PATHWAYS FOR IMPROVING WATER MANAGEMENT IN WESTERN ALGERIA: A MULTI-STAKEHOLDER ANALYSIS

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ABSTRACT

The aim of this study is to assess the relationships between the main stakeholders involved in water management in Sidi Bel Abbes city (western Algeria) to establish pathways for good governance, fair allocation and sustainability of water resources. A multi-stakeholder analysis was performed using the MACTOR method (method of actors and power relations) to analyze stakeholder strategies, alliances, and potential conflicts regarding water management. Data for the study were collected mainly during multi-stakeholder workshops with 6 main stakeholders who are directly involved in managing potable water. A field survey of 329 local households was conducted with the use of supplementary questionnaires. This study proposes that the power dynamics among actors should be considered during the decision-making process to improve collaborative interactions and the effectiveness of stakeholders engaged in water management. The research findings show that the stakeholder's roles and strategies should be coordinated and strengthened to ensure equitable allocation of water. Technical public agencies deploy management strategies that do not consider water quality as a priority, and they are more concerned with other strategic objectives. Additionally, the stakeholders disagree on many issues relating to water management due to overlapping and conflicting powers, which threatens the quality and availability of water resources. The study also demonstrated that the National Sanitation Office could play an important role as a relay stakeholder and that the Hydrographic Basins Agency should strengthen alliances and commitments with all stakeholders. Enhancing the participation of these stakeholders in water management procedures and empowering domestic water end users, particularly in densely populated residential areas, could help bridge divides and foster a unified approach to achieving sustainable water management objectives.

Keywords: MACTOR method, stakeholder analysis, water management, western Algeria

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INTRODUCTION

The management of water resources in developing countries is a major political, economic, and social priority that governments and international institutions have placed high on the 21st century political agenda (Sowers et al., 2011). This management primarily involves allocating these scarce and fragile water resources sustainably, in the context of socioeconomic and climatic changes.

Northwestern Algeria, situated within the semi-arid regions of the Mediterranean area, comprises four major basins: the Tafna River, Sebkha salt lake of Oran, Macta Basin River, and Chellif Basin river. In this region, there is an abundance of water resources, including surface water, cold groundwater, and hydrothermal water, which have traditionally served as the primary sources of water consumption (Zemour et al., 2023). However, these resources are currently encountering challenges due to increasing demand and overuse, leading to the depletion of large groundwater reservoirs (Famiglietti, 2014). Despite the presence of these natural resources, water scarcity is a significant issue in Algeria. This scarcity is primarily attributed to recurrent droughts and the mismanagement of water resources, exacerbated by factors such as a substantial population growth, improved living conditions, urban and industrial development, and more (Kherbache, 2020). This phenomenon has adverse effects on meeting water requirements and allocating water for various purposes (Hamiche et al., 2015).

The Algerian government has made undeniable efforts to mobilize and distribute water, through implementing various projects like dam, network, and purification station construction, in order to provide domestic, industrial, and agricultural water. However, water problems persist, mainly due to issues with legislative procedures like laws and users' rights, problematic organization and collaboration between involved water management actors, and challenges with social acceptance (Hamiche et al., 2015; Hamlat et al., 2013).

Sidi Bel Abbas city is considered one of the Algerian regions that are part of a natural area endowed with the rarest and most fragile water resources. The drinking water supply in this city suffers from a permanent deficit and an unfair allocation between the user sectors (Otmane et al., 2021). The lack of adequate institutional arrangements for water management results in challenges related to collaboration among stakeholders involved. This issue contributes to the overexploitation of the limited water resource (Kherbache & Molle, 2023) and disproportionately affects certain users, particularly privileged social groups.

To effectively implement sustainable water management, meet all user sector needs, and conserve these limited resources, it is crucial to gain a deeper understanding of allocation systems, interconnections among public institutions, non-governmental organizations, and users, as well as the distribution and exercise of governance powers. This understanding will enable informed decision-making and improve overall water resource governance. Governance here refers broadly to the rules, regulations, institutions, and processes that determine natural resource use through stakeholder interactions (Clement et al., 2020; OCDE, 2012). While numerous studies have examined organizations and regulations in relation to water management, with a focus on actor's behavior and institutional arrangements, less emphasis has been placed on understanding the influential power dynamics of these actors. However, it is crucial to recognize that actor's power forces play a pivotal role in facilitating the functioning and effectiveness of organizations involved in water management (Fetoui et al., 2021).

This study asserts that to achieve effective, collaborative action between water management stakeholders, it is vital to consider the power dynamics among actors during decision-making processes. Successful collaborative implementation relies on thoroughly understanding the relationships between institutions and organizations, as well as how governance powers are distributed within management processes (Fetoui et al., 2020).

