



Water Stress: Between Farmers' Needs and Public Policies the Case of Smallholder Farmers in the Villages of Nabatieh Governorate

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Water scarcity is a paramount developmental and livelihood issue globally, posing life-threatening challenges in the Arab world and the Eastern Mediterranean. This scarcity manifests in two forms: physical scarcity, due to insufficient water resulting from local environmental conditions, and economic scarcity, characterized by inadequate water infrastructure. When these forms of scarcity converge, they lead to severe water stress, exemplified by regions experiencing both low rainfall and inadequate water storage and sanitation facilities. In Lebanon, state policies, or the lack thereof, have significantly exacerbated water scarcity. Governmental negligence and

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mismangement of water resources, compounded by insufficient investment in infrastructure, have intensified both physical and economic water scarcities. The lack of effective water conservation policies, poor maintenance of existing water facilities, and failure to develop new water projects have led to severe water stress, hindering developmental progress and threatening the livelihoods and health of the population. The combined effect of environmental challenges and governmental inaction has made water scarcity a critical issue, necessitating immediate and comprehensive interventions to ensure sustainable water management and availability for the future

Keywords: Water scarcity; water storage; sanitation; water sources; governmental negligence and mismangement of water resources.

1. INTRODUCTION

Experts say, "Even when there are significant natural causes of water stress in a region, human factors are often pivotal to the problem, especially regarding access to clean water and safe sanitation (Klobucista & Robinson, 2023).

Given that the Arab region is one of the most water-scarce areas in the world, covering about 9% of the land area, it is home to about 5.6% of the world's population but receives only about 0.6% of the world's renewable water annually [1]. Consequently, eight Arab countries, including Jordan, Bahrain, Kuwait, Libya, Qatar, Saudi Arabia, the UAE, and Yemen, are among the ten poorest countries in the world in terms of per capita renewable water resources, with less than 500 cubic meters per person per year [2]. These countries are located entirely within arid land belts.

"There is a significant imbalance between water supply and demand in these Arab regions. On the supply side, the average per capita water availability is about 10% of the global average, while demand is continuously increasing due to a population growth rate of 2% per year, which is twice the global average (UNDP, 2013). By the end of this decade, the annual water availability per person in the Middle East and North Africa region is expected to fall below the absolute water scarcity threshold of 500 cubic meters per person per year. Estimates also indicate that by 2050, an additional 25 billion cubic meters of water per year will be needed to meet the region's needs [3].

2. WATER SCARCITY: MULTIPLE CAUSES, ONE OUTCOME

In reality, there is no single cause for water scarcity, and therefore no single solution. However, it is agreed that water scarcity is a critical issue for many countries suffering from it.

In addition to physical scarcity, various factors exacerbate this problem. Studies that address global water scarcity "rely on long-term projections of climate, population growth, technological changes, and other largely uncertain factors (Dolan, F., Lamontagne, J., Link, R. et al., 2021 [4]. "The reasons for water scarcity are diverse, and according to some reports, human factors such as population growth are among the pressures on water supplies. "It was expected that by 2025, the average annual renewable water resources in the Middle East would drop to 667 cubic meters per person, compared to the global average of 4,780 cubic meters per person" [5]. Poor management of water resources can also lead to scarcity. Excessive consumption of water resources, for instance: "continuing to invest in water infrastructure to increase supply for agriculture and urban populations, are practices that strain water sources [3]. Poor water management can also take another form, as seen in Central African countries that suffer from water scarcity despite high rainfall [6]. "The Democratic Republic of Congo, for example, experiences water scarcity despite its high rainfall, due to poor infrastructure and high levels of water mismanagement (Klobucista & Robinson, op. cit., 2023)." Another reason exacerbating water scarcity is "the long-term general trend among various countries in the region to focus on increasing water supply rather than managing demand [3].

Like the Democratic Republic of Congo, "Lebanon is generally considered a water-rich country, with water available almost everywhere. This means that it does not have physical scarcity in the literal sense. However, a deeper look at supply and demand reveals a different reality: the water availability per person is actually below the water poverty threshold, which is widely defined as not having enough water of adequate quality to meet basic needs [2].

"The water deficit in Lebanon is linked to various factors, including "rapid population growth in the region (Bou-Zeid & El-Fadel, *ibid* Spinoni, J. et al, 2021)" unplanned expansion of inhabited urban areas, unregulated tourist projects along riverbanks, the influx of Syrian refugees, and poor distribution of water resources [7]. Additionally, there are issues of pollution and administrative reform failures. The water deficit is also caused by several ecological factors, such as "climate change, drought, decreased precipitation, and the threat of desertification [8,9] particularly with significant decreases in rainfall in the Eastern Mediterranean region, including Lebanon and Jordan [10]" Water scarcity worsens in the summer due to "a severe decline in water storage capacity, linked to deteriorating old infrastructure and limited water storage systems such as dams and water collection ponds [11].

Above all of that comes water policies embodied by erratic water policies and poor governance of the sector. Fragmented legislation and unclear laws lead to overlapping roles and responsibilities, compounded by weak enforcement against violators. This overlap in roles and responsibilities among institutions involved in the sector is one of the main challenges facing the water sector.

Within this general framework, the agricultural sector in Lebanon, which is "one of the largest consumers of water, had approximately 277,000 hectares of cultivated land in 2007, of which 142,000 hectares were irrigated, despite the secondary role this sector plays in the national economy, contributing 5% of the Gross Domestic Product (Qomhair, 2010)." Currently, the cultivated land has decreased to "200,000 hectares or 494,000 acres, employing about 8% of the effective workforce [12]" While in 2007 it was around 277,000 hectares, with about 142,000 hectares irrigated [13].

In the same context, the villages of the Nabatieh region are considered to be water-rich villages, due to their proximity to the "Litany River, which is an important source of water in the region [14]" on the one hand, and their richness in groundwater and the flow of springs in their lands on the other hand. However, "these important water sources are currently suffering from severe problems, due to climate change, the decrease in the annual rainfall rate in them, and the deterioration of their quality, due to the pollution that occurs in them, which causes a decrease in

the level of their flow, and reduces the farmers' benefit from them for a long period during the summer season [15] and this negatively affects their crops, sustainable agriculture, not to mention its effect on public health [14].

3. QUESTION AND THE METHODOLOGY

This paper sheds light on the problem of water scarcity and farmers' adaptation mechanisms in the face of confusing water policies. It raises the following research question:

How do water policies deal with water scarcity? What are the options that smallholder farmers in the Nabatieh region - South Lebanon have resorted to adapting to water scarcity and the policies associated with it?

