International Journal of Advanced Engineering and Management Research

Vol. 5, No. 04; 2020

ISSN: 2456-3676

DETERMINANTS OF LAND DEGRADATION AND INDICATORS OF FOOD INSECURITY IN THE MUNICIPALITY OF ZAGNANADO SOUTH OF BENIN

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ABSTRACT

Land degradation is a problem that affects about a third of the world's land. The phenomenon is alarming when we know that the final phase of the degradation process is desertification of the land and, in turn, a threat to food security. The purpose of this study is to analyze the determinants of land degradation and its impacts, including food insecurity in the municipality of Zagnanado.

The data collected and submitted for analysis are essentially demographic, topographic, soil and climatological data. The processing and analysis of this data was done using the PEIR (Pressure-State-Impact-Response) analysis model. A sample of 205 households and resource people were consulted for access identification indicators determining food insecurity.

From the analysis of the data, it emerges that the prevalence relative to food insecurity is around 33% for moderate food insecurity and 6% for severe food insecurity with indices of climatic aggressiveness varying between 30 and 60 mm from 1984 to 2014. Similarly, the fall in agricultural production is one of the consequences of land degradation. This situation poses a problem of food and nutritional insecurity and thus deteriorates the purchasing power of the populations. Other factors contributing to the degradation are the pressure, the climatic, demographic effects and the farming techniques.

Keywords: Determinant, degradation, food insecurity, Zagnanado

Introduction

The world's land and water resources are limited and are under pressure from population growth. Global figures show that a relatively small share of land and water is actually used by agriculture, but they mask considerable variations between regions, as well as a series of locally significant imbalances between supply and demand (FAO, 2011). With the degradation and depletion of land and water resources, various essential food production systems are threatened globally, posing a serious challenge to feed a population expected to reach 9 billion people. 'by 2050. (CIRAD, 2009)

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A total of 975 million people, most of whom live in rural areas, do not have the food security they deserve. Under pressure from agriculture, soils and waters are damaged, erosion accelerates, salinization and marine intrusions increase, and groundwater is depleted (FAO, 2011).

The poorest people around the world are also those who have the most difficult access to land and water resources and who are trapped in poverty because their farms are small, have poor soil quality and are particularly affected by land degradation and the effects of climatic hazards.

Neglecting the health of African soils could lock the continent into a cycle of food insecurity for generations to come (Montpellier Panel, 2015). The decrease in soil productivity reaches 50% in some regions and the final stage of degradation is irreversible (UNDP, 2015).

Sub-Saharan agriculture is characterized by an unequal distribution of available suitable land, altered and infertile soils and failing markets (FAO, 2015). Very often, the private sector remains too embryonic and under-capitalized to take charge of rural development. The vast majority of sub-Saharan countries are still net importers of food and remain dependent on nutritional assistance during humanitarian crises (WFP, 2015). Suitable areas are estimated at one billion hectares, but only just over 200 million are currently in use (MDG, 2015). One of the main difficulties currently facing Beninese agriculture is the decline in soil fertility (Fangnon, 2012). Indeed, cultivated land is being depleted at an accelerating rate and crop yields are continually declining; which dangerously compromises food security and the sustainability of the entire agricultural system (Igué et al., 2002). This has the consequence of reducing the income of producers; the debt of producers; the high cost of agricultural products and food insecurity (Houngbo, 2008). Land degradation affects all the soils of the southern plateaus of Benin in different forms and causes a significant loss of agricultural soil resources and a decline in land productivity (Azontondé, 2004). In the Municipality of Zagnanado, it is noticed that the soils are under great pressure due to inappropriate agricultural practices, and become degraded. This severely threatens food security and the survival of populations.

1. Presentation of the study environment

Located in the Department of Zou, more precisely on the Zagnanado plateau, the smallest of the plateaus north of the Lama depression between 7 ° and 7 ° 30 'north latitude and 2 ° 15' and 2 ° 30 ' east longitude. Limited to the north by the Commune of Dassa-Zoumè (Department of Hills), to the south by the communes of Ouinhi and Zogbodomè, to the east by the Communes of Kétou and Adja Ouèrè (plateau) and to the west by the Covè, Za-Kpota and Djidja municipalities (Figure 1)

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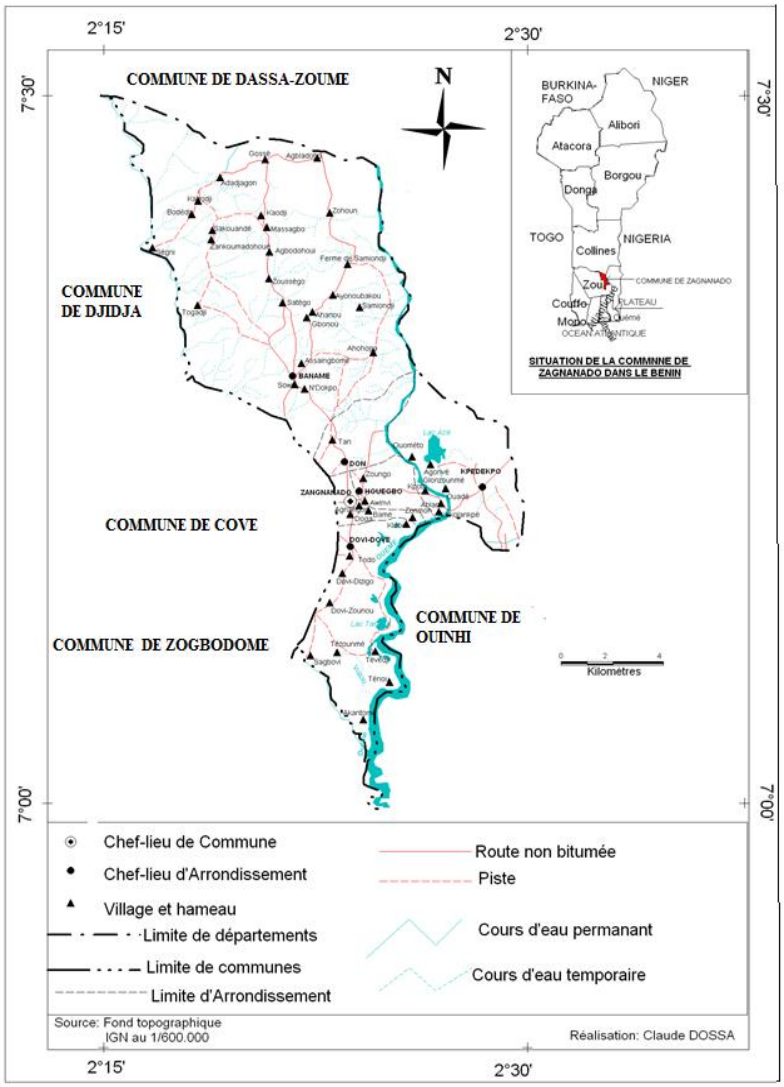

