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Water Safety Plan Resources In Jordan Quantity and Quality

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ABSTRACT

Water scarcity is a significant challenge facing Jordan today. It is a challenge in all areas that use water, and it has become certain that water is the critical factor in the population/resources equation. The water resources in Jordan have become limited with the noticeable increase in the population, mostly resulting from forced migrations in neighboring countries because of the wars and until our time. The rising natural population growth rate, along with the massive influx of refugees, has turned into a state of disproportion between the daily consumption of the population and the amount of water available. That Jordan shares most of its surface water resources with neighboring countries has exacerbated the situation. The current use of water already exceeds its renewable supply. Excessive withdrawal from aquifers, which leads to a lowering of the water table and deterioration in water quality, covered the deficit. This paper focuses on assessing the water situation in Jordan, mainly evaluating this problem and the solution being considered, the true basis for a sustainable water solution requires awareness by the population, and several governmental and non-governmental organizations are actively involved in educating residents about water shortages. The most important and 'actionable' elements of comprehensive water solutions are discussed in this paper, and these elements exist, develop extra water supplies, water harvesting, water desalination, proper wastewater reuse in the agricultural sector, and reduce the demand for drinking water. This research provides specific recommendations to address the shortage of water resources in the Kingdom and highlights the importance of water conservation and optimal use.

Key words : Water shortages, Irrigation Water, water Use , Water Harvesting , Aquifers storage

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Introduction

One of Jordan's primary difficulties is the lack of water supplies and one of the limits for economic growth, particularly in agriculture. With the times for farming and non-agricultural reasons, the amount of water systems increases (Mohsen, 1999). Jordan is being subjected to rainfall of around 6,000 million cubic meters, and an additional 2.065 MCM is being provided to the Syrian Yarmouk River basin watershed. A relatively limited yearly flow of roughly 878 MCM, omitting Jordan River flow, is caused by high ablation and absorption. The expansion capability of surface water sources mainly relies on completing the Al Wehdeh Dam, which is envisaged at Yarmouk (Raddad, 2005).

Jordan is the world's second scarce water country. The yearly water resources for Jordan's renewable energy sector are below the 500 m3 criterion per person, far below that of the acute water scarcity (Beek, 2017). Although more than 98% of the community has access to an expanded body of energy, only 93% have right to a safe maintained resource and 86% to a ground water. Water is normally accessible every week in metropolitan areas and therefore less often once every 2 years in distant places with lower rates in summer (Khan, 1986). Barely 77.3% of contemporary medical systems are secure or only one 1/3 have basic services (Unicef, n.d.).

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Background

According to Gulbenkian (2014), in terms of water assets, Jordan is regarded being one of the major causes of poverty. The predominant weather is dry, with more than 90% of Jordan's land falling below 200 mm each year and over 70% below 100 mm per annum. The average temperature of more than 300mm in the northwestern mountains is about 2% of the earth's area. The highlands of the northern region can to 600 mm. Some 5.5% of Jordan is considered dry, with annual rainfall ranging from 200 to 300 mm (Haasnoot, 2013). Jordan's freshwater consists of rainwater and fossil water found throughout Jordan at various depths in aquifers. Alternative water supplies have included Jordan River Monsoon surface water streams and the enhanced treatment of sewage and potential supplies of other supplies like as seawater. (Habersack, 2013).

In the Middle East, the Kingdom of Jordan covers 89,322 km2. The population of Jordan in 2008 was 6.2 million, with a current population growth rate of 2.3% predicted to reach 8 million by 2024 (Hoekstra, 2008). In metropolitan regions, however, around 70% of Jordan's population lives. This predicament in Jordan, which itself is expected to grow only over a time, is supplemented by the fact because water availability is connected to financial hardship and a shortage of energy resources in Jordan. Jordanian is among the world's most waterproof countries. Water is Jordan's only critical global commodity (Hoekstra., 2012).

The shortage of water in the Jordan is a concern, and in the decade, it is a country's disaster. As reported by (IPCC 2007), some over of aquifers that it was projected for the total water supply in 2010 to be 1059 MCM. Even when over-pumped, residents only carry data sporadically in most Jordanian cities, and residential water is shallow, less than 100 liters per day (Mohsen, 2007).

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According to (Jaber 2001), the rapid population growth, inadequate water management and consumption, a lack of suitable wastewater treatment, and improper price increases worsen water shortages. Wide-ranging desalination is still not economically viable. A mix of new supplies, demand control, and decreasing population growth is expected to include long-term solutions. In the medium term, successful control of current water resources and better quality of wastewater for reuse is the most practical strategy for minimizing the gap between the Supply of water and Supply (Bataineh, 2002).

