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Drivers and barriers towards sustainable water management in Erbil Kurdistan Region of Iraq

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Abstract

This study identifies and examines drivers and barriers toward effective integrated and sustainable management and governance practices based on ecosystem services' perspective of the Kurdistan Region of Iraq's water management area. A combination of a systematic literature review and 28 individuals from Ankawa, Kasnazan, Haran City, Eskan, Bakhtiari, Tairawa, Mastufi, Khabat and Saiudawa were randomly interviewed. The decisions to use residents of these areas are based on their location as well as mixed challenges and conditions regarding water supply and use based on their social and economic statuses. The responses were analysed using NVivo 12 and the results of the study indicated that there have been substantial increases in environmental and ecosystem services awareness has been a key driver of heightening sustainability initiatives in the Kurdistan Region of Iraq. Additionally, the study reveals that lacking coherence between actors and sectors concerning natural resource governance is a major obstacle to undermining sustainable water management initiatives. It is inferred through the established findings that sound leadership, localized, decentralised management structures, and sustainable developments are pivotal for enhancing the water management efforts in the Kurdistan Region of Iraq. Moreover, local water suppliers, residents, farmers and decision-makers are encouraged to adopt additional and sound water monitoring practices to improve ecosystem services and valuable contributions toward improving human beings' well-being.

Keywords: Ecosystem Services; Kurdistan; Sustainable Water Management; Water Governance; Water Management

1. Introduction

It is undoubtedly prominent and accepted that water is an essential commodity that is vital for sustaining plant and animal life. Studies provide substantial documented evidence about the importance of water and draw reasons like life survival [1], chores [2], agricultural purposes [3], and other basic needs and waters [4]. However, changes in climate conditions coupled with structural imbalances like drought have proved that it is not always easy to have adequate access to clean water in the desired quantities. Consequently, it is disturbing that water problems are substantially taking a huge toll on the world and threatening human survival. Evidence provided by UNICEF shows that about two-thirds of the world's population (approximately four billion people) face severe water scarcity for at least one month each year [5]. Additionally, UNICEF also states that more than two billion people live in countries where water supply is inadequate and that half of the world's population could be living in areas facing water scarcity by as early as 2025 [5]. There is mounting evidence about what water scarcity problems are triggering. For instance, it is forecasted that about 700 million people could be displaced by intense water scarcity by 2030 and that by 2040, roughly 1 in 4 children worldwide will be living in areas of extremely high water stress [5, 6].

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One of the key countries that are facing such issues is the Kurdistan Region of Iraq where residents in most places do not have a 24-hour government water supply and have to rely on private companies to meet their water needs. Such problems are bound to worsen as Kurdistan faces an increase in population which increased to 6 million in 2021 [7]. Such problems are being compounded by a decline in budget expenditure toward infrastructural development as the government is struggling to contain the effects of a financial crisis that is shrinking its revenue-generating capacity [8]. Consequently, the Kurdistan government does not have adequate resources to continuously provide adequate clean water to its residents.

Meanwhile, key measures like sustainable water management have been introduced to address not only water scarcity problems but also its management. This follows suggestions denoting that a key number of water-related problems can easily be addressed by adopting sustainable water management practices [9, 10, 11].

One of the key reasons behind the high prevalence of water scarcity problems in countries like Kurdistan is the lack of sustainable water management practices by both residents and the government. But there is no guarantee that the adoption of sustainable water management practices will be able to alleviate such problems. This is because there are significant drivers like cultural activities that are exacerbating such problems. Besides, studies depict that the feasibility of attaining sustainable water management practices can be dim because of the existence of barriers undermining sustainable efforts [9, 10]. To make matters worse, it is to the authors' knowledge that no studies are exploring the drivers and barriers of sustainable water management practices in Kurdistan. Hence, efforts to implement sustainable water management practices can prove to be futile when the related barriers and drivers of sustainable water management practices are not identified. Given such circumstances, the study aims to determine drivers and barriers to sustainable water management in the Erbil Kurdistan Region of Iraq. This knowledge gap is addressed by investigating the following research question: what are the key drivers and barriers affecting sustainable water and land management? Driving forces, as well as barriers, are often multiple and interacting factors such as political, biophysical, economical and societal determinants. Their causal linkages are often mediated by other factors (e.g., climate variability), thereby complicating statements of causality or attempts to establish the proportionality of various contributors [12].

