total water requirement to support basic food self-sufficiency and to meet the domestic water demand of the 12 million Libyans in the year 2025 is estimated to range between 10.5 and 16.4 km<sup>3</sup>/year, compared to 4.3 km<sup>3</sup> per year at present. When the GMRP is fully operational, the total amount of water available for all uses, assuming that the present groundwater production equipment will be maintained until 2025, will be in the order of 6.5 km<sup>3</sup>/year and will thus barely cover 50 percent of the total water requirement.



Source: [www.gmmra.org](http://www.gmmra.org)

Figure 2.8: usage of water from the GMMRP

## 2.4 The Study Area

The authority has performed special studies related to soil aiming to optimize utilization of land suitable for agriculture, giving priority to the best soils in quality to utilize high productivity projects within the program of investment of the Great Man-Made River Project Water. The Abu Shieba project is one of many agricultural projects that GMMRP use the water. Abu Sheiba is a town located in west of the Libya (Figure 2.9). The town itself is home to about 5000 people. Before the GMMRP, the agriculture area of the town covered only 700ha and used ground water as its main source of water. After the Great Man-Made River's water reached this area the agricultural area increased in space to 1600ha and the number of farmers increased from 117 farmers to 305 farmers (figure 2.10). Abu Shieba land before GMMRP was bushes with small trees and not much tillage required for preparing the land. After getting water from the GMMRP, more land was turned into agriculture land for planting many type of crops. Before the GMMRP the farmers planted mostly type of crops that did not need a lot of water like wheat, barley and clover but after the GMMRP the farmers plant even crops that need a lot of water like corn, peanut and many other types of crops like vegetables (potato, cauliflower, cabbage, pepper etc) fodder (wheat, barley, clover etc) and fruit (orange, grape, tomato etc). There is still a potential for the agriculture land to increase as is the income for farmers.



Source: [www.gmmrwua.com](http://www.gmmrwua.com)

Figure 2.9: Abu Shieba agriculture project location.



Source: [www.gmmrwua.com](http://www.gmmrwua.com)

**Figure 2.10: Abu Shieba agricultural project.**

## **2.5 Conclusion**

Based on the above literature review it is sufficient to conclude that the great man made river has tremendous impact on the water supply of Libya. Agriculture sector receives the biggest impact since most of the water generated is meant for irrigation. As a consequence of this, agriculture activities have been identified and more lands are opened up for farming. As such, the potential impact on the environment as a result of the increase in agriculture activities should be a concern.

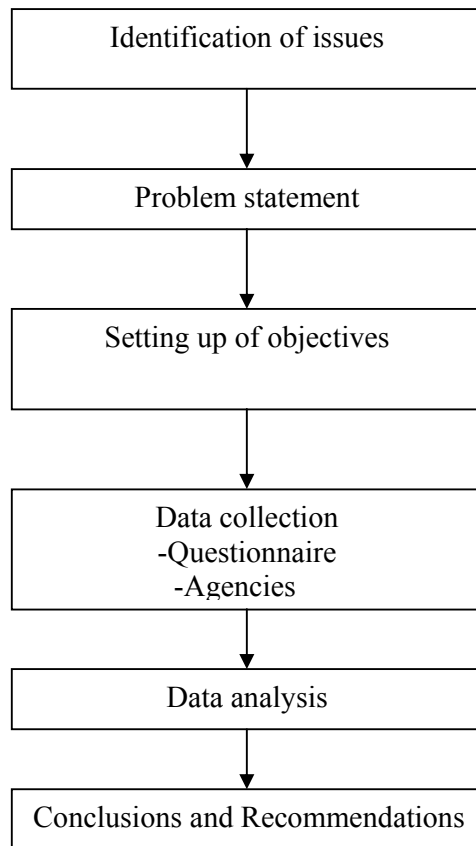


## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

Earlier chapter (i.e. Chapter Two) has explained the fundamental physical and technical principles of the great man made river project. The purpose of this chapter is to elucidate the research method utilized in gathering and analyzing the data for examining the environmental impact of the Great Man Made River Project through agricultural activities. The study hypothesizes that the Great Man Made River Project has dual impact (e.g. positive and negative impact) on Libyan's agriculture activities and consequently the environment. Figure 3.1 shows the step involved in conducting this study.



**Figure 3.1:** Methodology

### **3.2 Data Collection Procedure and Sample**

Data collected for this study are of two types; primary and secondary. Primary data that are collected first hand from a sample of farmers through questionnaire. Secondary data are data obtained from relevant government agencies such as Investment Authority of the Great Man-Made River water.

### **3.2.1 Primary Data Collection**

Data was collected for this study through the use of questionnaire survey on a sample of population involved in agriculture in the study area. Specifically, the recipients included the project authority personals and the farms owners. A total of 150 farmers were included in the sample.

The project authority personals included such key informants as chief economist and directors of project investment. The rationale for using these respondents was that they represent major knowledgeable personal about the project over all. The second category of the respondents consist the farmers benefiting from the using of the GMMR water. The rationale for using these respondents was that they are representing the public that are benefiting from the project.

### **3.2.2 Secondary Data Collection.**

To find better application for the qualitative method, the project documents and related literature were collected. The objective here is to review the quantity of text material based on identified the themes and patterns of the environment impacts issues. the secondary data collected from Investment Authority of the Great Man-Made River project's water archives the data was about Abu Shieba agriculture project after and before the GMMRP , change of land size, number of farmers, type of land use in Abu Shieba after and before the GMMRP, if there were cut trees or earthwork in this land. Also if there is any loss of the natural habitats, the possibility of increase in agricultural land, the type of crops the farmers plant there and if there is change of type of crops after the GMMRP, the water resource before GMMR Project e and after, if it has any control on the water and control on fertilizer and pesticide use, what impacts on environment and the quantity of fertilizer and pesticide use after and before the GMMRP.

### **3.3 Instrumentation**

The instrument for data collection in this study is a set of questionnaire on the GMMRP water impact on Libyan agricultural environment. The questionnaire developed by the researcher based on previous literatures. The question selected in order to cover the entire of the underlying issue concerning the agriculture activities, environmental and food impacts. The questionnaire distributed to the farmers in Arabic language as shown in Appendix A after and being collected the questionnaire translated into English as shown in Appendix B. The questionnaire consists of 22 questions grouped in three major sections, i.e agriculture activities, environmental impact and food impacts.

### **3.4 Data Analysis**

SPSS software was used to analyze the responded questionnaire. Proper analyses were selected to realize statistically the study objective, descriptive analysis and cross tabulation analysis to obtain good result. For descriptive analysis, frequency tables were generated. For checking the relationships between variables, a series of cross tabulations were generated.

## **CHAPTER 4**

### **DATA ANALYSIS**

#### **4.1 Introduction**

This chapter discusses the analysis done for the data collected from the survey done in one agriculture project in Abu Sheiba that uses the GMMRP water. The sampled 150 respondents indicated that they have different occupations and different level of education but all of them have agriculture land and they use the GMMRP water for producing food in their lands. Abu Shieba project is one of many projects that use GMMRP water. It was small project 700ha before the GMMRP water come to it but after the water reached the area, agriculture land increase to the total area of 1600ha. This analysis examined the impacts of the GMMRP on agriculture land, food, market price and the environment.

The type of analysis used is descriptive statistical analysis with some cross tabulation. This study focused on four sections as result of the GMMRP and examines the impacts of it and investigates whether these impacts are positive or negative. The four sectors are:

1. Impact on agriculture land.
2. Impact on food.
3. Impact on market price.
4. Impact on environment.

## **4.2 General background of respondents.**

Most of respondents surveyed do not have educational certificates but they are full time farmers and they started farming when they were young and they are having experience. Some are not full time farmers but they have other jobs and they have lands as investment. Out of all the respondents surveyed, 32.67 percent have only primary education, 16.67 percent have up to secondary education, 6 percent high school education and 2.67 percent up to undergraduate level. Forty two percent indicated that they had no formal education.

Of the farmers surveyed, 38.67 percent are retired, 49.33 percent are full time farmers, 9.33 percent are employer and 2.67 percent are engineers. Here we note most of the respondents are full time farmers. Other respondents actually they are not farmers but they own lands as investment and they manage the farming, they have other jobs and have workers stay in farms and do the work. The owners between time to time visit their lands since they do not stay in Abu Shieba.

## **4.3 Impact on agriculture activities.**

As mentioned in Chapter Two about 70 percent of the GMMRP's water use for agriculture and the GMMRP provide huge quantity of water (6.5 million m<sup>3</sup> water per day) , from that we understand Libyan agriculture sector improved so much. We tried measuring this change especially in the area where we did survey (case study). Availability of water as result of the GMMRP and as the respondents said of course increase of agriculture land and this increase have many effects, we tried clarifying these effects through our questionnaire to obtain the objectives of this study. The GMMRP supplied unlimited quantity of water that was main reason for increase the agriculture land (Figure 4.1) and farming income, some of the farmers are new because before the GMMRP they don't have farms but after the availability of water they decide to own agriculture land and try to invest in new field that was impossible before the GMMRP because limitation of water all that factors above has

been effected on Local agro-based industrial of course surplus of food make some people to establish new and improve the old factories for this surplus of food , that more employments for the people and this will improve the economic activities for whole the country.



Source: [www.gmmrwua.com](http://www.gmmrwua.com)

Figure 4.1: Agriculture land

A. Increase of agriculture land.

Ninety percent of the respondents said the GMMRP has increased the agriculture land space while 9.3 percent neither agree nor disagree the

GMMRP increased the agriculture land space. On the other hand, 0.67 percent did not agree that the GMMRP increased the agriculture land space (Figure 4.2). The GMMRP was main reason behind the increase in agriculture land because it provides the water use in agriculture. Libya has big area about 2 million Km<sup>2</sup> but most of that area is desert that do not have much rain that means not much water to increase the land and resisting the desertification is considered a big issue in north and middle Africa region. Thus the GMMRP is able to help solve this problem, even through small. However the agriculture land increase is noticeable in whole Libya in general and in Abu Shieba project in particular where the agriculture land was 700ha before the GMMRP and 1600ha after the GMMRP.

