FROG FARMS AS PROPOSED IN AGRIBUSINESS AQUACULTURE: ECONOMIC VIABILITY BASED IN FEED CONVERSION

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ABSTRACT

Frog farming is an aquaculture activity that is represented little in the socioeconomic profile of Brazil, resulting in little technological investment and development in the food industry. However, the growing interest in the consumption of white and healthy meats, it has been projected as an alternative source of protein. The objective of this work was to estimate the economic viability of a commercial frog pond in the Southeast region of Brazil. The results demonstrated the high set up and operating costs, where the feed and handling were considered the two aspects that define the cost of the product. The viability of the enterprise is attained only with good zootechnical rates (feed conversion ≤ 1.5:1 in the fattening phase and ≤ 2:1 in the tadpole phase) and high selling price (US$ 21.50 to 24.00 kg^{-1} – minimal prices). The internal rate of return observed under the most viable conditions was 41.69% and payback of 2.33 years, rates commonly used in aquaculture. Therefore, the commercial breeding of frogs is attractive if practiced with good feed conversion rates and favorable prices for market positioning in the sale of the meat as a gourmet product.

Keywords: Production cost; investment; frog farming; *Lithobates catesbeianus*

A CRIAÇÃO DE RÃS COMO PROPOSTA DE AGRONEGÓCIO NA AQUICULTURA: VIABILIDADE ECONÔMICA BASEADA EM CONVERSÃO ALIMENTAR

RESUMO

A ranicultura é uma atividade aquícola pouco representativa no perfil socioeconômico do país, acarretando em pouco investimento tecnológico e de desenvolvimento nas indústrias de insumos. Entretanto, o crescente interesse do consumo por carnes brancas e saudáveis, projeta esta atividade como uma fonte alternativa de proteína. O objetivo desta pesquisa foi estimar a viabilidade econômica de um ranário comercial na região Sudeste do Brasil. Os resultados apontaram altos custos operacionais, onde o alimento e manejo foram considerados os dois aspectos que definem o custo do produto. Por outro lado, esse estudo demonstrou a viabilidade do empreendimento, desde que se atinjam bons índices zootécnicos e elevado preço de venda (R$ 40,85 a 45,60 kg^{-1}). A Taxa Interna de Retorno observada na condição mais viável foi de 41,69% e "payback" de 2,33 anos. Portanto a criação comercial de rãs torna-se atrativa quando praticada com índices de conversão alimentar favoráveis (≤ 1,5:1 na fase de engorda e ≤ 2:1 na fase de girino) e o posicionamento da comercialização da carne como produto "gourmet" de alto valor agregado.

Palavras chave: Custo de produção; investimento; ranicultura; *Lithobates catesbeianus*

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INTRODUCTION

Since the 1980s, because of the growing interest in healthy eating, the consumption of meats considered white increased substantially. Aquaculture responded to this tendency, and the representatives of consumption in this sector reached in 2008 a world production of 73 million tons, with a profit of approximately US$ 105 B, led by China with 49.1% (LOPERA-BARREIRO *et al.,* 2010).

Brazilian aquaculture production grew more than the world mean since 1995. Even with negative growth on the order of -1.4% between years 2003 and 2004, this activity had a mean increase of 25%, while the world figure was about 10% in the period of 2003 to 2009 (OSTRENKY *et al.,* 2008). In this scenario, the breeding of frogs (frog farming) was projected as an alternative source of protein. World production of frog meat during the period of 1999-2008 was about 44,000 tons annually, with production as high as 85,000 tons in 2008. Brazil in the same period produced only 600 tons annually, showing that productivity in the country stagnated for at least ten years (FAO, 2010).

The species most utilized for Frog culture is *Rana catesbeiana*, reclassified as *Lithobates catesbeianus* (FROST *et al.,* 2006), native of North America (south of Quebec, Canada and eastern United States), which is popularly known as the American bullfrog. This species was introduced in many regions of Latin America and Europe for the purpose of being commercially bred (CARRARO, 2008).

