

Full Length Research Paper

A proposed Paradigm for integrated water resources management under changing political, economic and social conditions "The Case of Palestine"

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Abstract

The integrated management of water resources is considered one of the complex issues, where the nature of institutional structure, governance, economic, social, and political dimensions of the state intersect. This complexity extends to the state's relationships with neighboring countries when participating in international water sources. The aim of this research is to identify the challenges facing integrated resource management amidst changing political, economic, and social conditions, and within a fragile general management framework. Through this research, the author presents a comprehensive model for analyzing a social, economic, and political system that contributes to achieving greater integration in water resource management. This analysis is developed through a case study of Palestine, where uncertainty prevails in social, economic, and political issues and interactions with neighboring countries. The research methodology will adopt the mixed method, which combines quantitative and qualitative analysis. The researcher utilized various appropriate research techniques for foresight studies, including the Delphi method, 5Ts framework, (Trend, Tensions, Transition. Today(now) Tomorrow (future), cross impact matrix and in the Delphi methodology, 18 experts two Delphi rounds were conducted to minimize bias and verify the consistency of answers. Additionally, the researcher examined experts' responses from other specialties to utilize this technique for validation. 18 indicators were used in other techniques (6 social, 5 economic, 7 technological and enabling and enabling environmental in addition to 25 sub-indicators (breakdown of the 18indicator). Through these utilized techniques, it was revealed that there are 10 indicators falling under the category of uncertainties economic, social, and external environmental uncertainties accounting for 56% of the total factors.

Keywords: IWRM, Delphi Technique, Cross impact matrix, Uncertainties.

1. Introduction

The inclination to incorporate the use of both qualitative and quantitative approaches has increased, particularly the utilization of one another's methods, which was supported by a number of aspects that were mirrored in subsequent research.

The goal of each of the two approaches is the same, which is to understand the phenomena and the reality surrounding us and work to adapt this reality for the good of man. Many studies that have looked at a particular

phenomenon but used a different approach have often reached the same results.**2)** Employing both approaches to understand different aspects of the phenomenon (according to the strength of each technique with the appropriate aspects of the phenomenon) helps in the tightness and accuracy of the results.**3)** A particular technique in a particular approach often underpins another technique from a different approach (Alamara, 2010).

Literature Review

The concept of the integrated water resources management has been around for nearly 60 years. It was rediscovered in the 1990s in order to try to give specific references. While at a first glance, the concept of IWRM looks very attractive, a deeper analysis brings out many problems both in concept and implementation (Biswas 2004). Each country however, has created its own model which takes into consideration all socioeconomic, political and environmental dimensions. The IWRM concept should be a continuous process and a part of the general policies trends in each country.

The Technical Advisory Committee of the Global Water Partnership defined Integrated Water Resources Management (IWRM) "as a process, which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems", and emphasized that water should be managed in a basin-wide context, under the principles of good governance and public participation (GWP 2000).

IWRM is not a new idea. In a number of countries, water management has been institutionalized in an advanced and integrated way over centuries. Embid writes that Spain was probably the first country to organize water management on the basis of river basins, as it adopted the system of "confederaciones hidrograficas" in 1926. Embid 2003. Over the last several decades, there have been serious attempts to implement IWRM in different global regions. In the 1940s, an early version of IWRM occurred when the Tennessee Valley Authority began to develop the water resources for that region (Barkin and King, 1986). Several international events recommended or mentioned IWRM as the most acceptable approach in order to achieve a holistic management of water resources.

21. International Vision

At the United Nations Conference on Water in the Mar del Plata (1977), IWRM was the recommended approach to incorporate multiple competing uses of water resources. Although in the 1980s water disappeared, for the most part, from the political agenda; the situation changed in the 1990s thanks to the efforts of a number of conferences and international organizations. Efforts such as the International Conference on Water and Environment (1992), Second World Water Forum (2000), International Conference on Freshwater (2001), World Summit on Sustainable Development (2002) and Third World Water Forum (2003) collectively led to breakthroughs that thrust IWRM onto the political agenda.

The international community now recognizes IWRM as the most efficient and effective water resources management mechanism to enhance economic well-being, social-equity, and environmental sustainability.

