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ECONOMIC ANALYSIS OF SMALL-SCALE TILAPIA AQUACULTURE IN MOZAMBIQUE

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ABSTRACT

The aim of this project is to make an economical analysis of small-scale fish farm investment and operations under the environmental and financial conditions in Mozambique. For this purpose/reason, 500 m^2 of the pond was used as the basis for analysis because this is the average size used by most private fish farmers in Mozambique.

The profitability of the venture was determined using indicators of investment returns including net present value (NPV), internal rate of return (IRR) and payback period as well as analysis of the risks that could be involved. The results obtained indicate a positive NPV of USD 891 for the capital invested and 1,645 for the equity when 15% of the marginal attractive ratio (MARR) is used. The payback period was eight years for the total capital invested, and three years for the equity. The ratio capital and equity after 10 years equals 4.6.

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1 INTRODUCTION

The Republic of Mozambique is a tropical country located on the southeastern coast of Africa bordered by Tanzania to the north, South Africa and Swaziland to the south, Zimbabwe to the west, and Zambia and Malawi to the northwest. The total area of the country is about 801,600 km^2. The average temperature ranges from 15.5 to 33.9^{o}C. There are two seasons; summer/dry season (October to March) and winter/wet/cold season (April to September). The annual average rainfall is between 400 to 2000 mm/year though the average maximum varies from 1,422 mm in the north to 762 mm in the south (MCEARM 2002).

The total population is about 21,000,000 with an average population density of about 27 people per km^2; most of the people (80% of the total population) live in the rural areas depending on the subsistence agriculture, livestock and fisheries (MCEARM 2002). Mozambique has a coastline of about 2,700 km (Indian Ocean), 13,000 km^2 of inland water which includes a large number of rivers, lakes, reservoirs, and streams. The potential fishing is estimated at about 240,000 tonnes year^{-1} (Elsy *et al.* 2005). There are 258,000 ha of land suitable for aquaculture. However, fish culture is currently practised in only about 6,500 ponds with in average size of 400-500 m^2 distributed across the country (Elsy *et al.* 2005). The Mozambique fishing sector provides employment to 130,000 people and contributes 4% to the GDP and 8% to foreign exchange earnings. The per capita fish consumption is about 5.0 - 15 kg per year and is much higher in coastal communities. The fisheries are divided into marine capture, inland capture and freshwater aquaculture sectors. The marine fisheries (artisanal and commercial) constitute 90% of total catch. The average annual catch is about 120,000 tonnes of which 80% comes from artisanal fisheries and is consumed within Mozambique. On the other hand, the commercial fishing sector provides the majority of export of fisheries products (FAO 2007). The main marine resources include crustaceans (prawns, deepwater shrimp, crayfish, lobsters and crabs), fish (demersal and pelagic species such as grouper, snapper, emperor and sea bream, yellow fin tuna and shark), and several other invertebrate species (squid, octopus, sea cucumbers and bivalves). The total capture in 2002 was about 36 thousand tonnes, 44 thousand tonnes in 2003, 45 thousand tonnes in 2004, 42 thousand tonnes in 2005 and 43 thousand tonnes in 2006 (FAO 2007). The production values of commercial fisheries (industrial and semi-industrial) reported was about USD 97 thousand in 2004, USD 98 thousand in 2005, USD 92 thousand in 2006 and USD 79 thousand 2007, showing a clear reduction in the value fisheries products. In general, catches have declined over the past three years due to an increase in the price of fuel on the international market, obsolete vessels, changes in the price of fisheries products in the international market and reductions of the stock due to fishing effort (Mozambique National Ministry of Fisheries of Mozambique 2008). Inland water includes Lake Niassa/Malawi Cahora Bassa Lake and many rivers and lagoons. The capture fishery is dominated by a small pelagic species locally known as kapenta, tilapia and carps. The total reported catch processed and marketed each year is about 10,000 tonnes, of which 4,000 tonnes comes from artisanal and small-scale fisheries. The Ministry of Fisheries of Mozambique (2008) reported total commercial catch was about 30 thousand tonnes in 2004, 26 thousand tonnes in 2005, 28 thousand tonnes in 2006 and 19 thousand tonnes in 2007. The reasons for the reductions in total catch are the same as for the marine fisheries above.

2 JUSTIFICATIONS

According to Elsy *et al*. (2005), Mozambique is a country with good conditions for both marine and fresh water aquaculture. There are 258,000 ha suitable for inland aquaculture and 33,000 ha for marine aquaculture, currently less than 10% of this is exploited. Most fish farmers lack information on how to assess the profitability of their farms. This has partly hampered aquaculture development in the country. This is leading to 'potential' farmers not opting into fish farming and even others becoming 'inactive' because the profitability of aquaculture has not been demonstrated to them. Furthermore, the financing institutions and banks are not keen to give loans to farmers whose enterprise profitability has not been feasibly appraised.

A small-scale aquaculture study from Tanzania published in 2006 on mixed tilapia which was cultured with and without predator proved to be economically unsustainable in the manner in which was developed (Kaliba *et al*. 2007). Greater profitability was suggested by a partial economical analysis for Nile tilapia in Kenya, where that species was mixed with catfish, and a urea fertilizer was used weekly and fish were fed maize bran, (Gichuri *et al*. 2001) or rice bran (Liti *et al*. 2006).

For those countries where such studies have been conducted and results demonstrated, the people are more interested and the bank have information on the economical feasibility of aquaculture. Mozambique is one of the countries where hunger, poverty, and unemployment are powerful issues in the government countries so proponents of the development of this practice in Mozambique are optimistic. .

Further studies on aquiculture viability in Mozambique are needed in order to improve the standard of living for people in poor communities and to help farmers in executing a successful trade. . It is expected that it will note take long to develop a knowledge base to help the small-scale fish farmers to understand better their business in order to make a significant profit. Therefore, the goal of this study is to analyse whether tilapia pond farming in Mozambique is profitable or not and to assess the risks involved in this.

2.1 Vision

Generally, there has been a continued reduction in the artisanal and industrial fishing sectors in the last two years; and the government has defined a long-term development goal to increase the production of aquatic products progressively. In order to manage and facilitate the development of the country's aquaculture, the Mozambique government has established the Institute of Aquaculture (INAQUA) in 2008 under the Ministry of Fishery.

3 LITERATURE REVIEW

Aquaculture is defined by the FAO as “the farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants. Farming implies some form of intervention in the process to enhance production, such as regular stocking, feeding, protection from predators, etc. It also implies ownership of stock being cultivated” (Earth Trends 2003).

Tilapia which belongs to the Cichlid family originated from Africa where the temperature ranges from 14 to 33˚C (Philippart and Ruwet 1982). In nature, the maximum weight of tilapia published was about 4.3 kg (IGFA 2001) and the maximum length of 60 cm (Moreau *et al.* 1988) at the age of nine years (Balon and Noakes 1982). The same characteristic of 60 cm as maximum size was reported by Eccles (1992). The unsexed fish in ponds reach about 24 cm in length (Trewavas 1983). Sexual maturity is reached at 3-6 months depending on the temperature when the fish are at about 30 g and reproduction occurs only when the temperature is over 20˚ C, (Trewavas 1983).

Tilapia is well suited to fish farming because it grows quickly, is able to survive in poor water conditions and eats a wide range of foods. The adult tilapia prefers vegetarian diets, varying from macrophytic to phytoplanktivorous. In ponds with supplementary feeding, natural food contribute 30 to 50% of tilapia growth. Sexual maturity in tilapia depends on age, size and environmental conditions. The males grow faster than females. Nile tilapia with 75 to 500 g body weight can deposit 50 to 2,000 eggs per spawning and can breed easily with no need for special hatchery technology (Chhorn *et al.* 2006).

Various water quality parameters need to be monitored such as temperature, dissolved oxygen, acidity (pH) and salinity. The optimal water temperature for growth is between 29 and 31˚C and salinity should not exceed 15 ppt (Chhorn *et al.* 2006). For easy management, a pond size range from 500–2000 m^2 is recommended (Nandlal and Pickering 2004).

There are three commercial species of Oreochromis such as Nile tilapia (*O. niloticus), Mozambique tilapia (O. mossambicus)* and blue tilapia (*O. aureus)*. *O. niloticus* has been reported as the best species for cultivation in ponds. Since O. *niloticus reaches* sexual maturity after three to five months of age, they typically weigh 150 to 200 g more than *O. mossambicus* . In ponds after eight months of culture, tilapia can weight 500 g. Overpopulation can be controlled (by stocking one catfish per two tilapias). Doing so causes the production homogeneous weight of individuals that can be sold at a uniform price, (Ministry of Agriculture, Animal Industry and Fisheries 2005).