Water Shortage and quantity

The Jordanian government said that the Jordan annual average share of 200 m3 was 200 m3 in 1993, an aggregate of 1200m3 for Egypt, 1800m3 for Syria, and 480m3 for Israel comparing with other Jordanian countries. (Mimikou, 2016). Water needs to be increased to 300,000 m3/day in Amman, and the highest possible daily water levels, or 35 million cubic meters (Mm3) per year, are 90,000m3 larger. Water for irrigation represents 61% of overall water requirements, while municipal and industrial requirements are 31% and 6% (Karamouz, 2003).

Jordan is situated in a climate of arid semi-arid temperature an yearly rainfall in about 80 percent of the country of less than 100 mm per year is frequently considered arid. 12.5% between 100 and 200 mm/yr, 3.8% between 200 and 300 mm/yr, 1.8% between 500 and 300 mm/yr, and only 1.2% gets upwards of 500 mm/yr, correspondingly. The sections of the northeastern dunes are 50 mm/yr. The rainfall is throughout Jordan (MRC, 2009).

In 2004/2005, Jordan had around 9304 Mm3, of which 93,9% evaporated. On the groundwater recharges just about 3.9 percent of the precipitation. Jordan has meager water resources from rivers, the same name as the Jordan River, as waterways and rivers dry. So Jordan depends

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primarily on rainfall. Jordan is considered to have a large area of tribal area towards its central and eastern frontiers with Iraq and Saudi Arabia (Nijhuis, 2015).

Water availability prospects for the future are not promising. By 2010 the demographic of Jordan will be 7.3 billion and the disparity both producers and consumers will expand significantly. (Sadoff, 2015).

At present, Jordan utilizes around 941 million cubic meters, allocated as irrigation 603.5 Mm3 (2005), as industry 38.4 Mm3, household 291.3, and livestock 7.8 Mm2 each year. The demographics and economic growth are projected to increase this amount in the foreseeable future (WWAP, 2011).

According to (Hadadin 2010), a careful examination of the current state of water resources in the country shows that the following reasons are ascribed to the current problem of water:

1. The lack of precipitation affected the surface water in the country; climate changes reduced the rainfall (PRB, 1998).

2. Rising urbanization and industrialization contribute to the overuse of water supplies and adulteration.

3. Deficient wastewater processing capacities in industry and municipalities; sitting adjacent or immediately upstream of industrial plants overuse and abuse of insecticides and drinkable supplies; pollution-led fertilizers (Gideon, 1990).

4. The Jordanian people have been threatened by high water usage, notably in agriculture, and have produced so much shortage. This excess led to the drainage, drying, and pollution of the water sources from Jordan.

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The Jordanian government estimates that the current water level in the region was 1200 m3, a Syrian 1800 m3, while that of some contemporaries in Jordan in 1993 had an annual water level of 200 m3 (Alon, 2007).

Objectives

The objectives of the study are to:

- Analyze the situation of water in Jordan
- Assess the problem of water shortage in Jordan
- Provide the solutions

Challenges

The increasing water demand due to population development and industrial/agricultural capacity has worsened these difficulties. Long-term surveillance of rainwater in the principal aquifers in the country reveals a drop in water levels, with annual decreases in certain aquifers of over ten meters. The high levels of non-income water (flows of water, illegal connections, and meters), estimated at 52%, are also a compounding issue and predicted to be a source of fear and a high subsidies level. Water is a non-income resource (NidalHadadin, 2010).

Due to the significant open defecation rate and inadequate access to safe water, the situation in informal settlements is of particular concern. Vulnerable households are pushed on insufficient and inadequate quality services to spend a considerable part of their limited money (Nations, n.d.). The effect of climate change on Jordan is projected to be marked, most likely resulting in the rising heat, weather patterns, extreme events, and flooding. This will jeopardize the resilience of water

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and sanitation services, making the attainment of sustainable development goals six more challengings (Sharif, 2021).

Critical standards in hygiene, such as hand hygiene, are in practice in Jordan, yet disparities in the access of needy members to essential hygiene products exist. The effect of climate change on Jordan is projected to be considerable, most likely resulting in the rising heat, weather patterns, extreme events, and flooding. However, the essential standards in hygiene, such as washing hands, are in practice in Jordan, yet disparities in the access of needy members to crucial hygiene products exist (Steven M. Gorelick, 2021).

