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Rainfall Variability and Lowland Development in the Gomba Haoussa Watershed (Southern Zinder, Niger)

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ABSTRACT

In the Sahel, rainfall is the fundamental climatic element that conditions the various agricultural activities. Their absence, scarcity, excess or poor spatial and temporal distribution are generators of food crises. In Niger, as in most Sahelian countries, climatic crises are recurrent and expose the country to chronic food deficits. As a result, producers resort to lowlands to mitigate rainfed food deficits. This study aims to analyze the climatic variability in the Gomba Haoussa watershed and to reveal the rainfall and socio-economic trends of the exploitation of the lowlands. The climatic diagnosis was made from the Pettitt test (1979) on the Magaria series from 1950 to 2015. The field surveys in five sampled lowlands, involved 80 producers. The results show longer dry periods, thus making the rainfed agricultural production system more vulnerable. These changes translate to producers using lowlands for agricultural development.

INTRODUCTION

In the Sahel, breaks in rainfall and the concentration of large amounts of rainfall over a few days hamper agricultural production and, consequently, increase the risk of food insecurity (Traoré et *al.*, 2000; Ali and Lebel, 2009). This situation is gradually leading farmers to change their farming practices and develop adaptation strategies that make crops less vulnerable (Gbetibouo, 2009). The new dynamic of agricultural intensification geared towards the development of lowlands is imposing cropping choices and is one of the strategies for adapting agriculture to climate disruption and/or reducing water stress. Nowadays, lowlands are an agricultural area with enormous potential for agricultural production (Somé, 2006) and deserve to be developed (Courtieu, 2002). This study aims to analyze the socio-economic effects of inland valley development on the lives of farmers in the context of marked climatic deterioration in the Gomba Haoussa watershed (South Zinder, Niger).

1. Data and methods

The study area is the Gomba Haoussa catchment (between 13.49' and 13.03' north latitude, and between 8.48' and 9.13' east longitude). It covers an area of 263,986 hectares in the communes of Kantché, Bandé, Magaria, Dogo and Gouna (Figure 1). The average climate is Sahelian, with a normal annual rainfall of between 400 and 600 mm (DRA Zinder, 2016).