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The purpose of this study is to gain insights into the representation of stakeholders from various decision levels and sectors, identifying key actors, determining their level of influence, and examining power dynamics between dominant and subordinate entities. Furthermore, the study aims to explore the potential convergence or divergence of objectives concerning water resources (Godet, 1991; Lienert et al., 2013). The aim is to collect data on the positions, interests, influence, interrelationships, networks, and other attributes of these stakeholders, as this information is highly relevant for studying water management. A comprehensive understanding of stakeholder relationships is especially important for analyzing water governance, particularly in the early stages of decision-making processes (Hermans &Thissen, 2009).

This research paper aims to identify potential options and pathways for enhancing water governance in Sidi Bel Abbes city, with a specific focus on the roles of institutions and governance. It utilizes a stakeholder analysis approach to assess and understand the relationships between key water management stakeholders, along with their management strategies. The goal is to establish strategic recommendations for good governance and equitable water distribution between user sectors

Stakeholder analysis is applied in order to assess these relationships, using the MACTOR method (Godet, 1991). The selection of this methodology is rooted in the understanding that employing social research to evaluate the relationships and interactions among governance structures and actors can offer valuable insights into sustainable water management (Giordano et al., 2004; Ingold, 2011). This methodology can be characterized as a comprehensive strategy for comprehending the intricacies of a system and its transformations. It involves the identification of pivotal stakeholders, evaluating their specific interests within the system, examining conflicts and social perspectives, and proposing opportunities for collaboration and synergy (Fetoui et al., 2021). By adopting this holistic approach, a more profound comprehension of the system and its dynamics can be attained, enabling effective decision-making and fostering harmonious interactions among stakeholders in the domain of water management.

METHODS

Case Study

The study was conducted in Sidi Bel Abbes city, located in northwest Algeria. The city is situated in the center of a vast undulating plain with an average altitude of 500 m. It is bordered by the mountains of Tessala to the north, and the mountains of Daya to the south. Sidi Bel Abbes is mainly located in the Macta watershed, which covers an area of 9,150 km2. The city has a population of 212,935 inhabitants (National Bureau of Statistics, 2008). It is located within the Oued Mekkera hydrographic basin, which belongs to the Macta Basin. It is contains 15 administrative districts (daira) and 52 communes (Fig. 1). Sidi Bel Abbes belongs to the semi-arid bioclimatic zone. The average annual rainfall in the region is 400 mm per year. Rainfall is low and has an uneven seasonal distribution, often resulting in a regional water deficit. The region suffers from water management and allocation challenges for drinking, services, industries, etc. This is due to climatic factors, urban expansion, and population increase (Benblidia & Thivet, 2010). The city depends on a water quota system to cover all districts. The water allocation system has two main groups. The first group has good quality distribution networks. It serves the city center and Sidi Al-Jilali districts, which are family housing areas. This group serves 109,031 people, which is 45% of Sidi Bel Abbes' total population. These people have 24 hour water supply. The second group represents the most populated single family housing areas. 133,261 people live in this group. They only get an average water supply of 14 hours per day (Benblidia & Thivet, 2010).

When it comes to agricultural potential, this city serves as a hub for wine cultivation. The industrial sector primarily concentrates on the production of agricultural machinery, electrical equipment, hoes, and dairy products. The irrigated agriculture in this area accounts for 30 Mm3 (33%) of the total water
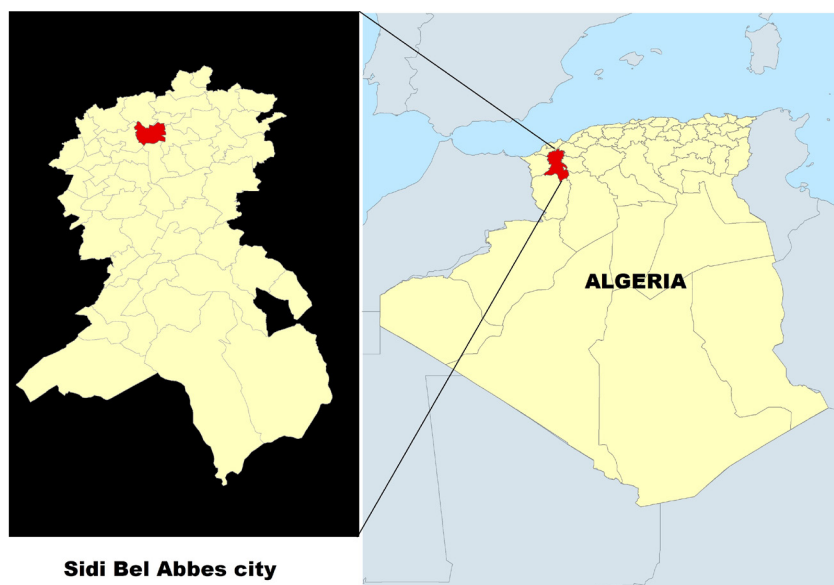
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Fig. 1. Localization of the city of Sidi Bel Abbas (Northwest of Algeria)

usage, as reported by the Directorate of Agricultural Services in Sidi Bel Abbes in 2017. Notably, one aquifer, namely the SBA aquifer, is currently overexploited due to the heavy demand from the agricultural sector.