Frog breeding is a relatively recent alternative for an agro industrial enterprise in Brazil, initiated in 1970. One of its main advantages is the need for little space in relation to other production activities such as cattle ranching, and others that do not involve an intensive production system. Frog farming has a series of biological and technical specificities in relation to raising other livestock. The adequacy of the installations, temperature, feeding and handling of the frogs is essential for making production technically viable and guaranteeing its profitability (FERREIRA *et al.,* 2002; FEIX *et al.,* 2006; DIAS *et al.,* 2010). Commercial frog ponds, for the majority, are constituted by various sectors including: reproduction, embryonic development, tadpole growth, metamorphosis and fattening. The fattening sector represents about 70% of the installations in a frog pond, where the tanks can be constructed of masonry with a nylon screen covering (FERREIRA *et al.,* 2002).

Over the years, Brazilian frog farming went through various phases, with oscillation in the number of producers and alternating periods of breeding technologies. Even with a mean productivity of 100 animals per square meter, the activity was still subjected to a series of sociocultural, economic and infrastructure limitations, for its development. In Brazil, frog meat is ordered at gourmet restaurants, but at popular places as well. This constant market demand along with low availability increases the final price of the product, often making the business unviable (FERREIRA *et al.,* 2002; FEIX *et al.,* 2006).

The objective of this work was to estimate the economic viability of a commercial frog farm in the Southeast region of Brazil, based on the set up and operating costs.

MATERIAL AND METHODS

Utilized data in reference to a frog pond situated in the region of the "Cinturão Verde" (Green Cincture) of the state of São Paulo (23°31'S 47°01'W).

Its installations comprised a total area of 10,000 m², including 3,100 m² of constructed area. This area was composed of two agricultural greenhouses; 1 greenhouse of 1,625 m² with 16 pre-fattening tanks (13 m² each) and 41 tanks for fattening (19 m² each); 1 greenhouse of 1,254 m² with 32 tanks for embryonic development (0.36 m³ each), 34 tanks for tadpole growth (1.18 m³ each, and capacity for 4,000 animals), 12 tanks for tadpoles in metamorphosis (8.82 m³ each, and capacity of 10,000 animals); 1 deposit of feed of 24 m², 1 sector for reproduction of 68 m² with 8 tanks for egg-laying (Figure 1).

