

## Frog Culture-Why Not?

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### ABSTRACT

Cool nights during the annual monsoons - hundreds of tropical villages in rural Goa come alive with the cacophony of croaking bullfrogs, calling for mates after several months in hibernation. Some lucky amphibians manage to attract a female consort, however, an unfortunate few fall prey to poachers, who follow their distinctive mating calls to zero in on what they call "jumping chicken".

"Jumping chicken", as frog legs are known locally in the Indian resort state, are a delicacy, as in France, where they have become a symbol of the country's cuisine. Goans, famed for their love of meat, developed a taste for lean frog flesh when catching these amphibians was legal. The large Indian Bullfrog and Jerdon's Bullfrog, which are found in wetlands throughout the Indian subcontinent, were very popular because of their fleshy legs.

This study aims at studying the scope and viability of initiating commercial frog culture within the state of Goa. This will not only help meet the demand of the people for frog meat but will also discourage poaching and the use of other illegal means and methods, thus contributing to their conservation in the wild.

### Introduction

Cool nights during the annual monsoons-hundreds of tropical villages in rural Goa come alive with the cacophony of croaking bullfrogs, calling for mates after several months in hibernation. Some lucky amphibians manage to attract a female consort, however, an unfortunate few fall prey to poachers, who follow their distinctive mating calls to zero in on what they call "jumping chicken".

Gearing up for a frog hunt is like preparing for a covert military mission: one chooses a moonless night, wear camouflage to blend in with the surroundings, carry a powerful torch

to stun the target and a knife for a quick, silent kill.

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The Indian government designated frogs as a protected species in 1985, amid concern over their falling numbers. Now, any individual or restaurant caught catching, killing, selling, serving or eating frog meat runs the risk of a Rs. 25,000 fine, a jail term of up to three years or both. Both types of frogs also feature on the International Union for Conservation of Nature's Red List of endangered species, the wildlife conservation body says their numbers are stable and the main risk comes from the loss of their natural habitat.

This paper aims at studying the scope and viability of initiating commercial frog culture within the state of Goa. This will not only help meet the demand of the people for frog meat but will also discourage poaching and the use of other illegal means and methods, thus contributing to their conservation in the wild.

### **Objectives of the study**

1. To study the potential and viability of Frog farming as a commercial activity.

### **Research Methodology**

The data will be collected from both primary & secondary sources.

Primary data will be collected through interviews with aquaculture farmers, environmentalists and other knowledgeable persons.

Secondary data will be collected from reports of studies done earlier, e-books and the internet.

### **Scope of the study**

The scope of this study is immense, as it seeks to encourage the farming of frogs on a commercial basis, in and around Goa. Frog meat is a good source of proteinous food and has a huge demand both locally and internationally. Frog meat has a readymade demand from hotels and restaurants as it is considered a prized delicacy. Besides, commercial frog farming through achieving economies of scale will not only bring down the price of frog meat but will also minimize illegal poaching and trafficking of frogs, which will in turn help stabilize their populations and prevent their extinction.

### **Limitations of the Study**

- 1) The study is based purely on international and national reports.
- 2) Primary data has been collected through interviews with knowledgeable persons from Goa only. No previous studies have been conducted in Goa.

### **Introduction to Frog Culture/Farming**

In India, frogs breed in the wild and in water bodies located mostly in the rural areas. If these can be systematically organized, their production can be increased considerably to bring about economic benefits to the individual farmers as well as to the nation.

Frogs and fishes can be reared together, after the egg and larval/tadpole stages. Once they grow to a sufficient size, they do not prey upon each other. At the egg, larval/tadpole stage they prey upon each other and destroy one another's spawn. Frogs are excellent feed for a number of wild animals including snakes and hence they get attracted to the frog ponds, hence, frog ponds have to be protected from these wild predators.

For the interested entrepreneurs a large variety of data/ information is available to start rearing not only at the home level but also on a small/ large scale commercial level. Frog culture can be gradually developed in our country, into an attractive business opportunity, having immense export potential and job opportunities.

