

A COMPARATIVE ECONOMIC ANALYSIS OF EXTENSIVE AND SEMI-INTENSIVE FARMING OF GENETICALLY IMPROVED FARMED TILAPIA (GIFT) IN TAMIL NADU

*Thesis submitted in part fulfillment of the requirements of the Degree of
Master of Fisheries Science in Fisheries Economics
to the Tamil Nadu Fisheries University, Nagapattinam.*

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CERTIFICATE

This is to certify that the thesis entitled, "A comparative economic analysis of extensive and semi-intensive farming of Genetically Improved Farmed Tilapia (GIFT) in Tamil Nadu," submitted in part fulfillment of the requirements of the degree of **Master of Fisheries Science in Fisheries Economics** to the Tamil Nadu Fisheries University, Nagapattinam, is a record of bonafide research work carried out by **Mr. P. PASUPATHI, MFT 15076 (FEC)** under my supervision and guidance and that no part of thesis has been submitted for the award of any other degree, diploma, fellowship or similar titles or prizes and that part of thesis has been published peer reviewed journal(s) and copy / copies appended.

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*Dedicated to my sweet
family members and
friends...*

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(PASUPATHI. P)

ABSTRACT

ABSTRACT

Title	:	A comparative economic analysis of extensive and semi – intensive farming of Genetically Improved Farmed Tilapia in Tamil Nadu
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The present study was carried out to analyse a comparative economics of extensive and semi - intensive farming of GIFT tilapia culture practices in Krishnagiri and Thanjavur districts, Tamil Nadu. These districts were chosen as the study area and the total sample size was fixed as 100 for the present study which was equally distributed among 50 extensive (25 Krishnagiri and 25 Thanjavur) and 50 semi intensive (25 Krishnagiri and 25 Thanjavur) farms. The above stated GIFT farms were selected randomly for data collection in the present study.

The predominant age group of the selected semi-intensive fish farmers was 40-49 years in Krishnagiri district (40%) and the same age group farmers reported 60% in Thanjavur district. Alternatively, in extensive fish farmers 80% of the fish farmers age was within 20-39 years in Krishnagiri district and 48% of the farmers age was

within 30-39 years in Thanjavur district. 84% of the semi - intensive GIFT farmers had aquaculture as their secondary occupation in Krishnagiri district and 52% of the GIFT farmers had aquaculture as their primary occupation in Thanjavur district. Similarly, 84% of the extensive GIFT farmers had aquaculture as their secondary occupation in Krishnagiri district and 80% of the GIFT farmers had agriculture as their primary occupation in Thanjavur district.

The total cost in the case of semi-intensive GIFT farming was worked out to ₹1,10,718. Among the total cost the total fixed cost and variable cost was calculated as ₹49,049.20 and ₹61,669, in Krishnagiri district, respectively. Similarly, in Thanjavur district the total cost, fixed cost and variable cost were worked out to ₹1,45,714.47, ₹51,793.37 and ₹93,920.75, respectively in semi-intensive GIFT farming. The benefit cost ratio of semi-intensive GIFT farming was 1.3 and 1.2 in Krishnagiri and Thanjavur districts, respectively.

The total cost in the case of extensive GIFT farming was worked out to ₹4,47,081.87. Among the total cost the total fixed cost and the variable cost were calculated as ₹53,048.93 and ₹43,910.06 in Krishnagiri district, respectively. In Thanjavur district, the total cost, fixed cost and variable cost were calculated as ₹1,06,769.14, ₹55,276.77 and ₹51,492.37 respectively in extensive GIFT farming. The BCR for extensive GIFT farming was 1.4 and 1.3 in Krishnagiri and Thanjavur district, respectively.

Among the marketing channels, channel 3 (Producer → wholesaler → retailer → consumer) was adopted frequently (48%) by the respondents of Krishnagiri district. Thirty percent of respondents used Producer → consumer channel in Thanjavur district.

