

## The impact of the man-made river project in providing domestic water in Benghazi Plain, Libya

■ G.S. MANSOR AND M.E. TORIMAN

**ABSTRACT :** This article focuses on examining the contribution of the man-made river project (MMRP) – Water Transfer Project of Libya in providing domestic water in the plain of Benghazi, Libya. The MMRP documents literature reports and journals are the main sources of secondary data. Besides, this study applies a questionnaire survey carried out on July 2010 to a sample of 200 respondents in order to assess the role of the MMRP in providing the plain of Benghazi with potable and domestic water. The study compares the sources of potable and domestic water in the plain of Benghazi before and after the MMRP. The survey findings reveal that MMRP provides the plain of Benghazi with enough water for domestic use. About 87 per cent of respondents mentioned that the MMRP provided their needs of domestic water. The remaining 13 per cent of the respondent make a claim that the MMRP has not provided for their domestic water needs. However, it has not been able to provide enough potable water, as 69.5 per cent of respondents said that the MMRP did not provide enough potable water. Only 29.0 per cent mentioned that it could provide potable water.

**Key words :** Man-made river project

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### INTRODUCTION

In the early sixties of the last century and while search for new oil in the desert of south Libya led to the discovery of major oil reserves as well as of aquifers containing huge quantities of fresh groundwater. Most of this fossil water was collected over 35,000 years ago. 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 around 80 per cent of its people live. This project is called the Man-made River. The construction of this 'river' of pipes, pumps and reservoirs began in the mid 1984s and continues today (Loucks, 2004).

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The Man-Made River is a network of pipes that supplies water to the north part of Libya, from the Nubian Sandstone Aquifer System fossil aquifer in south Libya. It is the largest underground network of pipes and aqueducts in the world. It consists of more than 1,300 wells, most of them more than 500 m deep, and supplies 6,500,000 m<sup>3</sup> of freshwater per day to the cities of Tripoli, Benghazi, Sirt and elsewhere (Anonymous, 2010d. www.gmmra.org.com).

Benghazi is considered the second large city in Libya. The Benghazi region has suffered water shortages. GEFLI (1972) indicates that the plain of Benghazi is in need of 61.52 million cubic metres of water per year for the purpose of irrigation, which accounts for 86 per cent of the total water needed by the plain for various uses (71.54 million cubic metres annually), a study focused on the Benghazi plain water basin and carried out on some of the wells in the field of Benina (the main groundwater basin in the plain of Benghazi) shows that there was a decline in water levels as a result of a great withdrawal, which amounted to 1.57 metres by 0.31 metres/year (Libyan Arab Republic. 1977).

Policy makers in Libya established the MMRP to transport

the groundwater from the south to the north part of Libya to cover the water requirement in the country as a whole and in the plain of Benghazi particularly. This article focuses on examining the contribution of the MMRP in providing enough water in the plain of Benghazi.

## EXPERIMENTAL PROCEDURE

The plain of Benghazi is located in the western corner of north-eastern Libya, which is bordered by the Mediterranean Sea in the north and west. The plain borders Al-Jabal Al-Akhdar in the east and north-east and, from the south, it interferes with the plain of Sirte, without any natural barriers in between them. Fig. 1 shows the location of the study area. The plain of Benghazi is astronomically located between longitudes 45°–19° and 00°–21° south of the equator and between latitudes 58°–30° and 44°–32° north of the equator. Benghazi has a warm semi-arid climate. Mediterranean Jabal Al-Akhdar is located in the north of the city, and the climate is desert like in the south. Summers in Benghazi are hot and dry. In winters there is occasional rainfall with mild temperature. Annual rainfall is recorded low at 268mm per year (<http://en.wikipedia.org/wiki/Libya>).

According to the 2006 census, about 1,382,688 people live in the plain of Benghazi. The plain of Benghazi is considered the centre of population concentration in the eastern region of Libya; the proportion of population in the plain of Benghazi about 53.4 per cent of the eastern region. This due to the attractiveness of the plain of Benghazi and especially the main cultural centre of the city of Benghazi, which has a strong influence on the movement of internal migration from neighbouring areas and other areas at the state level. With regard to the population density of the city of Benghazi is approximately 54.3 persons/km<sup>2</sup> (Libyan Statistic Agency,



Figure 1 : Location of Benghazi plain

census 2006). The data were collected from two sources. A questionnaire was designed to collect the primary data. The questionnaire was survey on a sample of people in the plain of Benghazi. A total of 200 people were included in the survey.

A questionnaire was designed and collected using the personal interview during July 2010; A systematic random sampling has been drawn with a size of 30 per cent of the total beneficiaries from the MMRP's water. A total of 200 respondents were included in the survey. The questionnaire distributed to the respondents in Arabic language, after collected that data the questionnaire translated into English. Meanwhile, the secondary data were collected from official sources like books, censuses, reports and journals.

## EXPERIMENTAL FINDINGS AND ANALYSIS

The goals of the MMRP not only include providing a large quantity of water for agriculture, but also providing a considerable quantity of potable and domestic water as well. For these reasons the study seeks to ascertain the impact of the GMMRP in solving the problem of the potable and domestic water shortage in the study area. The results are presented in the following sections.