Starting frog culture entails considerable preparation, in the form of a well researched plan to ensure the best possible utilization and management of all the resources, with the least amount of investment and variable costs. Preparation of a blue print of the frog culture unit, however small it may be, is necessary. Priority needs to be given in the plan for the smooth flow of fresh water in each pond, easy feeding, efficient care, protection from the predators, easy cleaning, breeding, disease and pest control, minimum movement and effort, to perform the day to day operations and harvesting.

### **Types of Frogs**

There are hundreds of species of frogs and

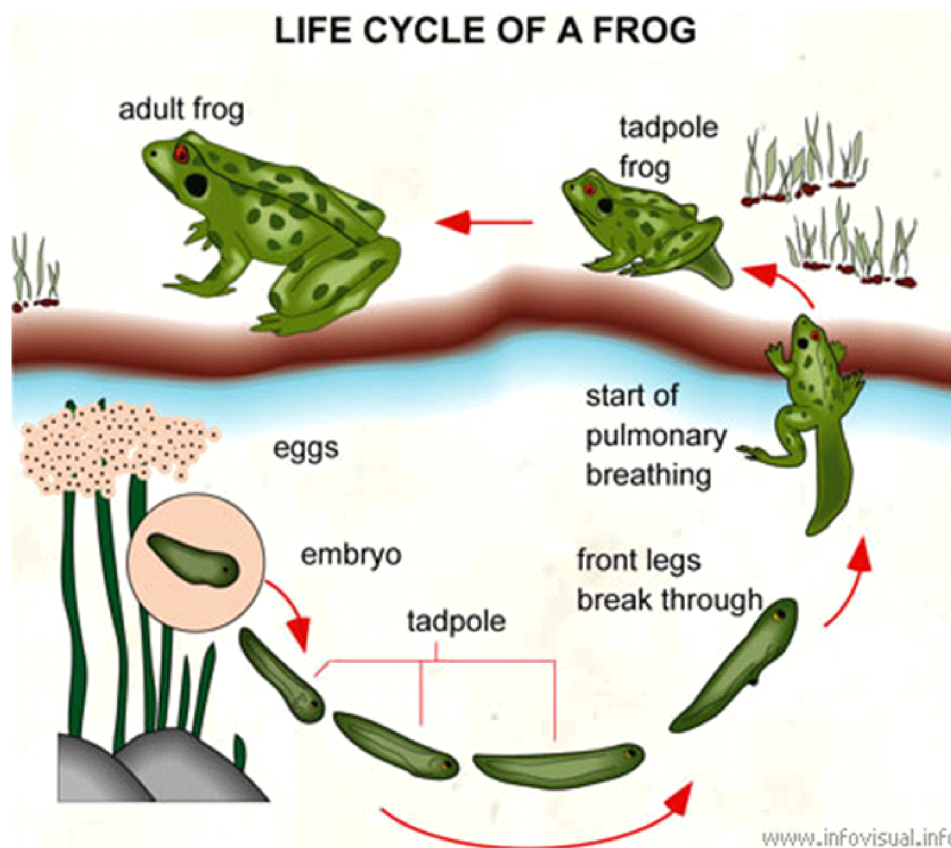
toads in the world. A large number of them are edible, however, only a handful of them can be reared for commercial purposes.

India is blessed with many species of frogs and toads. All known toad species are mostly poisonous and hence, not edible. Among the many frog species, four species have been identified for their fast growth and other economic characteristics that make them suitable for rearing. They are:

1. *Rana hexadactyla* (Green frog)
2. *Rana crassa* (Jerdon's frog)
3. *Rana tigrina* (Indian bullfrog)

4. *Rana catesbiana* (North American bull frog)

In all the breeds the males and females can be easily distinguished. The male are generally bigger in size, however, the size alone cannot be an identifying factor. The male frogs have bigger ear drums and a bulge at the base of the thumb in the hand, which is absent in the females. The presence of vocal sacs, are another identification feature of the male frog. Mature male frogs have a bright yellow throat, while in the female it is pale yellow. These characteristics may vary in intensity and size in different species.



The life cycle is a cyclic process and can be begun at any point. The laying of eggs is called spawning. The female frogs lay about 8000 to 20,000 eggs together in the form of a sticky mass, which swells up when comes in contact with water and floats, the eggs mass is called a spawn. The male frog discharges the sperms over the egg mass and the fertilization of eggs takes place externally.