Major constraint faced by the semi-intensive GIFT farmers was unavailability of quality GIFT seed with the mean score value of 31.05 in Krishnagiri district. Alternatively, in Thanjavur district poor quality of GIFT seeds with mean score value of 28.67 was recorded. In Krishnagiri district, among extensive GIFT farmers, high cost of supplementary/pelleted feed with mean score value 33.52, unavailability of quality GIFT seed (30.67) and poor quality of GIFT seed (29.24) were the major constraints, while in Thanjavur district, unavailability of quality GIFT seed (28.38), poor quality of GIFT seeds (26.48) and short supply of water (25.71) were reported as the major constraints. It could be stated that GIFT seeds can be produced in a large scale and the government should create awareness programmes about GIFT farming.

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INTRODUCTION

Chapter - I

INTRODUCTION

Fisheries and aquaculture sector plays pivotal role of income and livelihood for the millions of people around the world. Fisheries plays an important role in the world – wide economic growth. In both developed and developing countries, fisheries is a main source of food, employment, national income and foreign exchange earnings.

Globally, the estimated fish production reached 167.2 million tonnes in 2014. The global capture fisheries were about 93.4 million tonnes and aquaculture production was 73.8 million tonnes. In recent years, the Global and India's per capita fish consumption is around 20 kg and 9 kg, respectively. In the context of stagnant production or slow growth from capture fisheries, aquaculture is the only way to meet the increasing global demand for food (FAO, 2016).

According to FAO, Aquaculture is defined as “the farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants. Farming 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).

1.1 Fisheries in India

India, by virtue of its 8129 km long coastline, 2.02 million sq. km of Exclusive Economic Zone (EEZ) and extensive geographical stretch with varied terrain and climate, supports a wide diversity of inland and coastal wetland habitats.

Fisheries constitute an important sector of the Indian economy not only from the point of view of food security and foreign exchange earning but also due to its huge employment potential. Further, protein from animal source is complete as it contains all the essential amino acids and vitamins which are lacking in protein from plant sources.

India is a major producer of fish through aquaculture and ranks second in the world after China. In 2013-14, India is the second largest producer of fish in the world contributing 5.68% of global fish production (Handbook on Fisheries Statistics, 2014). In recent years, Indian fish production through aquaculture is 42.10 lakh tones. It contributes about 6.3 % in global aquaculture. It is not only a source of livelihood for over 14 million people; but also, needed for socio -economic development of country, it has contributed for foreign exchange earning of ₹30,420 crores (Crs). In inland fish production, Andhra Pradesh is showing aggressive growth pattern from 2006 till 2014 amongst all states. In first 3 years, though West Bengal was the top producing state; but now it holds second position and shows a steady growth. Other top producing states are Gujarat, Kerala, Tamil Nadu, Maharashtra and Karnataka indicating flat growth (Goswami, 2015).

The status of Indian fisheries is presented in Table 1.1.

Table: 1.1 Status of Indian Fisheries

Total fish production (MMT)	10.16
Inland fish production (MMT)	6.59
Marine fish production (MMT)	3.65
Fish seed production (million fry)	21000
Hatcheries	1070
FFDA	429

BFDA	39
Global position	3 rd in fisheries, 2 nd in aquaculture
Contribution of fisheries to Indian GDP (%)	1.1
Contribution to Agriculture. GDP (%)	5.30
Per capita fish availability (kg)	9.0
Annual export earnings (₹. in Crores)	30,420.83
Employment in sector (million)	14.50

Source: National Fisheries Development Board & MPEDA (2015-16)

1.2 Fisheries in Tamil Nadu

Fisheries resources of Tamil Nadu are categorised as marine, inland and brackish water. The total fish production of Tamil Nadu during 2015-16 is 7.08 lakh tonnes (4.66 lakh tonnes in marine and 2.42 lakh tonnes in inland). Tamil Nadu stands 4th position in total fish production of the country, besides exporting marine products of 85,063 Metric tonnes (MT) and earning foreign exchange of ₹4,184.06 crores (Cr) during 2015-16 (Tamil Nadu Fisheries policy note, 2016-17).

