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RESEARCH ARTICLE

INFLUENCE OF CLIMATIC ACCIDENTS ON THE FREQUENCY OF CROP REGROWTH IN THE KABOUA DISTRICT (SAVE COMMUNE), BENIN

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Abstract

The Kaboua arrondissement is facing increasing challenges related to climate incidents, such as droughts, floods, and temperature variations. These events disrupt not only traditional cropping cycles but also affect the frequency of crop regrowth, which is essential for food security and the income of local farmers. The general objective of this research is to analyze the influence of climate incidents on crop regrowth in the study area. The data used include rainfall heights from 1928 to 2018, as well as maximum and minimum temperatures from 1961 to 2018, all sourced from the Savè meteorological station. This data was collected from Météo-Bénin. Additionally, a survey was conducted among the population of the Kaboua arrondissement to correlate meteorological data with local field observations. The results of this research showed that climate change alters the rainy seasons and growing periods, leading to crop losses and difficulties in maintaining sustainable crop regrowth. It is essential to emphasize that regrowth plays a key role in helping producers cope with food insecurity during the lean season. Furthermore, according to 95% of the surveyed producers, it also helps meet their financial needs. Regrowth is also crucial in the soil fertility cycle, serving as a vital link in the conservation and regeneration of nutrients necessary for crop growth. Its impact on soil health and quality is fundamental to maintaining long-term agricultural productivity.

Introduction:-

Agriculture is the cornerstone of the Beninese economy. It employs approximately 50% of the workforce and contributes 28%, 77%, and 15% to Gross Domestic Product (GDP), export revenues, and public revenues, respectively (MAEP, 2020). Furthermore, agriculture is vital for the development of the secondary and tertiary sectors due to its production of raw materials (Bjornlund et al., 2020). The population of Benin is increasing, and to meet the growing demand for agricultural products, farmers are intensifying their production by shortening fallow periods. This diminishes the natural capacity for soil fertility regeneration (Westerberg et al., 2017).

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Additionally, inappropriate agricultural practices and climate change reduce soil productivity and contribute to land degradation, food insecurity, and conflicts between farmers and herders (Honfoga, 2018). According to national statistics, agricultural yields have significantly decreased in recent years for all crops, except for vegetable crops such as tomatoes and peppers. At the same time, agricultural production has considerably increased due to a significant rise in cultivated areas at the expense of forests and other state-owned lands.

Firstly, crop regrowth plays a crucial role in maintaining soil fertility. It captures residual nutrients in the soil, preventing leaching and making them available for subsequent crops. Moreover, certain cover crops have the ability to fix atmospheric nitrogen, enriching the soil with essential nutrients without resorting to expensive and potentially polluting chemical fertilizers (Serpantié et al., 2001).

Furthermore, crop regrowth helps prevent soil erosion by protecting it from the erosive action of wind and water. Their extensive root systems improve soil structure, increasing its capacity to retain moisture and resist erosion. Thus, the presence of crop regrowth contributes to soil conservation, a major issue for the long-term sustainability of agricultural systems.

Moreover, crop regrowth promotes biodiversity and the health of agricultural ecosystems. It provides habitat and food for a variety of beneficial organisms such as pollinators, biological pest control agents, and soil organisms, thus helping to maintain an ecological balance in cultivated fields (Launay, 2015). It is also important to note that crop regrowth plays a crucial role in mitigating climate change. By sequestering atmospheric carbon in the soil, it helps reduce greenhouse gas emissions, thereby assisting in limiting global warming. Additionally, its presence increases the resilience of agricultural systems to extreme weather events such as droughts and floods by improving the soil's capacity to retain water and regulate temperature (Hopkins et al., 2020).

The frequency of crop regrowth in modern agriculture should not be overlooked. Its thoughtful integration into agricultural practices can provide multiple benefits, ranging from soil fertility preservation to carbon emission reduction. Recognizing and promoting the importance of crop regrowth in agricultural systems is essential for ensuring the sustainability and resilience of agricultural practices in the face of current and future challenges.

The research area is located between 7°40’ and 8°21’ north latitude and between 2°20’ and 2°45’ east longitude. It is situated in the center of Benin and comprises eight villages: Alafia, Atesse, Bako, Gogoro, Oke Olou I, Montewo, and Oke Olou II (see Figure 1).

Methodology:-

Data Used

The data utilized includes rainfall heights from 1928 to 2018, as well as maximum and minimum temperatures from 1961 to 2018, all sourced from the Savè meteorological station. This data was collected from Météo-Bénin. Additionally, a survey was conducted among the population of the Kaboua district to correlate the meteorological data with local observations on the ground.

Determination of Sample Size

The sample size was determined using Cochran's method. The formula is as follows:

$$n_0 = \frac{Z^2 \cdot p \cdot (1-p)}{e^2}$$

Where:

- **n_0**: initial sample size
- **Z**: Z-score corresponding to the confidence level (for example, 1.96 for 95%)
- **p**: estimated proportion of the population that possesses the characteristic being studied
- **e**: margin of error or desired precision (in decimal form)

This table illustrates the distribution of household heads surveyed by village.

