

Research article

GIS APPLICATION TO DEVELOPMENT OF DECISION SUPPORT SYSTEM (DSS) FOR REFUGEE MANAGEMENT IN IRBID, JORDAN

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Abstract: The issue of immigration and political asylum is among the serious problems afflicting the world. Because of the strong pressure it causes on the host country, this pressure is closely and directly linked to basic services for the population, such as water, health, and housing services, so the government must take initiatives to limit any negative impact on the sectors. This study was conducted to examine the impact of Syrian refugees in Jordan's Irbid governorate on the aforementioned sectors. And Irbid is the second, following the capital Amman, in the number of refugees (Department of Statistics, (2016). This constitutes a social and economic burden on the population, in addition to the burden on the infrastructure facilities in the governorate, especially the education and health sectors. Syrian asylum and its impact on the urban sector, water, and health the urban sector the rise in land prices due to the increase in urbanization and the rise in the average rent of housing increased by 200% of the normal rate (Public Institution for Housing (2022). Jordan treated the Syrians for free, and then, because of the burden, the treatment became 80% free, but there are free services such as thalassemia and maternal and child health.

The Services sector (Ministry of Health (2016) is burdened by the fact that Jordan is known to be one of the 10 poorest countries in the world in terms of water resources (Economic and Social Council (2022). This poses challenges for the government and its citizens, which need to be addressed. The objective of this study is to identify the impact of refugees on the water and health sectors, as well as on urbanization changes in Irbid Governorate.

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Additionally, it aims to understand the overall impact of refugees on the host country. In this study, the

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sectors are considered independent variables, while the Syrian refugees are the dependent variable. The study employed a quantitative method, with face-to-face distribution of questionnaires to respondents. The study population consisted of the population of Irbid. A total of 563 respondents were randomly selected and distributed across the administrative regions (Qasabah of Irbid, Ramtha, Koura, Bani-Kinana, Northern Ghawar, Alwesteiah, Northern Mazar, Al-Taybeh and Bani-Ubaid) into which the Irbid governorate is divided. The data was then analyzed using GIS software. The analysis revealed a significant impact of Syrian refugees on basic services. This impact was evident in the increase in water loss and consumption, the growing pressure on government health centers in terms of visitor numbers, the reduced ability of medical institution workers to provide services, the insufficiency of medical institutions in the governorate, and the emergence of a housing crisis. Specifically in the Irbid area, married couples face difficulties in finding housing due to high costs, and land and real estate prices have significantly increased. This has led to a rise in the cost of building houses in Irbid. To cope with rent burden, refugees often share housing with other families, which has created a form of exploitation related to housing among citizens.

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1. Introduction

When the Arab uprisings spread from their initial spark or something similar, Tunisia turned to Syria, where it became an Arab autumn but a hot winter due to the regime's failure to fall, which led large numbers of Syrian citizens to resort to the quietest and safest places. Jordan shares a border with Syria to the south is a place for the forced emigration movement coming from its various governorates.

Since the outbreak of the Syrian revolution and over time, the regime has tightened its grip even more as a result of the international interventions supported by Russia, Iran, and Lebanese Hezbollah, which has made it more complicated and difficult to fall. It made Syria a place of death, destruction, hunger, and disease. The region was famous for its beautiful nature and ancient cultural history, but it became a hot spot, forcing citizens to flee to various parts of the earth through sea and land migration. Because Jordan shares a border with Syria to the north, it was the first destination of displacement of Syrians and their concentration in the closest provinces to the border, as Irbid.

In general, migration has a political burden on the host countries and raises security concerns related to the large numbers of these countries and the issue of organizing, managing, and dealing with them. It is important to consider the economic consequences of the Syrian asylum in Jordan, which are to provide food and health relief, safe shelters, education, and service centers. This will put pressure on Jordan and on the Jordanian in the sharing services sector.

This research relies on the descriptive approach as the main method in its study of the problem and the analytical approach as an auxiliary method for extracting and analyzing the results. We will follow the following objectives to study the problem and analyze it: designing a questionnaire covering all variables to determine the economic and demographic impact on the health and water sectors and the urban expansion and its impact on the study sample.