Figure 1: Geographical location of the municipality of Zagnanado

2. Data and methods

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

2.1. Data

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

- ***Climatological data:*** They take into account the monthly rainfall amounts, temperature and ETP extracted from the files of the National Meteorological Directorate (DNM), from the period 1984 to 2014.

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- ***Data on agricultural statistics.*** They also concern agricultural production available to the Ministry of Agriculture, Livestock and Fisheries (MAEP) and the Territorial Agency for Agricultural Development. Data on the availability of food by the National Food Security Support Office (ONASA Benin, 2016).

- ***Demographic data:*** These are the General Censuses of Population and Housing (RGPH) from 2002 to 2013 available at INSAE which made it possible to assess the dynamics of the population of Zagnanado. The rate of population growth has favored the projection to 2025 and to measure the extent of human pressure on the environment.

- ***Topographic and pedological data:*** They are obtained from the National Institute of Agricultural Research of Benin (INRAB) and from the Science, Soils, Water and Environment Laboratory (LSSEE) to characterize the systems of slopes and types of soils in the Municipality of Zagnanado. These data provided clues on the types of soils and their exposure to the risks of degradation within the Municipality. Other data on land use obtained at the national center for remote sensing and ecological monitoring of Benin (CENATEL-Benin) favors the study of the dynamics of landscape units in the Commune.

2.2. Methods

2.2.1. Socio-economic data processing techniques

The analysis of data on food insecurity in the Municipality of Zagnanado is based on the approach advocated by Coates et al. (2007). This processing method promotes the identification of access indicators determining household food insecurity in the study area. For Abou et al. (2018), four types of indicators are proposed by this technique to quantify the characteristics and changes in household food insecurity through:

- ✓ conditions linked to household food insecurity;
- ✓ areas related to household food insecurity;
- ✓ the scale score related to household food insecurity;
- ✓ the prevalence linked to household food insecurity.

With regard to these indicators and the objective of this research, the prevalence linked to household food insecurity is the indicator on which the surveys have focused in this study. The measurement of food insecurity experienced at the household level according to Coates et al. (2007) is based on a nine-item questionnaire on the lack of food and the household's reactions to this situation. For each item, the response is graded from "0" to "3" depending on the severity or frequency of the situation mentioned.

As for the indicator, it was used for households in four food level categories: food security, light food insecurity, moderate food insecurity and severe food insecurity. It was also a question of

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calculating the access category for household food insecurity (AIAM) by assigning a code to the food insecurity category in which it falls for the Municipality of Zagnanado in order to determine the prevalence rate at study area level. The four access categories were created to check households based on their response of greatest severity. The formulas used to calculate the AIAM category and prevalence are shown in Table I.

Table I: Calculation procedure for the AIAM category

Catégorie AIAM	Catégorie AIAM = 1 si [(Q1a = 0 ou Q1a = 1) et Q2 = 0 et Q3 = 0 et Q4 = 0 et Q5 = 0 et Q6 = 0 et Q7 = 0 et Q8 = 0 et Q9 = 0]
	Catégorie AIAM = 2 si [(Q1a = 2 ou Q1a = 3 ou Q2a = 1 ou Q2a = 2 ou Q2a = 3 ou Q3a = 1 ou
	Catégorie AIAM = 3 si [(Q3a = 2 ou Q3a = 3 ou Q4a = 2 ou Q4a = 3 ou Q5a = 1 ou Q5a = 2 ou
	Catégorie AIAM = 4 si [Q5a = 3 ou Q6a = 3 ou Q7a = 1 ou Q7a = 2 ou Q7a = 3 ou Q8a = 1 ou

Source: Coastes et al. (2007) and Abou et al. (2018)

Thus, according to Abou et al. (2018), the prevalence of different types of household food insecurity (access) is obtained by the formula:

$$AIAM = \frac{\textbf{Nombre de ménages avec catégories AIAM}}{\textbf{Nombre total de ménages avec une catégorie AIAM}} * 100$$

Table II, presents the types of questions that characterize access to food insecurity

Table II: Types of questions for access to food insecurity

Questions	**Possible answer**	**Code**
In the past four weeks, has the household ever been without food at all because there were no resources to buy it? Answer: No. In fact, just a few times.	0 = No (go to Q8) 1 = yes	1
How many times has this situation occurred in the past four weeks? Answer: four times	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to 10 times the past four weeks) 3 = Often (more than 10 times in the past four weeks)	2

Source: Coates et al. (2007) and Abou **et** al. (2018)

The stratified sampling method was used for the choice of households to be surveyed. In total, 205 households were surveyed in the Municipality of Zogbodomè.

The data collection tools include the observation grid, interview guides and questionnaires. These tools made it possible to collect information using appropriate techniques.

