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Navigating the Currents: Land Use Challenges Amidst Water and Food Security Debates and Social Media Misperceptions

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Abstract: This research aims to understand the complexities of energy deployment requiring nexus governance solutions. Nexus governance involves coordinating decision-making across policy areas and sectors, seeking compromise among stakeholders with varying positions. The challenge lies in coordinating diverse sectors and stakeholders amidst potentially conflicting priorities and interests. Moreover, social media significantly influence stakeholders' perceptions and actions, serving as a platform for idea exchange and mobilization but also contributing to echo chambers and polarization. This study examines the impact of social media on perceptions of the oil shale project in Al Attarat, Jordan, focusing on the intersections of social, economic, and environmental concerns. The findings highlight that social media significantly influences public discourse, often skewing perceptions with misperceptions about land use, water, and food security. Analyzing key social media narratives reveals that food security is a primary concern, with energy and water security also gaining attention, though less prominently. Furthermore, misinformation has exacerbated tensions among stakeholders, leading to polarized views and resistance to proposed governance solutions. This research underscores the need for effective strategies to counter misinformation and promote informed dialogue.

Keywords: nexus governance; land use challenges; policy and intersectoral coordination; social media impact; perception analysis

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1. Introduction

Contested policy problems refer to issues or challenges that are subject to disagreement and debate among different stakeholders, such as government officials, interest groups, and members of the public. These policy problems are often complex and multifaceted, and may involve competing values, interests, and perspectives. Contested policy problems can be difficult to resolve because they often involve competing values and interests. In order to address these issues effectively, it is important for policymakers to engage in dialogue, compromise with different stakeholders, and consider a range of perspectives and options [1–3].

In recent years, the deployment of new technologies in sectors such as energy and infrastructure has brought forth contested policy problems, exemplified by the case of oil shale. While oil shale holds significant potential economic benefits, its environmental and social risks have led to considerable debate among stakeholders. This complexity requires a governance approach capable of addressing diverse interests, environmental concerns, and economic pressures [4]. Nexus governance, which emphasizes integrated decision-making across various sectors and policy areas, is particularly critical in managing

these conflicts. It aims to harmonize the conflicting priorities of local communities, environmental groups, industry representatives, and governments, ensuring more balanced outcomes [5]. The governance challenges related to energy technologies like oil shale are well-documented, particularly in terms of navigating policy barriers, local opposition, and regulatory frameworks. Furthermore, the deployment of energy infrastructure often leads to environmental controversies due to the varied perceptions of risks and benefits among different groups [6,7]. Oil shale, specifically, presents notable social and environmental risks, requiring careful consideration of its broader impacts. Stakeholder engagement becomes an essential tool in such contexts, where coordinated efforts can help address conflicts and align diverse interests [8–10]. Together, these studies underscore the importance of nexus governance in managing the complexities of modern energy deployment and achieving sustainable, widely accepted solutions.

The rise of social media adds a new dimension to governance challenges, especially concerning the shaping of public opinion. Social media platforms facilitate the exchange of ideas and the mobilization of stakeholders, but they also contribute to echo chambers, polarization, and the spread of misinformation. This dynamic has been well-studied in the context of energy projects, where public perception and local acceptance or resistance to technologies can be influenced by narratives on social platforms. Research on the impact of social media in other sectors, such as heritage buildings and sustainable urban development, has revealed similar trends. Social media's role in spreading information and mobilizing support or opposition to projects has been observed in several studies on sustainable energy deployment, including smart energy systems and building retrofitting projects [4,10,11]. However, these studies also highlight the risks of misinformation and the resulting challenges to achieving consensus and trust.

While existing research provides insights into social media dynamics in energy and heritage building sectors, gaps remain. There is limited understanding of how social media specifically influences land use challenges associated with oil shale deployment, particularly in the context of emerging markets like Jordan. Additionally, although the influence of social media on public perception is well-recognized, there is a need for further analysis of how these perceptions translate into tangible governance outcomes, such as policy adaptation and stakeholder engagement strategies [10,11].

This study aims to address these gaps by examining the deployment of oil shale technology in Al Attarat, Jordan, through the lens of nexus governance. By focusing on the role of social media in shaping stakeholder perceptions and identifying the key social, economic, and environmental factors involved, this research contributes to a deeper understanding of the mechanisms that affect local acceptance or resistance to energy projects. Furthermore, this study underscores the importance of addressing misinformation in order to promote informed dialogue and sustainable outcomes.

The paper is structured as follows: Section 2 reviews the literature on nexus governance and social media's impact on public perceptions of energy projects. Section 3 presents the research methodology, which involves a combination of qualitative and quantitative analyses, including stakeholder interviews, social media content analysis, and policy document review. Section 4 discusses the findings of the study, highlighting key factors influencing stakeholder perceptions and land use challenges. Finally, Section 5 offers policy recommendations and conclusions, emphasizing the need for enhanced coordination between sectors and improved management of social media's role in shaping energy debates.

By integrating the role of social media and adopting a nexus governance approach, this study aims to provide actionable insights for policymakers, industry stakeholders, and local communities grappling with the challenges of energy deployment and land use.

2. Background: Nexus Governance and Social Media

Nexus governance refers to the process of coordinating and integrating policymaking and decision-making across different sectors and policy areas in order to address complex,

interconnected challenges. The term "nexus" refers to the interconnectedness of various policy areas, such as the linkages between energy, water, and food security, for example.

Nexus governance can be applied at various levels, from local to global, and involves a wide range of stakeholders, including governments, civil society organizations, academia, and the private sector [12]. It often involves the development of multisectoral or interdisciplinary approaches to policymaking and decision-making, as well as the use of tools such as cross-sectoral dialogue, integrated planning, and stakeholder engagement.

Social media has had a significant impact on the way that stakeholders, including individuals, communities, and organizations, view and engage with policy issues. Overall, the impact of social media on stakeholder views is complex and multifaceted, and it can vary depending on the specific policy issue and the stakeholders involved [13]. While social media can provide a valuable platform for the exchange of ideas and the mobilization of people around policy issues, it also has the potential to create echo chambers and contribute to the polarization of views.

Social media has been increasingly recognized as a source of misinformation: false or misleading information that is disseminated intentionally or unintentionally. Misinformation can have serious consequences, including damaging public trust in institutions, undermining public health efforts, and influencing public opinion and policy decisions [14–16]. It is important to note that the spread of misinformation on social media is not always intentional [17]. Sometimes, people may share content without fully verifying its accuracy, or they may not be aware of the potential consequences of sharing false or misleading information. However, the amplification of false or misleading content by influential users can contribute to the spread of misinformation even when it is not done with the intention of misleading others [18].

Misinformation can have significant impacts on nexus governance, as it can distort the decision-making process and lead to poor policy outcomes. One way in which misinformation can impact nexus governance is by distorting the public debate around policy issues. When people are presented with false or misleading information, they may form opinions or make decisions based on that information rather than on facts. This can lead to a distorted or misguided public discourse, which can in turn influence the decisions made by policymakers.

Finally, misinformation can also lead to the implementation of policies that are not effective or that may even have negative consequences. When people are presented with false or misleading information, they may support policies that are not based on sound evidence or that may not be in their best interests. This can lead to the implementation of policies that do not address the intended problem or that may even make the problem worse. For example, Ref. [19] discusses the negative consequences of misinformation in the context of cybersecurity. The authors argue that misinformation can lead to the implementation of ineffective or harmful policies, as well as to the adoption of risky behaviors. Likewise, Ref. [20] identifies the ways in which misinformation can shape social reality and influence public opinion and policy. The authors argue that misinformation can lead to the implementation of policies that are not based on sound evidence or that may not be in the best interests of the public. Another study, Ref. [21], found that social media platforms, including Facebook and Twitter, played a significant role in the spread of fake news during the 2016 US presidential election. The authors suggest that the dissemination of false or misleading information on social media may have influenced public opinion and policy decisions related to the election.

