

BIG DATA ANALYTICS FOR THE MOROCCAN WATER ACTORS: TOWARDS AN ADOPTION MODEL

Elhassan JAMAL^{1*}, Youssef RISSOUNI¹, Hicham JAMIL¹, Rachid EL ANSARI¹, Bouabid EL MANSOUR², Jamal CHAO², Aniss MOUMEN¹.

¹Systems Engineering Laboratory, Kenitra ENSA, Ibn Tofail University, Morocco

²Natural Resources Geosciences Laboratory, Kenitra Faculty of Sciences, Ibn Tofail University, Morocco

Abstract. This paper delves into the adoption of Big Data Analytics (BDA) within the Moroccan water management sector, specifically examining data collection, management flow, and decision-making processes. Through insightful interviews with representatives from the public sector responsible for water management, this study investigates the pivotal role of effective data governance in optimizing water resources[1]. Given the centrality of natural resources, particularly water, in national development strategies, the imperative for robust water governance is underscored. The impact of climate change further highlights the need for sufficient data collection and an efficient data management system[2]. In the management of natural resources, the accumulation of extensive data necessitates the application of BDA technology for streamlined processing. While BDA provides a solution for optimal data utilization, this article emphasizes the importance of maintaining control over processing and decision-making to ensure the success of functional and technical designs. The outcomes contribute to the formulation of an adoption model for BDA in the Moroccan water sector, facilitating well-informed and strategic decision-making for sustainable water resource management.

Keywords: Big Data Analytics, Water Resources Management, Adoption Model, Data Governance.

* Corresponding author: jamal.elhassan@gmail.com

1 Introduction

In the ever-evolving landscape of water resource management, the integration of cutting-edge technologies becomes paramount to address the challenges posed by climate change and growing demands on natural resources. This research delves into the intricate realm of water management in Morocco, a country where the effective utilization of water resources is pivotal for sustainable development. At the forefront of this exploration is the adoption of Big Data Analytics (BDA), a transformative technology that promises to revolutionize the way water-related data is collected, processed, and leveraged for informed decision-making[1].

Against the backdrop of global shifts in climate patterns impacting water resources, this study focuses on the intricacies of data collection, management flow, and decision-making processes within the Moroccan water sector. Through insightful interviews with key representatives from the public sector responsible for water management, the investigation sheds light on the indispensable role of effective data governance in optimizing the nation's water resources. Natural resources, particularly water, stand at the nexus of national development strategies, emphasizing the critical need for robust water governance.

In this context, the article underscores the significance of a sophisticated data management system and the imperative for sufficient data collection, especially in the face of climate change affecting water resources worldwide. The burgeoning volume of data generated in the process necessitates the application of Big Data Analytics (BDA) technology, presenting itself as a primary means to efficiently process and derive meaningful insights from this wealth of information.

However, the adoption of BDA is not without its challenges. While BDA technologies offer a promising solution for optimal and rapid data utilization, the success of functional and technical designs hinges on maintaining complete control over the processing and decision-making processes. This article delves into the delicate balance between harnessing the power of BDA and ensuring governance over its application[3].

The research outcomes contribute to the formulation of an adoption model for BDA in the Moroccan water sector. This model, rooted in empirical insights, aims to guide strategic decision-making for sustainable water resource management[4], setting the stage for a technologically advanced and environmentally conscious approach to addressing the complexities of water governance in Morocco.

2 Adoption Model

In response to the evolving dynamics of water resource management, the development of a robust adoption model is crucial to guide the seamless integration of Big Data Analytics (BDA) within the Moroccan water sector. This section introduces a comprehensive model that encapsulates key components and a schema designed to facilitate the effective adoption of BDA technologies.

2.1 Model Framework

The adoption model proposed herein is framed around a multi-dimensional approach, considering technical, organizational, and contextual factors. It delineates the sequential stages of adopting BDA in Moroccan water management, ensuring a systematic and well-orchestrated transition.

