



Exploitation of Frogs in the Ouémé Valley in Benin Republic (West-Africa)

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Abstract

Frog meat is a dish that is becoming increasingly popular in African gastronomy. It is an excellent source of dietary protein whose exquisite taste does not leave consumers indifferent. The frogs served at the table in Benin come from capture in the wild and the method of exploitation and the pressure it exerts on the batrachofauna are still unknown. The objective of this study is to provide data on the exploitation of edible frogs in the Ouémé Valley for the raniculture of frog species threatened by capture activities. The methodology adopted consisted of subjecting individual frog catcher from the communes of Bonou, Adjohoun, Dangbo and Aguégués to a 20-minute semi-structured interview and then analysing the data collected. The frog capture activity in the Ouémé Valley is carried out by farmers, hunters and fishermen using capture equipment that varies according to the species caught. Four species of frogs are edible in the Ouémé Valley: *Hoplobatrachus occipitalis*, *Aubria subsigillata*, *Xenopus tropicalis* and *Xenopus fishbergi*. These frogs are sold to fish marketers at a price ranging from 25 XOF to 200 XOF depending on the species and size. *H. occipitalis* is the most caught species and *A. subsigillata* is the least available. The exploitation of edible frogs in the Ouémé Valley is uncontrolled and unregulated, making its sustainability and perpetuation uncertain.

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An environmentally raniculture would be adequate to safeguard frogs in the Ouémé Valley and satisfy human food needs.

Keywords: Anuran; Capture; Consumption; Sustainability; Surveys; Ouémé Valley.

1. Introduction

In recent years, the nations of the world have set themselves the so-called "Millennium Development Goals" (MDGs) of reducing poverty and achieving food security. This challenge requires the participation of a large number of sectors, including aquaculture [1]. Africa's aquaculture production is dominated by fish, which accounts for 96% of the total volume of aquaculture species farmed [2]. The concern to diversify activities and the desire to identify promising niche markets have for some time now encouraged economic operators in tropical countries to engage in new speculations [3]. Thus, with the continuous growth of human demography and the simultaneous decrease in protein resources such as fish, the exploitation of frogs is also increasing [4]. Indeed, edible frogs are highly appreciated in European gastronomy or in traditional and restorative cuisine in tropical Asia and Madagascar [3]. Annual imports of frog legs into the European Community correspond to values ranging from 18 to 39 million ECU (European Currency Unit) [5,6]. According to the article published in the latest TRAFFIC Bulletin, in West Africa, demand for frogs for human consumption is increasing sharply in some regions. In Benin Republic, many restaurants in Cotonou are becoming increasingly involved in marketing dishes made from frog meat. In Malanville, northern Benin Republic, millions of frogs are caught, killed, dried and sold as food in Nigeria by local fishermen [7]. However, the edible frogs eaten or sold in Benin come mainly from the natural environment and no comprehensive data on edible frog species and their exploitation by the populations has been clearly elucidated until today. The few studies carried out on the exploitation of frogs in Africa are those of Legrand [8] (in Cameroon), Mohneke [4] (in Burkina Faso, Nigeria and northern Benin), Akinyemi [9] and Efenakpo [10] (in Nigeria). In Benin Republic, no inventory of edible frog species and the way they are exploited by populations have been carried out. Moreover, the evolution of frog capture in the wild has not been evaluated until today. This leaves in ignorance the sustainability of the species exploited for posterity and for the functioning of amphibious ecosystems. It is in response to all these shortcomings that the present study was initiated and aims to provide information on the exploitation of edible frogs in the Ouémé Valley in order to breed frog species threatened by capture activities.

2. Material and methods

In order to detect the diversity of capture methods and to gain a direct understanding of the multiplicity of techniques and tools for exploiting frogs in the Ouémé Valley in Benin, a semi-structured interview was carried out with the people living along the Ouémé River. A survey questionnaire with mixed questions on frog exploitation methods was drawn up for this purpose. The survey lasted 20 minutes per interview and was conducted over a period of three months. A total of 30 respondents per district were considered. The districts were chosen by commune according to their proximity to the Ouémé River. At Bonou, three districts were considered. They were Damè-Wogon, Bonou-centre and Atchonsa. At Adjohoun, four districts were selected, namely Akpadanou, Kodé, Adjohoun-centre and Gangban. At Dangbo, four districts were also selected: Dèkin,