Solutions

As accorded by (Unicef n.d.) that UNICEF supports urgent, durable, and high-impact, water-based and restoration programs to promote the access of most vulnerable children and families to safe, regulated basic sanitation.

Working closely with the Ministry of Water Resources and critical stakeholders, UNICEF supports policies and programs to improve city, schools, flight camps, and community/household sewer systems, and helps to promote social solidarity and an appropriate level of water and sanitation for most disabled individuals, except those who are at risk (Haddadin, 2009).

- Support vulnerable people in residents with sustainable, environment-friendly and extending coverage of water treatment infrastructures to unaffiliated regions;
- Improvement and cleanliness in community schools of WASH facilities.
- Good clean water and sanitation facilities for Syrian refugees at camps and sites that are hard to reach; • build and operate outlay, sustainable connections of wastewater treatment in camps of migrants in Azraq and Zaathar, both improve water quality and fair

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distribution, as well as increase the lives of over 100 000 children and their families; refugee camps;

- • Increase output of available water technologies, including rainwater harvesting and reuse in community and school environments, and involve people as agents of flood mitigation change.

Surface Water

Jordan, Zarqa, and Yarmouk are three major rivers. Three major rivers exist. The Jordan River is salt, thus it is not drunk or irrigated. There is significant urban, industry and farm effluent in the Zarqa River, which makes irrigation for house and dry season unsuitable. Only during flood seasons does water quality increase (Reliefweb, 2021). Although the river Yarmouk is less strained, it is also a municipal wastewater drain. The Jordan River, so famous for its history and its religions, is now only a halfway brook (southern and northern Jordan Rivers)(Lindsey, 2020).

Salinisation of groundwater is also a Jordanian concern. The biggest difficulty in the Jordan Valley is the growth in the number of salt minerals flowing into the Jordan Valley (Schwartzstein, 2019). In the Jordan Valley, abandoned salty corpses are one of the principal sources of salinisation. The wadis, rivers, dams from psychiatric hospitals and dump sites downhill are also water surfaces affected by pollution. Factors releasing unrecovered trash from the rivers of the reservoir in Talal Dam King, the extremely large surface reservoir, are dangerous for salinity, the chemicals and metal concentration. (McDonnell, 2020).

A further issue of increasing relevance is the regional water resource dispute, and more than two countries share about one-third of the Kingdom's transboundary basins. Unusually, the circumstance is generally seen as food for neighborly enmity. Jordan River and Jarmouk River are

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two main sources of surface water in Jordan, both depleted in upstream water diverting and over pumping, in Syria and Israel (Xinhua, 2021). Limited-potential aircraft, like the already almost complete Azraq Oasis, also offer Jordan with water sources for Amman.(USAID, 2020). Mobilization and the judicious use of water resources (Pierce 2021) indicates that integrated water and environmental management policies need to be adopted regionally to find a durable solution and to turn a situation of conflict into a solution open to each other.

Water demand and Supply

The current scenario of water resource management in Jordan raises serious concern both for water balance in the country and for the deterioration. The water equilibrium of Jordan. The picture is so dreadful that any water scholar can understand that it is all too simple for the country to "cross the red lines" given regular water scarces, over-use, degradation of resources, or contamination. Figures based on water resources reflect water deficiencies based on average water year (Nadhir Al-Ansari, 2014).

The lack of water in Jordan makes it highly complex to manage this crucial resource politically, technologically, socio-economically, and environmentally. Jordan has a water budget of roughly 1 trillion cbm, which compares to social, economic and ecological needs, with a comparatively small budget. The main parties should be considered in any water strategic approach: domestic, industry, tourism and agriculture. However, the future supply of water, demand and resulting Mm3 deficit up to 2040.(Pixabay, 2021).

Aquifers and basins are the principal water sources in Jordan that are feed and refilled from annual precipitation. The basin of Yarmouk is the biggest in the country. Approximately 93.9 percent of

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the entire water amount is influenced by the loss of Jordan water source via evaporation and transpiration, leaving only a little amount of water and soil available for water (STAFF, 2021).

Water, which represents 77,5% of all water use, is mostly used in agriculture in Jordan while the remainder is used in residential and commercial applications. The urbanisation in Jordan is expected to grow annually at 25 Mm3 per year.

(Hof, 1995). This growth is linked to urbanization and industrial development, and household use, mainly due to population development (Abu-Zreig, 2000).

