

Determinants of the Exploitation of Groundwater Resources of the Alluvial Plain of Karfiguela

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Abstract:- The alluvial plain of Karfiguela, located in the western part of Burkina Faso, has significant surface and groundwater potential. However, its surface water resources are under pressure due to the combined effect of agricultural areas and the increasing number of farmers, driven by population growth. Studies have shown that the plain contains a very important and accessible aquifer that, however, remains underutilized. In this context, understanding the determinants of the use of alluvial aquifer waters. The objective of the study is to analyse the factors that determine the exploitation of groundwater to address the shortage of surface water for irrigation purposes. The methodological approach adopted involves conducting a survey among farmers and their organizations. The results reveal that the low exploitation of this resource is attributed to several factors, including the high cost of drilling wells and the lack of awareness regarding the availability and accessibility of the alluvial aquifer. The reliability of these results is limited by the low level of participation from some farmers in the data collection process, which was influenced by negative past experiences.

Keywords:- Burkina Faso, Karfiguela Alluvial Plain, Groundwater, Irrigation.

I. INTRODUCTION

Agriculture in Burkina Faso is predominantly rainfed and faces challenging agro-ecological conditions due to climate degradation and the increasing anthropogenic pressure associated with rapid population growth. As a result, the development of irrigated agriculture has become a major issue for achieving food security in the country. Indeed, the share of irrigated production in total agricultural output, which was 15% in 2015, is expected to reach 25% by 2020 (PNDS, 2016 - 2020).

This political environment favorable to the development of irrigation has led to the expansion of irrigated agricultural areas, increased water demand, and sometimes improper water resource management, exacerbated primarily by competition and conflicts over water usage. This expansion is particularly noticeable in the Karfiguela plain. According to NOMBRE A., 1984 (cited by CNID-B, 2009), 75 ha of the Karfiguela plain were developed in 1975. This developed area increased to 150 ha in 1976 and 350 ha in 1977. In addition, there are also non-irrigated operations. Furthermore, the West African Irrigation Project (WAIPRO) in its diagnostic analysis and action plan identified issues related to the Karfiguela irrigation perimeter. A prioritization of these issues, according to their significance in the eyes of local farmers, places insufficient irrigation water at the top of the list.

Moreover, the importance of water intake in highly irrigated areas creates a competitive and sometimes even conflictual situation regarding water use. It is important to note that water usage conflicts arise in two forms: those directly related to water and those not directly related to water (TRAORE R, 2012). Indeed, in the Comoé basin, conflicts between operators of the developed plain and illegal water users are frequent and sometimes open. Latent conflicts also exist between the operators of the developed plain and the SN/SOSUCO. This puts pressure on surface water resources despite the significant potential of the alluvial aquifer, as confirmed by several studies (M. ZOUNDI 2013, A. Symboro, 2016, PADI 2016).

In this context, understanding the determinants of groundwater use in the Karfiguela plain will help reduce pressure on surface water resources and mitigate the water shortage for irrigation.

II. METHODOLOGICAL APPROACH

➤ Presentation of the study area:-

The Karfiguela alluvial plain is located in the extreme southwest of the country, approximately 10 km northwest of Banfora in the Comoé province. The plain lies between longitudes 4°50' and 4°42' West and latitudes 10°44' and 10°28' North. It covers an area of 46 km², extends over 28 km in length (COMPAORE N.F, 2012), encompassing the localities of Karfiguela, Tangréla, Nafona, Lémouroudougou, Kribina-Lèna, Tiékouna, Niankar, Bounouna, Kossara, Diarabakoko Sitiéna and Banfora. It is accessible from Ouagadougou by the National Road No. 1 (RN1) from Ouagadougou – Bobo – Banfora, a 445 km route that is passable year-round, followed by the Banfora – Karfiguela road, which becomes difficult to traverse during the rainy season.