In short, misinformation can have significant impacts on nexus governance by distorting public debate, undermining trust in governing institutions, and leading to the implementation of ineffective or harmful policies. It is therefore important for policymakers and the public to be vigilant in seeking out accurate and reliable information and to be critical of sources that may present false or misleading information.

3. Methodology

To understand public perception and narrative, it is necessary to map the context of social media posts and their sentiments. In this research, two different approaches are employed to map the context of the posted tweets. The first one is the approach proposed in [22,23], which is to map the key phrases in the posts with their sentiments. This approach visualizes the narrative and discussions around a given topic in social media by mapping the connectivity of key phrases in the discussion. This map would present each key phrase, the context in which it was discussed, and visualize the structure of the discussion. The steps in this approach are given in Figure 1.

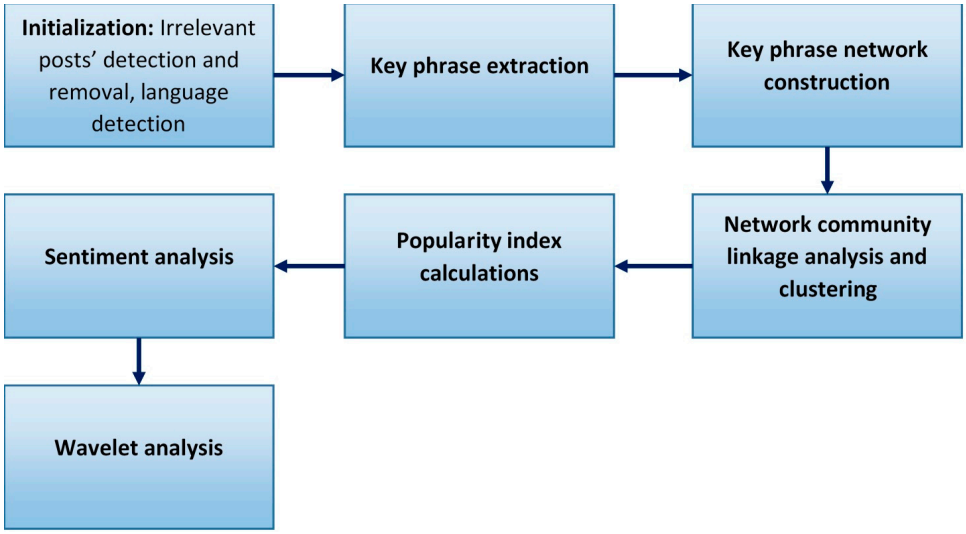

Figure 1. Steps for analyzing the public conversation about a topic [13].

As can be seen, the key phrase contextual map of a publication is drawn in the third step of this approach, and the later steps focus on analyzing the popularity of different aspects of public discussion over time. Since this research is focusing on the context of public conversation, rather than periodic behavior and a phrase's popularity, the analysis would not go beyond the third step.

While a contextual map of key phrases in a public discussion is helpful to draw a picture of general conversations in society, it does not give specifics about public concerns and the solutions people believe can address those concerns. The second approach proposed here focuses on the concerns and solutions expressed in public discussion. Since parts of the tweets are posted by citizens, mapping the concerns and solutions would paint a detailed picture of citizen science as well as concerns expressed by authorities and their solutions for these expressed concerns. Building this contextual map not only helps policymakers by visualizing citizens' concerns around a topic but also presents potential solutions (or, at least, general ideas) to address those concerns. This approach follows these steps:

1. For each post, extract concerns expressed in a post if the post is expressing any concerns.
2. For each concern in each post, extract proposed solutions if there are any solution proposed.
3. Build the concern–solution matrix for each post. For example, if the post has concerns $c_1, \ldots, c_n$ and offers solutions $s_1, \ldots, s_k$, the CS matrix will be $n \times k$ matrix with binary elements cs_{ij} such that:

$$cs_{ij} = \begin{cases} 1 & \text{if Solution } j \text{ is proposed for concern } i \\ 0 & \text{otherwise} \end{cases}$$

It should be noted that each concern might have more than one proposed solution and each solution might address more than one concern.

4. Categorize the subject of concerns extracted from all the posts by comparing the semantics of two concerns. At the end of this step, all the concerns in the CS matrix will have subject categories $C_1, \ldots, C_h$ assigned to them. In other words, the rows of the CS matrix will be labeled based on concern subject categories.
5. Categorize the subject of solutions extracted from all the posts by comparing the semantics of two solutions. At the end of this step, all the solutions in the CS matrix will have subject categories $S_1, \ldots, S_m$ assigned to them. In other words, the columns of the CS matrix will be labeled based on solution subject categories.
6. Extract a summary and the topic of each concern subject category.
7. Extract a summary and the topic of each solution subject category.
8. Build the categorized CS matrix (CCS) by summing up the CS elements in the same concern and solution category:

$$CCS = \{ccs_{ij}\},\ ccs_{ij} = \sum_t \sum_l I_{\{c_t \in C_i\}} I_{\{s_l \in S_j\}} cs_{tl}$$

   where $I_{\{c_t \in C_i\}} = 1$ if the concern c_t is in solution category C_i. Otherwise, $I_{\{c_t \in C_i\}} = 0$. $I_{\{s_l \in S_j\}} = 1$ if the solution s_l is in solution category S_j. Otherwise, $I_{\{s_l \in S_j\}} = 0$.
9. Use the CCS matrix as an adjacency matrix to build concern–solution contextual networks.

It should be mentioned that steps 1, 2, 4, 5, 6, and 7 should be implemented with NLP models. Since developing NLP models primarily for analyzing social media posts is expensive and time consuming, existing general purpose language models and libraries can be used in these steps. In this research, OpenAI's GPT-3.5-turbo engine is used for these steps.

Once the contextual network is built, it can be used as a contextual map of concerns and solutions, and the summary and topics extracted in steps 6 and 7 can be used as the map's key and legend. Steps for building the concern–solution contextual map are summarized in Figure 2.

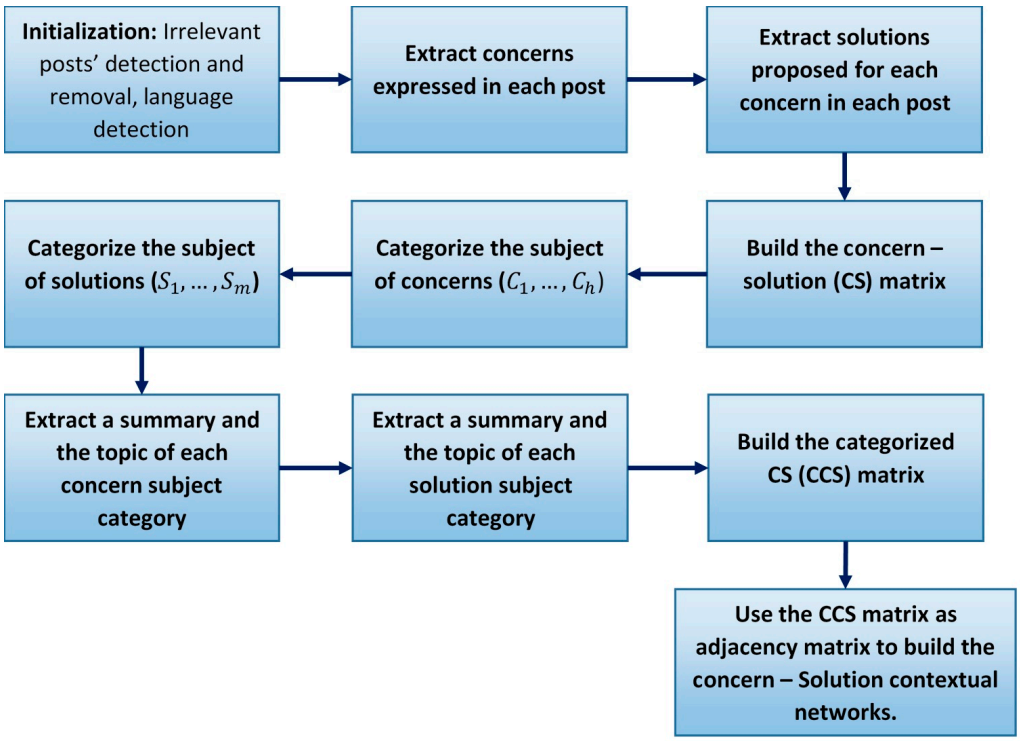

Figure 2. Steps for building the concern–solution contextual map.