Dangbo-centre, Zounguè and Gbéko. In the commune of Aguégoués, the two districts of Avagbodji and Houédomé were taken into consideration. The completion of the survey form was preceded by a meeting with the village chiefs of each district, to whom the objective of the work was presented. Under his authority, the people concerned were brought together for a meeting on the moment or by appointment. The framework and objectives of the survey were presented to them so that they could get an idea of the context in which the study was being carried out. Each respondent was then asked to fill a questionnaire. Three main areas were addressed in the questionnaire, namely: the socio-professional characterisation of the respondents, the exploitation mode and the economic analysis of the activity. To better illustrate the survey results, the statistical analyses were carried out with a micro - Personal computer. Thus, frequency histograms were produced with the Excel spreadsheet (2007) on the age of the catchers, their level of education, the average quantities of species caught, the period of capture, the duration of capture, available frog stock; evolution of captures and improvement. Tables presenting the capture instruments and the different parameters of the analysis of the profitability of the activity are made with the Excel spreadsheet (2007). Economic parameters have been calculated for the analysis of the frog catch activity profitability:

Average monthly harvest = average daily catch x average weight caught x average weekly catch frequency x 4 weeks;

Average annual harvest = Average monthly harvest x Average annual catch time;

Monthly turnover = Average selling price x Average monthly harvest;

Annual Turnover = Average selling price x Average annual harvest;

Monthly fixed costs = Sum of the monthly depreciation costs of the equipment;

Annual fixed costs = Sum of equipment depreciation costs per year;

Net profit = Monthly turnover - Monthly fixed costs;

Equity capital = Sum of expenses at the start of the operation;

Commercial profitability = (Net profit x 100)/Equity capital.

3. Results

3.1 Socio-demographic characteristics of catchers

The figures 1 to 3 below present the socio-demographic characteristics of frog catchers in Ouémé Valley.

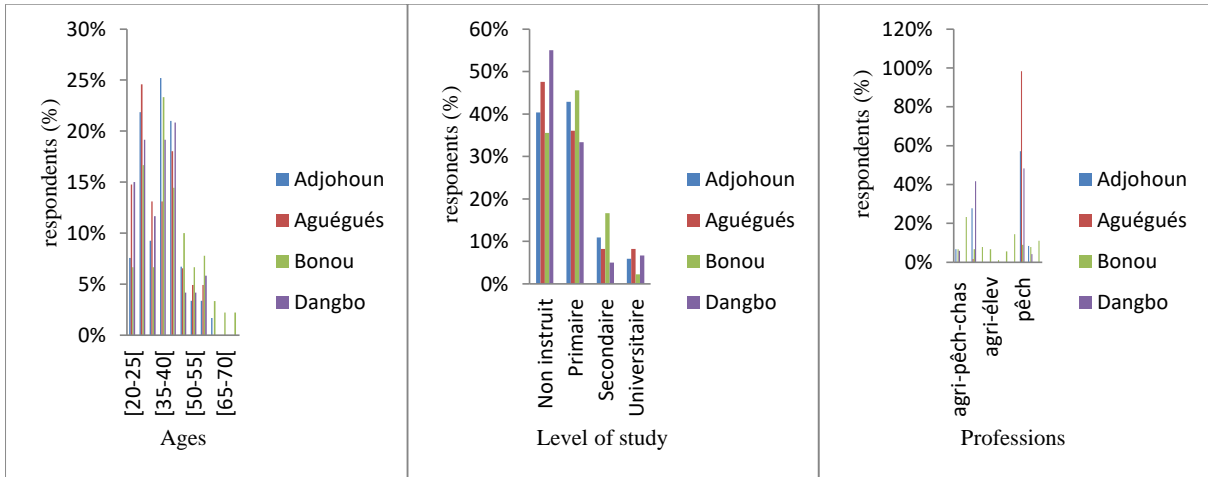


Figure 1: Age of catchers

Figure 2: Study level of catchers

Figure 3: Profession of catchers

The capture of edible frogs in the Ouémé Valley is a night-time activity that takes place between 7.30 pm and 6 am. It is carried out by men in the 25-45 age group who have not attended school for the most part or have only had primary education (figures 1 and 2). The capture of edible frogs is a secondary and seasonal activity for them. Indeed, their main activities are the fishing and agriculture (figure 3).

3.2. Exploitation parameters

The figure below shows the species of frogs exploited in the Ouémé Valley in Benin Republic.

