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Agricultural production and environmental degradation in the district of Barei (Djougou municipality)

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ABSRACT

This research is a contribution to a better knowledge of agricultural practices and their effects on the environment in the district of Barei (Djougou Municipality). The methods adopted consisted of literature search, direct field observations and surveys made beside 86 agricultural households. The results of this study show that there are several modes of access to land, namely inheritance (70%), borrowing (25%), and donation (5%). In addition, the identification of the different types of soils makes it possible to determine the dominant crop in the study environment. The cultivation skills of ferruginous soils and denatured ferralitic soils offer favorable conditions for cereal crops and tubers (yams and cassava). In addition, in the study area, land is overexploited. This has led to increasing deforestation (55%) in this district (use of agricultural land varies from 10 to 16 years and that of fallow land from 02 to 06 years) and resource depletion (40%). Thus, to combat land degradation and adapt to the unavailability of agricultural land, producers practise crop rotation, crops association, the use of chemical fertilizers and organic manure to fertilize the soil.

Keywords: Agicultural practises, destruction, environment, effects.

INTRODUCTION

Agriculture occupies a prominent place in the economies of developing countries, particularly in Benin Republic. Agriculture plays an essential role in society maintaining the existence of human and animal species that meet the needs related to human existence, it creates markets and others for goods and services (Akaba, 2018).

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The earth is an indispensable resource for humans because it feeds about 6.8 billion people on the planet every day. Immense potentialities still largely exploited exist in Benin Republic. For 300,000 ha of irrigable land available to the Benin, 20,000 ha are developed and equipped, including 9786 ha of perimeters with total water control and thousands of hectares of poorly developed shallows (ABE, 2002).

In Benin, agricultural production is the result of various interacting factors. It forms the basis of the economy. The natural foundations of this agricultural production consist essentially of soil factors. Land, a precious and limited resource, is constantly decreasing due to population growth and the adverse effects of human activities that in 1990, 2 hectares of land were available per capita worldwide compared to less than 0.5 hectares in 2012 (Boukoma, 2016). However, this natural resource is often threatened by population growth and the increasing need for agricultural products (Kpékou, 2011).

In Benin Republic, the satisfaction of vital needs first passes through agriculture, because the country is essentially agricultural (Tometinsi, 2015). This essentially rain-fed agriculture is the main activity and a source of food and financial return of the populations, especially in rural areas.

But the agricultural activities that play a very important role in the district of Barei affect it. It is in this logic that the subject "Production and degradation of the environment in the district of Barei" was chosen all this to allow the improvement of the living conditions of the populations.

Materials and methods

The materials and methods adopted in this study are based on some data. These include demographic data from the results of the 1979, 1992, 2002 and 2013 censuses, which made it possible to assess the population dynamics of the Barei district; geomorphological data extracted from the documentation available to know the nature of the soils; climate data (rainfall) extracted from Meteo-Benin files over the period from 1989 to 2019 to characterize the atmospheric state of the Barei district and determine whether these factors are favorable to agricultural production. Thus, it was a question of exploring the field. This exploration made it possible to meet with officials and authorities at various levels; to define the criteria for choosing the villages selected for the survey; readjust the problem, objectives and assumptions and then establish a lexicon for the collection of primary data. In addition, several data collection techniques and tools were used in this research. It is the direct and participatory observation to understand the different approaches adopted by farmers for a sustainable management of agriculture, the Active Method of Participatory Research which consists in taking an interest in the difficulties encountered by agricultural actors. Also, direct interviews are carried out using an interview guide. It was also used the technique of immersion which made it possible to make contact with the population selected for the survey. A GPS (Global Positioning System) device for taking the geographical coordinates of the middle, a camera for illustrative shooting. In order to achieve the objectives, set, a plural approach has been adopted.

The information gathered in the documents was supplemented by field research. Thus, the surveys were carried out using questions and interview guides addressed to farmers, managers of the producers' union, the supervisory officer, local authorities and SCDA-Djougou agents.

The data processing made it possible to analyze the data from the field. Question sheets are scanned manually. Word and Excel (2010) software are used respectively for the processing of text formatting and the realization of figures. The maps were made using Arc view 3.2 software.

Assessment of agricultural land dynamics

For the assessment of agricultural land dynamics, Allan's L coefficient is used (Wokou, 2009). This coefficient makes it possible to characterize the level of disturbance (degradation or not) of soils. In the present research, this coefficient was used to assess the level of fertilization of agricultural land in

Barei. It is obtained from the following formula:

$$\boxed{\mathbf{L = (C+J) / C}}$$

With:

C: number of years of cultivation;
J: number of years of set-aside or rest;
If L $\geq$ 5, then the land is well exploited and does not undergo any pressure;
If L < 5, then the land is overexploited.

Methods for analysing the impacts of agricultural production and environmental degradation

The matrix of Leopold and al. (1971) quoted by Makpotche (2017), the EBA Reference Letter (2002) were used for the environmental impact assessment. It consists in establishing the relationship that exists between the main activities of the study environment that require the use of fire identified as a source of impacts and the different components of the physical, biological and human environments affected. This analysis was addressed through the identification of the sources of impacts thanks to the questionnaire administered and the observations made in the field.

Identification of sources of impacts and components of the environment

The sources of impacts are drawn from the main activities that are carried out on farms. Bisset's list (1998) cited by Agbamate (2017) has highlighted the sources of impacts related to agricultural practices. The matrix of Leopold et al. (1971) quoted by Makpotche (2017) made it possible to cross these sources of impacts with the components of the environment to highlight those affected by agricultural sub-activities. Thus, Table 1 presents the sources of impacts and the components of the environment affected.