Implementation of MACTOR analysis

In this study, the MACTOR method was employed as an integrated approach to thoroughly analyze and gain a profound understanding of stakeholders' networks, perceptions, and values. This method illuminates the nature of their relationships, identifies potential alliances, and conflicts while also examining their influence on local water governance and management. Through the utilization of the MACTOR method, a comprehensive evaluation of stakeholder dynamics is conducted, offering valuable insights into strategies aimed at improving water governance and effectively addressing potential challenges.

MACTOR is a stakeholder analysis method that employs a "matrix of alliances, conflicts, tactics, and objectives" to scrutinize interactions among various actors. This approach facilitates the analysis of actors' strategies and the assessment of power dynamics between them, while also delving into their

agreements and disagreements concerning specific stakes and objectives (Elmsalmi & Hachicha, 2014; Godet, 1991). The utilization of MACTOR provides a comprehensive understanding of stakeholder dynamics, allowing for an in-depth examination of their relationships and objectives within the context of the study. MACTOR employs qualitative variables to assess the level of influence and dependency of each stakeholder in decision-making processes involving the other stakeholders. In this research, MACTOR is applied in the following two steps:

1. The process begins with the mapping of key stakeholders involved in water management within Sidi Bel Abbes city, with an emphasis on presenting their individual missions, strategies, and objectives. Through surveys and interviews conducted with these stakeholders, two primary matrices are constructed;

a. The first matrix, referred to as the "MIDI matrix" (Matrix of direct and indirect influences) or the stakeholder/stakeholder matrix, categorizes stakeholders into five levels of relationships based on their degree of influence or dependency: The stakeholder has no impact on "stakeholder x" (assigned a score of 0);

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– The stakeholder has the ability to negatively affect the management processes of stakeholder x to some degree in terms of time and space (assigned a score of 1);
– The stakeholder has the ability to significantly undermine the success of projects undertaken by stakeholder x (assigned a score of 2);
– The stakeholder has the ability to prevent stakeholder x from fulfilling their mission (a score of 3);
– The stakeholder has the ability to significantly jeopardize the existence of stakeholder x or is vital for their existence (assigned a score of 4);

b. The second matrix is known as the "MAO Matrix" ("Matrix of Actors/Objectives") or the stakeholder/objective matrix. In this matrix, the attitudes of each actor towards a specific water management objective are represented, indicating their level of agreement (+1), disagreement (-1), or neutrality (0) towards that objective. Additionally, the matrix also indicates the importance of each objective.

2. The second step concerns the analysis of stakeholders relationships with MACTOR. The main outputs generated are:

a. The "influences and dependencies plan" depicts the positioning of stakeholders based on their direct influences and dependencies on each other. This plan is developed using the MIDI matrix, which identifies the levels of relationships among stakeholders. The stakeholders' positions are plotted in a two-dimensional graph with two axes representing influence (I) versus dependence (D). This visual representation helps to understand the relative influence and dependence among stakeholders in the context of water management. The plotted graph highlights the dominant stakeholder (s) and provides insights into four distinct position types: dominant stakeholders (having significant influence and low dependence), dominated stakeholders (having limited influence and high dependence), intermediate or relay stakeholders (exhibiting both influence and dependence), and autonomous stakeholders (neither influential nor dependent) (Elmsalmi & Hachicha, 2014; Godet, 1991). This analysis helps identify the power dynamics and interdependencies among stakeholders involved in water management;

b. Based on the MIDI matrix, the MACTOR method can also generate a "balance of power" indicator (R) that reflects the relative strength of each stakeholder. An aspect that could be the subject of a more comprehensive analysis of water policy in Algeria. This indicator takes into account direct influences and dependencies, as well as indirect influences that a stakeholder i has on a stakeholder j through a relay stakeholder called feedback. The value of R indicates the stakeholder's position in terms of decision-making power. A stakeholder with an R>1 has a strong influence on others. A high balance of power value suggests that a stakeholder holds a strong position, characterized by high influence and weak dependence and feedback (Godet & Durance, 2011). This indicator provides insights into the power dynamics among stakeholders involved in water management;

c. The "correspondence map of stakeholders/objectives" portrays the strategic stakes, goals, and positions of each stakeholder in relation to water management objectives. This map is constructed using the "MAO Matrix" and enables the visualization of stakeholder groups with shared interests. It facilitates the assessment of their apparent independence, identification of stakeholders potentially threatened by others, and analysis of the overall social system's stability. This method offers valuable insights into stakeholder dynamics, interdependencies, and potential conflicts, contributing to a comprehensive understanding of the water management context.