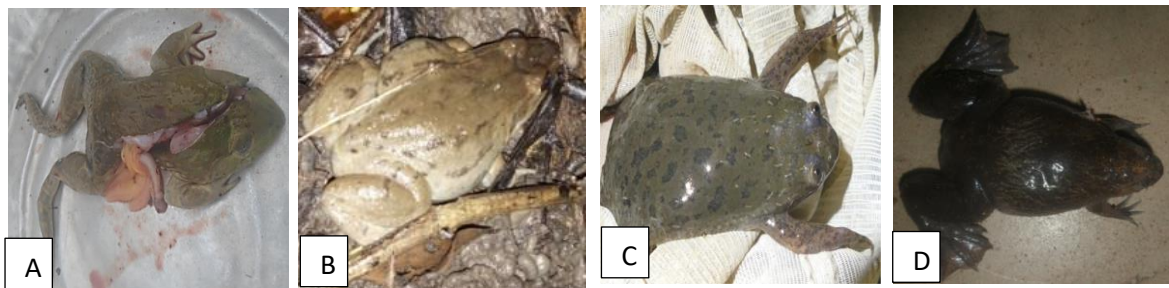


Figure 4: List of edible frogs species in the Ouémé Valley

A: View of an individual of *Hoplobatrachus occipitalis* butchered with a daba at Bonou.

B: View of an individual from *Aubria subsigillata* in a muddy area of the Bamèzoun forest in the Aguégoués.

C: An individual of *Xenopus fishbergi* caught in a mowing net at Adjohoun.

D: An individual of *Xenopus tropicalis* photographed at Dangbo.

Four species of frogs are exploited for consumption in the Ouémé Valley: *Hoplobatrachus occipitalis*, *Xenopus tropicalis*, *Xenopus fishbergi* and *Aubria subsigillata*. The species most caught and sold is *Hoplobatrachus*

occipitalis (95% of the catchers) (figure 7). The vernacular name of this species varies according to locality. The population of Bonou and Aguégoués calls it "kpan", that of Adjohoun calls it "finco", while the population of Dangbo calls it "Kpan-houngo". Individuals of this species captured have a maximum average size of 28 ± 0.4 cm. The second genus less captured than the first species is the *Xenopus* genus (10% of the catchers), called "chèdèkèpèkè" or "kpèkèdèkè" (Aguégoués, Dangbo, Adjohoun) or "toutroukpètè" (Bonou). It has an average maximum size of 10 ± 0.3 cm. These kinds of frogs are used for self-consumption and especially for sale (100% of the catchers). The third species *Aubria subsigillata* of its vernacular name "Sokpan" (Bonou), layé (Adjohoun) and gohoukpé (Dangbo), is less exploited than the first two species (less than 5% of the catchers). Captured specimens have a maximum average size of 18 ± 0.4 cm. It is more exploited for self-consumption. As for the capture instruments used to catch frogs, they are various. They include spears, traps, nets (hawks, seines, barrier nets), lines and daba (Table 1).

Table 1: Characterisation of capture instruments

Types of instruments	Features	Locality	Captured species
Three-point spear (Hwan)	tip length: 20cm to 25cm, bamboo wood length: 3m to 6m, number of tips:3, number of notches on tips: 7 to 14	Bonou	<i>Hoplobatrachus occipitalis</i> , <i>Aubria subsigillata</i>
Lines (xou)	60cm bamboo wood; 60cm rope; 14 to 17" bamboo hooks with hooks.	Adjohoun	<i>Xenopus tropicalis</i> and <i>X. fishbergi</i> , <i>Hoplobatrachus occipitalis</i> , <i>Aubria subsigillata</i>
Landing nets	length: 2m; diameter: 1m; mesh size 0.5mm	Adjohoun	<i>Xenopus tropicalis</i> and <i>X. fishbergi</i>
Single-pointed spear	tip length: 17 cm, bamboo wood length: 6m number of tips: 1, number of notches on tips: 3	Adjohoun	<i>Hoplobatrachus occipitalis</i> , <i>Aubria subsigillata</i>
Two-pointed spear	tip length: 20 cm, length of bamboo wood:4m number of tips:2, number of notches on tips	Adjohoun, Bonou	<i>Hoplobatrachus occipitalis</i> , <i>Aubria subsigillata</i>
Multi-tipped spear	tip length: 30cm, bamboo wood length:4m number of tips:4 to 5, number of notches on tips: 24	Dangbo	<i>Hoplobatrachus occipitalis</i> , <i>Aubria subsigillata</i>
Sparrowhawk net (do)	length: 1.5 to 2m; mesh size: 1 to 2cm	Adjohoun, Aguégoués	<i>Hoplobatrachus occipitalis</i> , <i>Aubria subsigillata</i> , <i>Xenopus tropicalis</i> and <i>X. fishbergi</i>
Seine net (C)	Length: 3m; mesh size: 1cm; number of seals: 4	Adjohoun, Aguégoués, Bonou	<i>Hoplobatrachus occipitalis</i> <i>Aubria subsigillata</i> , <i>Xenopus tropicalis</i> and <i>X. fishbergi</i>
Fishing basket	Length: 1 m; width 21cm	Adjohoun, Aguégoués, Bonou	<i>Xenopus tropicalis</i> and <i>X. fishbergi</i>
Barrier net	Length: 1 m; width 21cm	Adjohoun	<i>Hoplobatrachus occipitalis</i> , <i>Aubria subsigillata</i> , <i>Xenopus tropicalis</i> and <i>X. fishbergi</i>

