
Socio-economic Characteristics of the Rice Growing Perimeter Developed from Dokomey to Abomey-calavi (Benin)

Françoise VALEA³, Asai Akinni Gervais ATCHADE^{1,2}, Hilaire AÏMADE^{11,2}, Expédit Willfrid VISSIN^{1,2}

¹ Department of Geography and Regional Planning, University of Abomey-Calavi, BP 1338

² Pierre Pagney Laboratory: Climate, Water, Ecosystems and Development (LACEEDE),
University of Abomey Calavi, B.P 526

³ Laboratory Dynamics of Spaces and Society (L D E S) Ouaga University Pr Joseph KI ZERBO
(Burkina-Faso),

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Abstract

The development of lowlands has become a major issue for agricultural development in order to increase production yields. The characterization of these agroecosystems is necessary for the management of natural crises such as floods and droughts. This is the objective of this study at the Dokomey site in the municipality of Abomey-Calavi in Benin. Float gauging methods and infiltration methods using the Porchet method have made it possible to characterize the shallows. The latter is reinforced by field visits for direct observations and semi-structured interviews with the rice farmers who operate the site; The Strengths, Weaknesses, Opportunities and Threats (SWOT) matrix is the results analysis model used.

The analysis of the results obtained shows that the site is crossed by a tributary of the Ouémé River named "Lokpa" with an average flow of 3.12 m³/s in the main canal. Runoff and rainfall are the secondary sources of supply at the site. Also, the soil of the study site is clayey-sandy with an average longitudinal slope of about 2.71% and its average transverse slope fluctuates around 3.99%.

The permeability of the soil is 4.57.10⁻²m/s. Despite the potential, the operating groups encounter several difficulties. These are mainly related to water management but also to access to the site during flood periods. It would be wise to enhance the entire site with total control of water in all seasons by installing infrastructure that is more resilient to the current climate context.

Keywords: Lowlands, Developed perimeter, Rice cultivation, Hydrology, Water control.

Introduction

Benin is a country in sub-Saharan Africa that has been facing climate variability for several years. According to GIZ (2012), this climate variability manifests itself in space and time by the appearance of periods of drought during the rainy season. This situation today influences the water/agriculture relationship which is today of major importance because, according to the FAO (2005) at the global level, agriculture is the largest user of water with 70% of total withdrawals. There is growing demographic pressure leading to the consuming urbanization of agricultural land and a strong evolution of dietary practices in certain parts of the globe (Denier-Pasquier, 2013).

Faced with this observation, the African Development Bank (AfDB) launched, in 2014, the Agricultural Infrastructure Support Project in the Ouémé Valley (PAIA-VO). In Benin, this project helps the populations of the Ouémé valley in carrying out their agricultural activities. Indeed, the development of development models and water management methods has enabled farmers to better control it in order to limit the risks of drought or excessive flooding and also to extend cultivation periods (IVC/CBF, 1997).

“Benin has 375,000 ha of irrigable land including 117,000 ha of floodplains and valleys and 205,000 ha of lowlands” according to data from the MAEP (2017). But only 20% of this irrigable land potential is exploited to date. Rice is one of the crops produced in the rainy season on these lands. Soils in lowlands are generally more fertile than other soils in a watershed, because nutrients are transported from upstream to this area, allowing productivity to increase.

To this end, to exploit these potentialities, it is necessary to mobilize surface and/or underground water in a given location by creating hydro-agricultural infrastructure: water retention (surface water); wells and boreholes (groundwater) and appropriate management systems for its rational and efficient use for agricultural production. It is therefore a question of making agriculture less dependent on climatic hazards. The use of lowlands for better agricultural productivity is a great agricultural step forward. However, it is important to question the different steps to take for appropriate and rational use of this resource.

The Dokomey site is located in the Municipality of Abomey-Calavi. It is limited to the North by the Municipality of Zè, to the South by the Atlantic Ocean, to the East by the Municipalities of Sô-Ava and Cotonou, to the West by the Municipalities of Tori-Bossito and Ouidah. The study area is represented by the figure below.