### Potable water:

There are only a small number of respondents who use MMRP water for drinking; others do not use the water of the MMRP for drinking. Most of them indicate that the MMRP has not provided potable water to the population, the problem of potable water shortage still persists, and they further add that the main source of potable water is from desalination.

### Respondents who use the MMRP's water for drinking

Among all of the respondents, 69.0 per cent do not use the MMRP water for drinking, while only 31.0 per cent of them only use the water for that purpose. According to this result, the problem of the potable water shortage still persists in the area under study. As to the reason why only a small number of the respondents use it for drinking, this may be because they cannot ensure access potable water from other sources, which may be due to water prices (Table 1).

Table 1 : Potable water

Potable water	Count	%	
Respondents whom use MMRP water for drinking	Do not use it	138	69.0
The MMRP provides enough water for drinking	Disagree	139	69.5
The MMRP provides enough water for drinking	Desalination	140	70.5
The source of potable water after the MMRP	Desalination	107	53.5

**Why respondents do not use MMRP water for drinking:**

There are three main reasons why most of respondents do not use the MMRP water for drinking: 58.5 per cent of them do not use it because the water is stored in open reservoirs before it comes to their residence, hence the factor of hygiene, 10.0 per cent of them said they do not use it for drinking because the MMRP water is not approved by the World Health Organization, and only 0.5 per cent per cent asserted that the MMRP had not provided enough potable water to drink.

**The MMRP provides enough water for drinking:**

Regarding the role of the MMRP in providing enough potable water, 69.5 per cent of respondents said that the MMRP did not provide enough potable water; only 29.0 per cent mentioned that it could provide potable water for them, and 1.5 per cent totally agreed that the GMMRP had made potable water available in the plain of Benghazi.

**Domestic water:**

Most of the respondents surveyed use MMRP water in their houses as non-potable water (which can be used in toilet flushing, for house cleaning, and for watering gardens and so on). In this respect most of the respondents mentioned that the MMRP provided sufficient water to the plain of Benghazi.

**Respondents who use the MMRP's water for domestic purposes:**

Of all the respondents, 87.0 per cent of them use the water of the GMMRP for domestic purposes, whereas the remaining 13.0 per cent do not (Table 2). It is noted that the MMRP is considered as the main source of domestic water and that this may be due to the large quantity of domestic water provided to the study area by the MMRP.

**Table 2 : Domestic water**

Water for domestic use		Count	%
Respondents who use MMRP water for domestic uses	Using it	174	87.0
The MMRP provides enough water for domestic uses	Agree	110	55.0
Source of domestic water before the MMRP	Groundwater	148	74.0
Source of domestic water after the MMRP	GMMRP	174	87.0
The plain of Benghazi has become more suitable for human settlement after the MMRP	Agree	133	66.5

**Providing domestic water via the MMRP:**

Out of the sample selected, 55.0 per cent are unified to say that the MMRP provides enough domestic water, 32.0 per cent strongly agree that the domestic water has become

available in the Benghazi Plain due to the MMRP. However, around 13.0 per cent of them make a claim that the MMRP has not provided for their domestic water needs.

The objective of the study sheds light on the role of the MMRP in providing the plain of Benghazi with potable and domestic water. Based on the secondary data which have been collected from the documents of the MMRP which include reports, books, research, and other sources, this project consists of five phases' transfers of about more than 6,000 000 m<sup>3</sup> of water per day from the south to the north of Libya where the plain of Benghazi is located.

Phase I is composed of two pipeline systems: the first system extends from Tazrbo to Benghazi and the second from the al-Sarir to Sirte. Through this double line of pipes, 2,000 000 m<sup>3</sup> of water is transferred per day from al-Sarir to the reservoir in Ajdabiya which is considered a branch of the water-carrying pipeline systems. It is a circular tank; with an inside diameter of 923.2 metres and a height of 9 metres, designed to accommodate approximately four million cubic metres of water.

After the arrival of water through the system to the reservoir of Ajdabiya it forks into two branches: the first branch heads west to transfer water to the centres stretching from Ajdabiya to Sirte. The total quantity of water transferred in this direction is 287,000 000 m<sup>3</sup> annually.

The second branch heads north towards the plain of Benghazi to the reservoir, which is located near the area of Sellouk, and the total quantity of water flowing in this direction is 413,000 000 m<sup>3</sup> annually; 275 million cubic metres have been allocated annually for agricultural purposes, 111,490 cubic meters allocated as the source for potable and domestic uses, 14,694 cubic meters for Industrial use and 11,564 cubic meters counted as evaporation losses and the distribution system. (MMRP, 1998). Theoretically one can conclude that the MMRP has already provided the plain of Benghazi with enough water but based on the data collected through the questionnaire summarized, the results reveal that the MMRP has provided the plain of Benghazi with enough water for domestic use. However, it has not been able to provide enough potable water as well (Table 3).