There are vast practical and theoretical contributions embedded in this study as it enhances understanding of the application of sustainability principles in water management. Additionally, this study can provide an effective course of action capable of rectifying water scarcity and management problems faced in Kurdistan. Furthermore, solutions provided in the study can be generalised to other regions in and outside Kurdistan.

2. Literature review

Efforts to identify and understand the drivers of sustainable water management practices are influenced by the prevalence of knowledge about what resources are being managed [9]. Hence, it is always vital to first identify the water resources together with the underlying management and governance practices in Kurdistan.

Knüppe and Meissner opine that the integration of ecological and social systems perspectives is the key to efficiently, equally and sustainably managing natural resources like water [13]. Such also includes a bridging component in the form of ecosystem services [14]. Meanwhile, social-ecological systems comprise bio-physical units and their related institutions and state actors responsible for instituting norms and rules [15]. The connection between causal chains, feedbacks and networks expressing the dynamics and relations between patterns and structures of the relations system's elements is described using what is known as a [16]. This study regards the Kurdistan Region of Iraq's social-ecological system as structurally challenging and naturally restricted by functional or spatial boundaries about specific ecosystems and their related situational contextual issues such as ecosystem damages, water scarcity, and water pollution. Such a concept is widely recognised and has been significantly applied to enhance the sustainable management of natural resources. For instance, it is suggested that the integrations of sustainability principles with the ecosystem strive to maximise human beings' dependence on ecological life support systems [17]. Additionally, it has risen significantly to be essential in setting up foundations for political, conservationists and academics in heuristic analysis aimed at preserving nature's legacy [18]. Such a concept is vital and offers distinct and significant benefits encompassing addressing conflicting demand matters between land and water resources and the integration of competing for environmental decision-making needs [19]. It is also suggested that such a concept is essential in creating novel relations between governmental and corporate entities, the local population and civil society [20]. However, this does not disregard the fact that the notion of ecosystem services creates challenges undermining planning, implementation and monitoring [21].

Meanwhile, the other notable concern that surrounds issues and aspects related to water management and sustainability is the governance and management of natural resources. The governance of natural resources is used in describing the connections linking traditions, rules, processes, and structures determining how individuals ensure accountability, exercise responsibility, share power, and make decisions and how stakeholders influence the use and management of natural resources [22]. However, it is imperative not to forget that various interest groups, local communities, non-governmental organizations, private companies, governmental agencies, and societal actors tend to influence the effectiveness of governance measures introduced in a particular state. In some studies, it is highlighted that both are influenced by institutions with related structures and rules shaping the political, economic and social behaviour or transaction within societies [23]. The term management refers to analysing, monitoring, developing and implementing measures to maintain natural resources in a state that is within desirable limits [24].

Al-Jawad, Alsaaffar, Bertram, and Kalin (2019) contend that water management and governance systems can reap substantial benefits from ecosystem services methods in harnessing services and functions provided by ecosystems. Pahl-Wostl contends that sound adaptive resources management commands the following aspects [24]:

- Broad integration of non-state actors and states such as people's values and aims linked to ecosystem services (stakeholder participation).
- Sound and effective connectivity and interplay of several political systems and management aspects at both national and local levels.
- Effective multi-level integration and cooperation between various sectors based on land and water resources like fisheries, tourism, forestry, and agriculture (sectoral cooperation and multi-level interaction).
- Institutional development encompasses agriculture reforms, conservation measurements, and land and water policies capable of promoting the attainment of adaptive and sustainable management of land and water resources that guide social practices and define related actors' responsibilities, rights and roles.

