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FEASIBILITY OF AQUACULTURE IN CAMEROON: THE CASE OF THE NOUN DIVISION IN THE WEST REGION

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ABSTRACT

The purpose of this project is to assess the feasibility of aquaculture in Cameroon. To achieve this, operations of small-scale polyculture fish farming of mixed-sex Nile Tilapia *(Oreochromis niloticus)* with African catfish *(Clarias gariepinus)* in the Noun Division West Region of Cameroon are used. A production planning model and a profitability model were applied to analyse operations of production. This was made from the formulation of assumptions based on secondary data collected. 12 ponds of 0.5 hectares and 400 m^2 each were used. 0.5 ha is the average water area a dedicated technical labourer can efficiently follow for the different aquaculture operation in this semi-intensive pond culture. To assess the feasibility of this project, all the cost needed for the production were estimated and projected for a ten year planning horizon. This time horizon was selected to allow adequate time to evaluate the indicators of the investment returns and to measure the risk. One major objective of this study was to determine if aquaculture in the Noun Division (Cameroon) is profitable as the result of the economies of scale through the cash flow generated by the business over the year. From the findings, it appears that aquaculture in the Noun Division is feasible given: the positive NPV and the IRR of 19% and 24% greater than the discounting rate of 15% (used in this study as the minimum rate) respectively for the NPV Total Capital invested and for equity. In addition, a payback period obtained is nine years. The Debt Service Coverage ratio is around 2 on average; this shows the ability of the investment to generate substantial cash flow and the repayment of debt at the time required. The impact analysis shows that aquaculture business is more sensitive to the sales price than costs.

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1 INTRODUCTION

The feasibility of aquaculture in Cameroon is based on the very high biophysical potential for fish culture in the country. This potential includes natural inland waters covering over 40.000 square kilometres, a per capita consumption of fish of 17.9 kilograms per year, supported by an annual growth rate of the population estimated at 2.6% and rapid urbanization with city residents estimated at 52 % of total population in 2010 (Central Bureau of Census and Population Studies, 2010).

Fish remains widely popular and demand is predicted to grow. The potential for productive and profitable aquaculture is large and growing. Unfortunately, pond fish farming, which started in Cameroon in the early 1950s, is still poorly established and far from realizing its potential (Pouomogne & Pemsl, 2008).

The development of aquaculture in Cameroon since independence in 1960 has been largely driven by donor support through technical assistance and subsidies. All these projects have collapsed once the subsidies have been wilthdrawn (Pouomogne & Pemsl, 2008). A new framework to develop the rural sector including aquaculture has been undertaken by the government through the implementation of the sectorial plan (SDGE, 2009). Overall the implementation of this framework is to improve the quality of life of the people of Cameroon.

Currently, the aquaculture sector in Cameroon is predominantly comprised of small-scale producers with some larger-scale commercial activities. The small scale fish farming, in the most cases, is based in the rural zones (villages). The development of small scale commercial fish farming is around big cities such as Yaoundé, the capital of Cameroon and others cities in the West (Bafoussam), East (Bertoua) and South (Ebolowa) regions (Pouomogne & Pemsl, 2008).

A study on freshwater aquaculture in 2008 noted that the owners of commercial fish farm are business people interested in the diversification of their investment. These rich people have a capacity to hire bulldozers for the building of the ponds and to afford purchasing quality pelleted/extruded feed. In addition, entrepreneurs also tend to have experience in successfully conducting land-based animal husbandry (cattle, poultry or pigs). Ponds built by using hoes, shovels and picks require significant physical labour. Normally, a bulldozer is required for the building of ponds which small scale farmers with low income cannot afford (Pouomogne & Pemsl, 2008).

Previous studies on aquaculture in Cameroon have demonstrated good future prospect for the sector whatever the scale of fish farming, if some of the constraints were overcome. Among the constraints are: low skills, lack of technical support, lack and poor quality of fingerlings and feeds, lack of capital, lack of infrastructure, poor management and marketing. In most cases, these constraints are the cause of low productivity and low levels of profitability. The effect of this is a high rate of abandoned ponds. Most farmers practiced fish culture primarily to earn money, which can explain the high rate of abandoned ponds due to poor outcomes. (Pouomogne & Pemsl, 2008).

To make business opportunities in aquaculture in Cameroon, farmers should focus on three aspects of their operations: technology, farming management and accounting. Those aspects can create important changes in the trajectory of aquaculture development. It is expected that,

with progressive improvement in the management of human capital and natural resources, Cameroonian aquaculture may finally fulfil its potential as an engine for development in Cameroon (Pouomogne & Pemsl, 2008).

For aquaculture to become a sustainable and profitable activity at the acceptable level for fish farmers and others stakeholders, special attention should be paid not only to the supply and demand of fish, but also to financial and economic management of the company.

1.1 Project goal

The goal of this project is to assess the feasibility of aquaculture in the Noun Division and thus promote financial and economic management practices in the sector. This requires a good knowledge of the resources needed for business and marketing. This project will also make useful information about the feasibility of aquaculture available to stakeholders. In the near future, this project may be a valuable help for the management of the aquaculture as business in the country.

To carry out this project, a production model will be developed on one pond model of 400 m^2 (this is the common size in fish pond farming in Cameroon), based on the information on the practice of the production and other data and information are assumptions. In order to perform the profitability model for this project, twelve ponds model will be developed over ten years of operation. Two species are targeted: mixed-sex Nile Tilapia *(Oreochromis niloticus)* (Figure 1) and African catfish *(Clarias gariepinus)* (Figure 2) in polyculture. The Noun Division in the West Region of Cameroon is the pilot area for the implementation of the project.

Figure 1: Market-ready Nile tilapia

Figure 2. Market-ready African catfish

1.2 Main objectives

The overall objectives of this project are as follows:

1) Collect and analyse data on fish farming polyculture of mixed-sex Nile tilapia *(Oreochromis niloticus)* with African catfish *(Clarias gariepinus)* operations in the Noun Division in order to estimate the parameters of production and the indicators of investment returns.
2) Develop a production model which will serve to plan the operations of mixed-sex Nile tilapia *(Oreochromis niloticus)* with African Catfish *(Clarias gariepinus)* farming in the Noun Division.
3) Develop a profitability model for mixed-sex Nile tilapia *(Oreochromis niloticus)* with African catfish *(Clarias gariepinus)* in the Noun Division.
4) Preform sensitivity analysis in order to measure risks in aquaculture farming parameters.

2 JUSTIFICATION AND BENEFITS

2.1 Justification

The goal of most entrepreneurs is to maximize profits from their investments in order to ensure the sustainability of the company. However, to achieve this, knowledge about the feasibility of the activity proves very important for taking strategic decisions. For example, decision about the choice of investments in connection with the level of production and knowledge of the market. Several entrepreneurs have found themselves disappointed a few years after a significant investment due to lack of information, or false information on the feasibility of the business.

To be profitable and sustainable, investments in aquaculture businesses need to generate profit through sufficient revenue which can clear all the cost required for the production such as the purchase of inputs and hiring of labour (Brummett & Pouomogne, 2006).

Proximity of market and management frameworks seem to be the key drivers for profitable and sustainable aquaculture in Cameroon. Once a farmer is connected to urban and sub-urban markets, other opportunities to increase production and profits are open to them. Many years of projects aimed at improving the efficiency of African artisanal food production systems have improved productivity and efficiency. However, without markets that can turn these

changes into cash that can be used to hiring labour, purchasing inputs and expansion, significant increases in rural wealth is unlikely (Brummett & Pouomogne, 2006).

Most of the farms are located in rural areas and transport costs are high. This affects the cost of raw materials, the cost of production and thus the earnings. Farmers produce fish to make money. Domestic markets, particularly around urban and sub-urban zones, may provide the impetus for change, with urbanization, due to population growth and rural-urban migration growing at some 7-10% per year (Heck *et.al.* 2006; Brummett *et.al*. 2011).

The feasibility and sustainability of aquaculture in Cameroon is strongly linked not only with the scale of production and market, but also to the financial and economic management. Despite a number of research and extension projects aimed at improving the productivity and profitability of small-scale aquaculture systems in Cameroon, few of these have achieved sustainability. Typically, within a few months after the end of project subsidies, productivity collapses to background levels of approximately 300 kg/ha instead of 2,450 kg/ha in average in 300 days (Brummett & Pouomogne, 2006).

As in other activities, financial management rules need to be strictly applied to aquaculture businesses so that they can remain sustainable (Pouomogne & Pemsl, 2008). Financing institutions and banks are not keen to lend money to farmers whose enterprises cannot be feasibly appraised (Brummett & Pouomogne, 2006). It is of great importance for fish farmers to have realistic plans, good record keeping and reliable financial statements. These documents are sources of information not only for the farmers but also to other stakeholders such as financial institutions and banks for eventual credit agreements. The financial statements show all the operations and results of the business and help to appreciate the profitability, the level of liquidity and solvency of the company.

2.2 Anticipated benefits

The outcome of the study will be a production model and a profitability model assessment on the polyculture of mixed-sex Nile Tilapia *(Oreochromis niloticus)* with African catfish *(Clarias gariepinus)* in the Noun Division.

The findings of the study will be used as a guide for prospective and existing fish farmers in Cameroon. The methodology developed here can easily be adapted to evaluate any type of investment for fish farming enterprises of other species or fisheries operations. The information generated here provides fish farmers and investors with the appropriate tools of financial management of their farms and serves as the budget plan of the enterprise. In addition, it will help lending institutions and other stakeholders to better assess the feasibility of the aquaculture projects.

However, a good communication between fish farmers and investors is necessary to achieve the ultimate aims of the project. It is expected that fish farmers might grow in capital, income, knowledge and transform themselves into medium and eventually large scale farmers in the production of fish.

3 CAMEROON AQUACULTURE

3.1 Overview of the aquaculture in Cameroon

Aquaculture in Cameroon is underdeveloped compared to other farming activities. In Cameroon, field observations and discussions with farmers revealed that, in rural areas, aquaculture is normally viewed as a secondary activity after staple crop production (plantains, maize, cassava, vegetable production) (Harrison *et.al*.,1994).

Aquaculture in Cameroon is primarily practiced in freshwater ponds. Most of these ponds are located in rural areas. However, aquaculture has developed considerably in terms of culture techniques and the species cultivated both in diversion ponds and dammed ponds (FAO, 2012).

Aquaculture in Cameroon is mostly carried out in small ponds with an average size of 350 m^2. The feeding is indirect through compost cribs loaded with organic material (mainly grass and weeds) and kitchen waste. This is the common practice by most small scale rural fish farmers without supplementary feeding. These cribs occupy an average of 10% of the pond water surface (Figure 3). The emerging commercial fish farmers feed their fish with supplementary feeding (single feed ingredients such as wheat bran and cotton seed oilcake) in a fertilized ponds. These ponds are fertilized using organic fertilizer such as chicken manure. Extensive and semi-intensive earthen pond fish farmings are the two most common aquaculture systems in Cameroon (Pouomogne, 2007).

Figure 3: Small scale fish pond in Cameroon (Pouomogne & Pemsl, 2008)

In many cases and despite years of development, fish farming remains at a subsistence level of production, characterised by low yields. Farmers are poor and their purchasing power is too low to efficiently carry out commercial fish farming. Nile tilapia *(Oreochromis niloticus)* is the most commonly farmed species, followed by African catfish *(Clarias gariepinus).* The most common practice is polyculture of Nile tilapia, either with African catfish where possible, or with other locally available species such as the African bonytongue *(Heterotis niloticus)*, snakehead *(Parachanna obscura)*, banded jewel fish *(Hemichromis fasciatus)*, common carp *(Cyprinus carpio)* or gougeon *(Barbus spp.)* (Pouomogne & Pemsl, 2008).

In 2006, 4,200 active fish farmers with 7,500 ponds (average size of 350 m^2) were recorded during a field study of the aquaculture sector. The annual production was estimated at 870 tons divided as follows: 450 tons of tilapia, 350 tons of catfish and 90 tons of others species (Pouomogne & Pemsl, 2008). This production is too low to meet the demand of fish which is anticipated to increase with the growth of the population. To meet demand, Cameroon has imported more than 100,000 tons/year of frozen fish for the past decade (Pouomogne & Pemsl, 2008).