Analysis and assessment of the environmental impacts of agricultural production

The analysis and evaluation of the magnitude of impacts is based on a methodological approach that integrates the three parameters of impact: nature, duration, extent and intensity. The crossing of these parameters in accordance with the reference framework for the evolution of the importance of impacts (Thibault, 2005, cited by Agbamate, 2017), made it possible to deduce the importance of impacts that can be of three kinds: strong, medium, and weak. To this end, Table 2 is the reference framework for assessing the significance of impacts.

Another methodological approach that integrates the three parameters of negative impact, namely duration (momentary, temporary and permanent), extent (punctual, local or regional) and degree of disturbance (low, medium, strong and very strong) is that of the EBA (1998) cited by Makpotche (2017). Table 3 presents the EBA's reference framework for assessing the significance of impacts.

According to the observation in Table 3, the impact analysis is carried out in a general and specific way. The positive impacts are grouped together to later form part of the compensatory measures. Measures are also proposed for each significant impact, distinguishing between maximisation measures and those intended to limit negative impacts.

Determination of sample size

The sampling took into account all the different categories of persons involved in agricultural production. This made it possible to have diversified information. At the village level, the choice of respondents is made according to their activities. Thus, one must belong to an agricultural household to be eligible. The choice of respondents meets certain criteria that are not cumulative, namely: be the head of an agricultural household with fields on the farm or in departments dealing with agricultural or environmental issues. This criterion is taken into account because agricultural actors have a better grasp of the realities of the agricultural world; be at least thirty-five (35) years old in order to better inform about the potentialities and constraints of agricultural land in the borough; reside in the borough. This criterion is chosen because to talk about the realities of an environment, one must have lived there for a certain number of years. The sample size at the village level is determined according to the formula used by Schwartz (1995) cited by Makpotche (2017).

$X = Za^2\ p\ q\ /d^2$

With:

X = sample size per village;

Za = 95% confidence level (standard value of 1.96);

d = 5% margin of error (standard value of 0.05) which gives the desired precision or confidence interval;

p = number of agricultural households per district / total number of households in the commune of Djougou;

q = 1-p;

It is necessary to determine the X by the following numerical application:

P = 1292 / 18673 = 0.06

q = 1-p = 1-0.06 = 0.94

$X = (1.96)^2 \times 0.06 \times 0.94 / (0.05)^2 = 86$

These different calculations carried out on the other villages made it possible to draw up (Table 4).

The Table 4 presents the sampling of the Barei district by village chosen during our field survey. A total of 86 heads of households were interviewed.

Table 1: Impact factors and environmental components affected.

	Environmental components						
	Physical environment			**Biological environment**		**Human environment**	
Sources of impacts	Air	Water	Ground	Fauna	Flora	Social	Economic
Clearing-save	-	-	-	-	-	-	-
Ploughing	-	-	-	-	-	-	+
Weeding	-	-	-	-	-	-	+
Spreading	-	-	-	-	-	-	+
Herbicide use	-	-	-	-	-	-	+

Source: Leopold et al., 1971 adopted by Muhammad, 2020

Legend: + =positive impact +/- = negative and positive impact- = negative impact

Table 2: Reference letter for assessing the significance of impacts.

		Intensity		
Duration	**Scope**	**Weak**	**Average**	**Strong**
Short	Point	Minor	Minor	Minor
	Local	Minor	Minor	Average
	Regional	Minor	Average	Average
Average	Point	Minor	Minor	Average
	Local	Minor	Average	Average
	Regional	Minor	Average	Major premise
Long	Point	Minor	Average	Average
	Local	Minor	Average	Major premise
	Regional	Average	Major premise	Major premise

Source: Thibault, 2005

Table 3: EBA reference framework for assessing the importance of EBA.

Duration	Scope	Degree of disturbance			
		Weak	Medium	Fort	Pungent
		Importance of impact			
Momentary	Point	Weak	Weak	Average	Average
Momentary	Local	Weak	Weak	Average	Average
Temporary	Point	Weak	Weak	Average	Strong
Temporary	Local	Weak	Weak	Average	Strong
Momentary	Regional	Weak	Average	Average	Strong
Permanent	Point	Weak	Average	Average	Strong
Temporary	Regional	Weak	Average	Strong	Strong
Permanent	Local	Weak	Average	Strong	Strong
Permanent	Regional	Average	Strong	Strong	Strong

Source: ABE, 2002

Table 4: Distribution of the number of households by village.

Villages of Barei	Total number of agricultural households	Number of agricultural households selected	Percentage (%)
Anoum	203	15	17,44
Bandessar	82	6	6,97
Bandetchouri	58	4	4,65
Barei	501	30	34,88
Dangoussar	290	15	17,44
Gondessar	69	4	4,65
Selra	89	12	13,95
Total	1292	86	100

Source: Field results, December 2020

RESULTS

Presentation of the geographical location of the study framework

Located between the North latitudes 9°38'24" and 9°42'0" and the East longitudes 1°31'48" and 1°36'36", the Bareï district is located in the Municipality of Djougou (Donga division) with an area of 155.1 km². It is bounded to the north by the District of Pabegou, to the west by the Municipality of Ouake to the east by the District of Djougou 2 and to the south by the District of Penessoulou. The District of Barei has 07 villages namely: Anoum, Bandessar, Bandetchouri, Barei, Dangoussar, Gondessar, and Selra (INSAE, 2013). These villages are the environments favourable to agricultural production.

Figure 1 shows the geographical location and administrative subdivisions of the district of Barei. The district of Barei is located in the west of the Donga division and benefits from the asphalt road.

Demographic characteristics

The district of Barei has an estimated population of 12849 inhabitants in 2013. It is home to a very dynamic population that has been growing rapidly in recent decades. The rate of increase is estimated at more than 3.9% in 2002 (INSAE, 2013). Figure 2 shows the evolution of the population of the Barei district between 1979 and 2013.

