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Endogenous adaptation strategies of WEME communities in the Aguegues commune facing annual flooding

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Abstract

The various changes in climatic parameters have direct and indirect consequences on the lives of communities, particularly those in areas that experience periodic flooding. This study aims to catalog the endogenous adaptation strategies employed by households in the Aguégués Commune to cope with annual flooding. The methodological approach is based on the data used, data collection via Kobo-Collect, their processing, and the analysis of results using the PEIR model. A total, of 71 households were surveyed as part of this research. The study results indicate ten (10) the endogenous adaptation strategies in the face of flooding in Aguégués. These include: cultivating on raised beds (15 %), repairing or building pirogues (10 %), pirogue transportation (20 %), installing drainage canals (5 %), building semi-permanent dwellings (17 %), traditional bridges installing (10 %), occupying public roads (5 %), premature harvesting (8 %), adopting short-cycle seeds (5 %) and temporary migration (5 %).

Keywords: Aguégués Commune; Wémè communities**;** Lakeside Communities**;** Annual Flooding; Endogenous Adaptation and Strategies

1. Introduction

In addition to the adverse effects of strong anthropization on natural ecosystems, hydro-climatic risks constitute one of the main natural calamities linked to climatic events. These events are characterized by a strong interannual irregularity in their abundance and spatial distribution. River regimes record very sensitive changes each year, resulting in flooding of riverbeds (E. Amoussou, 2010, cited by S.F. Hazounmè, 2020, p. 12).

Like most West African countries, Benin is subject to increasingly marked rainfall variability, which causes both droughts and floods that result in socio-economic and environmental damage (Y.C. Hountondji et *al*., 2011, p. 3). These events destroy an increasing number of financial and material assets. This is the case in southern Benin, particularly in the Lower Ouémé Valley, where the 2010 floods caused significant damage, with 0 % agricultural yield for several crops. Like other communes in the lower Ouémé valley, the Aguégués is severely affected by the consequences of annual flooding. It records damage in the educational, health, economic, agricultural, security and other sectors. Agricultural and commercial activities that sustain the inhabitants are in decline, marking living conditions difficult for households. These households are therefore forced to endure the disadvantages while implementing new adaptation strategies throughout the flood period.

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With an area of 103 km², it is located between 6°26'24''and 6°30'36''north latitude and between 2°28'48''and 2°33'36'' east longitude. It is a set of alluvial accumulation islets located in the lower part of the Ouémé river, submerged by floods for three to five months each year. The figure below (Figure 1) shows the geographical and administrative situation of the Aguégués municipality.

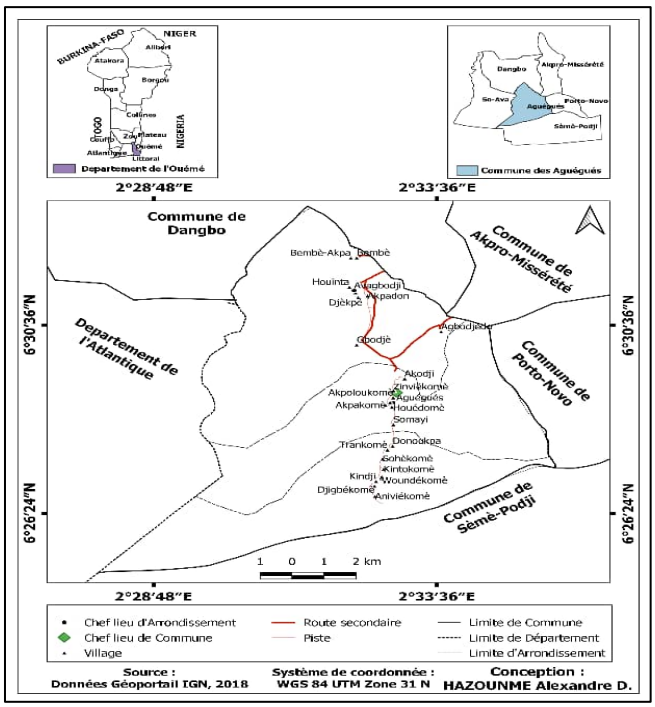


Figure 1 Geographical and administrative situations of the Aguégués communes

From figure 1, it emerges that the geographical situation predisposes the research area to a diversity of relief forms (valleys and marshes) that are highly favorable to flooding of households living conditions.

2. Methodological Approach

The methodological approach is based on four main phases: identifying the data, collecting them, processing them, and analyzing the results.

2.1. Data Collection

The data used in this study include socio-demographic data obtained from the General Censuses of Population and Housing (1979, 1992, 2002, and 2013), available from the National Institute of Statistics and Demography (INStaD). These data were used to study population trends and determine the sample size. In addition, socio-anthropological information relating to adaptation strategies was collected from local populations to better analyze the effectiveness (by order of importance) of the endogenous strategies implemented in response to flooding in the study area. Data collection involved determining the sample, and the use of tools and techniques for gathering information.

