

Agricultural Risks and Social Vulnerability in Rural Areas in the Commune of Houéyogbé in South-Benin

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Abstract

The present research aims at studying the social vulnerability of the agricultural risks in the Commune of Houéyogbé. The methodological step used is articulated around the analysis and, their treatment data-gathering of the results. The data-gathering consisted of the information retrieval and of investigation of ground by using the individual talks and the method of x-ray group. The statistics heights of rains and the data hydrometric of the period 1981-2010 then the pedo-geomorphological and agricultural data of same period (SCDA Houéyogbé) made it possible to study the agricultural risks. The data and information resulting from the information retrieval and the socio-anthropological investigations made it possible to apprehend the social vulnerability of the rural populations to the agricultural risks. The matrix of appreciation of the vulnerability made it possible to determine the current and future vulnerability rural communities (for example, the level of high impact and low capacity of adaptation give the high level of vulnerability). With the latter, the strategies of mitigation locally installation are added (early harvest, temporary migration towards the no flooded grounds, etc). Moreover, the data and information relating to the agricultural risk management collected with the seat of the specialized organizations such as the ANPC and Caritas-Benign made it possible to propose suitable mechanisms of management.

Key words: Impact; Malnutrition; adaptability; rural communities; migration.

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1. Introduction

No country, whatever its level of development, is immune to social evils, the unpredictability of which requires man to constantly seek appropriate solutions in order to face them effectively. The worsening consequences of disasters are due to two major factors, namely: climate change and urban expansion linked to population growth and rural exodus. This situation explains the destruction of crops and the difficulties in preserving agricultural products, thus creating a shortfall for producers [1]. Thus, subsistence agriculture, land, biodiversity, water resources and human health constitute the factors most exposed to agricultural risks in Benin. Therefore, the socio-professional groups most at risk are represented by small farmers, fishermen and pastoralists. Food insecurity and widespread poverty in sub-Saharan Africa today are increasingly leading populations, especially rural populations, to exert pressure on natural resources with all the environmental consequences [2]. These realities are occurring more and more in the rural commune of Houéyogbé, in southern Benin in recent decades.. It is necessary to strengthen the capacity of the rural populations of the Commune of Houéyogbé to manage the agricultural risks they also face and to reduce their degree of exposure and vulnerability in this regard. Given the predominance of agricultural activity in this poor environment, this study will be strongly focused on the social vulnerability of populations to agricultural risks and the presentation of the strategies implemented. What are the determinants of agricultural risks in the Municipality of Houéyogbé? Can agricultural risks be factors of social vulnerability of the populations of the Commune of Houéyogbé? What are the adaptation strategies in the face of agricultural risks in the Municipality of Houéyogbé?