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✓ ***Processing of climatic data***

It is devoted to the analysis of precipitation data from the pluviometric stations and the synoptic station of Zagnanado and Bohicon over the period 1984 to 2014. This made it possible to follow the interannual evolution of runoff water within the Municipality. The interannual evolution in runoff water of the Municipality is reflected by the coefficient alpha (α), which enters the formula α = Pi / ETPi (Pi: the rain of year i in mm and ETPi: the potential evapotranspiration calculated from year i in mm) shows the availability of runoff water. This runoff water with the behavior of the soil/vegetation system partly contributes to the water reserves in the first horizons of the soil, between 0 and 30 cm (Sutcliffe and Piper, 1986) cited by Amoussou (2010) to show the pressure of the soil. intensity of rainwater in the study environment.

✓ ***Calculation of climatic aggressiveness***

The assessment of soil losses in the Municipality of Zagnanado is based on the USLE. Thus the procedures followed to carry out the assessment of soil loss using the Wischmeier formula are fully described in Agricultural Handbook 537 (Wischmeier et al., 1978). In fact, given the quality of the available data, these procedures were not followed within the framework of this study. However, other methods similar to those of (Wischmeier, 1978) without major impact on the final result, are planned for such cases and were used in this research. The USLE formula looks like this:

$$A = R.K.LS.C.P$$

where A = soil loss in t/ha/year; R: precipitation aggressiveness factor; K: soil erodibility factor; LS: slope factor and slope length; C: plant cover factor; P: Conservation practice factor.

The erosivity of precipitation fluctuates considerably depending on the environment. R is defined as the product of the kinetic energy (Ec) and the maximum intensity in 30 minutes (I 30). The calculation of the precipitation aggressiveness is done according to the following formula, proposed by Wischmeier et al. (1978):

$$R = Ec \times I30$$

with Ec = 11.9 + 8.73 log (I) (its value is in J / m² / mm of rain); I30 = the average intensity of the rain in 30 minutes (mm / h).

The erosive nature of rain is therefore a function of its physical characteristics. These include the diameter of the drops and their impact speed. However, various secondary formulas have been developed depending on the context of each region and the data available. Thus, the Belgians, the Thais, the Malays, etc. have developed formulas for calculating R based on their climatic conditions. For West Africa, the so-called Fournier (1962) index is used. Its formula is:

$$R = P^2 / P$$

With: P = average precipitation for the wettest month in the series; P = mean precipitation of the series.

The precipitation aggressiveness factor R can be determined for variable periods (over a downpour or a year). When used as a parameter of the Wischmeier model, the R-index is usually calculated as the average of several years. Roose (1977) established the rain erosivity map over West Africa, which makes it possible to estimate R. Similarly, Azontondé (1988) has already produced from his experiments the isoerodent map for the whole of Benin.

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It is this last formula which is applied in the framework of this research and is in line with the work of Roose and Azontondé (1988).

2.2.2. Results analysis methods and model

The stratified sampling method was used for the choice of households to be surveyed. In total, 205 households were surveyed in the Municipality of Zogbodomè.

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

3. Results

3.1. Climate aggressiveness index (R)

The elements of the climate that mainly contribute to land degradation are precipitation, including the intensity of the climate aggressiveness index of the study area. Figure 2 shows the interannual variation of the climatic aggressiveness of the Municipality of Zagnanado.

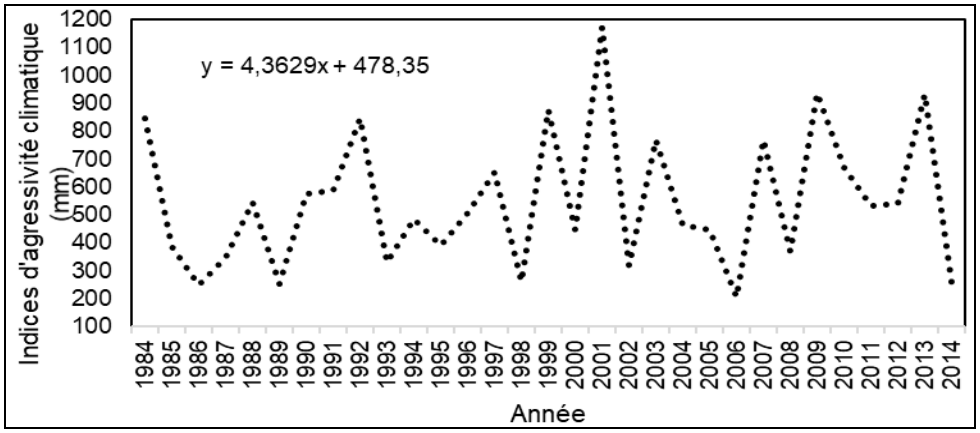

Figure 2: Climatic aggressiveness index of the study area (1984 -2016).

Source: ASECNA, 2016

The analysis of figure shows 2 that the climatic aggressiveness of the Municipality varies between 200 and 1200 mm during the period of 1984 and 2014, with high values after the 1990s unlike the period before in the series. For Kodja et al (2018) the period 1984 and before 1990 is marked by a rainfall recession both in West Africa and in Ouémé. This situation has already been pointed out by Houndénou (1999); Amoussou (2010) and Agbomahenan (2016). According to Amoussou (2010); Amoussou (2010), the rainfall recovery from the 1990s and 2000s, is responsible for the high rainfall and high index of climatic aggressiveness in the study area (Kodja et al., 2018). Added to this are the pressures of human activities on ecosystems and on the socioeconomic and environmental issues that characterize land degradation and erodibility in the municipality of Zagnanado.

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Such a situation has repercussions on agricultural areas, where populations use inappropriate agricultural techniques, which accentuates soil poverty and consequently the decline in agricultural productivity in the study sector (Dossa, 2016).