Thanjavur district has the largest number of owned, dug-out fish ponds in the state. Being part of the Cauvery Delta Zone (CDZ), it is the granary of the state accounting for about a quarter of the total rice production. The district is blessed with a vast network of irrigation canals and public community ponds. River water is available for about 6-8 months which is enough for aquaculture. (Nitai Roy, 2007). The irrigation channels, canals, major and minor tanks are rich with many varieties of fish. The inland fishing consists mostly of local carps, Indian Major Carps (IMC) and other varieties such as cat fishes, murrels, tilapia etc.

Krishnagiri district is also one of the leading inland fish producing district in Tamil Nadu. It has huge amount of water resources like Cauvery river water, Krishnagiri Reservoir Project (KRP) dam, Pamparu reservoir, the irrigation channels, major and minor tanks. The inland fisheries consist mostly of minor carps, major carps, Tilapia etc.

1.3 GIFT tilapia

Genetically Improved Farmed Tilapia (GIFT) strain, a synthetic strain of *Oreochromis niloticus* that was developed through selection of several generation from a base involving eight different strains of Nile tilapia (*O. niloticus*) was introduced in Bangladesh in July 1994 from Philippines (Hussain et al., 2000).

The GIFT strain was reported to show faster growth (average 60%) and better survival (above 50%) at harvest than most commonly farmed strain (Eknath, 1992; Sultana et al., 1997). Tilapia has comparatively good market price, become marketable size in 3-5 months and requires low input cost. It is also preferred both by farmers and consumers due to its fast growth and tasty flesh. Tilapia can grow in a wide range of environmental condition and has good resistance to poor water quality and disease (Balarin and Haller, 1982).

Further, it is necessary to know the current status of GIFT production in terms of technology, economics and management so that it would pave way for development through entrepreneurial and policy initiatives. Hence, this study was undertaken.

1.4 Objectives of the study

The overall objectives of the proposed study are to undertake a comparative economic analysis of extensive and semi – intensive farming of Genetically Improved Farmed Tilapia (GIFT) in Tamil Nadu - mainly Krishnagiri and Thanjavur districts.

The specific objectives are

1. To study the socio-economic profile of GIFT farmers in the study area
2. To estimate and compare the costs and returns of the extensive and semi - intensive GIFT farming
3. To investigate marketing aspects of GIFT
4. To identify the constraints and suggest policy measures for sustainable GIFT farming

1.5 Scope of the study

The study would provide information on the costs and returns from the extensive and semi - intensive GIFT farming which would help in formulating development strategies. The estimation of economics of GIFT farming would reveal the profitability of the enterprise. The study would suggest for better marketing strategies to the farmers. Constraints faced by GIFT farmers would also be identified, ranked and discussed. The recommendations of the present study would serve as a basis for the policy makers in the formulation of aquaculture development policy for Krishnagiri and Thanjavur districts in particular and Tamil Nadu state in general.

1.6 Limitations of the study

Though the study is important from aquaculture, it was restricted to 25 each of the extensive and semi-intensive GIFT farmers in Krishnagiri and Thanjavur districts of Tamil

Nadu as a part fulfilment of the post-graduate research programme. The study has the limitation of covering only a part of the representative GIFT farmers in the districts due to lack of time and logical constraints. The information collected for the study was only on recall basis the respondents and not based on the farm records. Farmers were hesitant to reveal the information on the costs and the returns for various reasons. The results of the study are subjected to many factors like farm-specific situations, level of knowledge of farmers, access to information sources and extension agencies and other factors like inter-temporal and inter-regional variations. Hence, the findings of this study could not be over generalised.