To answer this question, the research focused on a sample of smallholder farmers selected from 38 villages in the Nabatieh region. A total of 178 farmers of both genders were surveyed using a descriptive and analytical approach, which involved collecting information and classifying it quantitatively and qualitatively. The aim was to understand the challenges of farmers in the villages surrounding the city of Nabatieh due to water scarcity and confusing water policies on their irrigation methods and identify the strategies they use to adapt. The research relied on a mixed-method approach [16-19].

The qualitative approach had two main objectives: first, to conduct exploratory interviews with farmers in the region to understand their challenges, and second, to develop themes for the questionnaire. The quantitative approach involved a survey using the developed questionnaire technique.

Moreover, this research has methodologically relied on a wealth of academic articles and specialized reports concerning water issues in the Arab world and Lebanon. These scholarly sources have provided critical insights and data essential for the study. Additionally, the electronic platform of the Litani River Authority has been an invaluable resource, offering rich and comprehensive information that has further informed the research. These combined sources have enabled a thorough and nuanced understanding of the water scarcity challenges and management issues in the region.

It is essential to recognize that the results of this study cannot be generalized because of the

absence of a representative sample of villages and farmers. Nevertheless, they offer valuable insights into the behaviors of farmers regarding their water use and management practices, as well as their interaction with government water policies.

4. SOCIODEMOGRAPHIC CHARACTERISTICS OF THE SAMPLE

The distribution of individuals in the sample based on gender indicates that there is a significant majority of males working in the agricultural field, with 79.8% compared to 20.2% females. This dominance of males over females in agriculture may be attributed to social and religious norms that favor males inheriting land and real estate. Additionally, Chart 1 confirms this trend, showing that 80.6% of males own the land they cultivate, while only 19.4% of females own land. This disparity highlights the gender gap and discrimination in land ownership. The Global Gender Gap Index for 2023, issued by the World Economic Forum, also reflects this gender gap, specifically in Lebanon, which scored 62.8%, indicating the depth of the gap in participation and economic opportunities between the sexes (World Economic Forum, 2023).

Despite the low percentage of women who own land compared to men, it's important to recognize the significant contribution of rural women in the agricultural sector. According to a study by the FAO, women constitute 43% of the agricultural workforce [13]. The gender gap is also evident in the educational levels of male and female farmers, with a higher percentage of illiteracy among females (33.3%) compared to males (8.5%). This disparity in educational levels is observed across all stages of education.

5. WATER SOURCES USED FOR IRRIGATION AND FACTORS AFFECTING WATER PROBLEMS

Agriculture in Nabatieh Governorate relies on the Litany River and its tributaries, but several factors hinder farmers from benefiting. These factors include:

- Water pollution: negatively affecting the quality and health of crops.
- Water waste: occurring due to indiscriminate and excessive exploitation.
- Decrease in annual rainfall: affecting the groundwater and springs.
- Increase in water demand: due to the expansion of villages, population growth, and Syrian displacement.

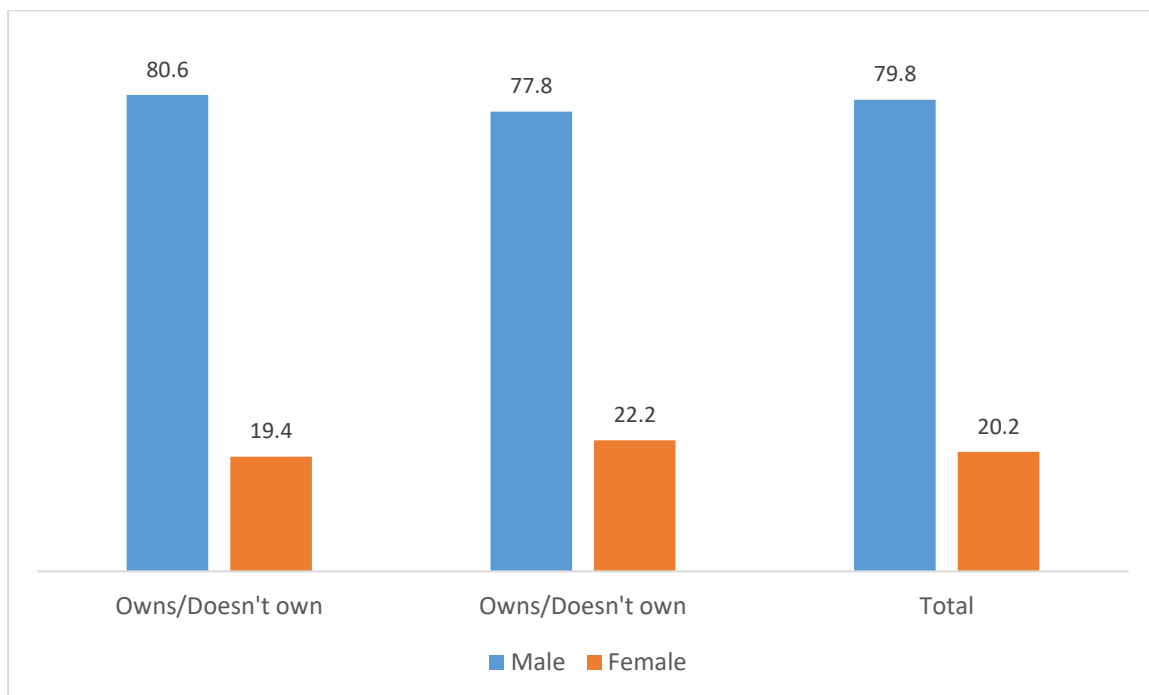


Chart 1. Distribution of sample members according to gender and ownership of agricultural lands

Source: Results of the field research 2024, with smallholder farmers in the villages of Nabatieh Governorate

As a result, the region has witnessed a noticeable decrease in the flow of rivers and springs, especially in the summer. Water scarcity has led some farmers to abandon irrigated agriculture and switch to rainfed agriculture, which requires less water. They also adopt various methods and modern irrigation systems, some of which may be stressful for water sources. As well as reduce the area used for agriculture, which has not exceeded three dunums* according to this research.

According to the study results, multiple water sources are used for irrigation. Over a third of the sample (34.3%) rely on state water sources. These sources are drawn from nearby rivers and springs, directly by the farmers or indirectly through modern pumps to village reservoirs. The reservoirs are considered public property and are used by all residents without exception. This information is based on Chart 2.