But current IWRM principles are often overlooked due to the reality on the ground. The integration of different sectors related to water management is a difficult and challenging task. In addition, the problems and solutions associated with IWRM implementation in different regions are not universal. Overly general or universal policies and guidelines for implementing IWRM may become counterproductive. Integrated water resources management (IWRM) is nowadays regarded as the vehicle that makes the "integrated view" of sustainable development operational for the management of water resources, since the interests of people, society, economy, and environment are seen as an interconnected whole (and where tradeoffs concerning all interests need to be taken into account). The holistic approach adopted in IWRM implies that information is needed on the state economy, society, and water resources. The most widely adopted indicator (DPSIR) framework is the Drivers-Pressure-State-Impact-Response (DPSIR) Framework developed by the Organization of Economic Cooperation and Development (OECD) in 2003. According to the DPSIR, social and economic changes, such as population growth, agricultural policies, food demand and uncertainties potentially cause different kinds of pressures on the environment. The DPSIR Approach is widely used in order to understand what kind of policies should be implemented in order to achieve IWRM. This approach heavily depends on the major functions of indicators and the trends of the indicator overtime. However, one of the shortcomings of this approach is that the accuracy of the indicators affects the overall conclusions. Since this research will attempt to cover the knowledge gap that this method does not fully address by using a large number of indicators and examining the method thru their integration with other methods.

The UN-Economic and Social Commission for West Asia (UN-ESCWA) has two sets of indicators for the water sector, the first one related directly to water aspects (environmental sustainability and water supply data), while the second is related to socioeconomic aspects (equity, affordability etc). The main targets of the two sets are: an enabling environment (policies and regulation); institutional roles (performance indicators of utilities) and management instruments (economic, social instruments). Many academic studies query how to achieve the optimal benefits of IWRM and how to use it to achieve a combination of social, economic, and environmental results. What kind of policies should be taken by decision makers to achieve an efficient system that takes into consideration the socioeconomic uncertainties of each country?

2. Background of Water resources

The state of Palestine, also known as the occupied Palestinian territory (OPT), encompasses an area of 6,005 square kilometers. It includes the West Bank, which incorporates East Jerusalem, as well as the Gaza

Strip. These territories have been under Israeli occupation since June 1967. According to the Palestinian Central Bureau of Statistics, its population is expected to reach 5.48 million in 2023, with 3.26 million living in the West Bank and 2.22 million in Gaza.

Water resources in Palestine are severely limited, particularly when it comes to surface water. In the West Bank, the only permanent surface water available is the Jordan River which Palestinians are denied its access in addition to the seasonal stormwater discharging into wadis, while the Gaza Strip has completely lost its surface water resources due to the depletion of the main wadi, known as Gaza Wadi, caused by upstream water abstraction practices in Israel. Most wadis flow for only a few weeks a year, typically during flashfloods triggered by thunderstorms. However, utilizing and capturing this water is challenging due to the complex geological and geographical characteristics of the valleys. The construction of large storage dams is further complicated by the scarcity of plains and the presence of karstic limestone substratum in most areas. The Jordan River is extensively utilized by Israel for irrigation and domestic water supply. However, since 1967, the Palestinians have been denied access to this crucial resource. The Jordan River is a trans-boundary resource shared among Jordan, Syria, Lebanon, Israel, and Palestine. In order to establish a sustainable long-term strategy, it is essential to prioritize the integrated management of this resource and reach a comprehensive basin-wide agreement among all involved parties. Palestinian Water authority 2023.

Palestine is mostly reliant on groundwater where the majority of Palestinian water supply comes from this source either by wells and/or springs. The total long term average renewable groundwater resources have been estimated as 578-814 MCM/year in the West Bank and around 55-60 MCM/year in the Gaza Strip.

The Palestinian Water Authority (PWA) has been given the mandate PWA Establishment **Law No. 2**, and has been stressed on in its amendments Law no.3 for 2002 to manage the water resources, execute the water policy, establish supervise and monitor water projects, and to initiate co-ordination and co-operation between the parties affected by water management. Afterwards, [Decree No.\(14\) for the year 2014 Relating to the Water Law](#) was issued in 2014 to establish for a new phase for the water and wastewater sector and its governance and management. The new water law aims to improve the level of water services. The law established a new institutional framework for the water sector that includes separation of regulatory, planning, and operation functions. The law identifies the roles and relations among various water sector institutions:

- The PWA has the overall responsibility for managing and regulating water resources, setting policies, determining water allocations, protecting water quality, and developing projects.
- The law authorizes the commercialization of water supply through the establishment of a National Water Company through restructuring the West Bank Water Department (WBWD).
- The law also provides for performance monitoring of water service providers by an independent Water Sector

Regulatory Council, with legal status and budget independent from the PWA.