3.1 World aquaculture

The world population is increasing as is the demand for aquatic food products. Predictions indicate that in the future, capture fisheries will, not be be able to meet the growing global demand for aquatic food. This is because most of the main fishing areas have reached their maximum potential yield (FAO 2005).

Total world fisheries in 2000 were 130 million tonnes, of which aquaculture contributed 36 million tonnes and the total global population was about 6 billion. In 2005 world fisheries catches had reached 140 million tonnes, 48 million tonnes of which were produced through aquaculture, and global population had climed to 6.5 billion. Therefore, we can clearly see the reduction in catches (Figure 1) which means there is a likely reduction of fishing stock and the human consumption is increasing (FAO 2007).

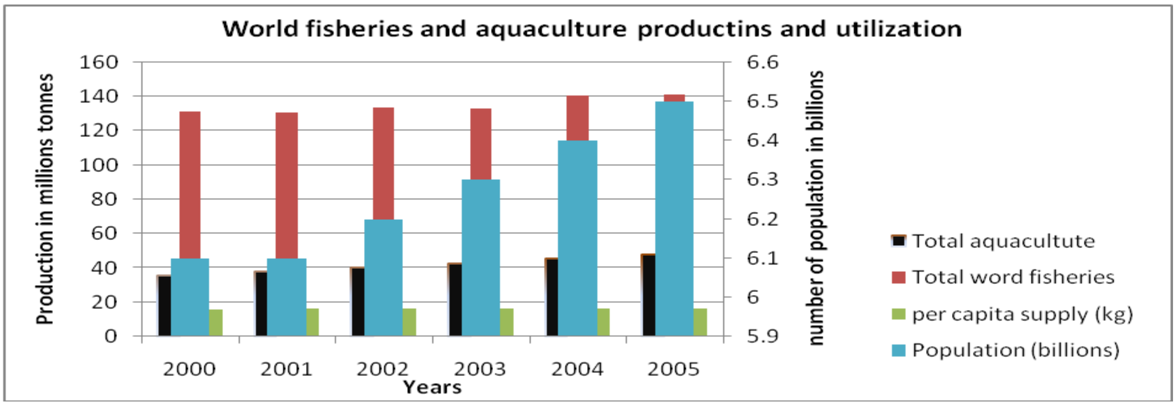

Figure 1: World fisheries and aquaculture production and utilisation (Ichiro Nomura. 2007.

3.2 Sub-Saharan Africa aquaculture

The sub-Saharan Africa region continues to be a minor player in aquaculture in the world, although the tilapia species most cultivated in the world originate from Africa. Nigeria leads in the region, with reported production of 44 thousand tonnes of catfish, tilapia and other freshwater species. But there are many species of greater importance such as black tiger shrimp (*Penaeus monodon*) in Madagascar, *Eucheuma* seaweed in the United Republic of Tanzania and abalone (*Haliotis* spp) in South Africa (FAO 2006).

According to FAO (2006), in 2004 the Asia Pacific contributed 21.92% of the global aquaculture production, China produced 69.57% and the other 8.51% from the rest of the world Sub-Saharan Africa contributes only about 0.16% of that last 8.51%. In terms of the money generated from global aquaculture China is leading with 51.20% followed by Asia and Pacific with 29.30% and finally other countries with about 19.50% where sub-Saharan Africa contributes with 0.36%. (Figure 8)..

The principal aquaculture export products from countries in Africa are mariculture products, mainly shrimp, abalone and seaweed. Shrimp are exported frozen (Madagascar and Mozambique), seaweeds are exported dry (United Republic of Tanzania, Madagascar and Mozambique) and 80-85% of abalone produced in South Africa is exported live and the remainder is canned (FAO 2006).

The contribution of sub-Saharan Africa to the total fish production in 2004 was about 6 million tonnes. Fish consumption is the lowest if compared to the rest of the world. In order to maintain the current level of per capita supply in sub-Saharan Africa of 6.6 kg per year until the year 2015, capture fisheries and aquaculture must increase by 28% over this period (FAO 2006).

The aquaculture industry has great potential to meet this increasing demand for aquatic food in most regions of the world. However, in order to achieve this, the sector (fisheries organisations, governments and farmers) may face significant challenges because:

- ✓ Economic and bio-technical constraints exist, and the transition from non-commercial to commercial fish farming is not common.

- ✓ Fingerling availability, quality and distribution remain a serious constraint to non-commercial and commercial aquaculture development in all countries however this also presents unique business opportunities.

- ✓ Feed availability, quality of seed, distribution of fingerlings and acceptable food conversion ratios remain major constraints to both non-commercial and commercial producers. Most non-commercial farmers use protein limiting diets, the use of farm made feeds is increasing slowly, while manufactured feeds are generally of a low quality. High quality extruded feeds are only manufactured in South Africa (Machena and Moehl 2001).

3.3 Aquaculture in Mozambique

Aquaculture activity in Mozambique like tilapia culture has existed since 1950. In 1960, as a way of ensuring the sustainability of this activity, three hatcheries were built by the government (FAO 2005) through the Ministry of Agriculture in Umbeluzi-Maputo (0.05 ha), Sussundenga-Manica (2 ha) and Chowke-Gaza (1.6 ha). Two of them (Maputo and Manica) are still in operation but under private management (Elsy *et al*. 2005).

The government, through the Ministry of Fisheries, has adopted a strategic plan to combat extreme poverty and hunger by developing aquaculture to reduce the dependence on fish from the capture fisheries. Developing aquaculture in that way the government will play an important role in the socio-economics of development of the country through provision of cheap and affordable fish as a source of protein, improving the population’s diet, creating jobs, generating income and promoting regional development (Elsy *et al*. 2005).

INAQUA incorporates the Actions Plan for the Reduction of Absolute Poverty in Mozambique (PARPA II). The PARPA II intends to reduce the poverty index from 70% (1997) to below 45% in 2015. At present, the attention of the government in relation to aquaculture is in inland waters. The program was defined by the plan of food production approved in 2007 under the National Strategy for Green Revolution in Mozambique (Aquaculture Association of Southern Africa 2009).

The activities of INAQUA are based on recommendations in the Mozambique Master Plan of the Ministry of Fisheries and in the general strategy of aquaculture. The Master Plan defined the ways how to set up incentives for investment in marine aquaculture enterprises, especially shrimp aquaculture and encouraging developing fresh water fish farming in the inland areas of the country (Elsy *et al*. 2005).

Although the aquaculture is not new, it is practiced mostly at subsistence level by 7,000 small-scale fish farmers which are characterised by low capital investment resulting into low production. The ponds are small (150-300 m^2) in size and the average stocking density used is about two fingerlings m^{-2}, and the average production per year is about 20 kg per pond (Aquaculture Association of Southern Africa 2009). In order to be developed as a commercial business not only in Mozambique, but also in all of sub-Saharan Africa countries, aquaculture must overcome certain constraints related with lack of availability of quality fingerlings, access and availability to credit by small-scale farmers, limited capacity of market/marketing and processing infrastructure (Elsy *et al*. 2005).

The total catch of Mozambique in 2001 was about 30,000 metric tonnes and had rapidly increased by 2004 when production was 45,000 metric tonnes. In 2005 the registered total was about 42,000 metric tonnes (FAO 2007). From 2005 to present, the catches have declined each year because of main constraints (like petrol, taxes and aging of vessels). Production (quantity and value) from aquaculture, mariculture and inland fresh water is presented below (Figure 2). The production in 2004 declined because of changes within the European Union and in 2006 one of the shrimp companies abandoned their facility, (Mozambique National Ministry of Fisheries of Mozambique 2008).