The above four aspects are essential in improving implementation and compliance, increasing the acceptance of innovative approaches and decisions, and contributing towards enhancing the quality of management through the inclusion of several forms of land and water information and knowledge about the ecosystem services they offer [25].

3. Methodology

The study used a mixture approach comprising of a systematic literature review and interviews to gather detailed information concerning the barriers and drivers of sustainable water management in Kurdistan. Such an approach was used because it enhances the ability to identify empirical gaps, enhance the study's contributions and test the validity of unproven ideas and facts. As a result, journals, peer-reviewed articles, research reports and governmental publications were used in this study to provide the required information. Meanwhile, 28 individuals from Ankawa, Kasnazan, Haran City, Eskan, Bakhtiari, Tairawa, Mastufi, Khabat and Saiudawa were randomly interviewed. The interview questions comprised of open and closed-ended questions that were developed by the researcher based on the reviewed studies. The decisions to use residents of these areas are based on their location as well as mixed challenges and conditions regarding water supply and use based on their social and economic statuses. The interview questions were covered.

- Drivers and barriers toward more sustainable practices
- Institutional development and the integration of ecosystem services and,
- The role of state and non-state actors. The interviews were coded and processed using NVivo, an Aided Qualitative Data Analysis Software capable of coding, conducting transcription analysis and text interpretation [26, 27].

3.1. Study area

Attempts to design a reinforced concrete detached house were made possible by using the situation in Erbil, Iraq in designing the required detached house. Erbil is located in northern Iraq between longitudes 43° 22' and 45° 05E, and latitudes 35° 30'. The geographical map of Erbil which was formerly known as Arbil is shown in Figure 1.



Figure 1 The geographical map of Erbil, Iraq

3.2. Climate Conditions in Erbil North Iraq

The climate conditions in Erbil are classified using the Koppen climate classification as a Mediterranean climate. That is, there are mild, humid and wet winters and extremely hot and long summers. The wettest month is January and there is no rainfall between June and September. Table 1, shows the climate conditions of Erbil from January to December. It can be noted that the maximum temperatures are experienced in July averaging 42°C. The highest daily average temperature experienced in Erbil is 33.4°C.

Table 1 Climate data for Erbil

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. relative humidity (%)	75	70	65	59	42	29	25	28	31	44	61	76
Avg. rainy days	9	9	10	9	4	1	0	0	1	3	6	10
Average rainfall (mm)	111	97	89	69	26	0	0	0	0	12	56	80
Average low °C	2.4	3.6	6.7	11.1	16.7	21.4	24.9	24.4	20.1	14.5	8.9	3.9
Daily mean °C	7.4	8.9	12.4	17.5	24.1	29.7	33.4	33.1	29.0	22.6	15.0	9.1
Average high °C	12.4	14.2	18.1	24.0	31.5	38.1	42.0	41.9	37.9	30.7	21.2	14.4

Source: Climate-Data.org

Table 1 shows that the average rainy days in Kurdistan do not exceed 10 and that the month of June, July, August and September are dry and do not experience any form of rainfall.

3.3. Approaches to water and land resources management in Kurdistan

Kurdistan is classified under hot climate regions and the surging water demand causes the environment, industry and humans to be extremely vulnerable, and hence, adopting sustainable management is not only necessary but also vital [28]. Additionally, efforts to eradicate poverty and enhance opportunities aimed at improving the livelihoods of disadvantaged individuals require urgent attention towards improving access to water and the management of related ecosystem services [29]. Moreover, recommendations stipulated by the Water Legislation are essential for regulating the environment and its related water resources worldwide [27,30]. Such legislation regulates the sustainable, efficient and equitable allocation and use of ecosystem services and water resources. Furthermore, vast and diverse innovative policies connected to such legislation also exist in the form of resource, ecological reserve, and water resources classification qualitative objectives. Such efforts denote the importance of balancing the use of water for productive purposes such as mining, industrial and irrigation uses. However, there is a lack of policies encouraging stakeholders to drift from rights-based water allocations toward a system where water allocation decisions are interest-based [31].