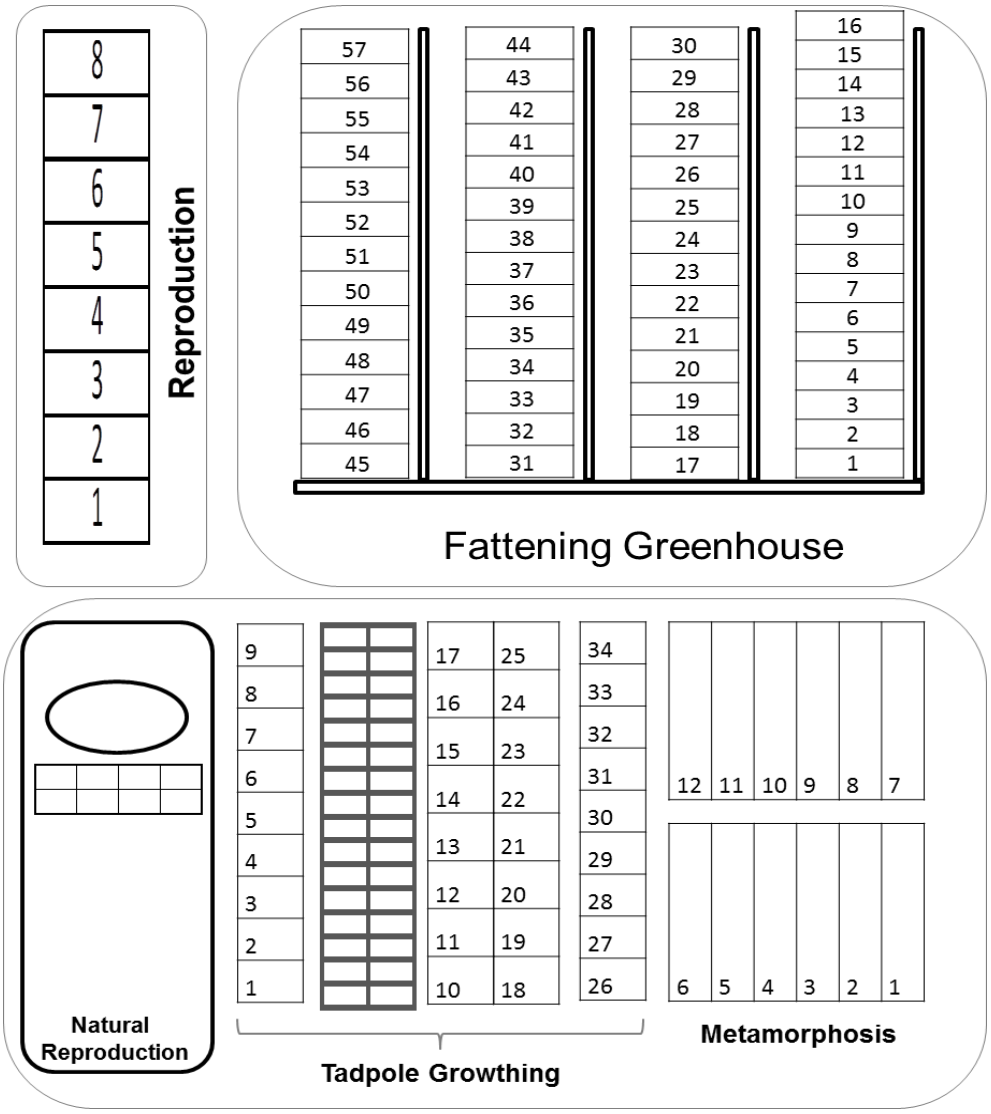

Figure 1. Floor plan illustrating the installations of the greenhouses (tadpole greenhouse and fattening greenhouse) of the commercial frog pond proposed in the study.

In preparing executive project considered as basic data obtained from a commercial frog farm, aiming to guide producers in relation to the investment required to start and operate the economic activity of frog culture in Brazilian conditions. Therefore, it was expected hiring zootechnist with a monthly salary of US$ 1,388.90 and five auxiliary production with remuneration of US$ 388.90 monthly.

Zootechnical Aspects

Assumed as premises the zootechnical rates obtained in the commercial frog pond, which showed a production of 1.5 cycles per year (egg phase up to slaughter weight). Each cycle began, on average, with 105 spawns and minimal yield of 5,000 eggs per spawn. Feeding the animals was performed manually feed fingerlings (55% crude protein (CP), 7% ether extract (EE), 8% energy). During the tadpole phase, estimated mortality was 10% and during the subsequent phases, metamorphosis and pre-fattening, mortality was estimated as high as 35%.

In pre-fattening, a mixed system of frog farming was utilized for feeding (covered troughs with addition of fly larvae for conditioning of feeding on moving prey).

The fattening system utilized was wet (inundated) system (FERREIRA *et al.*, 2002), with slaughter weight established as 250 g and carcass yield of 55%. The feeding of the animals in this phase was carried out with the use of an automatic dispenser with feed for carnivorous fish (40% CP, 10% EE and 8% energy). Mortality in this period was estimated as 10%.

In this study, was chosen two conditions of feed conversion, "A" and "B." In "condition A," utilized a conversion of 3:1 for the tadpole phase and 2:1 for fattening. For "condition B," used a conversion of 2:1 in the tadpole phase and 1.5:1 in the phase of fattening.

Economic Analysis

In this economic evaluation, the costs, income and profit obtained for the production of frog meat were considered, utilizing partial analyses of the budget for comparing costs and variations of incomes in each situation proposed (SHANG, 1990).

Costs of production

The structure of the costs considered in the present study was:

a) Effective operating costs (EOC), which include the expenses for: permanent labor, feed, office and cleaning material, infrastructure (electricity, telephone, taxes and rates) and replacement parts.

b) Total operating costs (TOC), include: the sum of the EOC plus social obligations, when concerning labor (holidays and other expenses), utilizing for this calculation a value of 40% of the costs for labor; financial obligations, estimated as being the annual interest rate which falls on half of the EOC in the production cycle; and the depreciation of equipment and material.

c) Total production costs (TPC), the sum of TOC plus costs related to annual depreciation of the installations and annual interest of the investment capital.