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Collecting and analyzing field data

First, the data were collected from the literature (water resource potentials, resource users and allocation, and population density at the study site). Field data were gathered through.

Targeted surveys with 329 households selected based on two stratification levels. First, the selected samples belonged to the 15 administrative units. Second, samples were based on the potable water allocation system typology previously carried out in the region (Benblidia & Thivet, 2010), where two main beneficiaries are identified (family groups and single-family housing), in addition to the industrial sector. The process of identifying the surveyed beneficiaries was carried out in collaboration with community leaders and technical services. The research team conducted interviews with the beneficiaries between May and November 2017.

Multi-stakeholder workshops involve the participation of six primary stakeholders directly engaged in the management of potable water. These stakeholders include a representative from ADE (Algerian Water Company), DRE (Water Resources Department), ABH (Hydrographic Basin Agency), and ONA (The National Sanitation Office). Additionally, the workshops include the active involvement of 20 household representatives from both family groups and single-family housing.

The surveys and workshops had several objectives:
1. To engage in discussions regarding the challenges and issues faced by the city in terms of water resources.
2. To identify the objectives that stakeholders aim to achieve concerning water improvement.
3. To provide an explanation and gain approval for the methodological framework of stakeholder analysis.
4. To implement and analyze the extent of cooperation in joint water management initiatives.
5. To assess stakeholders' strategies and interactions, with scores recorded to indicate the level of influence and dependence between them.

A script (two empty matrixes) is used to record this scoring. This assessment allows us to identify two main entry data to MACTOR: the matrix of "stakeholder/stakeholder" influences and dependencies, and the matrix of "stakeholders/objectives".

A scoring system is used to assess the relationships between stakeholders. This assessment identifies two main types of data that are needed to use the MACTOR tool, they are:
1. The matrix of "stakeholder/stakeholder" influences and dependencies, which shows how each stakeholder can influence or be influenced by other stakeholders.
2. The matrix of "stakeholders/objectives", which shows the objectives of each stakeholder.

RESULTS

Stakeholders' map, challenges, and objectives

The focused surveys with key stakeholders aimed to identify issues and challenges in Sidi Bel Abbes' water management. They also characterized the roles and strategies of each stakeholder regarding these issues. The main recorded challenges are drought, water scarcity, resource degradation, overuse, and allocation and management problems. Further challenges come from the significant costs to install and maintain water infrastructure. Other issues are inadequate monitoring, shortcomings executing development projects, and a lack of technical and managerial expertise among local staff.

The interviews also defined the roles and strategies of involved stakeholders in water management. These include urban water management (supply, transportation, distribution, marketing, network maintenance) by the Algerian Water (ADE). They also include infrastructure development to mobilize water resources (surface, groundwater, unconventional) by the Water Resources Directorate (DRE). Other roles are water resource management in natural hydrographic units by the Hydrographic Basins Agency (ABH). And managing the urban sewage network (operating, maintaining, renovating facilities) is done by the National Sanitation Office (ONA). The end users are represented by family housing groups (MHC) and single-family housing (MHI).

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They are key actors that must be considered in water programs, based on their needs and consumption.

The analyses identified six main water management objectives regarding the specific challenges: Urban drinking water allocation (O1-GEPV) etc. These objectives represent the main missions and principles of national water policy, as outlined in Law 05-12 on water.

Relationships, influences, and dependencies among stakeholders (MACTOR results)

The analysis of relationships and mutual influences among the identified stakeholders (Fig. 2) shows that the ADE and ABH are the most influential stakeholder groups in the drinking water allocation system. They exert significant influence on other stakeholders for decision-making related to water management and access, while they are less susceptible to external influences. The analysis also shows DRE and MHC are dominated and especially influenced by and dependent on ADE and ABH.

This is despite DRE's important role managing the Ministry's programs and implementing water projects and allocation. ONA is considered a relay between the dominant and dominated stakeholders. Finally, MHI (residents of collective housing) are neither influential nor dependent (autonomous) regarding water management at the study site.