3.2 Profile of the Noun Division area of study

The Noun Division is one of the eight divisions that make up the West Region of Cameroon. It covers an area of 7,687 km^2 and has a population estimated at 502,412 inhabitants as of January 1, 2010 (Central Bureau of Census and Population Studies, 2010).

This region was named after River Noun, the largest river in the region that serves as boundary with other divisions of the region namely, Bamboutos, Mifi, Kounghki and Nde. Most of the land consists of a hilly savannah with wooded valleys. The area has an average altitude of 1,150 m. The climate is uniform with one long rainy season from April to November, and a dry season from December to March. Annual rainfall averages 1,500 mm, whereas the average annual temperature is 22°C (minimum 19°C in September, maximum 29°C in March). Although temperatures are suboptimal for many tropical fish species, suitable sites for aquaculture are common. All farmers own their land. Farms are usually large (average 5.5 ha), gently sloping, with fertile to highly fertile soils in 90% of cases. Potential areas for fish farming (e.g., wetlands) account for 17% of total land holdings (Pouomogne *et.al.,* 2010).

In the region, 76.7% of fish farmers are muslems and their ages range from 30 to 60 years. They are mostly polygamous (52.5%) with an average number of 14 people in each household. 44.3% of fish farmers have primary school educational level while 23.6% have no formal education. However, 30% have secondary school education and only 2.1% have higher educational level (Pouomogne *et.al.,* 2010).

The activities generating revenues in the region are agriculture, livestock, fisheries, aquaculture and handicrafts. Among these, agriculture is most practiced by people, with high yields. The Noun division has 9 sub-divisions and each of them has a market. Foumbot and Kouoptamo are two popular markets for food products including fish not only for Cameroonians but also for neighbouring foreign countries, Equatorial Guinea, Gabon, and Congo.

3.3 Aquaculture in the Noun Division

Aquaculture in the Noun Division is considered a secondary activity, after agricultural products such as maize, plantains, cassava, fruits and vegetables. 360 fish farmers with 445 ponds in the region were inventoried in 2009 (Figure 4). These ponds have an average size of 250 m^2. Among these, 23% are operational, while the remaining 77% have been abandoned. Both active and inactive ponds were constructed prior to the 1960s. Most are poorly designed and with little management. Ponds tend to be shallow, with little or no bottom slope and narrow dikes. Although over 90% have reasonable water retention, a large number are

undrainable (77%), full of weeds (24%), and/or less than 50 cm deep (20%) (Pouomogne *et.al.,* 2010).

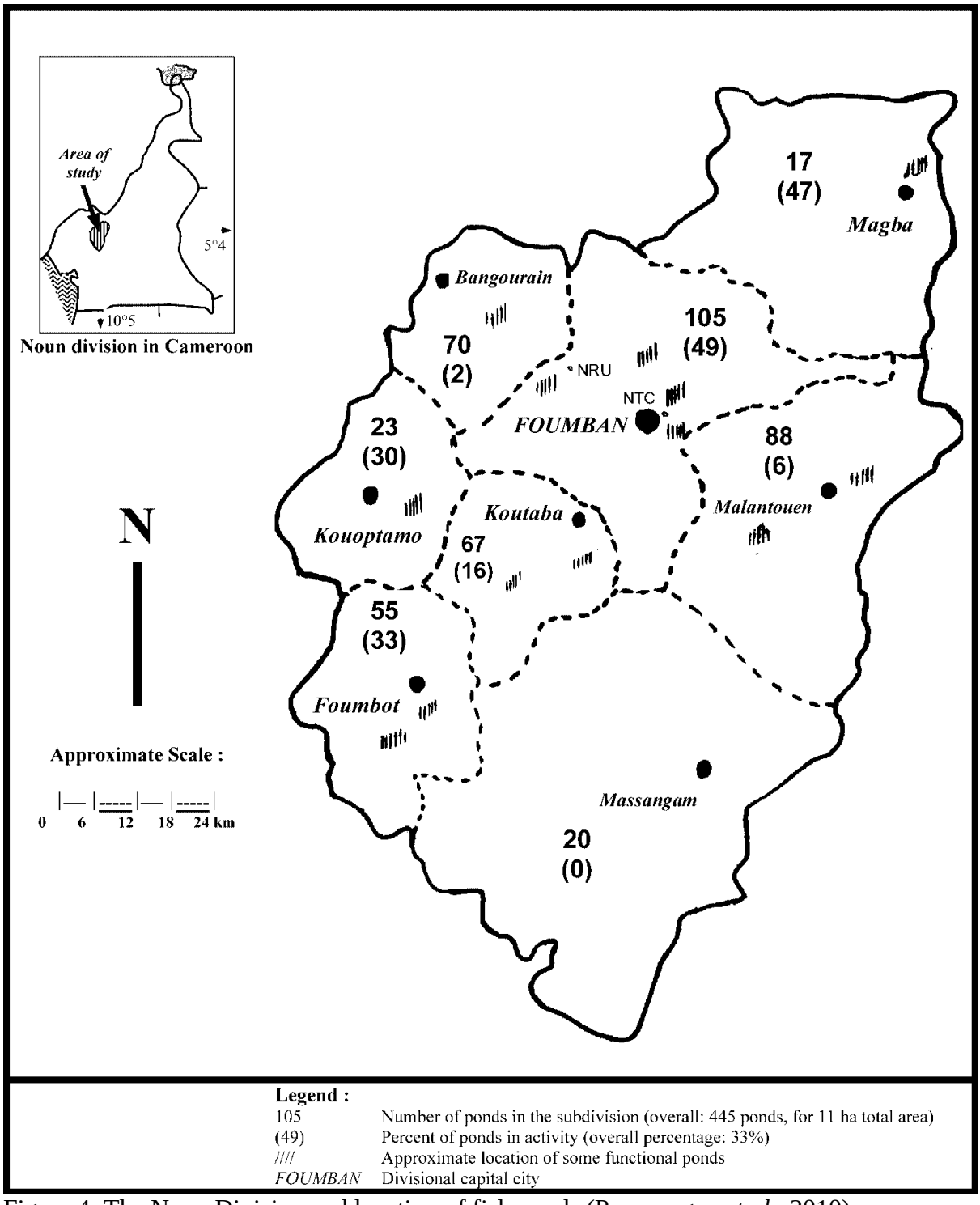

Figure 4: The Noun Division and location of fish ponds (Pouomogne *et.al.,* 2010).

3.3.1 Production and Management of active fish ponds in the Noun Division

Production is primarily based on earthen ponds stocked with mixed-sex Nile tilapia *(Oreochromis niloticus)* grown alone (42%) or in polyculture (54%) with the African catfish

(*Clarias gariepinus).* Most of the ponds are poorly managed: fish is underfed despite the availability of large quantities of agricultural by-products that could be used as pond inputs (Pouomogne *et.al.,* 2010).

The quantity of fish produced yearly is only 1,263 kg/ha (an average of 10.4 kg per pond of 250 m^2). Almost all fish farmers (92%) harvest their ponds once a year at festive periods (near the end of the year). In 41% of cases, intermittent partial harvesting by hook and line angling also takes place. Most ponds (89%) are drained by breaking the dike. In spite of low yields, more than 56% of fish farmers say they are satisfied with aquaculture as a secondary farming activity (Pouomogne *et.al.,* 2010).

Overall, 73% of household revenues are derived from sale of farming products. Fish accounts for only less than 1% of total income. It is a subsistence aquaculture, which can explain the very low level of the income from the activity (Pouomogne *et.al.,* 2010).

3.3.2 Market and demand for fish products in the Noun division

Fresh fish in many cases is sold on the pond bank often on credit (25.4%) to wholesalers, who will pay their debt after sale on the market. However 60.4% of fish harvested will be eaten by the family or given away (14.2%) (Pouomogne *et.al.,* 2010).

The farmed fish sells per kg 600 FCFA – 1,200 FCFA for African catfish and 500 FCFA – 1,000 FCFA for Nile tilapia, which competitive with other fish products (including fresh fish from natural water bodies, smoked or frozen)[1]. The price of fish depends on the site of production and the location of the market. Price is high in markets at urban and sub-urban areas and can increase considerably with the increase in demand due to population growth (Brummett, *et a*l., 2005; Heck *et.al.,* 2006).

In the urban and sub-urban markets, price of a kilogram of Nile tilapia can be between 1,000 and 1,500 FCFA and African Catfish 1,500 to 2,000 FCFA. Fresh fish at lower prices can only be found in areas where more case substantial capture fisheries (Pouomogne *et.al.,* 2010).

Current average annual consumption of fish in Noun Division is over 15 kg/person as compared to 9 kg for beef and 2 kg for bush meat and poultry. With a production of only 0.9 kg/person/year from aquaculture and with capture fisheries probably remaining static or declining, fish prices are expected to increase further. Aquaculture seems to be the alternative for the production of more fish in order to satisfy the need of the population in animal protein, improve the income of farmers and therefore their livelihoods (Pouomogne *et.al.,* 2010).

3.4 Economic analysis of aquaculture in Cameroon

Aquaculture seems to be the alternative to face the continuing decline in fish catch and to reduce the import of frozen fish. In 2012, the import of fish in Cameroon increased by 30%. This was evaluated at 200 million US dollars. And yet Cameroon offers enormous potential

[1] 1Dollar US = 500 FCFA

for the production of fish. Investors and youth (men and women) have been urged to invest in the sector that generates employment and income (MINEPIA, 2012). To achieve this, a framework for the development of the rural sector (SDGE, 2009) has being undertaken by the government in order to boost the production. Cameroon set about reviving aquaculture in order to meet the strong demand as a result of the increasing population and to reduce massive outflows of foreign exchange (FAO, 2012).

In most African countries, the principal objectives for rural development are to increase food supplies and to create economic opportunities while protecting the environment. However, in Africa where up to 80% of the population is composed of low-income, small-scale farmers, achieving food security will require a concentrated effort on the rural poor, possibly by supporting extension, especially marketing. This may be expensive and has to be viewed as a long term investment, but it can be worthwhile (Brummett, 2011). Unfortunately, the fish production of most rural farmers in Cameroon remains at the subsistence level with little surplus production being sold in the market.

For aquaculture to be a business activity in order to maximize profit, the production involves more than the biological processes of fish growth. It should also include the financial aspects of the production. In addition, a careful allocation of the resources and their utilisation is required in order to ensure the sustainability of the enterprise. The fish farmers and investors should put more emphasis in the choice to be made in order to produce. This choice should be the result of reflection on the parameters of production, their utilisation and the marketing of output. Strategic decisions should be taken about the level and type of investment in relation which the combination of factors of production which can lower the cost of production, increase the productivity, the operating surplus and thus their net earnings. During the production, fish farmers and investors need to assess the implication of the utilisation of the resources before implementing a new strategy for their investment (Curtis & Howard, 1993).

3.5 Importance of polyculture of Nile tilapia with African catfish

In aquaculture, fish farmers have to make choices not only on the species but also on the system of rearing which can be either monoculture or polyculture. Nile tilapia (*Oreochromis niloticus*) is currently the most widely cultivated fish species in Africa.

However, the excessive reproduction of tilapia is a problem because at harvest, up to 23% of the biomass may consist of fingerlings. These fingerlings usually compete for and consume the feed provided for the adult tilapia. Consequently the growth rate of the adult tilapia is reduced (de Graaf *et al*.,1996). The overcrowding of tilapia is controlled by using a predatory fish. *Clarias gariepinus* is the most commonly utilized species for this (Pouomogne, 2008).

An advantage of rearing African catfish in polyculture with Nile tilapia is that the lower-valued tilapia fingerlings are replaced by the higher-valued catfish. Another advantage is that larger adult tilapia is obtained as the growth rate of the stocked adults increases (FAO, 1996; Pouomogne *et al*., 1998). The economic comparison between monoculture and polyculture of catfish indicates that polyculture is slightly better with a higher economic rate of return. In addition the net cash flow for the polyculture is high than the monoculture (NACA, 1989). The main difference between the culture systems is in farm costs which are much higher for monoculture because formulated feed is required to cover for the protein requirements at the given production level (FAO, 1996).

It is from this background information that the study was undertaken.

4 MATERIALS AND METHODS

The study on the feasibility of aquaculture in Cameroon is based on the budgeting of all the revenue and costs required for the production. One way of evaluating whether an opportunity such as a new aquaculture investment is worthwhile in the long-term, or choosing between aquaculture opportunities which vary in size, is by using capital budgeting (Curtis & Howard, 1993). Ten years of operation on the fish production were projected in order to determine if the aquaculture operation was feasible. Some of the data and information about the practice of polyculture of tilapia with cathfish were collected in Noun Division.