Integrating the contextual maps of public concerns and proposed solutions with the sentiment of posts reveals a more complete image of people's perceptions on issues and possible solutions. The more optimistic or supportive posts usually accompany positive sentiments, while posts referring to imminent concerns, pressing issues, or dilemmas, more likely carry negative sentiments.

To paint a more realistic image of public concerns, the sentiment of each post was estimated with Microsoft Azure Text Analytics' library [24,25].

4. Data and Results

To understand recent public opinion and narratives of land use in Jordan in relation to Jordan's water, energy, and food security, all the Arabic tweets posted in 2024 between January 1 and June 15 that related to these keywords was collected from the X platform (See, Table 1). Since the main focus of this paper is Jordan's land use and water, energy, and food security, any posts that were not mainly concerned with Jordan were removed from the dataset. Selecting Arabic posts ensured that the posts had a native audience and were part of the Jordanian community's public conversation. The following query was used to pull posts from the X platform (Table 1):

Table 1. Arabic queries and their English translations.

Original Query	English Translation of the Query
(الأردن OR الاردن OR أردن OR اردن) AND ((تنمية الأرضى) OR (حماية البيئة) OR (استدامة الغذاء) OR (سلامة المياه) OR (استخدام الأرضى) OR (البيئة الطبيعي) OR (الأمن الغذائي) OR (الأمن المائي) OR (استقرار الطاقة) OR (الأمن الطاقة)) since: 1 January 2024; until: 15 June 2024	(Jordan OR Jordan OR Jordan OR Jordan) AND ((land development) OR (environmental protection) OR (food sustainability) OR (water safety) OR (land use) OR (natural environment) OR (food security) OR (water security) OR (energy stability) OR (energy security)) since: 1 January 2024; until: 15 June 2024

With this query, 262 posts were collected, which included both original posts and replies related to these keywords. Collected posts included posts from citizens, officials, and news outlets. To make sure that the public perception was solely focused on Jordanians' public discussions and concerns, we focused on posts where users stated in their profile that they were either Jordanian citizens or located in the country. Figure 3 shows the key phrase networks for the pulled tweets.

As can be seen, the most frequently connected key phrases were "Jordan", "food security", and "agricultural lands". There are also connected nodes representing the frequent connection between "Jordan" and "water security" as well as "Jordan" and "energy" and "Jordan" and "nuclear safety"; however, there is no direct frequent connection between "energy", "water security", and "land use". This shows that, although the public narrative showed concern for food, energy, and water security, concerns for land use were more discussed in relation to food security and agriculture. Furthermore, Figure 3 shows that the main concern in public discussion was "food security", while "energy security" showed the least popularity in this discussion.

To visualize the evolution of the public narrative about "land use", "energy security", "food security", and "water security", the contextual network for each month was also estimated. The frequently connected key phrases are presented in Table 2, and the monthly networks are shown in Figures A1–A6 in Appendix A.

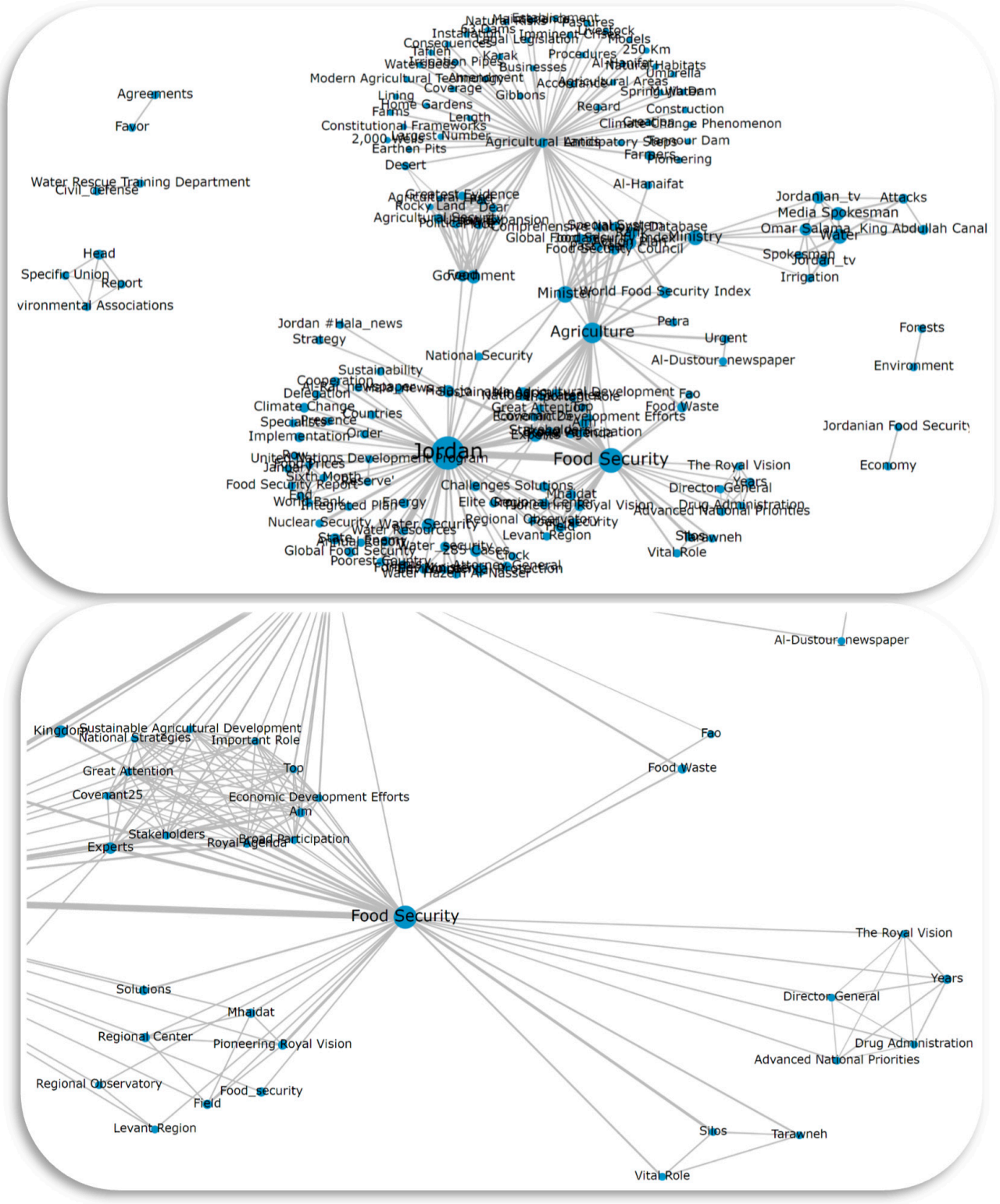

Figure 3. Top: Context network for the pulled tweets. Botumn: Context network zoomed on 'Food Security' keyword.