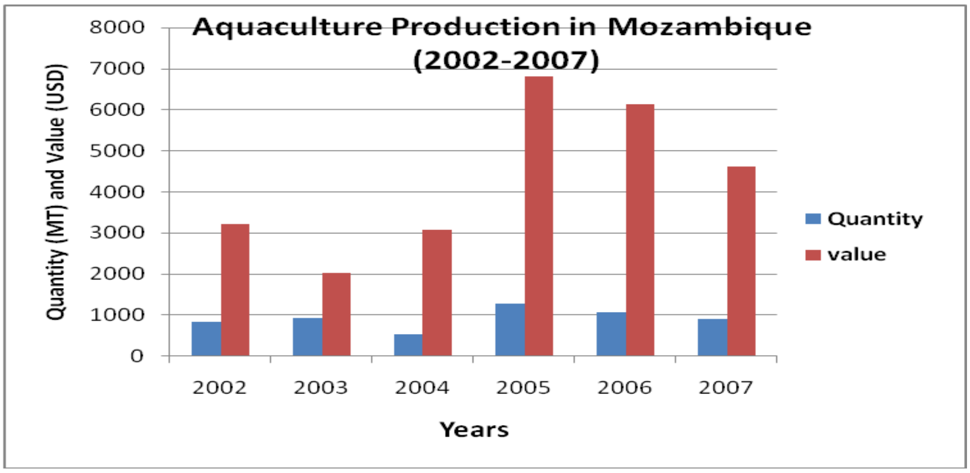

Figure 2: Aquaculture production in Mozambique (from 2002-2007) (FAO, Fishery and Aquaculture Country Profile 2006-2009)

3.4 General economic analysis

Before starting any activity all likely costs involved in that activity should be taken into account. In the case of aquaculture it is important that technical factors such as availability of water throughout the year, water quality, location of the company, availability of raw material (fingerlings, feed, etc.) and size of likely market must be taken into account as well as the cost and supply of labour and the selling price of the final product. Depending on the interest rate applied in the country the person who is interested can opt for a bank loan or not. Many people express interest in fish farming, but before making a decision they must investigate carefully the costs of and requirements for becoming a successful farmer. Fish farming is not for everyone and is certainly not for the "weekend farmer". Fish are living animals that require daily attention and patience. Therefore, for successful management it is important to combine technical and financial measures for aquaculture (Nandlal and Pickering 2004).

The purpose of business is to generate profits. An enterprise budget is used to see whether any business is profitable or not. If the total farm revenues from sales generated for the period are greater than the costs, it means profits are generated for that given period (Nandlal and Pickering 2004).

Another indicator that is used is the internal rate of return (IRR) that shows the returns of the capital investment (cash or goods used to generate income either by investing in a business or a different income property) over the life of the investment. The returns measure the profitability of the investment capital (Engle and Neira 2005).

The most fundamental types of financial records and analyses that all fish farmers should maintain include the following: enterprise budget, balance sheet, income statement. Cash flow budget which is used to measure the solvency and liquidity in the business. Each of these tools provides a different perspective on the farm business. The enterprise budget gives an estimate of the overall profitability of the enterprise (Engle and Neira 2005).

The balance sheet indicates the capital position and solvency of the business and whether net worth, or the wealth of the farm owner, is increasing overtime. The income statement shows annual profits or losses of the business, while the cash flow budget shows whether or not the farm will be able to make its payments when the payments are due (Engle and Neira 2005).

4 METHODOLOGIES

In the present study, the data used was collected from small-scale inland water aquaculture in Mozambique and other information was estimated on the basis of thorough literature review (Table 1 and Table 2).

Table 1: Data collection

All values in USD

Item		Mozambique	Literature review	My assumptions	Reference
Pond area	500 m^2	*			
Pond cost	355.56	*			
Month days	30	*			
Batch cycle length	8 months	*			
Stocking density	5 fingerling/m^2	*			
Initial weight of tilapia stocking	10-12 g			*	
Cost of each tilapia fingerling	0.26	*			
Survival rate at harvest	80-90%		*		Satya and Timothy 2004
Harvest weigth	414 g		*		Li, S, 1998
Tilapia selling price	3.6	*			
Cost of feed	0.24	*			
Limestone $CaCO_3$	1000-2000kg/ha, 1-2kg/10m^2		*		Satya and Timothy 2004
Quantity	315 kg	*			
cost	0.6	*			
Urea	6 g /m^2		*		Satya and Timothy 2004
Quantity	235 kg	*			
Cost	1.68	*			
Equity	1,419			*	
Loan	3,311			*	
Income taxes	12%			*	
Interest on Loan	9%	*			
Depreciation on equipment	10%			*	
Depreciation ponds	4%			*	
Depreciation of others	10%			*	
Years for equipment and pond loans	10%			*	

Table 2: A guide for supplementary feeding of tilapia

A guide for supplementary feeding of tilapia (Satya and Timothy 2004)			
Body Weight of fish (g)	Number of fish per kilogram	Feeding rate	No. Of feeds per day
1.-.5	1000 - 200	10 -6%	4. -. 6
5.-.25	200 - 40	5%	4
25 - 155	40 - 7	4 - 3%	4
150 - 250	7.- .4	3%	3 -. 4
250 - 450	4. - .2	2 - 3%	2 -. 3

4.1 Data analysis

Some of the data were collected from one of the small-scale fish farm companies in Mozambique and the rest from literature review.. This data was used to calculate revenue from the one pond tilapia production. Profitability analysis of the operation of one aquaculture pond over 10 years was carried out based on this data. For the present study one 500 m^2 pond was used as an example and the profitability was assessed based on stocking with five fingerlings m^{-2}. The cost involved in fertilisation with urea and limestone to promote the primary production was estimated. Eight months were considered as the batch cycle length and 90% was used as the survival rate. The market price for tilapia in Mozambique is 3.6 USD/kg (Table 3 and Table 4) and this price was used to calculate the value of the produced fish.

The price of buying one kg of fingerlings was estimated at about USD 1.32. The total cost of buying fingerlings per cycle was USD 1,100. The cost of urea- fertiliser per kg was USD 1.7 and $CaCO_3$ per kg was USD 0.6. The total cost of fertilisers during the cycle of eight months was USD 550. The harvesting cost reported was about USD 8 per person per day and five persons were hired for this purpose, (Table 4). The other data collected were grouped into investment (building, equipment and other costs) and operation (variable and fixed) costs (Table 5 and Table 6).

4.2 Production planning model

4.2.1 One pond model

A one pond production model was developed based on the data in Table 1 and some of the data from Table 5 and Table 6 such as harvesting cost and labour. Initially, 2,500 fingerlings were used to achieve stocking at a density of 5 fingerlings m^{-2}. The pond was supposed to be fertilised with 20 kg of urea and 75 kg of limestone ($CaCO_3$) monthly in order to promote the primary production in the pond. Mean body weights and percentages of mortality were determined as in Table 3.

In this study a survival rate was 90% for all a complete cycle was assumed. This was used to calculate the biomass in the pond by multiplying the total number of fish in the pond by the weight divided by 1000 g kg^{-1}. That biomass multiplied by the percentage of feeding per month was used to determine the quantity of food needed per month (Table 3).

Biomass (kg) =Number of fish × Mean body weight (g) × 10^{-3}
Length (Cm) =Infinitive length × [1- Exp (-K × Time)]
Mean body weight (g) =a × Length^{b}

Table 3: Production data of tilapia cultured stoked density at five fingerlings

infinitive length	34.7			cise of pond in m^2	500	Price/fingerlings	0.26	Price of food /kg	0.24	Number of feeding/day	3	
K	0.27			Density/m2	5	cost/kg of fingerlings	1.32	Fertiliser cost Urea/kg	1.7			
a	0.04			Initial Number	2500	Tocal cost of fing	1,100	Fertiliser cost CaCo3/kg	0.6			
b	2.7									urea	CaCO3	
Time (month)	**Length (cm)**	**Mean body weigth (gr)**	**% of mortality/month**	**Number of fish**	**Biomass (kg)**	**% of feeding/month**	**Kg of food**	**cost of feeding/kg/Cycle**	**Kg of fertilizer/month**	**cost of fertilizer/Cycle**	**CaCO3, Price/Kg**	**cost of fertilizer/Cycle**
0	0	0		2,500								
1	8	12		2,500	29	7%	6	1	20	34	75	45
2	14	54	10%	2,250	123	6%	22	5	20	34	75	45
3	19	118	4%	2,160	254	5%	38	9	20	34	75	45
4	23	188	3%	2,095	394	4%	47	11	20	34	75	45
5	26	256	1%	2,074	532	3%	48	11	20	34	75	45
6	28	318	1%	2,054	653	2%	39	9	20	34	75	45
7	29	371	1%	2,033	753	1.5%	34	8	20	34	75	45
8	31	**414**		**2,013**	**834**	1.5%	38	9				
							272	**65**	**140**	**235**	**525**	**315**

The net revenue from this pond was obtained by subtracting the cost of production during the cycle (purchase of fingerlings, fertilizer and food) by total sales. Thus it was possible to determine the net revenue of producing 1 kg of fish by subtracting the total costs from the gross revenue (Table 4).

Table 4: Costs, gross revenue and net profit contributions from one pond tilapia production.