The public water network is a crucial resource for one-third of farmers, however, farmers are dissatisfied with it due to unfair water distribution and issues with fuel scarcity¹, high fuel costs, and decreased energy supply. The situation is worsened in parallel with the current economic conditions in Lebanon. Additionally, the public water network supplies are almost completely affected by power outages, which previously were powered by 87% of Lebanon's electricity grid. As a result, many farmers, regardless of their background, struggle to access sufficient water².

On a significant note, the column "Farmers' use of sewage to irrigate their crops" was deleted from the above chart because the answer to this column was zero. However, reality shows the opposite of this result, as the National Litani River Authority has indicated, according to estimates, "that the estimated areas of agricultural land on the banks of the river (within 2 km of the riverbanks) are approximately 8,396 hectares, based on land use maps. All of this land can be irrigated directly from the river. According to experts in the sector, more than 1,000 hectares of this land are irrigated in the

summer from the river polluted with sewage water"³.

As a result of the factors mentioned above, farmers have been forced to rely on other sources to meet their water needs for irrigation. Paid-for water tanks are the first of these sources after state water, with 25.9% of farmers using these sources, which incur very high costs relative to their incomes (see Chart 2). These individual solutions to secure water for agriculture involve buying water from unlicensed water suppliers (tank owners, private wells, etc.) who wastefully withdraw water" (Farajalla et. al., 2015).

The majority of farmers have switched to using alternative water sources for irrigation, which may be more cost-effective than buying water tanks. For instance, 18.2% utilize water collected in ponds from rainwater, 12.2% rely on water from rivers, springs, and streams near their land, and 9.4% use private wells for irrigation. According to the National Litani River Authority, "the estimated agricultural land area on the riverbanks and within a 2 km radius is approximately 8,396 hectares, and all of this land can be irrigated directly from the river. When combining the last three water sources with the state water source, it is found that 74.1% of farmers rely on low-cost sources, while 25.9% rely on paid-for water tanks. This last source is considered expensive to the low incomes of the farmers, which mainly range between \$299 and \$400 according to study results.

Farmers face challenges related to the high cost, interruption, and scarcity of water, as well as the excessive consumption caused by the establishment of large industrial, tourist, and agricultural projects. These projects consume lots of water, particularly state water, which poses unavoidable challenges for smallholder farmers. According to Chart 3, the majority of farmers (71.6%) expressed their primary concern about the proliferation of tourism projects in the region. This has become more evident in the recent period following the spread of COVID-19, and these projects are seen as important investments with high financial returns,

* A dunam in the Levant, Syria, Palestine, Lebanon, and Jordan is equivalent to 1,000 square meters.

¹ See: Inter-Agency Coordination Lebanon Water Sector, 2022 end-year SECTOR DASHBOARD Water Sector, available

@file:///C:/Users/lamak/Downloads/Q4%20dashboard%20-%20WASH.pdf.

² Ibid

³ See: Litani Water Authority Official Website. "Future Projects and Pollution Issues." https://litani.gov.lb/ar-lb/depollution/pollutionchallenges

particularly given the worsening economic conditions. be directly irrigated from the river ⁴.

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The foundation of large agricultural and touristic projects affects some farmers at a rate of 18.2%. These projects acquire a large proportion of water, which weighs on the farmers. Many of these tourism projects encroach on public river properties in the Litani River Basin. There "are 293 public and private rest houses on the river banks, covering an area estimated at one million square meters in the upper and lower basins⁵.

Establishing facilities near river courses has many negative effects, including water pollution, changes in the water flow system, and impact on biodiversity⁶. In the lack of supervision and the rule of law, hundreds of water pumping stations have been set up on river courses and water points. According to the National Litani Water Authority, these stations have contributed to the disappearance of many springs, the deterioration

of many perennial rivers, and the reduction of their discharge ⁷.

"A small percentage of farmers (4.5%) are worried about the industrial projects. These projects put pressure on water resources, especially t in the summer when "the Litany River shows a low flow compared to 40 years ago. The odor emanating from the river also reveals the presence of raw sewage, untreated industrial waste, and agricultural runoff⁸"

The farmers are aware of the encroachments on public water resources and the pressures they face, but they do not hold the state responsible for protecting these resources. They may not even care about the corruption in the bad investing and distributing the resources. This could be due to their chronic feeling of the absence of the state and its role, and their total reliance on themselves to manage their affairs.

The current disorder in water extraction for the mentioned projects poses a threat to farmers and subjects them to difficult challenges. This disorder has led to what is known as water stress. Can this situation raise awareness and prompt people to adopt plans and strategies to protect their water resources? Will farmers take specific steps to manage effectively their water usage? Have they implemented any adaptive measures to overcome the problems associated with water scarcity? How do they react to water policies? The following discussion will address these questions.

6. MISUSE OF WATER RESOURCES AND ITS IMPACT ON SCARCITY

The water resources in the region, particularly in the villages of the Nabatieh Governorate, are facing numerous threats. The most significant of these threats is the presence of illegal water pumping stations that have been established on river courses without proper supervision. This has led to the vanish of numerous springs, the deterioration of perennial rivers, and a decrease in their flow. These pumps pose serious environmental hazards and have contributed to

⁴ See: Litani Water Authority Official Website. "Future Projects and Pollution Issues." <https://litani.gov.lb/ar-lb/depollution/pollutionchallenges>

⁵ See: Litani Water Authority Official Website. "Future Projects and Pollution Issues." <https://litani.gov.lb/ar-lb/depollution/pollutionchallenges>

⁶ See: Litani Water Authority Official Website. "Authority News." <https://litani.gov.lb/ar-lb/news/detail>

⁷ See/ Litani Water Authority Official Website. "Future Projects and Pollution Issues." <https://litani.gov.lb/ar-lb/depollution/pollutionchallenges>.

⁸ See: USAID, LITANI RIVER BASIN MANAGEMENT SUPPORT PROGRAM LITANI RIVERWALK -THROUGH SURVEY REPORT, October 2011

@<https://www.litani.gov.lb/getattachment/AboutLRAB>.

increased water scarcity, affecting over two-thirds of the farmers in the area (65.7%).