2. Presentation of the study environment

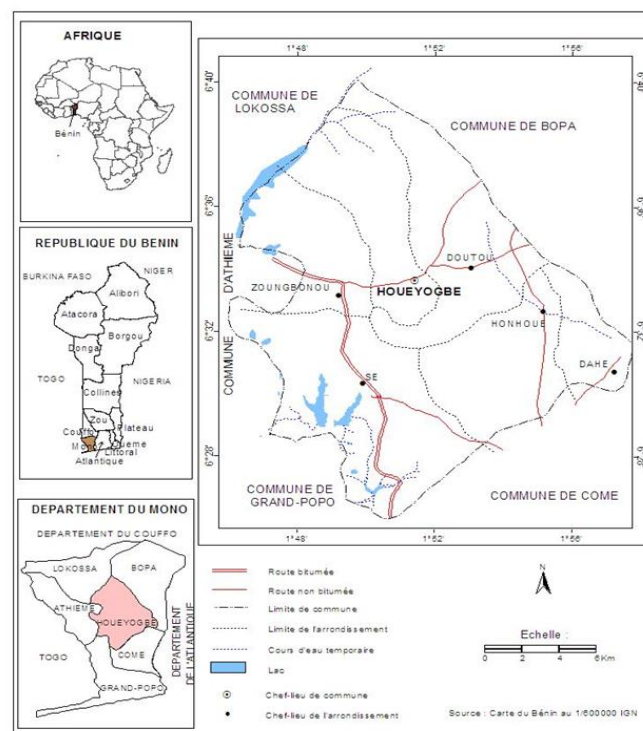


Figure 1: Geographical location of the Municipality of Houéyogbé

Located in the south of Benin, the municipality of Houéyogbé is located between 6 ° 28 'and 6 ° 40' north latitude and between 1 ° 48 'and 1 ° 56' east longitude. The town is limited to the north by the municipalities of Lokossa and Bopa, to the south by the Communes of Comé and Grand-Popo, to the east by the Commune of Bopa and to the west by that of Athiémé (figure 1).

3. Data and methods

The methodological approach adopted was based on documentary research and fieldwork, processing of data collected in the field and analysis of the results.

Several data were used in this research. These include, among others:

- ✓ **pedological and geomorphological data** the National Center of Agro-Pedology (CENAP) to know the characteristics and distribution of soils in relation to risks in the Municipality of Houéyogbé;
- ✓ **climatological data** of the National Meteorological Agency (DNM) of Cotonou over the period 1981-2010 to develop and analyze the climate diagram for the Municipality of Houéyogbé;
- ✓ **hydrological and hydrometric data** of the General Directorate of Water (DG-Eau) for the period 1981-2010 for a partial view of the rivers and bodies of water in order to better determine the floodplains of the Municipality of Houéyogbé;
- ✓ **socio-anthropological data** to learn about the level of vulnerability of the rural populations of the Municipality of Houéyogbé to agricultural risks;
- ✓ **crop year data** from the period 1999-2009 taken from the files of the Territorial Agency for Agricultural Development (ATDA) covering the Mono-Couffo to assess agricultural risks;
- ✓ **epidemiological data** of the Departmental Directorate of Public Health of Mono-Couffo to inventory the diseases caused by agricultural risks in the Municipality of Houéyogbé.

2.1 Documentary research

The documentary research consisted of visiting the documentation centers. Thus, reading a few general and specific works, briefs, reviews and articles dealing with questions of agricultural risks made it possible to take stock of the documentation relating to the problem.

2.2 Field work

This phase marks the effective presence on the study site. To conduct the surveys, a sample was drawn up. In fact, to have convincing results on the vulnerability of populations to agricultural risks, the survey was carried out in the six districts of the Municipality. The number of people (heads of households) surveyed was determined with a rate of 1% by random choice. The choice of these respondents meets the following criteria:

- ✓ be a farmer or mining operator;
- ✓ be at least between eighteen (18) and eighty (80) years old;
- ✓ having lived in the Municipality for the past ten years.

The data collection tools are among others the observation grid, interview guides and questionnaires. These tools made it possible to collect information from appropriate techniques, in particular:

- ✓ individual interviews were organized with key actors (notables, managers, SCDA agents and local elected officials) using an interview guide in order to collect useful information for achieving the objectives of the 'study ;
- ✓ direct observations in the field made it possible to note the pressures on agricultural land and agricultural production in particular;
- ✓ the organization of focus group interviews was necessary to complete the individual interviews.

All of these techniques have made it possible to have a base of empirical data to properly analyze the relationship between rural populations and agricultural production in the Commune of Houéyogbé.

2.3 Data processing and analysis of results

The data processing consisted of graphical processing using Excel 2007 and SPSS 2003 software, cartographic processing with MapInfo and the use of various mathematical formulas including arithmetic mean, standard deviation

- **Arithmetic average \bar{X}** : The arithmetic mean was used to calculate the average of the densities and rainfall data. It is obtained by the formula: \bar{X}

$$\bar{X} = (1) \frac{1}{n} \sum_{i=1}^n x_i$$

- **standard deviation** noted $\sigma(x)$ for the study of the dispersion of annual rainfall and hydrological values in the present study.

$$\sigma(x) = \sqrt{V} \text{ where } V \text{ the variance is: } V = (2) \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2$$

3. Results

3.1 Natural and social foundations of agricultural development in Houeyogbé

The natural environment is made up of relief, climate, soils, hydrography and vegetation which underpin agricultural development from which the social aspect derives.