We can say that the problem of the study was represented by the waves of asylum that came to Jordan over time, which affected, in one way or another, the host country, Jordan. Across the history of Jordan, there have been waves of migration: Palestinian refugees in 1948 and 1967, Iraqi refugees in 2003. And recently, the presence of Syrian refugees persisted from 2011 until the end of 2018. Jordan has 1,053,462 Syrian refugees and 308,939 Syrians in Irbid, 29.3% of the total number in Jordan, and Irbid is the second following the capital Amman in the number of refugees (Department of Statistics, 2016). This constitutes a social and economic burden on the population, in addition to the burden on the infrastructure facilities in the governorate, especially the education and health sectors. According to the 2017 statistics, Irbid has a second place after the capital of the refugee population. In Jordan, 80% of the refugees are outside the camps, and the rest are accommodated in 5 camps (Al Zaatari, Marjib Al Fahud, Cyber City Blue Park) (Department of Statistics., 2017).

Syrian asylum and its impact on the urban sector, water, and health the urban sector the rise in land prices due to the increase in urbanization and the rise in the average rent of housing increased by 200% of the normal rate (Public Institution for Housing, 2021), and 79% of the refugees live in rented accommodation, while the rest live with relatives or in exile (of Planning and International Cooperation, National Resilience Plan 2014-2016, 2021). The additional government expenditure on the Ministry of Housing in 2017 was 320580 million US dollars (of Planning and International Cooperation, 2021). All this is a burden on the government and the citizens that needs to be resolved. The impact of refugees on the services sector, particularly the health sector, has been significant. In the initial three years of the Syrian revolution, Jordan provided free medical treatment to Syrian refugees. However, due to the burden on the healthcare system, the treatment became 80% subsidized. Nevertheless, certain services such as thalassemi and maternal and child health services continue to be provided for free (Of Health, Conditions of Syrian Patients in Jordan, 2021). This study aims to examine the impact of Syrian asylum on various aspects, including urbanization in Irbid Governorate. The study will explore how refugees have influenced the pattern of urbanization in the governorate.

There are two modes of urbanization: horizontal expansion, which involves using the existing space more efficiently, and vertical expansion, which includes the utilization of new areas, including previously unused agricultural lands. The study may identify a combination of both types, leading to increased housing costs, higher land prices, and additional burdens.

The impact of asylum on basic services, such as the water and health sectors, is profound. Jordan faces significant water scarcity and is considered one of the ten poorest countries in the world in terms of water resources (Jordanian E. a., 2014). The influx of refugees further strains the water sector, as their water consumption exceeds the country's water quota. Jordan requires approximately \$376 million annually to cover the operational costs of providing water services to Syrian refugees (Abu Rumman, 2015). In the health sector, the increasing number of refugees has placed additional pressure on hospitals and health centers in the governorate. The workload in these facilities has reached 100% due to the influx of refugee patients, including those injured in the conflict (Carnegie Centre., 2016). The cost of treating Syrian refugees from the beginning of the revolution until 2015 was estimated to be between \$1 billion and \$998 million.

Furthermore, the study will examine the effects of Syrian asylum on the housing sector. It will analyze the supply and demand dynamics in the housing market, the annual increase in housing construction, and changes in housing prices before and after the arrival of Syrian refugees in the governorate. The study also aims to assess the impact of asylum on the water sector. This includes comparing water consumption quantities, water losses, and changes in water supply periods. The study will address the challenges faced by each sector before and after the arrival of refugees, as well as the satisfaction level of local citizens with these service sectors.

2. Methods

Jordan the Hashemite Kingdom of Jordan is an Arab country located in southwest Asia. Jordan's located in the southern part of the Levant and the northern part of the Arabian Peninsula. It has common borders with Syria from the north, historic Palestine (West Bank and Israel) to the west, Iraq to the east, and Saudi Arabia to the east and south. Irbid lies in the far north of Jordan. The border extends to south and southeast, where the Yarmouk River is located. The eastern parts of the province are part of the Houran Plain (Ramtha) between Syria and Jordan, while the northern parts overlook the Golan Heights, while the west is geographically composed of plateaus, gradually decreasing below sea level

in the Jordan Valley. Irbid is located in northern Jordan, about 20 km south of the Syrian border, and shares a border with Syria (the Nasib border).