In addition, the erosion phenomenon is triggered and developed in different ways, depending on whether it affects types of crops, soils and topography of the Municipality of Zagnanado.

3.2. Human factors of land degradation

Figure 3 shows the density per capita in each district of the Municipality of Zagnanado.

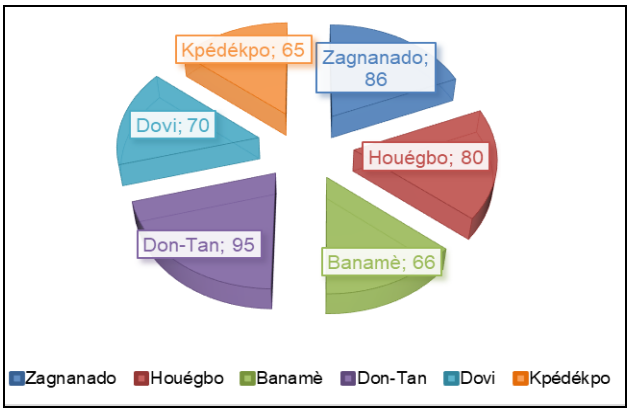

Figure 3: Density by district in the Municipality in 2013

Source: INSAE, 2013

From the analysis of Figure 3, it appears that the population density is very high in almost all the districts of the Municipality of Zagnanado. This increase in population constitutes a human pressure on ecosystems including land degradation and its corollaries (Akognongbé et al., 2014). However, according to Agoinon et al. (2012) agriculture is the main activity of the populations in the region. According to this author and the results of this research, agricultural activities in recent decades have faced the problems of land shortages and declining soil fertility. These problems are accentuated which means that in the quest for cultivable spaces and fertile land, the populations go very far, even leaving their own town to go to the field. These fields are very remote, while the access tracks are for the most part very degraded and impassable during the rainy season. This situation increases production difficulties. Post-harvest losses are also increased mainly because of the difficulties in transporting products and all this, coupled with the lack of credit which reinforces the weakness of capital, favors the mechanisms of food insecurity seriously ruining the populations.

3.3. Inter-annual variation in the yields of the main crops in the Municipality of Zagnanado

Figure 4 shows the interannual evolution of maize production yields in the Municipality of Zagnanado 1996 to 2016.

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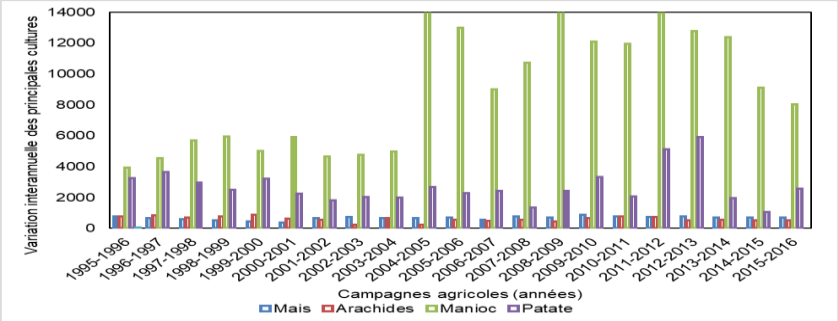

Figure 4: Agricultural yields of maize in the Municipality from 1996 to 2016
Sources: MAEP, 2016

The analysis in Figure 4 reveals an increasing trend in agricultural maize yields within the Municipality of Zagnanado. The 2008-2010 and 2012-2014 sub-periods recorded higher returns while those of 2001-2005; 2006-2009 and 2012-2016 saw a drop in yields

3.4 Yield deficit of agricultural products

The analysis of the food balance from 2000 to 2012 shows that the majority of local food production recorded a deterioration in the food balance which indicates the total quantity of food produced in a Commune increased by the total quantity imported and adjusted according to variations. of stock since the start of the reference period corresponds to the quantities available during this period (FAO, 2014). The deficits of the various speculations show the dependence of the Municipality of Zagnanado vis-à-vis the surrounding municipalities or the country or the sub-region to meet the food needs in these different food products. Figure 5 shows the evolution of food balances for the main crops in the study area.

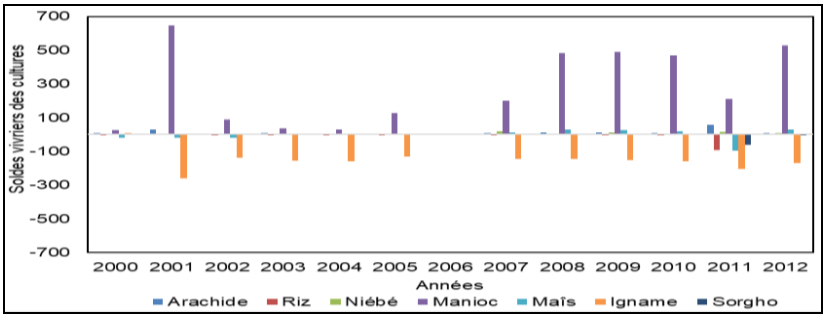

Figure 5: Commune food balances from 2000 to 2012
Source: ONASA, MAEP, 2016

The analysis in Figure 5 shows a general weakness in the food balances of the main food crops in the Municipality of Zagnanado. According to 60% of the farmers surveyed, this significant drop in food sales is due to land degradation, low agricultural yields of foodstuffs, not very modern farming techniques and above all to the density of food flows to neighboring municipalities and localities.

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3.5. Food insecurity indicators in the municipality of Zagnanado

The indicators of food insecurity in the Municipality concern the conditions of food insecurity, the low agricultural yields, the low purchasing power of the populations as well as the nutritional problem.