The indicators of feasibility that were used include the Net Present Value (NPV), Internal Rate of Return (IRR) (Curtis & Howard, 1993) and Payback Period (Pillay & Kutty, 2005). However, the financial ratios were also calculated and a sensitivity analysis of the investment was performed.

Net Present Value (NPV) gives an indication of the present value of future earnings from an investment or project. It is the difference between the future cash inflows and outflows discounted to present value. If the NPV is positive, the prospective project or investment is profitable. If it is negative, the project should be abandoned. (Curtis & Howard, 1993). The higher the NPV value, the more profitable an investment or project is.

The NPV can be calculated by using the formula as follows:

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+i)^t}$$

CF_t = Cash flow in year t

i = Discounting rate

n = number of year for the investment

Internal Rate of Return (IRR) measures the efficiency of an investment or project to turn a profit. IRR is the interest rate that brings the NPV to zero. It is the higher interest rate that the project can support. It indicates the estimated rate of return that a project is expected to generate to an investment (Curtis & Howard, 1993).

Payback Period is the time required to recover the costs of an investment through the net cash revenues it generates (Curtis & Howard, 1993). It is calculated as the investment cost of a project divided by the project's projected annual cash inflow.

The indicators described above focus on the level of revenues related to the profits generated by the project or investment. However, higher revnues do not necessarily translate into profits for the fish farmers or investors. A project or investment must have the ability to clear all of its expenses and costs.

Financial ratios are used to assess the ability of the business to generate earnings as compared to costs engaged during a given operational period. They take into consideration not only how the project is to return a profit, but also how that profit relates to other important

investment characteristics of the project. They provide a comparison of profits generated and what has been invested in a project. For most of these ratios, having a higher value is an indication that the investment is good (Curtis & Howard, 1993). The financial ratios used in this study include: Return on Investment (ROI), Return on Equity (ROE), Liquid Current Ratio, Net Current Ratio, Debt Service Coverage.

Fish farmers and investors need to have a knowledge of the sensitivity of their investment in order to evaluate risk and make strategic decisions. The implementation of investments or projects is in most cases based on market prices, quantities, yield and average costs (Carole & Ivano, 2005). Some of these aspects are volatile and any change can affect the profitability of the projects or investments. To make a rational choice, fish farmers and investors need to know the key drivers of success of their company and their fluctuations. Is it the cost of raw materials (inputs: fingerlings, feed etc), the level of production (output) or market location and market prices for products? The expected cash flows from operations could be affected by any or all of these aspects.

4.1 Data collection and main assumptions

This study depends on secondary data and information about aquaculture management and economic data on the polyculture of mixed-sex Nile tilapia *(Oreochromis niloticus)* with African catfish *(Clarias gariepinus)* in the Noun Division.

The production system under consideration in this study is semi-intensive.

From the data and information collected, the budgeting of operations is made in order to have the investment cost, operating cost and sales. Performing the production model (one pond and twelve ponds) and the profitability model.

The initial investment cost estimate includes the land cost, construction costs (pond and stores), cost of acquisition of equipment.

The operating cost needed for the production includes the cost of inputs of production (fingerlings, feed, fertilizer), payment of labour, harvest cost, transportation costs and payment of electricity and repair of equipment.

Sales include: the quantities of product which are produced and the market price of product per unit value of product.

However, a number of assumptions are made about the production in polyculture of mixed-sex Nile tilapia *(Oreochromis niloticus)* with African catfish *(Clarias gariepinus)* in a given cycle. The main assumptions used in the production planning schedule are: the construction of 12 ponds of 400 m^2 each on 0.5 ha of land and 0.2 ha of land for the buildings and other eventual infrastructures in the future for the company.

The stocking density is 3 fingerlings per m^2 (2 tilapia fingerlings and 1 catfish fingerling). The initial weight per fingerlings is 12 g and 10 g, respectively for tilapia and catfish. The cost per fingerling is 50 FCFA for tilapia and 100 FCFA for catfish. The size of the fingerlings is to avoid excessive mortality. It also aims to control new recruitment of tilapia in the pond by the catfish without the catfish being a threat to the tilapia stocked initially. Large

catfish will be able to control the recruitment of mixed-sex tilapia and increased the weight of adult tilapias (de *Graaf et al.,* 1996; Pouomogne *et al*.*,* 1998).

Fish are harvested after 8 months of rearing. Mixed-sex tilapia and catfish fingerlings are stocked simultaneously in the ponds. It is assumed that the survival rate of tilapia and catfish is 90%. The average weight at harvest is around 330 g for tilapia and 400 g for catfish with the FCR of 1 – 1.5. In addition, the pond is fertilised with organic fertilizers manure and the fish are given complementary feed (de Graaf *et al.*, 1996).

At harvest this study did not assess the new recruitment of tilapia in the pond and their fingerlings. Indeed, the first spawning begins when female tilapia has an average weight of 30 g (de Graaf *et al.,* 1999).

To ensure continuous production, it is assumed that two ponds are simultaneously stocked with fingerlings every month. The assumed values are based on references discussed in the text and other from the fish farmers in the Noun Division and assumptions. (Table 1)

Table 1: Data collection and assumed values

Assumptions and estimates on pond management characteristics (N-B: 1$US = 500 FCFA)					
Items	**Assumed values**		**References**	**My assumptions**	**Cameroon**
Area	0.7	ha		*	
Land cost per ha	800,000	FCFA			*
Land cost	560,000	FCFA			*
Stores (construction: 20 m2)	200,000	FCFA			*
Pond area	400	m2	de Graaf *et al*, 1996 Poumogne, 1998		*
Pond cost	300,000	FCFA			*
Number of ponds	12	ponds		*	
Stocking density(3 fingerlings /m2: 2 tilapia and 1 catfish)	1,200	fingerlings	de Graaf *et al*, 1996 Poumogne, 1998		
Cost of Tilapia fingerlings (800 fingerlings)	40,000				*
Cost of Catfish fingerlings (400 fingerlings	40,000				*
Initial weight per Fingerlings stocked:					
Tilapia	12	g	de Graaf *et al* ,1996, Poumogne ,1998	*	
Catfish	10	g	de Graaf *et al*, 1996, Poumogne, 1998	*	
Cost of fingerlings:					
Tilapia (50 FCFA/individual)	50	FCFA			*
Catfish (100 FCFA/individual)	100	FCFA			*
Survival rate at harvest of Tilapia and Catfish	80-90%		de Graaf *et al*,1996		
Average weight at harvest of Tilapia	336	g	de Graaf *et al* ,1996		
Average weight at harvest of Catfish	403	g	de Graaf *et al*,1996		
Batch cycle length	8	months			*
Month days	30	days			*
Averages annual mean temperature	22-26 °C		Pouomogne *et al* 2010		*
FCR (tilapia, Catfish)	1 - 1.5		de Graaf *et al* ,1996		
Feed Cost	300	FCFA/kg			*
Organic fertilizers(chicken manure):			Pouomogne, 2007		
Quantity(1 bag = 50 kg)	8	bag			
Cost (2,000 FCFA/bag)	40	FCFA/kg			*
Agricultural lime:			Pouomogne, 1998		
Quantity	50	kg/pond			
Cost	350	FCFA/kg			*
Harvest cost(2,000 FCFA/person/day) (5 peoples)	10,000	FCFA			*
Sale prices:					
Tilapia	1,000	FCFA			*
Catfish	1,500	FCFA			*
Monthly wage (01 permanent)	15,000	FCFA			*
Equity	30%	financing		*	
Loan	70%	financing		*	
Interest on loan	12%				*
Depreciation of equipment	10%				*
Depreciation others equipment	20%				*
Depreciation of ponds	5%				*
Years for equipment and pond loans	10	years			*
Depreciation of stores	5%				*
Income taxes	20%				*
Operation system used is semi-intensive			Pouomogne, 2007		

In order to analyse data summarized in table 1, a production model and a profitability model were performed.

4.2 Production model

This production model is done in two steps as follows: one pond model and twelve (12) ponds model.

4.2.1 One pond model

To build the model, the assumptions in the table 1 are used. The production model is developed based on one pond of 400 m^2. The pond is cleaned, limed, filled with water and fertilized with dry organic fertilizer manure. The pond is stocked with 1,200 fingerlings (3 individuals /m^2) as follows: 800 fingerlings (12 g/individual) of mixed- sex Nile tilapia *(Oreochromis niloticus)* and 400 fingerlings (10 g/individual) of African catfish *(Clarias gariepinus).* The mean temperature assumed for the production is 22-26^{o}C.

To ensure the growth of fish, the pond is fertilized again seven days after the first fertilisation and it will be continuous every day until the end of the rearing. 400 kg of dry organic fertilizer (poultry manure) is used.

The fish are also fed daily two times with a feed which is formulated with the ingredients as it is stated in Table 2.

Table 2: Ingredients for feed

Feed/ingredient	**Percentages**
Local white maize	10%
Groundnut meal (or Cottonseed meal)	20%
cassava meal	2%
Draff of breweries or other form of draff	20%
Palm kernel cake,	5%
Palm oil	2%
Soymeal	10%
Fishmeal	10%
Remoulding (wheat bran)	15%
Bone seashell flour	2%
Blood flour	4%
Total	**100%**

(Pouomogne, 2007)

All ingredients are available in the local market in Cameroon, at the production cost of 300 FCFA/kg.

At the end of each month, the pond was sampled in order to determine the growth of fish and to adjust the feeding levels for the next month in relation with the mean body weights (g) of the fish. At the end of the eight months of rearing, the feed conversion ratio (FCR) is around 1.5. The mean body weight obtained at harvest at the end of cycle of production is around 330 g for tilapia and 400 g for catfish.

This assumption on growth per month is adapted from FAO, 1996. The monthly growth of fish is used to compute biomass of the fish in the pond at the end of each month. A survival

rate for a complete cycle is around 90% for tilapia and catfish. This is used to calculate the biomass (kg) in the pond by multiplying the total number of fish in the pond by the average individual weight divided by 1,000g kg^{-1}.

Biomass (kg) = Number of fish x Mean body weight (g) x 10^{-3}.

The biomass (kg) per month is calculated and the biomass at the end of cycle (eight months) is estimated and represents the net production to be sold. In this study, the net production (biomass in kg) gives a total of 390 kg from the pond of 400 m^2. This is obtained from 1,090 fish harvested; 730 tilapias and 360 catfish. Table 3 describe the operations of the net production (biomass in kg).

