Research Journal of Environmental Sciences

ISSN 1819-3412

Academic
Journals Inc.

www.academicjournals.com

Research Journal of Environmental Sciences 8 (4): 225-230, 2014
ISSN 1819-3412 / DOI: 10.3923/rjes.2014.225.230

Assess the Status of Groundwater in Municipalities of Yefren and Gado, Northwest of Libya

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ABSTRACT

Libya is a country of desert and dry climate makes the acute shortage of surface water. Then it becomes groundwater is a very important resource to meet economic and agricultural demands in the northern areas. Groundwater has been over-exploited and there have been some problems such as degradation and salty degradation of the aquifer since the 1960s. Groundwater resources are the main source of fresh water mountain west. However, groundwater and exploitation in the region increased significantly over the past decades, mainly due to the increase in agriculture, tourism and industry. This phenomenon has a significant impact on groundwater depletion amount as well as the deterioration in the paper quality. This aims to assess the status of water in cities and towns (Municipality of Yefren and Gado) Northwest Libya, Western Mountain and the extent of adoption of these cities on groundwater, through the efforts of the local authority and determine solutions deficit and the current and future recommendations, setting contribute to the alleviation of the problem.

Key words: Assess, groundwater, Yefren and Gadu, Northwest of Libya

INTRODUCTION

The study area of Jebel Al-Gharbi (Western Mountain) is a semi-arid mountain range on the northern boundary of the Sahara Desert, in Northwestern Libya between the Mediterranean Jefarah coastal plain and the Tripolitanian Plateau (Fig. 1). It is coordinated between 31°and 32.30° Northern latitudes and 11.45° and 12.45° Eastern longitudes. It extends some 250 km within Libya, from just east of the city of Gheryan (about 60 km south of Tripoli) in the east to the city of Wazzin at the Tunisian border in the west. It is also divided into numbering 126074 on an area of 9,120 km^2 according to administrative boundaries of the region as studued by National Information and Documentation Office, 2005. The study area belongs to the major hydrological basin called 'Aljabal Al-Gharbi Basin' (Dhaw and Muhammad, 2006).

This area has experienced long-time dryness and suffered from rain scarcity with no feasible management of its water resources has been implemented. By time, harsh conditions led by water deficiency forced local inhabitants to drill for groundwater extensively to support their living and irrigating the crop lands. The water was excessively pumped out from the ground in a way the consumption of groundwater exceeded the capacity of the reservoir. The continuous groundwater pumping was faster than replenishing. This human impact of unsustainable practice changed the situation of water to worse and complicated it by bringing further problems to the area (Baruni and Al-Futeisy, 1997). Drying of wells and lowering of the water table as water pumping from wells has