The increase in the land has increased significantly after the construction of GMMR as shown in the Figure 4.2. The land increased so much after the GMMRP water's came to Abu Shieba project whereas the land was 700H the farmers were use ground water. The ground water limited and not renewable because this area don't has much rain and don't has any surface water ressource that made Abu Shieba project small and difficult to increase but after the GMMRP water's gave big chance to expansion in land. Currently the land 1600H the different about 900H this increase has many impacts one of that impacts increase of farmers number ,the number was 117 farmers to 305 farmers that is mean the GMMRP saved more than 118 job chance (Figure 4.3) ( investment authority of the GMMRP water) and advantage as shown follow .



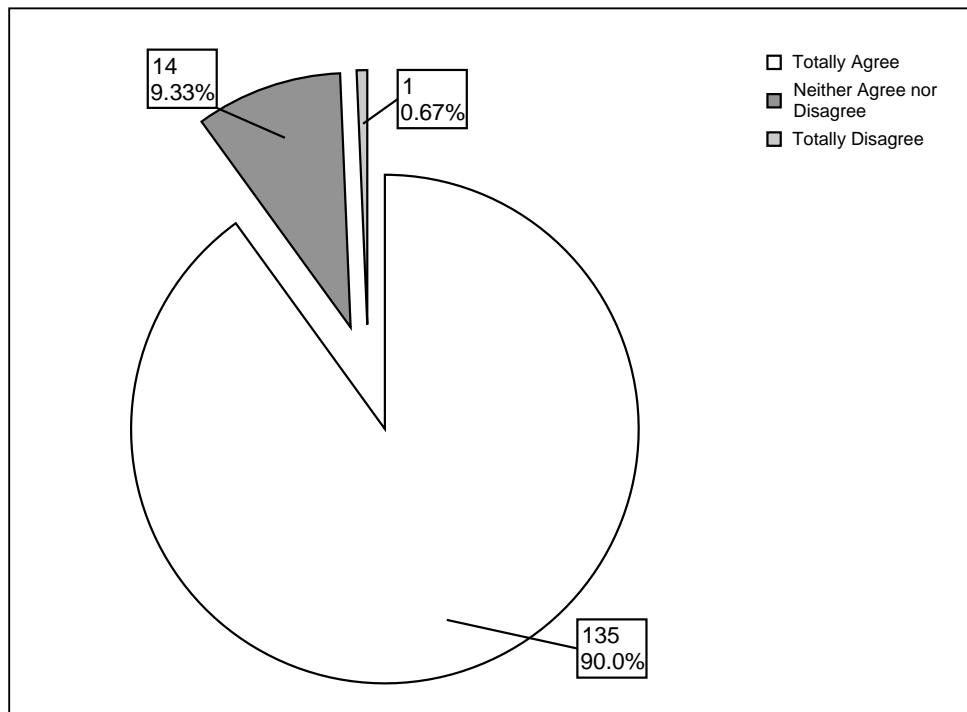


Figure 4.2 Increase agriculture land space.

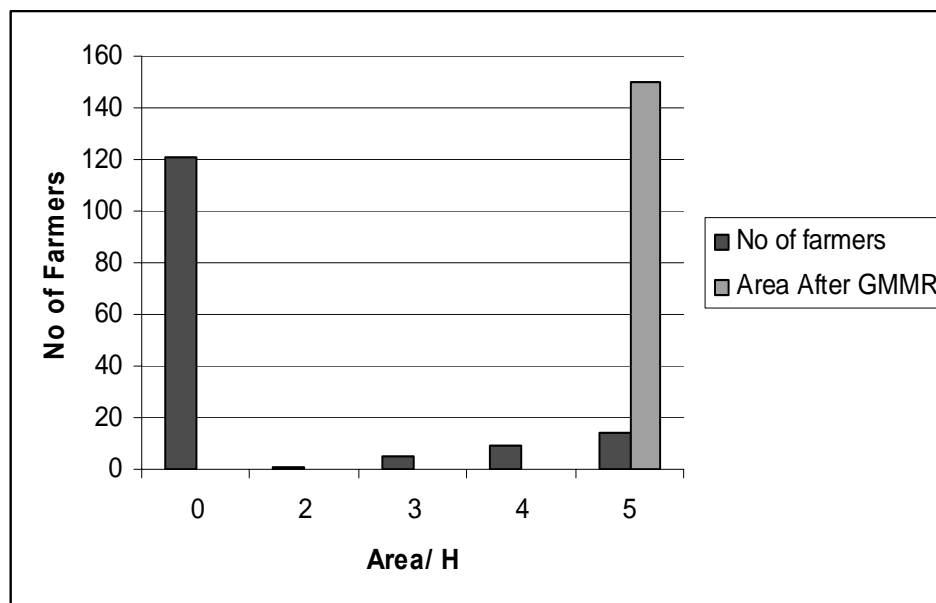


Figure 4.3 change in agriculture land before and after the GMMRP

The GMMRP has also encouraged farmers to invest more on seasonal plants that produce yield only in certain atmospheric conditions. To achieve this, farmers build green houses. A total of 44 greenhouses have been built and owned by about 41 of the respondents. A survey of the respondents shows that almost 88 percent of the agreed that the GMMRP help increase the number green houses (Figure 4.4).

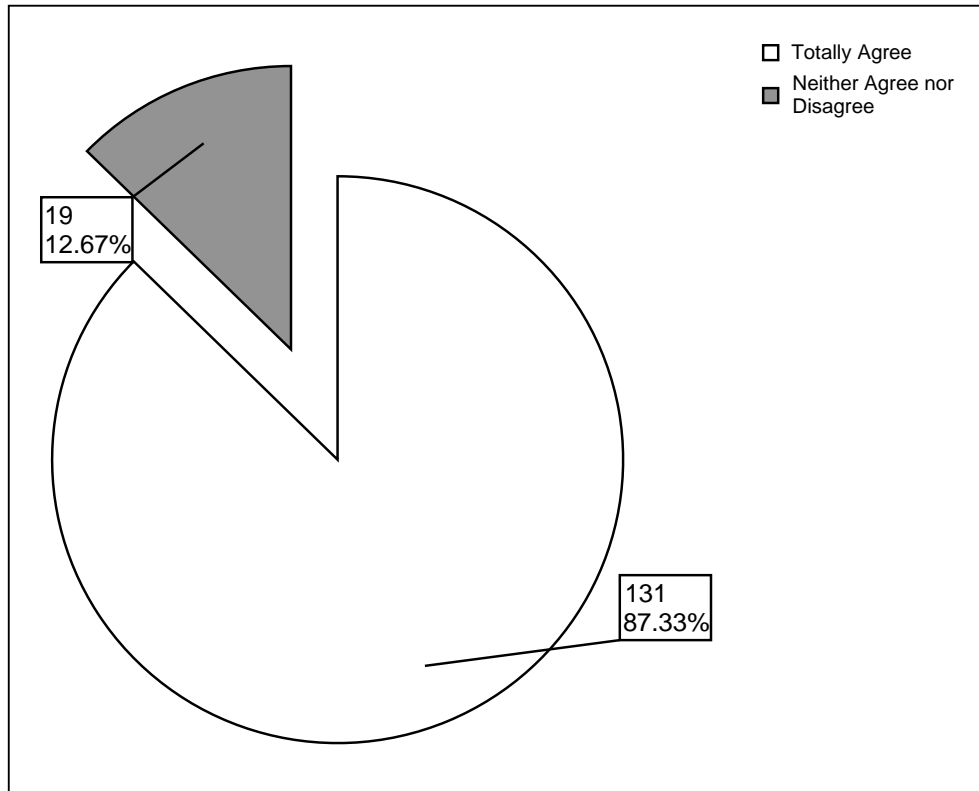


Figure 4.4: Increase green houses

#### B. The Water Availability.

The total of 80 percent of the respondents said the GMMRP has made the water available and unlimited, 17.3 percent said not too much available and unlimited and 2.7 percent said the GMMRP didn't make the water available and unlimited (Figure 4.5). The GMMRP provides Abu Shieba project with huge quantity of water and unlimited, this quantity helped to increase the agriculture land

not as before the GMMRP the water was small amount and limited where it was not enough to make high produce and increase the land. Before the GMMRP project, Abu Shieba project dry area did not have many water resources the farmers were using ground water.