3.1.1 Geological and pedological facets

The relief of the Municipality of Houéyogbé is characterized by:

- The continental one, composed of a clay-sand-sand plain which constitutes the large part of the Municipality and extends to Bopa and Comé thus forming the Tchi depression;

- An Eo-Paleocene mass composed of clay, marl and limestone found in the district of Sè and along Lake Toho in Zoungbonou.

On the extent of the Municipality the altitudes vary between 8 m and 90 m. The presence of clay and the geomorphological structure of the environment favor, among other things, periodic flooding given its impermeability.

There are three classes of soils in this municipality:

- hydromorphic soils are located along water bodies (lakes, ponds), in lowlands and in certain valleys which collect rainwater. These are hydromorphic soils on sandy-silty-clay alluvial material. They are found in some parts of Dahè, Sè and Zoungbonou. These are black clay vertisols, with very poor external drainage conditions. These soils allow the development of off-season agricultural production.
- impoverished ferralitic soils occupy most of the Municipality and consist of deep indurated soils and denatured or little evolved soils. These soils are rich in gravel. They are found in all the districts of this Municipality where the extraction of gravel is developing, favoring the destruction of cultivable soils.
- Tropical ferruginous soils which are very rare in the town and are located in the district of Sè.

These different classes of soils allow the development of agriculture in a diversified manner, particularly in the face of recurring climatic hazards.

3.1.2 Rainfall and hydrological regime

The climate is of the subequatorial type and is characterized by the annual succession of four seasons: two dry seasons (mid-November to mid-March and mid-July to mid-September) and two rainy seasons (mid-March to mid-July and mid-September to mid-November) alternately. A specific study on the pluviometry of Houéyogbé at the level of the synoptic station of Bohicon, for lack of presence of synoptic station in the Municipality, makes it possible to determine the average monthly rainfall regime covering the years 1981-2010. Likewise, figure 2 makes it possible to make a comparative analysis between the rainfall levels of the Municipality and that of the flow of the Mono river over the same 30-year period in order to assess the vulnerability of agricultural production in this environment.

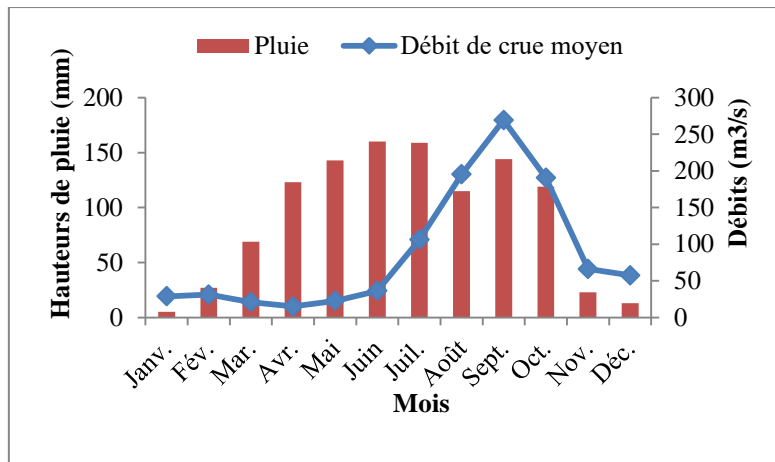


Figure 2: Average monthly rainfall (1981-2010) at Houéyogbé

Data source:DNM, 2012 and DG-Eau, 2013

The analysis of figure 2 shows that the months of June and July record the highest rainfall which causes the flooding of the Municipality of Houéyogbé. From July to November, the populations are subject to the constraints linked to flooding according to 90% of those surveyed. The Mono River has an overall tropical pluvial hydrological regime, although it is also influenced by the subequatorial climate [3].