Return on investment and indicators of profitability

For the economic analysis proposed, considered a study time horizon of ten years, with the total investment applied in year zero. The viability of the investment was evaluated based on indicators such as internal rate of return (IRR). According to ALLEN (1984), it is important to try to estimate and evaluate the rate of attraction for which the project is selected. This indicator can be considered as the interest rate obtained for an investment for a particular period, within regular intervals, where payments are made to cover all the expenses with breeding and revenues from the sale of the product.

In evaluating a project by IRR, it is only economically viable when IRR is greater than a particular rate of attractiveness. The minimal rate of attractiveness considered in this study was 12.00% a.a.[1], equivalent to the interest that could be obtained in financial applications, which are based on the SELIC rate (Sistema Especial de Liquidação e Custódia) which is published by the "Comitê de Política Monetária Brasileiro" (COPOM = Brazilian Monetary Police Committee). It is of vital importance in the economy, because interest rates charged by the market are established by the SELIC rate.

Utilized other indicators of economic viability besides IRR, such as payback period (PP), defined as the number of years necessary for the owner to recover the initial capital invested in the project (NORONHA, 1987) and the net present value (NPV), which is the current value of the series of future income for a period, discounting the interest rate, subtracted from the net investment.

Considered also an indicator of costs in terms of units produced, called break-even point (BP), which determine what is the minimal production necessary to cover the costs, given a selling price per kilogram of frog meat (P_{kg}), as follows: $BP = TOC/P_{kg}$.

Other assessment indicators of profitability used in the present study have been described by MARTIN *et al.* (1994):

a) Gross income (GI): the production of frog meat in kg multiplied by the selling price on the market;

[1] *Rate as of August, 2011. Source: <http://www.bancocentral.gov.br>, accessed on August 16, 2011.*

b) Operating profit (OP): difference between GI and TOC. This indicator measures lucrativeness in the short-term, showing the financial and operating conditions of the business. Therefore: OP = GI – TOC;

c) Gross margin (GM): margin in relation to TOC, that is, the result obtained after the producer bears the operating costs, considering a particular selling price per kilogram of frog meat and the productivity of the system. Therefore: GM = (GI – TOC) /TOC x 100;

d) Index of profitability (PI): relation between OP and GI, in percentage. Important indicator that shows the available income rate of the activity after paying all operating costs. Thus: PI = (OP/GI) x 100.

e) Cash flow (FC): is the algebraic sum of the gross revenues and expenses incurred during the business cycle. It is an instrument that enables the identification of a net financial flow each year, which will be utilized for the calculation of the IRR. According to MARTIN *et al.* (1994), it shows the situation with business cash and is the result of covering other fixed costs, risks, return on capital and business capacity.

Cash flow was calculated considering the expenditures for the initial investment in the first year (considered year zero) and the effective operating costs plus the financial and social obligations for labor and annual interest of the investment capital. Estimates were made based on two zootechnical conditions and two selling prices per kilogram of frog meat (US$ 21.50 and US$ 24.00), reflecting the variation in values commonly seen in frog farming in the state of São Paulo, Brazil.

RESULTS

Zootechnical rates of the frog farm model as proposed, utilized for the analysis of economic viability are presented in Table 1.

The initial investment for the establishment of the frog farm with the capacity previously described in Table 1 is shown in Table 2. To calculate viability, used the linear depreciation of each item based on its useful life and annual interest of 12%.

Table 1. Zootechnical rates of the frog farm utilized in the study of viability, April 2011. Condition: A = FC 3:1 for the tadpole phase and 2:1 for fattening; B = 2:1 in the tadpole phase and 1.5:1 for fattening.

Index	Values
Cycles per year	1.5
Spawning per year	105
Mortality spawning phase considered (%) per cycle	20
Mortality tadpole phase (%) per cycle	10
Mortality imago phase (%) per cycle	35
Mortality fattening phase (%) per cycle	10
Tadpole ration quantity per year (kg) – Cond. A	14.175
Tadpole ration quantity per year (kg) – Cond. B	9.450
Fattening ration quantity per year(kg) – Cond. A	166.308
Fattening ration quantity per year(kg) – Cond. B	124.731
Slaughter weight per frog (kg)	0.30
Slaughter yield per frog (kg)	0.17
Total slaughtered per year (kg)	14.000

Source: Research Data, 2010

Costs of the frog farm, considering the effective operating costs (EOC), total operating costs (TOC) and total production costs (TPC) are shown in Table 3.