The figure 5 below show some equipments used for frog exploitation in the Ouémé Valley.

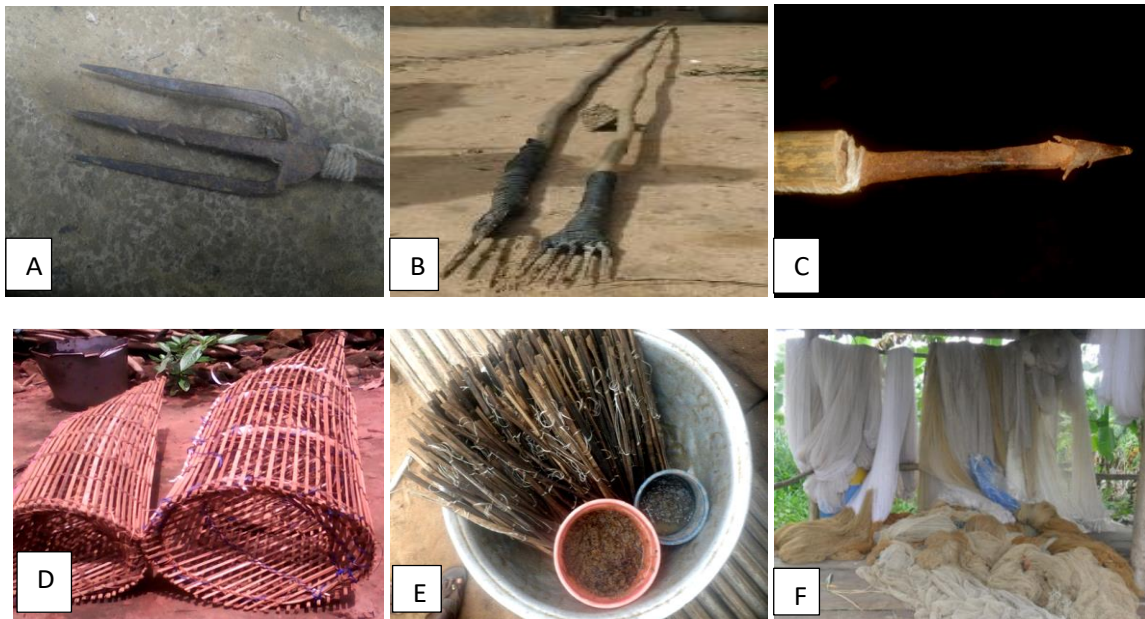


Figure 5: Some of the capture instruments used to catch edible frogs in the Ouémé Valley.

A: View of a spear at Bonou showing the three points and shear lines.

B: View of a spear at Dangbo showing the five points and the wood used to attach it.

C: View of a spear at Adjohoun showing the tip and the three shear lines.

D: View of two fishing baskets at Adjohoun

E: View of the hooks arranged in an aluminium basin at Adjohoun with two small plastic containers containing earthworms.

F: View of the seine nets on woods at Aguégués.