3.2 Risk characterization and social vulnerability of rural populations

3.2.1 Major agricultural risks

The major agricultural risks recorded can be cited according to the categorization of Mabawonkou. These are: natural risks, social risks, economic risks, environmental risks and personal risks. Thus, natural risks (flood, drought and erosion), are based on the uncertainty noted at the level of natural factors, these are biophysical factors (vegetation, soils and rivers) and climatic factors (heights of rain and temperature). The economic risk (agriculture, transport, trade) in the Municipality of Houéyogbé is linked to the variation in the prices of agricultural products due to the degradation of roads, loss of harvest, etc. As for social risks (health, scarcity of drinking water, transport, education, sanitation) they are observed in peri-urban farms, it is about theft, burning and changing the social structure. Finally, the personal or human risk is present in all rural areas of the Municipality where we can note the possibilities of loss of income due to the uncertainty of the human factor (sudden death of a family member or the occurrence of a accident) that disrupt agricultural activities. The identification of major risks by the populations is presented in Figure 3.

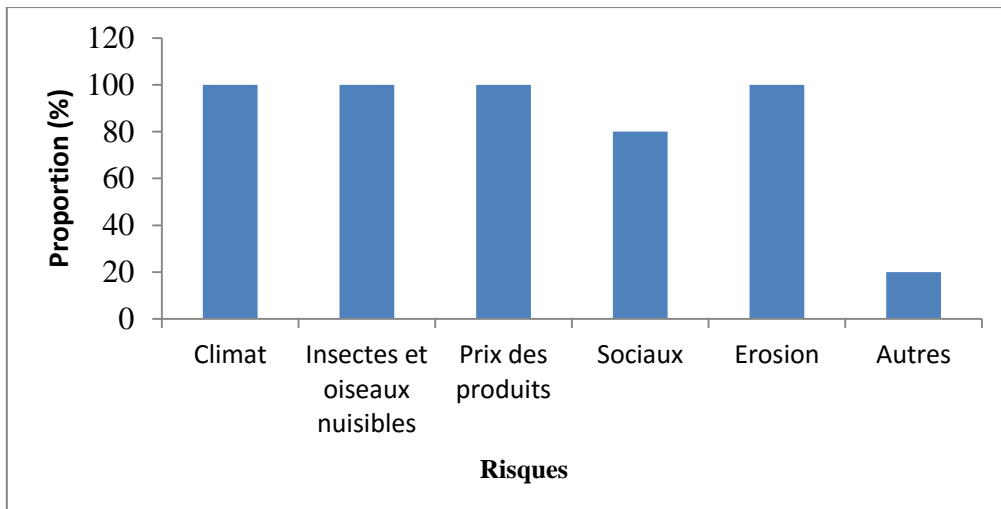


Figure 3: Identification of risks by farmers

Source: Field survey, 2015

Figure 3 shows the risks faced by rural populations in the Commune of Houéyogbé. In view of these identified risks, derive among others the rainfall risks, the environmental risks and the human risks vulnerable to the peasants of the Municipality of Houéyogbé. These specific agricultural risks are the subject of this study because they impact the majority of this rural population according to 80% of respondents.

3.2.2 Rainfall risks

The high temperature and the lack of water compromise the crops. At the beginning of the great rainy season (month of April) the strong heat leaves no sign of humidity announcing the first rains of the great agricultural season, hence the prolongation of the dry season. This can be explained by the decline in the great rainy season. All the producers claim to have experienced the great drought in 1977 and 1983, when they felt the greatest water deficits. In addition, in recent years, the multiplication of pockets of drought, that is to say the small dry periods that occur in the middle of the rainy season with high heat, causes yellowing and wilting of crops. This explains the deterioration in yields linked to agricultural drought. Figure 4 shows the evolution of rainfall and maize yields over the period 1999-2009. Its analysis shows that rainfall and maize yields fluctuated from 1999 to 2002 and an upward trend from 2002 to 2005 then 2006 to 2009. In 2003-2004, rains peaked with 890 mm then that the yields are 979 Kg / ha.