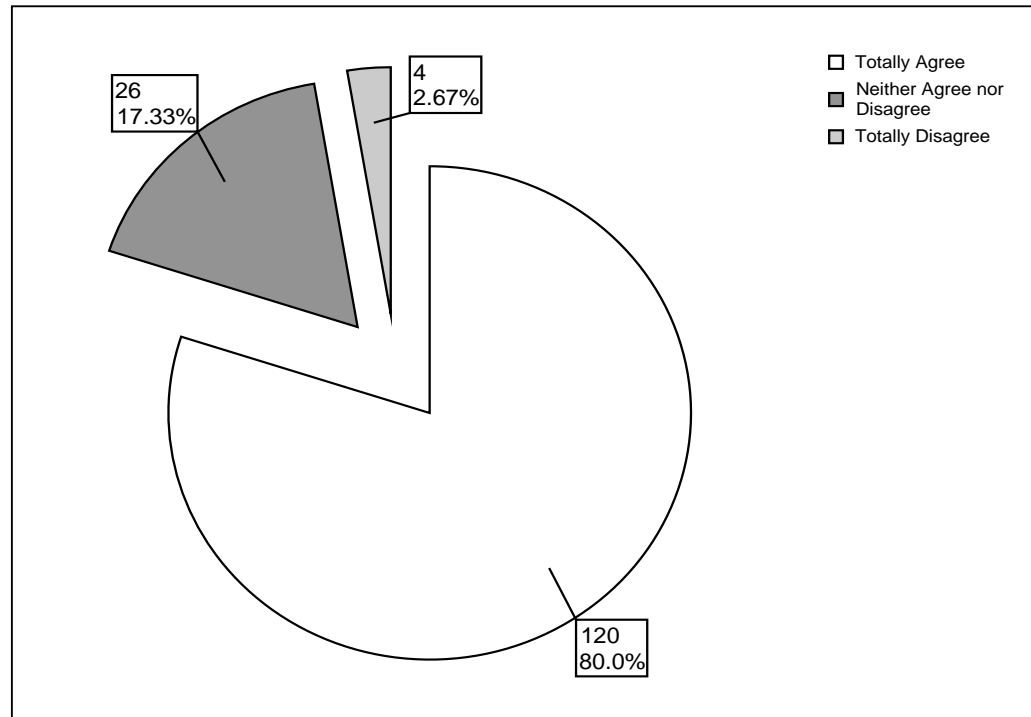


Figure 4.5: Water availability

C. Local agro-based industrial and economic activities.

About 81 percent of the respondents said the GMMRP increase the local agro-based industrial and economic activities due to the water supply by the river and 18.67 percent said the GMMRP don't has impact on the local agro-based industrial and economic activities (Figure 4.6). This has made an opportunity to develop new

industries that will use the raw materials obtained from the farms which eventually has brought a rise in the economy.

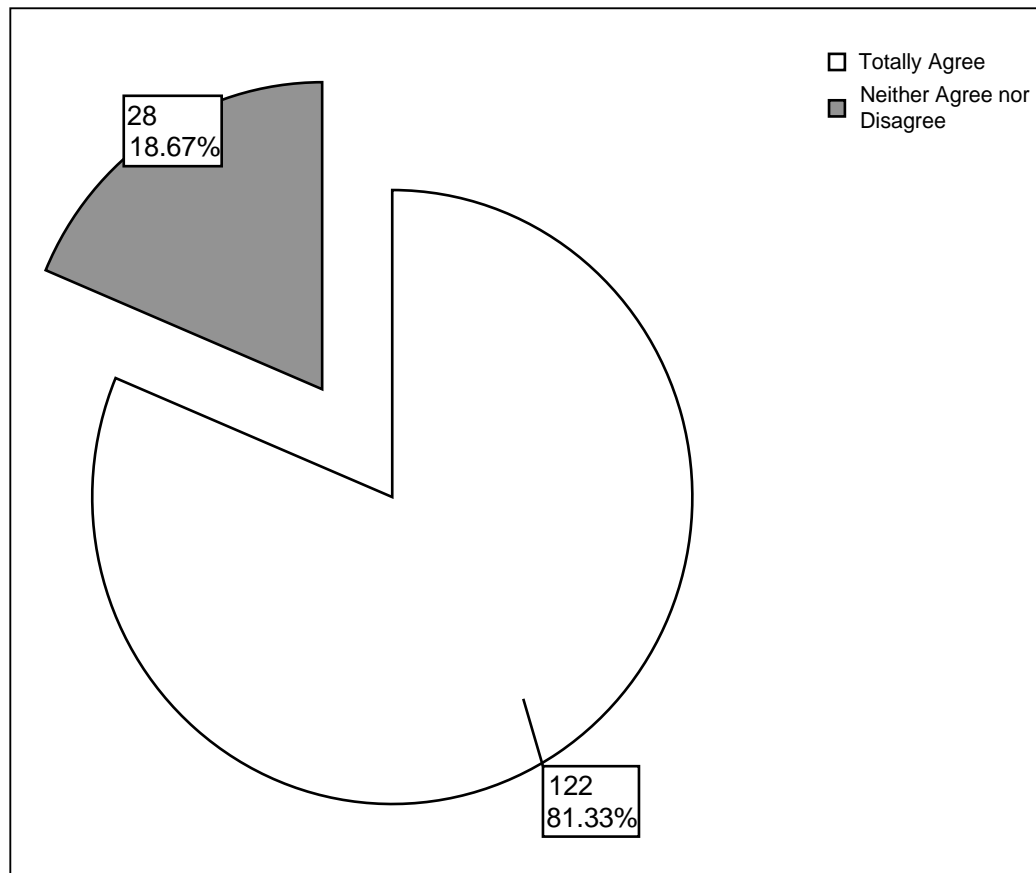


Figure 4.6: Growth of local industry after the GMMRP.

#### D. Farming Income

Most of the respondents said there increase in farming income where 70 percent of the respondents said the GMMRP increase the farming income, 29.3 percent not much increase farming income and 0.7 percent said the GMMRP didn't increase the farming income (Figure 4.7). The farmers are now able to plant those

plants that needed more water such as corn, peanut which was not possible before the GMMRP was completed. There is also an increase in the use of machinery, for automation of various works that were manually done earlier. Overall, the GMMRP has recently attracted more people to invest in the field of agriculture.

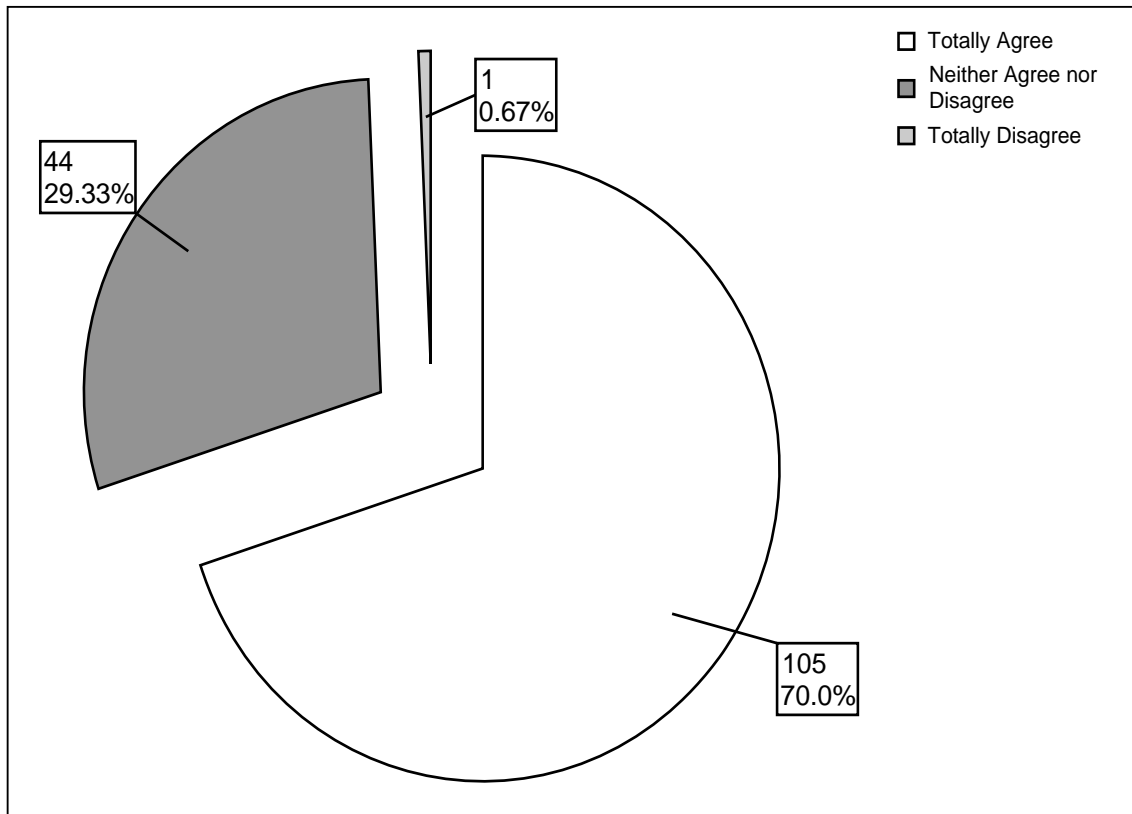


Figure 4.7: Increase in farming income

#### 4.4 Impact on Food & Price.

The water is main reason for produce the food when the area has water like river or ground water that mean this area produce a lot of food also the water has impact on food quality it is improve of the quality of food(Figure 4.8). After the

Great Man Made River Project the water became available with large quantity that help to produce more of food and improve of quality of course availability of food has impact on food price, income for farmers and the animal production because some of the farmers plant fodder that help to increase number of animals not like before the GMMRP the fodder was very expensive difficult for breeder to own big number of animals but after the GMMRP became easy to breeder to get big number of animals and as result of that the animal production increase and reduce the price for the production like meat, milk, egg, cheese and butter. Also some industrial use animal marital like skin for shoes and bags improved. All these impacts give more active to national economic, that give more significance to the GMMRP.



Source: [www.gmmrwua.com](http://www.gmmrwua.com)

Figure 4.8: impact on food.

#### A. Food availability.

As result water availability and increase of land, more production of food can be expected. Eighty eight percent of the respondents agree that there is a significant increase in the availability of food, 11.3 percent neither agrees not disagree and 0.7 percent disagree (Figure 4.9). The increase in quantity and types of food is because of two reasons: 1) the farmers try to produce more quantity to improve their income,

and 2) some try to plant new types of crops to open new market. All those have positive impact on food availability producer and consumer. The water also made the land more efficiently. For example 1m<sup>2</sup> was giving 1 Kg of wheat before but now 1m<sup>2</sup> gives 2 Kg of wheat.