Quantity of sales in kg	834
Price/kg (USD)	3.6
Gross revenue	**3,001**
Cost of fingerlings/Cycle	650
Cost of feeding/Cycle	65
Urea Cost of fertilizer/Cycle	235
CaCo3 Cost of fertilizer/Cycle	315
Harvesting cost	40
Labour	460
Total Costs/Cycle	**951**
Net Revenue/Cylce	**2,051**
Net Revenue/kg	2.46

5 PLANNING FARM OPERATION

5.1 Profitability model

The profitability model analysis based on excel calculations is defined as a simulation model of an initial investment and subsequent operations. It was developed by Pall Jensson, professor of engineering at the University of Iceland and has been used by several countries in Iceland as well as other countries. The model is based on given assumptions which are deterministic, however random variables reflecting uncertain factors can easily be added. Time unit is one year.

In the present case study, 10 years were used as the planning horizon for the business. The profitability model was developed based on the results of the 500 m^2 pond production model. The profitability model has the following components (see Appendix 1 to Appendix 7).

a) Assumptions: In the first component of the model most of the calculations are done such as cost of buying fingerlings, cost of fertilizers, calculation of biomass in the pond, mean body weight, number of fish at the end of production (Appendix 1). The 10 years production plan was presented here showing the stocking, harvesting and cleaning period, as well as net revenue, (Table 7 and Table 8).

b) Breakdown: In this component the investment and operation costs are detailed such as cost of equipment, infrastructure, buying fingerlings, food, salary and other costs (Table 5 and Table 6).

c) Summary: The summary component shows the inputs, i.e. the main assumptions. Here, a total financing 4,729 USD is needed for investment. This is assumed to be 30% by equity and 70% by a bank loan at a real interest rate of 9% (inflation is omitted).. The assumptions about creditors tax is also indicated (Appendix 1).

d) Investment: The investment component shows how loan payments will be covered. It also shows booked value and depreciation of buildings, equipment and other investments during the planning horizon of 10 years (Appendix 2).

e) Operations: The operations component shows the revenue or loss from the operation over 10 years. The sales price per kg and the annual quantity of sales in kg are used here to calculate the gross revenue (sales multiplied by price). Variable cost factors are subtracted from the revenue, fixed costs, depreciation, financial costs, taxes and dividend to calculate the net profit or loss (Appendix 3).

f) Cash flow: The cash flow component shows the movement of cash into (inflows) and out of (outflows) the business. The outflow of cash includes paid dividend, taxes, financial costs and repayment of loans. The inflow includes the cash that the company will receive from customers, lenders and investors, Appendix 4.

g) Balance sheet: The balance sheet component shows the financial status at the end of each year, what the assets are, what the liabilities are and the net worth. The "bottom line" of a balance sheet shows the total liabilities (company obligations) subtracted from the assets. This must always balance each other, that is assets have to be equal to summation of liabilities (Appendix 6).

h) Profitability: This component shows financial indicators (Appendix 7) that measure the profitability of the project. The most important are the net present value (NPV) and the internal rate of return (IRR). The NPV can be calculated by using the formula below where:
CF_t = Cash flow in year t and
i = Discounting factor

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

The IRR is a (discounting factor) that brings the NPV to zero. In other words, IRR is the highest interest rate that the project can support (see Appendix 7). The minimum attractive rate of return or MARR is the interest rate that represents the minimum profit that an investor wants to gain when an investment is done. IRR should be greater than MARR for an investment to be economically feasible (Appendix 1).

Sensitivity Analysis: The business impact analysis is an essential component of an organisation's business continuance; it includes an exploratory component to reveal any vulnerability and a planning component to develop strategies for minimising risk.

5.2 Investment costs

In the present case study the building costs were divided into pond construction, fencing and house constructing. The total value of buildings in the present case study, including contingency, was assumed to be about USD 2,200. Regarding equipment needed in the operation such as a pump, vehicle, containers, refrigerator, scales and others, the total value was calculated as 2,178 USD. The value for other investment costs assumed was about USD 154. The total investment in the farm was about USD 4,529 (Table 5).

Table 5: Investment costs

Investment Costs:									
Equipment		Quantity	**Total Cost**						
	Pump	1	800		**Buildings:**			**Total**	
	Nets	1	12			Pond	1	356	
Rent	Vehicle		360			Fence		160	
	Containers	5	60			House	1	1,600	
	Refrigerator	1	240				Sub total	2,116	
	PVC Pipes		24			Contingency	4%	85	
	Wheel Barrow	2	160			**Total**		**2,200**	USD
	Hoes	4	28						
	Cutlass	2	6		**Other Investment**				
	Scales	1	120			other costs		**Total Cost**	
	Test Kit PH	2	48			License		150.00	
	Termometer	2	180				Sb total	150.00	
	Shovels	2	56			Contngency	1%	1.50	
		Sub total	2,094			**Total**		**152**	USD
	Contngency	4%	84						
	Total		**2,178**	USD	**Total investment**	**4,529**			**USD**

5.3 Operating costs

Yearly operating costs are composed of variable and fixed costs. Variable costs are cost factors that are likely to change over the operation period. The variable cost factors in the present case include acquisition of fingerlings, feed, fertilizers and harvesting costs (Table 6). For example, the price of fertilizer and harvesting costs can easily fluctuate within a short period of time. The fixed costs considered include the payment of salary, because employees are permanent in the farm.

Table 6: Operating costs in one pond per cycle

Operation Costs:							
Variable cost		**Total Cost / kg**		**Fixed Cost**		**Total Cost/Year**	
Fingerlings		1.32		Employees	2	400	
Feeding		0.08		Security	1	60	
Fertilizers(urea)		0.28			Sub total	460	
CaCo3		0.38		Contingency	3%	14	
Harvesting cost	5	0.05		**Total**		**474**	USD
		2.11					
	Sub total						
Contingency	4%	0.08					
Total		**2.19**	USD/kg				

5.3.1 Expected returns

The returns on investment (gross revenue) is found by multiplying total sales by the price per kg/tonne/unit according to which unit is used minus all costs involved in the production. To get net profit or net revenue from the gross revenue all cost factors such as (taxes, variable and fixed costs, depreciation, cost of sales, etc.) are subtracted from the gross revenue.

The expected return is used to measure the health of a company or a business. The forecast of profit is the most important measurement used by possible investors to assess the viability of the enterprise. Profit also allows for business expansion. Profit is the first concern of an investor and businesses without proper profitability analysis may lead to disappointments if returns on the investment turn out to be low or negative. The net profit in the present case study was calculated in the operation sheet (Appendix 3).

6 RESULTS

6.1 The net and total cash flow

The results show that during the first year of the present case study, the net and total cash flow are negative. This is explained mostly by the initial investment. However, in the following years the net and total cash flow are both positive, but variable over the planning horizon (Figure 3).

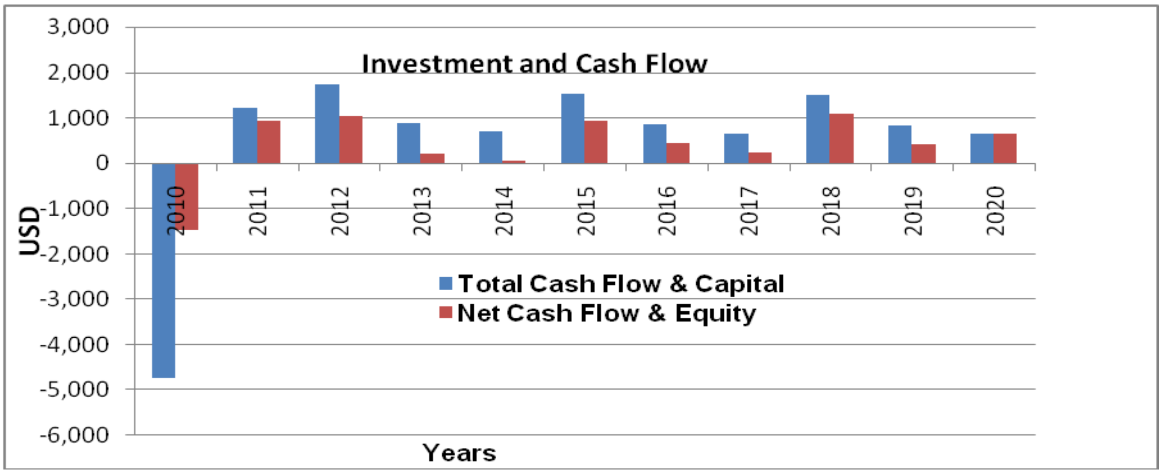

Figure 3: Net- and total cash flow of the company during 10 years of operation.