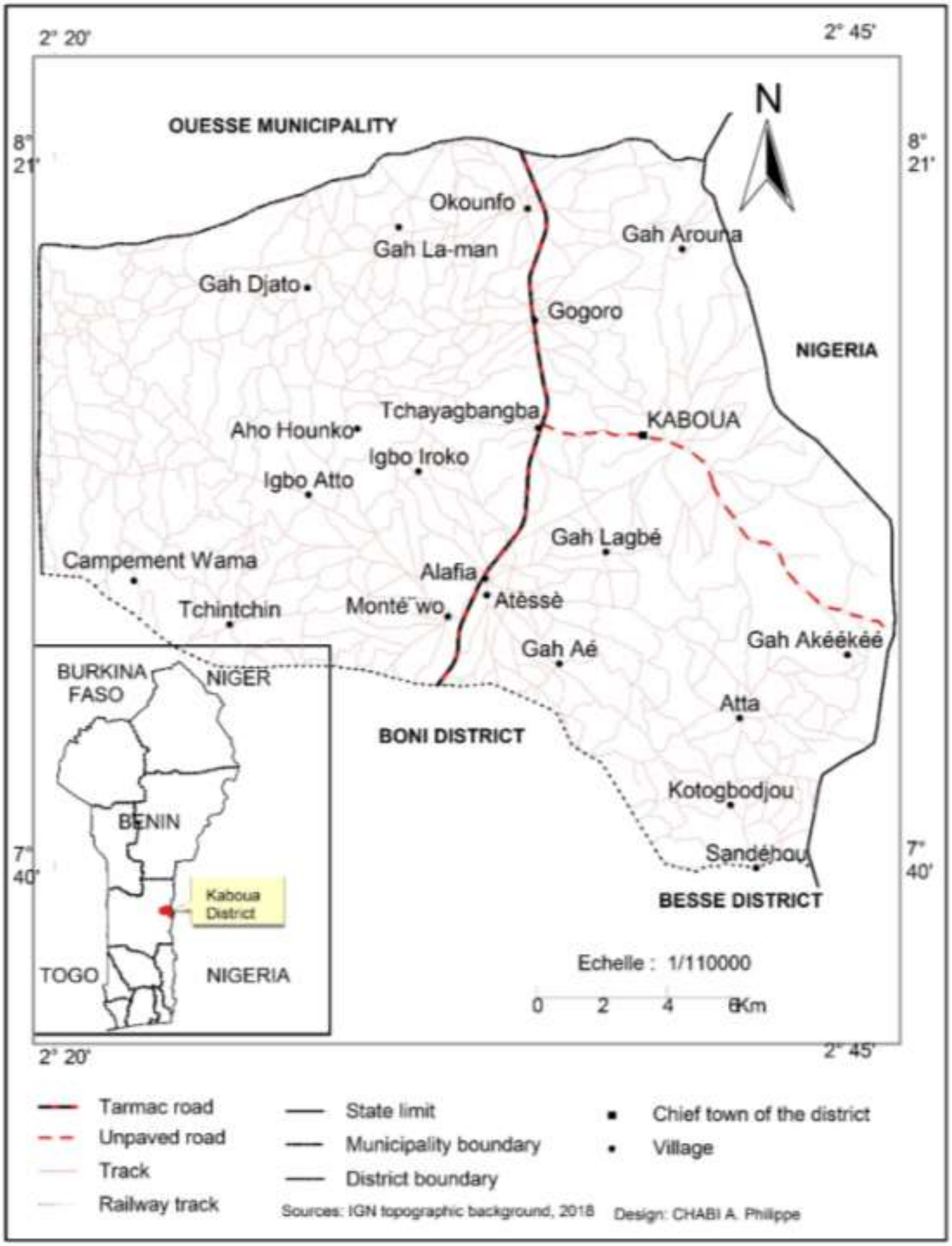

Figure 1:- Geographic Location of the Research Area.

Table I:- Distribution of Surveyed Household Heads by Village.

Village	**Total population**	**total households**	**Number of surveyed household heads by village**
ALAFIA	1758	369	20
ATESSE	1493	286	10
BAKO	1775	274	15
GOGORO	1619	305	18

MONTEWO	1158	234	12
OKOUNFO	2952	438	25
OKE OLOU I	1357	401	22
OKE OLOU II	1917	237	20
TOTAL	14029	2544	122

Source: RGPH, 2013 and field survey 2023

Data Collection:-

Data collection took place in 2023 across several villages in the Kaboua district. This initiative aimed to gather information on past and present crop regrowth. Data was collected through surveys of farmers, field observations, and climatic records from the Savè meteorological station.

Analysis of Climate Accidents

Climate accidents, such as droughts and floods, were identified based on meteorological records and farmers' testimonies. Each climate accident was classified according to its severity and duration. This classification allowed for the determination of the influences of surplus and deficit years on crop regrowth in the research area.

Results and Discussion:-

Rainfall Regime

Figure 2 illustrates the rainfall regime of the research area.

Please insert Figure 2 here to provide a visual representation of the rainfall data.