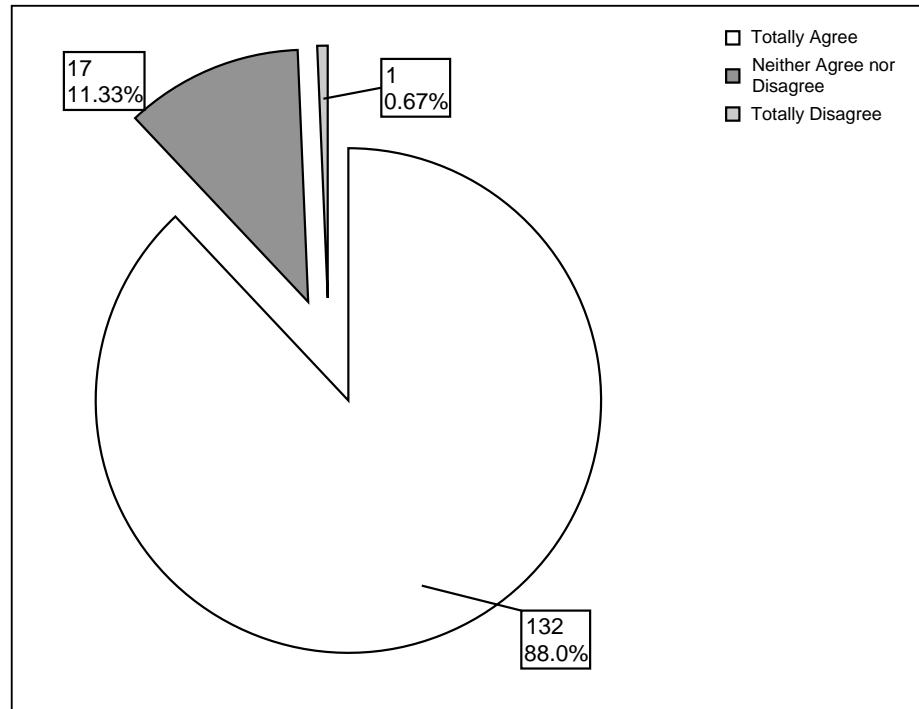


Figure 4.9: Impact on food availability

#### B Impact on food quality

With a lot of water becoming available, the quantity of the food is also expected to improve. Enough water makes produces become better in quantity and size. This is agreed in the surveyed where about 61 percent of the surveyed agree that the food quantity is better now after the GMMR project. Only 26 percent of the respondent neither agreed nor disagree to the improvement in food quantity while 13 percent disagreed (Figure 4.10).

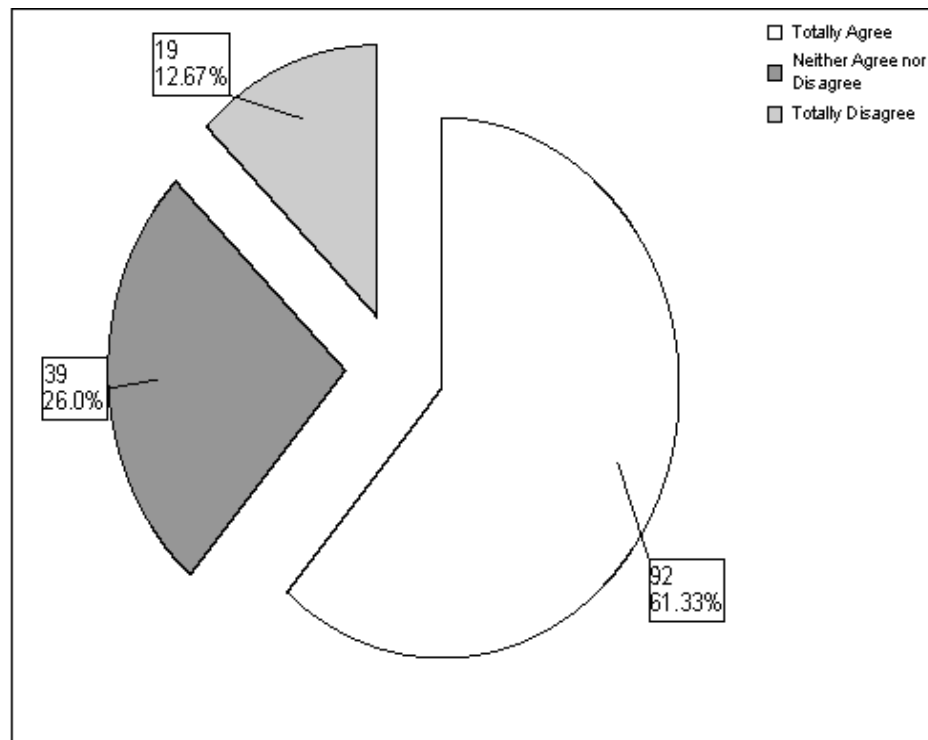


Figure 4.10: Impacts on food quality

### C Vegetal and animal production

The cattle feed cost was previously very high and there were very less investors. However, after the GMMRP's completion there is a decrease in the cattle feed cost probably due to increase in fodder production encouraging many to invest on animals like cow, sheep and camel. As a result, about 77 percent of those surveyed agreed that there is a noticeable increase in vegetal and animal production as a result of the GMMRP while 23 percent disagreed (Figure 4.11).



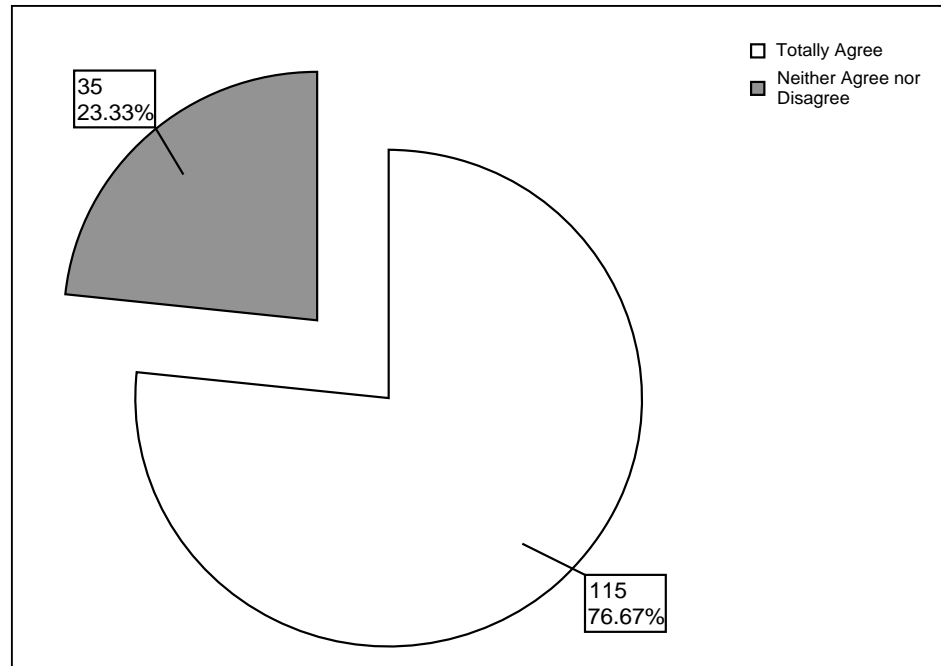


Figure 4.11: The vegetal and animal production

#### D Food price

After the increased in the agriculture land, number of farmers as a result, availability of food, food price are expected to decrease because there are more supply as result of increase in production. This is evident in the survey where a total of 73.3 percent of the respondents the said MMRP reduce the food prices, 23.3 percent neither agreed nor disagreed while 3.3 percent said no impact on food prices of the GMMRP (Figure 4.12). Whole those elements gave more advantage to seller and buyer. All that came after Abu Shieba project use GMMR projects water.

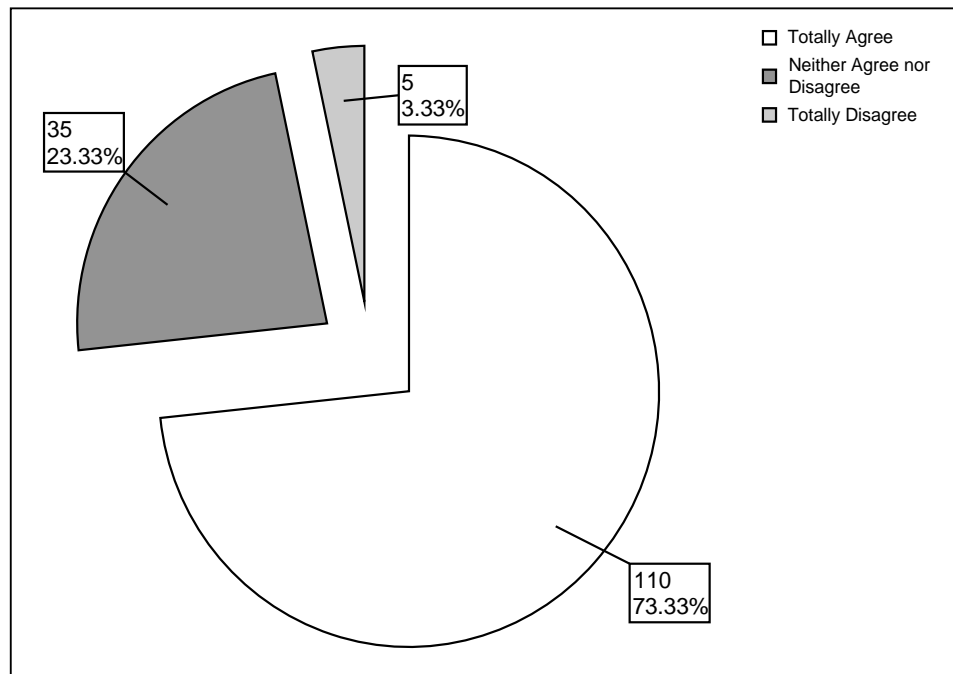


Figure 4.12: Impact on food price

#### E Impact on price in general

More than fifty eight percent of the respondents said the GMMRP reduce the market price and 35.33 percent said has impact but no too much and only 6 percent said the GMMRP didn't reduce the market price (figure 4.13). Some products that were not available domestically had to be brought in from far places, which increased their cost price. Now most of the products have been produced locally, which means there is a decrease in the overall transportation expenditure, thereby in the products cost itself.