✓ ***Conditions linked to household food insecurity***

The conditions linked to household food insecurity relate mainly to the severity of poverty in households and the consumption of food not preferred by a large segment of the population. Surveys related to the insufficiency (quantitative and qualitative) or lack of household food provide information on behaviors, opinions and concern 50 people of different socio-professional categories and 155 mainly agricultural households in the Municipality. The survey results illustrated in Figures 6 and 7 relate to the number of people and households who answered yes or no to the question relating to the quantities and qualities of food available during the survey period.

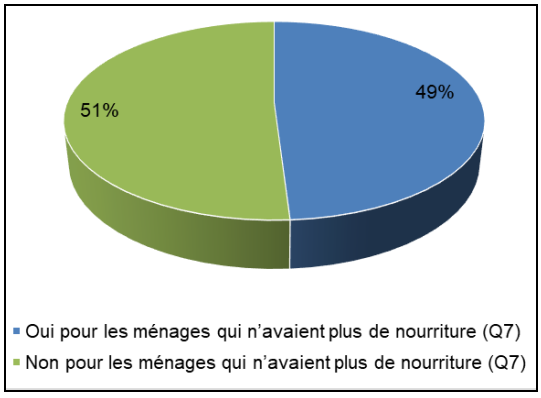

Figure 6: number of people and households who answered yes or no to the question relating to the quantities and qualities of food

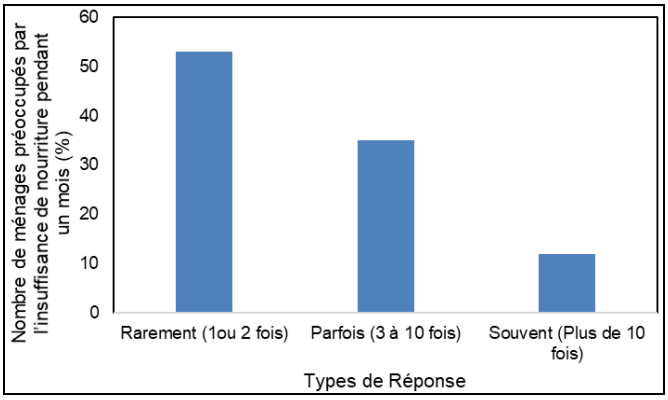

Figure 7: Number of households concerned about insufficient food for a month according to the frequency of occurrence

The analysis of Figure 6 shows that there are fewer households (49%) that had no food during the last four weeks preceding the period of the survey compared to households with food during the same period (51%). As for figure 7, which is a summary of the frequency of occurrence indicates in view of field data that there are very few households (05 out of 43) or 12% of households suffering from chronic deprivation (often more than 10 times) of food during the last four weeks preceding the survey period in the study area. Indeed, this situation of the non-availability of food in households is mainly explained by land degradation which causes low food production and economic problems relating to the insufficient financial resources of certain households.

3.6 Insufficient / Nutritional Amount

It is important to remember that insufficient quality includes food varieties and preferences. However, the data relating to the insufficient quality of food during the four weeks preceding the survey in the Municipality of Zagnanado are presented in Figures 8 and 9.

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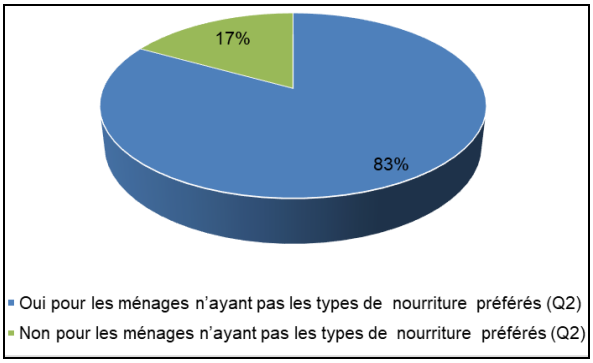

Figure 8: Number of households not having the preferred types of foods for a month according to the types of occurrence responses

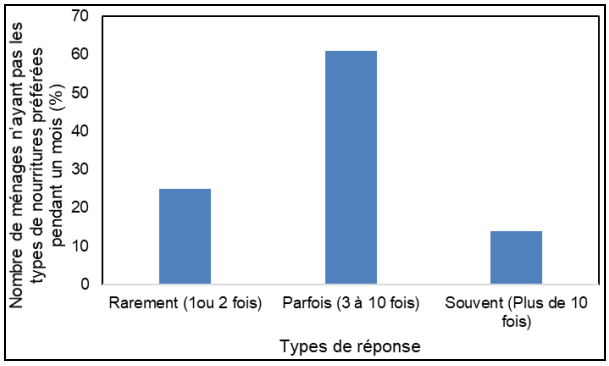

Figure 9: Number of households not having the types of foods preferred for a month the types of responses to occurrence

It emerges from the analysis of Figure 8 that out of all the households surveyed, there are more households that do not have the preferred types of foods during the last four weeks preceding the period during which the investigation. This situation is exacerbated by Figure 9 on the quality of occurrence, it should be noted that few households are concerned by the insufficiency of the types of foods they prefer in the Municipality of Zagnanado. The lack of financial means or the limited choice in the type of food that households eat is due to insufficient financial resources.

Figure 10, shows the frequency of the number of households having a limited variety of foods during a month and the response types of occurrence.