Table 2. Frequent keywords and the topic and summary of monthly public narratives about "land use", "energy security", "food security", and "water security" in Jordan.

Month	Frequent Key Phrases	Public Narrative Topic	Public Narrative Summary
January	Jordan, Food Security, Agriculture, Action plan, Minister, Water security, Agricultural lands.	Efforts of the Minister of Agriculture in Jordan to improve the country's food security through various initiatives and projects.	The Minister of Agriculture in Jordan is focused on improving the country's food security by establishing a Food Security Council and a national database, amending laws to protect farmers, and implementing projects like well construction and dam building. Environmental protection and water security are also key priorities in enhancing food security in the region.
February	Jordan, Food Security, Global Food Security, Agriculture, Action plan, Government, Minister, Irrigation, Food Waste, FAO, Urgent, Agricultural Security, Urban Expansion, Rocky Lands, Political Will, Water, Agricultural lands.	Challenges facing Jordan's agricultural sector, including declining sheep prices, food security, water scarcity, and climate change. It also discussed community projects aimed at enhancing food security and the need for political will and unified efforts to address these challenges. Additionally, texts highlighted concerns about urban expansion into agricultural lands and the disappearing agricultural sector, calling for anticipatory steps to prevent future crises.	The conversation focused on Jordan's declining sheep prices, food security, water scarcity, and climate change. Community projects were highlighted to enhance food security, with an emphasis on the need for political will and unified efforts. Users expressed frustration over urban expansion into agricultural lands and the disappearing agricultural sector, calling for anticipatory steps to prevent future crises.
March	Jordan, Food Security, Agriculture, Water Security, Ministry, Government, Food Waste, FAO, Regional Observatory, Levant Region, Urgent, Environment, Forests.	The main topic was Jordan's efforts to reduce food waste through the 'No to Food Waste' initiative as well as discussions on water security, environmental protection, and efforts to enhance food security through improving water infrastructure and reducing food waste. Regional cooperation and partnerships were also highlighted as important aspects of these efforts.	Jordan is taking steps to reduce food waste through the 'No to Food Waste' initiative. Discussions on water security and environmental protection are ongoing. Efforts are being made to enhance food security, with projects aimed at improving water infrastructure and reducing food waste. Regional cooperation and partnerships were emphasized.
April	Jordan, Agriculture, Water Security, Food Security, Water Resources Energy, Water, Attacks, King Abdullah Canal, Minister, Jordanian Food Security, Economy.	Various environmental and food security initiatives and challenges in Jordan and neighboring countries.	The Environmental Protection Directorate provided metal containers to Balqa Governorate municipalities. Jordan and Saudi Arabia are enhancing energy cooperation. The Food Security Council in Jordan is collaborating with the World Food Program. Illegal wells are a concern for water security. The World Bank is investing in food system resilience in Jordan and neighboring countries. Users discussed the Food Security Index Q2 2022 by Deep Knowledge Analytics, questioning its accuracy and sharing rankings of Arab countries. Egypt's deprivation and Iraq's resources were mentioned, along with references to Libya, Tunisia, and Saudi Arabia.

Table 2. *Cont.*

Month	Frequent Key Phrases	Public Narrative Topic	Public Narrative Summary
May	Jordan, Food Security, Cooperation, Integrated Plan, Agricultural Security, Water, Attacks, King Abdullah Canal, Ministry.	Training courses on water rescue and food security, as well as discussions on self-sufficiency in basic commodities and the importance of domestic plant growth for food security.	Specialized training courses on water rescue and food security were held in Jordan. A delegation visited the Aqaba Reserve to learn about marine environment protection. X users debated Saudi Arabia's self-sufficiency in basic commodities, with accusations and insults exchanged. The importance of domestic plant growth for food security was emphasized.
June	Jordan, Water Security, Voice, Agriculture, Food Security, Sustainable Agricultural Development, Economic Development Efforts, National Strategies, Government, Forests, Environment.	Water security, food insecurity, and agricultural development efforts in Jordan.	Various organizations and individuals in Jordan are discussing water security, food insecurity, and agricultural development efforts. The importance of protecting food security and sustainable agricultural development was highlighted. Issues such as illegal wells, water theft, and lack of access to water are also being addressed. Efforts are being made to strengthen food system resilience and ensure water safety.

As can be seen in Table 2 and Figures A1 and A6, in the earlier months of 2024, public conversations and narratives about land use and food, water, and energy security were primarily focused on agricultural land use and food security. In more recent months, however, the frequencies of these key phrases declined and water security gained more attention, although food security and agriculture remained among the frequent key phrases. Furthermore, public narratives in more recent months showed increased interest in economic development and sustainable planning.

Public Concerns and Proposed Solutions

As mentioned earlier, in order to find public concerns and their related proposed solutions to pressing issues and less imminent concerns, it was important to integrate the concern–solution context map with the sentiment of posts. To this end, the Microsoft Azure Text Analytic library [24] was used to estimate the sentiment of each tweet. The concern–solution context map was estimated by applying the steps outlined in Figure 2 to the positive sentiment and negative sentiment posts, separately. The extracted concern and solution categories and their connectivity for positive sentiment posts is presented in Figure 4 and Table 3.

Table 3. Concerns and solutions expressed in positive sentiment tweets.

Concern/Solution Category	Summary
Concern.cat.1	Lack of political will to address food and agricultural security.
Concern.cat.2	Urban expansion encroaching on agricultural lands.
Concern.cat.3	Government allowing urban expansion despite majority of land being desert.
Solution.cat.1	Encouraging government to prioritize food and agricultural security.
Solution.cat.2	Two individuals discussed advocating for policies to protect agricultural lands from urban expansion. They also talked about raising awareness about the impact of urban expansion on food security. Both agreed on the importance of addressing these issues to ensure sustainable food production in the future.

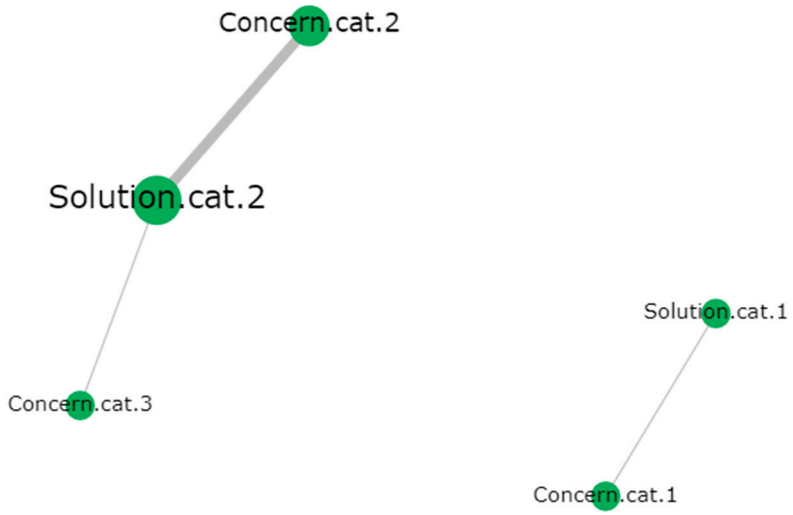

Figure 4. Concern–solution contextual network for tweets with a positive sentiment.

As can be seen in Table 3, the concerns expressed in positive sentiment tweets are related to food and agricultural security and the impact of urbanization on them. The proposed solutions to address those concerns were expressed in a positive and collaborative tone and included raising awareness and encouraging policymakers to adopt more efficient policies. Figure 4 shows that encouraging authorities to prioritize food and agricultural security in land use is proposed to the first concern, "Lack of political will to address food and agricultural security".