Jordan is divided into 12 governorates, each of which is further divided into districts. Irbid governorate includes 9 administrative districts and 18 town councils. The total area of Jordan is 88,794 km², and the area of Irbid is 1,572 km², accounting for 1.8% of the total area (General Statistics., (2022)). Jordan's population is 11.302 million. The population of Irbid is 2.95700 million, making it the second most populous city after the capital (General Statistics., (2022)).

Irbid is a city located in the northern part of Jordan, between 32° 32' 44.02" N and 35° 51' 25.99" E. It shares a northern border with Syria, where the Yarmouk River is located. The eastern regions of the governorate are part of the Houran Plain, which extends between Syria and Jordan. The northern parts of Irbid overlook the Golan Heights. From the west, the region is characterized by mid-rise plateaux, gradually descending below sea level in the Jordan Valley.

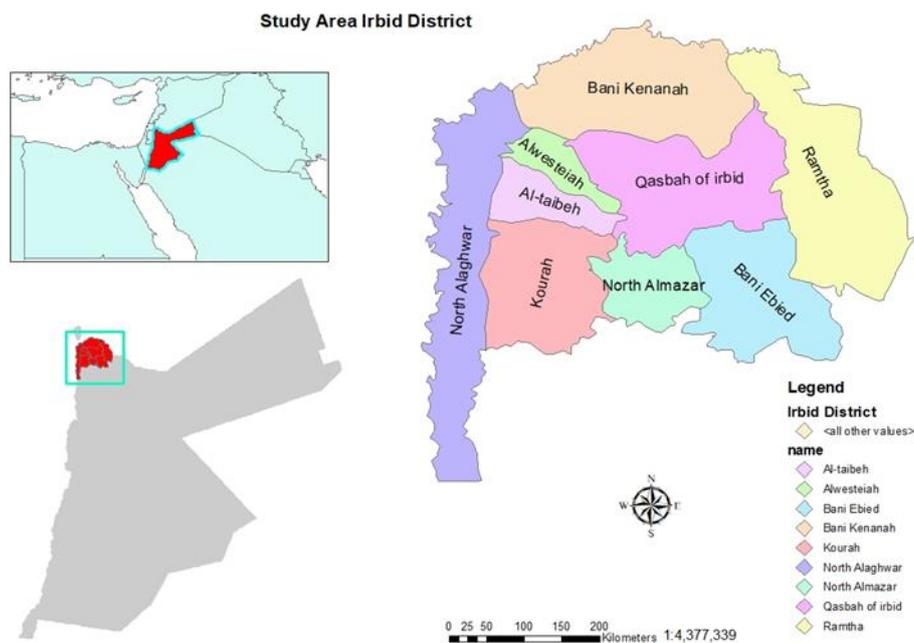


Figure 1: The study area of Irbid Governorate and its administrative divisions

Preparing the researcher on Gis

2.1 Data Set

In this study, the researcher used the primary source method to obtain primary data. Data were obtained from by designing a questionnaire covering all variables to determine the economic and demographic impact on the health, water, and urban expansion sectors and its impact on the study sample, then

distributing questionnaires to the respondents, specifically to the population centers of each of the regions: (Qasabah of Irbid, Ramtha, Koura, Bani-Kinana, Northern Ghawar, Alwesteiah, Northern Mazar, Al-Taybeh and Bani-Ubaid).

2.2 Concept of Inverse Distance Weighted (IDW) Interpolation Method

"The resulting data were analyzed in Excel and then modeled using GIS software specifically Arc Map 10.7.1 analysis tools and interpolated using the inverse distance weighting (IDW) technique. Previous research has shown that IDW has indisputable advantages, and spatial interpolation is widely used in climatology, physical geography and geological application, as well as in human and economic geography.