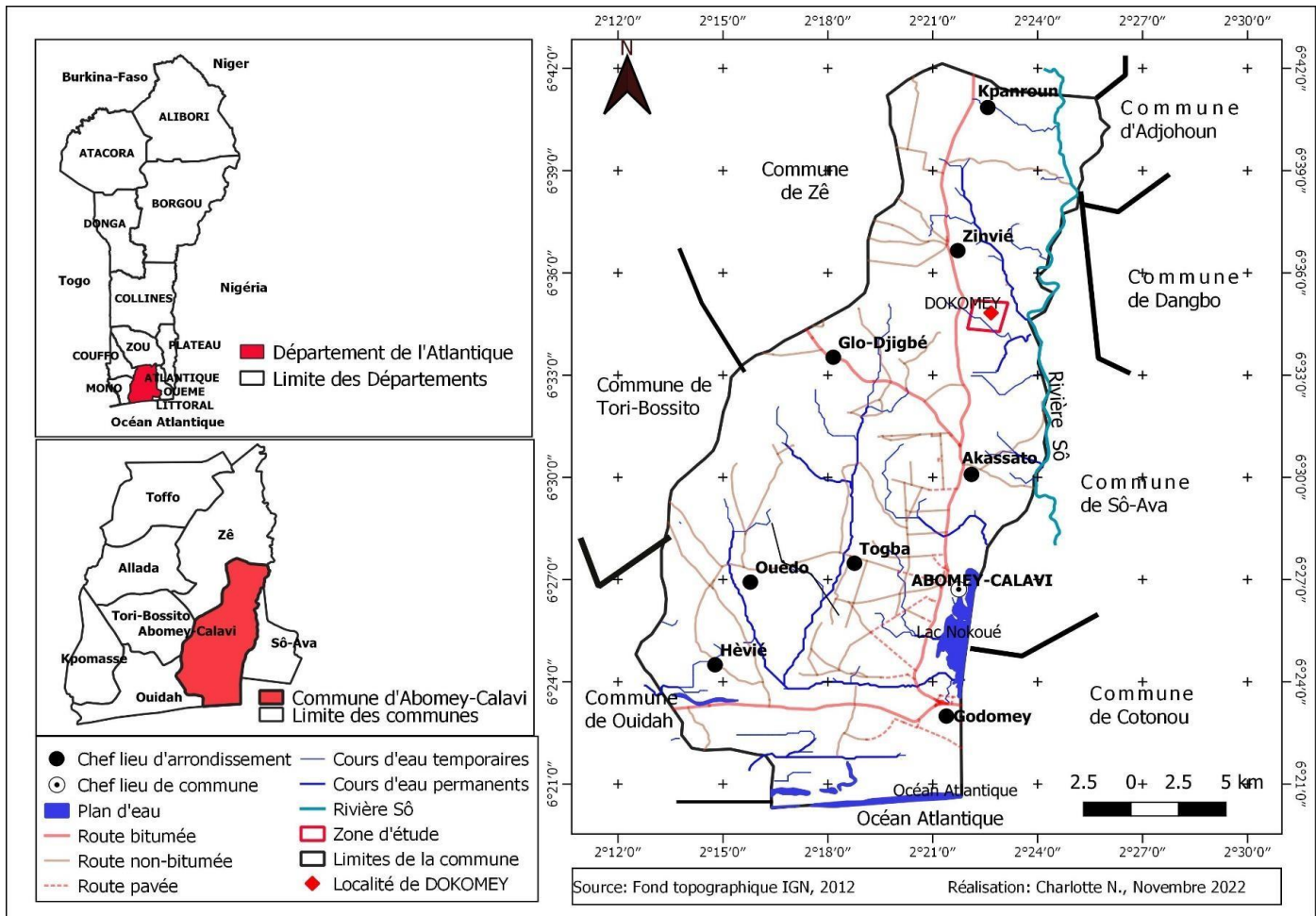


Figure 1: Geographical location of the Municipality of Abomey-Calavi

Source: IGN BENIN topographic fund, 2012; Our field work, 2022

The village which houses the site of our study is called Dokomey and is located in the district of Zinvié. The geographic coordinates at a point in Dokomey are: longitude 02 22'26.3 "East and latitude 06 34'56.4" North. It is located in the commune of Abomey-Calavi and in the Atlantique department (CID, 2015).