6.2 Accumulated net present value (NPV)

The NPV is the most common measure for evaluating the profitability of an investment or project. It indicates how much value an investment adds to the company. It is the difference between the sum of the discounted cash flow over the years, i.e. the net revenue expected from the investment and the amount which is initially invested.

The discounting rate or MARR used in this study is 15%. Using this rate, the NPV at the end of 10 years of business operation was found to be USD 891 for the total capital invested and USD 1,645 for the equity. As can be seen in Figure 4, the payback period in the present case study is eight years for the total capital invested and only three years for the equity. This means that it is to be expected that recovery of the initial investment will take eight years (Figure 4).

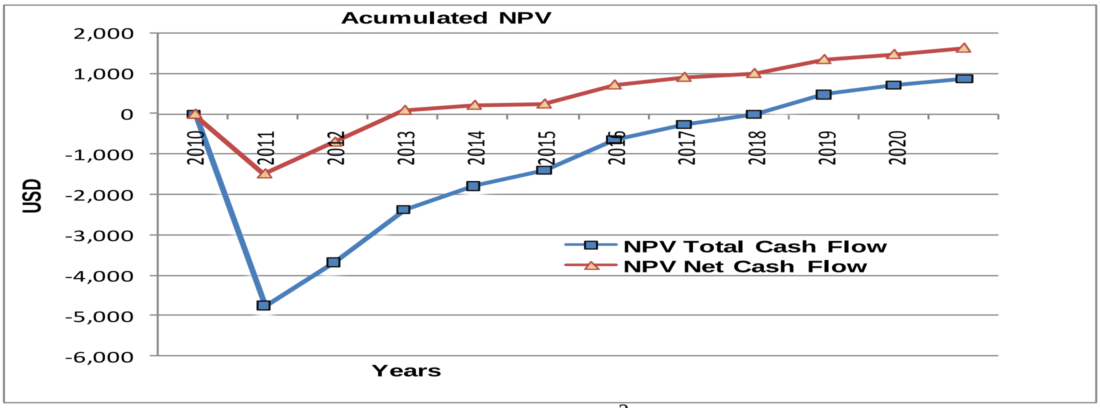

Figure 4: NPV and payback period of the 500 m^2 tilapia farm model.

6.3 Internal rate of return (IRR)

On Figure 5 we see that the IRR is 20% for the total capital and 46% for the equity. Already after five years of operations, the IRR of total cash flow is 10% and the IRR of equity is almost 40%.

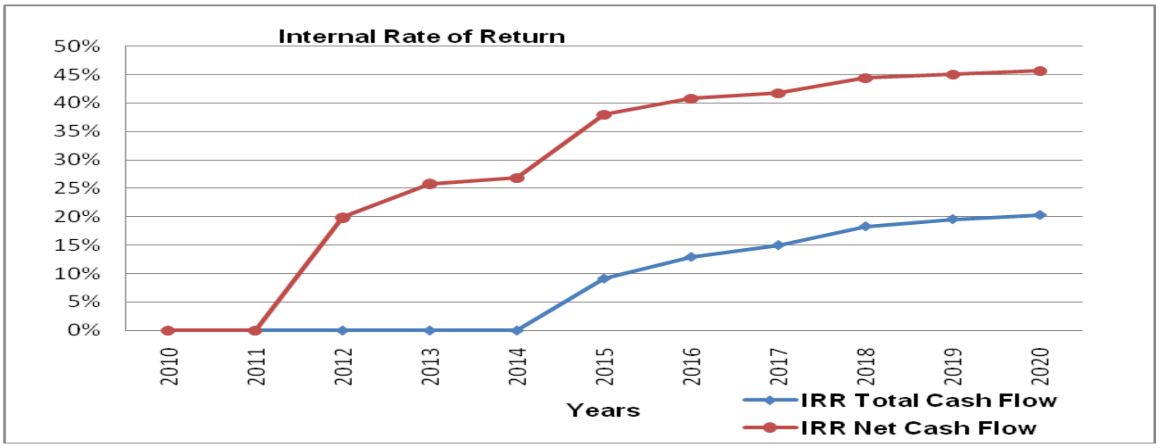

Figure 5: IRR of a tilapia farm.

6.4 Debt service coverage ratio

The debt service coverage ratio is a quantitative method used to determine if a project is able to pay its financing by means of cash flows generated. It is the relationship between the cash flow generated by the project divided by debt service (interest + amortisation of principal). The debt service coverage ratio in the present case shows that the project can pay its financing cost (Figure 6).

6.5 The net current ratio

The net current ratio shows the ability of current assets to pay the current liabilities. Figure 6 illustrates that the assets are enough to pay the liabilities in the present case study. In general a current ratio of 1.5 to 2 is adequate.

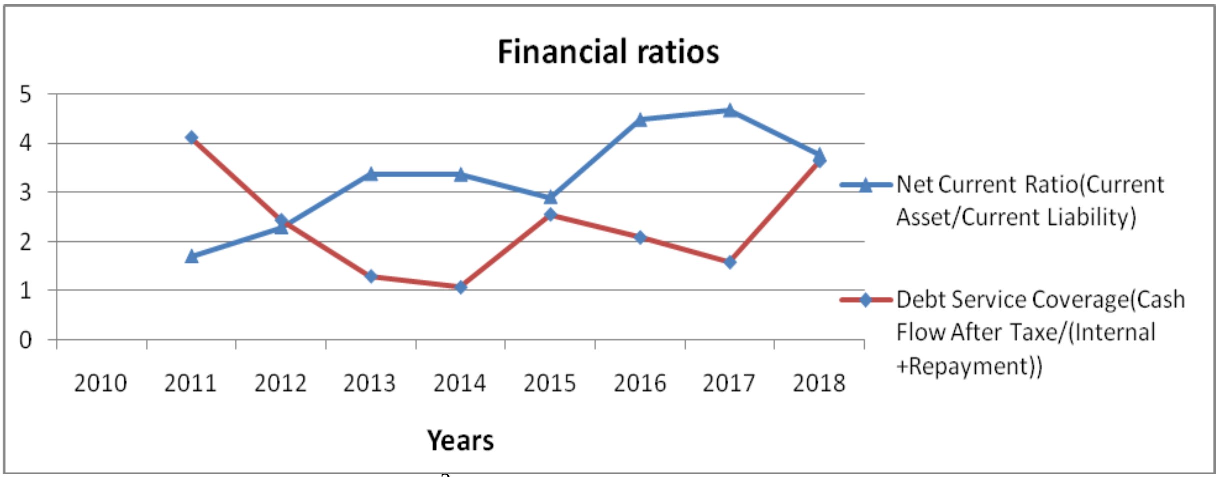

Figure 6: Financial ratios of 500m^2 tilapia production model.

6.6 Sensitivity analysis

An impact analysis was used in the present case study to analyse the risk of developing aquaculture as a business in Mozambique. The impact analysis on IRR of equity is shown in Figure 7. It appears that the profitability of the tilapia production is most sensitive to variations in the sales price. When the value of the sales price falls by 15% or more, a negative IRR of cash flow is observed.

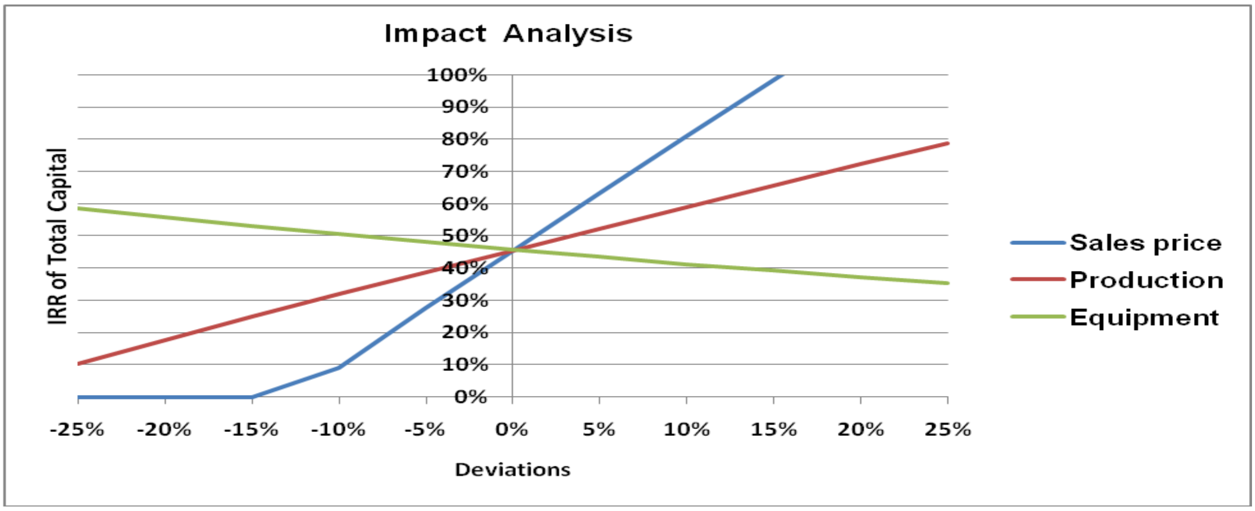

Figure 7: Impact analysis of sales price, production and cost of equipment of the tilapia production model.