**Table 3 : Source of potable water before and after the MMRP**

Source of potable water	Before the MMRP	After the MMRP
MMRP	0.0	31.5
Groundwater	26.0	13.5
Surface water	4.0	1.5
Desalination	70.0	53.5
Total	100.0	100.0

**Source of potable water before and after the MMRP:**

The purpose of comparing the source of drinking water before and after the MMRP is to identify the role of the MMRP in providing potable water to the residents of the Benghazi

Plain. Table 3 shows that around 70.0 per cent of the respondents said desalination was the main source of drinking water before water was provided by the MMRP. While 26.0 per cent of them stated the source of potable water before MMRP had been groundwater. However, only 4.0 per cent of the respondents said that surface water had been their major source of potable water before water arrived via the MMRP.

Nevertheless, about 53.5 per cent of the respondents mentioned that desalination was still the basic source of potable water even after water was being provided by the MMRP. In contrast, about 31.5 per cent of the respondents stated that after water came via the MMRP to the Benghazi region it had become their only source of potable water. Regarding the survey questionnaire, around 13.5 per cent of the residents responded that 'groundwater is the current source of potable water'. Finally, only about 1.5 per cent of the respondents said that the basic source of potable water for them was surface water.

Based on the above, it could be said that the MMRP has not provided the potable water as determined in the development plan, which has stated that around 12 per cent of the potable and domestic water would be supplied by the MMRP. However, at this time, it can be seen that this aim in the development plan is yet to be achieved.

Regarding (Mukheli, 2002) who assesses the role of the pungwe-matare water project in solving water problems in Zimbabwe, the results have discovered that the pungwe-matare water project has, on one hand provides clean water to sukubra, and on the other hand, in the absence of appropriate water which demands actions from the management, the water of the project inadvertently worsens many of the sukubras' existing water by way of leading to problems of sanitation.

#### Source of domestic water before and after the GMMRP:

Table 4 shows that before the MMRP, around 74.0 per cent of the respondents said that groundwater was the major source of water for domestic use. Meanwhile, about 26.0 per cent of them said that surface water had been the source of domestic water. However, after the MMRP water arrived in the study area, around 87.0 per cent of the respondents mentioned that the water from the MMRP had then become the main source of water for domestic use. In contrast, after the arrival of water via the MMRP, about 10.0 per cent of respondents said the groundwater was still the main source of water for domestic use. Lastly, only 3.0 per cent of the residents responded that the surface water was still the source of domestic water even

**Table 4: Source of domestic water before and after the MMRP**

Source of domestic water	Before the MMRP	After the MMRP
MMRP	0.0	87.0
Groundwater	74.0	10.0
Surface water	26.0	3.0
Total	100.0	100.0

after the arrival of the MMRP water in the Benghazi Plain. Based on the above discussion, one can conclude that The MMRP has provided a large quantity of water to the plain of Benghazi for domestic uses.

#### Conclusion:

This article has detailed the role of the MMRP on providing the plain of Benghazi with potable and domestic water. The MMRP provides the plain of Benghazi with a total quantity of water of 413,000 000 m<sup>3</sup> annually, where 275 million cubic metres have been allocated annually for agricultural purposes, 111,490 cubic meters allocated as the source for potable and domestic uses, 14,694 cubic meters for industrial use and 11,564 cubic meters counted as evaporation losses and the distribution system. Based on the responded questionnaire, one can conclude that the MMRP has not provided potable water to the population, the problem of potable water shortage still persists, and the main source of potable water is from desalination. It also can conclude that the MMRP has provided a large quantity of water to the plain of Benghazi for domestic uses and it has become the main source of domestic water for majority of the population.

#### REFERENCES

- Elhassadi, A.** (2008). Views on Libyan national plan (LNP) to resolve water shortage problem (WSP). Part Ib: Great Man-Made River (GMMR) project capital cost with interest rates, *Desalination* 220: 184–188.
- GEFLI** (1972). Soil and water resources survey for Hydro-agricultural Development, western Zone. Unpublished Report. Tripoli: Libyan Agricultural Ministry. p. 4
- MMRP** (1998). The man-made river project, the annual follow-up report, Ministry of the GMMRP, Benghazi, Libya. pp. 5-10.
- Loucks, D.** (2004). The great man-made river in Libya: Does it make sense?. Lecture in fluid Mechanics, Cornell University-USA
- Libyan Statistic Agency**, census 1973, 1984, 1995 and 2006 Libyan, Tripoli city. p 40
- Libyan Arab Republic** (1977). General Water Authority Benghazi Investigation of the Municipal Well Field Beninah Area, Benghazi, p 26. (In Arabic).
- Mukheli, A.** (2002). Is the Pungwe water supply project a solution of water accessibility and sanitation problems for households of Sakubva, Zimbabwe?. *Physics & Chem. Earth*, 27: 723-732.

#### WEBLIOGRAPHY

- Anon. 2010d. [www.gmmra.org.com](http://www.gmmra.org.com)  
<http://en.wikipedia.org/wiki/Libya>  
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