- Additionally, the 2014 Water Law requires that the PWA establishes four regional water utilities for the provision of water and wastewater services as legally and financially independent entities, which in turn requires consolidating existing water and wastewater service providers into regional entities.

Other line ministries and agencies have leadership on specific issues:

- Ministry of Agriculture (MoA): irrigation and promotion and organization of farmers' associations.
- Environmental Quality Authority (EQA): defining environmental regulations, including standards for the discharge of treated wastewater into natural water courses.
- Palestinian Standards Institute (PSI): standardization of rules for water facilities, sewerage, on-site sanitation, carbon footprint and water footprint regulations.
- Ministry of Public Works and Housing (MoPWH): national development plans, taking availability of water resources into account, to be assessed by the MoPWH.
- Ministry of Local Government (MoLG): implementing and supporting Joint Service Councils (JSCs) and local governmental units (LGUs).

Under the 1996 Law, Palestinian Water Authority (PWA) was performing a variety of functions, namely political and strategic (ministerial), regulatory, bulk utility operations, and project management services. The combination of functionality was causing PWA to engage in a crisis management process which in turn has impacted its ability to perform and deliver its mandated service. This is the reason why in-depth water sector reform was implemented during the last ten years, which were outlined in the, a new water law that was approved by the cabinet in 2014. The institutional structure of Palestine's water sector is outlined in the 2014 water law. (Palestinian Water Authority 2023)

- PWA is endowed with all ministerial functions (policy and strategy)
- A new body will be implemented with regulatory functions (the Water Sector Regulatory Council – WSRC)
- The existing bulk water supplier in West Bank (West Bank Water Department – WBWD) will be transformed into an independent national utility (the National Water Company) servicing West Bank and the Gaza Strip
- The municipal water departments or sections will be aggregated into regional water utilities (RWUs)

3. Objective of this paper: This paper proposes an analytical paradigm for IWRM under high using Palestine as a case study

4. Methodology

This paper adopts a multidimensional methodology that combines quantitative and qualitative approaches, utilizing multiple tools, including analytical instruments in foresight studies. The researcher conducted interviews with eighteen specialists, three from each of the following

Main factors of Uncertainties

Component

Social	Poverty	Unemployment	Gender	History of water Governance	of social Powers Impact				Total
	3	2	4	3	4				20
Economic	Gini Index	International aid	Agricultural Profitability	Water Cost	Affordability				
	3	4	4	2	2				15
Enabling Environment	Institutional arrangement	Israeli Control	National Water Policy	Legal Framework	Availability	Accessibility	New Technology		
	3	5	3	4	4	4	4		27