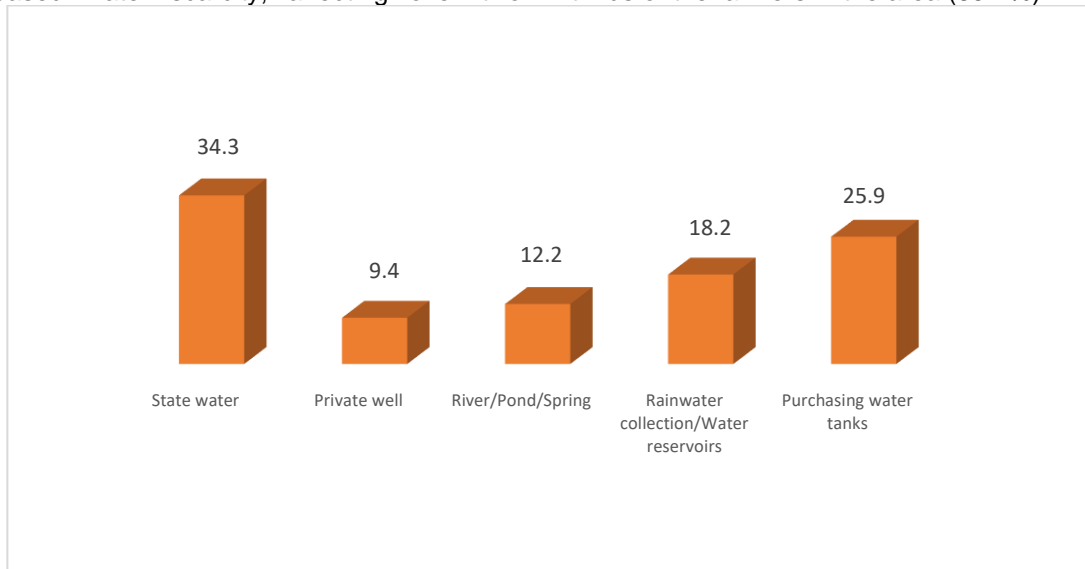


Chart 2. Distribution of sample members according to the sources of water used for irrigation of crops

Source: Results of the field research 2024, with smallholder farmers in the villages of Nabatieh Governorate

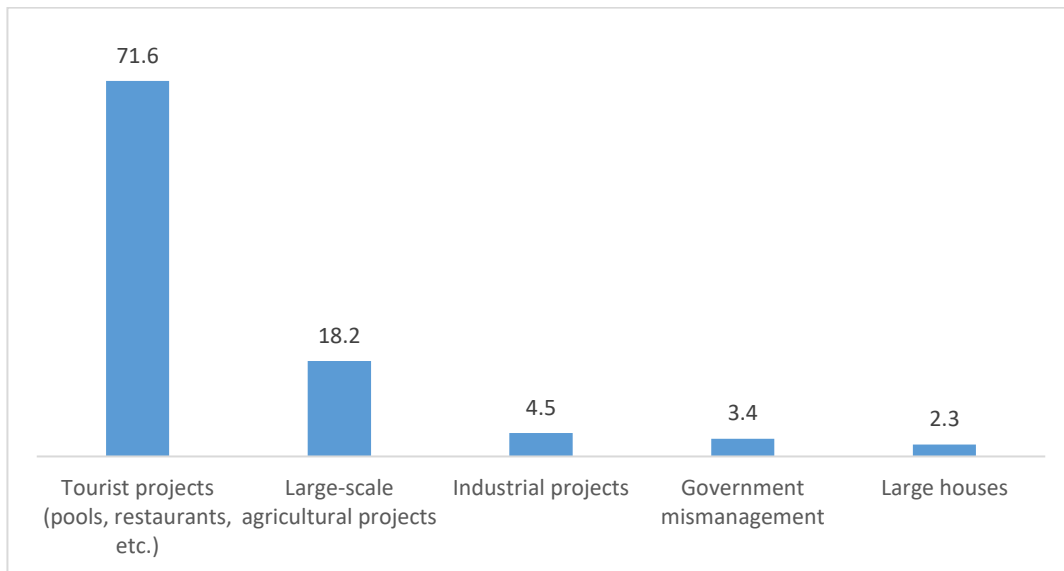


Chart 3. Distribution of sample members according to the factors exacerbating "water scarcity"

Source: Results of the field research 2024, with smallholder farmers in the villages of Nabatieh Governorate

The adaptive measures adopted by the majority of farmers are illustrated in Chart 1, which shows the "distribution of sample members according to the type of adaptive measures adopted in response to water scarcity.

Chart 4 reveals two main approaches farmers in the region use to adapt to water scarcity. The

first approach, adopted by nearly half of the sample (49.3%), involves implementing water-efficient irrigation management practices. Farmers have turned to irrigation systems they consider highly effective in conserving water while being low-cost. These practices include choosing specific and limited times for irrigation to minimize water evaporation and adopting

spaced-out irrigation intervals. In contrast, 16.6% of these farmers have adopted modern irrigation methods, such as drip irrigation and high-tech sprinkler systems. However, 5.3% continue to use traditional flood irrigation methods. The disproportionate number of farmers switching to water-efficient practices instead of modern methods can be attributed to two main reasons:

High Cost of Modern Irrigation Systems: The high cost of modern irrigation installations, particularly for small farms, is seen by farmers as prohibitively expensive compared to their income, especially for those with limited means. This highlights the vulnerability of the agricultural workforce to financial and economic crises, given the lack of social security guarantees. This is confirmed by an FAO report, which states that "12.1% of the total Lebanese labor force in agriculture, most of whom work informally and are denied access to social security, are more vulnerable to financial and economic crises"⁹[20].

Lack of Awareness and Institutional Neglect: The lack of awareness regarding the importance of sustainable water resource management, coupled with the neglect of government institutions in their pursuit of Sustainable Development Goal 6—which aims to provide clean water and sanitation for all—are also contributing factors.

The Second Adaptive Approach implemented by farmers involves changing crop types. Specifically, 14.1% of farmers have switched to crops that consume less water, while 14.8% have shifted to rainfed crops that do not require irrigation. Additionally, approximately 50% of farmers limit their irrigation to three to four days per week due to the financial constraints that smallholder farmers face.

Despite these adaptive measures, climate change has hindered farmers' ability to maintain agricultural production at levels sufficient to meet their needs. Scientific research on climate change, which we have previously referenced, indicates that the Arab region will experience severe climate changes, including decreased rainfall, rising temperatures, and more frequent droughts. These factors negatively impact agricultural production, with noticeable effects on both rainfed and irrigated crops [21-23].

⁹ Dal, E., Díaz-González, A.M., Morales-Opazo, C. & Vigani, M. 2021. *Agricultural sector review in Lebanon*. FAO Agricultural Development Economics Technical Study No. 12. Rome, FAO. <https://doi.org/10.4060/cb5157en>.

Chart 5 illustrates the impacts of these climate changes. It shows that 36.1% of farmers have changed their crop types, while 29.8% reported a reduction in their growing seasons due to drought. Furthermore, 29.5% of farmers were compelled to leave their land fallow, posing a significant threat to the agricultural sector and signaling its potential deterioration.