7 DISCUSSION

Mozambique is facing the problem of hunger, unemployment and absolute poverty. The catches are far from covering the needs of the population in terms of fish consumption. As a way to solve these problems, the government defined a long-term development goal to increase the production of aquatic products progressively and at the same time to reduce poverty, hunger and unemployment by using aquaculture because the area suitable for inland aquaculture is currently underexploited.

The goal of this study was to analyse whether tilapia pond farming in Mozambique is profitable or not and assess the risks involved, mainly because similar studies have never been demonstrated to the farmers.

The study showed that if one 500 m^2 pond is used to culture tilapia, then it can produce 834 kg of fish in one cycle of eight months (Table 4), and if two cycles are considered per year this number doubles to 1,668 kg $year^{-1}$. The newsletter published by the Aquaculture Association of Southern Africa (2009) reported productivity of 20 kg of fish per year for an average small-scale fish farmer in Mozambique. There are a few points that need to be considered based on our findings:

a) The very positive results found in the present case study may be related to an overestimation of the data used such as the mortality rate during the production cycle.
b) The low productivity reported by the Aquaculture Association of Southern Africa (2009), may be due to impractical management of the farms.
c) The results obtained in this case on one pond production should not be compared with the average or the lowest production per pond usually reported, but should rather be compared with farms where the same pond size was used and with appropriate management.

The total investment was estimated to be around USD 4,529 plus a working capital requirement of about USD 200. This means that the farmer will need approximately USD 5,000 to start the business. Due to the weak financial capacity of the people likely to want develop aquaculture, bank loans will be needed.

The impact analysis showed that the profitability of the tilapia production is most sensitive to variations in the sales price. When the value of the sales price falls by 15% or more, a negative IRR of cash flow is observed. Thus an investment like this is subject to some risk related to market conditions.

8 CONCLUSION

The results found from the profitability model in this study showed positive net revenue, NPV and IRR. The impact analysis showed that, aquaculture investment is rather sensitive to market conditions.

According to these results and based on the main assumption of one 500 m^2 pond, small-scale tilapia farm in Mozambique can be very profitable since one pond of this size can produce at least 834 kg per year (Table 4) and even more with two harvests some years. It is clear that if the production is indeed as low as reported by the Aquaculture Association of South Africa (2009), then the findings of the present study are in remarkable contrast with this. The current study includes some uncertain assumptions and , these results should be tested in at least one farm based on realistic data to obtain more reliable results.

Several points and recommendations can be drawn from our study:

- Better data records have to be collected from farms in order to allow better analysis.
- The farmers should use larger ponds. The most common pond size currently used 150 or 300m^2 may need to be almost 634 m^2 as reported by Kaliba *et al*. (2007).
- Careful consideration of constraints such as availability of quality fingerlings and feed manufacturing is necessary during planning and maintained throughout operation.

According to this study, it is a challenge of great importance in the short term for the Mozambique government, and especially for the National Institute of Aquaculture Development, to provide conditions conductive to the implementation of one point tilapia farming. This would give more precise results, and thus verify the results presented here. The next step would be to design strategies for the development of the sector as well as introducing the results to influence the lending institutions to become more interested in investing in aquaculture.

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APPENDICES

Table 1: Data collection

All values in USD

Item		Mozambique	Literature review	My assumptions	Reference
Pond area	500 m^2	*			
Pond cost	355.56	*			
Month days	30	*			
Batch cycle length	8 months	*			
Stocking density	5 fingerling/m^2	*			
Initial weight of tilapia stocking	10-12 g			*	
Cost of each tilapia fingerling	0.26	*			
Survival rate at harvest	80-90%		*		Satya and Timothy 2004
Harvest weigth	414 g		*		Li, S, 1998
Tilapia selling price	3.6	*			
Cost of feed	0.24	*			
Limestone $CaCO_3$	1000-2000kg/ha, 1-2kg/10m^2		*		Satya and Timothy 2004
Quantity	315 kg	*			
cost	0.6	*			
Urea	6 g /m^2		*		Satya and Timothy 2004
Quantity	235 kg	*			
Cost	1.68	*			
Equity	1,419			*	
Loan	3,311			*	
Income taxes	12%			*	
Interest on Loan	9%	*			
Depreciation on equipment	10%			*	
Depreciation ponds	4%			*	
Depreciation of others	10%			*	
Years for equipment and pond loans	10%			*	

Table 2: A guide for supplementary feeding of tilapia

A guide for supplementary feeding of tilapia (Satya and Timothy 2004)			
Body Weight of fish (g)	Number of fish per kilogram	Feeding rate	No. Of feeds per day
1.-.5	1000 - 200	10 -6%	4. -. 6
5.-.25	200 - 40	5%	4
25 - 155	40 - 7	4 - 3%	4
150 - 250	7.- .4	3%	3 -. 4
250 - 450	4. - .2	2 - 3%	2 -. 3

Table 3: Production data of tilapia cultured stoked density at five fingerlings

infinitive length	34.7			cise of pond in m^2	500	Price/fingerlings	0.26	Price of food /kg	0.24	Number of feeding/day	3	
K	0.27			Density/m2	5	cost/kg of fingerlings	1.32	Fertiliser cost Urea/kg	1.7			
a	0.04			Initial Number	2500	Tocal cost of fing	1,100	Fertiliser cost CaCo3/kg	0.6			
b	2.7									urea	CaCO3	
Time (month)	**Length (cm)**	**Mean body weigth (gr)**	**% of mortality/month**	**Number of fish**	**Biomass (kg)**	**% of feeding/month**	**Kg of food**	**cost of feeding/kg/Cycle**	**Kg of fertilizer/ month**	**cost of fertilizer/Cycle**	**CaCO3, Price/Kg**	**cost of fertilizer/Cycle**
0	0	0		2,500								
1	8	12		2,500	29	7%	6	1	20	34	75	45
2	14	54	10%	2,250	123	6%	22	5	20	34	75	45
3	19	118	4%	2,160	254	5%	38	9	20	34	75	45
4	23	188	3%	2,095	394	4%	47	11	20	34	75	45
5	26	256	1%	2,074	532	3%	48	11	20	34	75	45
6	28	318	1%	2,054	653	2%	39	9	20	34	75	45
7	29	371	1%	2,033	753	1.5%	34	8	20	34	75	45
8	31	**414**		**2,013**	**834**	1.5%	38	9				
							272	**65**	**140**	**235**	**525**	**315**

Table 4: Costs, gross revenue and net profit contributions from one pond tilapia production

Quantity of sales in kg	834
Price/kg (USD)	3.6
Gross revenue	**3,001**
Cost of fingerlings/Cycle	650
Cost of feeding/Cycle	65
Urea Cost of fertilizer/Cycle	235
CaCo3 Cost of fertilizer/Cycle	315
Harvesting cost	40
Labour	460
Total Costs/Cycle	**951**
Net Revenue/Cylce	**2,051**
Net Revenue/kg	2.46

Table 5: Investment costs

Investment Costs:									
Equipment		Quantity	**Total Cost**						
	Pump	1	800		**Buildings:**			**Total**	
	Nets	1	12			Pond	1	356	
Rent	Vehicle		360			Fence		160	
	Containers	5	60			House	1	1,600	
	Refrigerator	1	240				Sub total	2,116	
	PVC Pipes		24			Continge	4%	85	
	Wheel Barro	2	160			**Total**		**2,200**	USD
	Hoes	4	28						
	Cutlass	2	6		**Other Investment**				
	Scales	1	120			other costs		**Total Cost**	
	Test Kit PH	2	48			License		150.00	
	Termometer	2	180				Sb total	150.00	
	Shovels	2	56			Contnger	1%	1.50	
		Sub total	2,094			**Total**		**152**	USD
	Contngency	4%	84						
	Total		**2,178**	USD	**Total investm**	**4,529**			**USD**