4. Findings

4.1. Ecosystem services in the Kurdistan Region of Iraq

Based on the combined systematic literature review and expert interview suggestions, it becomes apparent that there is heightening competition for water resources and stern pressure caused by economic and demographic developments, as well as climate change in the Kurdistan Region of Iraq for the past twenty years [31]. Such problems tend to undermine ecosystem services management. The following were identified by the interviewees:

- Ecosystems' provisional services such as household water supply, fishing and farming, livestock and irrigation.
- Benefits of regulating and maintaining ecosystem processes. Such encompasses habitat services like fauna and flora diversity. For example, photosynthesis, nutrient cycling, pollination, etc. This also includes moderating droughts (climate adaptation), and water flow regulation (coastal, wetlands, groundwater).
- Non-material ecosystem benefits are obtained by people (social and cultural services) like heritage and aesthetic beauty, and tourism and recreation and tourism.

The above-given perspectives are vital for water flow regulation at both global and regional scales. The next section provides insights into the identified drivers and barriers affecting sustainable water management in the Kurdistan Region of Iraq.

4.2. Drivers of sustainable water management in the Kurdistan Region of Iraq

The conducted interviews led to the identification of four barriers undermining sustainable water management in the Kurdistan Region of Iraq. Such becomes vital and a major rationale for advocating sustainable water management. As noted, drivers were defined as climate change and variability and changes in global market forces, bottom-up movements, and institutional settings [31].

4.2.1. Climate changes and variability

The effects of climate change on water resources are undeniable and documented in several studies. For instance, some studies contend that climate change undermines individual health, food security, water resources and infrastructure development [32,33]. Such problems were also identified through the interviews to be prevalent in Kurdistan. As a result, the interviewees agreed that climate change is a notable driver compelling both the government and community members to adopt sustainable water management practices. Consequently, this was considered by the interviewees as affecting the tourism, agriculture and fishing sectors.

4.2.2. Global market forces

Changes in international trading systems and global market forces are major drivers of sustainable water management [34]. Consequently, the interview responses indicated that water users (individuals, producers like farmers, industrialists etc., are driven by the profit motive and hence, will seek to rationalise their decisions regarding the use of land and water resources. This also aligns with propositions suggesting that even the quality of water used for irrigation purposes has to conform to international trade treaties such as the Common Agriculture Policy [34]. Such entails that water quality and management initiatives have greatly improved so as to cater for changes in international trading systems and global market forces.

4.2.3. Bottom-up movements

It was noted through the interviews that bottom-up approaches at the catchment level are significant drivers of the negotiation of ecosystem service trade-offs and environmental awareness across sectors. Such constitute part and parcel of notable conditions of sustainable water use practices [34]. Examples of local water management initiatives implemented in Kurdistan include securing and prioritising biodiversity of land outside state-owned protected land and water resources and ecoregion-based conservation initiatives that were influenced by multi-stakeholder activities, processes and meetings in Kurdistan's rural areas.

4.2.4. Changes in institutional settings

The Kurdistan Regional Government has been making substantial initiatives for good governance and participation. Such has been evident in legislative measures like the Water Legislation and such legislation works towards enhancing sustainability, efficiency and equity in allocating and using both land and water resources [28]. The interviewees indicated that a lack of institutional changes will continue to drive individuals and/or communities to engage in

unsustainable acts such as cleaning house walls and floors, and dura walls with water every week. Nevertheless, the interviewees suggested that there were substantial efforts made towards addressing such problems through the establishment of the Kurdistan Region of Iraq Directorate of Water Management and the classification system of water resources as major factors capable of fueling further development of water resources pivotal for sustainable water management.