Table 2. Projection of investment for the production of the frog *Lithobates catesbeianus*, São Paulo, Brazil, April 2011. Values expressed in US dollars.

Index	Quantity	Total Price $	Useful life and replacement[1]	Annual Depreciation (a)	Annual interest on capital investiment[2] (b)	Sum (a)+(b)
1-Ground acquisition (10,000 m²)	1	6,315.79			757.89	757.89
2-Building						
2.1-Earthmoving, fence and floor plan	1	36,842.11	20	1,842.11	4,421.05	6,263.16
2.2-Tanks for egg-laying	8	4,842.11	10	484.21	581.05	1,065.26
2.3-Tanks for tadpoles in metamorphosis	104	30,000.00	10	3,000.00	3,600.00	6,600.00
2.4-Tanks for fattening	57	60,526.32	10	6,052.63	7,263.16	13,315.79
2.5-Ration deposition, office and accommodation	1	13,157.89	20	657.89	1,578.95	2,238.84
2.6-Water tank	1	10,526.32	15	701.75	1,263.16	1,964.91
3- Equipment and tools						
3.1-Water well (pumps and installations)	1	2,526.32	5 (1)	505.26	303.16	808.42
3.2-Material for maintenance	1	526.32	3 (3)	175.44	63.16	238.60
3.3-Informatic components	1	1,052.63	2	526.32	126.32	652.63
3.4-Handing implements	1	1,842.11	2	921.05	221.05	1,142.11
4-Matrix						
4.1-Males	35	736.84	3 (3)	245.61	88.42	334.04
4.2-Females	70	1,473.68	3 (3)	491.23	176.84	668.07
5-Documentation and preparation of project (3%)		5742.63				
Total		**175,479.47**	**-**	**15,603.51**	**20,444.21**	**36,047.72**

[1] *Useful life replacement (in years);* [2] *Rate of 12% per year on initial capital;* [3]*Amounts in Dollars (exchange R$1.90).*

Table 3. Projection of operating costs per cycle for the production of the frog, under conditions A and B, São Paulo, Brazil, April 2011.

Index	EOC	Social Charges[2]	Financial Charges[3]	TOC	Other Fixed Costs	TPC
1. Labor						
1.1. Zootchnist	10,526.32	4,210.53	842.11	15,578.95		15,578.95
1.2. Laborer	14,736.84	5,894.74	1,178.95	21,810.53		21,810.53
2. Ration Condition A	-					
2.1. Tadpole	17,407.89		1,392.63	18,800.53		18,800.53
2.2. Fattening	121,375.80		9,710.06	131,085.86		131,085.86
3. Ration Condition B	-					
3.1. Tadpole	11,605.26		928.42	12,533.68		12,533.68
3.2. Fattening	91,031.85		7,282.55	98,314.40		98,314.40
4. Eletric Power	6,315.79		505.26	6,821.05		6,821.05
5. Phone	1,052.63		84.21	1,136.84		1,136.84
6. Taxes and Fees	3,573.03		285.84	3,858.87		3,858.87
7. Cleaning material	7,894.74		631.58	8,526.32		8,526.32
8. Office material	105.26		8.42	113.68		113.68
9. Spare parts (hydraulic and electric)	1,263.16		101.05	1,364.21		1,364.21
10. Depreciation Const. Civil [4]					10,402.34	10,402.34
11. Depreciation Equip. and Tools.[4]				2,695.55		2,695.55
12. Matrices Depreciation [4]				933.33		
13.Annual interest on capital investment					13,629.47	13.629.47
Cycle Total - Condition A	**184,251.46**	**10,105.26**	**14,740.12**	**212,725.73**	**24,031.81**	**235,824.21**
Cycle Total - Condition B	**148,104.88**	**10,105.26**	**11,848.39**	**173,687.42**	**24,031.81**	**196,785.90**
Total annual - Condition A	**276,377.19**	**15,157.89**	**22,110.18**	**319,088.60**	**36,047.72**	**353,736.31**
Total annual - Condition B	**222,157.32**	**15,157.89**	**17,772.59**	**260,531.13**	**36,047.72**	**295,178.85**

[1] Amounts in Dollars (exchange R$1.90); [2] Social charges = 40% of the disbursement; [3] Financial cost-24% pay about half the COI added to payroll taxes; [4]Depreciation in accordance with the estimated service life. Values expressed in US Dollars.