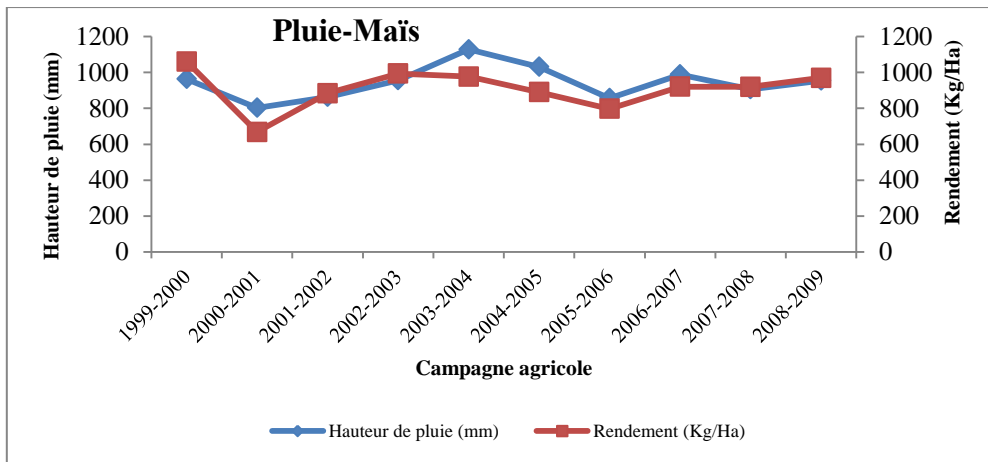


Figure 4: Evolution of rainfall and yields of maize over the period 1999-2009

Data source: MAEP and ASECNA, 2010

There was then a heavy rain against a poor yield. This is explained by the poor soil and the delay of the seed. Figure 5 shows the evolution of rainfall and cassava yields.

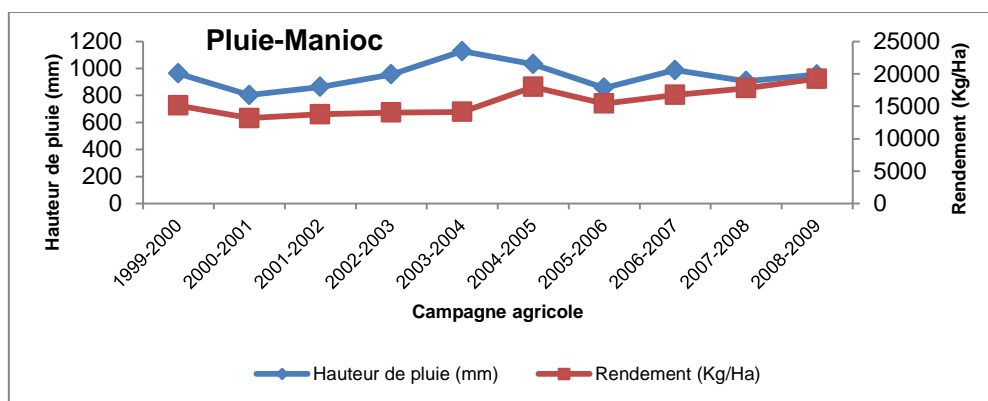


Figure 5: Evolution of rainfall and cassava yields over the period 1999-2009

Data source: ATDA / MAEP, 2010

Figure 5 shows the evolution of rainfall and cassava yields over the period 1999-2009. From 1999 to 2004, cassava production yields declined considerably. They went from 19,457 Kg / ha to 14,142 Kg / ha. This situation is due to the decrease in rainfall. From 2004 to 2005, rainfall increased with yields, from 14,142 kg / ha to 17,976 kg / ha. These yields are those of the farmers monitored by CARDER supervisory staff and who benefit from advisory support. The other farmers (the greatest number) who have remained in their usual practice still have a poor yield because they use a bygone cultivation method on poor land. The vulnerability of crops is observed at the level of the two agricultural seasons present during the agricultural seasons. During the first agricultural season, young plants in hydromorphic and humus-rich soils need a reasonable amount of water or rain from December to February to ensure their development. The heavy rains but well distributed in time

have no effect on the crops. On the other hand, heavy rains can decimate plants even if they occur once or twice during the growing season.