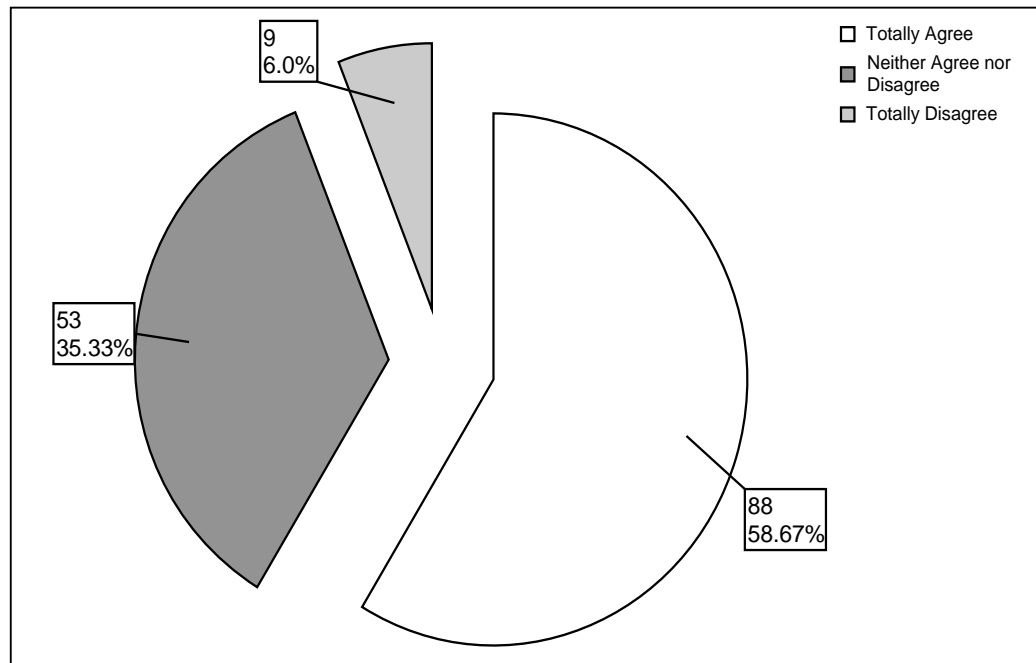


Figure 4.13: Impact on market price

#### F. Percentage of farming income

Figure 4.14 shows the distribution of the increase in farming income, due to the GMMRP. All of the respondents surveyed indicated that their income increased by a certain percentage. Majority of it, about 86 percent, increases 50-100 percent. The percentage of increase however depends on the types of plantation and number of farming seasons. Some of farmers plant only one season in the year to give the land a rest and they not use a lot of fertilizer but some plant two times in the year and they use a lot of water and fertilizer.

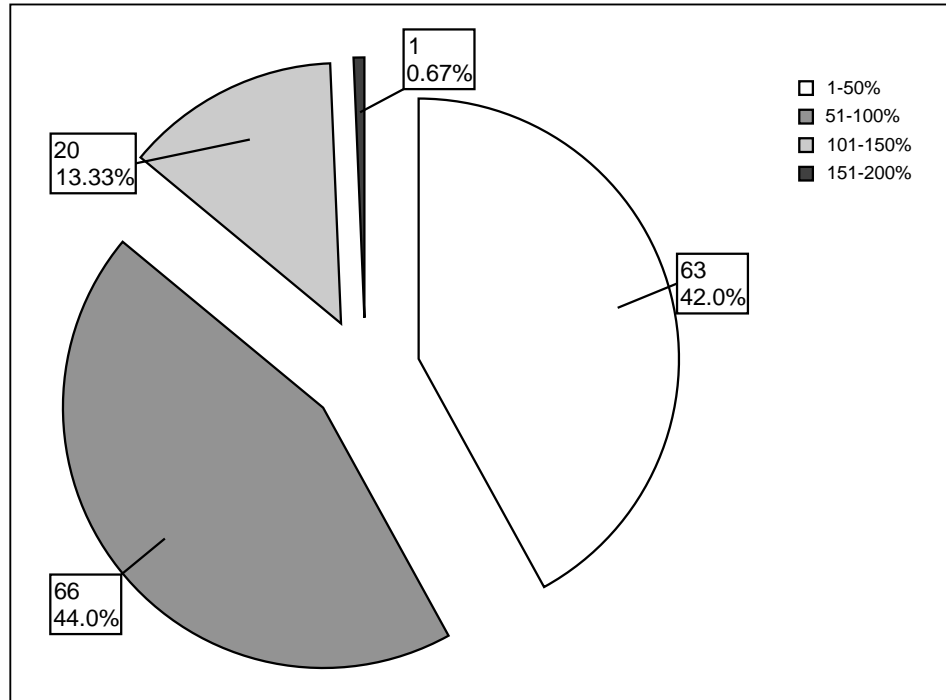


Figure 4 .14: Distribution of increase in farming income.

#### 4.5 Impact on the environment.

The big issue the world is concerned with now is the environment. The human activities make the pollution every the humans produce marital and emission elements hurt the environment like the pollution comes from factories, cars and so many activities help to increase the pollution some organizations and countries trying to product the environment but still can not control the rescues of pollution. The GMMRP as large project has impact o environment, through the questionnaire tried to realize this impact the result was there two types of impact first positive like resist the desertification because the green area stop the desertification(Figure 4.15), moderate temperature especially in the green area and the GMMRP increase the local rate of groundwater in Abu Shieba agriculture project because the farmers before the GMMRP were use the ground water but after the GMMRP the farmers close the local wells and some of the

surplus of water will feed the ground water. Second negative impact the farmers use a lot of water for irrigation that mean there is wasteful of water although there is control on water from the Abu Shieba agriculture project administration and the farmers use large quantity of fertilizer and pesticide they think that it will increase their product and some of them don't know the dangers of that also there is control on the quantity used of fertilizer and pesticide but still the farmers can use large quantity.



Source: [www.gmmrwua.com](http://www.gmmrwua.com)

Figure: 4.15: Stop desertification.

#### A Significant impact on environment

The GMMRP is one of bigger projects in the world because it brings water from the desert to the north of the country via pipe lines running through a total

length of around 4000km. This requires a lot of earthwork, wells drilling and also occupies very large area of land. All those processes have significance impact on environment. The authority has therefore a hag responsibility to take care of the environment and to reduce the negative impacts. A survey of the respondents shown that almost all of them agreed that the project has a significant impact on environment only 1 percent disagreed while another 16 percent neither agreed nor disagreed (Figure 4.16)

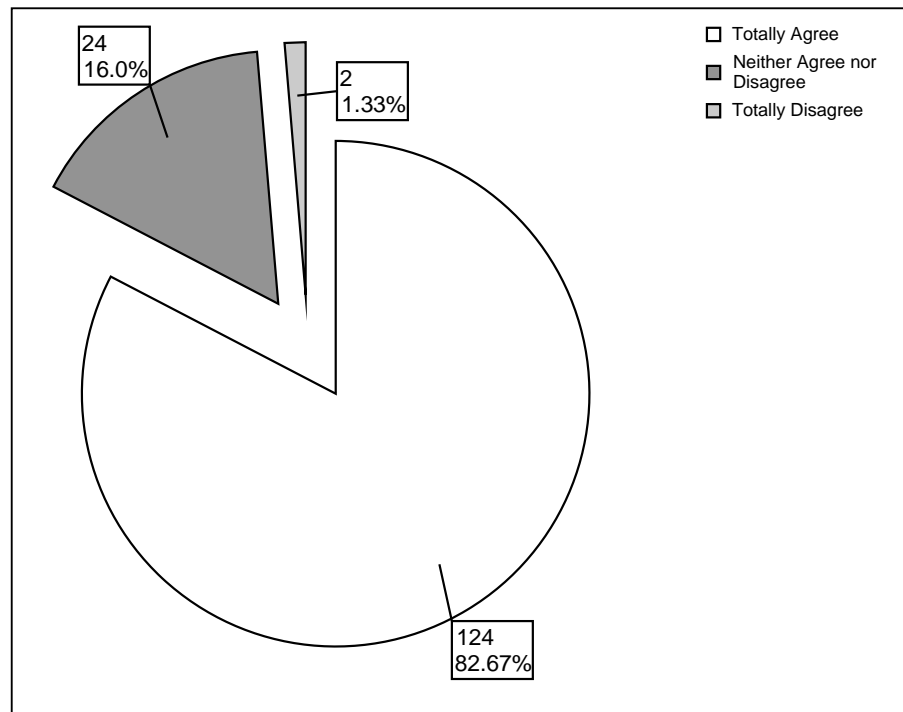


Figure 4 .16: Significant impact on the environment

## B Impact of fertilizer used on environment

Due to the increase in agricultural activities, the use of fertilizers has also increased. After a period of time the use of certain fertilizers can potentially degrade the quality of soil at the agricultural areas leaving the soil unusable in the future. There is however a limitation of quantity of fertilizer uses enforced by the investment

authority of the GMMRP's water. A survey on the awareness of farmers on the impact of fertilizer shows that almost all (83 percent) of them agreed that fertilizer has significant impact on the environment (Figure 4.17). Only 0.7 percent disagreed while the other 16 percent neither agreed nor disagreed.