IDW is a deterministic spatial interpolation process. This approach utilizes a linearly weighted combination of sample points to calculate cell values. It's a precise approach that ensures that a point's approximate value is influenced more by close-known points than by those further away. All predicted values are within the range of the known maximum and minimum values, which is a significant parameter of IDW interpolation. The IDW formula is used to estimate the unknown value of the monitoring station $Z^*(S_0)$ in site S_0 using the observed Z values at the sampled locations, where the number of monitoring stations is known. The formulas used in this study are the following:

Where:

$$Z^*(S_0) = \sum^n W_i Z(S_i) \quad (1) \quad W_i = \frac{1/d_i^\alpha}{\sum_j 1/d_j^\alpha} \quad (2)$$

$$\sum_i^n W_i = 1 \quad (3)$$

Each measurement is multiplied by the inverse of the distance $d_{oi} \geq 0$ from the station o to the station i with the exponent α . Then each product is divided by the sum of the term $1/d_{oi}^\alpha$ over all the stations i so that the sum of all W_i 's for an ensample station will be unity (Equation (3)). "Depending on the interpolated variable, the power of the distance must be chosen accordingly" (Madhloom, N., & Chabuk, 2018). Read in search for (Mustaffa, 2023).

3. Result and Discussion

3.1 Results of IDW

The results were based on three questions asked to respondents in the questionnaire:

- Dissatisfaction with the water situation in Irbid Governorate.

- Dissatisfaction with government health services in Irbid Governorate.
- Dissatisfaction with the housing sector in Irbid Governorate.

3.1.1 Model A: Dissatisfaction with the Water Situation in My Area

Based on Figure 2, it is evident that the majority of participants in Irbid Governorate expressed dissatisfaction with the water situation in their area when considering the presence of Syrians. The results obtained from the Likert scale indicate a moderate to a high degree of dissatisfaction, with agreement ratings ranging between 3.5 and 3.97.

As mentioned earlier, Jordan is recognized as one of the water-poor countries. The increase in population, whether indigenous or as a result of the influx of refugees, particularly Syrians who have arrived in large numbers, has hurt the water sector. This surge in population has placed a burden and increased pressure on the existing water infrastructure, including water supply pipes and delivery services.

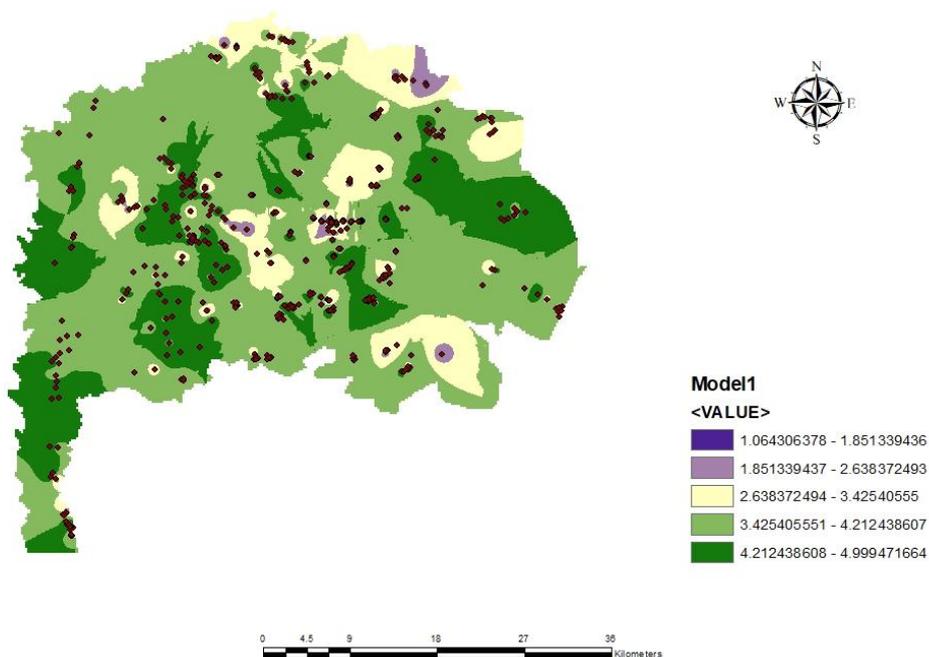


Figure 2 Model A: Dissatisfaction with the water situation in my area

(Based on respondents' answers)