The analysis in Figure 2 shows an increasing evolution of the population. Indeed, this population increased from 5341 inhabitants in 1979 to 7273 inhabitants in 1992 from 7273 to 9259 inhabitants in 2002. In addition, the latter increased from 9259 inhabitants to 12849 inhabitants in 2013; that is a growth of about 54% over the last twenty years. This population growth allows the borough to have an abundant workforce for agricultural production and a consumer market. On the other hand, the increase in population leads to the scarcity of agricultural land and the disappearance of fauna and flora. The population of Barei is unevenly distributed in the seven (07) villages of the district and a sociolinguistic diversity.

Main socio-cultural groups

The current populations of the district of Barei are of diverse origins and carry out complementary activities. Figure 3 shows the socio-cultural groups of Barei.

In the district of Barei, the population is mainly composed of Yowa and Lokpa (54.2%). This ethnic group is followed by Dendi and relatives (14.6%), Fulani (14.3%), Otammari and related (6.7%), and Baribas and related (3.9%). In addition, these ethnic groups engage in agriculture as their main activity.

Characterization of cultivable practices

This characterization is based on the modes of access to land, cultivation techniques and agricultural production in the district of Barei.

Modes of access to land in the district of Barei

In the district of Barei, there are several types of mode of access to land namely: inheritance, borrowing, and donation. Figure 4 shows the proportion of the different modes of access to land in the district of Barei.

The analysis in Figure 4 shows that 70% of the peasants surveyed inherit the land from their parents, 25% borrow the land and 5% access the land through donation. Photo 1 is an illustration of a yam field in Anoum.

It appears from the observation of Photo 1 that the soil of the borough is conducive to cultivation. Similarly, on the soils of the district of Barei, other crops are developed such as cassava, maize, sorghum, etc. Thus, Photo 2 shows a cassava field in Selra.

It appears from the observation of Photo 2 that the soil of Barei is also suitable for the cultivation of cassava, cultivated by several farmers in the district of Barei.

Cultivation practices

Several cultivation practises are used in the district of Barei. These are sarclo-butting techniques, the use of chemical fertilizers, the use of phytosanitary products and itinerant slash-and-burn cultivation. These practices are traditional techniques used by farmers in Barei district; that is to say, itinerant slash-and-burn cultivation, eco-bubbling, ploughing, butting, sowing in poquet. There are also techniques of soil preparation, ploughing and sowing, maintenance and treatment of the soil with tools such as hoe, cutter, axe, tractor, etc. Indeed, during the cultivation operation, the hoe and the cutter are the most used by the growers while the axe and the tractor are the least used.

In addition, agricultural equipment in the Barei district is mainly designed for manual work. These tools reflect the technical backwardness of Beninese agriculture in general and in particular that of Barei which deserve to be replaced by agricultural machinery adapted to the soils of the environment.

Soil preparation

Soil preparation is a first phase of agricultural activities. It occurs just before the rainy season and concerns clearing, desoiling, sweeping and desiccing. In general, this preparation takes place during the months of march and april. In addition, this technique is used to remove either the roots and stems of the previous campaign or the grasses on a plot that had remained uncultivated. This work is done with a hoe. Residues are very often burned. Clearing consists of removing unwanted plant species from the space intended to accommodate production while de-soiling consists of ridding the roots of this space.

Ploughing and sowing

This is the second phase of the production cycle. After manual clearing or by fire, the peasants make large ridges. These ridges are arranged in parallel strips of a length that varies between 20 and 25 m depending on the dimensions of the field.

Some farmers practice the technique of harness cultivation that allows them to plough the soil in a short time. But in the medium or long term, it poses the problem of soil degradation. Sowing occurs practically in June for all crops. It is carried out for most crops either directly or on ridge. On the other hand, ploughing is mainly applied to soils that are not very fertile. It allows to better stir the soil for better aeration and good infiltration. This cultivation method facilitates the sinking of the roots into the ground. However, this highly recommended practice for the development of the root system of plants is often misused. Indeed, ridges are sometimes oriented in the direction of the slope to facilitate the flow of rainwater to the valleys. This runoff causes the soils to lose organic fertilizing elements due to the stripping of the ridges put in place. These different factors (natural, human and organizational) with their inadequacies largely determine the management of cultivable areas and production in the district of Barei.

Techniques for itinerant slash-and-burn cultivation and eco-bubbling

Itinerant slash-and-burn cultivation is the main cultivation technique. In the district of Barei, about 65% of farmers adopt this technique for soil preparation. This preparation is made of clearing with incineration (inherited technique) when it comes to new land or land left fallow. The ecobuage consists after the clearing to make small piles to which the farmer sets fire. These two techniques facilitate, according to field investigations, the clearing and rapid updating of land.

Butting techniques

The butting technique is suitable for fairly loose soils and facilitates heaping along the banks. This technique is practised for tubers (yam and cassava). This technique is practised by 60% of the farmers selected for the survey in Barei's district. Thus, on these mounds, yam is the most developed crop.

Production systems

The production system is determined by the simple combination of cassava, yam and maize cultivation which is the most widespread technique in the commune. The technique of combining crops is carried out in environments where farmers do not have enough soil for rotation and rotation. Thus, they practise this method for a better yield because it allows to maintain the fertility of the soil. Photo 3 shows an example of a combination of crops. Shooting: Kadjegbin, December 2020.

It emerges from the observation of Photo 3 that the purpose of crop associations by farmers is to have several products with little effort and to cope with the unavailability of land.

Crop care and treatment techniques

The maintenance includes 3 operations: weeding, hoeing and butting. These operations are carried out after sowing and vary between 15 to 45 days depending on the crop. Mineral or organic manure and weeding are also carried out. As far as processing is concerned, it is used particularly for cassava, yam and maize. This treatment takes into account chemicals including herbicides, fertilizers and phytosanitary products.