Figure 5 and Table 4 present the concerns and solutions expressed in posts with negative sentiments.

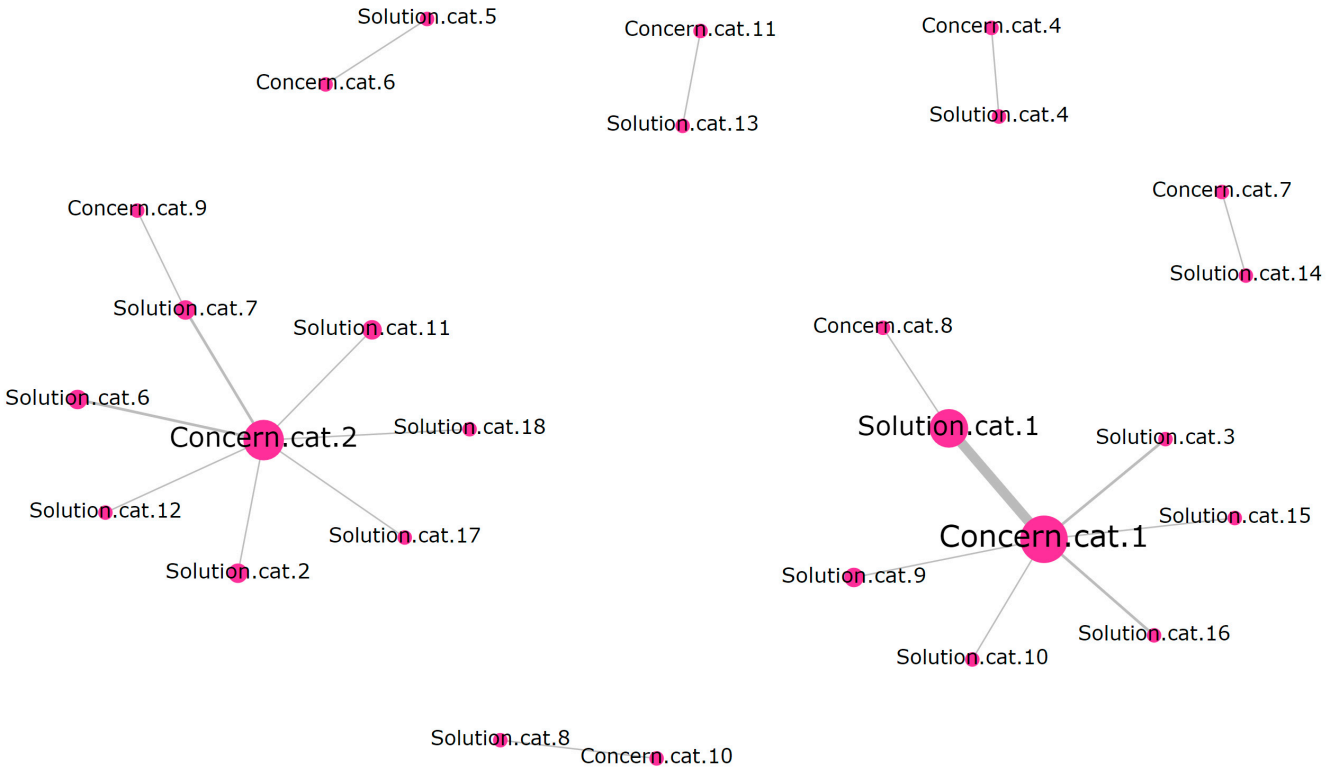

Figure 5. Concern–solution contextual network for tweets with a negative sentiment.

Table 4. Concerns and solutions expressed in negative sentiment tweets.

Concern/Solution Category	Summary
Concern.cat.1	There is a concern about insufficient drinking water wells in Jordan, particularly in the King Abdullah suburb area in Mafraq. Illegal wells are being seized and filled, compromising Jordan's water security. There are worries about potential threats from a neighboring country and Israeli threats to cut off water supply. The presence of over 2000 illegal wells and the lack of government response to these issues is alarming. There are concerns about the safety of the water supply, potential health risks, and compromising national security by allowing a criminal entity to control water resources. Additionally, there are allegations of water being sold in an illegal manner and inappropriate water supply to tourist facilities and chalets.
Concern.cat.2	The solutions focused on the potential destruction of crops by locusts and their impact on food security. This highlighted issues such as lack of effective management, insufficient government support for farmers and livestock breeders, poor diversification, lack of experience in agriculture post-harvest, and unequal access to resources contributing to food insecurity.
Concern.cat.3	Attacks on the King Abdullah Channel in Deir Alla Omar Salama.
Concern.cat.4	Food waste.
Concern.cat.5	Lack of understanding or agreement with the idea of renewing agreements.
Concern.cat.6	Lack of information about why the Eyes exploded.
Concern.cat.7	Random dumping of waste in public facilities.
Concern.cat.8	International studies labeling Jordan as the poorest country in terms of water resources.
Concern.cat.9	Lack of partnership between industrial and agricultural sectors.
Concern.cat.10	Lack of awareness about environmental protection.
Concern.cat.11	Global expansion of war.
Solution.cat.1	The solutions focused on the need for stricter regulations on well drilling and usage to prevent illegal activities. It was suggested to increase legal drinking water wells and enforce laws against unauthorized water sales. Implementing water conservation techniques and sustainable water management strategies were also recommended to improve water security in Jordan.
Solution.cat.2	The solutions focused on the need for increased government support for farmers and livestock breeders. There was also a discussion about working towards equal distribution of resources among them. Both points were seen as important for the sustainability and growth of the agricultural industry.
Solution.cat.3	Addressing any offensive actions towards other countries to protect national security.
Solution.cat.4	Implement stricter regulations to reduce food waste in the country.
Solution.cat.5	Provide a detailed explanation for the cause of the Eyes exploding.
Solution.cat.6	Increase funding for research on locust control methods.
Solution.cat.7	Strengthen partnerships between industrial and agricultural sectors to improve food security.
Solution.cat.8	Increase public awareness campaigns about proper waste disposal methods.
Solution.cat.9	Ensuring Jordan's energy and water issues are not mortgaged to prevent threats to national security.
Solution.cat.10	Increase humanitarian aid and support for Gaza to address the impact of war.
Solution.cat.11	Provide training and resources for effective management practices.
Solution.cat.12	Implement early warning systems to detect locust swarms.
Solution.cat.13	Activate risk plans in all sectors to prepare for potential impacts of global war.
Solution.cat.14	Implement stricter penalties for those caught dumping waste illegally.
Solution.cat.15	Issue a health advisory to inform the public about any potential risks.
Solution.cat.16	Establish guidelines for supplying water to tourist facilities and chalets to avoid inappropriate distribution.
Solution.cat.17	Encourage diversification of crops and livestock.
Solution.cat.18	Offer training programs on agricultural post-harvest practices.