Water Harvesting

Jordanian accumulation in the Sahara has an essential role of Water. The water is scattered across a broad range and can significantly boost the state water supply when the word is correctly collected (Hadadin, Water shortage in Jordan — Sustainable solutions, 2010). There have been several trials on sewage pipes and the findings of specific studies show that the liquid budget can be raised directly. Company ’s decision analysis in the upper Wadi Madoneh area, for example, assessed the moisture content, the dam location and the increasing volume of water around nine kilometres south and fifteen kilometers east of Amman. (Li, 2016).

Additional research concentrate on the production of water as an indirect indicator for improving water supply, by e.g. reducing water consumption, analyzing the production of precipitation in snowfall regions in which precipitation can be adherents on the soil and cultivated using balconies, rippers, shelf contours and other drip irrigation techniques. However, the efficacy of these devices is constrained by the earth's penetration and climate conditions. (GARTHWAITE, 2021).

Water availability for desalination

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Water desalination is almost semi for Jordanian domestic use, except in certain small family groups or water supplies businesses. For their industrial uses, a number of plants use plants of a total capacity of about 9000 m3 a day. Since 1980 the capabilities in the Hussain Thermal Power Plant, Oil Raffination Station, Pepsi Cola Co., Potash and all those little companies have been being built (Jaffery, 2021). One is the saline waters in the country, the other the marine waters of the Gulf of Aqaba. The Bay of Aqaba is the second. Brackish waters in southern Ghorea of around 5000–7500 ppm are the only source in Jordan with an output of about 60 mm3/yr between Dier Alla and The Dead Sea. Spring with length of 10 mm3/yr and brackishwater to the east and west of the Jordan Valley are other supplies estimated at roughly 100 billion cubic feet in the region.(Schyns, 2015).

Due to the country's topography, the distance among these distributed resources, and the necessity to handle certain types of chemicals such as manganese, sulfates, and iron and gasses such as hydrogen sulfide, it will be tough to utilize these resources. The primary concern, finally, is the disposal of the salt that can cause problems for the environment. However, these distributed sources can deliver solar or/or wind power with desalted water to tiny communities (Tarawneh, 2007).

The salty water from the Aqaba Gulf is an infinite water resource. It can be developed to meet tourism and industry needs in the Aqaba district and provide desalted water in other parts of Jordan. In addition to the deodorization process for this source, 350 km to Amman and more to other regions must be carried. It must also be injected from zero to around 1000m static head. In Ghore, brackish water is less expensive, but it must be taken from −400 to 1000(1400)m fixed charges for around 45 km (Maher, 1994).

Water Quality

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A study conducted by (Fanak 2015) examined the effects on the water quality of Jordan on the decline in availability and pollution and salinization; concluded: "About 70% of spring water is contaminated physiologically. There is a high level of toxicity in water supplies. Industrial dumping is inadequately or mistreated. The water quality of the Lower Jordan River and the Zarqa River, as is stated before, has deteriorated dramatically during the past 50 years. The Jordan River flow is, for instance, constantly declining due to upstream abstractions, as detailed in 'Water Resource.' Simultaneously the river continues to enter the Jordan River ascending from Israel, the West Bank, and Jordan, which impacts the quality of the minimal volume of water left (Murakami, 1998).

They contaminate the Zarqa River with industrial waste and unlawful discharge of waste, illegal mining, and rushing fertilizer back into the river from those farms by farmers. Groundwater quality is declining, primarily because of overpumping, typically leading to higher salinity.

Water quality will probably continue to decline as water demand grows and supplies decrease (Irani, 2000). (Schyns, 2015) states that a recent study examining the effects of water quality declines in Jordan on water supplies, erosion, and desertification has revealed that:

- Springwater contains about 70% of the spring water.
- Have signature of water resources
- Commercial releases are treated or untreated inadequately.
- The water table in certain aquifers has been cut by 5 m and treble saltiness by over-abstraction of water for irrigation purposes.
- Nitrates and phosphorous surged in water supplies due to the unauthorized application of fertilizers and pesticides.

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There is a fundamental and complicated problem with water quality. The fact that the reasons are recognized, and measurable is straightforward. However, the government still has a complex issue in dealing with these questions and finding a strategy to reduce the adverse impact on the quality of freshwater and wastewater resources (Alon, 2007).

- Only by solving the following challenges can water quality in Jordan be improved:
- Effective treatment at source of biological pollutants and other harmful substances.
- Improved regulation and compliance of industrial wastewater before disposal and processing of raw materials and amount for crop fertilization.
- We are reducing subsurface resource over-exploitation.