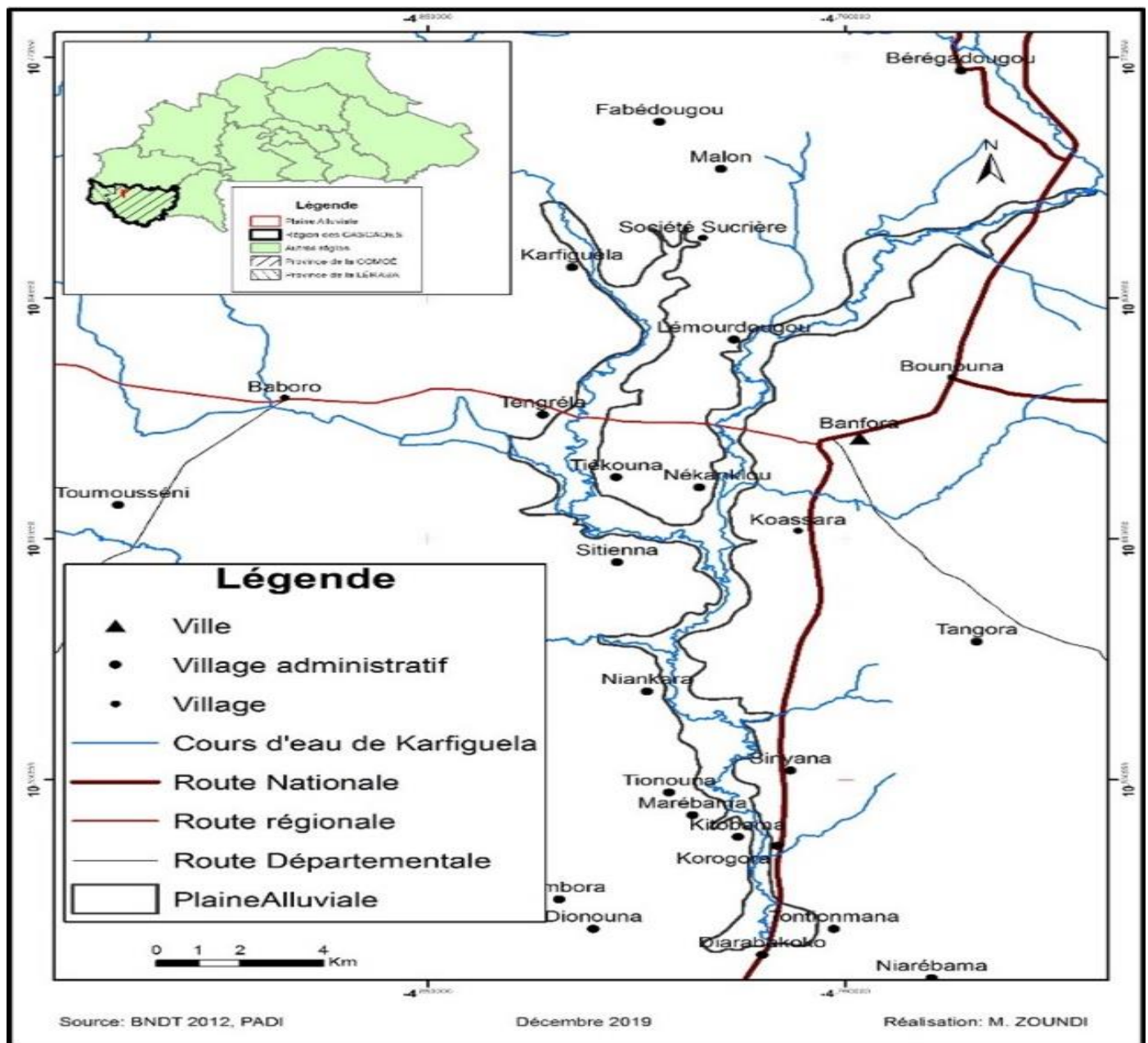


Fig 1 Geographical Location of the Alluvial Plain of Karfiguela

➤ *Data Collection, Processing and Analysis Approach:-*

The data consist of the farmers' perceptions of the available groundwater quantities and their arguments regarding the underutilization of groundwater. These data were collected through a sociological survey based on survey forms focused on a purposive sampling approach targeting the populations working the alluvial plain, agricultural advisory services, and decentralized administration. Specifically, the survey targeted farmer cooperatives, individual farmers, members of the agricultural council, and decentralized technical services. The majority of the target groups on-site were selected through a systematic approach. For the cooperatives, the survey included the Village Development Councils (CVD), Producer Groups, and the Karfiguela plain Cooperative Union. Following data collection, we first proceeded with data preprocessing, followed by data processing, and finally, analysis and interpretation of the results. The processing involved sorting, entry, cleaning, and grouping of the collected data by study variable and source. Finally, analyses were performed using Microsoft Excel, which allowed the creation of tables and graphs for interpretation.

III. FACTORS CONTRIBUTING TO THE LOW EXPLOITATION OF THE KARFIGUELA ALLUVIAL AQUIFER

The availability and accessibility of the alluvial aquifer's water are well-established. Additionally, the annual recharge of the aquifer is quite high. However, there is notable underutilization of the aquifer. Indeed, among the surveyed farmers, 97% use surface water, while less than 2% rely exclusively on groundwater from the alluvial aquifer. Studies by DAO D. M., 2015, and PADI, 2016, revealing that the aquifer's exploitation rate is only 10.60%, support our analysis. The results of the analysis of farmers' arguments regarding the factors contributing to the low exploitation of the alluvial aquifer highlight several reasons. These factors, listed in order of significance, are: (i) high well costs, (ii) ignorance of the availability and accessibility of the alluvial aquifer, (iii) ease of surface water exploitation, (iv) traditional water use sources, (v) lack of mastery over groundwater exploitation systems, (vi) accidents and flooding, and (vii) land insecurity.