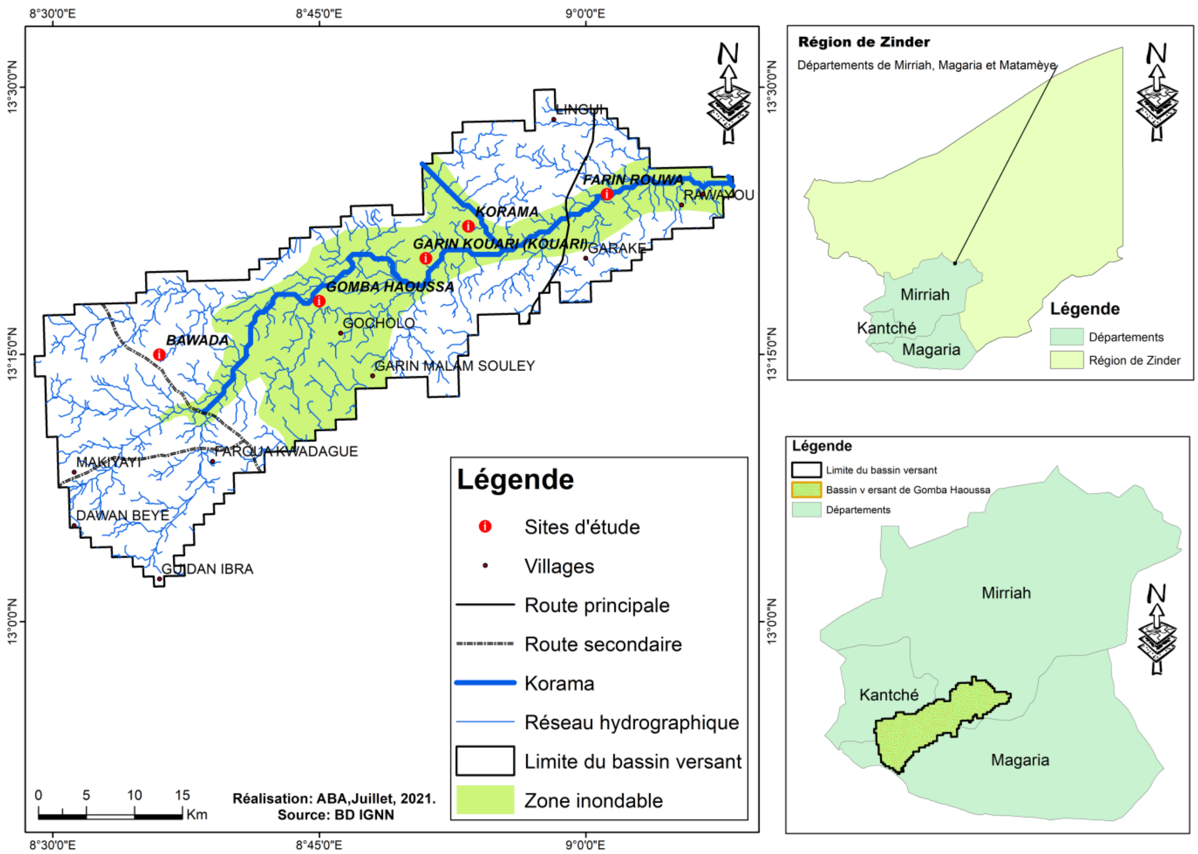

Fig. 1: Geographical location of study area

Daily rainfall data from the Magaria station (Agrhymet database in Niamey) for period 1950-2015 are used to study rainfall trends. Agricultural data relating to areas sown and production over period 2021-2022 are taken from statistics from the Zinder Regional Directorate of Agriculture. Other quantitative information (farm costs and selling prices of crops) and qualitative information were obtained during field investigations in the farming community in 2021. Individual interviews relating to use of the lowlands developed in South Zinder enabled 80 farmers to be interviewed.

2. Results and discussion

2.1. Rainfall pattern and temporal variability

Rainfall occurs between July and September, with the unimodal regime peaking in August. Interannual analysis over the period 1950-2015 shows a mixed trend in annual rainfall (Figure

2). This variability has a major impact on the development of crops. The years between 1967 and 1990 show deficits, and those between 2004 and 2012 show a return to wet years. The downward trend observed is accompanied by a lengthening of the dry season and a consequent shortening of the rainy season, characterized by a reduction in the number of rainy days (Ozer et al, 2005). Deficit years on interfluves pose major agronomic problems for crop establishment (Lamb, 1982), making the farming system vulnerable. The use of wetlands has become a necessity for farmers, as these hydromorphic areas have water resources even during a long dry spell.

As a result, productivity would theoretically be higher in the lowlands than in the uplands. With a view to supporting socio-economic development, and according to 86% of the farmers interviewed, inland valley development can help reduce the vulnerability of agriculture to rainfall variability.

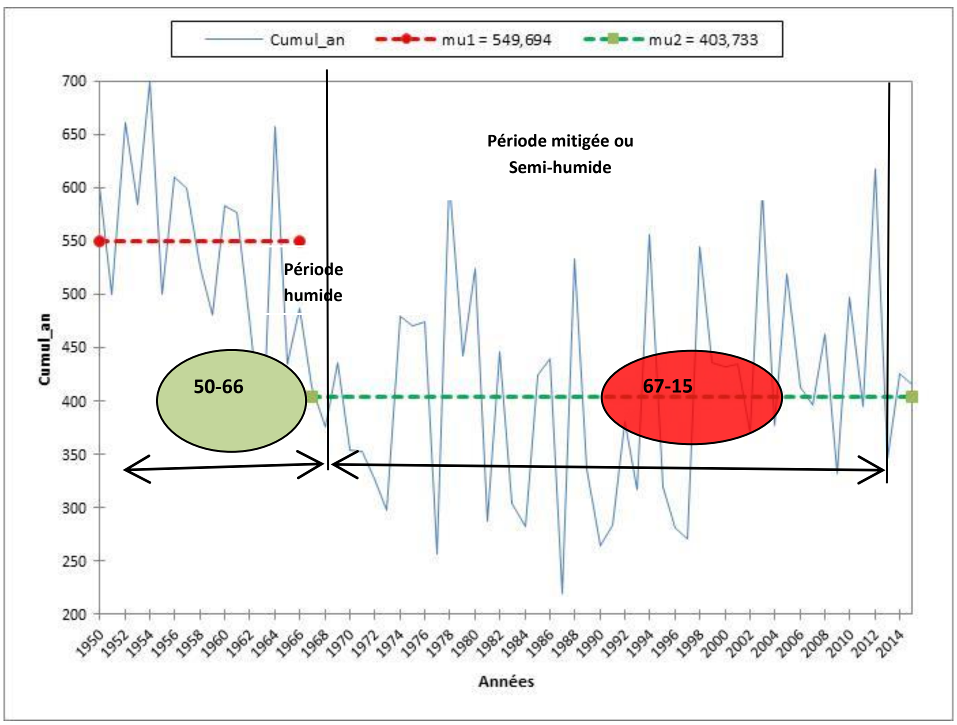

Fig. 2: Breakpoint test (using the Pettitt test) calculated on the rainfall series from the Magaria station (1950-2016).