The spear

The most widely used capture instrument in the entire Ouémé Valley is the spear (40 to 97% of catchers use the spear exclusively) (figure 4), the characteristics of spears vary according to the locality (table 1). At Bonou and Dangbo, the spears are the most commonly used; at Adjohoun, fishing nets and spears are the most commonly used, as well as at Aguégués. The interest granted to this instrument, the spear, reside in the fact that it has an unlimited lifespan (90% of respondents) and does not present any disadvantages not only for the user but also for the environment. The precision of this capture instrument in apprehending frogs is a testament to its effectiveness and its length (3 meters on average) which allows the catcher to access his prey from a distance and even in environments that are impossible to access. It also allows to catch other wild animals when *Hoplobatrachus* frog hunting becomes unsuccessful. It is sold at a price varying between 2000 XOF and 3000

XOF. The use of the spear to capture frogs is as follows:

At night, in the absence of the moon, the catchers are armed with a head torch, a saccatch, a small piece of wood and a daba to protect themselves from snake attacks. The mode of clothing consists of two to three long-sleeved shirts and two to three pairs of trousers, preferably (jeans) or old jackets. A hat or bonnet to protect their head. All this clothing is used to protect themselves from mosquito attacks. The feet are covered by two pairs of socks or boots and sometimes catchers go barefoot (Damè - wogon à Bonou) in order to be more discreet in the walk and not to frighten the frog at least noise. The catchers are guided by the frogs' croaks. The flash of their torch slowly sweeping from left to right over the surface of the reservoirs and waterfronts allows them to spot them. Their protuberant eyes show a brilliant shine reflected by the light rays of the torch. The light is placed on the frog at a distance and through a silent movement in the direction of the frog; the spear in their hands is used to point the animal. The frog is pierced by the tips of the spear. Notches are made on each tip to hook the frog. The frog is then removed and stunned with the piece of wood and put into the saccatch hanging from the catcher's shoulder. Instead of knocking them out, other catchers break their hind legs to bring them home alive. This technique of capture with a spear makes it possible to capture an average of 40 individuals per outing (35% of catchers). The species most captured and sold by the catchers is *Hoplobatrachus occipitalis* (figure 7).

The seine net

It is used during the day. The seine fishing is carried out by draining the net into the water in water reservoirs such as ponds or irrigation canals. Individuals of the genus *Xenopus* are the most abundant in these types of catches.

Sparrowhawk net

It is used in less vegetative areas. In fact, catchers are guided at night by the croaks of frogs located in the same less bushy area. The net is thrown to contain them. The species contained in the net sink in the mud in an attempt to escape. The catchers then exert pressure on the net in the mud with their hands. This forces the individuals stuck up in the mud to come to the surface to be held by the meshes of the fishing net. This method allows to catch all kinds of edible frogs.

Barrier net

It is installed in lotic ecosystems. It is used as a dam in watercourses in order to retain frogs during migrations. It allows both frogs and fish to be captured.

Fine-mesh nets

They are used clandestinely in water receptacles due to its proscription by the Beninese fisheries directorate. This capture technique collects all kinds of species regardless of their size. In fact, it is a fine-mesh net with a diameter of 45 cm and equipped with a long porch 1.5 m long. Earthworms <<*lombricus spp*>> are put in the net to attract frogs. The porch is drained into the water receptacles. The species of the genus *Xenopus* are the

most captured by this technique.

Fishing basket

Two fishing nets with a mesh size of 1 cm are used to delimit portions of water in the ponds. The traps are installed at the bottom of the water. The catchers walk noisily into the pond to force the species to get into the traps they remove. Another method of capture consists of installing the traps at the level of the water passages and putting inside a mixture of grilled corn and fish in the beginning of putrefaction which serve as an attractant for frogs.

The lines

They are installed in watercourses. The frogs are fished by line with earthworms or red petals. They catch all kinds of aquatic frog species.

The daba

It is a barbaric practice that is practised at night and in the same way as spear, with the difference that the spears are replaced by daba. It is mostly practised for self-consumption. The quantities captured are small. The figures 6 to 11 illustrate the way that frogs are exploited in the Ouémé Valley in Bénin.