Table 6: Operating costs in one pond per cycle

Operation Costs:							
Variable cost		**Total Cost / kg**		**Fixed Cost**		**Total Cost/Year**	
Fingerlings		1.32		Employees	2	400	
Feeding		0.08		Security	1	60	
Fertilizers(urea)		0.28			Sub total	460	
CaCo3		0.38		Contingency	3%	14	
Harvesting cost	5	0.05		**Total**		**474**	USD
		2.11					
	Sub total						
Contingency	4%	0.08					
Total		**2.19**	USD/kg				

Table 7: 10 years harvesting plan

														2500	Final kg of fish/Cycle	834
	1	2	3	4	5	6	7	8	9	10	11	12	N. of fingerlings	0.26		
Years	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**Agost**	**September**	**Octuber**	**November**	**December**	Price/fingering	**Cost of fingerlings/Year**	**Total Kg of fish/Year**	
2010								**Stocking**						0		
2011			Harvesting		Stocking							Harvesting	2	**1,300**	1,667	
2012		Stocking							Harvesting		Stocking		**2**	**1,300**	**1,667**	
2013						Harvesting		Stocking					1	650	834	
2014			Harvesting		Stocking							Harvesting	1	650	834	
2015		Stocking							Harvesting		Stocking		**2**	**1,300**	**1,667**	
2016						Harvesting		Stocking					1	650	834	
2017			Harvesting		Stocking							Harvesting	1	650	834	
2018		Stocking							Harvesting		Stocking		**2**	**1,300**	**1,667**	
2019						Harvesting		Stocking					1	650	834	
2020			Harvesting		Stocking							Harvesting	1	650	834	

Table 8: Net revenue for 10 years of operation

Production t	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
cost fo fingerlings		**1,300**	1,300	650	**650**	1,300	650	**650**	1,300	650	650
cost of feeding		131	131	65	65	131	65	65	131	65	65
cost of fertilysers Urea		470.4	470.4	235.2	235.2	470.4	235	235.2	470.4	235.2	235.2
cost of fertilysers CaCO3		630	630	315	315	630	315	315	630	315	315
Total Variable costs		***1,901***	***1,901***	***951***	***951***	***1,901***	***951***	***951***	***1,901***	***951***	***951***
Quantity of Kg of fishes		1,667	1,667	834	834	1,667	834	834	1,667	834	834
Price/ Kg of fish		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Revenue		***6,003***	***6,003***	***3,001***	***3,001***	***6,003***	***3,001***	***3,001***	***6,003***	***3,001***	***3,001***
Net revenue		***4,102***	***4,102***	***2,051***	***2,051***	***4,102***	***2,051***	***2,051***	***4,102***	***2,051***	***2,051***

Appendix 1: Profitability model: Assumptions and Results

Assumptions and Results

All amounts are in fixed terms

		2010	
Investment:		USD	
Buildings		2,200	
Equipment	100%	2,178	
Other		152	
Total		**4,529**	
Financing:			
Working Capital		200	
Total Financing		**4,729**	
Equity		30%	
Loan Repayments		8	years
Real Interest Rate of Loans		9%	

Discounting Rate	**15%**	(MARR)	
Planning Horizon	**10**	**years**	
	Total Cap.	**Equity**	
NPV of Cash Flow	**891**	**1,645**	
Internal Rate	**20%**	**46%**	
Capital/Equity after 10 years	**4.6**		

Operations:		**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	
Sales Quantity	100%		1,667	1,667	834	834	1,667	834	834	1,667	834	834	Kg/year
Sales Price	100%		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	USD/Kg
Variable Cost		2.19	USD/kg										
Fixed Cost		474	USD/year										
Inventory Build-up													
Debtors	20%	of turnover											
Creditors	15%	of variable cost											
Dividend	20%	of profit											
Depreciation Buildings	4%												
Depreciation Equipm.	10%												
Depreciation Other	10%												
Loan Managem. Fees	2%												
Income Tax	12%												

Breakdown of cost		
Variable Cost	25,560	38.7%
Fixed Cost	4,738	7.2%
Paid Taxes	821	1.2%
Financial Cost	1,333	2.0%
Loan Repayment	3,311	5.0%
Paid Dividend	1,218	1.8%
Cash Account	29,107	44.0%
Total	**66,088**	**100.0%**

Appendix 2: Profitability model: Investment and finance

Investment and Financing		Investment 2010	2011 1	2012 2	2013 3	2014 4	2015 5	2016 6	2017 7	2018 8	2019 9	2020 10	Total
Investment:													
Buildings		2,200	2,112	2,024	1,936	1,848	1,760	1,672	1,584	1,496	1,408	1,320	
Equipment		2,178	1,960	1,742	1,524	1,307	1,089	871	653	436	218	0	
Other		152	136	121	106	91	76	61	61	61	61	61	
Booked Value		**4,529**	**4,209**	**3,888**	**3,567**	**3,246**	**2,925**	**2,604**	**2,298**	**1,992**	**1,686**	**1,381**	
Depreciation:													
Depreciation Buildings	4%		88	88	88	88	88	88	88	88	88	88	880
Depreciation Equipm.	10%		218	218	218	218	218	218	218	218	218	218	2,178
Depreciation Other	10%		15	15	15	15	15	15	0	0	0	0	91
Total Depreciation			**321**	**321**	**321**	**321**	**321**	**321**	**306**	**306**	**306**	**306**	**3,149**
Financing:		**4,729**											
Equity	30%	1,419											
Loans	70%	3,311											
Repayment	8	0	0	414	414	414	414	414	414	414	414	0	3,311
Principal (=Loans)		3,311	3,311	2,897	2,483	2,069	1,655	1,241	828	414	0	0	18,208
Interest	9.0%		298	298	261	223	186	149	112	74	37	0	1,639
Loan Managem. Fees	2%	66											

Appendix 3: Profitability model: Operation statement

		Operations											
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Operations Statement			1	2	3	4	5	6	7	8	9	10	
Sales (kg/year)			1,667	1,667	834	834	1,667	834	834	1,667	834	834	11,672
Price (USD/Kg)			3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	36
Revenue			**6,003**	**6,003**	**3,001**	**3,001**	**6,003**	**3,001**	**3,001**	**6,003**	**3,001**	**3,001**	**420,206**
Variable Cost (USD/Kg)	2.19		3,651	3,651	1,826	1,826	3,651	1,826	1,826	3,651	1,826	1,826	25,560
Net Profit Contribution			**2,351**	**2,351**	**1,176**	**1,176**	**2,351**	**1,176**	**1,176**	**2,351**	**1,176**	**1,176**	**394,646**
Fixed Cost	474		474	474	474	474	474	474	474	474	474	474	4,738
Diverse Taxes													
Operating Surplus (EBITDA)			**1,878**	**1,878**	**702**	**702**	**1,878**	**702**	**702**	**1,878**	**702**	**702**	**389,908**
Inventory Movement													
Depreciation			321	321	321	321	321	321	306	306	306	306	3,149
Operating Gain/Loss (EBIT)(creditors)		0	**1,557**	**1,557**	**381**	**381**	**1,557**	**381**	**396**	**1,572**	**396**	**396**	**386,759**
Financial Costs (Interest+LMF)		66	298	298	261	223	186	0	0	0	0	0	1,333
Profit before Tax		**-66**	**1,259**	**1,259**	**120**	**158**	**1,371**	**381**	**396**	**1,572**	**396**	**396**	**385,427**
Loss Transfer	0	-66	0	0	0	0	0	0	0	0	0	0	66
Taxable Profit		0	1,193	1,259	120	158	1,371	381	396	1,572	396	396	7,241
Income Tax (taxe payable)	12%	0	143	151	14	19	164	46	48	189	48	48	869
Profit after Tax		**-66**	**1,116**	**1,108**	**106**	**139**	**1,206**	**335**	**349**	**1,383**	**349**	**349**	**384,558**
Dividend	**20%**	0	223	222	21	28	241	67	70	277	70	70	1,288
Net Profit/Loss		**-66**	**893**	**886**	**85**	**111**	**965**	**268**	**279**	**1,107**	**279**	**279**	**383,270**