3.1.2 Model B: Dissatisfaction with Government Health Services in Irbid Governorate

Based on Figure 3, it shows that in Irbid Governorate and its governorate, by answering the question in the questionnaire about dissatisfaction with government health services based on the presence of Syrians, the majority of participants agree that they are dissatisfied with the water situation. The results for the high degree of agreement according to the Likert scale indicate that the degree of agreement was between (3.8 and 4), which means a high degree of dissatisfaction. The population increase due to Syrian refugees affects the health sector negatively and constitutes an increased burden on health centers from patients, the capacity of hospitals and the inadequacy of medical institutions, the government’s ability to provide medicine for citizens, the decrease in the ability of the medical staff to provide services to patients, and the spread of infectious diseases among refugees. The financial deficit in the health sector is a result of the lack of financial and other resources mentioned above. Infrastructure. Whereas these factors have a role in the impact of the Syrian refugee on the Irbid governorate and the increasing demand for the health sector, The Syrian asylum has caused a shortage of devices and equipment that is not commensurate with the increase in health sector services as a result of the Syrian refugees, the accompanying diseases among the refugees, and pressure on health institutions.

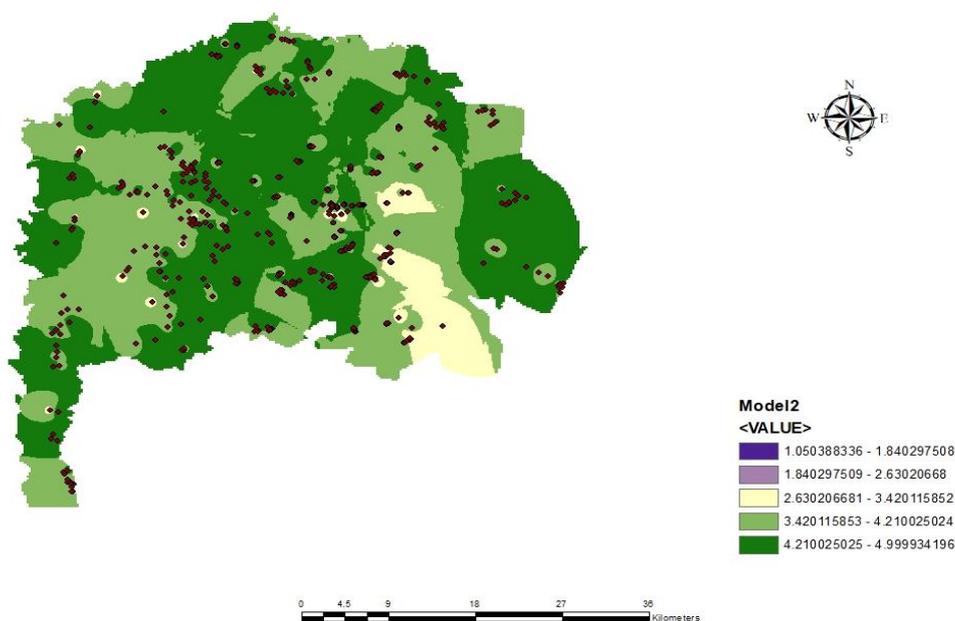


Figure 3 Model B: Dissatisfaction with government health services
(Based on participants’ answers)

3.1.3 Model C: Dissatisfaction with the Housing Sector

Based on Figure 4, it shows that in Irbid Governorate and its governorate, by answering the question in the questionnaire about dissatisfaction with the housing sector based on the presence of Syrians, the majority of participants agree that they are dissatisfied with the housing sector. The results on the Likert scale indicate a high level of disaffection, with agreement ratings between 3.5 and 4.2 means a high degree of dissatisfaction. The population increase due to Syrian refugees affects the housing sector negatively and constitutes a burden in terms of preferring the Syrian tenant over the Jordanian tenant because international organizations pay the rent. The Jordanian tenant is afraid of being asked to leave the house because there are better alternatives. The Jordanian tenant is concerned about being asked to raise the rent price. There is a difference between rental prices and the income of the Jordanian citizen. People who come to get married face difficulties in finding housing and high wages. Land and real estate prices have risen significantly. Land prices have risen, which has led to an increase in the cost of building housing, and a kind of exploitation has arisen regarding the housing issue among landlords.