Groundwater is the most invaluable component accessible, which may be used in different quantities, quality, and depths from a few centimeters to much more than 1000 meters in much more than 80 percent of the country. The water Jordan's groundwater is renewable and fossil of two kinds. Lastly, it represents 5% of the total water supply of Jordan's most geomorphological regimes (Gulbenkian, 2014).

It is interesting to look at the wastewater collecting and treatment system Ain Ghazal established by the government in the 60s in the vicinity of Amman to grasp the intricacy of these difficulties. Ain Ghazal was created to serve 300,000 houses and about 60,000 m3 of wastewater per day through a city-wide sewage network. Now, for several reasons, including the rapid population rise, the treatment system is excessively overcrowded, which has led to greater wastewater generation. In addition, treatment processes are antiquated at the plant and no longer treat water adequately.

Sustainable Solutions for Jordan

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1. New water supplies are being developed In the history of government and civil engineers, new sources of water have been tapped, but in Jordan, almost all of the cheap cost choices have been explored. Given the full use of all rivers and aquifers, few alternatives for generating new drinking water sources remain.

2. Fortunately, it has been demonstrated and still becomes cost viable for desalination, which means the energy-intensive process of transforming brackish water or seawater into freshwater. In Saudi Arabia, the United Arab Emirates, Kuwait, and the USA, a number of plants are available. Production of seawater has cost less than $1.50 per m3 to $0.63 per m3.

3. Since Amman has farther away from the seaside, additional costs of pumping and transportation of about $0.25 to $0.35 per m3 should be included for our people (since there is no cooperative water exchange scheme with its neighbors). Over the years, a number of mega-projects were proposed. One possibility is to generate freshwater from the Mediterranean or the Red Sea by transferring and purifying them. Currently in the environmental impact assessment phase, the Red-Dead sea-mega project. Freshwater can be imported by pipeline or by seas in ships or even in giant plastic bags from Turkey into the area.

4. The reuse processing of wastewater is a realistic alternative and is now in use in the Jordan Valley (and is being explored further). Moreover, demand for freshwater has been reduced. The costs of treating and providing water for farming demands vary on the crop and quality and the closeness of the farm to the city.

5. As agriculture is Jordan's main water industry, then using appropriate irrigation technologies such as sprinkler systems, drip irrigation systems, subsurface irrigation systems, and green plastic homes can increase hot season water savings.

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6. Domestic applications account for 30% of total demand. Greywater can be replaced partially with freshwater, while the efficient use of showerheads reduces the demand for freshwater. Furthermore, it is possible to capture and save rainwater from roofing for other domestic applications such as gardening to reduce the need for freshwater (GARTHWAITE, 2021).

Conclusion

The fundamental explanation for the serious shortage of water in Jordan lies simply in the absence of natural resources: rivers and lakes. In addition, the problem of water shortages has further complicated previous severe drought times. Currently, being a developing country, Jordan's economy cannot fully sustain the use of desalination as a fresh water supply. To supply Jordan with plenty of water for home and agricultural usage by 2020, two major aquifer projects need to be carried out.

First is a multi-Milliarden dollar company that connects the Dead Sea to the Red Sea with a Canal of 325 km. This power could be used in order to dismantle seawater as drinking water by performing this project hydropower energy. The second is the DISI Water Transportation Project. The major goal is to transport extra water from the Disi Aquifer to the Greater Amman Area. In particular, during the summer, the Disi-Mudawarra to Amman Water Transport Scheme will lead to a reliable water supply for Amman. This project has long been on the table because of a lack of funds.

Brackish water desalination offers the possibility of improving the water supply in Jordan. RO had the highest ranking in Jordan while assessing several desalination techniques. Economic, social, and economic factors for the multi-criteria analysis were used. In Jordan's seawater desalination, there is a huge demand for capacity growth. This comprises membrane industrial development,

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construction and maintenance, and specialized labor. Users that are able to pay will probably utilize desalinated water. These include domestic users of industry, tourism, and high wealth.

According to the high ratio of Evaporation from open Dams the new suggested policy and practical projects should be done is the Aquifer storage from open dams so the use of the dams jus to collect the water from the wadies net and after that it should be Storage under suitable aquifers in the same location of the Open Dams, we implement to Use aquifer Storage and Recovery Concept regarding to the Shortage of water Resources and to avoid the High Evaporation Rate which reaches to 90% of the water of The Dams and to avoid any propability of Pollution .

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