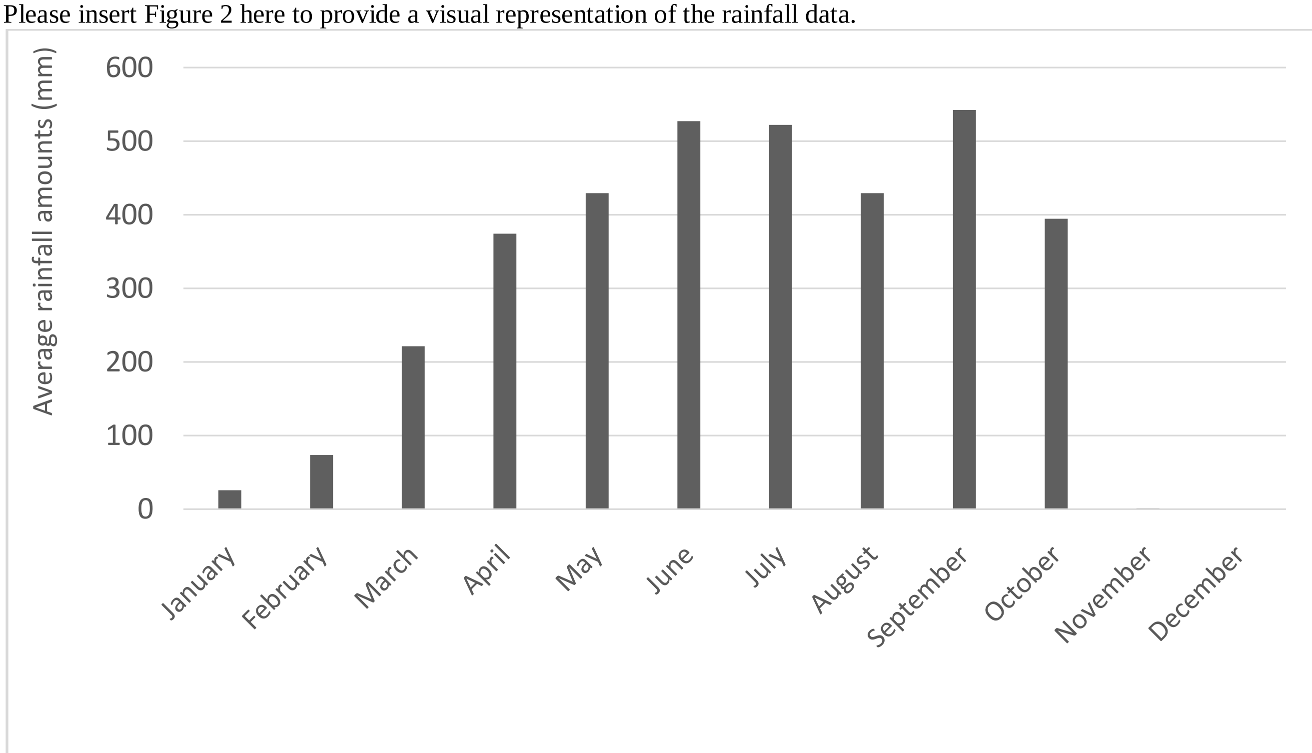

Figure 2:- Rainfall Regime of the Research Area.

The analysis of Figure 2 reveals that the rainfall regime of the research area is unimodal, characterized by a long rainy season extending from March to October, followed by a prolonged dry season from November to February. The recorded rainfall in June, July, and October is particularly significant, with amounts of 527.62 mm, 522.25 mm, and 542.73 mm, respectively. In contrast, the amounts recorded in March and April are lower, marking the beginning of the rainy season in the research area. This period also corresponds to the arrival of the meteorological equator, and it is only after its prolonged passage that abundant rainfall is observed. This rainfall regime is particularly favorable for crop regrowth.

It is important to analyze the interannual variability of rainfall amounts in the research area

Interannual Variability of Rainfall Amounts
Figure 3 presents the interannual variability of total rainfall in the research area.
Please insert Figure 3 here to provide a visual representation of the interannual rainfall data**.**