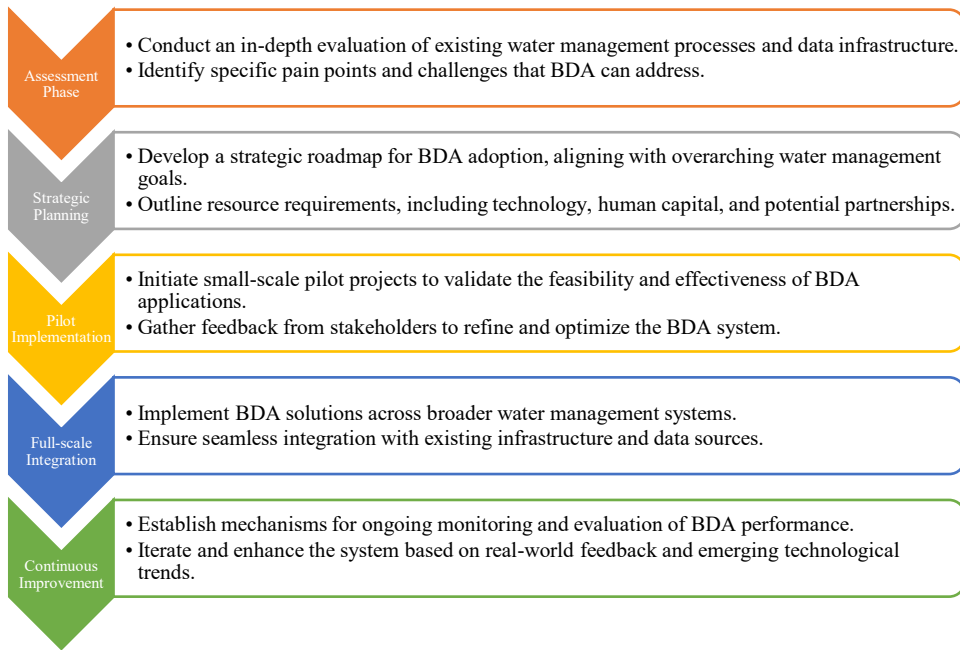


Fig. 1 . Framework model

2.2 Schema Overview

The schema accompanying this adoption model illustrates the interplay of various components, emphasizing the interconnected nature of technical, organizational, and contextual elements. The schema encompasses:

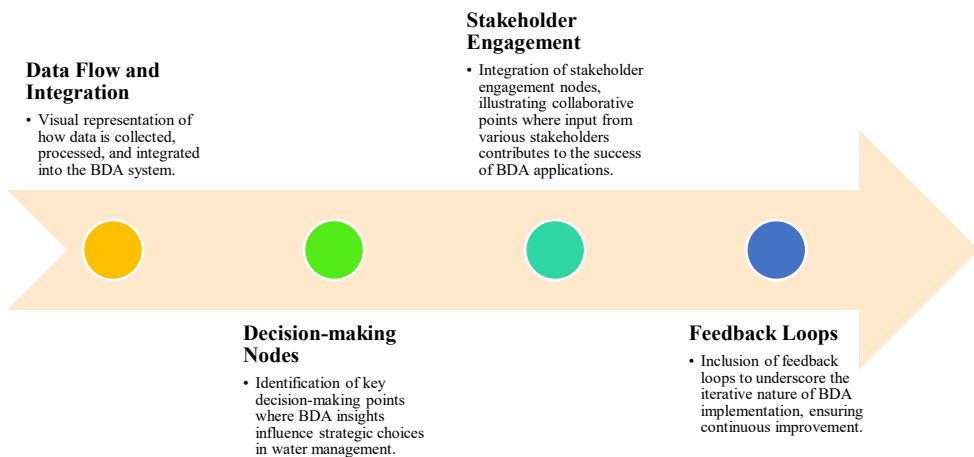


Fig. 2 . Overview schema

This comprehensive model and accompanying schema provide a structured framework for the adoption of BDA in Moroccan water management, aiming to empower stakeholders to harness the full potential of data-driven decision-making for sustainable and effective water resource management.

3 Methodology

The selection process for interview participants (totalling 10 individuals) was meticulously conducted, considering their levels of responsibility in addressing the core aspects of our research problem. The chosen participants are affiliated with three distinct entities critical to our study:

- Water Branch: Central Element of Water Management
- Water Basin Agencies: Organizations Entrusted with Water-Related Data Production
- Regional Environmental Directorates: Collaborative Partners in the Utilization and Presentation of Water Resources Data

Conversations were held with individuals actively involved in water management and possessing direct decision-making roles within their respective offices.

To conduct the interviews effectively, an interview guide was prepared as a comprehensive Word document. This guide comprises a general introduction that contextualizes the research and outlines interview expectations, including the date and location of the interview. Additionally, pertinent details about the interviewees and their roles are provided to facilitate a focused and productive exchange of information.