2-Methodological approach

2.1-Data collection, processing and analysis tools

➤ Field equipment

To collect data on the perimeter, several tools are used. These include:

- a topographic map of the Municipality of Abomey-Calavi from the IGN-Benin topographic database, 2012 for recognition of the site;

- a GPS (Global Positioning System) which was used to record the geographical coordinates of the terrain;
- a camera for taking pictures for illustration purposes;
- a questionnaire and an interview guide addressed to operators in order to collect information relating to their economic activities and the strategies adopted;
- An observation grid for better characterization of the study site.

➤ **Data analysis software**

To analyze this processed data, we used SWOT, which is an analysis tool allowing us to assess the internal and external environment of the sites. It makes it possible to highlight the strengths and weaknesses (internal diagnosis), opportunities and threats (external diagnosis) of a company. The interest of SWOT is the combination of the study of the strengths and weaknesses of the site with the opportunities and threats of the environment, in order to propose solutions for better development of the site.

➤ **Data collection**

This phase consisted of visiting the site to collect useful data through surveys and interviews with operators and technicians on the site and carrying out participant observations relating to the site, the study framework and also working with the producers on the site. The lowland was developed by different cooperatives with which we carried out our research

3-Results

3.1-Socio-economic characteristics of lowland farmers

➤ **Distribution of lowland farmers according to gender**

The Dokomey lowland was developed by 3 different cooperatives with a total workforce of 44 operators (table I).

Table I: Number of cooperatives on the Dokomey site

Cooperatives	Men	Women	Workforce
Ayidékon	08	04	12
Gbénonkpo	09	06	15
Mahufonmi	14	03	17
Total	31	13	44

Source: Nounagnon, October 2022

In addition to these three producer cooperatives, there are also several other individual operators on the site. The members of these cooperatives are mostly married men and women with children. They monitor and participate in the correct implementation of activities for the production of Paddy Rice, sweet potatoes, and other market garden products. Indeed, in the implementation of agricultural activities, producers use several workers, in particular family labor and that of workers who do not belong to cooperatives.

The figure 2 gives the distribution of people surveyed by gender

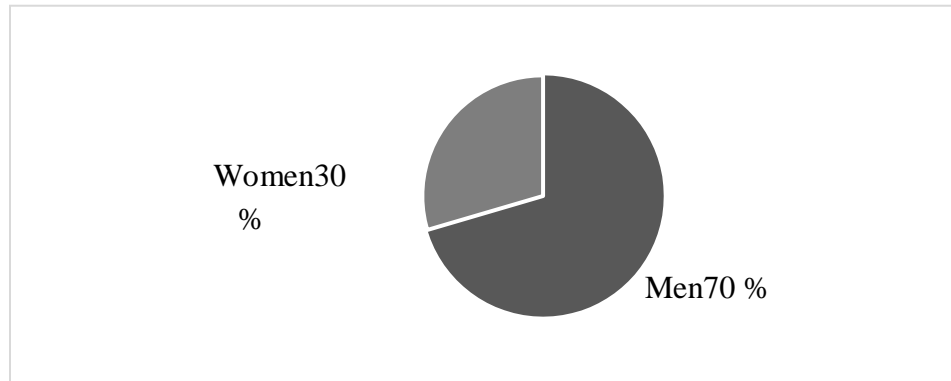


Figure 2: Distribution of respondents by gender
Source: Nounagnon (2022)

It appears from this graph that women represent 30% of the people surveyed compared to 70% for men.