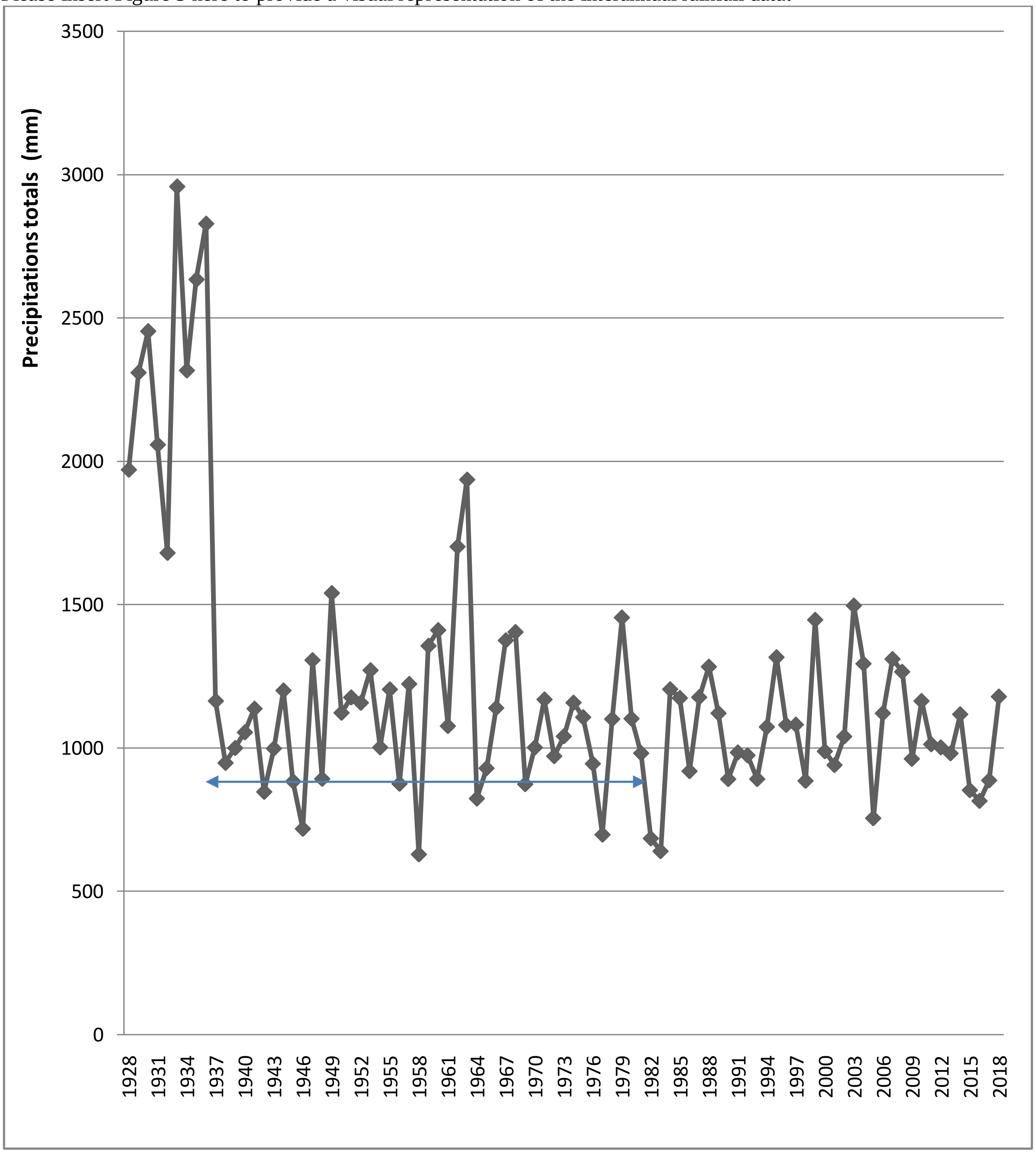

Figure 3:- Interannual Variability of Total Rainfall in the Research Area.

From the analysis of Figure 3, it is evident that the total rainfall in the research area varies considerably from year to year. Notably, the years 1932, 1963, 1933, and 2003 stand out with high rainfall amounts, reaching 2958.1 mm, 1935.9 mm, 1680.5 mm, and 1496.8 mm, respectively. In contrast, the years 1958 and 2005 recorded lower rainfall amounts, with 629.2 mm and 755.2 mm, respectively. These abundant rainfall amounts are generally favorable for the development of crop regrowth in the research area.

Now, let's examine the temperatures observed in the research area.

Interannual Variability of Maximum and Minimum Temperatures

Figure 4 illustrates the maximum and minimum temperatures in the research area.

Please insert Figure 4 here to provide a visual representation of the temperature data**.**