Table 3: Net production form one pond of 400 m^2 - Biomass (kg)

Period (month)	Survival rate (%)		Number of fish			Mean body weight (g)		Biomass (kg)		
	Tilapia	Catfish	Tilapia	Catfish	Total fish	Tilapia (g)	Catfish (g)	Tilapia(kg)	Catfish (kg)	Total Biomass (kg)
0	100	100	800	400	1,200	12	10	10	4	14
1	95	94	760	376	1,136	45	52	34	20	54
2	98	98	745	368	1,113	84	100	63	37	99
3	99	98	737	361	1,098	126	151	93	55	147
4	100	100	730	361	1,091	165	199	120	72	192
5	100	100	730	361	1,091	207	244	151	88	239
6	100	100	730	361	1,091	249	301	182	109	290
7	100	100	730	361	1,091	294	355	215	128	343
8			730	361	1,091	336	403	245	146	391

Based on the biomass (kg), the fish are fed during the cycle period of eight months. The quantity of feed needed per month is calculated by multiplied the biomass by the percentage of feeding per month. A total of about 520 kg of feed is used during the eight months of rearing. The total cost of this feed is estimated at 158 Th.FCFA*. (Table 4)

Table 4: Cost of feed per month/cycle/400 m^2 pond

Period (month)	Total Biomass (kg)	Feeding rate(%/biomass/day)	Feeding (kg/400m2/day	Monthly feeding(kg/400m2)	Feeding cost /cycle(Th. FCFA)*
0	14	3%	0.4	12	4
1	54	3%	1.3	40	12
2	99	2%	2.0	60	18
3	147	1.5%	2.2	66	20
4	192	1.5%	2.9	87	26
5	239	1%	2.4	72	22
6	290	1%	2.9	87	26
7	343	1%	3.4	103	31
8	391			527	158

* Th. FCFA: Thousands of Franc CFA

In addition to the cost of feeding, other costs are calculated. These include the cost of fingerlings, organic fertilizer, agricultural lime, harvest cost and others, giving a total cost of about 322 Th. FCFA. This total cost represents the variable cost needed for the production

per cycle/pond of 400 m^2. Labour cost is evaluated at 120 Th. FCFA. It is the total fixed cost needed per cycle. The sum of variable and fixed cost represents the total cost of production per cycle /pond of 400 m^2 in eight month of rearing. This is estimated at 442 Th. FCFA. (Table 5). A summary of Table 3 - Table 5 in Appendix I

Table 5: Cost of production /pond/cycle

Period (month)	Feeding cost /cycle (Th. FCFA)	Kg of Organic fertilizer/month	Cost of organic fertilizer/cycle	Agricultural Lime(Th. FCFA)	harvest cost	fingerlings cost (Th. FCFA)	others cost (Th. FCFA)	Total variable cost/cycle (Th. FCFA)
0	4	60	2	18	0	80	5	109
1	12	60	2	0	0	0	5	20
2	18	60	2	0	0	0	5	25
3	20	60	2	0	0	0	5	27
4	26	50	2	0	0	0	5	33
5	22	40	2	0	0	0	5	28
6	26	40	2	0	0	0	5	33
7	31	30	1	0	10	0	5	47
8	158	400	16	18	10	80	40	322
		Total Fixed cost/cycle						120
		Total cost of production/cycle/pond						442

The net production from one pond of 400 m^2 is estimated at 390 kg. This net production comprised 245 kg of tilapia and 146 kg of catfish. This net production is sold at 1,000 FCFA/kg and 1,500 FCFA/kg respectively for Nile tilapia (*Oreochromis niloticus)* and African catfish *(Clarias gariepinus).* The revenue from sales is calculated by multiplying the prices per kg of each species by their net production. The total revenue is obtained at about 464 Th. FCFA (gross revenue) for one pond of 400 m^2. The net revenue (profit) of 22 Th. FCFA is obtained by subtracting the cost of production by the total sales. The net revenue of producing a kg of fish is 0.055 Th. FCFA /kg. Summary of operation in Table 6

Table 6: Net revenue from one pond of 400 m^2

Summary one pond of 400 m2 operation (stocking density of 1,200 fingerlings)			
Items	**Values**	**Currency(FCFA)**	Percentages
Quantities sale:			
Tilapia(kg)	245		63%
Catfish(kg)	146		37 %
Total quantity Sale	391		100%
Price/kg:			
Tilapia(FCFA)	1,000		
Catfish(FCFA)	1,500		
Gross revenue:	464	FCFA	
Cost of fingerlings/cycle	80		18%
Cost of feed/cycle	158		36%
cost of organic fertilizer/cycle	16		4%
Agricultural Lime	18		4%
Harvest cost	10		2%
Transport fees	15		3%
Labour/cycle	120		27%
Other cost	25		6%
Total cost/cycle	442	FCFA	100%
Net revenue/cycle/pond (profit)	22	FCFA	
Net revenue/kg(profit)	0.055	FCFA/kg	

To restock, the pond is eventually left a month sanitary break, cleaned, repaired, quicklime applied, filled with water and fertilized with dry organic manure from animal prior to the following rearing cycle.

4.2.2 Twelve pond model

From the one pond model, the information generated during the operation is used to prepare a production planning model for a 0.5 ha in polyculture of mixed-sex Nile tilapia *(Oreochromis niloticus)* with African catfish *(Clarias gariepinus)*. 0.5 ha is the average water area a dedicated technical labourer can efficiently follow for the different aquaculture operation in this semi-intensive pond culture.

To have continuous production, two ponds are simultaneously stocked with tilapia and catfish fingerlings every month. All the twelve ponds are stocked after the first six months of operation. At the end of eight month, the first two ponds are ready for harvest.

The design of the model is such as the fish farmer will have every month and at the end of each year: the total costs of production, the revenue from the operations, and the operating surplus. This model is helpful for the fish farmers or investors, for the forecasting of the budget of investment and the level of resources needed for the production in a given period. It will be easy for the fish farmers to make decisions about what combination of resources are needed to have the optimal operating surplus from the production. The production planning of ten years of operations is used in these calculations (Appendix II).

The revenues per cycle and by year in relation with the quantity and sales price are assessed. The net revenues (operating surplus) per month and by year of operation are predicted. All the cost required for the production per month and by year is assessed. This is to discern whether the venture is profitable as a result of the economies of scale through the Cash flow generated by the operations over the year. By the end of first year of production (2014), ten

(10) ponds of the total of twelve (12) ponds stocking at the given period of the operation are harvested. A net production of 3.90 tons of fish are harvested and sold. A total revenues (gross revenues) recorded is 4.64 million of FCFA. The operating surplus estimated is -0.09 million of FCFA. A total cost of production estimated at 4.73 million of FCFA is divided into: variable cost 4.55 million of FCFA and fixed cost 0.18 million of FCFA. The summary of the first year operations is described in the table 7

Table 7: First year operations schedule for 0.5 ha

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years	2014											
Months / Items	1	2	3	4	5	6	7	8	9	10	11	12
Pond 1 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03
Pond 2 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea.rep	0.11	0.02	0.03
Pond 3 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 4 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea. rep	0.11	0.02
Pond 5 costs			0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11
Pond 6 costs			0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea.rep	0.11
Pond 7 costs				0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	
Pond 8 costs				0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea.rep
Pond 9 costs					0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 10 costs					0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 11 costs						0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 12 costs						0.11	0.02	0.03	0.03	0.03	0.03	0.03
Total Varia. cost/month	0.22	0.26	0.31	0.36	0.43	0.48	0.33	0.39	0.34	0.50	0.47	0.47
Total fixed cost /year												0.18
Total varia.cost by year												4.55
Total cost by year												4.73
Total reve./cycle/pond	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93
Total revenue by year												4.64
ope.surp./mont.	-0.22	-0.26	-0.31	-0.36	-0.43	-0.48	-0.33	0.54	0.59	0.43	0.45	0.28
Op surplus by year												-0.09
Net prod./cycle (tons)												3.91

To restock the ponds with fingerlings after harvest, the ponds are left two weeks sanitary break, cleaned, repaired, filled with water, fertilized with dry organic manure and kept two weeks for natural feed development before stocking anew.

In addition to the production model used to analyse data, the profitability model is performed for data analysis by planning farm operations over ten years.

4.3 Profitability model

The planning of farm operation is developed by using the results of the production planning model of twelve (12) ponds. Ten years is used as the planning horizon for the budgeting of the business. The profitability model is developed in order to analyse the performance of farm over the years projected.

The profitability model is based on the initial investment, the operating cost, sales quantities and sales prices. The time unit is year for all the calculations. The model is performed on given assumptions and data when available. The random variables reflecting uncertain factors can easily be added.

The components of the profitability model are as follows: Summary assumptions and results, investment and finance, operations statement, cash flow statement, balance sheet, profitability measurements statement and sensitivity analysis (Appendix III to VIII). The indicators of investment returns such as net present value (NPV) and internal rate of return (IRR), payback period, financial ratios (debt service coverage ratio etc…) are calculated. Those indicators are important to assess the profitability of the company and thus analyse the performance of business to turn investment into profit or loss. A sensitivity analysis was performed by varying some factors of production such as cost of fingerlings, sale prices, feed cost and others factors.

4.3.1 Profitability model assumptions

The first step of the profitability model is to outline the assumptions. This first component of the model is to calculate from the characteristics of factors of production and their assumed value all cost related to the production. These costs are the cost of fingerlings, cost of feed, cost of fertilizer and others cost needed. The biomass in the pond is assessed in relation with the mean body weight and the number of fish at harvest. (Appendix I)

From this evaluation in Appendix I, ten years planning production is performed for the twelve ponds. This production planning indicated the variable cost per month and by year, the fixed cost by year, and the revenues per cycle and by year, the operating surplus per month and by year, the net production per year and the period of cleaning/repair the ponds before restocking. (Appendix II)

4.3.2 Breakdown

Breakdown on the investment and operating cost are required to perform the profitability model. The initial investment and the operating cost assumed in this study in order to develop the profitability model are as follows:

Initial investment: This cost comprised the buildings (ponds and stores) for an amount of 3.8 MFCFA, land 0.56 MFCFA and equipment 190 Th. FCFA; giving a total cost of investment of 4.55 MFCFA for the farm. (Table 8)

Table 8: Initial investment

Investment Cost							
Items	**Quantity**	**Cost (Th. FCFA)**	**Currency(Th. FCFA)**	Items	**Quantity**	**Cost (MFCFA)**	**Currency (MFCFA)***
Equipment				**Construction**			
Cutlass	2	4		Pond	12	3.6	
Hoe	2	4		Stores	1	0.2	
Shovels	2	10		**Total Buildings**		3.8	MFCFA
Wheelbarrow	1	20		Others:			
Knife Sharpener	2	1.4		Land cost		0.56	
Pelleting Machine for feed	1	15		**Total Land**		0.56	MFCFA
Tarpaulin drying of feed	2	10					
Nets	2	7					
Buckets(50 l,30 l, 15 l, 10 l)	5	15					
Scales (100kg & 15kg)	2	15					
Boots	1	4.5					
PVC pipe	2	21					
Fence	3	45					
Subtotal		172					
contingency	10%	17.2					
Total equipment		190	**Th. FCFA**				
Total investment cost					**4.55**		**MFCFA**

MFCFA: Millions of Franc CFA

Other costs needed for the profitability model are the operating costs based in one pond per cycle for the variable cost and a year for the fixed cost. Variable costs include the cost of factors that can change during the operation. It has a strong link with the level of the production and market situation. The fixed costs are stable. In this study the wages of permanent employees are considered as fixed cost. The summary of the operating cost is in the Table 9.

Table 9: Operating cost/cycle

Operating Cost /pond/cycle)									
Items	**Quantity**	**Total Cost (Th. FCFA0**	**Cost/kg**	**Currency (Th. FCFA)**	**Item**	**Quantity**	**Total cost/cycle**	**cost/kg**	**Currency (FCFA)**
Variable cost					**Fixed Cost**				
Fingerlings cost:					Labour		180	Th. FCFA	
Tilapia		40	163		**Total fixed cost**		**180**	307	FCFA/kg
Catfish		40	275						
Feed cost /cycle		158	404						
Fertilizer (manure) kg		16	41						
Agricultural lime	50	18	45						
Harvest cost	5	10	26						
Transport fees		15	38						
Electricity, repair equipment		10	26						
Subtotal		307		Th. FCFA					
Contingency	5%	15							
Total variable cost		**322**	824	Th. FCFA/kg					
Total Operating Cost							**502**	**Th. FCFA**	

The forecast of the earnings or profit of the company is the most important measurement used by investors to evaluate the viability of the venture. The Investors need a profit which can improve his business and thus have a sustainable enterprise. Earning more money is the first concern of the investors. The profitability of the company depends on his expected return on investment from operations. Appendix V shows the net profit of the company in the operation sheet.

4.3.3 Summary assumption and results

This component describes the main assumptions which include: the total financing needed to carry out the activities. In this study the total financing needed for the company is estimated at 5.35 million of FCFA. This amount includes investment for 4.55 million of FCFA and Working Capital (WC) for 0.8 million of FCFA. It is assumed that 30% (1.6 million of FCFA) of the total financing are from the Equity and 70% (3.74 million of FCFA) are from the bank loan which a real interest rate of 12% without inflation. The assumptions about tax, debtors, creditors and depreciations are mentioned in this part. (Appendix III)

4.3.4 Investment and financing

This component shows how the investment will be financed during the period taking in consideration for the planning. It comprised: the booked value and their depreciation. These included the constructions, equipment and land during the 10 years planning. Booked value in this study is estimated at 4.55 million FCFA at the beginning of the operations in 2013. At

the end of 10 years (2023) booked value is evaluated at 2.48 millions FCFA with a total depreciation of 2.07 million FCFA except land which cannot be depreciated.

The model also indicates how loans payments will be covered, and the interest and fees paid for. In this study, repayment of loan (3.74 million of FCFA) is for six (6) years with one year of a grace period for the principal. The total interest of loan paid is 2.02 million FCFA, with 0.07 million FCFA paid as fees management (Appendix IV).