Use of chemicals

According to field surveys, the development of improved seeds requires the use of chemical fertilizers and pesticides. By neglecting ecological risks, farmers choose fertilizers such as "NPK" and "UREE". The dose vulgarized by the agents of the ATDA (Territorial Agency for Agricultural Development) on the improved variety of maize is: 100 kg of "NPK" and 50 kg of "UREE" for one hectare. Despite instructions from ATDA agents, farmers often do not adhere to this dose. However, the misuse of these products is dangerous to the environment.

Agricultural production in the district of Barei

The main speculations cultivated by farmers in the district of Barei are: yam (*Dioscorea* alata), maize (*Zea mays*), cassava (*Manihot esculenta*), and sorghum (*Sorghum bicolor*). Thus, Figure 5 shows the evolution of yam production in the district of Barei from 2009 to 2019.

Figure 6 shows that yam sown areas have varied over the last ten (10) crops years with an annual increase of 3.50%. The largest planting is recorded for the 2013-2014 crop year with a high yield of 500 kg compared to others. In a nutshell, during this agricultural season, the peasants sown a large area and followed the instructions of ATDR agents. As a result, yields depend on planting. The following Figure 6 shows the evolution of maize production in the Barei district from 2009 to 2019.

It follows from the analysis in Figure 6, those maize areas since the 2009-2010 to 2015-2016 crop year remain almost constant with a slight annual increase of 1.2%, while yields have gradually fallen from 400 to 60 kg for the period from 2016 to 2019, reduction of 25.3%, despite the large areas sown. Thus, the decrease in yields can be explained by the impoverishment of the soils due to their overexploitation by farmers or by the scarcity of rains. Figure 7 shows the evolution of cassava in the Barei rounding from 2009 to 2019.

Figure 7 shows that cassava sown area increased from 2009 to 2016, an increase of 2% and decreased by 10% in 2019. This is evidence of the intensification of agriculture in the Barei district. Despite a higher planting for the 2013-2014 crop year, the lowest yield of 42 kg compared to the others is recorded for this period. This situation can be explained by the depletion of agricultural land, by a sudden stop of rain, by the decline in soil fertility due to their overexploitation, etc. The following Figure 8 shows the evolution of sorghum production in the district of Barei from 2009 to 2019.

Figure 8 shows that sorghum sown areas fell by 4% after a 6% increase between 2012-2013. Yields have been gradually changing since the 2010-2011 crop year, with a slight decrease for the last crop year. It is therefore noted that yields do not necessarily depend on the areas allocated to sorghum cultivation. Yields may depend on soil fertility or the use of phytosanitary products. Photo 4 shows a cornfield (*Zea mays*) in Gondessar.

From to the observation of Photo 4, there is a corn field of two (02) hectares well bred. Thus, the soil of Barei is suitable for the cultivation of maize grown by several farmers in the district of Barei.

Effects of cultivable practices on the environment in the district of Barei

Direct observation of the field has shown that wildland fires have an impact on the components of the environment.

Identification of the sources of impacts and the environmental components of the environment affected

Agricultural activities have a huge impact on soil and vegetation. These most well-known cultural activities or practices are land clearing; weeding; ploughing; the use of herbicides; spreading.

The identification of the components of the environment made it possible to highlight the different parameters that can be affected by agricultural activities. Thus, these are the components of the physical environment (soil, water, air), the biological environment (fauna and flora) and the human environment (social and economic). Table 5 shows the environmental components affected positively or negatively by agricultural production.

An examination of Table 5 shows that cropping operations have consequences for environmental components including air, soil, flora, fauna, human health and the economy. These consequences are either positive or negative. Indeed, ploughing has a positive impact on the local economy. Also, the use of pesticides / fertilizers has allowed an increase in the yield of agricultural production, this thus participates in food self-sufficiency.

In addition, the use of chemical pesticides/fertilizers has negative impacts on air, soil, wildlife and human health. Indeed, from chemicals applied in the fields, through the different odors that these pesticides propagate, the ambient air is polluted. Similarly, during rainfall, chemical fertilizers used to increase yields are drained to streams through runoff. However, the water in the rivers is consumed by the surrounding populations. Its consumption causes the contraction of several diseases including diarrhea, cholera, bilharzia. In addition, fish species are threatened with the disappearance of rivers. In addition to these threats, the excessive use of fertilizers causes soil depletion. Clearing has a negative impact on water, soil, flora, and health. Indeed, the felling of trees for crops exposes the soil. This nudity of the soil causes the increase in erosion thus leading to soil degradation. Similarly, the disappearance of woody vegetation caused the escape of animals. Ploughing has negative impacts on water, flora and soil. In addition, weeding and spreading also have a negative impact on water, soil, flora, fauna, fauna and human health but a positive impact on the economy. Thus, the results of the assessment of these negative impacts are recorded in Table 6.

Table 6 shows that the impacts are of high and low intensity, of local extent and of temporary duration for fertilization, clearing and incineration. For ploughing and sowing, the impact is of low intensity, local extent and momentary duration. As for the phytosanitary treatment, the impact is of a strong intensity, a medium extent and a momentary duration. In addition, the impact is of a low intensity, of a local extent of a momentary duration for the harvest.

In addition, the use of chemical pesticides / fertilizers has negative impacts on the air, soil, wildlife and human health. Indeed, from the chemicals applied in the fields, through the different smells that these pesticides propagate, the ambient air is polluted. Similarly, during rainfall, chemical fertilizers used to increase yields are drained to waterways through runoff. However, the water in the rivers is consumed by the surrounding populations. Its consumption causes the contraction of several diseases including diarrhea, cholera, and schistosomiasis. In addition, fish species are threatened with disappearance from waterways. In addition to these threats, the excessive use of fertilizers causes soil depletion. Clearing has a negative impact on water, soil, flora, fauna, and health. Indeed, the felling of trees for crops exposes the soil. This bareness of the soil causes increased erosion, thus leading to soil degradation. Similarly, the disappearance of woody vegetation caused the escape of animals. Plowing has negative impacts on water, flora and soil. In addition, weeding and spreading also have a negative impact on water, soil, flora, fauna, fauna and human health but a positive impact on the economy. Thus, the results of the assessment of these negative impacts are recorded in Table 7.