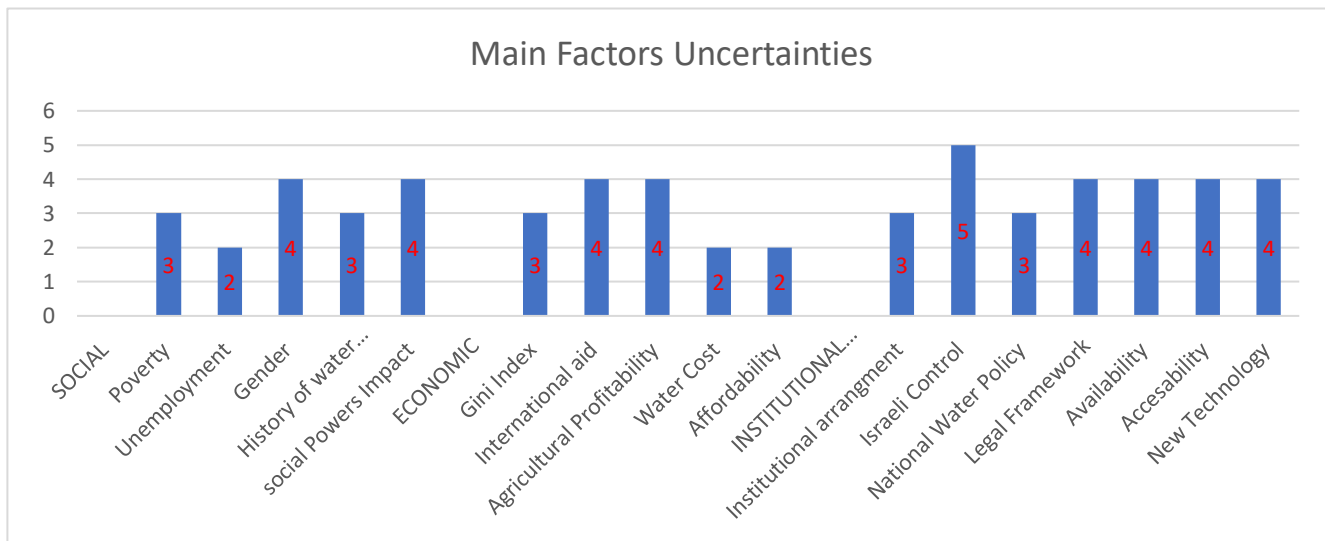


Figure 1. Uncertainties main factors.

fields: technology, water management, sociology, and the environment. Foresight); two rounds of Delphi to lessen prejudice

The questions were designed to address water management comprehensively, especially considering its various dimensions under rapidly changing social, economic, political, and technological and enabling environmental conditions (as in the Palestinian case). The researcher utilized various appropriate research techniques for foresight studies, including the **Delphi** method (The **Delphi Technique** is a structured communication method used to gather opinions and achieve consensus among a group of experts. It is especially useful when the subject matter is complex, uncertain, or lacks clear data. The technique is

commonly used in forecasting, policy-making, and decision-making processes. A questionnaire was distributed to experts in economics, social studies, environment, politics, and technology. The questionnaire was distributed once before the study began to identify the indicators and a second time to assign weights to the indicators.

5Ts framework, **cross impact matrix**. Abdelhay 2007 and in the Delphi methodology, experts were consulted twice to minimize bias and verify the consistency of answers. Additionally, the researcher examined experts' responses from other specialties to utilize this technique for validation. **18** indicators were used in other techniques (**6** social, **5** economic, **7**

1. Cross-Impact Matrix (CIM)

Item	Influential factors	Affected factors	Item	Influential factors	Affected factors
Poverty	-28	-12	Gini Index		
Unemployment	-40	-5	International Aid (water sector)	37	-1
Culture	-19	1	agriculture profitability	10	-6
Gender	-18	-3	water cost/price	-11	1
History of Water Governance	5	10	affordability	-10	0
Social Powers	-13	1	institutional arrangement	-8	1
National water policy	-8	-3	Legal arrangement	4	-1
Availability	15	-1	Accessibility	8	0
New technology for desalination and treatment of waste water	40	-3			

technological and enabling environmental in addition to 25 sub-indicators).

Through these utilized techniques, it was revealed that there are 10 indicators falling under the category of uncertainties economic, social, and external environmental conditions, accounting for 56% of the total factors.

5. Analysis and Results

Water management under uncertainties is a critical and challenging task, especially in the face of climate change, population growth, and increasing demands for water resources. Uncertainties in water management can arise from various sources, including climate variability, changing precipitation patterns, population growth, economic fluctuations, and technological developments. Below are the results of nontraditional approach using different analytical tools to analyze the main drivers and sub drivers

A.Uncertainties main drivers) Delphi technique

As shown in Figure (1), It is evident that uncertainty factors make up 56% of all factors, indicating that

uncertainty is a high percentage that makes the sustainable management of water resources extremely complex to the intensity of change. The enabling environment (internal and external) is the primary cause of uncertainty, followed by social factors, with economic factors having the least impact.