4.3.5 Operations statement

This operations statement shows how over 10 years, the investment generated revenues and thus the earnings or loss from operations on production and sales. For this study, the operating surplus (EBITDA) ranges from -0.09 million FCFA at the end of first year of production to 3.64 million FCFA at the end of production planning in 2023.

The earnings before tax (EBIT) fluctuated from -031 million FCFA from 2014 to 3.45 million FCFA in 2023. In addition, profit before tax, after tax and net profit/loss are projected. The net profit/loss ranges from -0.07 million FCFA in 2013 to 1.93 million FCFA in 2023 (Appendix V).

4.3.6 Cash flow statement

The cash flow statement describes the movements of cash inflows and outflows of the company. The inflows include the cash from the operations (operating surplus), cash from customers, lenders or investors. This includes all the movements in cash that the company will receive from the operation itself, the financial institutions, the stakeholders or investors. The outflows comprise all the payment in cash from the company. This includes the repayment of loans, interest of loan and loan management fees, paid dividend and taxes.

In this study, The Cash Flow before tax fluctuates from -0.57 million FCFA at the end of the year 2014 to 3.35 million FCFA at the end of production planning operations in 2023. The Cash Flow after tax fluctuates from -0.6 million FCFA in 2014 to 2.9 million FCFA at the end of operations in 2023. The Free (Net) Cash Flow after repayment of loans and their fees oscillates from -0.07 million FCFA at the end of year 2013 to 2.93 million FCFA in 2023. The Cash Movement is ranges from 0.73 million FCFA in 2013 to 2.42 million FCFA at the end of operations in 2023. It is calculated by subtracting to the Net Cash Flow the payment of dividend which started in 2016. This dividend represents 30% of the profit. The financing for the expenditure (Working Capital) needed for the operation is estimated at 0.8 million FCFA.

The summary of all the operation about Cash Flow of the company is recorded in the Appendix VI.

4.3.7 Balance sheet

The balance sheet presents the financial situation of the company at a particular time which is usually the end of each year. It has two parts: the assets that represent the properties of the company supported by the liabilities and equity or the capital.

The total asset includes currents assets which ranges from 0.73 million FCFA in 2013 to 9.64 million FCFA in 2023 and fixed assets (booked value). This total asset varies from 5.27

million FCFA in 2013 to 12.12 million FCFA at the end of operations in 2023. There is no stock (inventory) all the quantities of fish harvested are sold.

The current liabilities represents the short term debts of the company. This component is important for the company to face his current assets. The current liabilities here range from 1.31 million FCFA at the end of first year of operations to 2.2 million FCFA at the end of the operation planning in 2023. The total debt of the company includes the current liabilities and the long term loans. This ranges from 3.74 million FCFA in 2013 to 2.2 million FCFA at the end of the year 2023. The total capital of company includes equity and profit and loss balance. These are the real financial resources belonging to the company. Total capital ranges from 1.53 million FCFA in 2013 to 9.92 million FCFA in 2023.

The debt and capital is equal to the total assets: this is the normal financial situation of the balance sheet (Appendix VII).

4.3.8 Profitability measurement statement

This component provides the financial indicators useful for the measurement of the profitability of the project or investment. It indicates the total cash flow and capital with their Net Present Value (NPV) and Internal Rate of Return (IRR) year by year during the period of the activities. Also, it precise the Net Cash flow and Equity with the respective NPV and the IRR.

In this study, at the end of operations in 2023, the Total Cash Flow and capital is estimated at 2.93 million FCFA with the NPV of 1.23 million FCFA; given an IRR of 19%. The Net Cash Flow and Equity is estimated at the end of operation planning in 2023 at 2.93 million FCFA with the NPV of 1.49 million FCFA; given an IRR of 24%. The financial ratios are calculated. And, at the end of the operations in 2023, they are as follows: 36%, 35%, 3104%, 82%, 4.4, 4.4, and 6.2 respectively for Return on Investment (ROI), Return on Equity (ROE), Turnover Ratio (TR), Current Ratio (CR), Net Current Ratio, Liquid Current Ratio, and Total Capital/Equity. Also, the Debt Service Coverage is calculated during the period required for the repayment of the loans and interest. This ratio of Debt Service Coverage ranges from 0.7 from to 3.3 (Appendix VIII).

The Net Present Values (NPV), the Internal Rate of Return (IRR) are the most important indicators for the issue of profitability and thus the outlook on investment return. Other financial ratios are used such as the debt service coverage. This ratio measure the ability of the company to pay his debt with the cash issued from operations.

The IRR is the discounting rate on return on investment. The investment or project to be economically feasible or profitable, the IRR should be greater than the discounting rate in appendix III (15%) which is considered as the minimum rate for the project or investment to be profitable.

From the production model and the main components of the profitability model performing in this study, the results on the feasibility of aquaculture in the Noun Division appears.

5 RESULTS

In this study, five charts are used to present the results on the finding on the feasibility of aquaculture in Cameroon.

5.1 Cash Flow chart

During the 10 years of the operations used for this analysis, the results from this chart show that the Total Cash Flow and Capital and the Net Cash Flow and Equity during the first and second years of operations are negative. From the third year onward, Total Cash Flow and Capital and the Net Cash Flow and Equity are both positive except the Net cash flow and Equity, but variable over the period of the planning horizon (Figure 5).

These cash flows are indicators showing the ability of the investment to generate substantial revenues and therefore the viability and feasibility of aquaculture in the Noun division

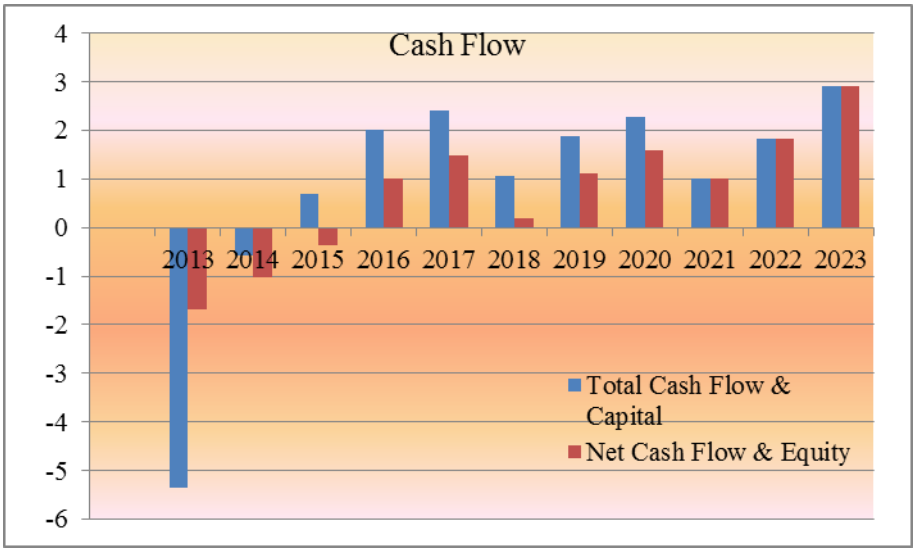

Figure 5: Cash flow polyculture tilapia & catfish operations.

5.2 Accumulated Net Present Value (NPV) chart

To assess the profitability of a project or an investment, the Net Present Value (NPV) is the most common indicator used. The NPV Total Cash Flow and capital and NPV Net Cash Flow and equity expected at the end of the 10 years of the operations planning with a discounting rate of 15% in this study is 2.93 million for both parameter of investment return. From this chart the payback period is nine years for the total capital invested and eight years for the Equity. This means that the total initial investment of 5.35 million of FCFA invested in 2013, are expected to be recovery in 9 years of operations. While for the Equity of 1.6 million FCFA invested at the same period, it is expected to be recovered in 8 years. These positive NPV over the year are the indicators that aquaculture is feasible in the Noun Division; but have a risk because of long period of time to recover the investment (Figure 6).

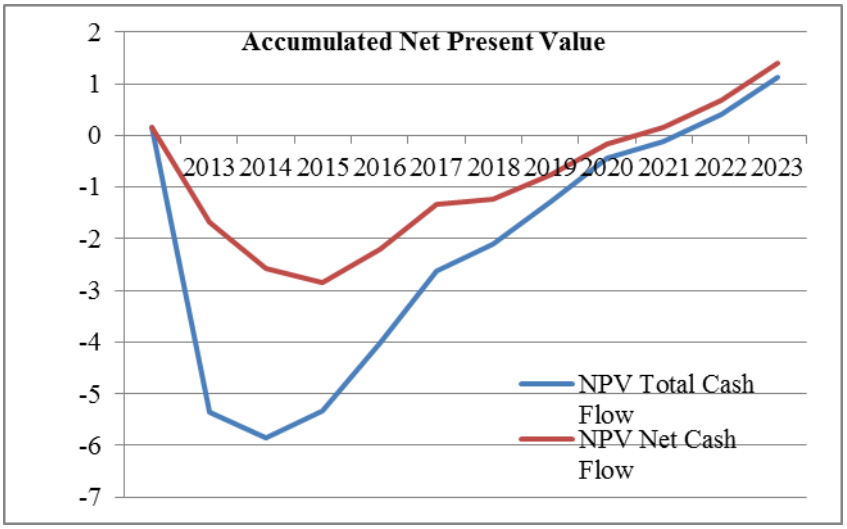

Figure 6: Accumulated Net Present Value of polyculture of tilapia with catfish

5.3 Internal rate of Return (IRR) chart

From the profitability measurements (Appendix VIII), the Internal Rate on Return (IRR) is predicted for the total Cash Flow and Capital and for the Net Cash flow and Equity. The IRR is 19% and 24% respectively for the Total Cash Flow and Capital and for the Net Cash Flow and Equity at the end of 10 years operations planning. These two rates are greater than the minimum rate of 15%. This means that the venture is profitable (Figure 7).

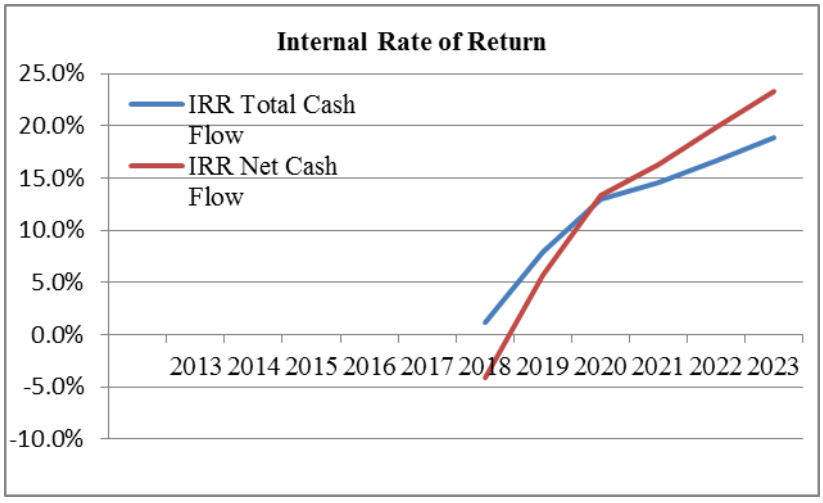

Figure 7: IRR of polyculture of tilapia with catfish

5.4 Financial ratios chart

The liquid current ratio shows the ability of the company to face its short term debts (current liabilities) through its current assets. In this case, the chart indicates that the liquid current ratio rises from 0.7 in 2014 to 4.4 in 2023. The Debt Service Coverage indicates the ability of the company to pay its debts and the services of debt through the cash generated by the

activities after paying tax. The chart shows that company will be able to cover all the debt. Those financial ratios are good for the company to ensure the solvency and reinforce the credibility (Figure 5).