However, prior to spawning some sort of a mating exercise takes place between the male

and female. During this time, the male frog mounts the female frog from behind in an embracing like activity, which goes on for one or two days. This helps in the physico-chemical process of formation, maturation and the release of eggs in the female frog. This also helps in the formation and maturation of sperms in the male frog. While the embracing like activity is going on, the male presses the sides of the female with the bulging thumb and thus helps in the release of the eggs from the female's ovary. After the mating and

fertilization of eggs, the male and female frog separates.

In natural conditions, depending on the temperature and the breed, the eggs take about 5 to 20 days to hatch into tiny larvae called tadpoles, however, in artificial conditions the eggs take only about one to two days (20 to 50 hours) to hatch. Each tiny tadpole carries a portion of the yolk inherited from the egg, from which it hatched out. This yolk forms the food for the tadpole for a few days and hence they do not need any feeding during that period. These tadpoles swim around in groups and when the yolk sack is exhausted, the tadpoles begin to feed. Tadpoles are omnivores and feed on anything that is edible.

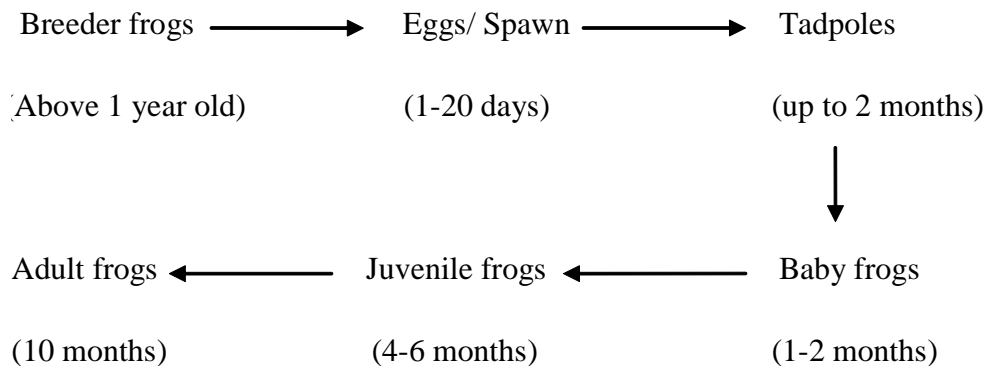
During the first two months after hatching, the tadpoles slowly undergo physiological changes and develop a tail. The tail slowly diminishes and the hands and legs begin to appear. As the hands and legs grow, the tail diminishes further and completely disappears to form into a baby frog. It takes about two months from hatching for the tadpoles to

become tail less and assume the shape of a baby frog, which may be about 5 cm long when stretched fully from head to the tip of the legs.

In another two months the baby frogs (5 cm) grow to the size of 12 cms. in length, i.e. within four months of hatching the frogs grow to approximately 12 cms. in length. In course of the next six months, the frogs on an average grow to about 20 cms. in length and become ready for harvesting.

The baby frogs and the juvenile frogs feed from nature i.e. mostly on live insects and to some extent on dead feed of animal origin. Feeding on live insects and maggots has been found to enhance the growth and maturation of frogs remarkably. However, in commercial rearing the frogs feed on mixed feeds of both plant and animal origin. Frogs mature sexually within a year, in other words, tadpoles hatched during one monsoon season become ready for breeding by the next monsoon season.

The life cycle of frogs is depicted diagrammatically as follows:



**Types of Frog Ponds**

Frogs in nature are found in the wild all over the country. In the nature, out of the 20,000 eggs released in a spawn on an average by a female, only about 1000 eggs hatch and out of these 5- 10% grow into adults. Hence, dependence on the wild sources cannot be relied on to generate sufficient frogs for commercial usage.

For the success of commercial production 80% hatching of the eggs should be ensured and out of these at least 80% should grow into marketable adults. This implies protection at every stage of the development of the frogs.

This is possible only in controlled pond environmental conditions, therefore, properly laid out and constructed frog breeding and rearing ponds are necessary for commercially successful business.

The principle of housing or enclosure for any animal is to provide sufficient protected space for the animal for all its body functioning and proper growth. In other words optimum spacing should be provided in order to achieve maximum growth.