Table 7 shows that impacts are high and low intensity, local in extent and temporary in duration for fertilization, land clearing and burning. For plowing and sowing, the impact is of low intensity, local extent and temporary duration. As for the phytosanitary treatment, the impact is of high intensity, medium extent and temporary duration. In addition, the impact is of low intensity, of local extent and of temporary duration for the harvest.

Effects of cultivation practices on soils and vegetation in the district of Barei

Agricultural practices compromise the state of health of living beings and in particular humans through the handling of pesticides and this appearance of affection of environmental components, it is the poor who will be more of both the main victims and the main perpetrators of environmental degradation in Benin (Daran, 2004). Indeed, most farmers surveyed in the field find that pesticides, chemical fertilizers and herbicides not only increase agricultural production but also harm the environment and human health. Thus, this results in soil depletion and runoff that drains these products to the ponds supplied by the population, which encumbers the health of the population.

Overexploitation of agricultural land

In the district of Barei, arable land is overexploited. Indeed, the strong demographic pressure leads to the excessive and irrational exploitation of the land by cultural practices that enormously deplete the soil. Fallow land, which was once a means of restoring soil fertility and which lasted more than fifteen years, now lasts only four to six years. The reduction in the duration of fallow land already shows the increasing pressure on soils that are becoming very poor. In addition, the recommended fertilizer doses for soil fertilization are not respected. Thus, the overdose of chemical fertilizer accelerates the degradation and impoverishment of soils. Table 8 shows the average duration of agricultural land use and the average duration of fallow land in the villages representing the sample of the study.

The analysis in Table 8 shows that the average working hours of agricultural land vary from ten to sixteen years and those of set-aside from two to six years. In addition, the Allan L coefficient calculated at the village level is less than five (05) which means that the land has been overexploited in Barei. Thus, to guarantee the land and preserve the environment in the district of Barei, farmers adopt certain strategies.

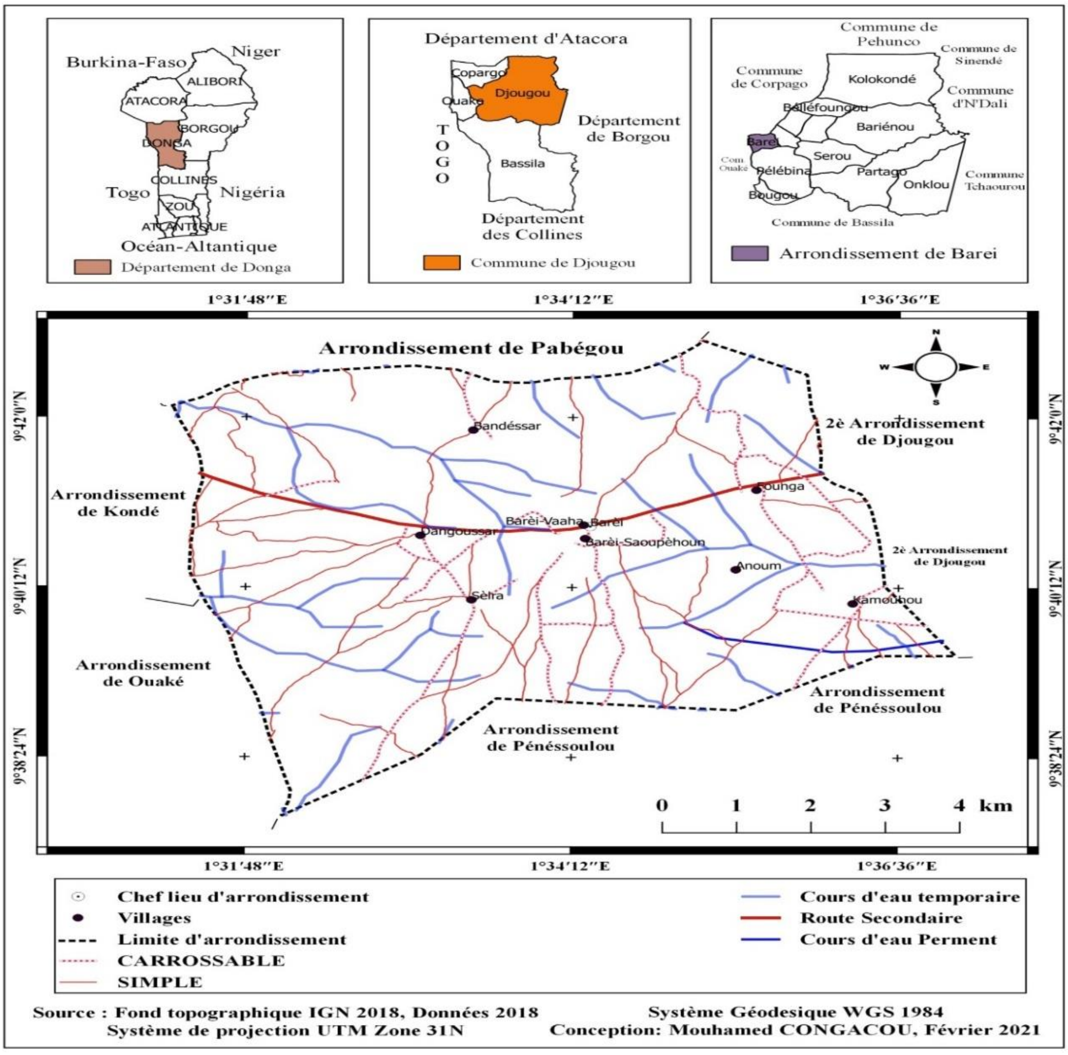

Figure 1: Geographical subdivisions of the district of Barei location and administrative.