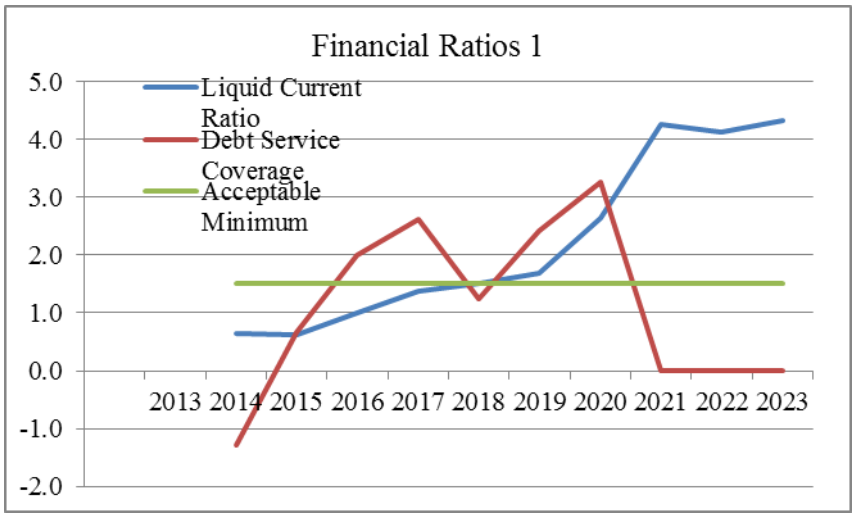

Figure 8: Financial ratio for polyculture of tilapia with catfish

From those charts, aquaculture in the Noun Division is profitable with the higher rate of IRR both for the total cash flow and capital (19%) and net cash flow (24 %) better than the discounting rate of 15%. These IRR (19% and 24%) indicate the positive NPV and thus the ability of investment of the company to generate more cash flow and thus the profitability of venture. With this cash, the company is able to pay the debt from the operations. However the payback period of 9 years for the total capital invested and 8 years for the equity indicates that there is a risk to recover the initial investment despite the positive NPV.

5.5 Sensitivity analysis

This component of profitability model is important for strategic decision-making. It takes into consideration the various changes in the factors of production required to manage the risks well. In this study, sale price seems to be more sensitive to the NPV and therefore on the profitability of the venture. From the Figure 9 below, at a decrease in sale price of 10%, the NPV/Equity is negative which is not acceptable. While an increase on sale price have positive impact on the NPV which increase considerable. However, an increase or decrease on costs such as pond, feed, fingerlings and labour do not have a great impact on the NPV.

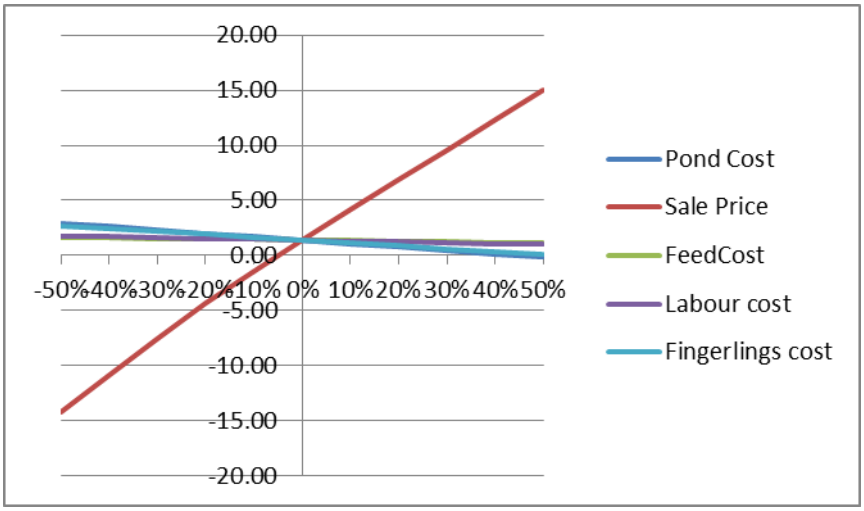

Figure 9: Sensitivity analysis of sale price, feed, pond, labour & fingerlings cost on NPV/Equity

6 DISCUSSION

The aim of this study was to evaluate the feasibility of aquaculture in the Noun Division. The fish farming polyculture of mixed-sex Nile tilapia *(Oreochromis niloticus)* with African catfish *(Clarias gariepinus)* in a semi-intensive system was assessed. This study was based on the production of fish in pond of 400 m^2 by fish farmers in the Noun Division at eight month as main assumption. Similar studies have been conducted and published on this issue.

The findings of this study showed that if fish farmers or investors in the Noun Division in Cameroon decide to produce tilapia with catfish in polyculture using a pond of 400 m^2, they will record a production of 390 kg of fish after eight month of rearing. This gives a production per hectare in eight months of 9-10 tons and by extension; the annual production per hectare estimated around 12-13 tons.

This production is greater than the average pond production of 2,000 kg of fish per hectare per year reported By Pouomogne and Pensl (2008) or 2,450 kg/ha/year reported by Brummett and Pouomogne (2006) in the case of small-scale fish farming in Cameroon, or 1,062 kg – 4,710 kg $ha^{-1}year^{-1}$ reported by Brummett (2011) in the case of small-scale fish farming in rural and sub-urban in Cameroon. It is also greater than the production of 7-8 tons/ha/year reported by de Graaf *et al.* (1996) in the Republic of Congo or 3-8 tons/ha/year estimated as possible by Pouomogne *et al.,* (1998) in the western Region of Cameroon during the study in the fish pond culture. Based on these findings, few points need to be taken in consideration:

a) The high yield in the present study may be due to an overestimation of some data, such as a daily growth of fish, the survival rate during the production cycle. The observation reported in the field about rearing fish in the pond by most of small scale fish farmers in Cameroon shows that, it will be difficult to achieve this high level of production. Most of fish farmers practice indirect feeding using the compost cribs which occupies an average of 10% of the pond surface. They also use exogenous food

pellets relatively balanced. Also, it will not be possible to achieve this high level of production estimated in this study by the commercial fish farming using organic fertilizer from animal and single-feed ingredients such as wheat bran and cotton seed oilcake as they are doing currently. These practices cannot give the expected yield. (Pouomogne & Pemsl, 2008).

However, previous studies on the issue of the fish production in ponds in Cameroon regardless size of farm, show that it is possible to achieve the production of 20 tons/ha/year or more if in semi-intensive or intensive system, the following are applied: good quality of fingerlings, good quality of extruded feed in sufficient quantities, feeding the fish as it is required to do, skilled labour, well paid and motivated and adequate monitoring of rearing. In addition to these, other rearing conditions must be filled: proper fertilization of water, temperature, oxygen, salinity, grading and rearing densities (Pouomogne & Pemsl, 2008).

To achieve that, farmers need a strong financial situation that can be able to cover all costs required for the company operations. Unfortunately, small-scale fish farmers, like most farmers in rural Cameroon, remain poor with subsistence production. For such farmers, their average annual household income hardly reach 200,000 FCFA (about 1$US per day) (Pouomogne & Pemsl, 2008).

Maybe with the government as facilitator through the implementation of the new framework to boost aquaculture sector in Cameroon could be a part of the solution. This framework focuses on commercial fish farming, with project facilitation guarantee funds from commercial banks for loans to young entrepreneurs who will be graduated from the CNFZV of Foumban in BTS and Ingenieur Scientists in fisheries from Yabassi. Also, the government framework is focused on the production of fish in Cages and by Raceways in monoculture of tilapia and catfish.

b) The results obtained in this study should be considered as an expected production in the context of promoting commercial aquaculture supported by the implementation of the new framework to improve the production of aquacuture sector.

c) From the findings of the study on one pond, it would be difficult for fish farmers in Cameroon to make more profit based on one or two ponds. The revenue generated is not sufficient to cover all the cost and can not therefore maximize the profit.

The use of a pond of 400 m^2 production in this study was to build the model of production and Profitability. It should be adjusted to the reality of the facts on the ground now and the future perspective of production that aims to improve the revenue of the producer.

Increasing the production by using more ponds is needed. Fish price in the suburban and urban market in Cameroon is an opportunity to farmers to increase revenue which can cover the cost of transport and therefore maximize profit (Pouomogne *et al*., 2010).

Investment are needed in the sector in term of repair of existing ponds, construction of new ponds respecting standards in aquaculture, adequate equipment and sufficient. Fish farmers in the Noun Division should consider aquaculture as other types of

production. The funds generated by aquaculture should be reinvests in this sector (Pouomogne & Pemsl, 2008).

How fish pond in general in Cameroon and particularly in the Noun Division can benefit rural poor farmers as a producers and consumers?

d) From the sensitivity analysis on some factors such as sales prices, pond cost, labour cost, feed cost and fingerlings cost shows that aquaculture business is more sensitive to sales price than others factors of production. In the situation of competition, farmers cannot decide about the price of market. Farmers should think about the combination of factors of production which can lower the cost of production in order to maximize the earnings.

   Uncertainty is one of the factors to be taken into consideration in production while remaining optimistic about achieving the objectives of the project. There is no investment without risk. For this project, the riskiest uncertainty may be the decrease in the market price, or a drastic increase in the cost of input. This situation may affect the revenues and thus the profit. Another uncertainty may be the disease that may arise during the rearing and affects performance of the company.

   The profitability model developed here does not take in consideration the inflation and the fluctuation of factors of production that may occur and affect the performance of the venture.

e) Aquaculture as a business can create more jobs and thus reduce the level of unemployment among young people (men and women), improve the income of farmers as producers and consumers and thus their wellbeing. If Cameroon wants to target economic expansion and job creation as is stated in the SDGE, 2009, it needs to support the growth of rural businesses (including aquaculture) of a sufficient scale to produce adequate profits and thus to achieve sustainability of the business in the absence of long-term subsidies (Brummett, 2011).

7 CONCLUSION

The findings of this study resulted from a profitability model of aquaculture in the Noun Division, which is feasible and profitable under the following conditions:

Based on the assumption and the analysis of the profitability model on the production obtained from one pond of 400 m^2, polyculture of tilapia with catfish appears feasible and profitable in the Noun Division with 390 kg/cycle/pond in eight month of rearing (around 12-13 tons ha^{-1} $year^{-1}$). As it is discussed in this study, this level is an expected production. Fish farmers in the Noun Division or another part of the region in Cameroon at this moment are not be able to achieve this yield.

The initial capital needed to carry out the investment for 0.5 ha of fish pond areas with 12 ponds of 400 m^2 each, is estimated at 5.35 million FCFA. This is the money required to start-

up the business. Fish farmers may not be able to have this entire amount. They will need the access to loans.

The operating surplus obtained from economies of scale in Appendix 2 for the first year of operation for ten ponds harvested (-0.09 million FCFA) and the following years is positive given the positive net revenue which cover all the costs. This shows the ability of the investment to generate cash flow as the result of the economies of scale and therefore the profitability of the venture.

The positive Net Present Value (NPV) with the Internal Rate of return (IRR) greater than the discounting rate, obtained in this study indicate the profitability of the business (Appendix 8: Profitability Measurements). The payback period for the total investment is nine years. However, it should be noted that these results are obtained from the assumptions in the Table 1.

The repayment of loans, the payment of the interests and their fees management, were possible given the average debt service coverage ratio around 2 during the operations. This shows the ability of the investment to pay debts from operations.

The aquaculture activity is more sensitive to sales price than the costs. Any increase in price at certain level has positive impact to the NPV and thus to the profit of the venture and any decrease in price at certain level has a negative impact on the NPV and thus the profit.

The production model and the profitability model which were performed in this study are valuable management tools for the fish farmers, investors and others stakeholders to better assess the feasibility of aquaculture in Cameroon.

The financial statement obtained from the profitability model show the ability of the investment of the company to generate from his operations cash flow and thus, profit for the sustainability of the venture. However it is important for fish farmers to have a keeping record for all the operations.

Also, those financial documents will be useful for the financial institutions as banks to better assess the viability of aquaculture business and their ability for repayment of loans. It is from those financial tools that bankers can give their agreement or not for a credit to the fish farmers or investors.

Fish farmers and investors need to evaluate whether a proposed investment opportunity is interesting. To do this, they should take in consideration the context of their business objectives and financial constraints among these are: access to credit, skilled labour, access to market and information, quality of fingerling and feed.