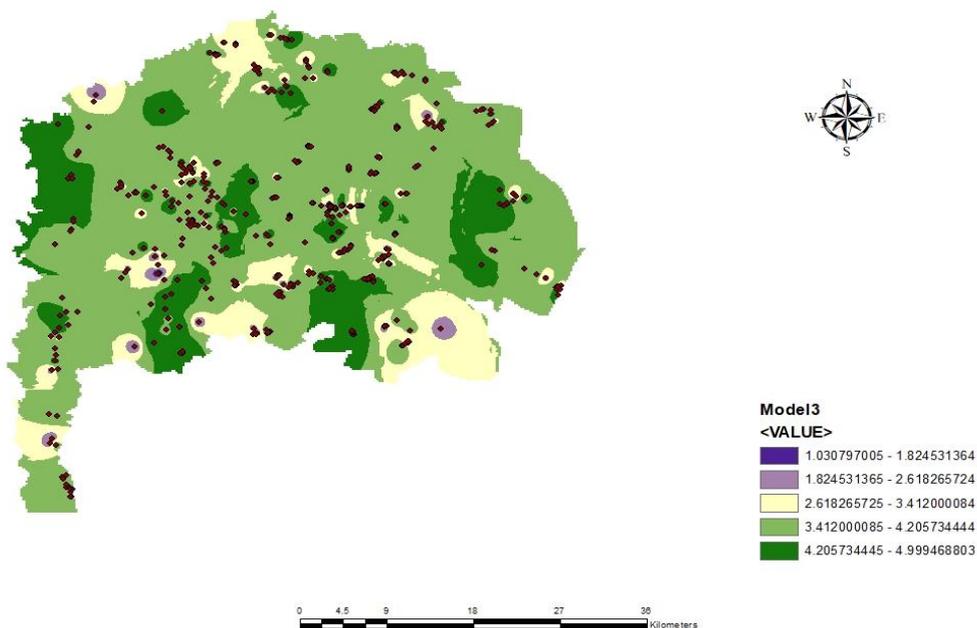


Figure 4 Model C: Dissatisfaction with the housing sector
(Based on participants' answers)

3.2 Conclusion

The Hashemite Kingdom of Jordan has faced waves of immigration coming from Syria since 2011 during the outbreak of the Syrian civil war, and these migrations spread throughout the kingdom, with a higher concentration in areas located close to Syria in northern Jordan, such as Irbid, so Irbid was chosen as the study area due to its proximity to the Syrian border. It was divided according to the administrative regions of the governorate, and there were nine administrative regions to mention: (Qasabah of Irbid, Ramtha, Koura, Bani-Kinana, Northern Ghawar, Alwesteiah, Northern Mazar, Al-Taybeh and Bani-Ubaid). Of course, migration always has a great impact on the host country, so we wanted to clarify this impact through a study on service sectors, namely the water sector, the health sector, and the housing sector.

This impact on the service sector by the refugees would lead to great pressure, and thus changes would occur that would reduce the share of the Jordanian citizen; for example, an increase in housing wages, an increase in land prices, a decrease in the per capita water allocation, an increase in pressure on sewage networks, and pressure on hospitals, drugs, etc. have been mentioned earlier in the discussion chapter. A model has been developed to assist decision-makers in identifying areas that require additional services and infrastructure projects.