According to the findings, in terms of influence in the water management decision process, and water governance, the ADE stakeholder has a higher R score ("balance of power" indicator that reflects the relative strength of each stakeholder) compared to other stakeholders, indicating that it is considered the most powerful (Fig. 3). This result confirms Algeria's and ABH's dominance in water management decision processes. The relay stakeholder (ONA) also has a strong influence on water management processes and governance because it has an R>1, so it could play an important role. The DRE, despite its high dependency, has a favourable balance of power. This analysis finally confirms that MHC and MHI have a weak influence, especially MHC, which is completely dominant and has a weak R score.
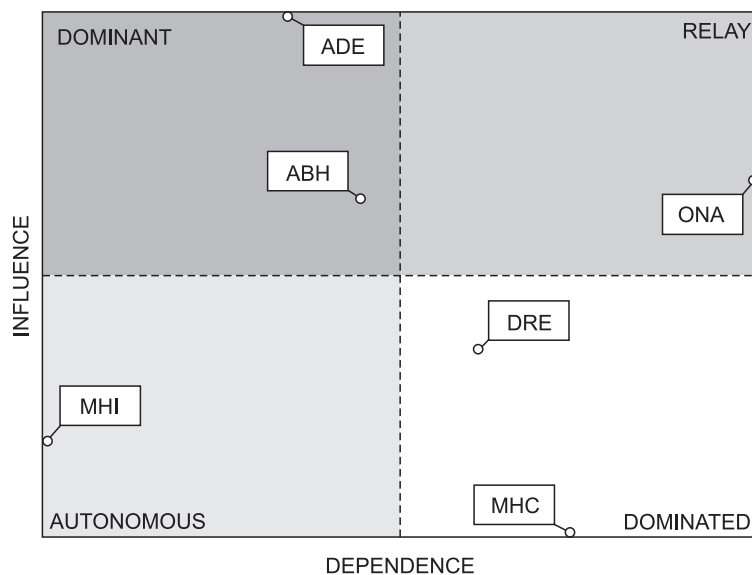
Fig. 2. Influences plan and dependencies between the main stakeholders involved in water management in Sidi Bel Abbes city
Source: own elaboration based on MACTOR analysis (2021).

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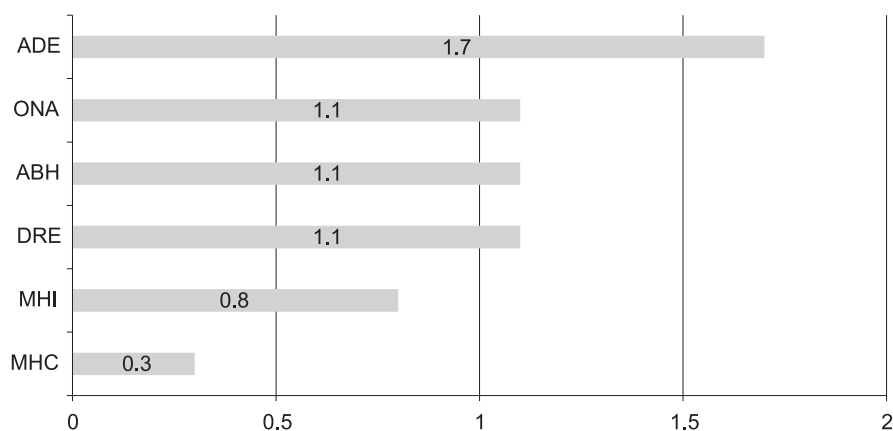
Fig. 3. Histogram of power relations of the main stakeholders involved in water management in Sidi Bel Abbes city
Source: own elaboration based on MACTOR analysis (2021).

The following analyzes potential alliances and conflicts between these stakeholders toward the expected water management objectives in Sidi Bel Abbes city. Their relationships or power relations can support achieving these objectives.

## Relationships and tensions among stakeholders concerning objectives and strategies in water management

The "correspondence map of stakeholders/objectives" (Fig. 4) reveals possible alliances and conflicts among stakeholders concerning water management objectives. The map shows a close proximity between most stakeholders and objectives, indicating they are aligned on the horizontal and vertical axes (Elmsalmi & Hachicha, 2014).

Additionally, the map provides an alternative perspective on relationships regarding specific objectives. It reveals potential alliances and conflicts regarding water management processes and procedures related to these objectives. Assessing the levels of convergence or divergence among stakeholders on the same objectives allows identifying where there is high consensus. It also reveals which stakeholders play a significant role in achieving or not achieving the objectives (Fetoui et al., 2020).

Figure 4 shows that the most involved stakeholders in water management are DRE and MHC, which are concerned with three objectives. The DRE is involved in the achievement of the urban allocation of drinking water (O1-GEPV), the development of storage infrastructure and water mobilization (O2-DIMSE), and the availability of drinking water (O5-DISEP). Family group housing (MHC) is concerned with the development of storage infrastructure and water mobilization (O2-DIMSE), and the availability and quality of drinking water (respectivelyO5-DISEP and O6-QUAEP). Despite being involved, MHC faces complete domination and possesses an unfavorable balance of power in achieving these three objectives.