2.2 Examples of lowland use and production factors

Interviews with farmers show that the lowlands are well used in the rainy and dry seasons for growing sugarcane, onions and cassava about the total area available (Figure 3). Given the constraints on site development, men are predominantly represented in farm work (76.7%), while women are more involved in household and domestic tasks. In the study area, there are few constraints on access to lowland land (70% of the farmers surveyed are landowners). The most common methods of acquiring land are inheritance (56.7%), loans (40%) and gifts (3.3%). But women, although very active in agricultural work, are marginalized in the acquisition of agricultural land because of the influence of religion, which confers very few rights on them compared with men. Nevertheless, on the sites sampled, partial control over water enabled women to organize themselves into groups on the sites. Labor is one of the determining factors in agricultural production, and is becoming increasingly scarce in the study area due to the prevalence of the exodus of young workers to Nigeria. The most commonly used method is family farming (46.7%), followed by mutual aid (28.4%) and salaried farming (12.4%). It should be noted that 78.3% of farming activities are self-financed.

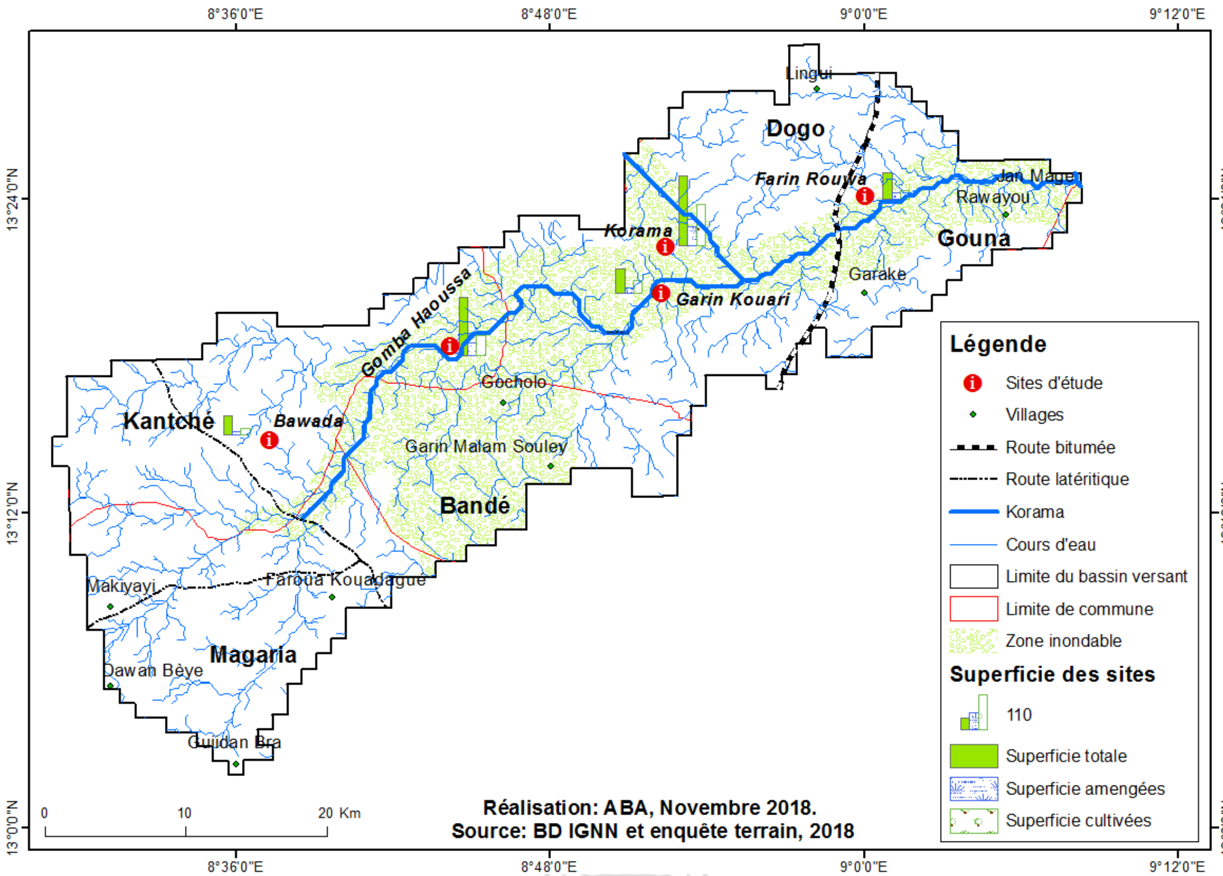

Fig. 3: Location of farm sites sampled for the field survey

2.3 Farming practices

The potential for lowland development in the Gomba Haoussa catchment is estimated at 138,374 hectares of the 263,986 hectares available (Bagna, 2016). Around 6,832 hectares (5%) are used to grow food crops (DRDA Zinder, 2016) and are also used for grazing in the dry season. On the other hand, sugar cane, squash, and cassava occupy a large proportion of the sown area (PRODAF, 2019). Lowlands are mainly used for sugarcane (84%). In the rainy season, crops are grown in combination (cereals + okra, tomatoes or other crops). Diversification is often a response to the cereal deficit in traditional crops such as millet and cowpea.