3.2.3 Environmental risks

Agriculture is the main source of income for the populations of the Municipality of Houéyogbé. In 2002, 60,863 agricultural workers were identified, ie 81% of the total population of the Municipality [4]. Thus, under the effect of demographic pressure through the combined action of deforestation, poor cultivation practices, overexploitation and the non-use of fertilizers, insecticides, the land is becoming impoverished and the cultivated areas are reduced. decrease from year to year [5] due to the gravel and sand quarries. In addition, the main working tool of this agriculture is the hoe with family labor. The area sown is therefore proportional to the size of the household. According to information gathered in the field, the farmers of Houéyogbé do not use fertilizers.

There are three types of farms in the Municipality:

- the small-scale farm, run by small farmers with limited resources with family labor to carry out cropping operations. These farms, practiced by 60% of farmers, generally have small areas (0.5 ha maximum);
- medium-sized farm, run by farmers who have few means and are able to finance an external workforce. These types of exploitation developed by 30% of the peasants generally have areas of between 0.50 and 1.50 h;

Large-scale farming, managed by large producers (10% of farmers) who, through new agricultural technologies, sow large areas of 5 ha and more. The crops produced on the soil are: cereals (corn, rice, etc.), tubers (cassava, sweet potato, taro, etc.), legumes (peanuts, pigeon peas, etc.), vegetables. Among these speculations, maize and cassava are the most produced in the Commune.

3.2.4 Vulnerability of cultivable soils to agricultural risks

Agricultural production is the main activity of the population of Houéyogbé. It is very dependent on natural conditions. The expected results of the agricultural exercise are then very uncertain, which gives the agricultural enterprise the character of risk. The main crops are maize and cassava for most of the farmers and this on the same areas which further impoverishes the land. In each season, maize is traditionally the most cultivated cereal for the simple reason that maize represents the staple food of the population of Houéyogbé. In fact, in the Municipality of Houéyogbé, agricultural soils are currently undergoing considerable degradation which leads to their losses in quantity and quality. This vulnerability of the soil gradually results in a drop in agricultural production and, in turn, a drop in the purchasing power of farmers. Figure 6 shows a soil in the process of degradation in quality and quantity. Figure 6 shows some exploitation sites in Houéyogbé and Sè.



Figure 6: Degraded soil after intense siliceous sand extraction at Sè (1.1) and soil in the process of degradation in quality and quantity (1.2)

Shooting : Kounoudji, July 2015

Photo (1.1) shows degraded soil following sand extraction in Houéyogbé while photo (1.2) shows on both sides the importance of anthropogenic pressure on agricultural soils in the Commune of Houéyogbé. In the background, there is the transformation of primary vegetation into secondary vegetation consisting of fallow oil palm (*Elaeis guineensis*) and acacias (*Auriculiformis*). The greenery of the vegetation (photo 1.2) shows that it is located on fertile soil. Photo (1.2) shows in the foreground a thorough degradation of agricultural soils by farmers. This exploitation phenomenon impoverishes the soil and exposes it to erosion (wind, rain, river). This layer which is scraped in depth varies between 2 and 3 m.