➤ **Age of lowland operators**

The age of these lowland operators constitutes an essential parameter to take into account for the proper development of this natural resource. Thus, three age classes were observed taking into account the people present in the surveyed sample, namely age classes under 35 years old, 36 to 45 years old and 46 years old and over. The graph in Figure 3 gives the percentage of staff by age group.

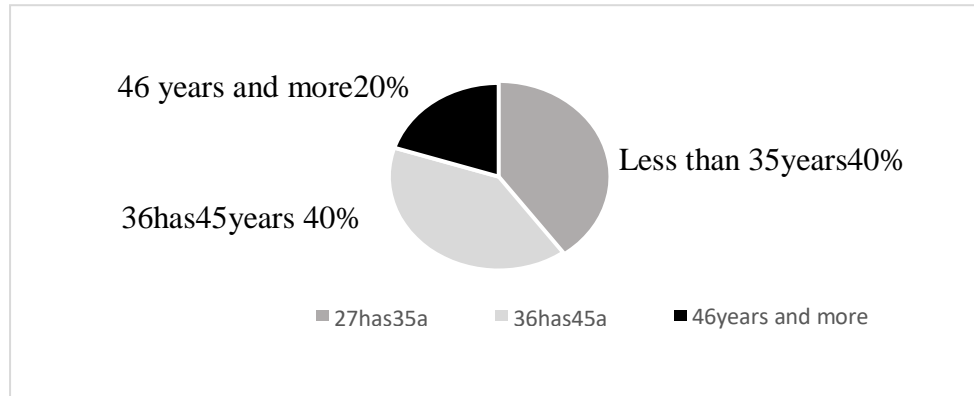


Figure 3. Distribution of respondents by age group
Source: Nounagnon, October 2022

From the analysis of this graph, it appears that 20% of the people surveyed have an age greater than or equal to 46 years, 40% are in the age group 36 to 45 years and the age group less than 35 years represents also 40%. Overall, they are mostly adults and therefore able-bodied with a lot of experience in the implementation of the shallows. According to the surveys carried out, the average length of service in the lowlands is 12 to 13 years, all sexes combined.

3.1.1- Level of education of lowland farmers

The level of education is a crucial factor in the management of a business in general and a farm in particular. Formally educated or at least literate farmers will be able to make a rapid assessment of their farm themselves, understand more easily the economic advantages of technological innovations coming from outside the rural world and understand the establishment of an operating account. (Midingoyi, 2003).

The graph in Figure 4 presents the different levels of education of the people surveyed.

Table II: Distribution of tasks according to gender

Gender	Clearing	Plowing	Transplantin g	Manurin g	Weeding	Avian hunting	Harvesting	Threshin g
Hommes	++	++	++	++	-	++	++	+
Femmes	+	-	++	+	++	+	++	-
Enfants	++	-	++	+	+	++	+	++

