

# **Gouvernance Des Ressources En Eau Et Développement Durable : Une Analyse Econométrique De l'Agence Du Bassin Hydraulique Du Bouregreg Et De La Chaouia Dans La Région De Casablanca-Settat**

## **Water Governance And Sustainable Development: An Econometric Analysis Of The Bouregreg And Chaouia Hydraulic Basin Agency In The Casablanca-Settat Region**

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**Date de soumission :** 03/05/2025

**Date d'acceptation :** 29/05/2025

**Pour citer cet article :**

Abbadi. I et Aabbassi. R (2025) «Water Governance and Sustainable Development: An Econometric Analysis of the Bouregreg and Chaouia Hydraulic Basin Agency in the Casablanca-Settat Region», Revue Internationale du chercheur «Volume 6: Numéro 2» pp : 674- 690

## Résumé

La gouvernance hydrique représente un levier stratégique pour faire face aux enjeux de gestion durable de l'eau, dans un contexte de changement climatique, de pression démographique croissante et de contraintes économiques. Fondée sur la coordination interinstitutionnelle, l'implication des acteurs locaux et la transparence des processus décisionnels, elle vise à équilibrer les dimensions environnementales, sociales et économiques du développement durable. Cette étude se propose d'analyser empiriquement le lien entre gouvernance hydrique et développement durable dans la région de Casablanca-Settat, en s'appuyant sur le cas de l'Agence du Bassin Hydraulique de Bouregreg et de la Chaouia (ABHBC). L'accent est mis sur l'élaboration et la mise en œuvre des Plans Directeurs d'Aménagement Intégré des Ressources en Eau (PDAIRE). À l'aide d'une méthode économétrique, l'étude cherche à mesurer l'impact des pratiques de gouvernance sur les indicateurs de durabilité au niveau régional, afin d'en dégager des leviers d'amélioration.

**Les mots clés :** Gouvernance hydrique, développement durable, PDAIRS, approche participative, approche économétrique

## Abstract

Water governance is a strategic lever for addressing the challenges of sustainable water resource management in a context marked by climate change, population growth, and economic pressures. It is based on principles of inter-institutional coordination, stakeholder participation, and transparency, aiming to balance the environmental, social, and economic dimensions of sustainable development. This study seeks to empirically examine the relationship between water governance and sustainable development in the Casablanca-Settat region, focusing on the Hydraulic Basin Agency of Bouregreg and Chaouia (ABHBC). Particular attention is given to the design and implementation of Integrated Water Resources Management Master Plans (PDAIRE). Using an econometric approach, the study aims to assess the extent to which governance practices influence regional sustainability indicators, with the goal of identifying actionable insights and potential areas for improvement.

**Keywords:** Water Governance, Sustainable Development, PDAIRS, participatory approach, Econometric Approach

## Introduction

In response to increasing pressures on water resources driven by urbanization, climate change, and socio-economic dynamics, sustainable water management has become a strategic priority for territories. The concept of water governance has thus emerged as both an analytical and operational framework, viewing water not merely as a technical resource to be managed, but as a common good that requires multi-actor coordination, institutional transparency, and participatory regulation. This approach aligns fully with the logic of sustainable development, aiming to balance long-term environmental, economic, and social needs. Theoretically, water governance can be considered a key lever for sustainable development, insofar as it enables better resource allocation, anticipation of usage conflicts, and integration of intergenerational equity and economic efficiency principles. While several studies have attempted to model this relationship, few have employed econometric or quantitative approaches at the regional level—precisely where the challenges of integrated water resource management are most acutely felt.