Finally, the production costs per kilogram of frog meat, for the two conditions chosen for the study (A and B), and the analysis of the costs and the profitability indicators of the frog farm in question are shown in Tables 4 and 5. To determine the effect of the calculation was considered two ranges of values that were compatible with the production costs for assessment of cash flow.

Table 4. Production costs per kg of frog meat in the frog culture, under conditions A and B, state of São Paulo, Brazil, April 2011. Values expressed in Dollars (exchange R$1.90). Condition: A = FC 3:1 for the tadpole phase and 2:1 for fattening; B = 2:1 in the tadpole phase and 1.5:1 for fattening.

Detail	Values
Total slaughtered per year (kg)	14.000
Effective operating costs (US$) – Cond. A	19.74
Total operating cost (US$) – Cond. A	22.79
Total production costs (US$) – Cond. A	25.27
Effective operating costs (US$)– Cond. B	15.87
Total operating cost (US$) – Cond. B	18.61
Total production costs (US$) – Cond. B	21.08

Table 5. Analysis of costs and profitability of the investment in the production of the frog *Lithobates catesbeianus*, under conditions A and B, state of São Paulo, Brazil, April 2011. Values expressed in Dollars (exchange R$1.90). Condition: A = FC 3:1 for the tadpole phase and 2:1 for fattening; B = 2:1 in the tadpole phase and 1.5:1 for fattening.

Indices	Condition A	Condition B	Condition A	Condition B
Cash Flow–Value of Sales (US$ kg^{-1})	21.50	21.50	24.00	24.00
Gross Revenue (US$)	301,000.00	301,000.00	336,000.00	336,000.00
Operating profit (US$)	(18,088.60)	40,468.87	16,911.40	75,468.87
Gross margin	(5.67)	15.53	5.30	28.97
Profitability Index (PI)	-	13.71	4.78	25.57
Internal Rate of Return (IRR)	-	19,02%	-	41,69%
Net Present Value (NPV)-12.25%	(-)276,646.58	50,857.52	(-)80,896.23	246,607.87
Net Present Value (NPV)-24%	-	(-)26,478.92	(-)113,214.11	102,386.05
Payback period (years)	-	4.34	-	2.33
Breaking Even Point	14,841	12,117	13,295	10,855

DISCUSSION

In the present study, the variables analyzed were only quantitative (feeding), while the qualitative variables (genetic improvement and technology of the installations) were not inferred, because there are still no significant investments in frog ponds to take into account the operating costs of production. According to MARCANTONIO *et al.* (2002), Brazilian frog farming developed rapidly in the last years, mainly in the improvement of the installations and management techniques, but there have not yet been substantial advances in the area of genetic improvement. Genetic improvement of the species could reduce the time for completing the production cycle, increase the percentage of marketable meat per animal and optimize feed conversion.

In the total production cost (TPC) analyzes show that spending on food ranging from 70 to 75%. According to FENERICK JUNIOR and STÉFANI (2005), the costs of feed are high because commercial, formulated and balanced products are utilized in most cases, based on knowledge of

the nutritional requirements of fish, since there is still insufficient information about the needs of frogs. Therefore, the lack of specific feed for each phase of the production cycle of frogs has resulted in inefficiency in the feed conversion of the animals, leading to higher production costs.

In this work, were analyzed two conditions of feed conversion to quantify the variables. "Condition A" (3:1/2:1) showed effective operating costs (EOC) of US$ 184,251.46 per cycle, while "condition B" (2:1/1.5:1) resulted in US$ 148,104.88 per cycle, demonstrating that the improvement of feed conversion by 0.5 kg feed per kg of fattening results in a 20% reduction in operating costs and, significantly, 25% in feed costs.

On comparing the operating costs of frog farming with the breeding of cobia fish *Rachycentron canadum* (SANCHES *et al.,* 2008), was observed that both have high total costs of production and of investment. However, the culture of cobia shows a high productivity, which reflects a cost per kg of fish of 4 to 5 times less than that of frogs. This condition would only be reached in the frog farm in question if the use of the installations were optimized and if there were an increase in the number of cycles per year (greater productivity).