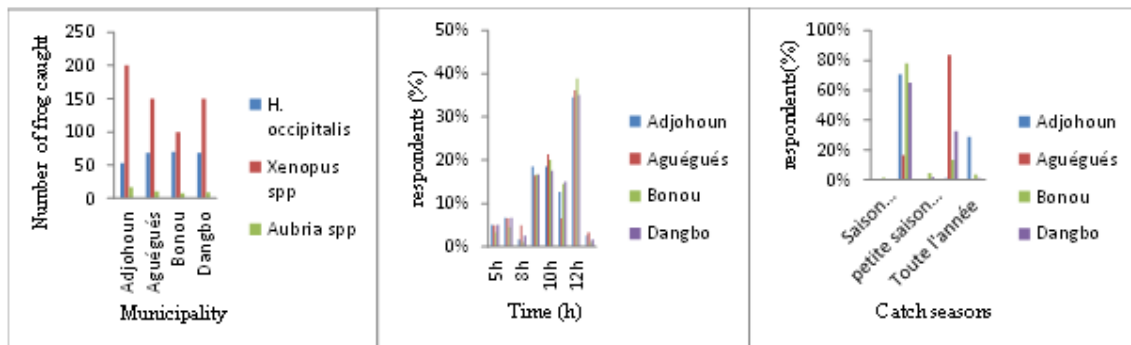


Figure 6: Mean quantity caught Figure 7: Catch time Figure 8: Catch seasons

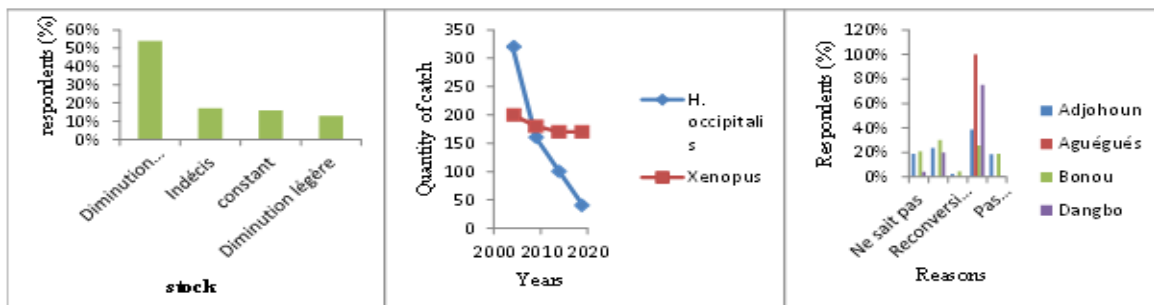


Figure 9: Stock level of H. occipitalis Figure 10: Catch advancement same 2005 Figure 11: Productivity improvement

Some catchers engage in year-round catch and make it a permanent activity (5% of catchers); on the other hand, the majority of captures make it a secondary or tertiary activity (35 to 40%), limited only to periods of abundance such as the rainy seasons and the period when the Ouémé River recedes (65% of catchers) (figure 8). *Hoplobatrachus occipitalis* and *Aubria subsigillata* are caught on the banks of the Ouémé River, on flood plains, fields and gutters. The genus *Xenopus* is captured in ponds and gutters. The length of time frogs are captured depends on the technique used and the species. For *H. occipitalis*, the use of the spear to apprehend it lasts 12 hours on average (37.5% of captures) (figure 7). The average daily catch is 67 ± 43.8 individuals (figure 6). The average number of *Xenopus* individuals captured is 150 ± 60 individuals. For 40-50% of the catchers, the major difficulties encountered in the exploitation of frogs lie in the fact that the capture activity is much more nocturnal where the catchers are confronted with mosquito and gill ant bites, snake bites, sleep and fatigue. In spite of these difficulties, the existence of the frog market, the high price of frogs, their high prolificity and the exquisite taste that distinguishes them from other wild animals make their exploitation very lucrative. For the majority of frog catchers, the sustainability of frog exploitation and particularly of *H. occipitalis* in the Ouémé Valley is undoubtedly uncertain. In fact, 54% of catchers state that the frog stock and especially of *H. occipitalis* is declining considerably from year to year (figure 9). Fifteen years ago, an average of 320-120 individuals per day was caught, but this has now fallen to 40 individuals per day (figure 9). An evaluation of the relative abundance of the species consumed has shown that in *H. occipitalis*, whatever the Commune considered, the abundance is close to 10%, while the abundance of *Xenopus tropicalis* has risen to 30%.

3.3. Economic variables

The captured frogs are sold to the fish wholesalers who wash and smoke them to sell them on the market. *Hoplobatrachus occipitalis* is sold according to its size. The individuals from 17 cm to more are sold at 150 ± 50 XOF / unit. Those between 10 and 17 cm are sold on average at 100 ± 25 XOF. The individuals smaller than 10 cm are sold on average at 50 ± 25 XOF/unit. The genus *Xenopus* on the other hand has a constant size and is sold at 30 ± 15 XOF/unit. The average duration of flow of the quarantine frogs is less than 1 hour (100% of the catchers). The frogs are sold in the markets of the Ouémé department, the plateau department and Nigeria State. These markets are Tatononkon, Azowlissè, Ikpilè, Dazoué, Ifangni, Badagri, Igolo, Dangbo, Awaya, Ouando. The edible frog market is early in the morning and ends early in the day due to its affluence, hence its rapid flow. Income from frog farming is used for household food, contributions to social subscription, clothing and schooling for children, health care in case of illness and to finance food crops during agricultural periods. The tables below give an overview of the profitability of the capture of *H. occipitalis* by a frog catcher at Zounguè in the Commune of Dangbo and the exploitation of *Xenopus fishbergi* and *X. tropicalis* by a frog catcher at Adjohoun-Centre

Table 2: Equity capital for *H. occipitalis* exploitation.