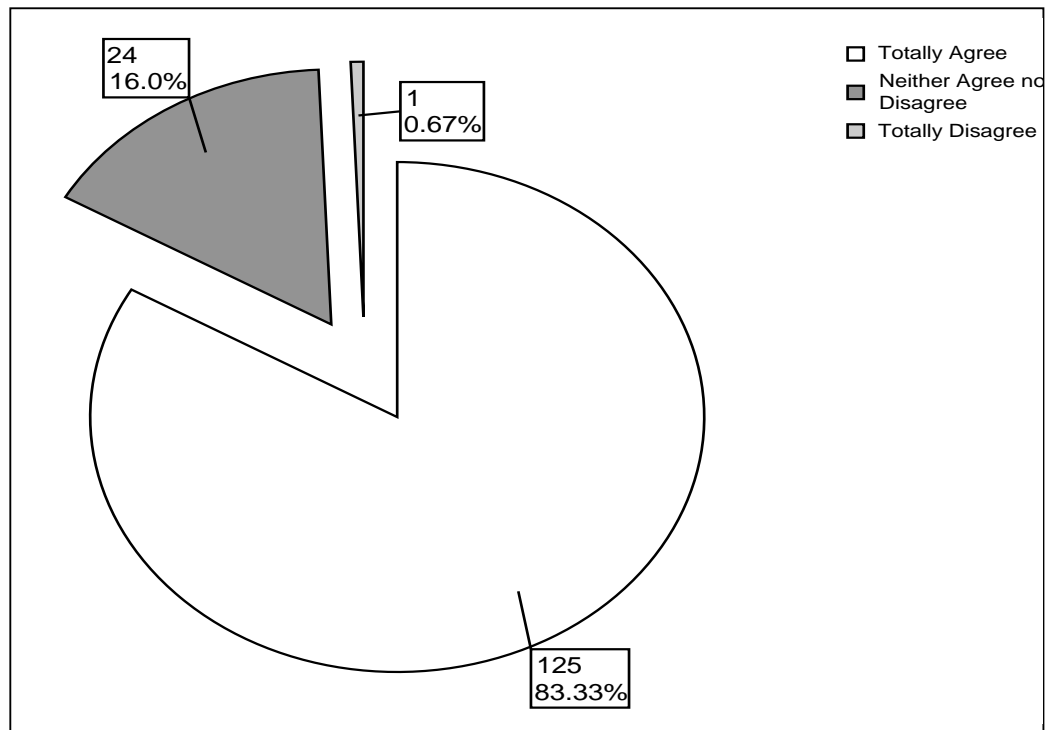


Figure 4.17: Impact of fertilizer use.

## C. Amount of fertilizer use and impact on environment.

Table 4.1 Amount of fertilizer use and impact on environment

Fertilizer used (kg/yr) Significant Impact on environment	1-100	101-200	201-300	301-400	401-600
Agree	59	37	21	7	1
Neither agree			13	11	
disagree					1

It can be noticed here the farmers don't care about the environment or they don't know the fertilizer has negative impact on environment use more then who agreed (Table 4.1), but the problem here most of farmers think the fertilizer has more advantage with large impact on production they think the fertilizer provide the crops by feed elements which help the crops to growth fast and give more production that why the farmers use a lot of fertilizer. The main reason of the large amount of fertilizer used availability of water and type of crops because some kind of corps need fertilizer more then other kind although there is some kind of control from the Abu Shieba agriculture project administration but not strong enough. Supposed on this administration explain to the farmers the effects of fertilizer and try reduce the amount of it especially the land still fresh don't need this quantity of fertilizer.



D. Amount of fertilizer used before and after the GMMRP.

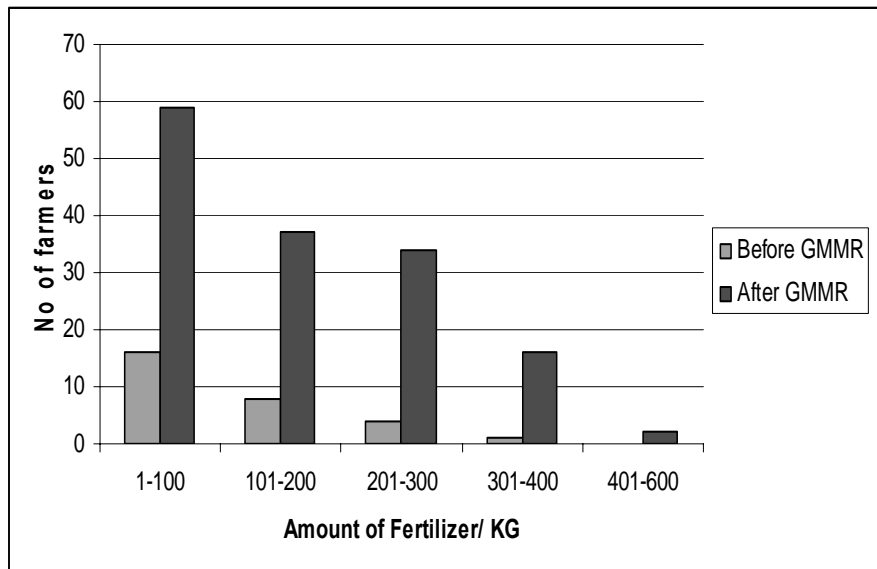


Figure 4.18: Amount of fertilizer used before and after the GMMRP

The increase in the use of fertilizer before and after GMMR can be noted according to the chart (Figure 4.18). Before the GMMRP, amount of fertilizer used was 28.5 kg/yr/ha after the amount increase to 39 kg/yr/ha to. There are two main reasons for the increase. First the farmers plant different type of plants and second the availability of water encouraging farmers to use a lot of fertilizer. The respondents who said the fertilizers have negative impact on environment used less fertilizer than those who said the fertilizers don't have negative. Some of respondents who said the fertilizers have negative impact but still use a great quantity of fertilizers since they think the fertilizers help big production.

E. Impact of Pesticides on environment.

Much like the impact of fertilizer there is also negative impact on environment from Pesticides and 82 percent of the respondents agreed, 11.33 percent different and 6.67 percent disagreed (Figure 4.19). Pesticides have great impact on

environment because pesticides contain chemical elements and some poisonous danger for. Among respondents who use pesticides, Table 4.2 show that majority of heavy users of pesticides (200-300 kg/yr) are those who disagree with the negative impact of pesticides on the environment.

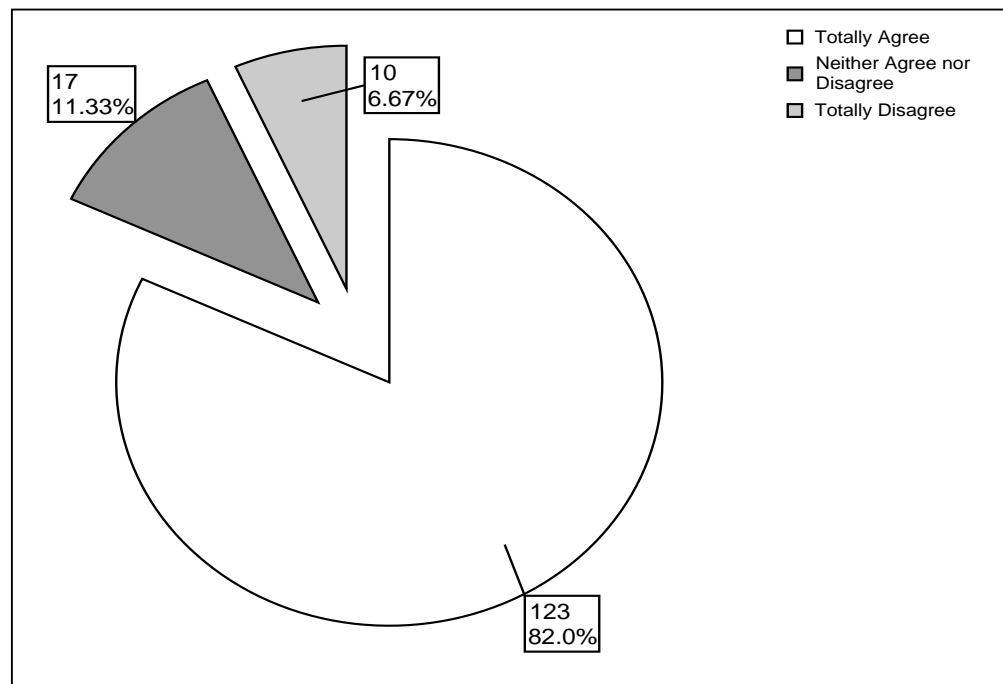


Figure 4.19: Impact of pesticides use

Table 4.2: Amount of pesticides use and impact on environment

pesticides used (kg/yr)	1-50	51-100	101-150	151-200	201-300
Significant Impact on environment					
Agree	53	39	35	23	
Neither agree		3	10	3	1
disagree			1	2	8

#### F. Amount of pesticides used before and after GMMRP.

The increase in use of the pesticides before and after the GMMR can be seen according to the area in the chart (Figure 4.20). Ever though total usage of pesticides has increased due to the increase in agriculture land size, the rate of usage still remain at 12kg/ha/yr. in the near future, however, the application rate is expected to increase due the expected increase in pests in the area as the new agriculture land establishes.

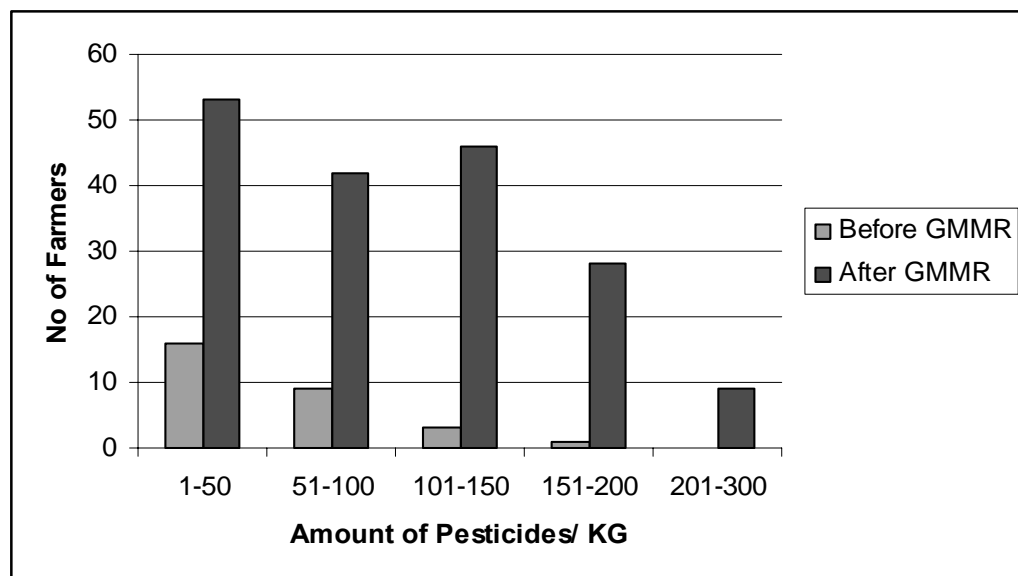


Figure 4.20: Amount of pesticides used before and after the GMMRP

#### G. Wasteful practice of water usage.

After the completion of the GMMRP, there has been abundance of water availability in the northern part. However, due to this fact wastage of water has also increased to a greater level (Figure 4.21) below indicates that about 67 percent of the respondents agreed that there is wasteful practice of water usage while only 8 percent disagreed. The other 25 percent neither agreed nor disagreed.