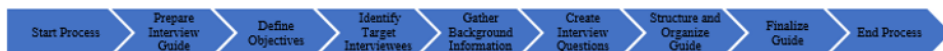


Fig. 3 . Methodology

4 Results & Discussion

The diverse nature and myriad formats, coupled with the sheer volume of data encompassing climatological, hydrometric, and hydrogeological dimensions, suggest that leveraging Big Data technology could offer a viable solution for effective data management. This assertion gains credence from the revelations in our interviews, where it became apparent that despite the abundance of available data, the actual mass production of analytical results remains remarkably limited.

The interviewees unanimously conveyed their eagerness to engage in collaborative efforts aimed at establishing a shared information system. This system is envisioned as a platform facilitating the seamless exchange of diverse water-related data among various stakeholders. Significantly, the underpinning support for this collaborative initiative is the integration of Big Data capabilities, enabling the centralization of additional data in diverse formats and large volumes.

To elaborate further, the implementation of Big Data technology holds the promise of overcoming existing limitations in data analysis and utilization. The vast array of data types, spanning climatological, hydrometric, and hydrogeological parameters, presents a complex landscape that can be effectively navigated through advanced analytics. Moreover, the expressed commitment from interviewees to contribute to a shared information system underscores a collective recognition of the transformative potential that Big Data holds in enhancing data collaboration, accessibility, and overall water resource management. This collaborative platform, supported by Big Data, emerges as a strategic initiative poised to

maximize the utility of existing data reservoirs for informed decision-making and comprehensive water resource governance.

We can summarize the various observations noted in the following table:

Table 1 . results

Issue	Proposed Solution (BDA)
Data entry	Possible with sensors connected continuously and in real-time
Standardizing data	Standardizing is possible with the data standardizing layer of Big Data Analytics systems
Data validation	Possible with effective monitoring
Data Storage	Unlimited data storage
Analysis and visualization in real-time	Big Data Analytics enables multi-dimensional analysis
Prediction	Possible based on BDA prediction layers

5 Conclusion

In conclusion, this article delves into the intricate landscape of water management in Morocco, with a specific focus on the potential integration of Big Data Analytics (BDA) to address contemporary challenges. The comprehensive exploration begins with an in-depth analysis of the current state of water resources, acknowledging the critical role they play in national development strategies. The research, conducted through interviews with representatives from key entities, namely the Water Branch, Water Basin Agencies, and Regional Environmental Directorates, reveals a consensus on the need for transformative solutions to optimize data utilization and decision-making.

The adoption model proposed in this study presents a structured framework, emphasizing a multi-dimensional approach that considers technical, organizational, and contextual factors. The sequential stages, ranging from the assessment phase to continuous improvement, provide a roadmap for the effective integration of BDA in Moroccan water management. The accompanying schema illustrates the interconnected nature of components, including data flow, decision-making nodes, stakeholder engagement, and feedback loops.

Furthermore, the challenges associated with the diverse nature and volume of water-related data underscore the potential of BDA technology to revolutionize data management. Despite the abundance of available data, the interviews highlight the minimal mass production of analytical results, prompting the need for a paradigm shift. The expressed willingness of interviewees to collaborate on a shared information system aligns with the transformative capabilities of Big Data, enabling the centralization of data in various formats and large volumes.

In essence, the adoption of Big Data Analytics emerges as a strategic initiative to overcome existing limitations, enhance collaboration, and pave the way for sustainable water resource management in Morocco. The collaborative platform, supported by BDA, reflects a collective commitment to harnessing the full potential of data-driven decision-making. As Morocco navigates the complexities of water governance, the integration of BDA stands poised as a transformative tool for informed decision-making, optimal resource utilization, and the sustainable stewardship of this invaluable natural resource.

References

- [1] J. Elhassan, M. Aniss, et C. Jamal, « Big Data Analytic Architecture for Water Resources Management: A Systematic Review », in Proceedings of the 4th Edition of International Conference on Geo-IT and Water Resources 2020, Geo-IT and Water Resources 2020, in GEOIT4W-2020. Al-Hoceima, Morocco: Association for Computing Machinery, mars 2020, p. 1-5. doi: 10.1145/3399205.3399225.
- [2] H. Jamil, E. Jamal, B. El Mansouri, A. Moumen, et C. Jamal, « Processing and decisions relating to water resources data: The case of Morocco », SHS Web Conf., vol. 119, p. 03007, janv. 2021, doi: 10.1051/shsconf/202111903007.
- [3] E. Jamal, A. Moumen, Y. Rissouni, J. Chao, et A. Tahi, « Big Data Analytic and IoT for Water Resources », janv. 2021, p. 433-439. doi: 10.5220/0010736000003101.
- [4] « Stratégie Nationale de l'Eau.pdf ».