Source: Nounagnon, October 2022

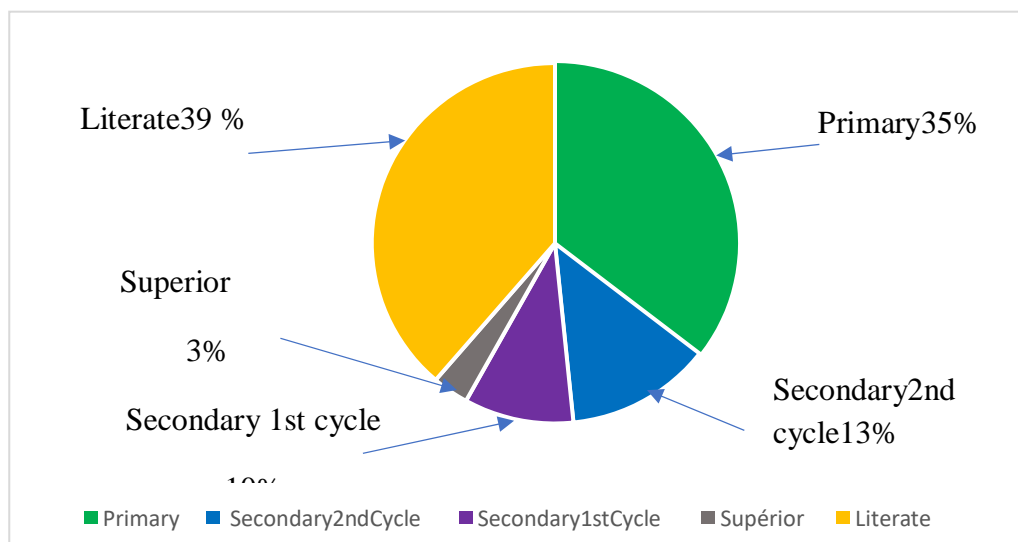


Figure 4: Distribution of respondents according to level of education

Source: Nounagnon, October 2022

It appears from this graph that 39% of the people surveyed did not receive formal education, while 35% remained in primary school, 10% in lower secondary school, 13% in upper secondary school and 3% reached the upper level. None of the people surveyed took literacy classes in their local languages. In total, 61% of those surveyed have once started school. These low levels of education of producers can have repercussions on the capacity building that the groups have benefited from through training. This will therefore have a direct consequence on production (misunderstanding and non-compliance with the information received during training) and therefore on the profitability of their activities.

3.2-Production factors on the lowlands

These are the different factors which enter into the production of rice and market gardening crops on the Dokomey perimeter. These are land (land), labor, capital and access to water.

3.2.1-Land

Land is the first essential factor in agricultural production. On the rice and market gardening perimeter of Dokomey, the problem of land insecurity exists. Indeed, we are witnessing the wandering of the animals of Fulani transhumants in the lowlands to the point of causing damage to crops and other violence against producers and their families. It is therefore a question of the conflict of space between farmers and the breeder. To do this, settlement mechanisms exist in the event of a land conflict or space conflict. In all cases, amicable settlement is preferred. In the event of failure, the protagonists turn successively to the village chief, to the police station, to the conciliation court, then as a last resort to the Abomey-Calavi court.

The different modes of access to the lowlands by the producers surveyed are illustrated through the graph in Figure 5.

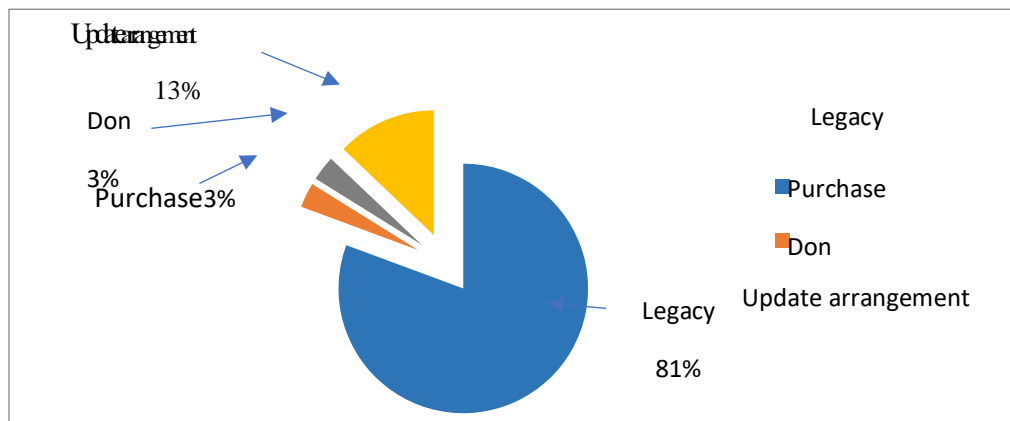


Figure 5: Main modes of access to the shallows
Source: Socioeconomic study by CID, October – December 2015

It appears from this graph that the lowlands are mainly occupied by the heirs of a community. Therefore, inheritance is the predominant mode of access in 81% of the cases of the people surveyed. It is followed respectively by free provision (13%), while donation and purchase each represent 3% of the cases studied. The place occupied by these last two modes of access would be justified by the fact that, on the one hand, part of this good is inalienable (donation to the community) and on the other hand, the provision of the land has replaced these two modes of access.