The intensification of droughts in recent periods has been a source of growing concern in the agricultural sector, as well as for economic and social stability in the country. Crop seasons have declined, and crops such as fruits, olives, and grains, with wheat at the forefront, have been negatively affected by the variability of rainfall and rising temperatures, not to mention long-term climate change.

On the other hand, due to the severe consequences of climate change that Lebanon is suffering from, "long-term trends indicate rising temperatures in the region, and short-term consequences include an increase in the level of climate variability, making it difficult for farmers, policymakers, and other stakeholders to develop plans for lean years or catastrophic weather events (Verner, D. et al., 2018).

7. CHRONIC PROBLEMS AND CRIPPLED MANAGEMENT

Despite Lebanon's relatively abundant rainfall and natural water resources, the country faces a significant annual water deficit, estimated at 283 million cubic meters in 2017. This deficit is projected to increase to 410 million cubic meters by 2025 if no substantial measures are taken. Several factors contribute to this worsening situation, including high population growth, unplanned urban expansion, unsustainable water use, climate change, and the influx of Syrian refugees. The refugee influx has exacerbated challenges for host communities, where the infrastructure needed to provide water and energy services was already under considerable strain (Weinthal & Sowers, 2020). Notably, 86% of Syrian refugees reside in areas predominantly inhabited by marginalized Lebanese populations (Al-Khalil, 2014), further compounding the issue.

Climate problems and their negative impact on water are compounded by existing problems such as water pollution. A report issued by the Litany Water Authority indicated that "after inspecting the upper basin of the river, a

noticeable increase in the rates of total colonies was observed, sometimes rising from approximately 15,000 colonies/100 ml to around 300,000 colonies/100 ml¹⁰. Reality has proven that the Ministry of Energy and Water's limited focus on water facilities is confined to a reaction. The primary focus has been on drinking water supplies, with almost no attention paid to wastewater and irrigation or building sustainable water supplies. In this way, the water sector faces serious challenges, including aging infrastructure, poor water facility management, limited water storage, poor irrigation efficiency, and pressure on groundwater and surface water supplies.

Making matters worse, "the official disregard for scientific reports that sound the alarm, one of which was a study by the National Council for Scientific Research, which focused on "rehabilitating the river from source to mouth", which was submitted to the government and the Council for Development and Reconstruction, has left those reports forgotten¹¹. This disregard has led to a continuous deterioration in the water quality of the Litani River in the upper basin, due to the direct discharge of sewage into the river, which in turn has caused an increase in the level of pollutants in it. As "the leakage of pollutants from sewage, industrial water, and the use of pesticides and agricultural fertilizers inevitably leads to water pollution and deterioration in its quality, which endangers public health and reduces the possibility of using it for various purposes, including irrigation of crops¹²".

These neglectful policies also lead to more problems in water-related state institutions. For example, it has been impossible to implement some projects that have been allocated huge sums of money, including the "Litani River Cleanup" projects and "Sewage and Treatment Plant" projects. This neglect has also led to the spread of epidemics and an increase in the incidence of cancer in the vicinity of the upper Litani basin. This is partly due to the delay in

implementing the "Qaraoun Lake Pollution Reduction" project, which it has been shown that its main activity, which is the construction of sewage networks, is not working well. In addition to other implementation problems, including poor administrative performance, lengthy procurement processes, and lack of coordination. "The financial value of this project is 55 million US dollars, and the implementation delays were as follows: only 4% of the sewage networks were implemented, only 6.3% of the project budget was consumed, and the number of houses connected to the sewage system reached only 1.8% of the specified number¹³".

The indicators above point to the confusion within the water authority and the neglect of sound water management. This macroeconomic reality is also reflected at the local intervention level. Most of what is being done is limited to short-term technical interventions that lack long-term strategies to protect water resources and ensure the right to a decent living for farmers.

8. MINIMAL INTERVENTIONS

The hardships faced by farmers in the region have intensified since the onset of the economic and financial crisis in 2019. Persistent power outages have led to significant losses due to the high reliance on electricity for irrigation systems. In response to the risks of water shortages, farmers have taken initiatives to conserve as much water as possible. However, governmental interventions have been inadequate given the severity of the situation.

Several modest projects have been implemented by relevant authorities to address water shortages, including:

- Installation of Solar Panels on the Banks of the Litani River: These panels generate electricity for pumps that supply water to reservoirs in nearby villages, helping to alleviate issues caused by power outages.
- Drilling of Artesian Wells: According to 29.2% of the surveyed farmers, artesian wells have been drilled in the region to provide additional water sources.

¹⁰See: National News Agency. "Litani river Authority End-of-Year Report: Environmental Improvement in the Lower Basin and Continuous Deterioration in the Upper Basin." December 2022.

<https://tinyurl.com/3njwece9>

¹¹ See: IMLEBANON-Addressing Litani River Pollution: \$4.4 Million per Kilometer, August 2016, Available at the following link:<https://tinyurl.com/3jdacmmw>.

¹² .See: Litani River Authority Official Website. <https://litani.gov.lb/ar-lb/aboutlr>

¹³ See: Litani Water Authority Official Website. "Future Projects and Pollution Issues." <https://litani.gov.lb/ar-lb/depollution/pollutionchallenges>

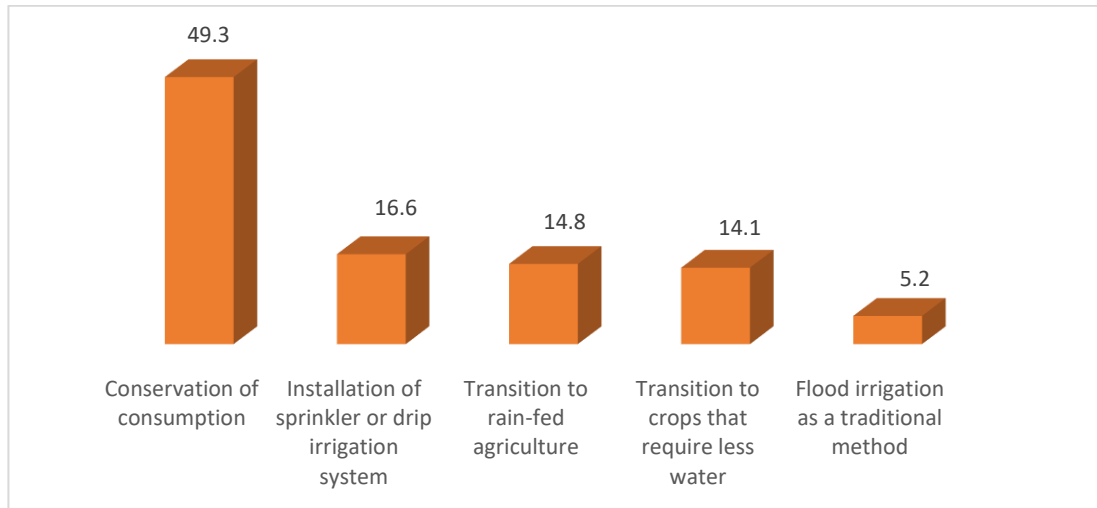


Chart 4. Distribution of sample members according to the steps taken to adapt to water shortage