Besides, the ADE is more concerned by the achievement of the urban allocation of drinking water (O1-GEPV) and is not effectively involved in achieving the other objectives, although it's a favorable balance of power. The ONA and ABH also have strong influences on water management processes (taking on account the direct and indirect influences and dependencies and the power forces), but they are not effectively involved to achieve the objectives of sanitation network management (O4-GREAS) and water management in natural hydrographic units (O3-GEUHN), respectively. The drinking water quality (O6-QUAEP) is required only by single-family housing (MHI), and this confirms its actual

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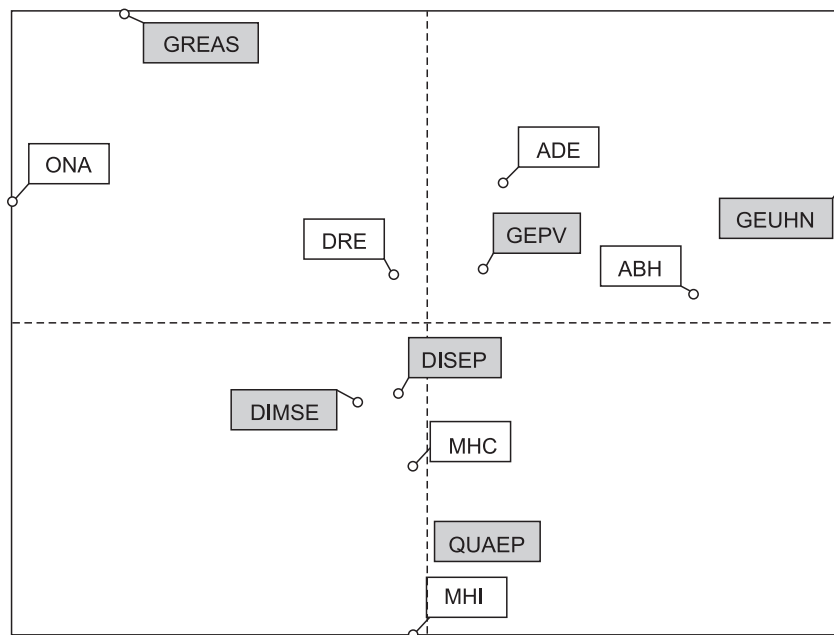
Fig. 4. Correspondence map of stakeholders/objectives for the case of water management in Sidi Bel Abbes city
Source: own elaboration based on MACTOR analysis (2021).

bad quality. The problem of water availability for MHI will persist if there is no cooperation with other stakeholders.

Urban drinking water allocation (O1-GEPV) has the highest consensus, agreed on by three stakeholders (ADE, DRE, and ABH). The most contentious objectives are sanitation network management (O4-GREAS), water management in natural hydrographic units (O3-GEUHN), and drinking water quality (O6-QUAEP).

DISCUSSION

Water resource sustainability in the Sidi Bel Abbes region requires a rational water policy relying on coordination between stakeholders. This work clarifies relationships between these stakeholders, suggesting potential alliances and cooperation. This is critical for successful water allocation projects and sustainable management strategies.

Most water resource management and allocation projects in Sidi Bel Abbes city are coordinated by ADE, ONA, and DRE – the most dominant stakeholders. Achieving objectives and project success depends on better involvement from these stakeholders. For example, DRE's strong power could enhance its influence and role in water management decisions. Given its favorable power balance, ONA has potential to strengthen its role as a regulating entity. This could facilitate communication and bridge gaps between other stakeholders. However, the challenge lies in achieving independence and fostering effective dialogue between ONA and other dominant stakeholders. To improve water allocation management, we propose enhancing the involvement of ONA in advocating for the interests and needs of all users and mediating conflicts. In fact, existing conflicts mainly concern the complication of the financial situation. This is related to network shutdowns when defects occur. It also relates to when the volume of wastewater exceeds the plant's capacity. The wastewater then flows directly into the Mekerra valley. This contributes to direct water pollution. It also creates conflicts and various pressures between stakeholders. Additionally, there are other contributing factors.

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The realization of project objectives and the overall success of these initiatives hinge significantly on the extent of collaboration and the improvement of relationships with other influential stakeholders. For instance, the effectiveness of these projects requires strengthening the influence of MHC and MHI (consumers). Although these stakeholders benefit from well-functioning distribution networks, they remain heavily reliant on ABH, which oversees water resource management within natural hydrographic units and assumes a pivotal role in water governance by considering both direct and indirect influences and dependencies with other stakeholders. Additionally, they depend on ADE for water supply, transportation, and distribution. This implies that these consumers, despite their vested interest, have limited control over both the quantity (availability) and quality of water. They possess minimal influence in the formulation of water management strategies and lack the ability to partake in decisions regarding water allocation. Additionally, their dependency is influenced by socioeconomic, political, and environmental factors.