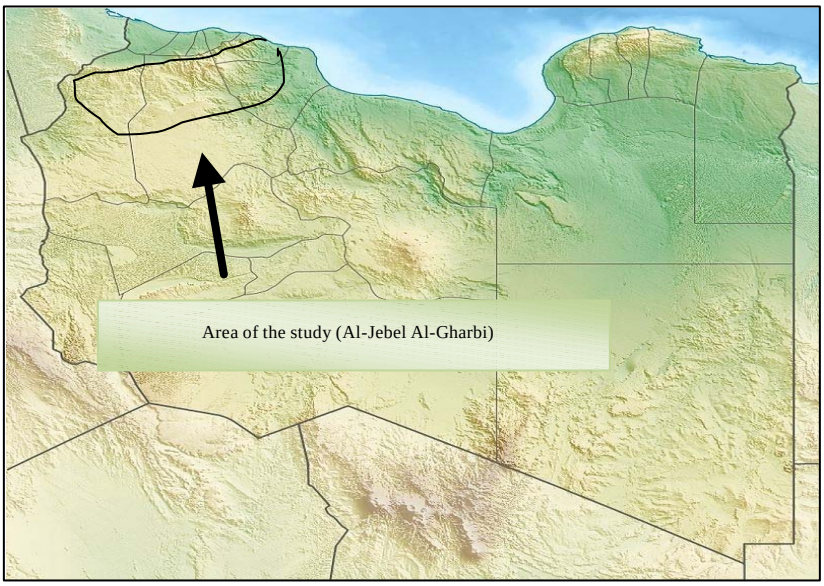

Fig. 1: Map of Libya and study area of Al-jebel Al-Gharbi

reached below the water table. The water shortage is expected to reach 1332 m^3 day^{-1} by year 2015. This led the inhabitants of Jebel El-Gharbi to deepen the well, drill a new well, or, at least, attempt to lower the pump. People also resorted to buy waters from tankers to compensate for the shortage. This was costly and expensive comparing to the lower income per capita of the local people.

In addition, water depletion of the natural springs in the nearby of the area by a shortage of 1000 m^3 day^{-1}, due to extensive groundwater pumping uteisy, (Baruni and Al-Futeisy, 1997; Hallaq, 1995) (Fig. 1).

SOURCES OF WATER

The area depends on groundwater as a main source for its water supply; it constitutes 90% of the produced water supplies and 10% rainwater. Exploitation of rainwater requires systems and procedures to acquire the benefits thereof. It also requires the need to implement a complete series of techniques and development projects that will guide the fundamentals; like increasing water from this natural resource. The exploitation for this resource is limited to underground reservoir system-wells and household tanks, which citizens have established due to a limited amount of underground reservoir systems.

Water wells that nourish the water rows and supplies the range with water constitutes 53 cultivated wells across six fields (Public Authority for Water, 2006): 42 surface wells and 11 deep wells and these fields are in two places; one in the southern mountain chain and the other in the northern mountain chain. There are 18 productive wells; 14 surface wells and 4 deep wells. It has the ability to produce 433 m^3 h^{-1} and 12 dry wells; 11 surface wells and 1 deep well, in addition 22 inactive wells that needs to be retained; 13 surface wells and 9 deep wells. On average the water pump from the wells pumps for 18 h in a day, producing a total of 2844000 m^3 of water per amount and condition. Table 1 shows the total public wells supervised by the State through General Company for Water in municipalities Jadu and Yefren.

Table 1: Total wells

Water system	Total wells: Surface wells	Total wells: Deep wells	Total wells: Total	No. of wells produced: Surface wells	No. of wells produced: Deep wells	No. of wells produced: Total	Amount of production (m h^{-1})	No. of dry wells: Surface water wells	No. of dry wells: Deep water wells	No. of dry wells: Total	No. of wells that need maintenance: Surface water wells	No. of wells that need maintenance: Deep water wells	No. of wells that need maintenance: Total	Amount of production
Yefren	6	-	6	3	-	3	62	1	-	1	2	-	2	1116
Zentan	5	9	14	-	3	3	72	3	-	3	2	5	7	1296
Rojban	6	6	12	-	1	1	46	4	1	5	2	4	6	828
Jadu	7	-	7	4	-	4	85	-	-	-	3	-	3	1530
Rohibat (Ashiab)	8	-	8	4	-	4	95	2	-	2	2	-		1710
Rohibat (Bazina)	6	-	6	3	-	3	73	1	-	1	2	-	2	1314
Total	42	11	53	14	4	18		11	1	12	13	9	22	9794

VIABILITIES AND SYSTEMS

Approximately six water systems supplies the area with water and it constitutes cycles of production, assembling, transportation and distribution, which is systematically distributed through a series of mechanisms. It starts at the wells, then moves onto the storage reservoirs, then to the respective pumping stations and finally to the main reservoirs through a network of principal water pipes and then distributed to the places of consumption.

Wells: Surface wells depth ranges between 100-150 m, submerging pumps pushes 12.5-15 horsepower and it is manufactured in Germany and Italy, for the upper pipes of the surface wells are mostly made of metal (3 inch radius), while deep wells depth ranges between 450-750 m, submerging pumps pushes 60-90 horsepower and manufactured in Germany. For the upper pipes is made of API iron (3 inch radius). The wells and the storage reservoirs are separated at different distances that range between 50-2000 m and the wells are connected to the reservoirs by galvanized ductile iron pipes (radius: 100-150 mm), the quality of water is good and consumable. However, there are some wells with a high concentration of salt, like in the fields of Fareed and Bazina.