• Labor

Labor is the factor that determines the producer's ability to sow a given area despite the availability of land. We generally distinguish between family labor, wage labor and mutual aid (Tossou, 2007).

It is essentially family at the level of these cooperatives. However, for certain types of operations such as clearing, manuring, weeding and plowing, producers use paid labor which is sometimes lacking due to the arduousness of these operations. Table II below presents the distribution according to categories of people by task.

Table II: Distribution of tasks according to gender

Gender	Clearing	Plowing	Transplantin g	Manurin g	Weeding	Avian hunting	Harvestin g	Threshin g
Hommes	++	++	++	++	-	++	++	+
Femmes	+	-	++	+	++	+	++	-
Enfants	++	-	++	+	+	++	+	++

Source: Nounagnon, October 2022

Legend: - No participation + Low participation ++ High participation

From the analysis of this table, it emerges that plowing is the only operation in which women and children are not found. As for man, he is absent only in weeding. Women and children therefore have a vital importance in carrying out agricultural activities.

3.2.2-Capital

Capital is generally all the financial means available to the individual or group. It can be biological or material. According to (Badoin, 1986), “biological capital is the function of biomass most directly useful to agricultural production. ”. Regarding material capital, two forms can be distinguished (Saliou, 2013): circulating capital.

In the village of Dokomey, fixed capital consists, for most of the rice farmers surveyed, of means of transport (motorcycle, tiller), production equipment (hoe, machete, axe, nets, barrels, sprayer). Concerning circulating capital, we find seeds, phytosanitary products (especially herbicides), savings (tontines and others), income from the sale of agricultural products on the various markets and any loans made. The majority of production is intended for sale. There are several markets for selling harvested products, notably the large consumption centers, namely Cotonou, Abomey-Calavi, Bohicon, etc. In these markets, prices vary enormously from one period to another depending on the principle of supply and demand and whether it is the harvest or lean season. The rest of the production is reserved for family consumption (self-consumption), donations and seeds. This capital is used by rice farmers to meet production requirements and the nutritional and health needs of family members.

3.2.3-Access to water

On the site, the population opts for a development with perfect water control, especially water from cyclical floods. Nothing must be initiated to prevent the flooding of the Ouémé which enriches the land in the valley. The water passing through the site is directly drained into the main canal which in turn feeds the secondary canals. These are connected to the rice bins.

Thus, pumps were installed on the site. These pumps are recharged using solar panels. The motor pump is used to pump water to serve the crops. But according to some producers surveyed, the connections linked to the motor pump do not manage to completely satisfy the different crops in their water needs. This is explained by the fact that the pump is unable to send a strong flow of water and to this is added the lack of control of the development plan by the producers. Faced

with this problem, they prefer to use drains to use the water from floods in their fields. The circulation of water in these drains is controlled by a cofferdam which blocks the water on one side to satisfy the second side of the field.

3.2.4-Analysis of the site development variant

To better appreciate the development system on the site, a summary was made using the SWOT/SWOT matrix (table III).

Table III: Strengths, weaknesses, opportunities and threats linked to the exploitation of the Dokomey rice perimeter

INTERNAL FACTORS	
Strengths	Weaknesses
<ul style="list-style-type: none"> -Availability of land; -Fertility of available land; -Existence of a tradition of working in groups; -Will of producers to promote the rice growing area; -Participation of women and children in the work; -Existence of permanent watercourses. 	<ul style="list-style-type: none"> - Inaccessibility of the site during rainy periods (floods); -Difficulties controlling water; -Non-operation of certain cooperatives on the site for reasons of absence of a management committee; -Low financial capacity of producers; -Labor scarcely available and expensive; -Inadequacy of agricultural equipment; -Parasitic pressure especially for market garden crops
EXTERNAL FACTORS	
Opportunities	Threat
<ul style="list-style-type: none"> -Existence of potential market for the sale of harvested products; -Existence of support projects and support structures (PAIA-VO, PAVPHA, ATDA7); -Will of the Beninese government to promote the development and development of lowlands. 	<ul style="list-style-type: none"> - Attacks by pests including the stem borer and stem biter (rice seed-eating birds, rodents, insects); -Rice diseases due to the main pathogens (champions, bacteria, viruses and nematodes); -Flooding by the flooding of the Ouémé river and the Sô-Ouémé complex; -Transhumance of cattle herds.