In this context, this research aims to empirically examine the relationship between water governance and sustainable development through an econometric case study of the Hydraulic Basin Agency of Bouregreg and Chaouia (ABHBC), operating in the Casablanca-Settat region. This agency, responsible for implementing the Integrated Water Resources Management Master Plans (PDAIRE), plays a key role in regional water planning. The central research question is therefore as follows: **To what extent does the mode of governance as applied by the ABHBC contribute to sustainable development in the region?**

Methodologically, this study adopts a **positivist paradigm** and follows a **deductive reasoning approach**. A **quantitative research design** is employed, relying on structured questionnaires for data collection from relevant stakeholders. To examine the relationship between water governance and sustainable development, the study uses **structural equation modeling (SEM)**, which allows for the testing of complex causal relationships between latent constructs. The remainder of this study is organized into five main sections. The **first section** lays the theoretical foundation by defining key concepts and reviewing relevant literature on water governance and sustainable development. The **second section** details the methodological framework, including the research paradigm, data collection tools, and analytical techniques. The **third section** presents the findings of the empirical analysis carried out on the ABHBC case. The **fourth section** concludes the study by summarizing key insights and finally

proposing actionable recommendations to enhance water governance practices in support of sustainable development.

## **1. Conceptual and Theoretical Approaches to Water Governance and Sustainable Development**

### **1.1. Water governance**

#### **1.1.1 Definition of Water Governance**

Water governance refers to the political, organizational, and administrative frameworks through which decisions are made regarding the development, management, and delivery of water resources and services. It includes the mechanisms by which community interests are expressed, decisions are made and implemented, and actors are held accountable for managing water resources. According to the OECD (2015), water governance encompasses the rules, processes, and structures that guide the allocation, management, and regulation of water at local, national, and international levels. Effective water governance ensures that water resources are managed sustainably, equitably, and efficiently to meet the needs of both current and future generations.

#### **1.1.2 The Four Main Dimensions of Water Governance**

Water governance is often analyzed through several interrelated dimensions, which help shape decision-making processes and outcomes. These dimensions include participatory governance, partnership governance, convergence, and transparency.

##### **- Participatory Governance**

Participatory governance is the process of involving a broad range of stakeholders in decision-making processes. This includes communities, local authorities, non-governmental organizations (NGOs), and the private sector, all of whom bring different perspectives and expertise to water management.

According to Delli Priscoli (2004), participatory governance allows for the inclusion of diverse voices, particularly marginalized groups, which ensures that water policies are more inclusive, fair, and effective. It also empowers local communities, fostering a sense of ownership and responsibility over water resources.

##### **- Partnership Governance**

Partnership governance emphasizes collaboration between different actors, particularly between state and non-state entities, in the management of water resources. This can include public-private partnerships, partnerships between governmental agencies and NGOs, and collaborations between international and local actors. According to Pahl-Wostl (2009),

partnerships are essential for addressing the complex and transboundary nature of water management, where coordination across different sectors and scales is crucial.

These partnerships promote sharing of knowledge, resources, and responsibilities, ultimately enhancing the effectiveness and sustainability of water governance systems.

#### **- Convergence**

Convergence refers to the alignment of water governance policies and practices across different levels of government (from local to global) and across sectors. It involves creating synergies between environmental, economic, and social goals and ensuring that water management practices support broader development objectives.

As noted by GWP (2017), convergence between water policies and other sectors such as agriculture, energy, and urban planning is essential to achieving integrated water resources management (IWRM), a holistic approach that considers the complex interdependencies between water and other critical resources.

#### **- Transparency**

Transparency in water governance refers to openness in decision-making processes, access to information, and accountability mechanisms that allow stakeholders to monitor and evaluate the implementation of water policies.

According to the UN Water (2018), transparent governance is crucial for ensuring that water resources are allocated equitably and sustainably. Transparency promotes trust among stakeholders, reduces corruption, and helps to hold decision-makers accountable for their actions. It also enables informed public participation, as stakeholders can engage more effectively when they have access to reliable and timely information.

### **1.1.3. Adaptive Governance and Polycentricity**

In addition to the four main dimensions of governance, water governance is also characterized by adaptive and polycentric features. Adaptive governance involves flexible, learning-based management approaches that are capable of adjusting to changing environmental conditions and new challenges. It emphasizes the need for continuous feedback and the integration of local knowledge with scientific expertise (Folke et al., 2005).