Various life functions like breeding, hatching, tadpole stage, baby frog stage, fast growing stage and maturing stage etc. all have to be

carried out in controlled conditions. Feeding requirements at the different stages are different and also controlled breeding cannot be practiced if any male has access to any female in the stock at any time. Which ones are to be crossed and which ones should not be crossed, should be decided by the grower for obtaining greater economic returns.

This is possible only if there are several small and big ponds. Small ponds may be a series of cement or earthen tanks required for stocking the breeding males and females separately or in batches of males and females. Similarly small ponds are required for breeder stocks, breeding spawning-hatching, rearing of hatchlings/tadpoles, metamorphosed young ones/baby frogs. Bigger ponds of 15x10 metres or more can be used for breeding, spawning, hatching and rearing of the tadpoles and the baby frogs. However, in these ponds provision of care and protection cannot be ensured as in smaller ponds. Bigger ponds are required for rearing the fast growing juveniles/ growers, finishers and adults for selection to be used in breeding.

For commercial production it is important to create facilities for observing keenly every

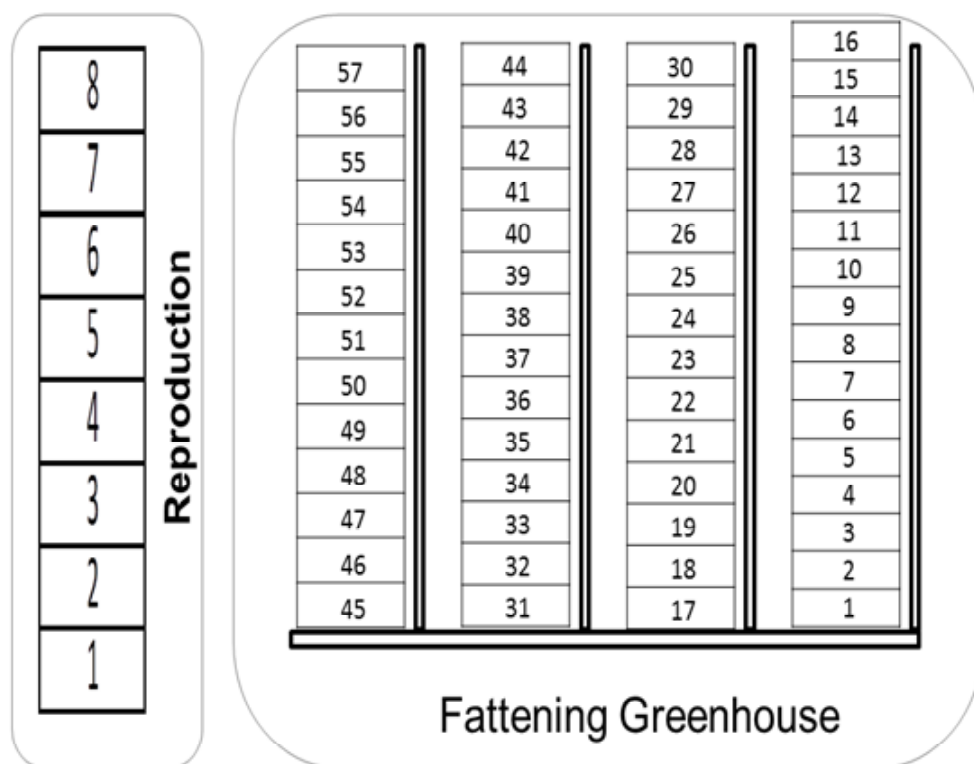
individual tadpole and the pond system, in general, to keep a watch on the quality of the water and existence of contaminants in the pond etc. For this it is advisable to have small tanks/ponds of thick glass similar to that of a home aquarium. The water level required in different ponds for various stages of the frogs life- cycle ranges from zero to 60 cms.