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APPENDICES

APPENDIX 1: BIOMASS AND PRODUCTION COST

Period (month)	Survival rate (%)		Number of fish			Mean body weight (g)		Biomass (kg)		
	Tilapia	Catfish	Tilapia	Catfish	Total fish	Tilapia(g)	Catfish(g)	Tilapia(kg)	Catfish (kg)	Total Biomass (kg)
0	100	100	800	400	1,200	12	10	10	4	14
1	95	94	760	376	1,136	45	52	34	20	54
2	98	98	745	368	1,113	84	100	63	37	99
3	99	98	737	361	1,098	126	151	93	55	147
4	100	100	730	361	1,091	165	199	120	72	192
5	100	100	730	361	1,091	207	244	151	88	239
6	100	100	730	361	1,091	249	301	182	109	290
7	100	100	730	361	1,091	294	355	215	128	343
8			730	361	1,091	336	403	245	146	391

Appendix 1 cont'd

Period (month)	Total Biomass (kg)	Feeding rate(%/biomass/day)	Feeding (kg/400m2/day	Monthly feeding(kg/400 m2)	Feeding cost /cycle (Th. FCFA)	Kg of Organic fertilizer/month	Cost of organic fertilizer/cycle (Th. FCFA)	Agricultural Lime(Th. FCFA)	harvest cost (Th. FCFA)	fingerlings cost (Th. FCFA)	others cost (Th. FCFA)	Total variable cost/cycle(Th. FCFA)
0	14	3%	0.4	12	4	60	2	18	0	80	5	109
1	54	3%	1.3	40	12	60	2	0	0	0	5	20
2	99	2%	2.0	60	18	60	2	0	0	0	5	25
3	147	1.5%	2.2	66	20	60	2	0	0	0	5	27
4	192	1.5%	2.9	87	26	50	2	0	0	0	5	33
5	239	1%	2.4	72	22	40	2	0	0	0	5	28
6	290	1%	2.9	87	26	40	2	0	0	0	5	33
7	343	1%	3.4	103	31	30	1	0	10	0	5	47
8	391			527	158	400	16	18	10	80	40	322
Total Fixed cost/cycle												120
Total cost of production/cycle/pond												442

Appendix 2 **Production planning model of 12 ponds in ten years**

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 1	**2014**											
Months / Items	1	2	3	4	5	6	7	8	9	10	11	12
Pond 1 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03
Pond 2 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03
Pond 3 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02
Pond 4 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 5 costs			0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11
Pond 6 costs			0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11
Pond 7 costs				0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep
Pond 8 costs				0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	
Pond 9 costs					0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 10 costs					0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 11 costs						0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 12 costs						0.11	0.02	0.03	0.03	0.03	0.03	0.03
Total Variable cost/month	0.22	0.26	0.31	0.36	0.43	0.48	0.33	0.39	0.34	0.50	0.47	0.47
Total fixed cost /year												0.18
Total variable cost by year												4.55
Total cost by year												4.73
Total revenues/cycle/pond	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93
Total revenue by year												4.64
Operating surplus/month.	-0.22	-0.26	-0.31	-0.36	-0.43	-0.48	-0.33	0.54	0.59	0.43	0.45	0.28
Op surplus by year												-0.09
Net production/cycle (tons)												3.91

Appendix 2 (cont'd) Production planning model of 12 ponds in ten years

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 2	**2015**											
Months / Items	13	14	15	16	17	18		20	21	22	23	24
Pond 1 costs	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03
Pond 2 costs	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03
Pond 3 costs	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03
Pond 4 costs	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03
Pond 5 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03
Pond 6 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03
Pond 7 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03
Pond 8 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03
Pond 9 costs	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02
Pond 10 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 11 costs	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11
Pond 12 costs	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11
Total Variable cost/month	0.46	0.43	0.48	0.33	0.39	0.34	0.50	0.47	0.47	0.46	0.43	0.48
Total fixed cost /year												0.18
Total variable cost by year												5.23
Total cost by year												5.41
Total revenues/cycle/pond	0.93	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93	0.93	0.00	0.00
Total revenue by year												6.49
Operating surplus/month.	0.47	-0.43	-0.48	-0.33	0.54	0.59	0.43	0.45	0.46	0.47	-0.43	-0.66
Op surplus by year												1.08
Net production/cycle (tons)												5.47

Appendix 2 (cont'd) Production planning model of 12 ponds in ten years

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 3	**2016**											
Months / Items	25	26	27	28	29	30	31	32	33	34	35	36
Pond 1 costs	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep
Pond 2 costs	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	
Pond 3 costs	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 4 costs	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 5 costs	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 6 costs	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 7 costs	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03
Pond 8 costs	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03
Pond 9 costs	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03
Pond 10 costs	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03
Pond 11 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03
Pond 12 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03
Total Variable cost/month	0.33	0.39	0.34	0.50	0.47	0.47	0.46	0.43	0.48	0.33	0.39	0.34
Total fixed cost /year												0.18
Total variable cost by year												4.92
Total cost by year												5.10
Total revenues/cycle/pond	0.00	0.93	0.93	0.93	0.93	0.93	0.93	0.00	0.00	0.00	0.93	0.93
Total revenue by year												7.42
Operating surplus/month.	-0.33	0.54	0.59	0.43	0.45	0.46	0.47	-0.43	-0.48	-0.33	0.54	0.41
Op surplus by year												2.32
Net production/cycle (tons)												6.25

Appendix 2 (cont'd) **Production planning model of 12 ponds in ten years**

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 4	2017											
Months / Items	37	38	39	40	41	42	43	44	45	46	47	48
Pond 1 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03
Pond 2 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03
Pond 3 costs	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02
Pond 4 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 5 costs	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11
Pond 6 costs	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11
Pond 7 costs	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep
Pond 8 costs	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	
Pond 9 costs	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 10 costs	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 11 costs	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 12 costs	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03
Total Variable cost/month	0.50	0.47	0.47	0.46	0.43	0.48	0.33	0.39	0.34	0.50	0.47	0.47
Total fixed cost /year												0.18
Total variable cost by year												5.30
Total cost by year												5.48
Total revenues/cycle/pond	0.93	0.93	0.93	0.93	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93
Total revenue by year												8.34
Operating surplus/month.	0.43	0.45	0.46	0.47	-0.43	-0.48	-0.33	0.54	0.59	0.43	0.45	0.28
Op surplus by year												2.86
Net production/cycle (tons)												7.03

Appendix 2 (cont'd) Production planning model of 12 ponds in ten years

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 5	2018											
Months / Items	49	50	51	52	53	54	55	56	57	58	59	60
Pond 1 costs	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03
Pond 2 costs	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03
Pond 3 costs	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03
Pond 4 costs	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03
Pond 5 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03
Pond 6 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03
Pond 7 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03
Pond 8 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03
Pond 9 costs	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02
Pond 10 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 11 costs	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11
Pond 12 costs	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11
Total Variable cost/month	0.46	0.43	0.48	0.33	0.39	0.34	0.50	0.47	0.47	0.46	0.43	0.48
Total fixed cost /year												0.18
Total variable cost by year												5.23
Total cost by year												5.41
Total revenues/cycle/pond	0.93	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93	0.93	0.00	0.00
Total revenue by year												6.49
Operating surplus/month.	0.47	-0.43	-0.48	-0.33	0.54	0.59	0.43	0.45	0.46	0.47	-0.43	-0.66
Op surplus by year												1.08
Net production/cycle (tons)												5.47

Appendix 2 (cont'd) **Production planning model of 12 ponds in ten years**

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 6	**2019**											
Months	61	62	63	64	65	66	67	68	69	70	71	72
Items												
Pond 1 costs	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep
Pond 2 costs	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	
Pond 3 costs	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 4 costs	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 5 costs	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 6 costs	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 7 costs	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03
Pond 8 costs	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03
Pond 9 costs	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03
Pond 10 costs	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03
Pond 11 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03
Pond 12 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03
Total Variable cost/month	0.33	0.39	0.34	0.50	0.47	0.47	0.46	0.43	0.48	0.33	0.39	0.34
Total fixed cost /year												0.18
Total variable cost by year												4.92
Total cost by year												5.10
Total revenues/cycle/pond	0.00	0.93	0.93	0.93	0.93	0.93	0.93	0.00	0.00	0.00	0.93	0.93
Total revenue by year												7.42
Operating surplus/month.	-0.33	0.54	0.59	0.43	0.45	0.46	0.47	-0.43	-0.48	-0.33	0.54	0.41
Op surplus by year												2.32
Net production/cycle (tons)												6.25

Appendix 2 (cont'd) **Production planning model of 12 ponds in ten years**

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 7	**2020**											
Months	73	74	75	76	77	78	79	80	81	82	83	84
Items												
Pond 1 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03
Pond 2 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03
Pond 3 costs	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 4 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 5 costs	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11
Pond 6 costs	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11
Pond 7 costs	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep
Pond 8 costs	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	
Pond 9 costs	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 10 costs	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 11 costs	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 12 costs	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03
Total Variable cost/month	0.50	0.47	0.47	0.46	0.43	0.48	0.33	0.39	0.34	0.50	0.47	0.47
Total fixed cost /year												0.18
Total variable cost by year												5.30
Total cost by year												5.48
Total revenues/cycle/pond	0.93	0.93	0.93	0.93	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93
Total revenue by year												8.34
Operating surplus/month.	0.43	0.45	0.46	0.47	-0.43	-0.48	-0.33	0.54	0.59	0.43	0.45	0.28
Op surplus by year												2.86
Net production/cycle (tons)												7.03

Appendix 2 (cont'd) **Production planning model of 12 ponds in ten years**

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 8	**2021**											
Months	85	86	87	88	89	90	91	92	93	94	95	96
Items												
Pond 1 costs	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03
Pond 2 costs	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03
Pond 3 costs	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03
Pond 4 costs	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03
Pond 5 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03
Pond 6 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03
Pond 7 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03
Pond 8 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03
Pond 9 costs	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 10 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02
Pond 11 costs	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11
Pond 12 costs	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11
Total Variable cost/month	0.46	0.43	0.48	0.33	0.39	0.34	0.50	0.47	0.47	0.46	0.43	0.48
Total fixed cost /year												0.18
Total variable cost by year												5.23
Total cost by year												5.41
Total revenues/cycle/pond	0.93	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93	0.93	0.00	0.00
Total revenue by year												6.49
Operating surplus/month.	0.47	-0.43	-0.48	-0.33	0.54	0.59	0.43	0.45	0.46	0.47	-0.43	-0.66
Op surplus by year												1.08
Net production/cycle (tons)												5.47

Appendix 2 (cont'd) **Production planning model of 12 ponds in ten years**

N-Ponds production Model (in Millions of FCFA) 1$US = 500 FCFA												
Years 9	**2022**											
Months	97	98	99	100	101	102	103	104	105	106	107	108
Items												
Pond 1 costs	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep
Pond 2 costs	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	
Pond 3 costs	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 4 costs	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 5 costs	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 6 costs	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03
Pond 7 costs	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03	0.03
Pond 8 costs	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03
Pond 9 costs	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03	0.03
Pond 10 costs	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03
Pond 11 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Cleaning-rep	0.11	0.02	0.03	0.03
Pond 12 costs	0.02	0.03	0.03	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03
Total Variable cost/month	0.33	0.39	0.34	0.50	0.47	0.47	0.46	0.43	0.48	0.33	0.39	0.34
Total fixed cost /year												0.18
Total variable cost by year												4.92
Total cost by year												5.10
Total revenues/cycle/pond	0.00	0.93	0.93	0.93	0.93	0.93	0.93	0.00	0.00	0.00	0.93	0.93
Total revenue by year												7.42
Operating surplus/month.	-0.33	0.54	0.59	0.43	0.45	0.46	0.47	-0.43	-0.48	-0.33	0.54	0.41
Op surplus by year												2.32
Net production/cycle (tons)												6.25

Appendix 2 (cont'd) **Production planning model of 12 ponds in ten years**

Years 10	**2023**												
Months	109	110	111	112	113	114	115	116	117	118	119	120	
Items													
Pond 1 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea.rep				
Pond 2 costs	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05					
Pond 3 costs	Clea.rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea.rep			
Pond 4 costs		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05				
Pond 5 costs	0.05	Clea.rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea.rep		
Pond 6 costs	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05			
Pond 7 costs	0.03	0.05	Clea.rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea.rep	
Pond 8 costs	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05		
Pond 9 costs	0.03	0.03	0.05	Clea.rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	Clea.rep
Pond 10 costs	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05	
Pond 11 costs	0.03	0.03	0.03	0.05	Clea.rep	0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Pond 12 costs	0.03	0.03	0.03	0.05		0.11	0.02	0.03	0.03	0.03	0.03	0.03	0.05
Total Variable cost/month	0.50	0.47	0.47	0.46	0.43	0.48	0.33	0.39	0.34	0.28	0.22	0.16	0.09
Total fixed cost /year												0.18	
Total variable cost by year												4.52	
Total cost by year												4.70	
Total revenues/cycle/pond	0.93	0.93	0.93	0.93	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93	0.93
Total revenue by year												8.34	
Operating surplus/month.	0.43	0.45	0.46	0.47	-0.43	-0.48	-0.33	0.54	0.59	0.65	0.71	0.59	0.83
Op surplus by year												3.64	
Net production/cycle (tons)												7.03	