SEIXAS FILHO *et al.* (1998) stated that the use of commercial extruded feeds, formulated for carnivorous or omnivorous fish is one of the few alternatives for frog farming, where it can result in differences in performance in frogs, influencing the economic viability of the activity. In Brazil, the small volume of production of frogs is reflected in the reduced tonnage of feed consumed in frog farm and, consequently, the decrease in interest of industry to develop and offer to the market specific and adequate feed for this amphibian (CASALI *et al.,* 2005).

Therefore, improvements in feeding techniques and adequate conditioning in the post-metamorphosis phase are vital for improving feed conversion and consequently diminishing costs.

The lack of technology in frog farming has also become a critical factor for success when equalizing labor costs, which represent 30 to 40% of EOC.

The productivity study was based on kg of live animal, but the selling price included the costs for slaughter that was outsourced (US$ 1.95 per kg live animal).

In the analysis of the viability of the breeding of *Lithobates catesbeianus* in the commercial field using the method proposed, based on a combination of return indicators (NPV) and risk indicators (IRR and payback) with flexibility of course of action (trajectories), suggest "condition B" for the operating costs, for US$ 21.50 as well as US$ 24.00 per kg of meat for sale. "Condition A" resulted in an unviable.

For the better condition, at the minimal selling price of US$ 24.00 per kg, NPV (12.25%) resulted in US$ 246,607.87 which demonstrates that for the stipulated planning horizon of 10 years, investment is recuperated in a period of 2.33 years, with a profitability index of 25.57. The IRR of 41.69% is higher than the interest rate of 24% commonly imposed on loans for this business activity in the Brazilian market. Considering the rate of 12.25% (SELIC), the profitability of the project was demonstrated to be considerably higher than the profitability of the financial security application (savings), for the two selling prices.

The return indicators presented by SANCHES *et al.* (2006) for the production of dusky grouper *Epinephelus marginatus* in aquaculture cages at the selling price of US$ 10.00, were 2 years of payback and IRR of 36%. Again, SANCHES *et al.* (2008) in breeding cobia in an offshore system at a selling price of US$ 8.30, obtained a payback of 2.5 years and IRR of 27.84%, corroborating in a comparative manner the results presented in the following work.

It should be pointed out that risk of total loss in any year was not considered, because it would make the project unviable in condition B.

The break-even point of the business in the better condition was 10,855 kg of live animal (71% of gross income), reflecting that despite the lack of technology and the considerable investment, the establishment of the zootechnical variables provides assurance to the entrepreneur, with more than 3,000 kg of margin, providing a medium lucrativeness, in the short-term. VERA-CALDERON and FERREIRA (2004) reported that fish farming of tilapia (*Oreochromis* spp.) in

aquaculture cages with an unfavorable scenario for lucrativeness has a break-even point of 53.53% (862,079 kg) of the gross income, while it is around 14.42% (66,444) for a profitable model. This indicates that despite the indices being favorable for frog farming, other aquaculture activities still show a much lower lucrativeness.

According to ÇAKLI *et al.* (2009), frog meat is sold in various countries at high prices and focuses on luxury markets. Luxury goods are products and services with very special behaviors in the market, and their market administration often contradicts the rules. Another study by VIERA *et al.* (2008), reported that the luxury world is extremely ideal for the development and trial of new technologies, which would be inaccessible to consumers with lower purchasing power, because of being initially expensive and having a reduced production scale. After a certain time, and beyond the initial phase of novelty, there is the *trickle-down* phenomenon; the technologies gain in scale costs and are then disseminated in other segments.

Therefore, with the current data, it is not possible to predict the course that frog farming will take, a professionalization of the business by large groups of entrepreneurs can make it into a demand valued by the luxury market, bypassing the local and international market. However, cannot ignore that this will be directly linked to investments in technology, genetic improvement, feeding management and environment, to enhance productivity and profitability percentages, which limit the operation.

CONCLUSION

Based on the data of the commercial culture analyzed, frog culture attractive when practiced with feed conversion rates less than 2:1 in the tadpole phase and 1.5:1 in the fattening phase and a selling price greater than US$ 24.00.

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