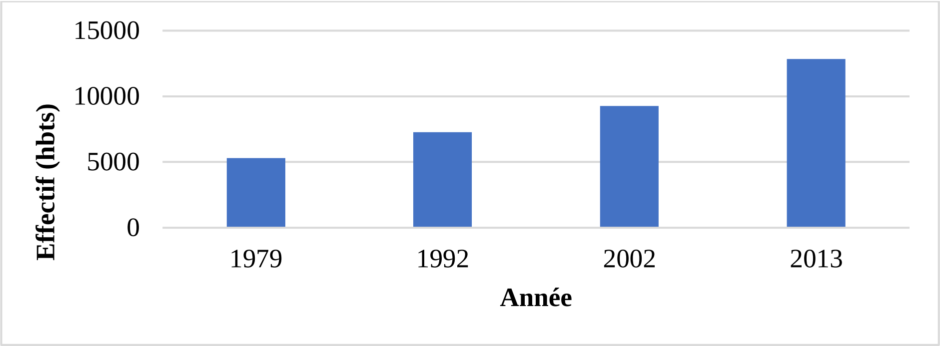

Figure 2: Demographic evolution of Barei from 1979 to 2013.
Source: INSAE data processing, December 2020.

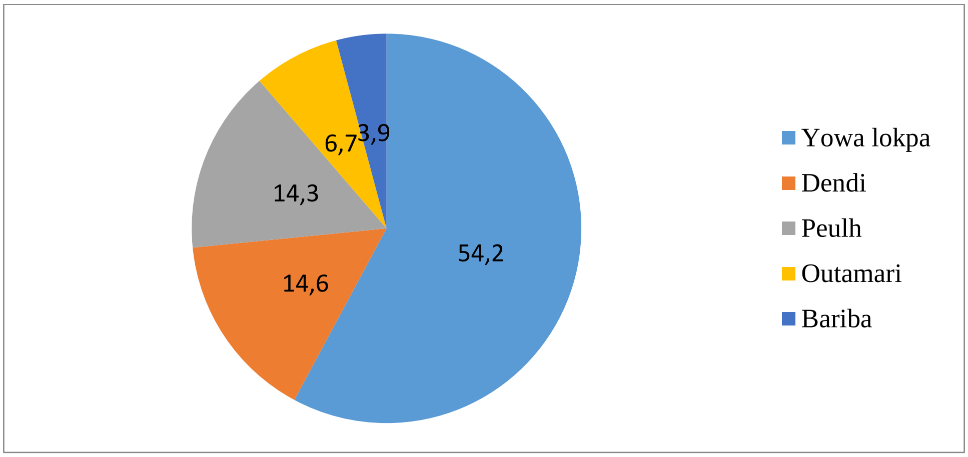

Figure 3: Culturals Socials Groups.
Source: INSAE, 2013.

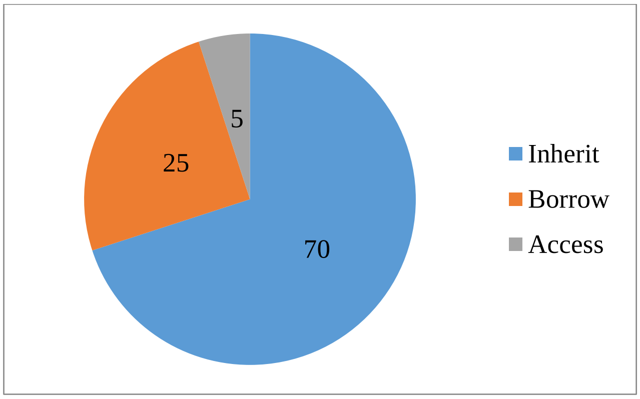

Figure 4: Mode of access to land in the district of Barei.
Source: Results of the field survey, December 2020.

Photo 1 : Partial view of a yam field (*Dioscorea Alata*) in Anoum.
Shooting: Kadjegbin, December 2020.

Photo 2 : Partial view of a cassava field (*Manihot esculenta*) in Selra.
Shooting: Kadjegbin, December 2020.

Photo 3 : Partial view of a field combining maize (*Zea mays*) and cassava (*Manihot esculenta*) in Dangoussar.
Shooting: Kadjegbin, December 2020.

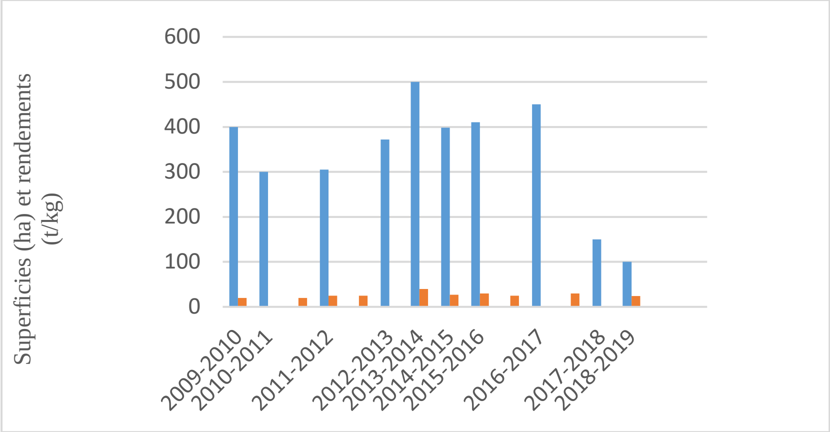

Figure 5: Evolution of yam production (*Dioscorea alata*) in the district of Barei from 2009 to 2019.
Source: Field survey data processing, December 2020.