To achieve stability and effectiveness in water management within the study area, it is imperative for the limitations associated with the influence of these stakeholders to either diminish or become more prominent. Therefore, measures should be taken to bolster their role, inclusiveness, and contribution to water management processes. This is essential for addressing the issue of imbalanced water distribution.

Fetoui et al. (2021), in their study on enhancing rangeland governance in Tunisian arid zones, confirm that the achievement of the objectives and success of rangeland management depend on the level of cooperation and improvement of relations between dominant stakeholders. A strategy development process was also recently undertaken, respectively, in South Khorasan (Iran) and Vojvodina Province (Serbia), based on the inclusion of all stakeholders in the water allocation strategy (Nasrabadi & Shamsai, 2014; Srdjevic & Srdjevic, 2013).

Flexibility in administrative processes is paramount to facilitate the meaningful engagement of both influential and less influential stakeholders.

Successful water governance demands accountability and transparency from all parties involved. As highlighted by Fetoui et al. (2021), effective coordinated management in public policy is contingent not only on organizational aspects but also on the establishment of legitimacy. Reliable transparency and coordination among stakeholders play a pivotal role in empowering various coalitions to attain their goals.

The findings of the study also also contribute to the categorization of objectives that can be subject to collective negotiation during the formation of alliances or close monitoring in cases of conflict. This categorization allows stakeholders to prioritize and collaboratively address crucial objectives or take necessary actions to manage conflicts effectively. It paves the way for the development of strategic recommendations and the identification of key challenges in achieving effective and equitable water management. Given that effective water sector management is the ultimate goal shared by all stakeholders, this study has enabled an analysis of each stakeholder's role in attaining this objective. The results highlight the quality of interconnections between all stakeholders, particularly ADE, DRE, and ABH, in ensuring the fulfillment of water supply objectives for end users.

The analysis also reveals that MHI faces no issues regarding water availability because some residents own licensed or unlicensed wells, which can serve as an ideal solution in case of interruptions and fluctuations in water distribution. Therefore, MHI's primary focus is on ensuring water quality. However, the identification of a stakeholder with limited influence can present challenges that may impact the sustainability of the water management process.

It is concerning to note that technical public agencies like ABH and ONA may prioritize specific aspects, such as water quantity, while potentially neglecting the critical element of water quality. This imbalance in priorities could have repercussions on overall water management and the attainment of sustainable outcomes. In fact, there is a disagreement in the goals for the water management process due to overlapping and conflicting powers between ONA

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and ABH, leading to differing concerns and weak alliances in achieving certain objectives. This situation poses a threat to the quality and availability of water resources.

As a result, the availability and quality of drinking water emerge as the primary concerns for end users, and any management approach that fails to address these objectives is unlikely to be successful. Therefore, it is imperative for all stakeholders to contribute to the achievement of these objectives, and the significant influence of ADE can play a pivotal role in facilitating this accomplishment. It could collaborate with ONA to consider and prioritize quality and availability in local water management projects. Furthermore, the convergence between ADE and DRE could be very beneficial for sustainable water management. This is explained by their strong cooperation in the process of preparing and improving water distribution programs. The efficacy of this collaboration could be further strengthened through the active engagement of ABH, ensuring the alignment of its objectives, which encompass identifying, assessing, sourcing, and distributing water, with those of ADE and DRE.

Other investigations have yielded comparable outcomes in strengthening multi-stakeholder collaborations in water management, for example the study of Pluchinotta et al. (2018). This study highlights the growing emphasis on promoting effective stakeholder cooperation to facilitate the decision-making process in water management. Du et al. (2019) conducted a study to examine the environmental awareness and preferences of multiple stakeholders regarding the adoption of best management practices (BMPs) in water conservation zones in northern China, aiming to address non-point source pollution challenges. In another study by Mirzaei et al. (2019), the authors aimed to identify and evaluate policy instruments that could enhance water reservoir governance. These policy instruments were classified into three interconnected dimensions of water governance: effectiveness, efficiency, and trust and engagement.

Several states in Algeria have implemented various management systems by incorporating new companies responsible for water allocation and sanitation, such as the Water and Sanitation Companies (SEOR, SEAAL, and SEACO) located in Oran, Algiers, and Constantine, respectively. In these urban areas, recent years have witnessed a notable improvement in water management, even in the face of occasional fluctuations and interruptions in water supply. This progress can be attributed to the effective coordination among all stakeholders, leading to positive outcomes and the delivery of high-quality water to many areas on a 24-hour basis.