As can be seen in Table 4, the concerns expressed in negative sentiment tweets are mostly related to food and water security, which is in alignment with the results of the key phrase contextual map presented in [24]. Some environmental concerns and concerns related to geopolitical conflicts were expressed. In Table 4, it is evident that not all the proposed solutions are practical or based on scientific facts. Since some of the solutions are proposed by citizens, there is a chance that they are being influenced by misinformation, personal agendas, or anxiety caused by these pressing issues. For instance, the solution proposed in Solution.cat.16 is a restrictive policy and could make the issue worse if it is not implemented along with relief policies. In general, restrictive policies that do not implement relief policies can worsen issues (see Hassani et al. [23–25], for example, in energy policies). As Table 4 shows, a range of solutions are presented for the expressed solutions; from policymaking approaches to more social, collaborative, and cultural solutions. According to Figure 5, for some categories of concerns, multiple categories of solutions were proposed. For instance, for concerns in "Concern.cat.1", which is related to water security, "Solution.cat.1", "Solution.cat.3", "Solution.cat.9", "Solution.cat.10", "Solution.cat.15", and "Solution.cat.16" were proposed, which include policy enhancement, public awareness, social collaboration, and geopolitical measures. It should be mentioned that not all the presented solutions came from public opinion. As mentioned before, the analyzed tweets include tweets from official authorities and news outlets, in which solutions based on expert interviews or official announcements of new policies could be expressed.

5. Conclusions

This paper introduces a novel approach to mapping public narratives and conversations by extracting and visualizing concerns and proposed solutions expressed in public discussions, particularly through social media platforms. Applying this approach combined with the methodology proposed in [23–25], we analyzed the public discourse in Jordan regarding "land use", "energy security", "water security", and "food security" by examining Arabic tweets posted on the X platform between 1 January 2024 and 15 June 2024. The analysis focused on tweets from users who were located in Jordan, ensuring the dataset represented local perspectives.

The findings revealed that the public narrative evolved over time, with significant changes in the frequency and focus of key phrases. In the early months of 2024, the contextual map of key phrases highlighted a predominant focus on food security and its connection to agricultural land use. However, as the year progressed, water security emerged as a major concern, gaining almost equal attention to food security. Interestingly, discussions around agricultural land use became less prominent in later months, indicating a shift in public focus toward more pressing concerns related to water resources.

The concern–solution contextual map further illuminates the pressing issues discussed in negative sentiment posts. The most significant concerns centered around food security and water security, with additional worries related to environmental protection. The solutions proposed within the public narrative varied widely, ranging from calls for stricter regulatory policies to efforts focused on raising public awareness and fostering social collaboration. Notably, while land use was not explicitly a dominant concern in negatively toned posts, it remained closely intertwined with food security issues, as was reflected in more positively framed discussions.

One of the key insights from this study is that not all proposed solutions within the public narrative are practical or feasible. The diverse array of voices contributing to the conversation—including citizens, government officials, and experts—means that the proposed solutions are often a mix of formally announced policies, expert-driven theoretical approaches, and general public perceptions. These public perceptions may be influenced by various factors, such as misinformation, emotional responses, or a lack of understanding of the complexities of the issues at hand. As such, the solutions identified in the concern–solution contextual map should not be viewed as definitive endorsements or rejections of specific policies. Instead, they provide a snapshot of societal perceptions and

highlight the diverse viewpoints circulating within the public discourse around land use, and energy, food, and water security.

In conclusion, these results underscore the importance of addressing the gap between public perception and practical policy implementation. While social media provides a valuable platform for expressing concerns and suggesting solutions, it is also prone to amplifying misinformation and emotional responses, which can complicate the policymaking process. To foster informed public dialogue and create more effective governance strategies, it is crucial for policymakers to engage with these narratives critically, recognizing the limitations and potential biases present in social media discussions. Ultimately, this approach offers valuable insights into how public discourse shapes the societal understanding of critical issues, informing more inclusive and responsive governance frameworks for land use and resource management.

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Appendix A. Monthly Contextual Networks of Public Conversation Based on Key Phrases

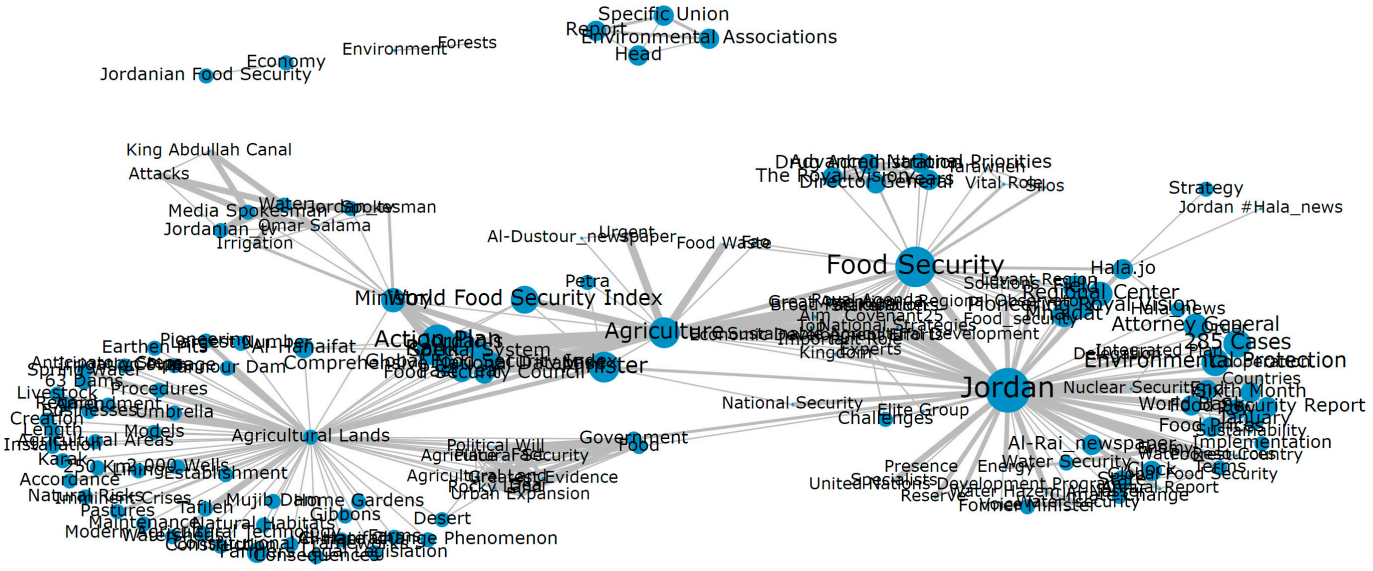

Figure A1. Context network for the pulled tweets in January.