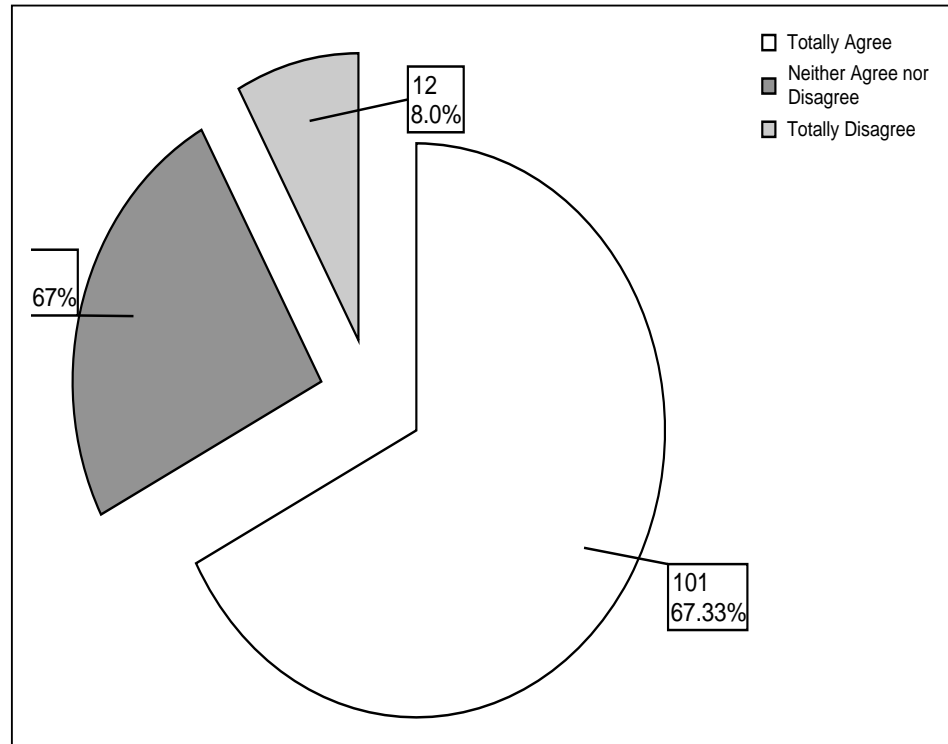


Figure 4.21: Wasteful use of water

#### H. Positive impact on environment more than negative impact

An overwhelming 88 percent of the respondents agreed that the GMMRP has more positive than negative impact on the environment, 10 percent neither agreed nor disagreed and only 2 percent disagreed (Figure 4.22). It is clear from their opinions that the GMMRP has achieved more positive outcomes. There is an increase in the overall green land area in the country. As a result of this, there is a very large decrease in the desertification of many places.

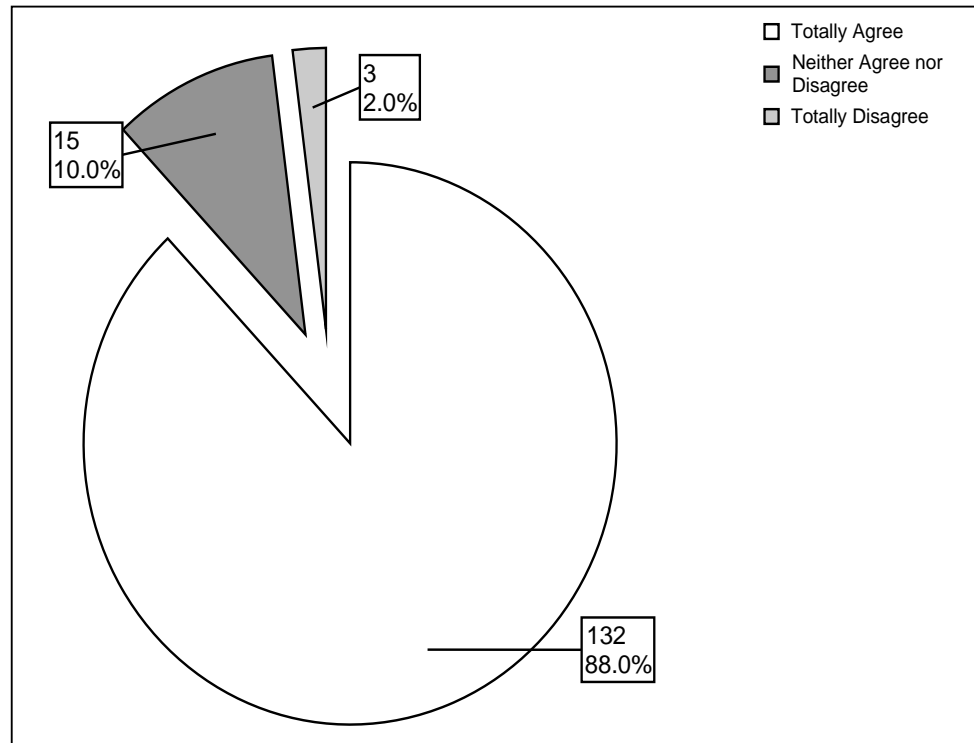


Figure 4.22: Positive impact more than negative.

#### 4.6 Conclusion

After the analyzers the data collected from questionnaire and secondary data the result seemed the GMMRP increases the agriculture land and provided large amount of water. These reasons made many people invest in agriculture. That means increase in number of farmers. The GMMRP improved the food quantity and quality, also reduce the food price in local market. The GMMRP developed the local agro-based industrial products and economic activities. Increase the farming income as result of the GMMRP. Increases the vegetal and animal production. The GMMRP as big project has significant impact on the environment must take it as big issue. Not all impacts are positive. The GMMRP also has negative impact for example increase quantity of fertilizer use and quantity of pesticide used. There are some wasteful use of water. When the local authority reclaimed the land there is small loss of the natural habitats. In general the GMMRP has more advantages on three sensitive sectors in Libya( agriculture, economy and environment) that encourage the

government to go a head in this project but must don't ignore the negative impact which now seemed small and easy to reduce it but might in future it will increase and difficult to control it

## CHAPTRE 5

### CONCLUSION AND RECOMMENDATION

#### 5.1. Introduction

There are lots of rivers has been found in the world which are found in nature but man made river project only started in Libya since 1984 and project has been completed about 80 percent and rest of 20 percent is going to finish by 2012. My contribution of this project is to study the environment impacts on area used the great man made river water in agricultural activities and examine the outcomes of these processes. To find out the outcome of the research, I have studies and analyzed about three factors which are agriculture land, economic activities and impact on environment. After the study and analysis I have found that based on the three factors: GMMRP has a positive impact more than negative in the three above sectors.

In addition, the research of this project is mainly done by two main phase, first phase is study the background of the problem which has discussed in Chapter Two. Second phase is data collection and analysis. Data collection and data analysis were discussed in Chapter Three. Data analysis has been done based on above stated three factors. More discussion about the three factors has been discussed in the chapter four. And the final chapter summarise the project and propose future work to obtain the better result and implementation of the project.

## 5.2 Conclusion

The great man made river project as one of largest project in the world of course has large impacts and these impacts could change the life for Libyan population. In Abu Shieba agriculture project the GMMRP water did have a huge impact on its agriculture activities and its environment. It was the main reason for the increase the agriculture land and increase number of farmers. Availability of water made the farmers plant different types of crops with some of the crops can not plant before the GMMRP water because the water no enough (some of crops need a lot of water). The GMMRP water increase the production of food and fodder that are give good influence to producers and consumers. Improve the food quality after the GMMRP and increase the production capacity for the land to become more efficient. The farming income increase for all farmers especially for those who use high techniqology and efficient irrigation system. Availability of food after the GMMRP water reduced the price for food and gave more choices to the consumers because the quality for food also changed to better. The most important thing we have to take care of is the environment because this very sensitive significant factor we keep clean environment and protect the natural resources to get healthy life for us and next generations. The GMMRP has significant impact on environment. The GMMRP consist many processes wells and pipe lines drilling, manufacture pipes, transfer the pipes in hug trucks and build the storage tank, etc. All these processes have lager impact on environment but these effects don't reach to Abu Shieba agriculture project , however there are many environment issues in Abu Shieba area . There are two types of impact ,positive impact the GMMRP water increase the green space that mean reduce desertification , increase the rate of local water in Abu Shieba project because the farmers stop use the groundwater and the green area can moderate temperature ,also there are negative impact. As result of availability of water the farmers use a lot of fertilizer and pesticide, some farmers practice wasteful use of water, all these things must be considered as it is big issues and try to reduce it and look for sustainable GMMRP.