All made of bolted armored concrete (re-enforced concrete), width ranging between 500-1000-600 m^3, some of the reservoirs are used for storage, while the others are next to the assistant pumping stations.

Pumping station: The output of the working pumps at the pumping stations range from 55-132 kW. Some are main stations and others are assistant stations, recovering stations that have old systems and weak production output sometimes neglects the recovery procedures by means of chlorine or by irregular periods.

Networks: The lines from the pumping stations to the primary reservoirs and places of distribution are made of stainless steel ductile pipes that have aradius 150-300 mm and it produces water by means of pumping, the length of the primary lines of the pumping station to the distribution reservoirs ranges between 11-30 km, there are different water levels ranging between 200-300 m between some of the primary reservoirs and places of consumption, as in the systems of Fareed-Jadu, Bazina-Arahibat and Ashiyab-Arahibat, there is a leakage in some of the primary lines.

Table 2: Systems, wells, storage, pumping stations, water networks

Water system	No. of wells produced		Ground reservoirs		Main pumping stations		Upper reservoirs		Water network (km)	
	Surface water	Deep water	Superficial	Deep (m^3)	No.	Size	Major	Assistant (m^3)	Main water	Sub-water
Yefren	3	-	2	1000	1	1	1	1000	47	180
Zentan	-	3	1	6000	1	1	1	1000	73	100
				220		1		500		
Rojban	-	1	1	500	1	-	1	500	35	114
Jadu	4	-	1	1000	1	4	3	150	9	77
				200						
			3	300						
			1							
Rohibat (Bazina)	4	-	2	300	1	2	1	500	36	90
			1	100			3	200		
Rohibat (Ashiab)	3	-	3	300	1	2	6	200	30	120
			1	100						
Total	14	4	17	12320	6	10	20	5950	204	681

Table 3: Statement of additional projects (project under completion)

Statement of the project	Finished	Under achievement	Did not start	Total
Overhead water tanks capacity of 200 m^3	4	16	5	25
Ground water tanks 500 m^3	3	54	-	8
Main water lines	42	58	5	105
Sub-water lines	9	16	-	25
Drilling shallow wells	11	7	-	18
Drilling deep wells	3	6	41	50

Most of the supreme reservoirs is made from armored (re-enforced) concrete that are of two types; 200 and 1000 m^3, while the lines from the supreme reservoirs to the consumers' destination is made of ductile pipes; with a radius 100-150 mm, the distribution lines inside the area of the consumers made of galvanized iron pipes with a radius of 1-4 inches, also there is a notable leakage in some of the secondary lines and distribution lines. Table 2 shows the systems-wells, storage, pumping stations, water networks and through the Table 3 can be observed statement of additional water projects under completion.

Production, consumption and coverage deficit of water supply per area: Working water wells reach production levels of approximately 2844000 m^3 annually, on average, one well uses about 170 L of water day^{-1}; therefore, 7986000 m^3 is required $annum^{-1}$, hence, the deficit is about 5081000 m^3 $annum^{-1}$, the deficit ratio in water supply in the area currently constitutes 64%, however, the coverage ratio in water supply constitutes 36%. Table 4 clarifies the actual supplies and level of consumption, the coverage and the deficit in the total quantity of water supplies.