Appendix 4: Profitability model: Cash flow

Cash Flow	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Cash Flow		1	2	3	4	5	6	7	8	9	10	
Operating Surplus (EBITDA)	0	1,878	1,878	702	702	1,878	702	702	1,878	702	702	11,722
Debtor's Changes		1,201	0	-600	0	600	-600	0	600	-600	0	600
Creditor Changes		548	0	-274	0	274	-274	0	274	-274	0	274
Inventory Build up												
Cash Flow before Tax	**0**	**1,225**	**1,878**	**1,028**	**702**	**1,551**	**1,028**	**702**	**1,551**	**1,028**	**702**	**11,396**
Paid Taxes	0	0	143	151	14	19	164	46	48	189	48	821
Cash Flow after Tax	**0**	**1,225**	**1,735**	**877**	**687**	**1,532**	**864**	**656**	**1,504**	**840**	**654**	**10,574**
Financial Costs	66	298	298	261	223	186	0	0	0	0	0	1,333
Repayment	0	0	414	414	414	414	414	414	414	414	0	3,311
Net (Free) Cash Flow	**-66**	**927**	**1,023**	**203**	**50**	**932**	**450**	**242**	**1,090**	**426**	**654**	**5,931**
Paid Dividend	0	0	223	222	21	28	241	67	70	277	70	**1,218**
Financing - Expenditure (Working Capital)	200											
Cash Movement	**134**	**927**	**800**	**-19**	**29**	**905**	**209**	**175**	**1,020**	**149**	**585**	**4,713**

Appendix 5: Profitability model: Source and allocation of founds

Source and Allocation of Funds

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Source of Funds												
Profit before Tax	-66	1,259	1,259	120	158	1,371	381	396	1,572	396	396	7,241
Depreciation	0	321	321	321	321	321	321	306	306	306	306	3,149
Funds from Operations	**-66**	**1,580**	**1,580**	**441**	**478**	**1,691**	**702**	**702**	**1,878**	**702**	**702**	**10,390**
Loan Drawdown	3,311											3,311
Equity Drawdown	1,419											1,419
Funds for allocation	**4,663**	**1,580**	**1,580**	**441**	**478**	**1,691**	**702**	**702**	**1,878**	**702**	**702**	**15,119**
Allocation of Funds												
Investment	4,529											4,529
Repayment	0	0	414	414	414	414	414	414	414	414	0	3,311
Paid Taxes	0	0	143	151	14	19	164	46	48	189	48	821
Paid Dividend	0	0	223	222	21	28	241	67	70	277	70	1,218
Total allocation	**4,529**	**0**	**780**	**786**	**449**	**460**	**819**	**527**	**531**	**879**	**117**	**9,879**
Changes Net Curr. Assets	**134**	**1,580**	**800**	**-345**	**29**	**1,231**	**-118**	**175**	**1,347**	**-177**	**585**	**5,240**
Analysis of Changes												
Current Assets												
Cash at start of year	0	134	1,061	1,860	1,842	1,871	2,775	2,984	3,159	4,179	4,329	24,193
Cash at end of year	134	1,061	1,860	1,842	1,871	2,775	2,984	3,159	4,179	4,329	4,913	29,107
Changes in Cash	**134**	**927**	**800**	**-19**	**29**	**905**	**209**	**175**	**1,020**	**149**	**585**	**4,913**
Debtor changes	0	1,201	0	-600	0	600	-600	0	600	-600	0	600
Inventory Movements	0	0	0	0	0	0	0	0	0	0	0	0
Changes in Current Assets	**134**	**2,127**	**800**	**-619**	**29**	**1,505**	**-391**	**175**	**1,620**	**-451**	**585**	**5,514**
Liabilities												
Creditor changes	0	548	0	-274	0	274	-274	0	274	-274	0	**274**
Changes Net Curr. Assets	134	1,580	800	-345	29	1,231	-118	175	1,347	-177	585	**5,240**

Appendix 6: Profitability model: balance sheet

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Balance Sheet			1	2	3	4	5	6	7	8	9	10	
Assets													
Cash Account	0	134	1,061	1,860	1,842	1,871	2,775	2,984	3,159	4,179	4,329	4,913	29,107
Debtors (Acc Receivables)	20%	0	1,201	1,201	600	600	1,201	600	600	1,201	600	600	8,404
Inventory	0	0	0	0	0	0	0	0	0	0	0	0	0
Current Assets		**134**	**2,261**	**3,061**	**2,442**	**2,471**	**3,976**	**3,584**	**3,760**	**5,380**	**4,929**	**5,514**	**37,511**
Fixed Assets (Booked Values)		4,529	4,209	3,888	3,567	3,246	2,925	2,604	2,298	1,992	1,686	1,381	32,324
Total Assets		**4,663**	**6,470**	**6,948**	**6,008**	**5,717**	**6,900**	**6,188**	**6,058**	**7,372**	**6,616**	**6,894**	**69,835**
Debts													
Dividend Payable		0	223	222	21	28	241	67	70	277	70	70	1,288
Taxes Payable		0	143	151	14	19	164	46	48	189	48	48	869
Creditors (Acc Payables)	15%	0	548	548	274	274	548	274	274	548	274	274	3,834
Next Year Repayment		0	414	414	414	414	414	414	414	414	0	0	3,311
Current Liabilities(Short Term Debdt)		**0**	**1,328**	**1,334**	**723**	**734**	**1,367**	**800**	**805**	**1,427**	**391**	**391**	9,301
Long Term Loans		3,311	2,897	2,483	2,069	1,655	1,241	828	414	0	0	0	14,898
Total Debt		**3,311**	**4,225**	**3,817**	**2,792**	**2,390**	**2,609**	**1,628**	**1,219**	**1,427**	**391**	**391**	**24,199**
Equity	0	1,419	1,419	1,419	1,419	1,419	1,419	1,419	1,419	1,419	1,419	1,419	15,607
Profit & Loss Balance	0	-66	826	1,713	1,797	1,908	2,873	3,141	3,420	4,527	4,806	5,084	30,029
Total Capital		**1,353**	**2,245**	**3,131**	**3,216**	**3,327**	**4,292**	**4,560**	**4,839**	**5,945**	**6,224**	**6,503**	**45,636**
Debts and Capital		**4,663**	**6,470**	**6,948**	**6,008**	**5,717**	**6,900**	**6,188**	**6,058**	**7,372**	**6,616**	**6,894**	**69,835**

Appendix 7: Profitability model: Profitability measurements

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Profitability Measurements													
NPV and IRR of Total Cash Flow													
Cash Flow after Taxes		0	1,225	1,735	877	687	1,532	864	656	1,504	840	654	10,574
Loans		-3,311											-3,311
Equity		-1,419											-1,419
Total Cash Flow & Capital		**-4,729**	**1,225**	**1,735**	**877**	**687**	**1,532**	**864**	**656**	**1,504**	**840**	**654**	**5,845**
NPV Total Cash Flow	0	-4,729	-3,664	-2,353	-1,776	-1,383	-621	-248	-1	491	729	891	2,148
IRR Total Cash Flow		**0%**	**0%**	**0%**	**0%**	**0%**	**9%**	**13%**	**15%**	**18%**	**20%**	**20%**	
NPV and IRR of Net Cash Flow													
Net (free) Cash Flow		-66	927	1023	203	50	932	450	242	1090	426	654	**5,931**
Equity		-1419											**-1,419**
Net Cash Flow & Equity		**-1,485**	**927**	**1,023**	**203**	**50**	**932**	**450**	**242**	**1,090**	**426**	**654**	**4,513**
NPV Net Cash Flow	0	-1,485	-679	94	228	256	720	914	1,006	1,362	1,483	1,645	
IRR Net Cash Flow		**0%**	**0%**	**20%**	**26%**	**27%**	**38%**	**41%**	**42%**	**44%**	**45%**	**46%**	
Financial Ratios													
ROI (Profit+Interest/Debt+Capital)			33%	24%	5%	6%	27%	6%	6%	26%	5%	6%	
ROE (Profit/Shareh. Capital)			82%	49%	3%	4%	36%	8%	8%	29%	6%	6%	
Turnov Ratio(Revenue/Debit+Capital)			19%	14%	1%	2%	17%	4%	5%	18%	4%	4%	
Capital Ratio(Capital/Debt+Capital)			35%	45%	54%	58%	62%	74%	80%	81%	94%	94%	
Net Current Ratio(Current Asset/Current Liability)			1.7	2.3	3.4	3.4	2.9	4.5	4.7	3.8	12.6	14.1	
Liquid Current Ratio(Curr Assets-Inventory)/Curr Liability			1.7	2.3	3.4	3.4	2.9	4.5	4.7	3.8	12.6	14.1	
Internal Value of Shares(Total Capital/Equity)			1.6	2.2	2.3	2.3	3.0	3.2	3.4	4.2	4.4	4.6	
Debt Service Coverage(Cash Flow After Taxe/(Internal +Repayment))			4.1	2.4	1.3	1.1	2.6	2.1	1.6	3.6	2.0		

Figure 8: Aquaculture production by region grouping in 2004