➤ *High Well Costs:-*

The cost of constructing groundwater mobilization infrastructure influences some farmers' choice of water source. Farmers argue that the cost of drilling a well is beyond their financial capacity, which leads them to rely solely on river water for irrigation. Among the surveyed farmers, 28% cited the lack of funds to dig a well as the reason for exclusively using river water.

➤ *Ignorance of the Availability and Accessibility of the Alluvial Aquifer:-*

Knowledge about the availability and accessibility of the alluvial aquifer significantly impacts the choice of water source for irrigation. Farmers are generally unaware of the availability and accessibility of alluvial groundwater. In this regard, some say, "We do not know about groundwater,

which is why we only use surface water." In fact, 24% of farmers who use river water are unaware of the sufficient quantity of the alluvial aquifer that could meet their needs. The current water management approach in the Karfiguela plain, based on sharing surface water among the three main users, does not account for the availability of groundwater resources.

This approach should therefore be revised into an integrated and participatory water resource management strategy.

➤ *Ease of Surface Water Exploitation:-*

The physical cost of exploiting water determines its use. Some farmers in the Karfiguela plain believe it is easier for them to exploit surface water. Indeed, 22% of farmers assert that their choice of surface water for irrigation is due to the ease of using river water. The spatial configuration of these farmers' plots also suggests a proximity-based rationale for their choice. More than 90% of their plots are located within 20 meters of the riverbanks. Consequently, these actors experience strong proximity interdependencies, particularly in times of water scarcity (TOROU B. M., et al., 2018). Some farmers, in times of water shortage, even go as far as the riverbed to ensure the final phase of crop irrigation. As one farmer put it, "When there is a lack of water, we dig in the river to get it."

➤ *Traditional Water use Sources:-*

The exploitation of the alluvial aquifer faces competition from traditional water sources. Farmers in the Karfiguela plain, once accustomed to an abundance of surface water, did not foresee the progressive pressure on these resources, nor did they expect to experience water scarcity. A segment of these farmers claims they have always used surface water. Frequently used terms include "We use surface water because that is the water we have always used." Indeed, 18% of the surveyed farmers have always used surface water.

➤ *Lack of Mastery Over Groundwater Exploitation Systems:-*

One key determinant in choosing a water source for irrigation is mastery over the water exploitation system. The lack of technical knowledge on how to mobilize groundwater prevents some farmers from utilizing the alluvial aquifer. In fact, 4% of the surveyed farmers use surface water because, despite their desire, they do not know how to operate groundwater exploitation systems.

➤ *Accidents and Flooding:-*

Accidents and flooding are significant factors influencing the choice of water source. Negative experiences with using wells have led farmers who previously exploited both surface and groundwater to rely solely on surface water. Furthermore, incidents involving animals and child drownings, as well as flooding of irrigation perimeters during high water levels, have deterred farmers from using groundwater. Among the surveyed farmers, 3% justify their choice of surface water due to the desire to avoid accidents and flooding, incidents they have previously experienced. For example, TOU Amadou, one of the farmers, stated: "I use

surface water because I had a well that I had to close because animals and humans fell into it."

➤ *Land Insecurity:-*

Analysis revealed that land insecurity, even if minor, constitutes an obstacle to managing groundwater resources in the Karfiguela plain, particularly for women and landless farmers. Land ownership plays a crucial role for some farmers in their preference for a specific water source for irrigation. Even though they are a minority (1%), some farmers are unable to decide to build a well because they do not own the land they cultivate. The lack of land tenure security hinders the management of groundwater resources, especially its use and protection by farmers. According to the Groupe de Recherche et d'Action sur le Foncier (GRAF, 2018), the expansion of commercial crops, mining activities, increased competition for land, and the monetization of land transactions in a context of weak enforcement of legislative and regulatory frameworks increase land insecurity for women and other vulnerable groups. Land ownership being a determining factor in water management, securing land rights is essential to ensure sustainable management of irrigation schemes and water resources.

IV. CONCLUSION AND DISCUSSION

The findings leading to the research hypotheses are discussed here. This study allowed us to estimate the potential land area for irrigation in the Karfiguela plain. The study indicates that the low exploitation of groundwater reserves by farmers in the Karfiguela plain can be explained by several factors, including (i) high well costs, (ii) ignorance of the availability and accessibility of the alluvial aquifer, (iii) the ease of exploiting surface water, (iv) traditional water sources, (v) lack of mastery over groundwater exploitation systems, (vi) accidents and flooding, and (vii) land insecurity.

The results of this study are limited by the lack of farmer participation due to negative past experiences with the data collection process. It was necessary to first gain their trust with the support of the regional agricultural department of the Cascades to ensure their cooperation.

Despite this limitation, the implementation of actions based on the exploitation factors identified would allow the use of groundwater in the plain for irrigated agriculture and facilitate decision-making related to land use planning according to water sources.

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