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**Water Problems in the Middle East:**  
**An Engineer Reflects on Growing up in Jordan**  
 By Laith Al-Faqih

Water is the root of life at any place. It is the engine that pushes industry, agriculture, economy, and services. Water affects many aspects of life and life without water is hard.

I was born and raised in one of the most beautiful countries in the world, Jordan. A developing country, Jordan is one of the top ten poorest countries in the world in terms of drinking water resources.

I remember until the late 1980s and early 1990s, Jordan, especially the capital city of Amman, did not have such a huge water problem. Water was accessible within one's home at any hour of day. The problem became significant after the first Gulf War in August 1990. Although Jordan has had many refugees over the years, including 130,000 in 1948 and 270,000 in 1967, they did not have a significant impact on the water budget. The sudden increases in population were within the bearable limits for the water budget. With the start of the Gulf War in 1990, however, Jordan became a haven for more than a half-million people who settled and restarted their lives. This population increase had a sudden and huge impact on the infrastructure in general, and particularly on the water and wastewater infrastructure. The country was not prepared for this shock, especially Amman, where most of the people settled. Within a decade, the scenario repeated itself with the current war in Iraq, forcing around one million Iraqis to migrate to Jordan and settle, again, mainly in Amman.

**Water Distribution in Jordan: An Uneven Divide**

The 1990 and current population influxes have had significant impacts on the wastewater network. Amman has a very hilly terrain which makes it difficult and expensive to connect the houses and other businesses to the wastewater system.



*Old water tanks (1m<sup>3</sup> and 2 m<sup>3</sup>) on the ground in Jordan, with newer tanks on top of the house. Photo by Laith Al-Faqih*

In order to connect them to the network, it takes a long time for design, available money, and the most important thing is the bureaucratic issues to connect a certain service to houses and commercial areas. Along with the increase in population the expansion of the city is unorganized. It has exceeded the capability of the cities and municipalities to provide the people with services especially wastewater. I remember when we moved to our house in 1993, the area had just been connected to the wastewater service although the neighborhood was 5 years old. Therefore, people construct septic tanks to collect their wastewater.

In 2004, only 65% of the population was serviced with city wastewater collection systems. Even if the houses get connected to the network, there are not enough wastewater treatment plants to treat these volumes of wastewater. Amman is serviced with 3 wastewater treatment plants. The biggest one has a hydraulic load design capacity of 68,000 m<sup>3</sup>/day and the actual load is 236,076 m<sup>3</sup>/day. The other plants are smaller and their capacity is 4,000 m<sup>3</sup>/day. Jordan is currently expanding and constructing new wastewater treatment plants to cope with the increase of population and city expansion.

Just imagine that when you wake up and go to wash your face or to take a shower, there is no water. Or you have to fetch your water everyday. I believe this would be an unthinkable situation in developed countries such as the United States. Turning the faucet and having clean water come out is almost a given for the majority of people in

developed countries, especially in cities. During my stay in the United States, I have not seen anyone needing a water truck to come to their house to fill the water tank; or people walking 20 to 30 minutes everyday to collect water.

I remember in the news last summer in Alabama there was a story regarding the frustration of Shelby County residents who were instructed to not water their lawns between certain hours during the day due to water shortages. This made me wonder, “what would these people do if they had water to drink only for few hours a week?” Such is the case for many in Jordan.

Amman, lies on seven beautiful hills. Jordan is a relatively small country in the heart of the Middle East, bordered by Syria from the north, Iraq from the east, Palestine and Israel from the west, and Saudi Arabia from the south. Jordan’s total area is 92,300 km<sup>2</sup>; a little bit smaller than the state of Indiana. Its population is around 6 million – 3 million live in the capital Amman metropolitan area.

Jordan’s climate is arid and semi-arid – typical of the Mediterranean region. The rainy season begins in October and lasts until April. The highest precipitation is around 750 mm per year in the northwestern region, and the lowest is in the eastern and southeastern regions around 200 mm per year. The latter region forms 80% to 85% of the country’s area. The evaporation from water surfaces during summer reaches about 70% in the Jordan Valley; especially near the Dead Sea.

While only 8% of Jordan’s land is suitable for agriculture, this sector consumes approximately 75% of the water budget annually – leaving only 22% for domestic use and 3% for industrial use. The agricultural industry employs about 10% of the manpower and it produces around 12% of the annual gross domestic product.

The annual water budget in Jordan is about 1.3 billion m<sup>3</sup> but the renewable water resources only account for about 750 million m<sup>3</sup>. This leads to a deficit of around 40%. This deficit is covered by using deep groundwater aquifers that are not renewable and taking water from Israel and Syria. Additionally, the water loss in the network due to poor infrastructure and illegal connections is around 50% of the pumped water.

The budgeted daily water use per capita without any losses is around 130 L/day. Unfortunately, people in Jordan do not receive this volume of water. In comparison, the water budget per capita for the United

States is 275 L/day, the Netherlands is 218 L/day, and Israel is 195 L/day.

The majority of the people reside in Amman because it is the location of the government and businesses. It has high living standards, good jobs, good education, and the majority of the investments are there. Additionally, during the summer, tourists and locals working abroad return to Jordan for visiting and vacation time over there. This adds another half-million people who will use water and the various infrastructures.