Organisation of thesis

- Chapter 1 : Introduction - objectives, scope, and limitations
- Chapter 2 : Review of literature - Review of the earlier studies
- Chapter 3 : Materials and methods – Concepts, methodology and tools of analyses used and a short profile of the study area
- Chapter 4 : Results and Discussion – results of the study followed by a brief discussion
- Chapter 5 : Summary and Conclusion – Summary of the study along with conclusion and policy implications
- Chapter 7 : References

REVIEW

OF

LITERATURE

Chapter – II

REVIEW OF LITERATURE

2.1 Review of Earlier Studies

2.1.1 India

The impact of selected variables on the market price of carps was reported by Das et al. (1991). The data were collected by adopting structured pretested questionnaire. Information was gathered by personal interview and discussion with 180 consumers, 72 retailers, 40 middlemen and 40 producers. The data collection was carried out at fortnight interval. They observed that the market intermediaries had shared a sizable profit in the process of marketing.

Jayaraman (2000) studied the marketing of cultured carps in Thanjavur district, Tamil Nadu. Four types of channels were identified in marketing of carps in the district. The producer's share was as high as 78.26% to 80% in the consumer's rupee. The study concluded that fish marketing need to be supported with necessary infrastructure with cold chain system to minimise fish spoilage required for marketing to supply quality fish in hygienic conditions and assure a fair price to all concerned.

Krishnamurthy (2001) assessed the fish culture in borewell water storage ponds in Karnataka. The results showed that an average yield of 1,250 kg of fish per hectare per year and a price of ₹30 per kg of fish were obtained. The total income earned was about 56 lakhs from these storage tanks. Therefore, he inferred that on an average, the fish culture was more beneficial for the farmers.

Setty Ajay (2001) assessed the economics of freshwater aquaculture in Thanjavur district, Tamil Nadu. He found that the total cost per ha per crop in carp farming was worked out to ₹1,14,620 and out of this, the variable costs and fixed costs were accounted to ₹61,820 and ₹52,800 respectively. The total returns and the net returns per ha were ₹1,47,640 and ₹33,020 respectively. Feed and labour were the major input cost accounting for 24.58 % and 11.08 % among the items of variable cost. Among the items of fixed cost, lease money/rental value for the land, depreciation, repairs and interest worked out to 3.17 %, 6.77 %, 1.62 % and 6.01 % of the total cost, respectively. The input-output ratios on variable cost basis and total cost basis were 2.88 and 1.29, respectively.

Theft and pilferages, non-availability of fish seeds, lack of government support both technically and financially, quarrel and litigations among the owners of the pond, poor adaptability of fish seed in new environment, labour crisis, cut throat competition, inconsistent supply of fish, lack of storage facilities etc. were major constraints faced by fish farmers of West Bengal, reported by Rahaman et al. (2013).

Prithwiraj Jha et al. (2004) had observed the constraints in fish farming in West Bengal. They observed that non-release of loan by institutional banks in proper time, lack of education and shyness of the poor fish farmers and poverty in general and ignorance are the barriers in taking up the fish farming. They inferred that training should be given to the farmers for their success in fish farming.

Bhatta (2004) analysed the economics of carp culture in Andhra Pradesh. He observed that average yield and the cost of production per ha/crop was 3,893 kg/ha and ₹79,362, respectively. The net income per ha per crop was varied among the states from ₹35,000 to ₹1,01,000 with a benefit-cost ratio of 2.30 respectively. He inferred that higher productivity was obtained from carp poly culture from these states.

Marketing behaviour of fish farmers in Thanjavur district was studied by Nagoor Meeran (2005). He reported that the farmers used three channels to sell farmed fish. Majority of the respondents (76.67%) marketed their produce through Producer → Consumer channel. About 60% of the respondents had used Producer → Retailer → Consumer channel for marketing carps produced in their farm. The conventional marketing channel, Producer → Wholesaler → Retailer → Consumer was used by 43.33% of the respondents.