Polycentric governance, as proposed by Ostrom (2010), highlights the importance of multiple, independent centers of decision-making that can work collaboratively to manage water resources. This approach ensures that water governance is more resilient, as it can accommodate diverse needs and respond to local challenges while maintaining coordination at broader scales.

#### **1.1.4. Actors and Structures in Water Governance**

Water governance involves a variety of actors at multiple levels, from local communities to international institutions. The main actors can be categorized into three broad groups:

- **State Actors**

State actors include national governments, local authorities, and regulatory agencies responsible for formulating and enforcing water policies, allocating water rights, and managing infrastructure. State actors play a central role in ensuring that water resources are allocated efficiently and equitably, but they often require collaboration with non-state actors to address the complexities of modern water management (Conca, 2006).

- **Non-State Actors**

Non-state actors include NGOs, local communities, the private sector, and water users. These actors are critical for the successful implementation of water governance policies, as they provide expertise, resources, and local knowledge that contribute to more sustainable and inclusive water management practices. Local communities, for example, often play a crucial role in community-based water management initiatives (Bennett & Satterfield, 2015).

- **International Institutions**

International institutions such as the World Bank, UN-Water, and the Global Water Partnership provide technical expertise, funding, and policy frameworks that guide water governance practices across borders. These organizations often facilitate cooperation on transboundary water issues and promote global standards for sustainable water management.

Water governance is a multi-dimensional, complex process that involves the coordination of various actors and institutions at multiple levels. The four main dimensions—participatory governance, partnership governance, convergence, and transparency—are crucial for ensuring that water resources are managed sustainably, equitably, and efficiently. Furthermore, adaptive and polycentric governance structures are essential for dealing with the dynamic and often unpredictable nature of water systems. A comprehensive understanding of these dimensions, combined with the active involvement of state and non-state actors, can help ensure the long-term sustainability of water resources worldwide.

### **1.2. Sustainable Development: Integrating Water**

#### **1.2.1. Concept of Sustainable Development**

Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It integrates three key pillars: economic, social, and environmental, which are all interconnected with water.

### **1.2.2. Pillars of Sustainable Development**

#### **- Economic Pillar: Inclusive Growth**

The economic pillar focuses on equitable growth, ensuring all segments of society benefit. Water is essential for agriculture, industry, and energy production, which drive economic development.

#### **- Social Pillar: Reducing Inequality**

The social pillar seeks to reduce inequality by improving access to basic needs, such as clean water, which is vital for health, sanitation, and quality of life. Water access also empowers marginalized communities.

#### **- Environmental Pillar: Ecosystem Preservation**

The environmental pillar focuses on maintaining natural resources and ecosystems. Water is key to preserving biodiversity and supporting ecosystems that provide essential services.

### **1.3. Sustainable Development Goals (SDGs) and Water**

#### **- SDG 6: Water and Sanitation for All**

SDG 6 ensures the availability and sustainable management of water and sanitation for all. It emphasizes water's central role in achieving other SDGs related to health, agriculture, energy, and inequality reduction.

#### **-Water's Role in Other SDGs**

Water impacts several SDGs, including SDG 2 (Zero Hunger), SDG 7 (Affordable Energy), and SDG 13 (Climate Action). Sustainable water management is essential for food production, energy generation, and climate resilience.

Water is crucial to the three pillars of sustainable development and is integral to achieving SDG Sustainable water management is key to addressing global challenges such as poverty, health, food security, and climate change, ensuring a resilient and equitable future for all.

### **1.3.1. Theoretical Frameworks Explaining the Link Between Water Governance and Sustainable Development**

#### **- Integrated Water Resources Management (IWRM)- Definition and Principles**

IWRM is a systemic approach aimed at sustainably managing water resources, considering the entire water cycle and the interactions between various uses. It is based on three fundamental pillars:

- **Participation:** Involving stakeholders in decision-making processes.
- **Coordination:** Harmonizing policies and actions across different levels.



- **Sustainability:** Accounting for environmental, social, and economic aspects.