Equity capital		
Designation	Quantity	Amount (XOF)
Torch	1	1500
Spear	1	2500
Trousers	3	2400
Hat	1	700
Jacket	1	1500
Saccatch	1	500
Pull over	2	1400
Daba	1	3000
Total		13500

Table 3: Small equipments renewed during the exploitation of *H. occipitalis*

Small equipments			
Designation	Quantity	Renewal period	Prix Price per unit (XOF)
Batteries	1	Per day	200
Mosquito	2	Per day	50
Socks	2	3 month	300
Matches	1	1 month	25
Total			575

Table 4: Assessment of the profitability of *H. occipitalis* exploitation

Parameters	Values
Average daily catch (number of individuals)	80
Average weight caught (g)	100
Average weekly catch frequency (number of days)	7
Average selling price (XOF)	100
Average monthly harvest (kg)	224
Average annual catch duration (number of months)	9
Average annual harvest (Kg)	2016
Monthly turnover (XOF)	22400
Annual turnover (XOF)	201600
Monthly costs (XOF)	5524
Annual costs (XOF)	49713
Net operating profit (XOF/ month)	16876
equity capital (XOF)	14075
Commercial profitability	75%

Table 5: Investments made for the exploitation of *Xenopus tropicalis* and *X. fishbergi*

Investments					
equipments	Price (XOF)	numbers	Amount (XOF)	Service life	Depreciation (XOF)
Nets	15000	1	15000	5	250
Fishing basket	2000	8	16000	1	1333
Total	17000		31000		1583

Table 6: Assessment of the profitability of the exploitation of *Xenopus fishbergi* and *tropicalis*

Parameters	Values
capacity/ plastic	50
average number of plastics collected/day	4
unit price	40
Average weekly catch frequency (number of days)	7
Average monthly harvest	5600
Average monthly costs	1583
Monthly turnover (XOF)	22400
Average annual catch duration (number of months)	12
Average annual harvest (number of individuals)	67200
Annual turnover (XOF)	2688000
Equity capital (XOF)	31000
Net income (XOF)	4017
Commercial profitability	18%

4. Discussion

In the Ouémé Valley, the exploitation of frogs is an unsustainable activity involving a certain number of actors such as the catchers, fish merchants and consumers. Although the frogs are sold locally, a spectacular increase in the number of frogs collected for the Nigerian food market is also noted in the Ouémé Valley. The natural stock of frogs is in sharp decline. Indeed, frogs that were once captured in houses during the rainy seasons are now being captured by catchers far away from their homes in the most remote districts. On average, a frog catcher walks for 5 km per night to reach the place of capture. The same situation has been reported by Onadoko in Cameroon where women walk long distances in search of frog tadpoles and adults to be collected [8]. Thus unsustainable harvesting is a report of increasing difficulties in catching frogs [4]. The consequences of this decline in frog populations are also being felt in the Ouémé Valley through the loss of frog biodiversity. *Aubria subsigillata* is a species of frog that is consumed by the Ouémé populations and is very difficult to find in the catchers' harvest because of their restrict numbers, which makes it difficult to find them in the natural environment. Another cause of the decline in frog populations is the unbalance in the food chain. *Hoplobatrachus occipitalis*, is a species of frog traded in the Ouémé Valley. It is carnivorous in the larval stage and omnivorous as an adult [4]. The tadpoles of this species control the larval stage of many aquatic organisms