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تطبيق نظم المعلومات الجغرافية لتطوير نظام دعم القرار (DSS) لإدارة اللاجئين في إربد، الأردن

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المخلص: تعتبر قضية الهجرة واللجوء السياسي من بين المشاكل الخطيرة التي يعاني منها العالم. وبسبب الضغط القوي الذي يسببه على الدولة المضيفة، فإن هذا الضغط يرتبط بشكل وثيق ومباشر بالخدمات الأساسية للسكان، مثل خدمات المياه والصحة والإسكان، لذلك يجب على الحكومة اتخاذ مبادرات للحد من أي تأثير سلبي على القطاعات. أجريت هذه الدراسة لدراسة تأثير اللاجئين السوريين في الأردن في محافظة إربد على القطاعات المذكورة أعلاه. وتحتل إربد المرتبة الثانية بعد العاصمة عمان في عدد اللاجئين (دائرة الإحصاءات العامة، 2016). وهذا يشكل انعكاساً اجتماعياً واقتصادياً ويشكل العبء على السكان، إضافة إلى العبء على مرافق البنية التحتية في المحافظة، وخاصة قطاعي التعليم والصحة. ومن المعروف أن الأردن من أفقر 10 دول في العالم من حيث الموارد المائية (المجلس الاقتصادي والاجتماعي، 2022).

حيث يؤثر على القطاع الحضري من حيث: ارتفاع أسعار الأراضي بسبب زيادة التحضر وارتفاع متوسط إيجار السكن بنسبة 200% عن المعدل الطبيعي (المؤسسة العامة للإسكان، 2022). ويظهر التأثير على القطاع الصحي حيث أن الأردن عالج السوريين مجاناً في بداية الأزمة ثم بسبب العبء وكلفة العلاج أصبح العلاج مجاناً بنسبة 80% ولكن هناك خدمات مجانية مثل مرض الثلاثسيميا وخدمات صحة الأم والطفل (وزارة الصحة، 2016). وكل هذا يشكل عبئاً على الحكومة والمواطنين ويحتاج إلى حل. الهدف من هذه الدراسة: التعرف على تأثير اللاجئين على قطاع المياه والصحة والتغير الحضري في محافظة إربد وفهم تأثير اللاجئين على البلد المضيف. وفي هذه الدراسة، تعمل القطاعات كمتغيرات مستقلة، في حين يعمل اللاجئون السوريون كمتغير تابع. استخدمت هذه الدراسة المنهج الكمي. وتم توزيع الاستبيانات على المجيبين وجهاً لوجه. مجتمع الدراسة هو سكان مدينة إربد. تم اختيار 563 فرداً عشوائياً، وتم توزيعهم على ألية إربد التسعة (قصبه إربد، الرمنا، الكورة، بني كنانة، الاغوار الشمالية، الوسطية، المزار الشمالي، الطيبة، بني عبيد) التي تنقسم إليها محافظة إربد. ومن ثم تم تحليلها باستخدام برنامج نظم المعلومات الجغرافية.

وأظهرت نتائج التحليل أن درجة تأثير اللاجئين السوريين على الخدمات الأساسية كانت مرتفعة. حيث ظهر الأثر بشكل واضح في زيادة فقدان المياه وزيادة كمية المياه المستهلكة في المنطقة، وفي زيادة الضغط على المراكز الصحية الحكومية من حيث عدد الزوار، وانخفاض قدرة المؤسسات الطبية والعاملون على تقديم الخدمات الطبية للمرضى، وعدم كفاية المؤسسات الطبية في المحافظة، ونشأت أزمة سكن حقيقية. وفي منطقة إربد بشكل خاص، يواجه المتزوجون صعوبات في إيجاد السكن والأجور المرتفعة، كما ارتفعت أسعار الأراضي والعقارات بشكل كبير في المنطقة، مما أدى إلى ارتفاع تكلفة بناء منزل في إربد، و يتقاسم اللاجئون السكن مع عائلات أخرى من أجل تحمل أعباء الإيجار، وهو نوع من الاستغلال فيما يتعلق بمسألة السكن بين المواطنين.

الكلمات المفتاحية: الهجرة، اللجوء، اللاجئين، نظم المعلومات الجغرافية، طريقة الاستيفاء المعكوسة.

هذه الدراسة من رسالة الدكتوراه في الفلسفة بمعهد الساحل الشرقي لبحوث البيئة بجامعة السلطان زين العابدين كلية العلوم الاجتماعية التطبيقية تحت إشراف الأستاذ الدكتور محمد خير العمري قمر الدين.