4.3. Barriers affecting sustainable water management in the Kurdistan Region of Iraq

Barriers were identified to be limited capacities, adaptation to new structures, and old and long-lasting practices. These barriers are discussed in detail in accordance with the established interview responses as follows:

4.3.1. Limited capacity

The Erbil Directorate has been facing substantially limited capacity issues and such has been proved to be true by the interviewees [29]. The interviewees indicated that both the local and regional governments have no adequate capacity to fund water projects and have been relying on loans and foreign direct investments. Such problems were regarded by the interviewees as being compounded by a lack of institutional knowledge and experience. Furthermore, poor leadership and corruption allegations were highlighted as major issues compounding limited capacity problems hindering the adoption of new ideas and injection of new streams of water management knowledge in the Kurdistan Region of Iraq.

4.3.2. Adaptation challenges to new structures

A series of political transformations observed in the Kurdistan Region of Iraq resulted in several challenges undermining society, the private sector and the government at large. The interviewees indicated that organizations and individuals are often at times incapable of adapting to the new ways of structuring, functioning and thinking. This is mainly because of challenges caused by the delegation of responsibilities at the catchment or regional level, and the decentralization of water management issues [28, 29, 34]. The interviewees attributed this to local and regional authorities being overwhelmed by the need to protect water resources, develop, operate and maintain infrastructure, coordinate integrated planning on a catchment basis etc. besides, adapting to contemporary legislative structures such as the Water Legislation can present challenges for non-state actors as well as the state. Additionally, it was inferred from the interview responses that several communities in the Kurdistan Region of Iraq are unaware of what to do and why.

4.3.3. Old and long-lasting practices

Breaking up old and long-existing habits has been proving to be a challenging task [28, 29, 34]. Residents in Kurdistan have a strange habit of using water excessively, especially in summer. The interviewees noted that a lot of people in Kurdistan tend to use a lot of water to wash their dura walls, house walls and floors. Such habits have long existed and appear to be passed from generation to generation. Moreover, Kurdish farmers were established to be presenting challenges undermining sustainable water management as they were considered by the interviewees as using a lot of water for irrigation purposes. Furthermore, such farmers are incapable of accessing approval from the related ministry to transform natural habitats into agricultural land.

5. Conclusion

The main emphasis of this study was to identify and analyse the drivers and barriers to sustainable water management in Kurdistan. Such was centred on the argument suggesting that efforts to implement sustainable water management practices can prove to be futile when the related barriers and drivers of sustainable water management practices are not identified. As a result, a combination of systematic literature review and qualitative interview methods were used for the related study inquiries. The study's findings showed the existence of limited capacity challenges undermining both the transfer of knowledge and skills and suggest the need to establish water management acts acting to harness efforts between state officials and local stakeholders in charge of water and land management. Problems in adjusting to contemporary structures were discovered and this requires closer cooperation between residents, communities and farmers with the Directorate of Water to introduce and implement sustainable water use and management practices. Cooperation between various government departments is vital for achieving sustainable water use and management objectives, especially between the Department of Agriculture, Environment, Development Planning and Water. This is vital for reducing administrative 'red tape' encountered by industries and farmers when renewing and applying for authorisations.

It is recommended that localised and decentralised management structures supervised by individuals with the necessary water management knowledge and experience are essential for enhancing the sustainable management of Kurdistan's water resources and ecosystem services. Furthermore, this study suggests that establishing adequate water monitoring systems is vital for residents, local water suppliers, farmers and decision-makers. Practically, the study calls for adequate and solid economic, social and water monitoring systems, and localised and decentralised management to sustainably manage water resources, improve coherence across actors and sectors and overcome political challenges undermining the efficient use of water resources. The study is by no means without limitations as the provided interview solutions only provide insights into the notable barriers that must be addressed in the Kurdistan Region of Iraq. Hence, additional perspectives must be sought to solve problems undermining sustainable water management practices and future studies must incorporate participatory and decentralised approaches when implementing plans related to institutional settings, socio-economic aspects, and ecological and physical circumstances connected with sustainable water management practices.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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