Appendix 3 Profitability model: Summary Assumption and Results

Assumptions and Results							
		2013		**Discounting Rate**		**15%**	
Investment:		MFCFA		**Planning Horizon**		**10**	**years**
Buildings		3.80					
Equipment	100%	0.19				**Total Cap.**	**Equity**
Land		0.56		**NPV of Cash Flow**		**1.23**	**1.49**
Total		**4.55**		**Internal Rate**		**19%**	**24%**
Financing:							
Working Capital		0.80					
Total Financing		5.35		**Capital/Equity**		**6.18**	
Equity		30%		**after 10 years**			
Loan Repayments		6	years	Minimum cash account		-1	
Loan Interest		12%					
Fixed Cost		20	MUSD/year				
Inventory Build-up			**0**				
Debtors	25%	of turnover					
Creditors	15%	of variable cost					
Dividend	30%	of profit					
Depreciation building	5%						
Depreciation Equipment.	15%						
Depreciation Land	0%						
Loan Management Fees	2%						
Income Tax	20%	of profit					

MFCFA: millions of Francs CFA

Appendix 4 Profitability model: Investment and Financing

Investment (millions of Francs CFA)													
Years		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Investment and Financing			1	2	3	4	5	6	7	8	9	10	
Investment:													
Buildings (Ponds & Stores)		3.80	3.61	3.42	3.23	3.04	2.85	2.66	2.47	2.28	2.09	1.90	
Equipment		0.19	0.16	0.13	0.10	0.08	0.05	0.02	0.02	0.02	0.02	0.02	
Other		0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	
Booked Value		**4.55**	**4.33**	**4.11**	**3.89**	**3.68**	**3.46**	**3.24**	**3.05**	**2.86**	**2.67**	**2.48**	
Depreciation:													
Depreciation Buildings	5%		0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	**1.9**
Depreciation Equipment	15%		0.0284	0.0284	0.0284	0.0284	0.0284	0.0284					**0.171**
Depreciation Land	0%		0	0	0	0	0						**0.00**
Total Depreciation			**0.218**	**0.218**	**0.218**	**0.218**	**0.218**	**0.218**	**0.19**	**0.19**	**0.19**	**0.19**	**2.071**
Financing:		**5.35**											
Equity	30%	1.60											
Loans	70%	3.74											
Repayment	6			0.62	0.62	0.62	0.62	0.62	0.62				**3.74**
Principal		3.74	3.74	3.12	2.50	1.87	1.25	0.62	0	0	0	0	
Interest	12%		0.45	0.45	0.37	0.30	0.22	0.15	0.07	0.00	0.00	0.00	**2.02**
Loan Management Fees	2%	0.07											

Appendix 5 **Profitability model: Operations Statement**

Operations (millions of Francs CFA)													
Years		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Operations Statement													
EBITDA (Operating Surplus)			**-0.09**	**1.08**	**2.32**	**2.86**	**1.08**	**2.32**	**2.86**	**1.08**	**2.32**	**3.64**	**19.47**
Inventory Movement													
Depreciation			0.2184	0.2184	0.2184	0.2184	0.2184	0.2184	0.19	0.19	0.19	0.19	**2.07**
EBIT (Operating Gain/Loss)			**-0.31**	**0.86**	**2.10**	**2.64**	**0.86**	**2.10**	**2.67**	**0.89**	**2.13**	**3.45**	**17.40**
Financial Costs (Interest + LMF)		0.075	0.449	0.449	0.374	0.300	0.225	0.150	0.075	0.0	0.0	0.0	**2.10**
Profit before Tax		**-0.07**	**-0.76**	**0.41**	**1.73**	**2.35**	**0.64**	**1.95**	**2.60**	**0.89**	**2.13**	**3.45**	**15.30**
Loss Transfer	0	-0.07	-0.84	-0.42	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Taxable Profit		0.00	0.00	0.00	1.30	2.35	0.64	1.95	2.60	0.89	2.13	3.45	
Income Tax	20%	0.00	0.00	0.00	0.26	0.47	0.13	0.39	0.52	0.18	0.43	0.69	**3.06**
Profit after Tax		**-0.07**	**-0.76**	**0.41**	**1.46**	**1.88**	**0.51**	**1.56**	**2.08**	**0.71**	**1.70**	**2.76**	**12.24**
Dividend	30%	0.00	0.00	0.12	0.44	0.56	0.15	0.47	0.62	0.21	0.51	0.83	**3.92**
Net Profit/Loss		**-0.07**	**-0.76**	**0.29**	**1.03**	**1.31**	**0.36**	**1.09**	**1.46**	**0.50**	**1.19**	**1.93**	**8.32**

Appendix 6 Profitability model: Cash flow statement

Cash Flow (millions of Francs CFA)												
Years	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Cash Flow												
EBITDA (Operating Surplus)	**0**	**-0.09**	**1.08**	**2.32**	**2.86**	**1.08**	**2.32**	**2.86**	**1.08**	**2.32**	**3.64**	**19.47**
Debtor Changes		1.16	0.46	0.23	0.23	-0.46	0.23	0.23	-0.46	0.23	0.23	**2.09**
Creditor Changes		0.68	0.10	-0.05	0.06	-0.01	-0.05	0.06	-0.01	-0.05	-0.06	**0.68**
Inventory Changes		0	0	0	0	0	0	0	0	0	0	**0.00**
Cash Flow before Tax	**0**	**-0.57**	**0.72**	**2.04**	**2.69**	**1.53**	**2.04**	**2.69**	**1.53**	**2.04**	**3.35**	**18.06**
Paid Taxes		0.00	0.00	0.00	0.26	0.47	0.13	0.39	0.52	0.18	0.43	**2.37**
Cash Flow after Tax	**0.0**	**-0.6**	**0.7**	**2.0**	**2.4**	**1.1**	**1.9**	**2.3**	**1.0**	**1.9**	**2.9**	**15.7**
Financial Costs (Interest + LMF)	0.07	0.45	0.45	0.37	0.30	0.22	0.15	0.07	0.00	0.00	0.00	**2.10**
Repayment of loans	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	**3.7**
Free (Net) Cash Flow	**-0.07**	**-1.02**	**-0.35**	**1.04**	**1.50**	**0.21**	**1.14**	**1.60**	**1.01**	**1.86**	**2.93**	**9.85**
Paid Dividend		0.00	0.00	0.12	0.44	0.56	0.15	0.47	0.62	0.21	0.51	**3.09**
Financing - Expenditure (WC)	0.8	0	0	0	0	0	0	0	0	0	0	**0.8**
Cash Movement	**0.73**	**-1.02**	**-0.35**	**0.92**	**1.07**	**-0.35**	**0.99**	**1.13**	**0.39**	**1.65**	**2.42**	**7.56**

Appendix 7 **Profitability model: Balance Sheet**

Balance (millions of Francs CFA)												
Years		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Balance Sheet												
Assets												
Cash Account	0	0.73	-0.29	-0.65	0.27	1.33	0.99	1.97	3.10	3.49	5.14	7.56
Debtors (Accounts Receivable)	25%	0	1.16	1.62	1.85	2.09	1.62	1.85	2.09	1.62	1.85	2.09
Stock (Inventory)	0	0	0	0	0	0	0	0	0	0	0	0
Current Assets		**0.73**	**0.86**	**0.97**	**2.12**	**3.42**	**2.61**	**3.83**	**5.19**	**5.12**	**6.99**	**9.64**
Fixed Assets (Booked Value)		4.55	4.33	4.11	3.89	3.68	3.46	3.24	3.05	2.86	2.67	2.48
Total Assets		**5.27**	**5.20**	**5.09**	**6.02**	**7.10**	**6.07**	**7.06**	**8.24**	**7.97**	**9.66**	**12.12**
Debts												
Dividend Payable		0.00	0.00	0.12	0.44	0.56	0.15	0.47	0.62	0.21	0.51	0.83
Taxes Payable		0.00	0.00	0.00	0.26	0.47	0.13	0.39	0.52	0.18	0.43	0.69
Creditors (Accounts Payable)	15%	0.00	0.68	0.78	0.74	0.80	0.78	0.74	0.80	0.78	0.74	0.68
Next Year Repayment		0.00	0.62	0.62	0.62	0.62	0.62	0.62	0.00	0.00	0.00	
Current Liabilities		**0.00**	**1.31**	**1.53**	**2.06**	**2.45**	**1.69**	**2.22**	**1.94**	**1.18**	**1.67**	**2.20**
Long Term Loans		3.74	3.12	2.50	1.87	1.25	0.62	0.00	0.00	0.00	0.00	
Total Debt		**3.74**	**4.43**	**4.03**	**3.93**	**3.70**	**2.31**	**2.22**	**1.94**	**1.18**	**1.67**	**2.20**
Equity		1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Profit & Loss Balance		-0.07	-0.84	-0.55	0.48	1.79	2.15	3.24	4.69	5.19	6.38	8.32
Total Capital		**1.53**	**0.77**	**1.06**	**2.08**	**3.40**	**3.75**	**4.84**	**6.30**	**6.80**	**7.99**	**9.92**
Debts and Capital		**5.27**	**5.20**	**5.09**	**6.02**	**7.10**	**6.07**	**7.06**	**8.24**	**7.97**	**9.66**	**12.12**

Appendix 8 **Profitability model: Profitability Measurements**

Profitability (millions of Francs CFA)													
Years		**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Profitability Measurements													
NPV and IRR of Total Cash Flow													
Cash Flow after Taxes		0.00	-0.57	0.72	2.04	2.43	1.06	1.91	2.30	1.01	1.86	2.93	**15.69**
Loans		-3.74											**-3.7**
Equity		-1.60											**-1.6**
Total Cash Flow & Capital		**-5.35**	**-0.57**	**0.72**	**2.04**	**2.43**	**1.06**	**1.91**	**2.30**	**1.01**	**1.86**	**2.93**	**10.34**
NPV Total Cash Flow	15%	**-5.35**	**-5.84**	**-5.30**	**-3.96**	**-2.57**	**-2.04**	**-1.22**	**-0.35**	**-0.02**	**0.51**	**1.23**	
IRR Total Cash Flow							**2%**	**8%**	**13%**	**15%**	**17%**	**19%**	
NPV and IRR of Net Cash Flow													
Free (Net) Cash Flow		-0.07	-1.02	-0.35	1.04	1.50	0.21	1.14	1.60	1.01	1.86	2.93	**9.85**
Equity		-1.60											**-1.60**
Net Cash Flow & Equity		**-1.68**	**-1.02**	**-0.35**	**1.04**	**1.50**	**0.21**	**1.14**	**1.60**	**1.01**	**1.86**	**2.93**	**8.25**
NPV Net Cash Flow	15%	**-1.68**	**-2.57**	**-2.83**	**-2.15**	**-1.29**	**-1.18**	**-0.69**	**-0.09**	**0.24**	**0.77**	**1.49**	
IRR Net Cash Flow							**-3%**	**7%**	**14%**	**17%**	**21%**	**24%**	
Financial Ratios													
ROI (Profit + Interest/Debt +Capital)			-6%	17%	41%	44%	12%	35%	38%	11%	27%	36%	
ROE (Profit/Shareholders Capital)			-50%	54%	139%	90%	15%	42%	43%	11%	25%	35%	
TR (Revenue/Debt + Capital)			569%	2309%	4129%	4986%	4228%	4946%	4247%	3642%	3762%	3104%	
CR (Capital/Debt + Capital)			15%	21%	35%	48%	62%	69%	76%	85%	83%	82%	
Net Current Ratio			0.7	0.6	1.0	1.4	1.5	1.7	2.7	4.3	4.2	4.4	
Liquid Current Ratio			0.7	0.6	1.0	1.4	1.5	1.7	2.7	4.3	4.2	4.4	
Total Capital/Equity			0.5	0.7	1.3	2.1	2.3	3.0	3.9	4.2	5.0	6.2	
Debt Service Coverage			-1.3	0.7	2.0	2.6	1.3	2.5	3.3				
Acceptable Minimum			1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	