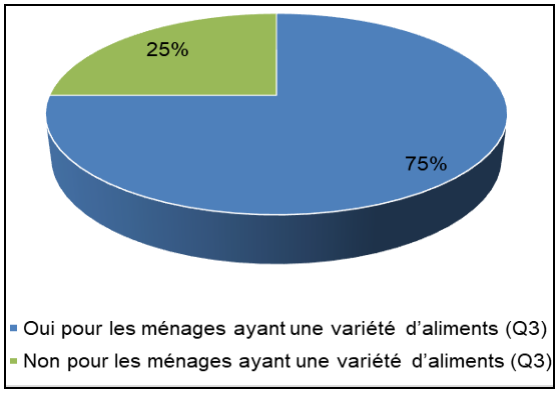

Figure 10: Number of households with a limited variety of foods during an occurrence response type

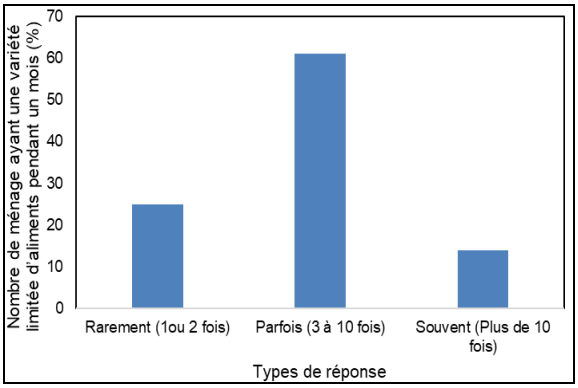

Figure 11: Number of households with a limited variety of foods during one month of occurrence

From the analysis of Figure 10 it appears that there are fewer households that have a limited variety of foods during the last four weeks before the survey period in the study area. Regarding the analysis of the number of households with a limited variety of foods during a month of occurrence (figure 11), it appears that very few households in the Municipality are concerned at this level and have a limited variety. food during the last four weeks preceding the survey period. It is therefore noted that very few households are diversified in the different types of food consumed. This trend shows that a large part of households are spared.

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Figures 12 and 13 show, respectively, the number of households and the frequency of households having eaten food other than what they wanted for a month according to the types of occurrence response.

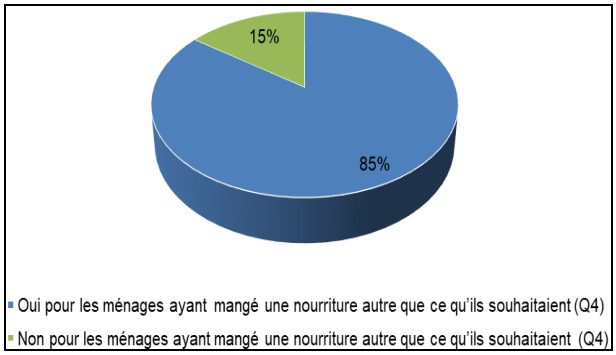

Figure 12: Number of households having eaten food other than what they wanted for a month according to the types of occurrence response

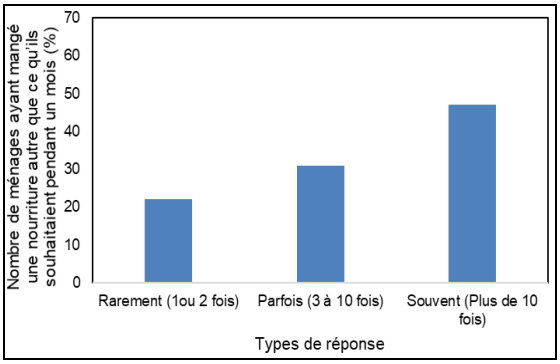

Figure 13: Number of households having eaten food other than what they wanted for a month according to the types of occurrence response

The analysis of figure 12, indicates on the frequency of households which answered yes to the questions (Q4), it can be noted that a considerable number of households (131 out of 155) in the Municipality often eat food other than what is required. 'they wished in the study area. This dimension of choice is explained by the precarious situation in which households find themselves due to the lack of financial resources. In addition, figure 13 shows the frequency of occurrence of households that answered yes to the question (Q4). It should be remembered that a significant portion of households is concerned at this level, do not often eat the food of their choice in the area. This dimension of choice is explained by the precarious situation in which households find themselves due to the lack of financial resources.

3.5 Insufficient food intake and its Physical Consequences

Data on insufficient food intake and its physical consequences during the last four weeks leading up to the survey are presented in Figures 14 to 17.

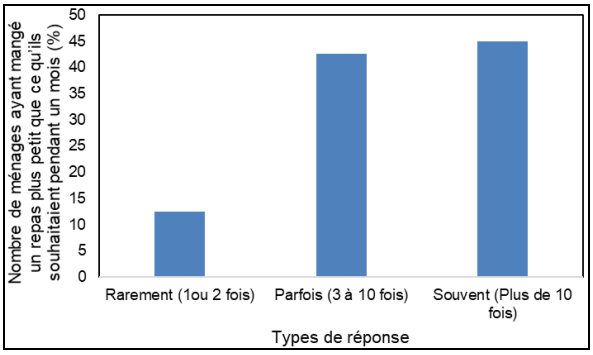

Figure 14: Number of households that ate a smaller meal than they wanted for a month

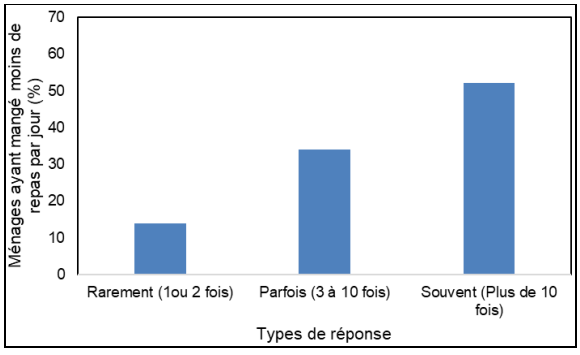

Figure 15: Households that ate fewer meals per day

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Regarding the number of households having eaten a smaller meal than they wanted for a month (figure 14), it should be noted that for a month, 45% of the households in the municipality often eat a smaller meal than what they wanted to eat in the study area while 42.5% sometimes eat it either 3 times or 10 times and 12.5% rarely eat it once or twice. From this analysis, it emerges that the households concerned run the risk of being undernourished and malnourished with its corollaries of chronic or disabling diseases, lack of resistance to physical effort which may result and which constitute a threat to production. agricultural sector which, however, needs able-bodied support for its development. All of this poses a threat to food security in the study area.