Pandey and Dewan (2006) analysed the constraints in fish farming practices in Uttar Pradesh, India. In this study, the most common problem areas were identified, analysed and ranked on the basis of farmer's perception. They concluded that financial, social and technical constraints was adversely affecting the farmers expected yield and income.

Abraham et al. (2010) carried out the comparative study on socio-economic profile of the fish farmers and the aquaculture practices of the two - leading fish producing states of India, namely Andhra Pradesh (AP) and West Bengal (WB). The study indicates that majority of the respondent of AP and WB practised aquaculture in owned (84%) and leased (67%) ponds, respectively. Although the farmers of both the states cultured carps, differences in farm holdings, farm size, species cultured, stocking and stocking density, nursery management, feed management, fertilization, harvesting, mode of marketing etc., were noticed and majority of the farmers in West Bengal (68%) had undergone short – term training in aquaculture and few among them (15%) were graduates. The study revealed that the Government organisations, non – governmental organisations (NGOs), educational institutions and other agencies failed to influence the farmers on aquaculture development.

The Central Institute of Fresh Water Aquaculture, Orissa (2011) had worked out the economics of carp poly culture. The mean total variable cost per ha was ₹74,000 which includes the pond lease value. The mean total cost and the production per ha was ₹80,000 and 4 tonnes. The gross revenue and the net returns per ha per year was ₹1,20,000 and ₹40,450 respectively. Therefore, carp poly culture was a profitable venture to fish farmers.

Gurunathan and Raghuram (2011) studied the profitability of Inland fish farms in Thanjavur district in Tamil Nadu. The study indicated that on an average, the total cost, gross returns, net returns and yield per ha was ₹1,30,190, ₹2,50,300, ₹1,20,120 and 3,520 kg respectively. The average variable cost and fixed cost per ha was ₹97,000 and ₹33,180 respectively. They concluded that fresh water fish farming was a profitable venture for the farmers.

Pandey and Upadhaya (2012) studied that socio-economic conditions with emphasis on education, employment, income levels from aquaculture and other farm and non-farm activities of fish farmers of Tripura. The study showed that the majority of fish farmers are in middle age group, education up to middle level, larger family size, in general categories with sufficient experience in aquaculture, medium level of social participation, smaller pond area, single ownership and very low level of family income.

Lack of technical know – how, plurality of ownership, lack of credit was denoted as the major constraints faced by the fish farmers in Gondia district, Maharashtra (India) and the study indicate that pond fish farming was an economically viable with the benefit – cost ratio (BCR) ranging from 2.22 to 4.44 (Goswami et al., 2013).

Bora and Das (2013) observed the costs and returns of integrated fish farming in Jorhat district of Assam. The farmers followed extensive farming practices using low

input technology. They mostly practised four major integrated fish farming system among that integrated pig-fish farming was the most profitable enterprise and the net return value was ₹95277.19/ha followed by horti-pig-fish farming with ₹89410.18/ha followed by poultry-fish farming with ₹50278.18/ha and horti-fish farming with ₹44952.92/ha.

The lack of training facilities relating to new technology, non-availability of good quality fingerlings, lack of storage facilities, financial problems and price fluctuation were denoted as the major constraints faced by the fish farmers in Manipur and the study reveals that overall the average cost of fish production per hectare was ₹99,107.90 and the net income per hectare was observed as ₹27940.77 (Devi et al., 2014).

The calculated Benefit cost ratio (BCR) was 1.05, 0.47 and 0.53 in feed based, conventional feed and extensive method, respectively (in fish culture for 10 months' period). The return on investment (ROI) was 0.86, 0.61 and 0.29 in feed based, conventional feed and extensive method, respectively. The study inferred that feed based fish culture was more profitable (Sivakumar et al.,2014).