IWRM supports sustainable development by promoting equitable and efficient water resource management. In Morocco, this approach is operationalized through programs like AGIRE (Support for Integrated Water Resources Management), which strengthens watershed-level management.

### **3.2. Commons Theory (Elinor Ostrom)**

Elinor Ostrom demonstrated that local communities can sustainably manage common resources, including water, through shared institutions and rules. She identified eight design principles for effective commons management:

1. Clearly defined boundaries
2. Rules tailored to local conditions
3. User participation in decision-making
4. Effective monitoring
5. Graduated sanctions
6. Conflict-resolution mechanisms
7. Recognition of the right to organize
8. Organizational autonomy

This theory emphasizes decentralized, community-based governance as a lever for sustainability. However, it also highlights challenges such as managing power asymmetries with influential stakeholders like industrial and agricultural lobbies.

### **3.3. Institutional Theory**

This theory posits that the quality of institutions (legal frameworks, administrative capacity, transparency) determines the effectiveness of water governance and its impact on sustainable development. Strong institutions ensure equitable, sustainable management, reduce conflicts, and enhance resilience. In Morocco, IWRM is implemented via Basin Agencies (ABHs), supported by international cooperation programs like AGIRE to enhance institutional capacity.

### **3.4. Socio-Ecological Systems Theory**

Water governance is seen as a dynamic interface between natural systems (aquatic ecosystems) and human systems (uses, norms, policies). Adaptive governance—based on learning and anticipation—enables responses to complex challenges such as climate change, urbanization,



and water scarcity. This approach stresses flexibility and resilience in water management systems under uncertain environmental and social conditions.

## **2. Research Methodology**

### **2.1. Problem Statement, Research Question, and Hypotheses**

This research seeks to address the following central question:

**"To what extent does the current water governance system, as designed and implemented, impact sustainable development in the context of the Hydraulic Basin Agency operating in the Casablanca-Settat region?"**

This central question is broken down into four key sub-questions aimed at exploring the different dimensions of water governance and its influence on sustainable development:

1. How is the water governance system structured within the ABHBC?
2. What is the causal impact of good water governance indicators on sustainable development?

### **2.2. Paradigm and Reasoning Approach**

This study is grounded in the **positivist paradigm**, which is based on an objective approach to reality. The **deductive reasoning** approach is adopted—starting from existing theories to formulate empirically testable hypotheses

Organizing this research around working hypotheses ensures methodological rigor and coherence. These hypotheses act as a guiding framework for data collection and analysis, helping determine what information is relevant in answering the research questions. In essence, they substitute the initial research question by providing a theoretical foundation for the empirical investigation.

The goal is to identify the most relevant data from among a multitude of sources—data that can confirm or refute the formulated hypotheses. The core hypotheses underlying the research problem are as follows:

- **Hypothesis 1: Participatory Approach**

Involving citizens, local actors, and industries in water management improves collective decision-making and reinforces shared responsibility, thereby promoting sustainable development.

- **Hypothesis 2: Public-Private Partnerships (PPPs)**

PPPs play a key role in sustainable water management by providing financial resources, technologies, and technical expertise critical to the implementation of water projects.

- **Hypothesis 3: Convergence of Actions**

Coordinated efforts between diverse stakeholders (government, businesses, NGOs, citizens) create synergies that optimize resource use and contribute to sustainable development.

- **Hypothesis 4: Transparency and Communication**

Transparency in water management and effective communication among stakeholders enhance resource governance, fostering trust, reliability, and sustainable outcomes.

These hypotheses are intended to structure the analytical framework and explore the connection between governance practices and sustainable development objectives in the Casablanca-Settat region. They also help identify both the enabling factors and challenges in water resource management.

### 2.3. Data Collection Techniques

This study uses a **quantitative approach**, by using quantitative data collection tools: Structured **questionnaires** are directed at institutional and professional actors within the water sector. Specifically, these include members of the “Sustainable Water Resource Management” and “Water Resources Evaluation and Planning” divisions of the ABHBC in Benslimane. The aim is to gather quantitative data on governance practices and their impacts on sustainable development.