In the same context, from the analysis of figure 15 on the frequency of occurrence, it should be noted that during a month, 52% of households often eat fewer meals per day while 34% and 14% of households eat them respectively. sometimes and rarely fewer meals per day in the study area, which can have repercussions on their diet, including the risk of undernourishment, malnutrition with the manifestation of disabling, lack of resistance to physical effort which can result from it and which constitute a threat to agricultural production which nevertheless needs valid arms for its development. All of this poses a threat to food security in the study area.

This research also focused on the frequency of the number of households having spent a whole day without eating for a month according to the frequency of occurrence (figure 16) and number of households having spent all day and night without eating (figure 17).). From the analysis of Figure 16 on the frequency of occurrence, it should be noted that 71% of households declared that it is rarely (1 or 2 times) then, 27% for sometimes (3 or 10 times) that they go a whole day without eating. As for figure 17, it is observed that for a month, and rarely 73% of households (1 or 2 times) spend all day and all night without eating compared to 27% of households (3 to 10 times) who sometimes spend all day and all night without eating.

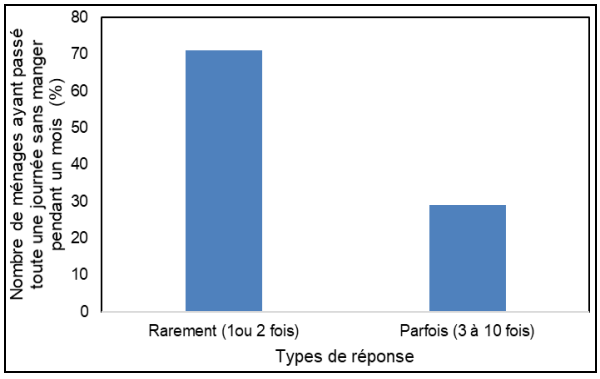

Figure 16: Number of households having spent a whole day without eating for a month according to the frequency of occurrence

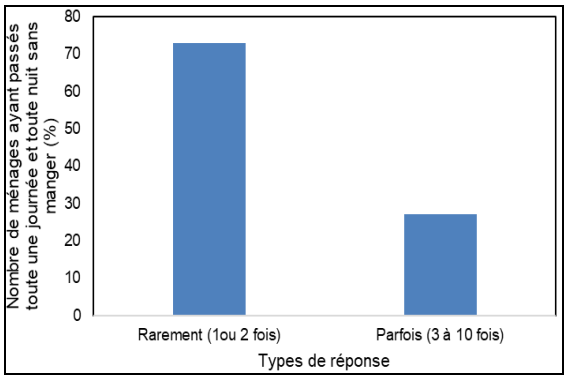

Figure 17: Number of households that went all day and night without eating

Based on the findings, it must be said that in the municipality of Zagnanado, households run a real risk of being undernourished and malnourished. This will not be without consequences for

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agricultural production and the health of populations. In addition, these results constitute an indicator of the prevalence of food insecurity in the Municipality.

3.6 Food insecurity scale scores

The household food insecurity scale score in the Commune is a continuous measure of the level of household food insecurity for the last four weeks (last 30 days) preceding the month in which the survey was conducted.

Looking at the data in Table III, four categories of access for food insecurity in households in Zagnanado are notable. These are food security, mild food security, moderate food insecurity and severe food insecurity. From the analysis of this table, it emerges that in the Municipality, the first condition is only verified at the level of the "food security" category when the field surveys have revealed that 63 household occurrence frequencies are enumerated. that is, 63 households that do not experience any of the food insecurity issues or 26 households that are just concerned but very rarely.

The second condition is not verified either since, of the number of the first eight questions asked, it is important to note that, already for the second question asked, the number of people having to answer is less than half of the total workforce considered. i.e. Q2 = 0 = 27 or 27 <77. So, on the second question asked, the second question is not verified. This amounts to saying that all the two conditions of the food security category are not met. Therefore, the conclusion that emerges is that there are no food secure households in the Municipality of Zagnanado.

According to the analysis of Table III and according to the category of light food security, it is noted that the first condition is verified in the Municipality due to the fact that 58 households are sometimes concerned about not having enough food or 08 households are often concerned about not having enough food or 41 households that rarely eat preferred types of food or 76 households that sometimes eat preferred types of food or 11 households that often eat preferred types of food or 38 households that eat a limited variety of foods or 39 households that rarely eat food other than what they want.

Table III: Categories of access to household food insecurity

Results: Field surveys, July, 2016

Types of AIAM categories	codes	Frequency of occurrence
Food Safety	1	(63 or 26 and Q2 = 0 = 27 and Q3 = 0 = 39 and Q4 = 0 = 24 and Q5 = 0 = 49 and Q6 = 0 = 81 and Q7 = 0 = 112 and Q8 = 0 = 121 and Q9 = 0 = 122)
Slight food insecurity	2	(58 or 08 or 41 or 76 or 11 or 38 or 39 or) and Q5 = 0 = 49 and Q6 = 0 = 81 and Q7 = 0 = 112 and Q8 = 0 = 121 and Q9 = 0 = 122
Moderate food insecurity	3	(66 or 12 or 63 or 29 or 48 or 45 or 26 or 38) and Q7 = 0 = 112 and Q8 = 0 = 121 and Q9 = 0 = 122)
Severe food insecurity	4	(13 or 10 or 23 or 15 or 05 or 24 or 10 or 24 or 09)

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Likewise at this level, the second condition is still not verified since from the fifth question asked, we note the number of people having to answer the question is less than half of the total workforce considered. i.e. Q5 = 0 = 24 or 24 <77. So, already in the fifth question asked, the second condition is not verified, which is to say that all the two conditions of the light food safety category are not met. Therefore, the conclusion that emerges is that there are no households with slight food security in the Municipality of Zagnanado.