Source: Results of the field research 2024, with smallholder farmers in the villages of Nabatieh Governorate

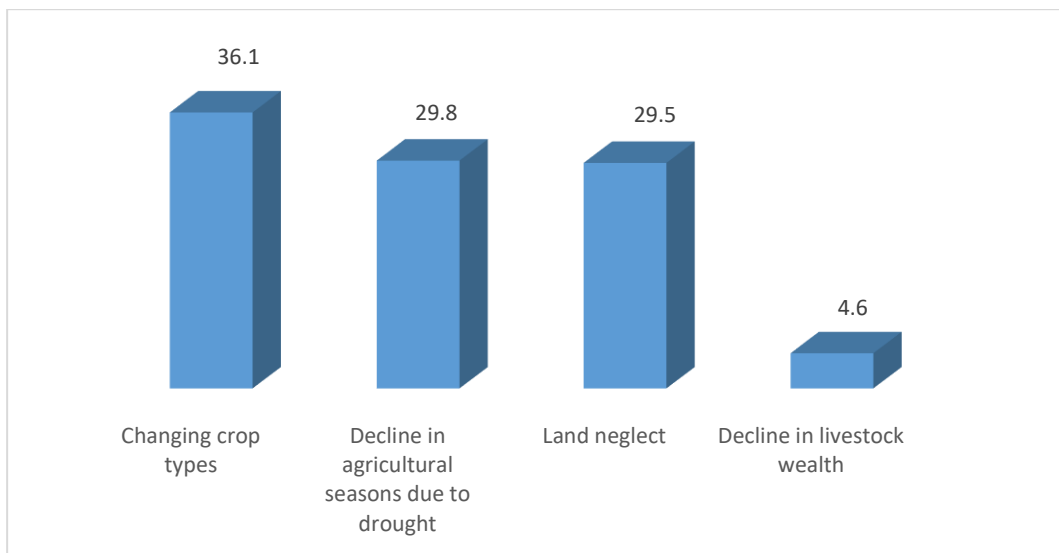


Chart 5. Distribution of sample members according to the effects resulting from the inability to secure irrigation water

Source: Results of the field research 2024, with smallholder farmers in the villages of Nabatieh Governorate

- **Construction of Artificial Water Ponds:** These ponds collect rainwater during the winter for use in irrigation. Despite their potential, the number of such projects is insufficient to meet the water needs of the population. This shortfall is due to governmental neglect and a lack of funded projects in the region

Here is another aspect of the negligence of water authorities, demonstrated by the lack of development and training for farmers to manage water resources. According, to Table 1, 79.7% of

the sample suffer from water scarcity for irrigating crops, while 20.3% do not experience this issue. The most common type of dispute arising from this water scarcity is the inequality in water distribution within neighborhoods, affecting 80.3% of the population. This is followed by disputes involving stakeholders such as municipalities and mukhtars, impacting 84% of the population. Additionally, 76.5% of the sample experience disputes between residents over water sources, and 83.3% report family destabilization due to these water-related issues.

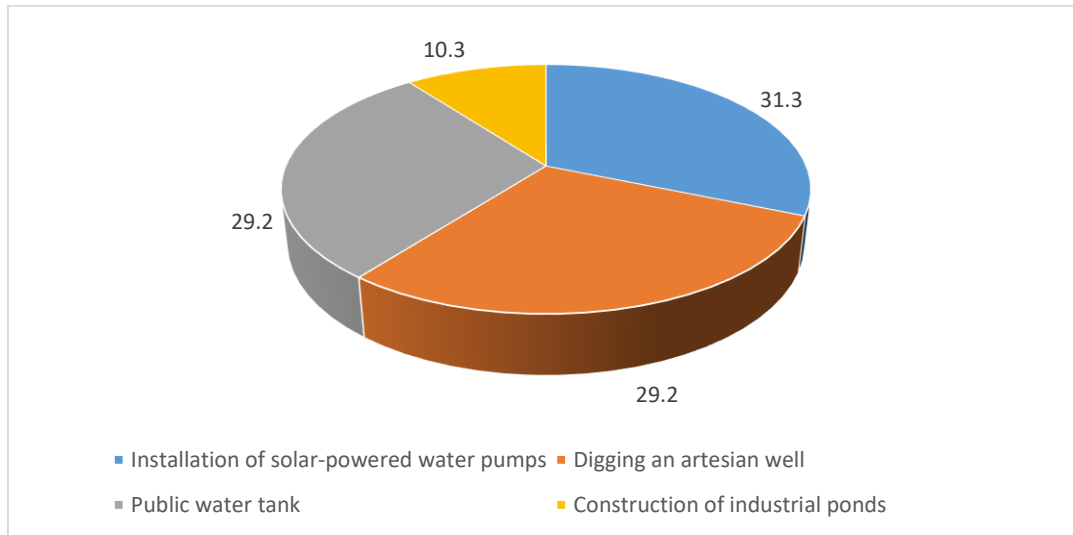


Chart 6. Distribution of sample members according to the projects implemented to provide water and improve its quality

Source: Results of the field research 2024, with smallholder farmers in the villages of Nabatieh Governorate

Table 1. Distribution of sample members according to the suffering from water scarcity for irrigation of crops and the type of disputes among residents over water sources

Suffering from water shortage	Type of disputes among residents		Total
	Yes	No	
Disputes among residents over water sources	39 %76.5	12 %23.5	51 %100
Disputes among stakeholders (municipalities, village chiefs, etc.)	21 %84	4 %16	25 %100
Inequality in water distribution within neighborhoods	53 %80.3	13 %19.7	66 %100
Disruption of stability within the family	5 %83.3	1 %16.7	6 %100
Total	118 %79.7	30 %20.3	148 %100

Source: Results of the field research 2024, with smallholder farmers in the villages of Nabatieh Governorate

Table 2. Distribution of sample members according to attending workshops and/or counseling sessions to increase awareness about water conservation

Attending workshops and/or counseling sessions to increase awareness about water conservation	Frequencies	Percentage
Yes	24	13.5
No	154	86.5
Total	178	100

Source: Results of the field research 2024, with smallholder farmers in the villages of Nabatieh Governorate

The conclusions drawn from these observations indicate that water scarcity for irrigating crops is a prevalent problem affecting many individuals. This scarcity leads to various disputes, including unequal water distribution within neighborhoods

and conflicts among stakeholders, such as municipalities and mukhtars. These disputes can stem from favoritism, lack of transparency, and inefficient management practices. When municipalities and mukhtars fail to equitably

distribute water, it exacerbates tensions within communities, as residents compete for the limited resources necessary for their livelihoods.