### Method of Frog Culture

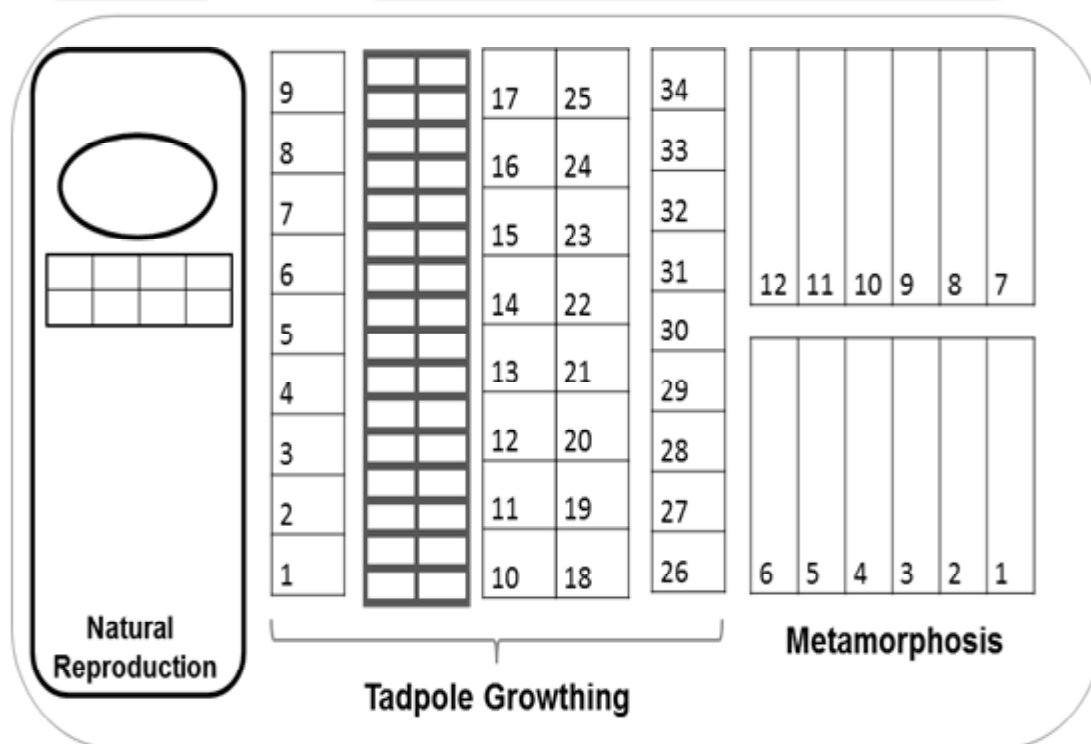
#### Floor plan for installation of greenhouses

The installation may comprise a total area of approximately 10,000 m<sup>2</sup>, which includes 3,100 m<sup>2</sup> of constructed areas. This area should cover two agricultural greenhouses; 1 greenhouse of roughly 1,625 m<sup>2</sup> comprising of 16 pre-fattening tanks (each of 13 m<sup>2</sup>) and 41 tanks for fattening (each of 19 m<sup>2</sup>); 1 greenhouse of about 1,254 m<sup>2</sup> with 32 tanks to be used for embryonic development (each of 0.36 m<sup>3</sup>), 34 tanks to be used for tadpole growth (each of 1.18 m<sup>3</sup>, having capacity for 4,000 animals), 12 tanks to be used for tadpoles in metamorphosis (each of 8.82 m<sup>3</sup>, having capacity of 10,000 animals); 1 feed depository of 24 m<sup>2</sup>, 1 area of approximately of 68 m<sup>2</sup> for reproduction, consisting of 8 tanks for egg-laying.

Figure 1: Floor plan of a commercial frog aquaculture farm as proposed in this study.







**Management and Disease Control**

Several aspects of the management and rearing of the frogs need to be evolved and established as standard practices. Frog culture can be done as mono culture or poly-culture along with fishes and crabs, depending on the type and size of the enterprise. So far no disease has been reported to be affecting frogs. Incidence of diseases can be prevented by maintaining a clean environment. Yearly disinfecting of the ponds as is done in the case of fish ponds is an effective means to ward off most of the disease occurrences. Spraying 25-30 ppm solution of bleaching powder or calcium hypochlorite is recommended for disinfecting the ponds. These chemicals are found to be effective within 3-4 hours of use and the toxicity remains effective for 7-8 days.

Anhydrous ammonia at the rate of 20-25 ppm has also been found to be effective as a disinfectant, fertilizer and herbicide.

Red legs (a simple irritation on the skin of the leg and body) is a common occurrence due to overcrowding and prolonged contact with a dry surface. Avoiding overcrowding and keeping the land mass always wet can prevent this disease.