2.1.1. Sampling

The sample was drawn from two out of the three districts that make up the Aguégués municipality. Three villages were selected per district, for a total of 71 households surveyed. These households were directly affected by flooding and included farmers, livestock breeders, and traders. The sample size was determined using the formula of J.P. Beaud and B. Marien (2003). Table 1 presents the sample distribution by village.

Table 1 Distribution of the Sample by Village

Municipality	Districts	Villages	Number of Households	Surveyed	Rate (%)
Aguégués	Avagbodji	Houinta	808	19	27
		Akpadon	465	11	15
		Djèkpé	529	12	17
	Houédomè	Aholoukomè	513	12	17
		Zinviékomè	547	13	18
		Somayi	193	04	06
Total	02	06	3055	71	100

Source: INStaD (RGPH4, 2013)

From Table 1, it can be observed that two (2) districts and six (6) villages were selected, covering a total of 71 households surveyed in the study area. To conduct the surveys, various techniques were employed:

Direct observation was carried out to identify the origins of flooding in the municipality. Interviews were conducted to collect information from the target population on the adaptation strategies. Focus group discussions helped cross-check and supplement the data obtained from questionnaires during individual interviews. The tools and materials used for this study included a digital camera for taking field photos, and a questionnaire designed based on the main objective, to collect relevant information from households and key informants.

The data collected via Kobo-Collect were processed in Excel 2013 to generate graphs and tables illustrating the adaptation strategies. The data used were mostly qualitative and obtained from field observations. The relative importance (weight) of each adaptation strategy was calculated based on the real scores assigned by respondents. Ten bars, each representing 10 % of the total, were used to estimate these weights. The collected information was synthesized based on the total number of people interviewed who were directly concerned with the subject.

2.2. Data Analysis

The results obtained were analyzed using the PEIR model (Pressures-State-Impacts-Responses).

3. Results

The results reveal ten (10) endogenous adaptation strategies in the face of flooding in Aguégués. These include:

3.1. Cultivating on raised beds (15 %)

This technique involves installing crops on raised beds separated by ditches to protect them from flooding.

Image acquisition: D. A. Hazounmè, June 2024

Figure 1 Raised beds at Djèkpe

According to 70 % of surveyed households, this method is essential during the farming season preceding the flood episode. This strategy is estimated at 15 % of all adaptation methods used.

3.2. Repairing or building pirogues (10 %)

Repairing or constructing canoes is crucial in the area because they serve as the main means of transportation during floods. To avoid unpleasant surprises during peak flooding, 100 % of households ensure their canoes are in good condition before the heavy rains of June.

Image acquisition: S. F. Hazounmè, June 2024

Figure 2 Repairing or building pirogues

The cost of repairing an old canoe varies according to its condition, while the cost of building a new one ranges between 60,000 and 70,000 CFA francs, according to all interviewed carpenters. This strategy represents 10 % of the total.

3.3. Pirogue transportation (20 %)

During the entire flooding period, 100 % of households use canoes or motorized boats for transportation. Unlike the dry season, when canoes are used only for river crossings, during floods they become the only means of transport for people and goods, as well as for moving between households.

Images acquisition: S. F. Hazounmè, August 2024

Figure 3 Pirogue transportation

This strategy accounts for 20 %, making it the most important adaptation method in the area.

3.4. Installation of Water Drainage Canals (5 %)

To collect the first volumes of water overflowing from the river, groups of men from various settlements dig drainage canals that run through several villages.

Image acquisition: S. F. Hazounmè, June 2024

Figure 4 Installing of Water Drainage Canals

These traditional channels direct water toward uninhabited lowland areas, helping reduce stagnation. This strategy accounts for 5 %.

3.5. Construction of Semi-Permanent Dwellings (17 %)

Semi-permanent constructions consist of a cement foundation, upper parts made of temporary materials, and metal sheet roofing. According to 100 % of surveyed households, this strategy is essential to ensure the durability of stilt houses during and after flooding.

Image acquisition: S. F. Hazounmè, June 2024

Figure 5 Construction of Semi-Permanent Dwellings

About 50 % of the dwellings in the study area follow this model, making it a preferred construction type. This strategy accounts for 17 %.

3.6. Installing traditional bridges (10 %)

To access homes and churches during flooding, households and religious congregations build traditional footbridges. This method is mainly used by families who cannot afford a canoe for permanent use. The footbridges are made entirely of temporary materials and are removed in December once the water recedes.

Images acquisition: S. F. Hazounmè, September 2024

Figure 6 Installing traditional bridges

They significantly reduce the risk of drowning and represent 10 % of the adaptation strategies.

3.7. Occupying public roads (5 %)

During floods, only the main roads remain above water. Local traders occupy these spaces to continue their economic activities since their usual shops and stalls are submerged. This strategy ensures survival and business continuity for small traders.

Image acquisition: S. F. Hazounmè, September 2024

Figure 7 Occupying public roads

It represents 5 % of all strategies.

3.8. Early Harvesting (8%)

Due to the geographical position and soil characteristics of Aguégués, almost all fields are submerged during flooding. Consequently, crops such as pepper, okra, and sweet potato are harvested early (August–September) and immediately sold in local markets to avoid loss. All surveyed producers (100 %) adopt this strategy, which accounts for 8 %.