3.3 Human damage from agricultural hazards

The human damage caused by agricultural risks and their repercussions on the living conditions of households make it possible to determine the vulnerability of rural populations. If agricultural production is very independent of natural conditions, it is also linked to the psychic characteristics of a population very attached to the gods and the rate of yields is always explained by divine will. The yields and prices of agricultural products help determine the vulnerability of rural populations. Thus the analysis of the comparison between monthly / annual yields of food products and the monthly / annual prices of these same products shows that the fall in the yields of food production leads to an increase in the prices of food products. Consequently, populations are subject to social problems such as: death, disease, famine, malnutrition, undernourishment, rural exodus to Cotonou and Nigeria and the reconversion of peasants into workers in the sand quarries. and gravel or motorcycle taxi thus abandoning agriculture. For 65% of those surveyed, recent years have been marked by the phenomenon of migration, which in the Municipality has led to a decrease in labor for agriculture. Seventy percent (70%) of respondents said there are days when they eat once. Similarly, 80% of the population affirms that their eating habits have been modified because of the drop in yields of food products. In addition, floods and droughts constitute agricultural risks which influence rural populations. In times of flooding due to torrential rains and flooding from the Mono River, rural feeder roads are not accessible to producers and the

transport of products to markets is impossible, which slows down rural activities. Likewise, the rural populations of the Commune of Houéyogbé are vulnerable to droughts due to the drop in rainfall. These populations are also exposed to health risks resulting from gravel and sand extraction work. The characterization of agricultural risks and the vulnerability of the rural population in the Commune of Houéyogbé are linked to the factors of social vulnerability of rural populations. The vulnerability of rural populations is linked to several agricultural risks, the list of which is not exhaustive. However, a few major agricultural risks are noted and their repercussions on the living conditions of households have made it possible to determine the vulnerability of rural populations.

3.4 Adaptation strategies developed by the populations and local authorities

The populations and the local authorities are putting in place strategies to deal with bad weather and agricultural risks despite their very limited means.

3.4.1 Actions taken by the populations

To fight against the social effects of agricultural risks in the rural areas of the Commune of Houéyogbé, the peasants have adopted several strategies.

➤ Adoption of short-cycle varieties

Drought leads to the development of adaptation strategies by farmers to cope with the food shortage [6]. Climatic variability is gradually leading to the replacement of certain cultivable species. Short-cycle 75-day maize gained momentum ahead of 90-day and 120-day corn, as did short-cycle groundnuts according to 70% of farm households. These measures are taken by farmers in order to limit their social vulnerability linked to the drop in yields.

➤ Crop rotation

It is the cropping system that establishes a change of crop on the fields according to the requirements of the seasons or for the maintenance of soil fertility. Crop varieties differ according to the seasons and the length of the growing cycles of crops. The longer season being more suitable for varieties with a relatively long cycle, the early varieties are chosen for the second growing season, which is shorter and more uncertain than the first. This cropping system promotes soil fertility for growing beans and corn; which makes the specificity of the study sector. These cultures come back not only because of eating habits but also because of the sanctification of the uses and customs of the locality.

➤ Retraining

In periods of disruption or after agricultural activities and in the dry season, some people engage in trade (purchase of food products), sheep breeding, fishing, allowing them to supplement their agricultural income and face the daily needs such as: children's health and schooling.

3.4.2 Actions taken by local authorities

With the aim of correcting the environmental damage following the exploitation of the gravel quarries, the Town Hall of Houéyogbé in agreement with the General Directorate of Mines and the rural populations, is developing strategies to backfill the pits and reforest empty spaces. Consequently, 30% of the population devote themselves to eco-citizen actions and a disaster management unit is created and is functional [7]. Similarly, 80% of vulnerable groups have access to arable land. In addition to these efforts of local elected officials, those of development partners are added. In addition, in terms of agricultural risk management related to floods and droughts, local authorities and organizations assess the damage and provide assistance to the populations (distribution of food, sleeping materials, impregnated mosquito nets and tablets).

3.5 Measures recommended for sustainable rural development

Raising public awareness, taking emergency measures and humanitarian aid are among other things essential for sustainable rural development in the face of agricultural risks.