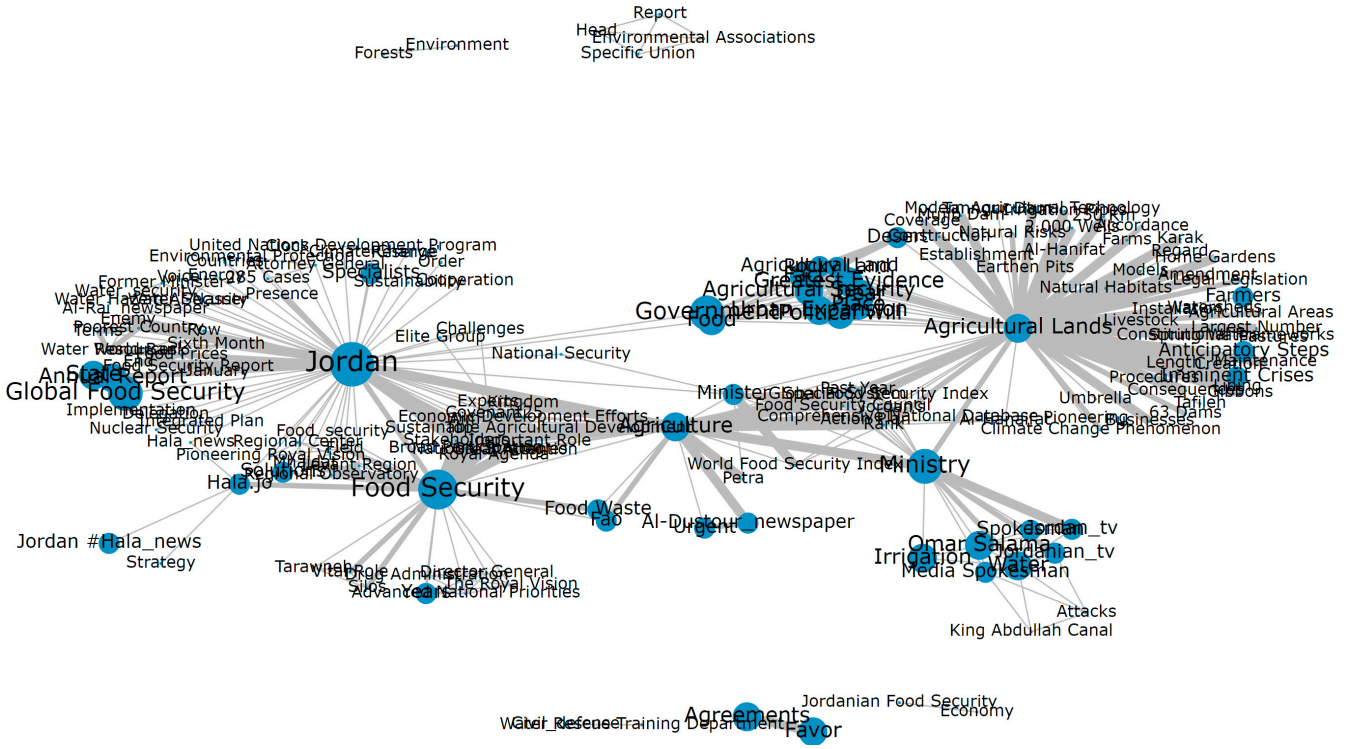

Figure A2. Context network for the pulled tweets in February.

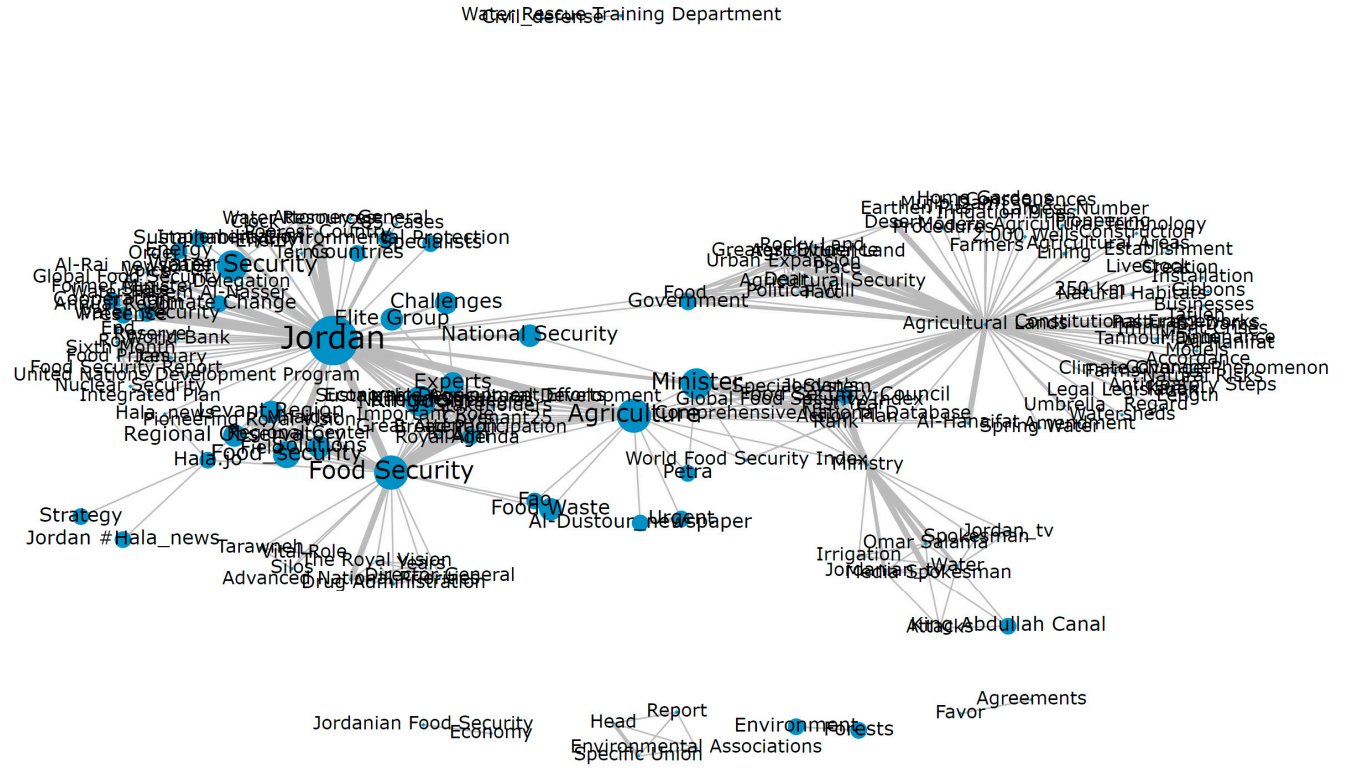

Figure A3. Context network for the pulled tweets in March.

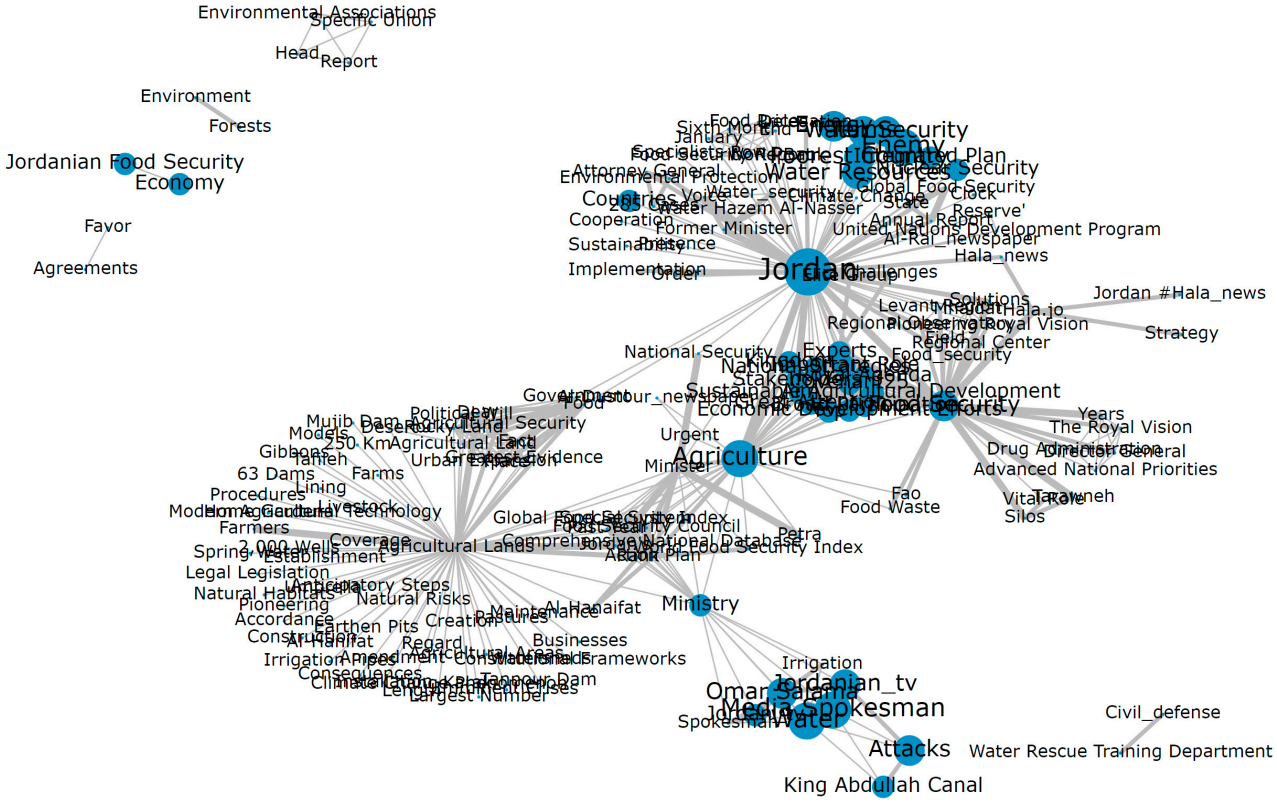

Figure A4. Context network for the pulled tweets in April.