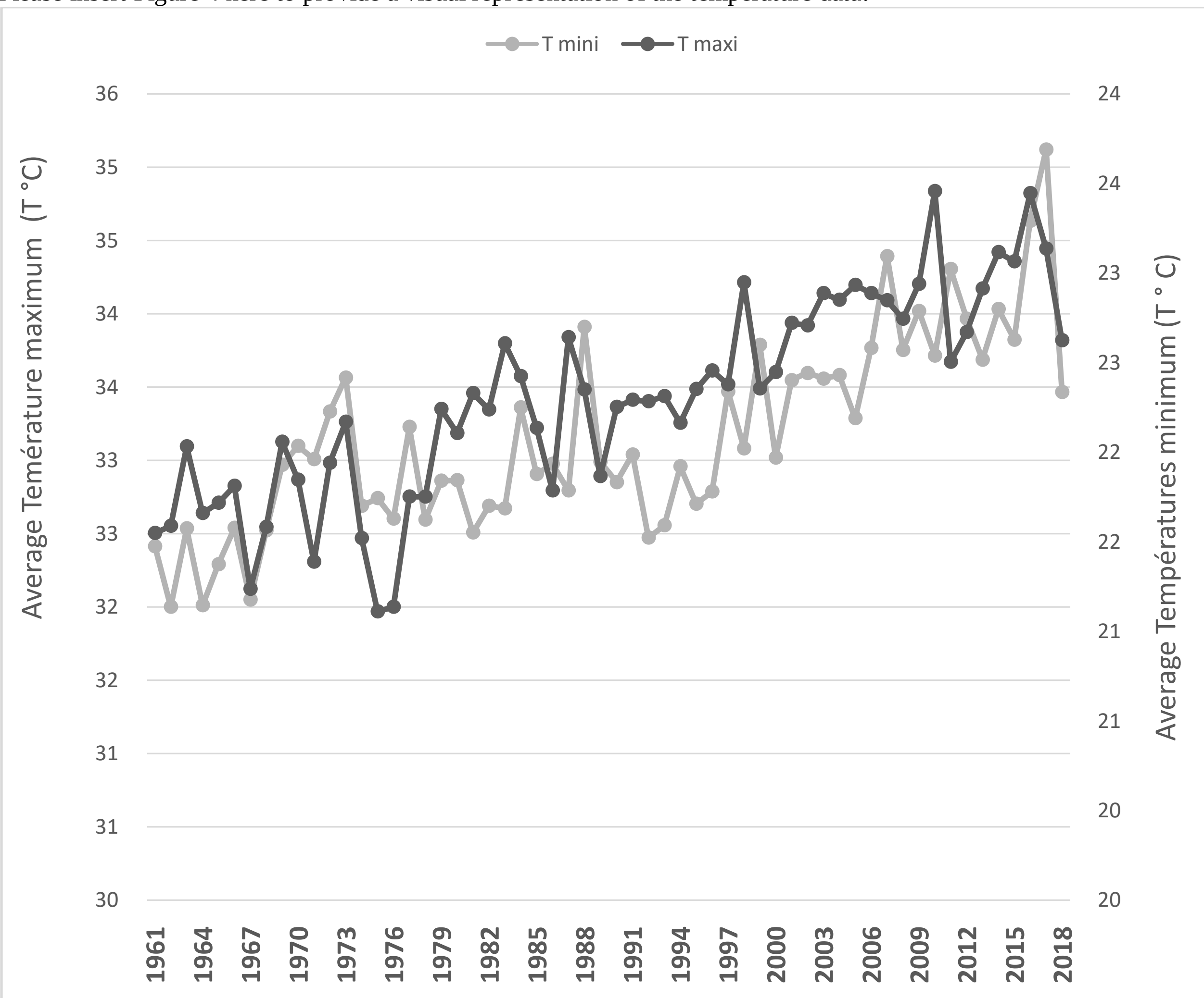

Figure 4:- Interannual Variability of Maximum and Minimum Temperatures.

The analysis of Figure 4 shows that both maximum and minimum temperatures exhibit interannual variations. The highest maximum temperatures were recorded in 1962 and 2017, reaching 32°C and 35.2°C, respectively. Conversely, the lowest temperatures were observed in 1975 and 2010, with values of 21.11°C and 23.46°C, respectively.

It is important to highlight that these thermal variations play a crucial role in the different phases of development and flowering of crop regrowth in the research area. One may also question the impact of rainfall indices, which represent one of the key factors of climate accidents, on the regeneration of crop regrowth in the research area. These indices, interacting with other climatic variables, significantly influence the growth, flowering, and resilience of crops in the face of extreme weather conditions.

Rainfall Indices in the Research Area

Figure 5 illustrates the rainfall indices, which are one of the key factors contributing to climate accidents in the research area.

Please insert Figure 5 here to provide a visual representation of the rainfall indices data.

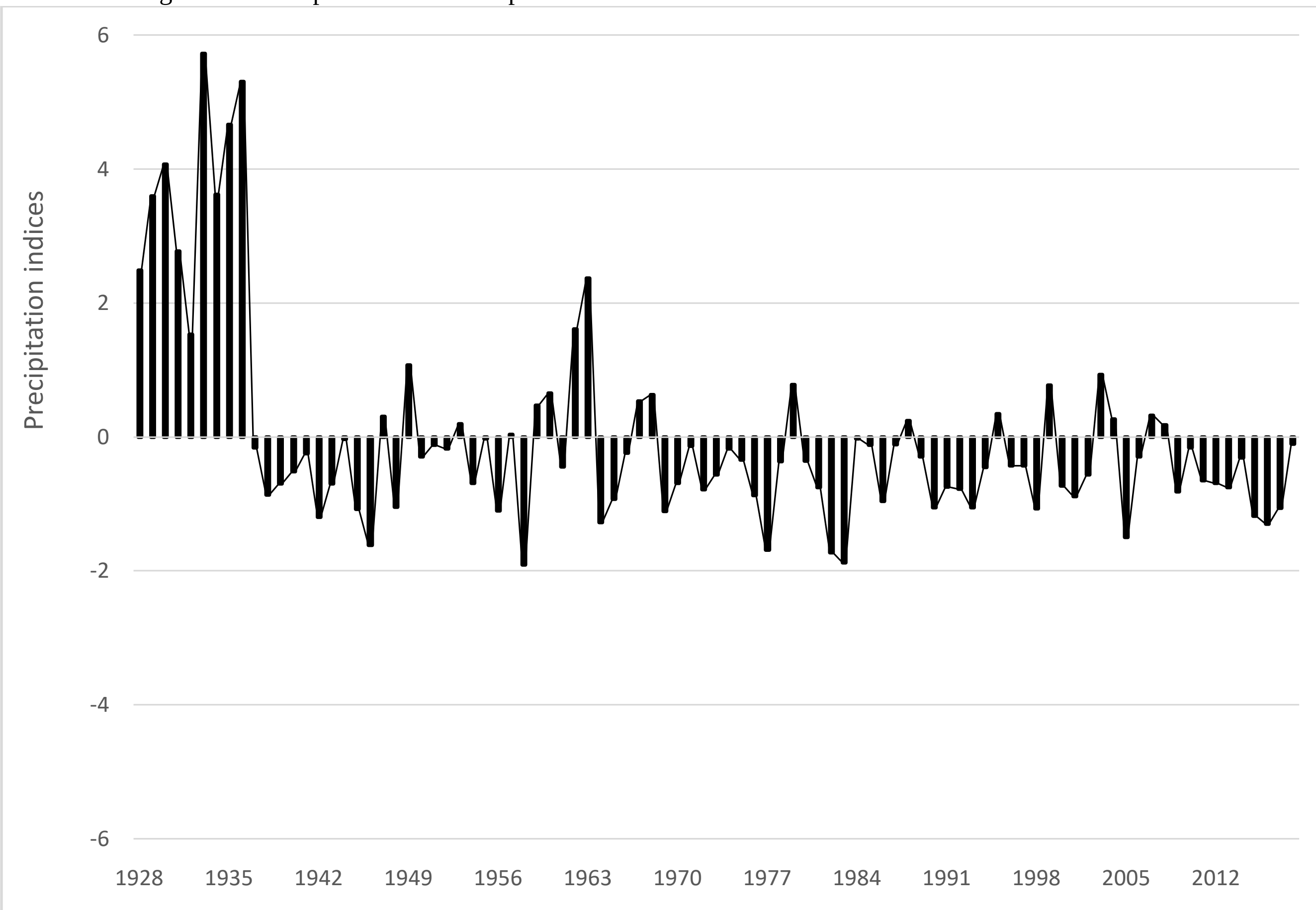

Figure 5:- Rainfall Indices in the Research Area.