Source: NOUNAGNON, October 2022

3.2.4-Synthesis of constraints to exploitation of the lowlands

The biggest constraint expressed by producers is early flooding which sometimes destroys crops. But these same producers consider these floods necessary because according to them, these floods restore the fertility of flooded areas through the deposition of nutrients following the withdrawal of water. This same phenomenon contributes to the stocking of fish holes because after the flood waters recede, fish are poisoned in their holes and are easily caught. The constraints which limit the smooth running of production activities on the Dokomey site

according to the producers are as follows:

- Early flooding which sometimes destroys crops;
- Congestion of canals;
- Lack of working capital;
- Difficulty of access to land;
- Non-existence of drying areas and storage stores (post-harvest loss);
- Attacks by pests (birds, rodents, insects);
- Lack of agricultural equipment.

After analyzing these constraints, the flooding of the site due to the very often surprising flood period justifies the failure to control the water. This phenomenon sometimes destroys cultures.

Then, we can note the lack of agricultural equipment, in this case tillers and motor pumps, thus leading to delays in the execution of operations on the site and the use of paid labor. In addition, the permanent human presence on the site is necessary to reduce the pressure of bird pests.

3.3-Some solutions for good operation of the site

For better exploitation of the Dokomey agricultural area, it will be necessary to put in place:

- ✓ a management committee which will monitor the development of activities in the different groups;
- ✓ a site maintenance committee which will ensure preventive maintenance, this essentially consists of cleaning, mowing along the bunds manually carried out by the producers and curative maintenance in order to repair the damage caused by the passage of animals in period of decline and various interventions by men;
- ✓ involvement of all stakeholders in the management of the works;
- ✓ establishment of a financing mechanism based on micro-credits adapted to agricultural activities;
- ✓ establishment of infrastructure for processing, drying, storage and conservation of agricultural products (processing workshop, storage warehouse, drying areas, drying tarpaulins, markets, etc.);
- ✓ strengthening the supervision and technical knowledge of producers;
- ✓ do the nursery and transplanting to prevent crops from being destroyed.

Today, the climate influences the water/agriculture relationship which is today of major importance (Klassou, 2011). According to FAO (2008) and especially global studies, agriculture is the largest user of water with 70% of total withdrawals. Climate change is the cause of

irregular rains, reduced precipitation, late onset of rains, frequent floods, prolonged droughts, soil degradation and consequently, a drop in agricultural production (Badjana et al. 2008). Soils in lowlands are generally more fertile than other soils in a watershed, because nutrients are transported from upstream to this area, allowing productivity to increase. Furthermore, Bouju (1998) states: "Development stakeholders see development mainly as a physical infrastructure making it possible to modify water flows and thus improve the productive potential of the developed space".

Conclusion

Lowlands, important natural resources, face several problems when developing them for exploitation. Among these problems is that of water management. The research carried out on the lowland of the Dokomey site in the commune of Abomey-Calavi allowed us to familiarize ourselves with the realities on the ground concerning the hydrological functioning and development of a lowland. In order to carry out our work, two research methods were used. This involves participant observation and a survey of operators and cooperatives present on the site. From the analysis of the results, it appears that the steep slopes located upstream and downstream of the canal are the basis of the uneven distribution of water on the site. In addition, the clay-sand texture of the soil favors a strong flow rate upstream, medium in the middle and low downstream.

However, the greatest difficulty highlighted by the majority of populations remains that linked to water control and accessibility of the site during periods of flooding.

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