The survey tools are carefully tailored to gather comprehensive and relevant data:

- **Closed-ended questions** to obtain clear, measurable responses for statistical analysis.
- **Multiple-choice questions** to offer standardized options and facilitate comparative analysis.
- **Open-ended questions** to allow respondents to express nuanced views, insights, and experiences.
- **Likert-scale questions** to evaluate perceptions on aspects such as transparency, effectiveness, satisfaction, and stakeholder involvement.

Additionally, **documentary analysis** is employed to complement primary data collection. Widely used in social science research, this method involves analyzing various texts related to the research subject. Key document sources include:

- **Reports from public and private organizations** (e.g., ministries, regulatory agencies, private firms).

### 2.4. Data Analysis

The study employs **Structural Equation Modeling (SEM)** using **AMOS software** to analyze complex relationships between variables related to water governance and sustainable

development. This statistical method enables the testing of causal relationships and latent constructs across multiple indicators.

Findings will be presented in a detailed report, supported by tables, graphs, and a discussion of the implications for water management practices in the Casablanca-Settat region.

## 2.5. Sampling

- **Institutional Actors:**

The institutional sample consists of 12 members from the ABHBC, specifically from the Sustainable Water Resource Management and the Evaluation and Planning divisions.

- **Civil Society Actors:**

The associative sample includes representatives from organizations actively engaged with ABHBC, such as the **Water Users Association of Berrechid**, involved in sustainable aquifer management, and NGOs focused on water conservation awareness in the Casablanca-Settat region.

## 3. Results

### 3.1. Validation Results for Measurement Instruments

In this study, each main variable has been broken down into sub-variables to allow for a more precise assessment. These sub-variables are measured using items based on an ordinal Likert scale ranging from 1 to 5.

#### 3.1.1. Scale Validity Analysis for Sub-Variables: Cronbach's Alpha

To ensure the reliability and validity of the measurement instruments, we conducted a series of statistical tests. Based on the factor analysis and reliability testing:

- The **communalities** for most items exceeded 0.3, confirming that the variables contributed adequately to the underlying factors.
- The **KMO values** were generally above 0.70, indicating a good level of sampling adequacy.
- **Bartlett's test** yielded p-values less than 0.05 for all tested constructs, confirming the statistical significance of correlations between items.
- The **Cronbach's alpha coefficients** ranged between 0.78 and 0.88, indicating good to excellent reliability for most subscales used in the questionnaire.

These results validate the robustness of the measurement instruments and confirm that the items are appropriate for evaluating perceptions of water governance and its link to sustainable development.

### 3.1.2. Factorial analysis

Before proceeding with the hypothesis testing, it is necessary to reduce the number of sub-variables and group them into factors that retain the maximum amount of information. To do this, we have chosen to use a Principal Component Analysis (PCA). This method will allow us to group the sub-variables of each variable in our model into factors, which will then be used for the model test and hypothesis validation.

**Table 1: Results of the Factorial Analysis of Sub-variables**

Measurement Variables	Number of Items	Number of Extracted Factors	Percentage of Information Retained by the Factor
<b>Governance</b>			
Participation	9 Items	1 factor	85.02%
Partnership	10 Items	1 factor	85.92%
Convergence	6 Items	1 factor	75.25%
Transparency	7 Items	1 factor	58.94%
<b>Sustainable Development</b>			
Environmental Dimension	7 Items	1 factor	85%
Economic Dimension	6 Items	1 factor	83.06%
Social Dimension	5 Items	1 factor	77.73%

### 3.2. Inferential Analysis: Econometric Model Results

Using **Structural Equation Modeling (SEM)** via **AMOS**, the study tested the relationships between water governance variables and regional sustainable development indicators (social, environmental, and economic).

- **Participation → Sustainable Development:**

A significant positive relationship was found ( $\beta = 0.41, p < 0.01$ ), confirming that participatory governance improves sustainability outcomes, particularly in water conservation and social equity.

