Data process and water resources management in Morocco: issues and challenges

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Abstract

This article will examine the data collection process, management flow, and decision-making process through interviews with public sector representatives responsible for water management.

Natural resources have always been at the heart of the world's most important government strategies. The development of economies is contingent upon the effective management of a country's water resources, which in turn requires good water governance that depends on the collection of sufficient data and an effective data management system (1), especially with climate change continuing to impact this resource around the world.

The management of natural resources, in general, necessitates collecting data and raw measurements, resulting in storing a large volume of data. Therefore, Big Data Analytics (BDA) technology is considered a primary means of processing such data. However, while Big Data technologies offer a suitable solution for ensuring optimal and rapid use of data, the success of functional and technical designs can only be guaranteed by maintaining complete control over the processing and decision-making processes.

Keywords: Information System, Water Resources, Big Data Analytics, Water Resources Management

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1. Introduction

Water, often called blue gold, is a vital resource essential for human survival and for various industries, particularly agriculture, which consumes nearly 70% of the world's annual water consumption and is responsible for significant water pollution from the release of excess fertilizers and pesticides. Given the growing problem of water scarcity, it is imperative to manage water resources more effectively, especially in developed and developing countries.

Fortunately, big data analytics, artificial intelligence, and machine learning have emerged as potential solutions to water management challenges, particularly in reducing water losses and preventing water pollution. These technologies continue to evolve and yield promising results.

This article explores the possibilities of using big data for water resources management through interviews with water stakeholders.

2. Methodology

Before starting the interview, the research context and objectives were presented to the various interviewees to obtain concrete and efficient answers that will serve as a valuable material and future discussions.

To determine precisely the data collection process and to get as close as possible to the decision-making operation, we have chosen to use a qualitative method based on direct interviews with the managers of the entities that are key players in these processes.

The interviews lasted between 40 minutes and 1 hour, recorded directly and then transcribed word for word on paper to carry out their analysis by Nvivo.

2.1. Context

Data collection and consolidation is the most critical operation to manage water resources data effectively.
In the case of Morocco, for example, the Hydraulic Basin Agencies (HBA) are the entities responsible for measuring and producing data. These must be stored and consolidated at the primary level to form a basis for decision-making.

According to the Moroccan water law 36-15, the Basin Agencies must obligatorily send the measured data to the Central Department of the General Directorate of Water (2,3).

2.2. Datawarehouse & Datamining

In the field of water resource management, the integration of data warehouses (Data Warehousing) and data mining can serve water management, particularly in optimizing water quality. Data warehouses serve as a centralized location to store significant amounts of data related to water sources, encompassing information on precipitation, river flow, and water quality from various sources. This centralized storage facilitates efficient organization and analysis (4).

Concurrently, data mining techniques explore this wealth of historical data, revealing patterns, correlations, and predictive models. Through data mining, water resource managers acquire insights that enable proactive decision-making. This synergy between data warehouses and data mining provides water resource managers with the necessary tools to optimize resource allocation, anticipate future trends, and implement sustainable strategies for the responsible management of water resources.

2.3. Interviewees

The selection of interviewees (05) was based on their degrees of responsibility in the flow of our problem, and they all belong to the following three entities:

- Water Branch: Central Element of Water Management
- Water basin agencies: organizations responsible for the production of water-related data
- Regional environmental directorates: partner in the use and display of water resources data.

The interviews took place with actors responsible for water management and direct decision-making actors in their offices.

2.4 Interview guide

The interview guide is a document prepared in a Word file that contains a general introduction explaining the context of the research and the expectations of the interview, the date and place of the interview, and the information about the interviewee and his function.

3. Results

After importing the interviews into Nvivo, we created a frequency table that allows us to indicate the percentage and frequency of each word in the answers and will enable us to display the table in Figure 1:

Mot	Longueur	Nombre	Pourcentage pondéré (%)
données	7	49	3,48
système	7	20	1,42
niveau	6	18	1,28
processus	9	15	1,07
badre21	7	12	0,85
partie	6	11	0,78
pas	3	11	0,78
sous	4	11	0,78
cas	3	10	0,71
mesure	6	10	0,71
excel	5	9	0,64
qualité	7	9	0,64
abh	3	8	0,57
partenaires	11	8	0,57

Figure -1 Overview of the frequency table keywords

3.1 Important comments

For the analysis of the interviews, the NVivo software was used.

Factor	Testimonial
A: Data Flow	*Data inserted directly by partners in the system or entered in the database of data managed by the observatory service* *Validation of data and indicators by central services;* *Tabular and geographic display.*
B: Data format & volume	*Climatological, hydrometric, and hydrogeological data*
C: Quality	*The production of information remains minimal. Mass production then allows the quality of the data to be judged, but the quality of the data produced remains generally satisfactory.*
D: Current System & Model Used	*Very limited, still a lot of things to do, and we need to have computer profiles at the level of business services*
E: Data usage	*Yes, the piezometric data for the monitoring of the web and the data in Excel concerning the flow*

F: Data sharing	*The development of the SNIE: It was necessary to develop an information system for the sharing of water data between the various bodies involved in the water sector*
G: Decision making	*It depends on the cases*

Tab -2 Topics of Analysis

3.2 Discussion

The first problem raised by the actors interviewed is the collection of water data: from measurement to storage, including data capture, processing, and storage; this makes it difficult to identify effective indicators for water management. There is an urgent need for standardization of data entry.

The interviewees also all expressed their willingness to collaborate on creating a shared information system that will make it possible to exchange the different data on the water between the other actors.

Issue	Current Situation
Data entry	Manual, non-standard
Standardizing data	Non-standardized data
Data validation	Absent
Data storage	Raw storage with difficulty for large volumes
Analysis and visualization in real-time	Minimal research despite the multitude of computer systems and DB
Prediction	Difficult/Absent

Tab -3 Results

4. Conclusion

Through interviews with the various leaders of the water sector, this study in the field clearly showed us the problem in the capture, analysis, treatment, and sharing of water resource data between the different actors to achieve a comprehensive national water management strategy.

But it has also shown that much work remains to be done in standardizing data flows and updating processes. (5)

New technologies can be ideally used for data management, in particular Big Data Analytics, to help in decision-making and create a National Water Information System (NIS). (6)

The prospects would be to study in depth the opportunities and possible challenges of adopting big data analytics by administrations in charge of water resources management (7,8), which allows coordination between the different entities for real-time responses to incidents (pollution, floods, drought, etc.).

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