The historical context of fragmented water management and the current challenges faced by the National Water Sector Strategy (NWSS) both contribute to the prevalent disputes over water distribution. The inequalities in water distribution within neighborhoods and the significant conflicts among stakeholders are direct manifestations of these issues. The historical context of fragmented water management and the current challenges faced by the NWSS both contribute to the prevalent disputes over water distribution. The inequalities in water distribution within neighborhoods and the significant conflicts among stakeholders are direct manifestations of these issues.

On the other hands, the data regarding respondents' participation in water conservation courses and awareness-raising lectures shows that only 13.5% have taken part in such educational activities. In contrast, the majority, 86.5%, have not participated in any courses or lectures related to water conservation or water scarcity management.

These findings suggest a low level of awareness about water conservation among the respondents, highlighting a significant need for more education and awareness programs focused on water conservation. Furthermore, it indicates a lack of action by water authorities to manage the sector effectively and a failure to promote understanding among farmers about the importance of conserving water.

9. CONCLUSION

This research identified several key findings regarding the adaptation mechanisms employed by smallholder farmers in response to water scarcity and the policies governing water resources. In other words, how do Public Policies on water impact Farmers in the Villages of Nabatieh Governorate? One of significant findings is the influence of smallholder farmers' economic conditions on their irrigation choices. Due to limited resources, these farmers often resort to traditional irrigation methods, which are less costly than modern techniques and are therefore not prioritized.

The research also highlighted the disarray in water management and the absence of effective

institutional oversight. Several critical issues were identified:

- Ambiguity and Confusion in Regulatory Laws: The legal framework governing water resources is characterized by vagueness and complexity, making it difficult to implement projects or reforms. However, Despite the 2000 reforms under Law 221 reorganized public water institutions and introduced a ten-year strategic plan. However, these changes continued previous policies, emphasizing large-scale projects and private solutions without significantly altering water resource planning [24].
- Conflicting Institutional Interests: the various institutions involved in water management often have conflicting agendas, impeding progress and resulting in contradictory decisions. The mandates of state authorities are fragmented and often conflicting. In the current economic, financial and political crisis in Lebanon, these barriers have become more entrenched and tend to dramatically attenuate the technical potential calculated [25]. This disorganization affects farmers' performance, forcing them to secure water resources independently. Some farmers illegally dig wells, circumventing established procedures by bribing officials or leveraging political support. Although the Ministry of Energy and Water has clear rules for issuing well permits, this process is frequently bypassed.

The current situation reflects a broader political failure, characterized by the authorities' inability to enforce laws due to a pervasive lack of trust in policy-making institutions. Consequently, circumventing the law has become routine, with farmers prioritizing their immediate needs over sustainable water resource management.

The crux of the issue lies in the erosion of trust between farmers and the governing bodies responsible for water management. This erosion stems from perceived inefficiencies, corruption, and a history of unfulfilled promises, which have collectively undermined the credibility of these institutions. Things get worse with the poor administrative capacities in the planning, implementation, and management of existing WWTPs and future reuse systems [25].

As a result, farmers, facing urgent water needs and lacking faith in official solutions, resort to

unauthorized and potentially unsustainable extraction of water. This behavior not only exacerbates water scarcity but also undermines long-term sustainability efforts.

The study also predicts that the mismanagement of water facilities will lead to increased dominance by the private sector[26]. Water distribution contractors often extract water from rivers without legal constraints or official oversight, which depletes water resources and poses environmental risks.

The water sector faces numerous challenges, including aging infrastructure, inefficient water management, limited storage capacity, poor irrigation efficiency, and increasing pressure on groundwater and surface water supplies [27,28]. Compounding these issues is the official neglect of scientific reports warning of these problems and the scarcity of reliable official data, which hinders the development of effective plans and policies for the sector's improvement and sustainability.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Jury WA, Vaux Jr HJ. The emerging global water crisis: managing scarcity and conflict between water users. *Advances in agronomy*. 2007;95:1-76.
2. **Websites:**
 - Arab Monetary Fund. Unified Arab Economic Report; 2023. Available: [https://tinyurl.com/es6kwzwh
 - Matar A, Lebanon Water Report, Water of the Middle East and North Africa; 2022. Accessed On:27 July 2022 Available:https://water.fanack.com/lebanon
 - United Nations World Water Development Report. Water and Climate Change, Executive Summary; 2020.
 - Inter-Agency Coordination Lebanon Water Sector. end-year sector dashboard water sector; 2022. Available:file:///C:/Users/lamak/Downloads/Q4%20dashboard%20-%20WASH.pdf.
 - The United Nations Development Programme, Regional Bureau for Arab States (RBAS), Water Governance in the Arab Region Managing Scarcity and Securing the Future; 2013.
3. de Waal, Dominick; Khemani, Stuti; Barone, Andrea; Borgomeo, Edoardo. *The Economics of Water Scarcity in the Middle East and North Africa: Institutional Solutions*. © Washington, DC: World Bank; 2023. Available:http://hdl.handle.net/10986/39594 License: CC BY 3.0 IGO."
4. Li L, Peng Q, Li Z. Evolution of drought characteristics and propagation from meteorological to agricultural drought under the influences of climate change and human activities. *Environ Sci Pollut Res*. 2024;31,26713–26736. Available:https://doi.org/10.1007/s11356-024-32709-z
5. Bou-Zeid E, El-Fadel M. Climate Change and Water Resources in Lebanon and the Middle East. *Journal of Water Resources Planning and Management* 2002;128(5): 343-355.
6. Hochman A, Marra F, Messori G, Raveh-Rubin S, Yosef I, Zittis G, Pinto JG. ESD reviews: Extreme weather and related societal impacts over the Eastern Mediterranean: A systematic review. *Earth System Dynamics*; 2022.
7. Farhat N, Sleiman W. Potential natural obstacles to groundwater engineering; *Civil Engineering and Applications Journal Part A*. 2023;4(1):46-61. Available:https://doi.org/10.22271/27078388.2023.v4.i1a.16
8. Farhat N., Makke H., Fadel B., Ayoub M., Koubeissi A. Remote Sensing and GIS to Assess Land Degradation in Wadi El Hjeir, Lebanon PERI-E-ISSN 2583744;2022. Available:https://doi.org/10.22271/2582-3744.2022.mar.10
9. Saha A, Pal S, Chowdhuri I, Roy P, Chakraborty R, Shit M. Vulnerability assessment of drought in India: Insights from meteorological, hydrological, agricultural and socio-economic perspectives. 2022;123:68-88.ISSN 1342-937X