2.4. Economic characteristics of lowland farming

2.4.1. Increase in sown area and production

In the Gomba Haoussa watershed, 61.7% of farmers increased the area of their lowland farms during the 2021-2022 cropping seasons. Farmers with at least 2.5 ha (48.58%) and seed suppliers clear more than 0.5 ha per year (Source: Field survey conducted in 2021). The area sown is increasing every year due to a number of factors, including climatic crises. Yields vary from two tones at Garin Kouari to more than four tones at the Bawada site (mainly for seed). Average production in the catchment area was 2,701 kg per hectare in the 2020-2021 seasons. Around 76.67% of farmers obtained below-average yields, in line with the technical guidelines for agricultural developments with partial water control in Niger (DRA Zinder, 2016). However, in Mali, these same yields with total control in the lowlands reach 5 tonnes/ha (Traoré et *al.,* 2000). From the results in Table 1, we can conclude that the development and supervision of advisors and the presence of functional cooperatives are factors that favour good production (Sarr and Traoré, 2010). These factors make it possible to compensate for climatic and agronomic conditions that are un-favourable to sugarcane production. The use of agricultural inputs such as chemical fertilizers and herbicides largely determines these yields. The best sugarcane yields were obtained at the site where growers applied a suitable dose of fertilizer (between 200 and 300 kg/ha) and herbicide (1 to 2 liters/ha).

Table 1. Sugarcane production yields by site (kg/ha)

Names of the sites	**Minimum**	**Maximum**	**Moyenne**
Bawada	2733	8246	4200
Gomba Haoussa	3648	3254	2071
Garin Kouari	2042	2955	2230
Korama	1424	3466	2544
Farin Rouwa	2400	3253	2461
Moyenne	**2449**	**3146**	**2701**

Source: Fieldwork, 2021-2022

2.4.2. Gross production income and improvement in farmers' living conditions

The gross annual income of the lowland farmers surveyed per area sown is determined on the basis of the total value of production and the value of the various operating costs of the plots. Table 2 shows the income per sowing for the five inland valleys surveyed for the last three seasons. The average production income for the 2021-2021 seasons per farmer is 301,661 FCFA/ha. This result confirms that obtained in Falki in 2014, where income from irrigated crops in the managed lowlands was 380,448 FCFA/ha (PRODAF, 2019). It should be noted that income could be even higher if producers were to focus on processing and marketing cassava, in addition to selling the raw produce, and if they were to standardize the selling price on the semi-wholesale markets set up by PRODAF in 2019 in Bandé.

Table 2. Income from gross sugarcane production per site (FCFA/ha)

Nom des sites	**Minimum**	**Maximum**	**Somme**	**Moyenne**
Bawada	156 214	2 028 453	4 122 193	465 289
Gomba Haoussa	98 823	302 323	2 167 475	199 254
Garin Kouari	186 864	989 250	4 202 783	424 764
Korama	164 291	352 439	2 283 429	209 692
Farin Rouwa	156 358	281 027	1 818 357	209 307
Moyenne	**152 510**	**790 698**	**2 918 847**	**301 661**

Source: Fieldwork, 2021-2022

Moreover, gross income per area sown depends mainly on yields, the type of labor and the farmers' ability to finance their plot activities (operating costs). The lowlands of Bawada and Garin Kouari generated more income for farmers. Sugar cane and manioc growers have seen their incomes increase locally. The development of lowlands as a strategy for adapting to rainfall variability has helped to maintain agricultural production levels and ensure household food security. The agricultural production achieved in these lowlands thanks to development work and other project interventions such as PRODAF (Programme de Développement de l'Agriculture Familiale) and PASEC (Programme d'Appui à l'Agriculture Sensible au Climat) have improved agricultural yields, the availability and quality of produce and increased incomes. For the farmers interviewed, agricultural production in the lowlands ensures self-consumption of food (91.7%), access to healthcare (40%), children's schooling (61.87%), orders for agricultural inputs and equipment, and social expenses (weddings, christenings, deaths).

CONCLUSION

The analysis of rainfall patterns and indices confirms the perceptions of farmers in the rural communes of Bandé, Dogo, Gouna, Kantché, and Magaria in South Zinder. Lowland development is a strategy for adapting to rainfall variability in the Gomba Haoussa catchment. Land use remains predominantly male (56.7%), with farm sizes varying widely. Lowland development helps to reduce poverty by diversifying farming activities. Their use enables farmers to meet their vital and social needs.

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