Observing Figure 5 reveals that between 1928 and 1935, rainfall surpluses were recorded in the research area. However, from 1936 to 2018, the area experienced rainfall deficits, with only a few surplus years. This observation suggests that demographic pressure may impact the quantities of observed rainfall. Furthermore, these variations, whether surplus or deficit, directly influence the regeneration of crops. During periods of abundance, excess water can hinder germination, while deficit periods expose crops to significant water stress.

It is important to analyze some frequencies of crop regrowth.

Analysis of the Frequency of Certain Crop Regrowths in the Research Area

Three cultivated plant species have been identified in the crop regrowths within the research area: pepper, peanut, and cassava.

Crop Regrowths from 1980 to 1999

Figure 6 presents the frequency of crop regrowths in the research area.

Please insert Figure 6 here to provide a visual representation of the crop regrowth data from 1980 to 1999.

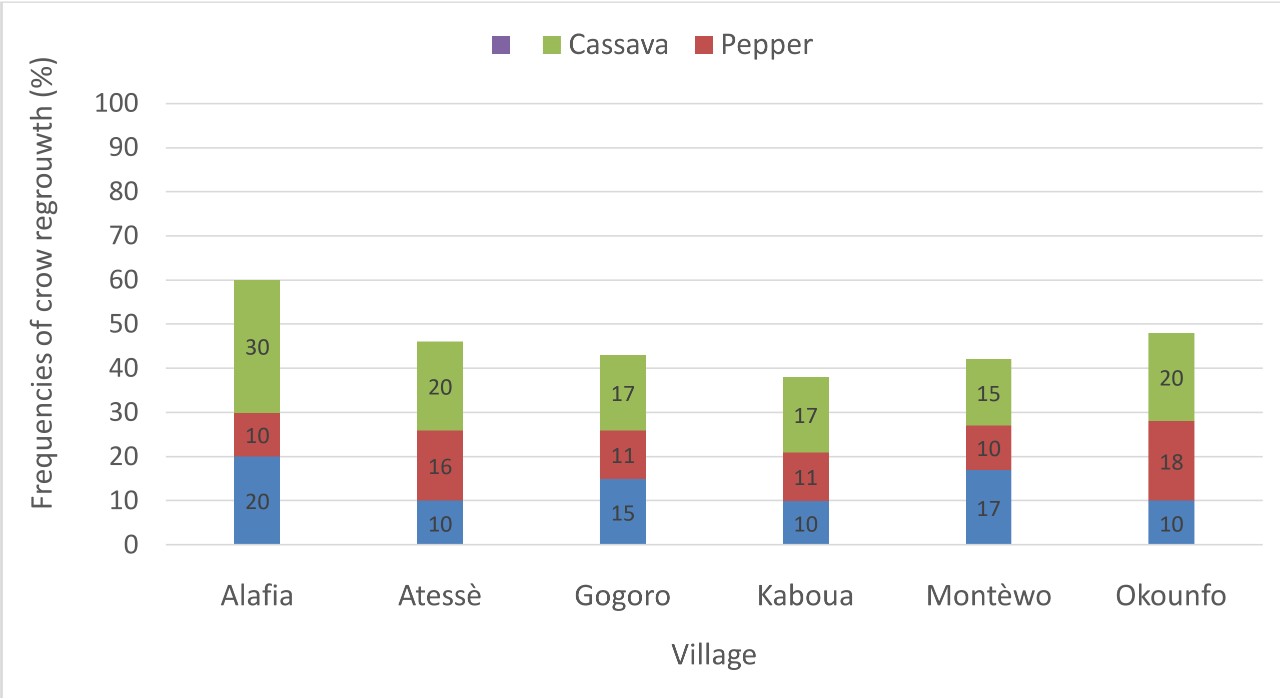

Figure 6:- Frequency of Crop Regrowths in the Kaboua District.

From the analysis of Figure 6, it is evident that the frequency of crop regrowths varies significantly from one village to another. For instance, the frequency of peanut and cassava regrowths is notably higher in Alafia, reaching 30% and 20% respectively, compared to other villages. In contrast, the village of Montewo shows the lowest proportion of cassava regrowth. It is relevant to question the reasons behind this low proportion in other localities. In the Kaboua district, it is also important to note that only 30% of producers engage in the practice of crop regrowths.

Crop Regrowths from 2000 to 2018

Figure 7 presents the frequency of crop regrowths in the Kaboua district from 2000 to 2018.

Please insert Figure 7 here to provide a visual representation of the crop regrowth data from 2000 to 2018.