In Zagnanado, in the category of moderate food insecurity; It should be noted that the first condition is verified since from the analysis of the field survey results, it is noticed that 38 households sometimes have a limited variety of foods or 66 households which often have a limited variety of foods or 63 households who sometimes ate food other than what they wanted or 29 households who rarely ate a smaller meal than they wanted or 45 households who sometimes ate a smaller meal than they wanted or 13 households who rarely ate fewer meals per day or 26 households rarely ate fewer meals per day or 38 households who sometimes ate fewer meals per day. As a result, the condition is verified since from the seventh question asked until the ninth, it is noted that the number of people having to answer these last three questions is greater than half of the total workforce considered Q7 = 0 = 112, Q = 0 = 121, Q = 0 = 122 or 112, 121, and 122> 77. So, the second condition is true; which is to say that both conditions of the moderate food insecure category are met. Therefore, the conclusion that emerges is that there are moderately food insecure households in the municipality of Zagnanado.

In the severe food insecurity category, the survey results showed that in the Commune, 13 households often ate a smaller meal than they wanted or 10 households often ate fewer meals per day or 23 households rarely ran out of food or 15 households that sometimes ran out of food or 05 households that often ran out of food or 24 households that rarely went all day without eating or 10 households that spent a whole day and every night without eating or even 09 households who have spent a whole day and a whole night. However, at this level, there is only one condition that is actually verified. It can therefore be concluded that there are severely food insecure households in the Municipality of Zagnanado.

Figure 15 shows the rate of food insecurity categories in the municipality of Zagnanado.

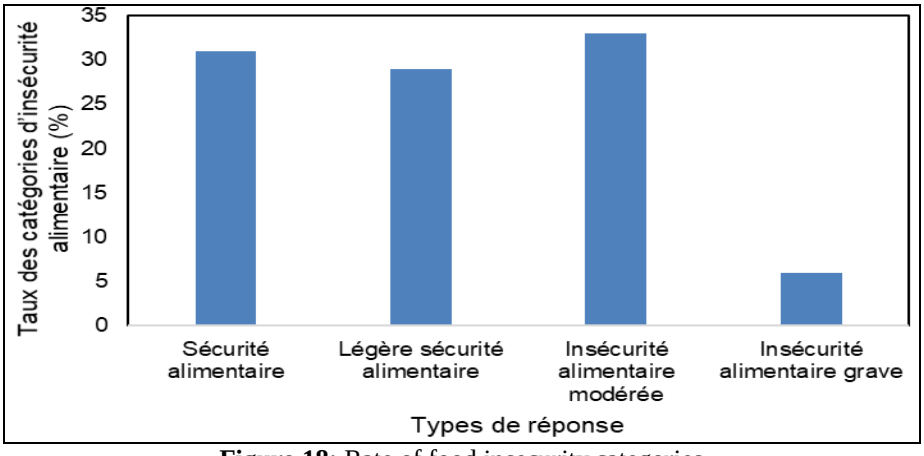

Figure 18: Rate of food insecurity categories

Results: *Field surveys, July, 2016*

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From the analysis of Figure 18, it appears that in the municipality of Zagnanado, there are two forms of food insecurity. These are moderate food insecurity and severe food insecurity. This makes the rate of moderate food insecurity the highest (33%) followed by 31%; 29%; and 6% respectively for Food Security; slight food security and severe food insecurity in the study area. These percentages constitute prevalence ratios obtained on households in relation to the food issue within the Municipality.

4. Discussion

The analysis of the results obtained made it possible to understand that the land degradation caused in particular by hydroclimatic variations and human actions have disastrous consequences on the populations of the Municipality of Zagnanado. This worsens the state of the food situation of the inhabitants, degrades their standard of living and also lowers the turnover of their income-generating activities. This is what makes Ali et al. (2012) that population growth locally influences plant formations and overall land use, which will create a greater demand to transform forests into agricultural areas. This is also attested by the results of the work of (Daane et al., 1997) which stipulated that this growth, if it is not accompanied by profound changes in the modes of production and consumption, could have consequences on biodiversity. disastrous. This same observation was made by Hardin (1968) who estimates that a finite space can only support a finite population: when the population increases, goods, resources, or food products per capita decrease until reaching zero. . In the same vein, Houngbo (2008) shows that the ecological destruction of the planet depends only on the absolute number of people who live there. Likewise, Fangnon (2012) notes in his work that the increase in the population leads to pressure on the land which manifests itself in an overexploitation of the environment and consequently in an environmental degradation, jeopardizing the sustainability of the land. food agriculture. Climatic variations, especially the frequency and intensity of extreme hydrometeorological events, have incalculable socio-economic consequences on communities lacking sustainable solutions to combat natural phenomena. The results from the PEIR model made it possible to understand that the factors responsible for these degradations are topography, lithology, hydroclimatic variability, anthropogenic pressures on soils and human activities (Ali et al., 2014). For Agoinon et al. (2012); Agbomahenan, (2016), biophysical factors are decisive in the analysis of land degradation which has accentuated food insecurity.

The PEIR model (Pressure-State-Impact-Response) made it possible to take stock of the factors acting and their respective impacts in order to propose sustainable solutions to the improvement of old strategies by new ones in the management of related impacts. land degradation in Zagnanado.

Conclusion

At the end of this study, it should be noted that several factors (natural and human) explain the foundations of land degradation observed in the Municipality of Zagnanado. These are the actions of man on morphological and biogeographical landscapes, soil types, the density of the hydrographic network, and ecosystem degradation. Land degradation influences the living environment and socio-economic resources of the Municipality, resulting in lower production and reduced income.

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