DISCUSSION

In developing water resources and the effort and services provided by the organization for general affairs in Yefren, this program was established for curing the current suspension through successful means and beneficial viabilities. The method for calculating a solution to the problem and water deficit in the area is due upon all stakeholders in the organization. Furthermore, it is

Table 4: Consumption, coverage and the deficit in the total quantity of water supplies

Water system	Water system	Population	Annual requirement of water (m^3)	Amount of available water supply (m^3)	Amount of water deficit	Water deficit (%)	Coverage (%)
Yefren	Yefren-Gala-Almshashia-Aryaina	56100	3481000	407340	3073665	88	12
Zentan	Zentan	27800	1724990	563706	1161284	67	33
Rojban	Rojban	11080	732190	211554	520636	71	29
Jadu	Jadu-Shkshok	10758	667534	558450	109084	17	83
Rohibat (Bazina)	Rohibat-weast Jadu	11240	697442	624150	73292	11	89
Rohibat (Ashiab)	Rohibat	10770	668279	479610	188669	28	72
Total	Total	127748	7926763	2844810	5081953	64	36

Table 5: Expected development in the increase of water supplies

	No. of new wells			Amount of production wells ($m\ h^{-1}$)		Total production wells after development		Rate of increase after development (%)	
Water system	Surface	Deep	Total	New	Previous	$m\ h^{-1}$	$year^{-1}$	Previous	Current
Yefren	6	-	6	102	62	164	1077480	12	31
Zentan	-	1	1	72	86	158	1038060	33	60
Jadu	4	-	4	60	85	145	952650	83	100
Rojban	-	2	2	63	32	96	630720	29	86
Rohibat (Ashiab)	2	-	2	30	73	103	676710	72	100
Rohibat (Bazina)	-	-	-	-	95	95	624150	89	89
Rohibat (Asslamat)	2	-	2	30	-	30	197100	New system/ No water network, using only trucks to bring water	
Total	14	3	17	357	433	791	5195870	36	66

required that it should be addressed in successful labor options to acquire the goals by distributing between all the affected areas. The company has pursued the development program for successful viabilities via the preparing and connecting eight surface wells' floodgates in Jadu with the established water systems four water wells in Jinawan/Jadu, with an output quantity of 60 $m^3\ h^{-1}$, two water wells in Salaamat/Al-Rahibat with an output of 30 $m^3\ h^{-1}$ and two water wells in Al-Shayaab/Al-Rahibat with an output of 30 $m^3\ h^{-1}$, also preparing and connecting three deep wells in Kartoum and Souf Al-jin with the established water systems two water wells in Kartoum/Al-Rihban with an output of 90 $m^3\ h^{-1}$ and one water well in Souf Al-jin/Al-Zintan with an output of 45 $m^3\ h^{-1}$, in addition digging, preparing and joining six surface water wells in the valley of 'Owmar/Yafran with the established water systems to acquire its output of 102 $m^3\ h^{-1}$. Based on this, 17 water wells may be exploited and joint with working water systems to increase the quantity of water supplies. Table 5 clarifies the expected development in the increase of water supplies after implementing this program.

CONCLUSION

The lowest production of the water relative to the current resources does not exceed 36% of consumption requirements in the area, water wells that constitute 40% of the water wells in the area are in need of retaining operations, the lowest storage ability for the storage reservoirs (land) reaches about 12320 m^3 in the existing water systems. There should be storage methods that do not

cause a decrease in the average daily requirements of water, which is 22000 m^3 of water; there are inactive [wells] in the established recovery stations dues to its exhaustion, low production and negligence in the current water systems despite the importance of preserving the water for health and environmental purposes.

The empirical results-Chemical-Microscopic-Gaseous-regarding the water, proves that the water is of a medium-good type, despite the high concentration of salt in some water.

The leakage of water from the pipe network causes 10-15% of water loss, from all the consumable water, especially in the secondary lines and the distribution lines and the lines that has deteriorated due to the high levels of salt in the water. In view of the construction developments, notice a delay in the distribution networks that convoys the water, the area is derived from knowledge pertaining to the general water pumps as it is currently administered by one of the National Agency offices.

RECOMMENDATIONS

From the information mentioned above, this study recommends that the Libyan government should supply the region from outside its borders Through the Great Man-Made River Project completion the general plan for the sewage network to contribute support the water resources and complete the drilling of new wells also restoration of networks to address leakage restoration of the wells that have been stalled for production. In addition, rehabilitation of existing water systems to reduce the amount of waste water. Last, exploitation of surface water considered as a renewable natural resource.

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