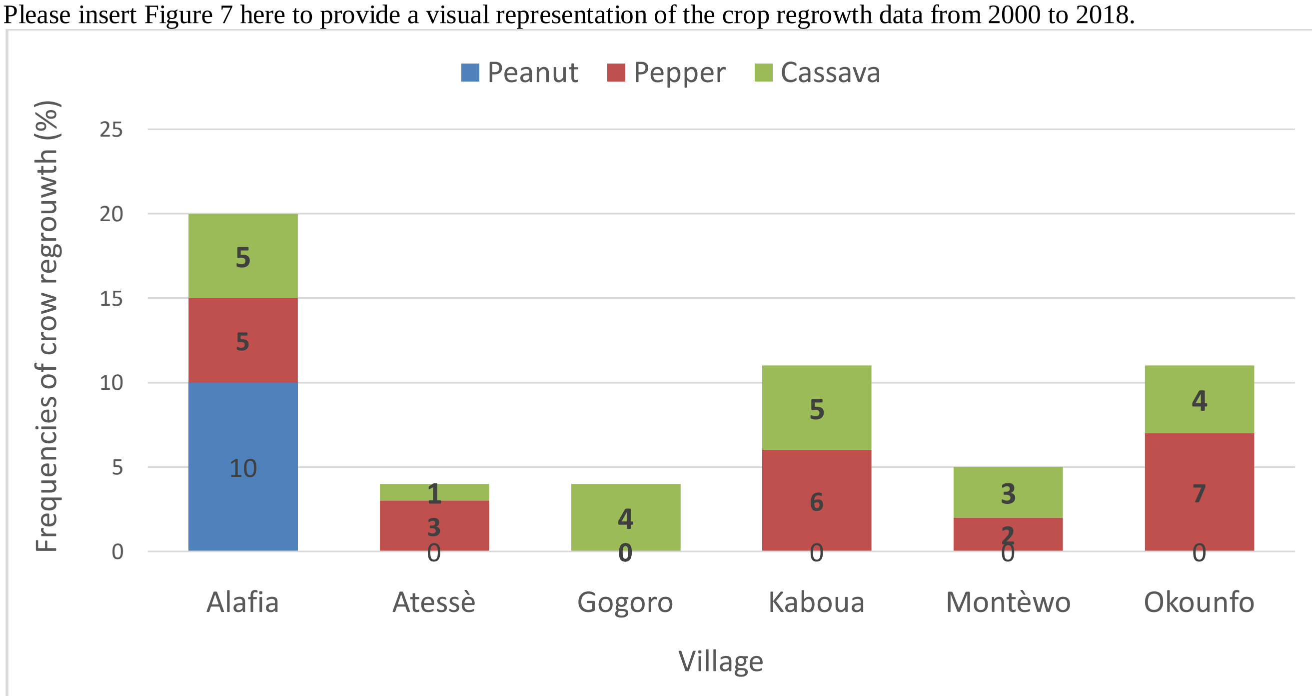

Figure 7:- Frequency of Crop Regrowths in the Kaboua District (2000-2018).

The analysis of Figure 7 reveals that crop regrowths are declining in the research area, with particularly low frequencies, except for cassava regrowths, which reach a frequency of 10% in Alafia. According to 90% of the producers surveyed, this gradual disappearance of regrowths can be attributed to the low engagement of youth in agriculture, with only 20% of them dedicating themselves to it. In fact, 80% of young people prefer to turn to activities such as motorcycle taxis and informal trade.

It should also be noted that climate change, characterized by dwindling rainfall, drought pockets, and early cessation of precipitation, significantly contributes to the decrease in crop regrowths in the research area.

Figure 1 illustrates some crop regrowths in the research area.

Plate 1:- Crop Regrowths in the Research Area.
Photographer: CHABI, April 2020

The observation of Plate 1 indicates that Photo A illustrates cassava regrowth in a producer's field in Alafia, while Photo B presents peanut regrowth from a producer in Kaboua. It is essential to emphasize that these regrowths play a key role in helping producers cope with food insecurity during the lean season. Furthermore, according to 95% of the producers surveyed, they also help meet their financial needs.

In summary, crop regrowths are of paramount importance for producers in the research area.

Plate 2 presents products derived from cassava cultivation, displayed for sale by female traders in the Alafia market. These products underscore the economic significance of crop regrowths for the inhabitants of the research area, particularly for women, who play a central role in the processing and marketing of these goods.

Please insert Plate 2 here to provide a visual representation of the cassava products.

Plate 2:- Sale of Products Derived from Crop Regrowths in Alafia.
Photographer : CHABI, April 2020

It is important to note that crop regrowths play a significant role in soil fertilization.
Please insert the image of the products for sale here.

Role of Crop Regrowths in Soil Fertility Cycle

Crop regrowths play an essential role in the soil fertility cycle, constituting a vital link in the conservation and regeneration of nutrients necessary for crop growth. Their impact on soil health and quality is fundamental to maintaining long-term agricultural productivity.

Crop regrowths act as agents for fixing atmospheric nitrogen. Plants from the legume family, often used as cover crops or regrowths, have the unique ability to form a symbiosis with rhizobial bacteria, which fix atmospheric nitrogen into the soil in a form that is assimilable by plants. Thus, when these regrowths are incorporated into the soil after their growth, they actively enrich the soil with nitrogen, a crucial element for the growth of subsequent crops. These findings align with those obtained by Voisin et al. (2015), which demonstrated that legumes have a high plasticity to utilize nitrogen fixation from the air or absorb mineral nitrogen from the soil.

It is also important to note that crop regrowths contribute to improving soil structure. Their extensive root systems penetrate deeply into the soil, creating channels that enhance air and water circulation. This increased aeration and water infiltration allow for better nutrient retention in the soil, reducing nutrient leaching and promoting their availability for plants.