by reducing their numbers through their diet. By consuming large quantities of algae, tadpoles reduce the eutrophication of aquatic environments by making the environment favourable to the survival of fish larvae [7]. Frogs are also biological control agents against insects. Their insectivore diet helps to reduce the number of mosquito larvae responsible for malaria in ponds and they can limit the use of insecticides in agriculture. Moreover, rice farmers at Hétin in Dangbo Commune revealed that despite the ban on the use of phytosanitary products in Ouémé, this practice is still going on. The use of insecticides in agriculture is evidence of the increase in insect populations in the fields. It is therefore a direct consequence of the decline in Anuran populations, particularly edible frogs. Further on, the phytosanitary products used in agriculture are washed out by the rains and drained into the Ouémé River, which is the frogs' main habitat. As frogs are biological indicators of the physico-chemical balance of aquatic ecosystems [7], they store high levels of chemical residues that are transmitted to humans. These pollutants accumulate in the human body and are the cause of many human carcinogenic diseases [11]. This points out that the exploitation of frogs in the Ouémé Valley should stop very soon to make way for raniculture practice in hygienic conditions and therefore fit for human consumption. In the Ouémé Valley, while *Hoplobatrachus occipitalis*, *Hildebrandtia ornate*, *Ptychadena pumilio* and *Pyxicephalus edulis* are exploited in Nigeria [9]; four species of frogs are exploited. These are *Hoplobatrachus occipitalis*, *Aubria subsigillata*, *Xenopus tropicalis* and *Xenopus fishbergi*. *H. occipitalis* is the most exploited and consumed species in the Ouémé department. Indeed, for consumers and collectors, it is the largest frog in size, it reproduces abundantly and has a more delicious flesh than the other three species. Although this frog is preferred by the wemenou, the yoruba appreciate them more. The most alarming finding is that individuals of all sizes are caught for commercial purposes; even the youngest individuals of less than 10 cm are sold at 50 XOF. Moreover, amplexus females are the most prized because of the eggs they carry, which are highly appreciated by consumers. A population without young individuals is ageing and a population without breeders is destined to disappear. Because, without breeders there will be no offspring left to sustain the species. The exploitation of frogs in the Ouémé Valley is unregulated. In fact, the capture time does not even respect the frogs' breeding period. Neither the quantities nor the size of the frogs captured are respected. New catchers can enter the system without bans. During the surveys, the Bonou frog catchers interviewed greatly appreciated the consumption of frogs as well as fish, even though most of them are fishermen. They stated that although they comply with the regulations in force on fishing and hunting, even a crackdown on the exploitation of frogs would never be welcome. This shows that the exploitation and consumption of frogs occupies a special place in the lives of the people of the Ouémé Valley and that it would be difficult to control or limit their capture. The techniques and equipments used in the exploitation of the frogs are various. In Burkina-Faso, frogs are caught with bare hands and with fishing nets. At Malanville, frog traps are used [4]. In the Ouémé valley the most commonly used capture equipment is the spear. This instrument offers the possibility to capture both *Hoplobatrachus occipitalis* and *Aubria subsigillata*. Nevertheless, it is efficient in the eyes of the catchers, it does not allow to provide frog meats in hygienic condition for consumers. Indeed, during capture, the frogs are pierced with the spear, which is never cleaned or disinfected after each use. As a result, many pathogenic microorganisms can penetrate inside the frog's body. All microorganisms are not thermolabile and some of them can survive after smoking. Furthermore, frogs sold smoked in the Ouémé Valley are not eviscerated and sand residues are encountered when tasting them.

5. Conclusion

The exploitation of frogs in the Ouémé Valley is carried out by farmers, hunters and fishermen using a spear << hwan>> which is the most widely used catching instrument. Four species of frogs are edible: *Hoplobatrachus occipitalis*, *Aubria subsigillata*, *Xenopus tropicalis* and *X. fishbergi*. The most commercialized species is the African tiger frog *Hoplobatrachus occipitalis*. Its growth performance is clearly superior to that of the other frog species consumed in the Ouémé and this makes it the most commercially important species in the entire Ouémé Valley. Although it is the most giant species consumed in the entire valley, it is one of the least abundant species in the Ouémé Valley. It is captured mainly during the rainy seasons and during the periods when the river Ouémé is at its lowest level. Edible frogs are sold smoked by the fish marketers at a price ranging from 25 XOF to 200 XOF depending on the species and its size in the markets of the Ouémé department, the plateau department and in Nigeria State. The exploitation enables the fishermen and the fish wholesalers to meet their vital needs and those of their families. The duration of flow of edible frogs is very short and the markets for smoked frogs in the Ouémé Valley are swarming with Nigerian buyers ready to do anything to bring home a large quantity of edible frogs. However, the exploitation of these edible frogs is uncontrolled and unregulated in the Ouémé Valley, making its sustainability and perpetuation uncertain. It will therefore be necessary to put in place very early on the domestication techniques for this species in order to limit the threat posed by catches to the species while at the same time satisfying the large consumer market which is growing day by day.

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