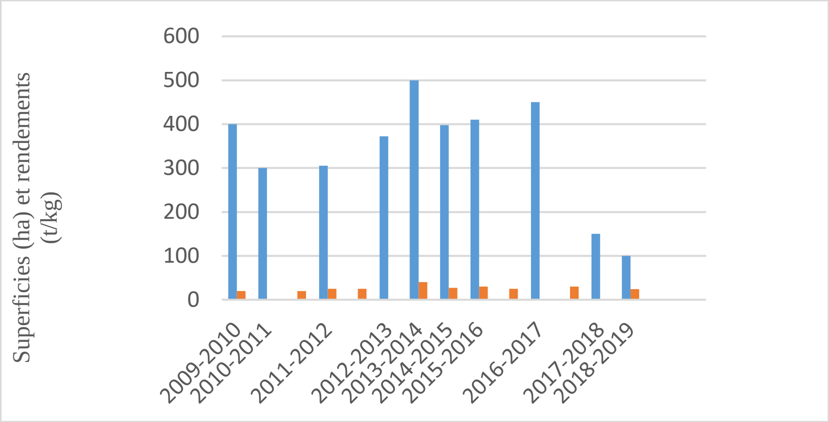

Figure 6: Evolution of maize production *(Zea mays)* in the district of Barei from 2009 to 2019.
Source: Field survey data processing, December 2020.

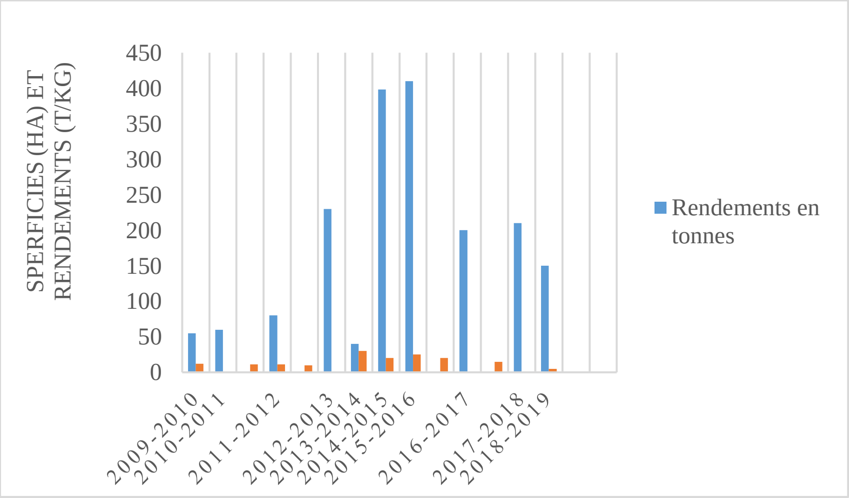

Figure 7: Evolution of cassava production (*Manihot esculenta)* in Barei district from 2009 to 2019.
Source: Field survey data processing, December 2020.

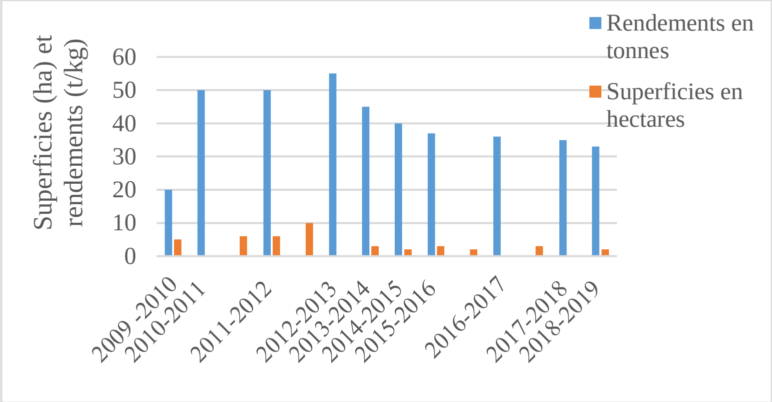

Figure 8: Evolution of sorghum production (*Sorghum bicolor*) in the district of Barei from 2009 to 2019.
Source: Field survey data processing, December 2020.

Photo 4 : Partial emptiness of a cornfield (*Zea mays*) in Gondessar.
Shooting: Kadjegbin, December 2020.

Table 5: Matrix for determining the sources of impacts and the components of the affected environment.

Activities	Affected items	Assessment of importance		
		Duration	Scope	Intensity
Clearing and incineration	Flora, fauna, soil	Temporary	Local	Strong
ploughing	Soil, air, water, flora, wildlife	Momentary	Local	Weak
Semis	Soil, wildlife, flora, air, water	Momentary	Local	Weak
Fertilisation	Water, air	Momentary	Average	Strong
Phytosanitary treatment	Water, air	Momentary	Local	Weak
Harvest	Soil, water, air, wildlife, flora	Momentary	Local	Weak

Source: Results of the matrix of Leopold et al., 1971, applied to our theme of study.

Table 6: Assessment of the significance of negative impacts.

Sources of impacts	Components of the environment					
	Physical environment		Biological environment		Human environment	
	Air	Ground	Flora	Fauna	Health/ Social	Economic
Clearing	Air pollution	-	Destruction of trees and herbaceous carpet	Disappearance of creeping species and insects	-	-
Ploughing	Air pollution	Soil degradation by runoff	Destruction of trees and herbaceous carpet	Disappearance of animals and destruction of their habitats	tiredness Ache	Increase sown surfaces
Weeding	Emission of fine particles (dust)	Destruction of soil microfauna, increase/decrease in soil fertility	Destruction herbaceous carpet	Flight of animals and disappearance of certain animal species	Respiratory diseases asphyxiation	Good crop growth
Spreading	Air pollution	Soil pollution by chemical or bacteriological contaminants	Disappearance of shrub plant species	Disappearance of creeping species and insects	-	Increase revenue from hunting
Herbicide use	Air pollution	Soil pollution by chemical or bacteriological contaminants	Destruction herbaceous carpet	Disappearance of creeping species and insects	Respiratory diseases asphyxiation	Good crop growth

Source: ABE (1998) and field survey, December 2020.
Legend: - = negative impact.