Chlorine below 0.5 ppm serves as a prophylactic measure against fungal and

bacterial diseases. Periodical mixing of an antibiotic at the rate of 10 to 20 mg per kilogram of feed can also prevent bacterial diseases.

Periodic checks of the pond need to be carried out to check for the presence of aquatic insects such as dragon fly larvae and beetles, which prey upon the stocked hatchlings and tadpoles.

Proper protection needs to be provided against wild animals like birds, rodents, snakes, mongooses etc.

**Harvesting and Yield**

The frogs can be harvested when they attain 200-250 gms body weight and 20 cms in length. These adult frogs become adapted to a semi-aquatic habitat and are exclusively carnivores, however, the *R. tigrina* (green frog) can feed on pistil or water lettuce or tropical duck weed (Jal kumbhi in Hindi) and few other aquatic plants.

Under the mono culture conditions a yield of 700 kg per year per hectare may be obtained. At present the frogs are caught from the nature for their fleshy legs which are exported to foreign countries where they are sold like chicken leg pieces. The rest of the body parts are mostly wasted as there are no facilities for processing and using them commercially.

The flesh on the head and other parts of the body is suitable for home level and local level consumption; otherwise it can be converted into meat meal along with other slaughter house waste. The skin also can be processed into good leather to produce all kinds of valuable leather goods.

At present such byproduct utilization is not possible because of the low quantity of frogs collected from nature.

### Economic Analysis

The frog farm model as proposed and used to study the economic viability is presented in Table 1.

The initial investment for the establishment of the frog farm is shown in Table 2. The viability has been computed by taking linear depreciation of each item based on its useful life and an annual interest rate of 12% on investments.

**Table 1: Zoo technical rates of the frog farm utilized in the study of viability, April 2011.**

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
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

**Table 2: Projection of investment required for the production of frogs *Lithobatescatesbeianus*, São**

Paulo, Brazil, April 2011. Values expressed in US dollars converted to Rupees, 1USD= Rs 60

Index	Quantity	Total Price (Rs)	Useful life and Replacement	Annual Depreciation (a)	Annual interest on Capital Investment(b)	Sum (a + b)
<b>1.Ground Acquisition</b> (approx 10000 m <sup>2</sup> )	1	1,00,00,000			12,00,000	12,00,000
<b>2.Building</b>						
2.1- Earthmoving, fence and floor plan	1	22,10,520	20	1,10,526	2,65,262	3,75,788
2.2- Tanks for egg-laying	8	2,90,520	10	29,052	34,862	63,914
2.3- Tanks for tadpoles in metamorphosis	104	18,00,000	10	1,80,000	2,16,000	3,96,000
2.4- Tanks for fattening	57	36,31,560	10	3,63,156	4,35,787	7,98,943
2.5- Ration deposition, office & accommodation	1	7,89,480	20	39,474	94,737	1,34,211
2.6- Water Tank	1	6,31,560	15	42,104	75,787	1,17,891
<b>3.Equipment &amp; Tools</b>						
3.1- Water well (Pumps & installation)	1	1,51,560	5(1)	30,312	18,187	48,999
3.2- Material for maintenance	1	31,560	3(3)	10,520	3,787	14,307
3.3- Informatics Components	1	63,180	2	31,590	7,582	39,173
3.4- Handing implements	1	1,10,520	2	55,260	13705	70811
<b>4.Matrix</b>						
4.1- Males	35	44,220	3(3)	14,740	5,306	20,046
4.2- Females	70	88,440	3(3)	29,480	10,613	40,093
<b>5.Documentation &amp; preparation of project</b>		344,580				
<b>TOTAL</b>	-	2,01,87,700	-	9,26,214	23,78,942	33,05,156

Table 3: Projection of operating costs for the production of frogs *Lithobatescatesbeianus*, São Paulo, Brazil, April 2011. Values expressed in US dollars converted to Rupees, 1USD= Rs 60