- Available:<https://doi.org/10.1016/j.gr.2022.11.006>
10. Darwish T, Shaban A, Masih I, Jaafar Jomaa I, Simaika JP. Sustaining the ecological functions of the Litani River Basin, Lebanon, International Journal of River, Basin Management; 2021. DOI: 10.1080/15715124.2021.1885421
 11. Khatib, Bassima, Tala Moukadam, Rita El-Hajj and Dalia Jawhary. On the Path of Resilience to Climate Change in the Upper Akkar Watershed Lebanon. International Union for Conservation of Nature; 2015. Available:https://www.iucn.org/sites/dev/files/import/downloads/lebanon_1.pdf. In Arabic Available:<https://tinyurl.com/mwpy5hf8>
 12. Madah Lina, Salem Dourish. The road to recovery for lebanese agriculture. Lebanese Center for Policy Studies; 2023. Accessed On:2 November 2023. Available: <https://tinyurl.com/4ynm52uw>
- Websites:**
13. -Food and Agriculture Organization of the United Nation. Role of Women in Lebanon, briefing Note March. @ Available:<https://tinyurl.com/4r97bjmc>
-Litany River Authority Official Website. In Arabic; 2021. Available:<https://litani.gov.lb/ar-lb/aboutlrb>
-Litany Water Authority Official Website. Authority News. In Arabic. @ Available:<https://litani.gov.lb/ar-lb/news/detail>
-Litany Water Authority Official Website. "Future Projects and Pollution Issues. In Arabic. @ Available:<https://litani.gov.lb/ar-lb/depollution/pollutionchallenges>
-Ministry of Information, Agriculture and Water, December 29, 2015, @: Available:<https://www.ministryinfo.gov.lb/494>
-National News Agency. Litany river authority end-of-year Report. Environmental improvement in the lower basin and continuous deterioration in the Upper Basin. In Arabic; 2022. Available:<https://tinyurl.com/2wpc2fyw>
-Ministry of Information. Agriculture and Water; 2015. Available:<https://www.ministryinfo.gov.lb/494>
Available:<https://www.ministryinfo.gov.lb/494>
4).
-UNICEF. On the brink of running dry': unprecedented scope and impact of Water scarcity in the middle East and North Africa; 2021.
-Addressing Litany River Pollution \$4.4 Million per Kilometer. In Arabic; 2016. Available:<https://tinyurl.com/tp4ee8z4>
 14. Shaban A, Hamzé M. The Litani River, Lebanon: An Assessment and Current challenges. Springer International Publisher. 2018;85. DOI: 10.1007/978-3-319-76300-2
 15. Farhat N. Effect of relative humidity on evaporation rates in Nabatieh Region. Lebanese Science Journal (LSJ), ISSN 2018;19:1561 – 3410; ISSN 2413 – 371X. Available:<http://dx.doi.org/10.22453/LSJ-019.1.059-066>
 16. Al-Khatib Lina. The repercussions of the syrian refugee crisis on Lebanon." In Arabic; 2014.
 17. Brodie Callum. The world's fastest-growing populations are in the Middle East and Africa. Here's why, Word Economic Progress; 2018. Available:<https://tinyurl.com/4hkb2sed>.
 18. Claire Klobucista and Kali Robinson. Water Stress: A Global Problem That's Getting Worse, Council on Foreign Relations; 2023. Available:<https://tinyurl.com/f5mrvk6cb>
 19. King Hamada. Lebanon between food insecurity and the path to reforming the agricultural sector, Malcolm H. Kerr Carnegie Middle East Center; 2020. Available:<https://carnegie-mec.org/2020/12/10/ar-pub-83427>.
 20. Dal E, Díaz-González AM, Morales-Opazo C, Viganí M. Agricultural sector review in Lebanon. FAO Agricultural Development Economics Technical Study No. 12. Rome, FAO; 2021. Available:<https://doi.org/10.4060/cb5157en>
 21. Mouawad Latifa. Due to chronic crises, citizens pay the price by paying double bills in all sectors! The Lebanese Center for Active Citizenship; 2014. Available:<https://lcaclebanon.wordpress.com/2014/08/11/doublebills>
 22. Qammar Fadi. The water reality in Lebanon, National Defense Magazine, 2010;72. Available:<https://www.lebarmy.gov.lb/ar/content>.
 23. Said Karim. 19 Arab countries suffer from water stress: what does this mean and what is the water poverty line? Fortune Arabia platform; 2023. Available:<https://fortunearabia.com>.

24. Riachi Roland. Water policies and politics in Lebanon: Where is Groundwater? IWMI Project Report No.9; 2016.
25. Eid-Sabbagh K, Roukoz S, Nassif MH, Velpuri N, Mateo-Sagasta J. Analysis of water reuse potential for irrigation in Lebanon. Colombo, Sri Lanka: International Water Management Institute (IWMI). (IWMI Research Report 181). 2022;145.
DOI: <https://doi.org/10.5337/2022.211>
26. Younes Samar. The syrian displacement crisis and its impacts on the lebanese reality 2011-2020. Paper presented at the conference "Current International Crises and Their Impacts on the Arab World," organized by the Jil Scientific Research Center, Conference Proceedings Series, Ninth Year, In Arabic. 2022;37.
27. Spinoni J, Barbosa P, Füssel HM, McCormick N, Vogt JV, Dosio A. Global population-weighted degree-day projections for a combination of climate and socio-economic scenarios. International Journal of Climatology, 2021; 41(11):5447–5464.
Available:<https://doi.org/10.1002/joc.7328>
28. González-Gómez F, García-Rubio MA, Guardiola J. Introduction: Water policy and management in Spain. International Journal of Water Resources Development. 2012;28(1):3-11.

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