### 5.3 Recommendation

Supply more of water to any land able to planting for increase and establish new agriculture projects because there is large quantity of water in the four huge basins in the desert but if there aren't side effect in other side like resources of water (to the Investment Authority of the Great Man-Made River water). Libya big country but most of it empty area and the population concentrate in some places on the costal line for must reclamation as possible as can of land without loss of the natural habitats to increase the income for people and distribute the population to development whole the country..(to the Investment Authority of the Great Man-Made River water). Ensuring more marketing for farmers to sale their production to encourage the farmers to produce more and better food that can be by export and build factories to growth the economic activities and increase the G D P. (Ministry of economy).

Help the farmers when they have problem and guide them to carrying out optimal agriculture and advise them to reduce the pollution on environment ( to the Abu Shieba agriculture project administration). Explain to the farmers dangers of the fertilizer and pesticide with minimize the quantity used and look for the substitutes like the natural fertilizer which comes from animals because this has good impact on the soil without negative impact on environment.( to the Abu Shieba agriculture project administration). Make stronger control on water and determine the amount of water to farmers to reduce the wasteful of water because now with the control still there is wasteful of the GMMRP's water. (to the Abu Shieba agriculture project administration). To examine the environment impact of the Great Man Made River Project in general must study the many areas use the GMMRP water and the area which the water come from it (to the researchers)

#### **5.4 Limitation.**

The case study was a small project among many big projects used the GMMRP water. There are some projects above 10.000 hectares the space, that it will give more advantages and defects. The case study was in one area. That means can not generalization the results on whole the projects use the GMMRP water because each area has characteristics for example different type of soil, different type of crops and the farmers have different behavior all these factors could be change the results .

## References

Abu fayed A and El-Ghuel, M (2001), Desalination process applications in Libya a College of Engineering, Al-Fateh University Received 23 March 2001; accepted 30 March 2001

Bandar and Walid (2000), Recent Developments in Water Desalination” Office of Scientific Activities, Mechanical Engineering Department, Tajoura Engineering Academy, Received 27 July 2000; accepted 14 August 2000

Loucks, Daniel P. (2004), The Great Man-Made River in Libya: Does it Make Sense? Department of Civil and Environmental Engineering Cornell University Presented November 5, 2004

Robert, H, and Alberte, U (1989) Transboundary Groundwater: The Bellagio Draft Treaty. NATURAL RESOURCES JOURNAL [Vol. 29

Saad A. Alghariani (2003): Water transfer versus desalination in North Africa: sustainability and cost comparison .Occasional Paper 49 March 2003

Salem, M. Ali (2005) Libya after the Great Man Made River Project, College of Engineering, Al-Fateh University

Vandewalle, Dirk. Libya since Independence. Ithaca, NY, Cornell University Press, 1999. p 226

Authority for the investment of Jabel Hasawna-Jefara water system of the Great Man-Made River water

The Great Man-Made River of Libya  
[http://www.unep.org/GC/GCSS-VIII/Libya\\_IWRM.doc](http://www.unep.org/GC/GCSS-VIII/Libya_IWRM.doc).

GMR (Great Man-made River) Water Supply Project, Libya

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<http://www.gmmra.org>. accessed on 1 10 2006  
<http://www.gmmrwua.com>.accessed 15 01 2007  
<http://flickr.com/photos/duimdog> accessed 15 01 2007  
<http://www.Wikipedia.free encyclopedia> 22 09 2006

Appendix A  
Sample of questionnaire (Arabic)

استفتاء عن تأثير النهر الصناعي العظيم على الزراعة  
كل المعلومات تعتبر سرية

المستجيب العزيز

بعد التحية

إذا امكن أن نأخذ بضعة دقائق من وقتك لإجابة الإستفتاء الملحق شاكرين لك حسن تعاونك. هناك بعض البيانات متوفرة معها خيارات. ليس هناك جواب صحيح أو جواب خاطئ، فقط أرائك الشخصية تهم. رجاءً اختر جوابك بدقة على اختيار واحد لكل بيان. هذه الدراسة تود أن تستنتج من أرائك مميزات تأثير النهر الصناعي العظيم على قطاع الزراعة في ليبيا .

## القسم الاول

## المستوى التعليمي

شهادة عليا	جامعي	معهد عالي	شهادة ثانوية	شهادة ابتدائية	مستوى اخر

## 2. الوظيفة

دكتور	مهندس	موظف	محاسب	متقاعد	فلاح

## 3. القسم الثاني

الرجاء اختر احد من الخيارات التالية

1	2	3	4	5
غير موافق بشدة	غير موافق	لاموافق ولامختلف	موافق	موافق بشدة

## ا. الزراعة

1. النهر الصناعي العظيم جعل الماء توفّر وغير محدود

1	2	3	4	5

قبل النهر الصناعي

بعد النهر الصناعي

ماهي مصادر الماء؟

مياه جوفية  
مياه سطحية  
النهر الصناعي

النهر الصناعي العظيم زاد من مساحة الارض الزراعية

1	2	3	4	5

مامساحة مزارعتك؟

قبل النهر الصناعي العظيم .....هكتار  
بعد النهر الصناعي العظيم .....هكتار  
الانتاج الزراعي كنتيجة للنهر الصناعي العظيم له تأثير على التالي

توفير المنتجات الزراعية

1	2	3	4	5

انخفاض سعر المنتجات الزراعية

1	2	3	4	5

تحسن جودة المنتجات الزراعية

1	2	3	4	5

توفر المياه بواسطة النهر الصناعي العظيم زاد الارض المزروعة

1	2	3	4	5

ب.الاقتصاد

النهر الصناعي العظيم زاد من دخلك الزراعي

1	2	3	4	5

نسبة الزيادة 1-50% 51-100% 101- 150% 151- 200%





النهر الصناعي العظيم طور الصناعات المحلية المعتمدة على الزراعة

1	2	3	4	5

الزيادة في الانتاج اثرث على سعر الاسواق

1	2	3	4	5

النهر الصناعي العظيم زاد من الانتاج الحيواني والزراعي

1	2	3	4	5

ج. البيئة

النهر الصناعي العظيم له تأثير مهم على البيئة  
بشكل عام

1	2	3	4	5

السماذ المستخدم له تأثير على البيئة

1	2	3	4	5

الكمية المستخدمة من السماذ؟

قبل النهر الصناعي.....كج/سنة

بعد النهر الصناعي.....كج/سنة

المبيدات الحشرية المستخدمة لها تأثير على البيئة

1	2	3	4	5

الكمية المستخدمة من المبيدات الحشرية؟

قبل النهر الصناعي.....كج/سنة

بعد النهر الصناعي.....كج/سنة

هناك تدير في استخدام مياه النهر الصناعي العظيم في الزراعة

1	2	3	4	5

الزيادة في عدد البيوت الزجاجية(الصوبات) كانت بواسطة النهر الصناعي العظيم

1	2	3	4	5

هل يوجد عندك صوبات نعم لا

كم

عددها؟

النهر الصناعي العظيم له تأثير ايجابي اكثر من تأثير سلبي على البيئة

1	2	3	4	5

**Appendix B**  
**Sample of questionnaire (English)**

**Questionnaire on:**

**The Agriculture Impact of the Great**

**Man-Made River**

*All information is treated as confidential*

Dear respondent

Greetings

If you could spare a few minutes of your time to answer the attached questionnaire it would be much appreciated. There are some statements with available answer choices. There is no right or wrong answer, only your personal opinions matter. Please mark your answer by ticking on one choice for each statement. This study would like to draw conclusion from your opinions on which characteristics are the most important in influencing and straightening the ability of the country to understand the impact of the Man-Made River on the Libyan's agriculture sector.



## 1. Section 1

### 1. Level of the education

Graduate	Undergraduate	High school	Secondary school	Primary school	Other

### 2. Occupation

Doctor	Engineer	Auditor	Employer	Retired	Fulltime farmer

## 2. Section 2

Please indicate one of the following 5 points likert scale

1	2	3	4	5
Totally Agree	Partially Agree	Neither Agree or Disagree	Partially Disagree	Totally Disagree

### A. Agriculture.

#### 1. The man made river makes water available and unlimited.

1	2	3	4	5

**What is the water resource? Before GMMR Project After GMMR Project**

* Ground water	<input type="checkbox"/>	<input type="checkbox"/>
* Surface water (Stream, lake, vale)	<input type="checkbox"/>	<input type="checkbox"/>
* GMMR Project	<input type="checkbox"/>	<input type="checkbox"/>

#### 2. The man made river increases the agriculture land space.

1	2	3	4	5

**What is the size of your farm?**

Before GMMR Project .....Hectares

After GMMR Project .....Hectares

**3. Agriculture products as a result of man-made river project have significant impacts on following.**

**\*food availability**

1	2	3	4	5

**\*lower food price**

1	2	3	4	5

**\*better quality of food products**

1	2	3	4	5

**4. The availability of the man made river's water can be used to increase size of your farm.**

1	2	3	4	5

**B. Economy.**

**1. The man made river project increases your farming income.**

1	2	3	4	5

How many percent increase    1-50%    51-100%    101- 150%    151- 200%





**2. The agriculture income improves the local agro-based industrial and economic activities.**

1	2	3	4	5

**3. The increase of production has impact on market price.**

1	2	3	4	5

**4. The great man made river project increases the vegetal and animal production.**

1	2	3	4	5

### C. Environment.

**1. The man made river project has significant impact on the environment**

*(General opinion)*

1	2	3	4	5

**2. The fertilizer used for farm has an impact on the environment**

1	2	3	4	5

**How much fertilizer used?**

Before GMMR Project .....KG/Y

After GMMR Project .....KG/Y

**3. The pesticides used for farm have impact on the environment**

1	2	3	4	5

**How much pesticides used?**

Before GMMR Project .....KG/Y

After GMMR Project .....KG/Y

**4. There is wasteful use of the water in agriculture as result of the great man-made river project.**

1	2	3	4	5

**5. The number of green houses increased by the great man made river project.**

1	2	3	4	5

**Do you own a green houses? Yes            No**  
**If yes how many?**

**6. The great man made river has positive impact more than negative impact on environment.**

1	2	3	4	5