Sr. No.	Costs	EOC (Rs)	Cost of Finance (Rs)	TOC (Rs)	Fixed Costs (Rs)	Total Production Cost (Rs)
1	Labour	15,15,720	50,520	15,66,240	-	15,66,240
2	Rations	61,58,160	4,92,600	66,50,760	-	66,50,760
3	Electricity	3,78,900	30,300	4,09,200	-	4,09,200
4	Telephone	63,120	5040	68,160	-	68,160
5	Taxes & Fees	2,14,380	17,160	2,31,540	-	2,31,540
6	Cleaning Materials	4,73,700	37,860	5,11,560	-	5,11,560
7	Office Expenses	6,300	480	6,780	-	6,780
8	Spares	75,780	6060	81,840	-	81,840
9	Depreciation- Civil Construction	-	-	-	6,24,120	6,24,120
10	Depreciation- Equipments & Tools	-	-	1,61,760	-	1,61,760
11	Matrices Depreciation	-	-	55,980	-	55,980
12	Annual Interest on Capital Investmnt.	-	-	-	15,79,317	15,79,317
13	Cycle Total	81,70,340	6,15,900	90,03,980	22,03,437	1,12,07,417
14	Total Annual	1,22,55,510	9,23,850	1,35,05,970	33,05,156	1,68,11,126

Table 4: Production costs per kg of frog meat in frog culture

DETAIL	VALUES
Total slaughtered per year (kgs)	14,000
Effective operating costs (Rs)	875.39
Total Operating costs (Rs)	964.71
Total Production costs (Rs)	1200.79

Table 5: Analysis of costs and profitability of the investment

Indices	Values	Values
Cash Flow – Value of Sales Rs/Kg (US\$/Kg)	1560(26)	1680 (28)
Gross Revenue (Rs)	2,18,40,000	2,35,20,000
Operating Profit (Rs)	50,28,874	67,08,874
Profitability %	23.02	28.52
Payback Period (years)	4.01	3.01
Break Even Point (kgs of live produce)	10,776.36	10,006.62

## Conclusion

Bio-indicators as well as studies conducted by herpetologists and amphibian specialists in Goa confirmed that frog populations are falling, just as it is in the rest of the world. The following are the chief threats to frog populations in Goa:

- 1) Catching, killing and consumption of frogs at the onset of monsoon: Frogs and their activation after the first rains and

come out to breed. This is when they are at their most vocal and hence easy to track down and catch and as most of the frog hunting is done before the frogs can breed. This has a drastic effect on the future of population of frogs.

- 2) The widespread use of fertilizers and pesticides in agriculture: Flooded paddy fields are the hotspots for frogs and since frogs absorb water through their skin,



they're particularly vulnerable to the toxic effect of residual chemicals in the fields.

- 3) Habitat destruction: i.e. filling of fields and clearing of forest cover are a few of the main reasons. Encroachment of forests by human activities such as mining, construction, etc. has caused entire resident populations to disappear within a short period of time.
- 4) A significant global trend: i.e. threatening frog populations as a whole worldwide phenomenon, this includes climate change, global warming, introduction of invasive species and spread of disease from agricultural and aquacultural farms to the wild frog populations.

There is a huge scope for entrepreneurs to take up frog culture on a commercial basis in Goa, due to the following reasons:

- 1) Huge demand for frog meat from the hotel industry.
- 2) The break-even point of the business is 10,006.62 kg of live animal (71.4% of gross income), reflecting that despite the lack of technology and the considerable investment, the establishment of the zoo technical variables provides assurance to the entrepreneur, with more than 3,000 kg of margin, providing a good level of lucrativeness, in the short-term.
- 3) Commercial production of frogs will minimize illegal poaching and trafficking of frogs within Goa and outside the state.
- 4) Taking up frog culture operations will help control and prevent extinction of frogs and make illegal poaching unattractive, as supply of frog meat will increase and its price will decline, due to economies of scale achieved in production.

#### Importance of Frog Culture/Farming

1. Frog meat is a good source of proteinous food and has huge demand locally and internationally.
2. Frog waste can be converted into nutritious fish and livestock feed.
3. Frog skins can be processed and made into valuable leather products.

4. Frogs can to some extent control the insect population harmful to humans and crops.
5. Frogs serve as good source of feed for domesticated reptiles, birds, snakes and other zoo animals.
6. Frog meat is considered to have medicinal value in Ayurveda.
7. Frogs are extensively used for laboratory experiments and cultures.
8. Effective organization of frog farming/culture in an environment friendly manner will make it a profitable venture in Goa.

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