Table 7: Assessment of the significance of negative impacts.

Activities	Affected elements	Assessment of significance		
		Duration	Extent	Intensity
Clearing and incineration	Flora, fauna, soil	Temporary	Local	Strong
Plowing	Soil, air, water, flora, wildlife	Momentary	Local	Weak
Sowing	Soil, wildlife, flora, air, water	Momentary	Local	Weak
Fertilization	water, air	Momentary	Mean	Strong
Phytosanitary treatment	water, air	Momentary	Local	Weak
Harvest	Soil, water, air, wildlife, flora	Momentary	Local	Weak

Source: ABE (1998) and field survey, December 2020.

Table 8: Breakdown of average farmland and set-aside periods by rounding.

Villages	Average operating time (years)	Duration of average set-aside (year)	Allan's L coefficient
Anoum	10	3	1,3
Bandessar	10	2	1,2
Bandetchouri	13	4	1,30
Barei	16	3	1,18
Dangoussar	12	5	1,41
Gondessar	10	5	1,5
Selra	13	6	1,46

Source: Field survey, December 2017.

DISCUSSION

Farmers in the Barei district, in order to have a better yield, adopt agricultural practices that hinder the quality of the environment. Thus, in order to obtain better agricultural yields, several techniques such as slash-and-burn cultivation, wildland fires, the use of pesticides, herbicides and phytosanitary products are used with their environmental effects corollaries. The results according to Avognon (1989), some farmers, in the interest of a greater profitability of their land, engage in practices that harm the environment.

Biaou (2000), goes in the same direction by showing that current practices characterized by shifting slash-and-burn agriculture, the use of pesticides for cotton and other crops, continue to put the environment under significant pressure, leading to the destruction of ecosystems. For him, Beninese farmers mainly use chemical fertilizers, and 90% of imported pesticides are used for cotton. It will conclude that, in view of cotton production, which is growing at a very rapid pace (20% compared to 3 to 7% for food production), cotton cultivation is a threat to the soil, human health and biodiversity. Indeed, farmers engage in its practices without worrying about the impact they have on their health or even on their well-being and the problems to which they will be exposed if natural resources are lacking. Pour Boko (2003), the causes of environmental degradation are also at the root of the degradation of human health. Overexploitation of land and increased use of rudimentary practices are making soils poor. To prepare the soils some make use of wildfires. Among these techniques, Zodome (2007) cited by Agbamate (2007) states that forms of agricultural land reclamation such as land clearing with incineration, deep ploughing, the use of chemical fertilizers and certain insecticides are the real causes of environmental and agricultural land degradation.

In addition, agricultural production, the main source of income for people to solve food and nutritional problems, faces enormous problems and fails to promote a good food security policy that would adequately meet food needs (FAO, 2006).

More important today, the pressure on arable land in the context of extensive agriculture with rudimentary instruments is becoming ever stronger because of the very significant crop losses; the lack of control of water, food crop chains not yet organized. These constraints, despite the cultural practices used, regularly lead to difficulties in accessing certain food products in the event of climatic disturbances (Tossa, 2011).

Indeed, Chabi (2011) addresses the question of biophysical and human assets favorable to the development of agricultural production which, moreover, contributes in part to the food security of populations. It evokes the vulnerability of agriculture because of its dependence on climatic hazards; population growth and migration of agricultural settlers reducing agricultural land; soil depletion and the use of rudimentary techniques and tools, which are determinants of the risks of food insecurity.

For Tente et al. (2011), the causes of the destruction of the vegetation are aggravated by the agricultural activities, which - according to some studies can only have negative effects on the natural ecosystems (Oloukoi et al., 2011). In the headquarters of Zou and even in the plateau of Abomey (Toko et al., 1999) who reported an increase of agricultural surface area, savannas which influences agricultural and built to the detriment of other categories of units of land use. Also, the connection established between the evolution of the units of land use and the progress of the number of the population highlighted that the more the size of the population grows, the more the natural formations lose surface. These results are in accordance with those obtained by other scientists (Arouna et al., 2011; Carr et al., 2005; Vodounou, 2005; Barima et al., 2009; Arouna, 2012) who reported that the natural space disappears with time and that the farming areas increase with the evolution of the size of the population. Mama and Houndagba (1991) also reported that the demographic pressure entails the destruction of about 100 000 ha of natural vegetations every year in Benin.

Conclusion

The research presence is a contribution to a better knowledge of agricultural practices and their effects on the environment in the Barei rounding. At the end of this research, it must be remembered that there are several modes of access to land, namely: inheritance, borrowing and donation. In addition, the identification of the different types of soils makes it possible to understand the dominance of crops in the study area. The cultural aptitudes of ferruginous soils and denatured ferralitic soils offer favourable conditions for cereal crops (maize, sorghum) and tubers (yams, cassava). On the other hand, the cultivation practices used in the district of Barei (sarclo-butting techniques, the use of chemical fertilizers, the use of phytosanitary products and itinerant slash-and-burn cultivation) and the constraints on land use contribute to the degradation of agricultural land. Thus, arable land is overexploited in the district of Barei. This has led to increasing deforestation, soil depletion and resource depletion, rural exodus, unemployment and endless state crises. Thus, to combat land degradation and adapt to the unavailability of agricultural land, producers practises crop combination, crop rotation, the use of chemical fertilizers and the use of organic manure.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

The main author of this article had to do the various field surveys followed by the writing of part of this article. As for the second author, he for his part produced the various maps relating to this study and also participated in the final drafting of the study which led to the final drafting of the article without forgetting the other authors as well.

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