3.5.1 Public awareness

As part of awareness raising, the populations are informed about the precautions to be taken in the face of the harmful effects of agricultural risks. The forecasting of agricultural risks, information and education of the populations require communication strategies to inform vulnerable populations [3]. Thus the following strategies can be adopted in the face of agricultural risks:

- ✓ the use of means of communication such as the radio to warn the population about the risks;
- ✓ the town criers in each village relaying information on the alert and the precautions to be taken;
- ✓ the “word of mouth” method to reach a large mass of the population;
- ✓ setting up a telephone line to come to the aid of the populations;
- ✓ the provision of a fund by the town hall for possible aid.

3.5.2 Action strengthening activities

The management of agricultural risks and by extension the preservation of vulnerable populations can go through the promotion of agroforestry which is a farming system using trees (generally in intercropping) in the production of food crops and cash crops. [8]. It consists of maintaining or increasing the fertility of the soil. This agroforestry shows economically and agronomically one of the best answers to the problems of soil degradation. Indeed, the role of the tree is fundamental to recycle mineral elements and regenerate the soil. In addition, the agroforestry technique makes it possible to make better use of the soil and therefore to produce more, without destroying the environment.

- ✓ In short, we can also develop strategies to create income-generating activities other than agriculture and livestock. For example, encourage women to transform agricultural products into finished products such as bread and biscuits made from cassava flour. The processing of oil palm raw materials must also

be strengthened.

- ✓ To strengthen measures, several actions are useful and must be implemented by the authorities.
- ✓ In addition, the public authorities will be able to set up a system which makes it possible to recover rainwater and excess water during flood periods and treat them if necessary, to supply local populations with drinking water of a on the one hand, but also to develop it for agricultural purposes during the lean season on the other hand. Community food stores should also be set up to make up for food shortages during agricultural disasters.
- ✓ NGOs cannot take the place of a state. Thus, during disasters their actions can only be temporary. It is therefore up to the State, in concert with the local communities to determine the locations, by taking the necessary orders so that these locations are final.

4. Discussion

The analysis of the results obtained made it possible to understand that the vulnerability of rural populations to agricultural risks has disastrous consequences on the populations of the Commune of Houéyogbé. This is what is said [9], the development of industrial and agricultural activities, the multiplication of means of transport and the demographic explosion over the past century have, in fact, generated an increase in the concentrations of gas discharges. Greenhouse Effect (GES), cause of current climate change. This situation has led to a growing interest of the scientific community for the study of the vulnerability and adaptation of agriculture to hydro-climatic risks such as floods and droughts. This is also confirmed by the results of works [10] and [11], who stipulated that the populations are very often confronted with the problems of devastating flooding of the fields. Floods exert influences on human activities in rural areas. The same observation was made by [12], who believes that the extent of the floods in recent years, specifically those of 2009 and 2010, prompted rapid mobilization for first aid actions. According to the author, several emergency actions have been initiated and implemented in favor of disaster victims by NGOs which are very active on the ground such as Caritas-Benin, Care-Benin / Togo and the Red Cross. To reduce their vulnerability to agricultural risks, farmers in the Municipality of Houéyogbé are developing several risk prevention and disaster management strategies.

5. Conclusion

The present study was based on the social vulnerability of rural populations to agricultural risks in the Commune of Houéyogbé. The study of natural and anthropogenic factors as well as the determinants of agricultural risks shows that the study area is under the influence of agricultural risks. Thus, 81% of the population of Houéyogbé, practice the activities of the primary sector which is agriculture. The demographic evolution of this population is estimated at 74,492 in 2002 and at 101,893 in 2013. Faced with this demographic surge and to meet their basic needs, the populations of Houéyogbé are anarchically using agricultural land for the exploitation of resources. mining (gravel and sand). Similarly, this rural population faces climatic and environmental risks (flood and drought), the effects of which lead to social problems. Socio-anthropological investigations attest that the main crops grown in the Municipality of Houéyogbé are vulnerable to excess and water deficits during their different vegetative cycle. This situation reduces the income of farmers through low yields. As incomes are reduced, social and economic living conditions are therefore threatened and sometimes

require the intervention of authorities at various levels of development who come to the aid of rural populations in general and agricultural populations in particular in the Commune of Houéyogbé.

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