The most important factor in the environmental factors is Israeli control (highest scope) The most important factor economically is the social forces and local culture The most important factor in economic factors is international aid and the economic feasibility of the agricultural sector As shown in the table (1) The application of the cross impact matrix (**Cross-impact analysis is defined** as a fundamental analytical technique used to evaluate the interdependencies between different variables or scenarios). (Enayat Allah ,2020) shows significantly the two most important influential factors are international aid and technology, and this comes in line with reality, as the development of water services and sources depends on external foreign financing, as well as the issue of technology is consistent with the plan of the National Authority in solving the problem of water shortage in the water sector is desalination, as shown in the table 1. the most important factor affected is water governance and management, and this is very logical, as Israel's control

5Ts method uncertainties scores								
	Political	Social	Economic	Environmental (climate change0)	Technological	Legal	Total	uncertinities and risk degree
Trend		-5	-3	2	-3	4	-4	-9 low
Tensions		-5	-2	-3	-4	4	4	-6 very low
Transitional		-3	-3	-3	-3	-3	-3	-18 high
Today (present sitution)		-4	-4	-4	-4	-4	-4	-24 very high
Tomorrow(Future)		-3	-3	-3	-3	-3	-3	-18 high
Trend		-9						very low
Tensions		-6						very low
Transitional		-18						high
Today (present sitution)		-24						very high
Tomorrow(Future)		-18						high

Category	Score	Risk Degree
Trend	-9	very low
Tensions	-6	very low
Transitional	-18	high
Today (present situation)	-24	very high
Tomorrow (Future)	-18	high

Table 2. 5Ts Frame work includes.

over water does not enable the Palestinian Authority to establish good governance, as well as technology. It needs very important governance.

6. 5Ts Framwork (It appeared that the degree of uncertainty is **high and very high** for several reasons, the most important of which are lack of control over resources, population and urban growth, climate change and mismanagement.

The negative signs in the current situation are very bad and this is reflected in the future if the challenges mentioned in the previous analysis are not dealt with.

Conclusion

In light of the increase in the number and weight of uncertainty factors, it suggests that the possibility of achieving integrated management is very difficult, and that the precondition for mitigating the effects of these factors must be the application of structural policies and nontraditional water management and governance paradigm in the water sector.

1. It has been shown that there is high population growth, a need for food, climate change, and conflicts in the region, which leads to an increasing demand. This requires the adoption of unconventional water sources such as seawater desalination or the use of treated wastewater in agriculture and other areas.

2. In dry agricultural countries, ways to adapt to climate change must take into account both the lack of water and the realities of the economy and society. Some

of the most important strategies are using efficient irrigation systems (like drip systems), collecting rainwater, reusing water, and growing crops that can survive dry spells. These solutions need to be cheap and easy for small-scale farmers to get, involve the community, and include training and education on how to manage water. For fair water distribution and infrastructure, institutions need to help. Putting these approaches first helps protect people's jobs, make sure everyone has enough food, and make sure that the most vulnerable people can adapt to climate change.

3. Addressing external control over water resources is identified as a critical enabling It is evident from the above that international financial support is an important factor, and therefore it is necessary to utilize this support and the willingness of wealthy countries to assist in the development of unconventional water sources.

4.

5. In dry agricultural areas, ways to adapt to climate change must take into account both the lack of water and the realities of the economy and society. Some of the most important techniques are using effective irrigation systems (such drip systems), collecting rainfall, reusing water, and growing crops that can survive dry spells. These solutions need to be cheap and easy for small-scale farmers to get, engage the community, and include training and instruction on how to manage water. For fair water distribution and infrastructure, institutions need to

help. Putting these techniques first helps protect people's jobs, make sure everyone has enough food, and make sure that the most vulnerable people can adapt to climate change.

6.

7. International agreement

Collaborative Agreements: Regional and international cooperation is very important in addressing environmental, water-related, and political issues, especially those related to shared water resources. This requires political stability and cooperation so that everyone benefits in facing crises, as conflict will not bring more water. On the contrary, cooperation is what enables countries to solve their problems collectively.

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- **Information Exchange:** Share data, knowledge, and best practices internationally to learn from others' experiences and enhance local strategies.

9. Climate resilience

- **Resilient Infrastructure** Improving resilient infrastructure in dry countries involves building and upgrading systems (like water supply, energy, transportation, and housing) to withstand droughts, heatwaves, and sandstorms. This includes using drought-resistant materials, developing efficient water management and storage, incorporating early warning systems, and designing structures to endure extreme heat and scarce water conditions. Investing in such infrastructure helps protect communities, reduces economic losses, and ensures essential services remain functional during extreme weather events.

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