- **PPP → Sustainable Development:**

The path coefficient ( $\beta = 0.36, p < 0.05$ ) confirms a positive but slightly weaker effect. PPPs contribute positively to infrastructure development and technological efficiency but require strong regulatory oversight.

- **Coordination → Sustainable Development:**

This relationship was the strongest ( $\beta = 0.52, p < 0.01$ ), indicating that institutional coordination is a key determinant of effective and sustainable water resource management.

- **Transparency → Sustainable Development:**

The effect was positive but marginal ( $\beta = 0.27, p = 0.07$ ). Although transparency enhances trust, its full potential is not realized without stronger public engagement and access to information.

### 3.3. Summary of Hypothesis Testing

Hypothesis Statement		Result
H1	Participatory governance improves sustainability outcomes	Confirmed
H2	PPPs enhance sustainable water management	Confirmed
H3	Coordinated actions among actors generate synergies that support sustainable development	Confirmed
H4	Transparency and communication strengthen governance and sustainable outcomes	Partially confirmed

### 4. Conclusion

This study aimed to empirically assess the impact of water governance practices on sustainable development within the region of Casablanca-Settat, focusing on the role of the Bouregreg and Chaouia Hydraulic Basin Agency (ABHBC). Using an econometric approach grounded in structural equation modeling, the research demonstrated that water governance—understood as a multidimensional system involving participation, coordination, partnerships, and transparency—has a measurable and significant effect on sustainability indicators.

Among the governance variables, **institutional coordination** emerged as the most influential, highlighting the importance of coherent actions among actors at different levels (governmental,

private, and civil society). **Participatory governance** was also confirmed as a key driver of socially and environmentally inclusive decision-making. **Public-private partnerships (PPPs)** played a vital role, particularly in terms of resource mobilization and technological innovation, though their effectiveness is conditioned by the presence of clear regulatory frameworks. The influence of **transparency and communication** was positive but more limited, suggesting that transparency efforts must be strengthened and accompanied by accessible information and inclusive dialogue.

This study contributes to the growing body of literature that links water governance to the broader agenda of sustainable development. It supports the idea that good governance is not only a normative ideal but also an operational lever for enhancing sustainability at the regional level, especially in contexts affected by water scarcity, demographic pressure, and environmental vulnerabilities.

## 5. Recommendations

Based on the findings of this research, the following strategic recommendations are proposed for improving water governance in the Casablanca-Settat region:

### 1. Strengthen Participatory Mechanisms

- Institutionalize platforms for dialogue with local communities, user associations, and civil society organizations.
- Ensure these actors have a real influence in planning and decision-making processes.

### 2. Enhance Inter-Institutional Coordination

- Foster greater coherence between sectoral policies (water, agriculture, urban planning, environment).
- Reinforce multi-level governance by clarifying roles and responsibilities across national, regional, and local institutions.

### 3. Promote Transparent and Open Data Policies

- Improve access to water data and monitoring results for all stakeholders.
- Encourage digital tools and open-data platforms to ensure real-time transparency and public accountability.

### 4. Regulate and Monitor Public-Private Partnerships (PPPs)

- Define clear regulatory frameworks to govern PPPs in water infrastructure and services.
- Ensure that contracts include environmental and social performance indicators aligned with sustainable development goals.

### **5. Build Institutional Capacity and Resilience**

- Invest in training and capacity-building programs for governance actors (public officials, basin agencies, NGOs).
- Foster adaptive governance approaches capable of responding to climate risks and socio-economic uncertainties.

### **6. Integrate Sustainability Indicators into Planning Tools**

- Revise and enrich the Master Plans for Integrated Water Resources Management (PDAIRE) to include measurable sustainability targets.
- Align regional planning with the Sustainable Development Goals (SDGs), particularly SDG 6 (Clean Water and Sanitation).

By implementing these recommendations, the Casablanca-Settat region can reinforce the alignment of its water governance system with the principles of sustainable development, and offer a model that can be replicated in other hydrological basins facing similar challenges.



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