A public-private partnership for water management in Sidi Bel Abbes city could present a viable solution. In such a partnership, either the public or private sector could undertake activities like drilling boreholes for agricultural and industrial purposes, establishing seawater desalination units, developing infrastructure for utilizing purified wastewater in irrigation, and connecting to water supply systems to guarantee self-sufficiency in communal and industrial areas. Margerum and Robinson (2015) conducted a study on the diverse requirements of public-private partnerships that rely on cooperation and coordination. They also examined the various levels at which these partnerships operate, including actions, organizations, and policies.

In addition to this alternative, providing the necessary financial capabilities to provide equipment for water exploitation and diversion from neighboring areas is also an important point that must be considered in the rehabilitation of the distribution network for Sidi Bel Abbes city. The increased daily consumption in the city also requires finding solutions that guarantee the creation of new water resources. These programs for mobilizing available water resources (groundwater and surface water) or diverting water from other governorates (Tlemcen, Camp, and Al-Bayadh) require great efforts and collective action at each stage of the process to fill the gap and ensure good water management.

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Houar, K., Fetoui, M., Bellal, S. A. (2024). Pathways for improving water management in western Algeria: a multi-stakeholder analysis. Acta Sci. Pol. Administratio Locorum 23(1), 57–70.

CONCLUSION

Sidi Bel Abbas city faces the challenge of water resource scarcity resulting from irregular inter-annual and seasonal rainfall distribution, rapid demographic growth, urban development, and notably, a deficiency in coordination among the stakeholders engaged in water management. As a consequence, addressing the issues of water scarcity and management calls for collaboration and harmonization among all relevant stakeholders. This cooperation is essential to judiciously harness and equitably distribute the existing water resources, mitigating the risk of conflicts, particularly in densely populated residential areas.

The primary goal of this research was to enhance water management in Sidi Bel Abbes city by identifying key questions and strategic recommendations derived from an in-depth analysis of stakeholder relationships. The insights generated from this analysis encompassed a range of aspects, including stakeholder networks, behaviors, mutual influences, dependencies, the distribution of power, as well as shared goals and areas of conflict. This analysis opens up possibilities for stakeholders to work together and discover common ground to achieve a variety of objectives related to water availability, quality, allocation, sanitation network management, water management within natural hydrographic units, the enhancement of storage infrastructure, and water mobilization. It's important to acknowledge that these objectives may sometimes be in conflict with one another. The insights derived from this analysis shed light on how these relationships can be cultivated and reinforced to ensure participatory and sustainable management of water resources. Consequently, some actors stakeholders have the capacity to enhance their dominance or, conversely, redress the balance of power to wield greater influence in the water management process.

The results indicate the presence of conflictual relations between the Hydrographic Basins Agency and the National Sanitation Office, impacting not only water availability and quality but also the equitable distribution of water. Furthermore, the results demonstrate that the Algerian Water Administration and the Water Resources Directorate are more effective in the water management process, owing to their dominance and their ability to form alliances and reach consensus in the preparation and improvement of water distribution programs. This collaboration could be further strengthened through the active involvement of ABH in tasks related to identifying, evaluating, sourcing, and distributing water.

This underscores the pivotal role played by ONA as an intermediary stakeholder, contributing to the reinforcement of alliances and commitments with all stakeholders to achieve the established objectives of sustainable water management. Through the active engagement of these stakeholders in water management processes and by empowering end users in decision-making, it becomes feasible to bridge the gap among stakeholders and establish a collective approach towards realizing the designated objectives.

Furthermore, flexibility within the administration is crucial to ensure the active participation of both dominant and less influential stakeholders. Effective water governance necessitates accountability and transparency among all stakeholders. Trustworthy transparency and coordination among stakeholders also play a significant role in enabling various coalitions to achieve their objectives. The findings of this study ultimately aid in categorizing objectives that can be collectively negotiated during alliance building or closely monitored in cases of conflict. This categorization enables stakeholders to prioritize and collaboratively address key objectives or take necessary measures to effectively manage conflicts.

While this research primarily focuses on the local scale, it offers valuable insights into the institutional design of water management approaches specific to this locality. These insights can also be extrapolated and applied to other regions with similar or diverse contexts. Consequently, the findings have the potential to contribute to the development of effective water management strategies across various geographical areas. To enhance the study, the integration of additional

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variables related to natural aspects, demographics, and human behaviors and practices would be beneficial.

Despite the significance of stakeholder analysis using the MACTOR method in the context of water management and governance, it's essential to acknowledge that this study, and the MACTOR method itself, has some limitations, particularly concerning the collection of required input. Stakeholders are naturally hesitant to disclose their strategic objectives and the methods of their external actions.

Acknowledgements

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