Finally, crop regrowths serve as protective agents for the soil against erosion. By covering the soil after the harvest of main crops, regrowths reduce the impact of rainfall and wind, thereby limiting soil erosion and nutrient leaching. This vegetative cover also helps maintain soil structure, preventing the formation of surface crusts that can compromise water infiltration and plant growth.

Additionally, crop regrowths promote soil biodiversity. Their roots provide habitat for a multitude of beneficial microorganisms, such as bacteria, fungi, and earthworms, which contribute to the decomposition of organic matter, nutrient release, and suppression of soil pathogens. This biological diversity enhances soil resilience and its capacity to support crop growth.

Conclusion and Recommendations:-

In conclusion, it is noteworthy that the frequency of crop regrowth varies significantly from one village to another. For instance, the frequency of peanut and cassava regrowth is considerably higher in Alafia, reaching 30% and 20% respectively, compared to other villages. In contrast, the village of Montewo shows the lowest proportion of cassava regrowth.

It is important to point out that crop regrowth is declining in the research area, with particularly low frequencies, except for cassava regrowth, which reaches a frequency of 10% in Alafia. According to 90% of the producers surveyed, this gradual disappearance of regrowth can be attributed to the low engagement of youth in agriculture, with only 20% of them dedicating themselves to it. In fact, 80% of young people prefer to turn to activities like motorcycle taxis and informal trade. Additionally, climate change, characterized by dwindling rainfall, drought pockets, and early cessation of precipitation, significantly contributes to the decrease in crop regrowth in the research area.

Given the importance of crop regrowth, it deserves to be encouraged. To do this, it is crucial to adopt innovative strategies that promote understanding of their benefits and facilitate their adoption by farmers. Here are some approaches to promote the use of regrowth in agricultural systems:

- Promotion of Research and Development: Invest in agronomic research to understand the specific benefits of regrowth in different agricultural contexts, including the study of the most suitable regrowth species for each region, their effects on soil health, and their interaction with main crops.
- Development of Adapted Varieties: Encourage the selection and development of regrowth varieties that meet the specific needs of farmers, particularly in terms of disease resistance, tolerance to challenging environmental conditions, and ease of management.
- Awareness and Training: Organize awareness and training programs for farmers, agricultural advisors, and sector professionals on the benefits of regrowth and appropriate management techniques, including field demonstrations and online educational resources.

- Public-Private Partnerships: Facilitate partnerships between governments, NGOs, private companies, and research institutions to promote the integration of regrowth into agricultural practices, thereby supporting research and the development of innovative technologies.
- Certification and Labeling: Establish certification and labeling programs for agricultural products grown with regrowth to raise consumer awareness of the environmental and social benefits of these practices.
- Sharing Best Practices: Encourage the sharing of best practices among farmers and agricultural communities through farmer networks, online forums, and discussion groups, highlighting testimonials from farmers who have successfully integrated regrowth into their agricultural systems.

These recommendations aim to strengthen the inclusion of crop regrowth in agricultural practices, thereby contributing to the sustainability and resilience of agricultural systems in the face of current challenges

Références Bibliographiques:-

1. Agossou, E., & Houngbo, F. (2022). Impact of climate change on agriculture in Benin: A case study of the commune of Savè*. Journal of Climate Change and Agriculture, 15(3), 210-225.
2. Anne-Sophie Voisin, Pierre Cellier, Marie-Hélène Jeuffroy. Functioning of the N2-fixing symbiosis of seed legumes: Agronomic and environmental impacts. Innovations Agronomiques, 2015, 43, pp.139-160. ffhal-01173363f
3. Bjornlund, V., Bjornlund, H., & Van Rooyen, A. F. (2020). Why agricultural production in sub-Saharan Africa remains low compared to the rest of the world: A historical perspective. International Journal of Water Resources Development, 36(sup1), S20-S53.
4. François Leclerc (2022): Optimizing agricultural productivity through regrowth: A case study in Zinvie, Benin, 22p
5. Gnonlonfin, G., & Ahanhanzo, C. (2021). Crop regeneration and climatic accidents in West Africa: The case of Benin*. Agricultural Research and Development, 9(2), 98-114.
6. Honfoga, B. G. (2018). Diagnosing soil degradation and fertilizer use relationship for sustainable cotton production in Benin. Cogent Environmental Science, 4(1), 1422366. https://doi.org/10.1080/23311843.2017.1422366
7. Hopkins, A., McKellar, R., Worboys, G. L., & Good, R. (2020). Climate change and protected areas, 69p
8. Houngan, L., & Dossou, S. (2020). Resilient agricultural practices in the face of extreme climatic conditions in central Benin*. Bénin Journal of Agricultural Sciences, 12(1), 67-81.
9. Jeanne Dubois (2023). The crucial role of regrowth in modern agriculture: An underestimated perspective, 15p
10. Launay, J. (2015). For our earth, choosing sustainable agriculture... ecological & Plant dyes: Nature and Environment. Édilivre, 99p
11. Serpantié, G., Ouattara, B., Louppe, D., Sougafara, B., Gnahoua, G. M., & Ouattara, N. (2001). Fertility and fallows in West Africa. Fallow land in tropical Africa, 2, 21-83.
12. Westerberg, V., Golay, A., Houndekon, V. & Costa, L. (2017). The economics of land degradation, the case of the commune of Banikoara. Is cotton really the white gold in Banikoara? A publication by German Cooperation and the Economics of Land Degradation Initiative available at www.eld-initiative.org.