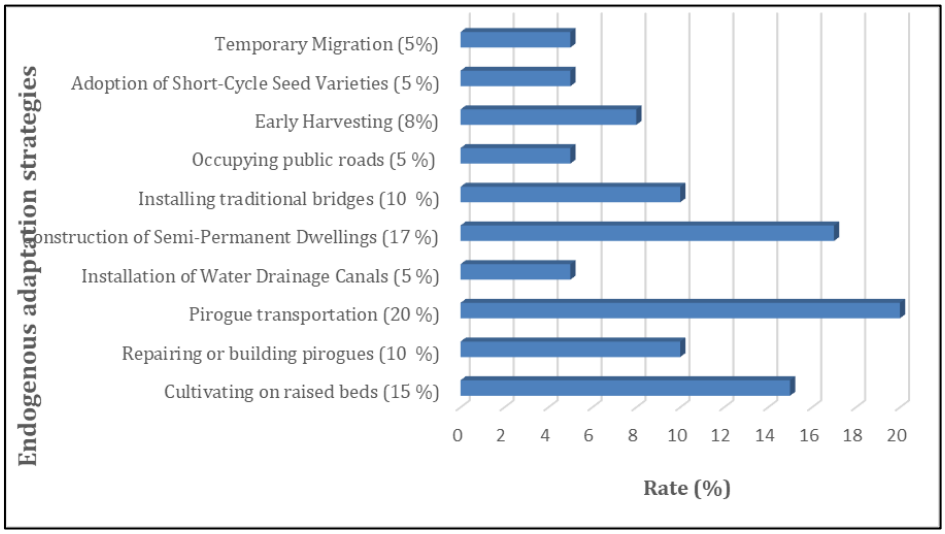
3.9. Adoption of Short-Cycle Seed Varieties (5 %)

- Farmers adopt short-cycle seeds (60–90 days) for various crops to minimize the risk of flooding before harvest.
- This strategy is implemented during the rainy season (June–July), preceding the major flooding period.
- It accounts for 5 % of all measures used.

3.10. Temporary Migration (5%)

According to 20 % of affected households, some residents temporarily leave the flood-prone area for nearby towns such as Dangbo, Akpro-Missérété, Porto-Novo, Cotonou, and even Nigeria, seeking refuge with friends or relatives. This strategy helps protect children from drowning, pregnant women from complications, and people with disabilities from

illness. Men often work as motorbike taxi drivers (Zémidjans) during migration, while women care for children and cook. Most migrants return home from October onward. This strategy represents 5 %.



Source: Field survey, 2023-2024

Figure 8 Weight of the Ten (10) Endogenous Adaptation Strategies

From Figure 8, five (5) major strategies are shown in yellow bars (at least 10%) with canoe transportation (20%) being the most dominant while five (5) minor strategies are shown in blue bars, with weights varying between 1% and 9%. The weights were estimated using ten bars, each representing 10% of the total.

4. Discussion

One of the consequences of climate variability is the rise in water levels caused by heavy rainfall, torrential rains, and high temperatures. These phenomena, though dangerous, are no longer new to human existence and originate from both climatic dynamics and human activities. As in most West African countries, Benin is exposed to increasing rainfall variability, leading to floods that cause socio-economic and environmental damage (P. Ozer *et al*., 2010). While flooding can bring certain benefits, it also causes significant harm. Communities have therefore developed local strategies to minimize its negative impacts. This study aimed to identify and document such endogenous adaptation strategies among the households of Aguégués Municipality. According to H. Dénis (2002), societies are vulnerable to both natural and human-induced disasters, which can damage built environments and cause internal displacement. Similarly, households located in flood-prone zones of the Lower Ouémé Valley (BVO) are highly vulnerable, as confirmed by S.F. Hazounmè (2020).

S. Berton (1988), cited by A. Yessouffou (2015), recommends building small and micro-dams in West Africa to control floods that disturb inhabitants of lowland regions. In the same vein, the affected households of Aguégués lacking the means to migrate have accumulated knowledge that enables them to develop the various strategies presented in this article. This highlights the importance and resilience of local adaptation practices in flood-prone environments.

5. Conclusion

At the end of this research, it appears that the Wémè communities of Aguégués Municipality have developed ten (10) endogenous adaptation strategies to face annual flooding. These include: Cultivation on raised beds, Canoe repair or construction, Movement by canoe, Installation of water drainage canal, Construction of semi-permanent dwellings, Installation of traditional footbridges, Occupation of public roads, Early harvesting, Adoption of short-cycle seeds and Temporary migration. These strategies demonstrate the communities' ability to adapt to the recurring floods that threaten their livelihoods and environment. They represent practical, locally inspired solutions for survival in the face of climatic challenges.

Compliance with ethical standard

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Disclosure of conflict of interest

The authors declare that they have no conflicts of interest related to this study. This study as approved by the Ethics Committee of University of Abomey-Calavi in Benin Republic. Informed consent was obtained from all participants before the interviews and observations. Participants were informed of the study objective, their right to withdraw at any time, and that their data would remain confidential.

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