### **Life in Jordan**

All the houses in Jordan have water tanks on their roofs. They come in different shapes and sizes, but they are typically 1 and 2 m<sup>3</sup> rectangular, galvanized steel tanks. They are considered distinguished marks for the houses and buildings. Some houses have water cisterns in their gardens as an extra resource. Originally, they were designed to collect rainwater, but people started filling them with clean drinking water from the main. These cisterns are mainly used during the hot summer season, when the water is pumped once or twice a week for few hours. Some areas stay without water for weeks and this forces them to buy water from private water trucks.

I remember my parents waking me up some mornings to turn on the water pump for the well when the water tanks were empty. I even remember a few times the water would just stop while I was taking a shower – that was just a bad feeling. Yet even though it was a bad situation at times, my family was fortunate because we only had to turn on the water pump and – voila – water was back in the pipes. My neighbors used to call on the water truck every few days because they did not have a water cistern.

Also, the houses that were at lower points in the network got their water tanks filled before the ones at higher levels because of pressure differences. Therefore, if your house or building was at the lowest part of the network, you were considered very lucky.

Today, the government is looking toward the future and addressing its water issues. The Jordanian government has prepared several studies on the nation’s water issues, and has put into action many plans to reduce the water shortage problem in Jordan and mainly in Amman by 2012, such as to withdraw water from the biggest aquifer in Jordan located around 300 km south east of Amman. The second big project is to connect the Red Sea and the Dead Sea together with a canal, which is a politically sensitive venture as are many water projects. This canal serves Jordan, Israel, and the Palestinian Authority. Since the Dead Sea area is around 400 m below sea level, the water will be pumped uphill from the Red Sea around 200 m then travels to the Dead Sea. This 600 m elevation difference is

used to produce electricity. The generated electricity will be used in desalinating the sea water and provide the participating countries annually with 850 million cubic meter of fresh water.

Also, the government is looking to implement more water harvesting projects during the winter season. In order to implement these projects many political and economical hurdles must be considered.

### **An Engineer's Work is Never Done**

The water situation and environmental issues in Jordan have influenced my decision to specialize in water and environmental engineering. But the main influence on me is my father – a professor in architectural engineering and currently the vice dean of engineering at the University of Jordan. I have been so close to my father during his Ph.D. studies in Scotland and during his teaching years at the University of Jordan. He taught me to always help people and to have a message in my life. I decided that my message would be helping people with the resource they need the most – water – and try to find suitable solutions for this issue that would help my country and others throughout the world.

During my undergraduate and graduate studies I had the opportunity of traveling to and learning about many countries. My focus was on their environmental (water, sanitation, and stormwater) issues, and what problems stemmed from these issues. How did the people deal with them? It was amazing to learn that countries have many similar problems but on different scales.

In the summer of 2004, I went with a team of students from the biology, ecology, and geology departments from The University of Alabama to Andros Island, one of the family islands in The Bahamas. The main purpose of my visit was to assess different hydraulic structures on the island. In addition to barely having a drizzle of water out of the faucet to take a shower, there were huge environmental and ecological problems. There are many estuaries on the islands, and in order for the locals to move around they build roads in these estuaries and block them. These road embankments become dams in the estuary and degrade the environmental and ecological life on the other side of the embankment where the sea water is blocked. The locals did not build any culverts or place any pipes in the roads to sustain the ecological life in these estuaries.

The Bahamas Environmental Research Center (BERC) tried over the years to protect these estuaries but with no success. After the visit, I submitted a

report about the situation of these estuaries and the ways to fix the problems and things to take into consideration for similar projects. In 2006, the head of BERC contacted me and informed me that the ministry of works is repeating the same mistake and blocking the estuaries. Therefore, the report from 2004 was sent to the ministry and an order to stop the construction took effect immediately. They decided to study the project further and its effects on the area.

In 2005, I worked with The University of Alabama student chapter of Engineers Without Borders (EWB). One of the interesting projects during our site visits was right in Alabama, around 50 miles south of Tuscaloosa, in Hale County. This area is actually quite similar to what I've seen in developing countries. One community has just recently been connected to the water network and unfortunately the water, when tested, had high concentrations of pollutants, such as *Escherichia coli*. The main water pipe has leaks and wastewater mixes with it. The student group is currently working to help this community find solutions.

Currently I am pursuing my doctoral degree in environmental engineering and I am working with the Aging Infrastructure Systems Center of Excellence (AISCE) at The University of Alabama. These environmental issues in Jordan and in many countries around the world have motivated me to help these communities find solutions that work and are suitable.

During my research I have found that the majority of water and environmental issues worldwide are due to improper planning and management. Decisions are made without looking at the big picture of the problem and not considering many stakeholders and parameters in the decision process. If these parameters and stakeholders were to be included in the decision process, many problems could have been solved.

Therefore, I have built a decision analysis framework that deals with these parameters and stakeholders. Additionally, the framework considers the effect of unavailable or uncertain data to make decisions under money and time constraints.

I hope one day that my research and work will be able to help the people around the world find suitable solutions that would fit their needs and solve their water problems.



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