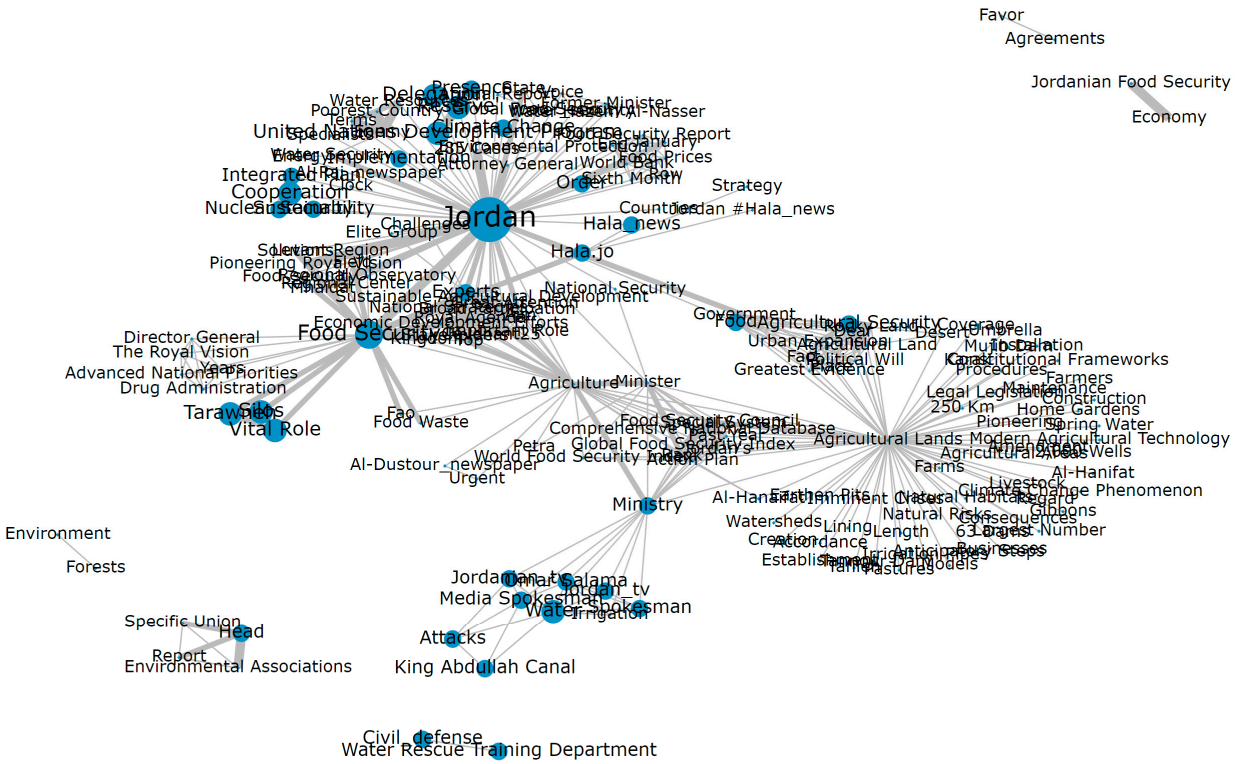

Figure A5. Context network for the pulled tweets in May.

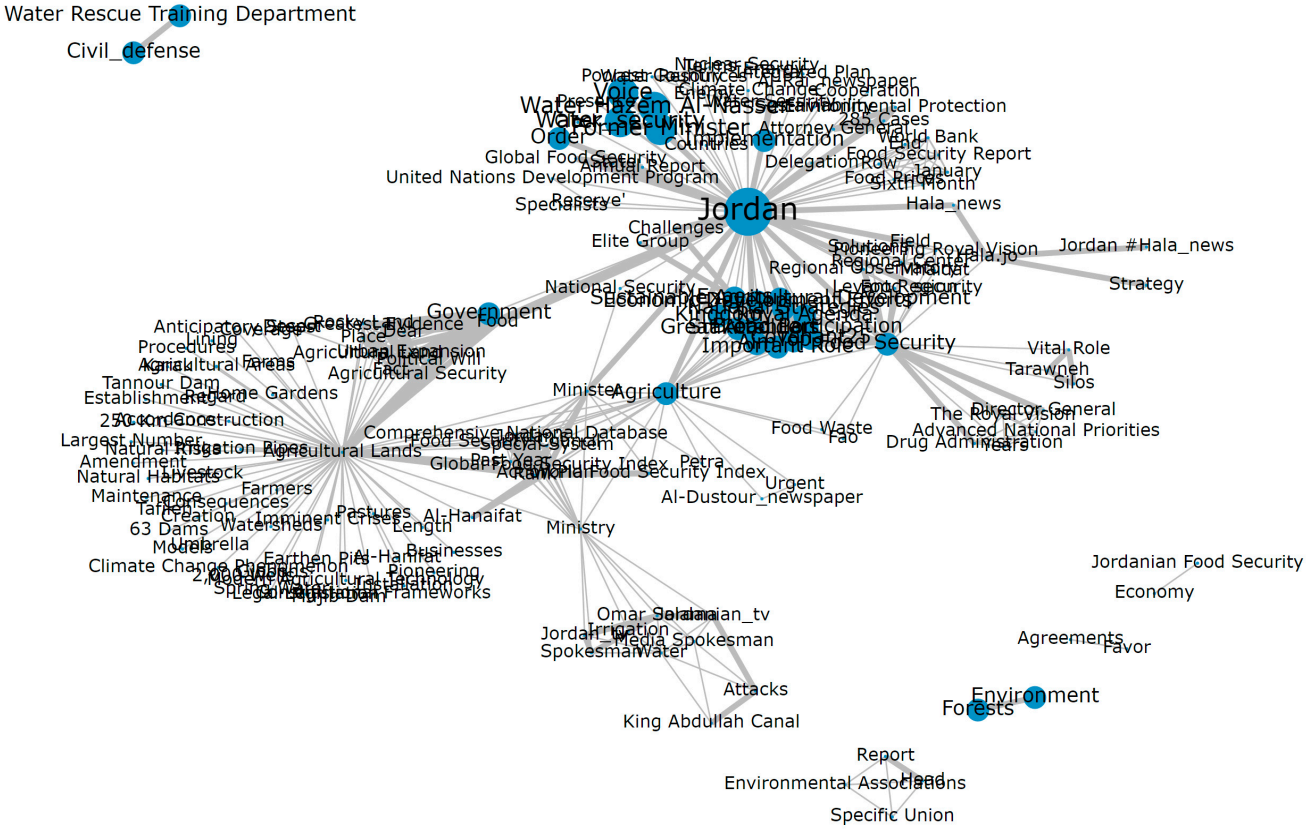

Figure A6. Context network for the pulled tweets in June.

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