2.1.2 International

The calculated net profit was found to be BDT 547177.77 (per 1.20 ha) and profit ratio was 78.11% in comparison to operational cost for tilapia culture in watershed pond in Bangladesh. Rahman *et al* (2012) inferred that tilapia culture was good with high profitability with less input of operational cost and reduced risk.

The calculated average total cost was found to be N 302614.25 and mean gross revenue was N 163995.59 for fish production from concrete pond system in Benue

state, Nigeria. Penda et al. (2013) concluded that fish production under concrete pond system was economically rewarding and capable of creating employment, augmenting income and improving the standard of living of the people.

Fish disease, low quality seed, poaching, insufficient water in dry season, poor technical knowledge, poor quality seed and lack of money were reported as the major constraints faced by the fish farmers in Shahrasti Upazilaa (Bangladesh) and the study indicates that average pond size was 0.24 ha with 85% of the farmers having ponds of single ownership. Most of the fish farmers belonged to the age groups of 41 to 60 years (44%), represented by 75% Muslims. About 10% had no education while 16%, 48%, 16% and 10% had primary, secondary, higher secondary and bachelor level of education respectively. About 20% of fish farmers were involved in fish farming as their primary occupation while 45%, 25% and 10% were involved in business agriculture and service respectively. Pravakar et al. (2013) revealed that fish farmer's socio-economic conditions were improved through fish farming.

Lack of scientific knowledge, illiteracy and lack of governmental support was denoted as the major constraints reported by the Ali et al. (2014) in fisherman of Lohalia river, Bangladesh. They indicate that most of the fisherman (60%) belonged to the age class 21-40 years and dominated by Muslims (75%). In the education categories, illiteracy was dominant (60%) and 35% had primary level and 5% could only sign.

Tunde et al. (2015) calculated that the total revenue was N 244364.30k per cycle, whereas total cost was N 129379.52k per cycle, for fish farming in Oye state, Nigeria. The BCR and rate of return on investment was 1.9 and 0.8887 respectively and concluded that fish farming was profitable.

Bannor and Bentil (2015) comparing the profitability of tilapia farming to maize farming on a hectare of land in Ghana. The study indicated that total investment cost for tilapia production was GH¢ 38916.8. the major investment cost was vehicle which was GH¢ 15000 (38.5). The cost of pond construction was found to be GH¢ 7200 (5.41%). The major operational cost for tilapia production was cost of feeding which was 61.75% of the total operating costs which was higher than total operating fixed costs (14.31%). In maize production, cost of fertilizer was the highest cost which was represented by 28.18%. The gross and net revenue from tilapia production for two cycles in a year were GH¢ 129600 and GH¢ 51864 respectively. The gross and net revenue for the maize production for two production cycles in a year were GH¢ 4800 and GH¢ 1923.12, respectively. They concluded that both tilapia and maize production can still be viable.

Okpeke et al. (2015) assessed the profitability of the fish farming in delta state, Nigeria. They collected data from 50 fish farmers from the study area. The study indicated that variable cost accounted for 72.95% of the total cost while fixed cost of production accounted for 27.05%. The results show that a total cost of N 592316 was incurred by a respondent per farming season while total revenue of N 976622 was realized with a returning gross margin of N 544528 and the net farm income of N 384306 per farmer per annum, thus indicates that fish farming was profitable in the study area. They are listed some constraints in fish farming it includes insufficient funds, high cost of feed, lack of processing/storage facilities and marketing price fluctuation.

Jia et al. (2016) analysed farm level returns and costs of yellow catfish (*pelteobagrus fulvidraco*) aquaculture obtained from 87 fish farmers that includes farmer's demographics (such as age, education, experience and etc.). The study

reveals that the overall returns – cost ratio was 1.31 and 1.17, respectively in Guangdong and Zhejiang.

Dubey et al. (2016) stated that aquaculture plays a vital role in the socio-economic development of the communities. The study encompasses the prevailing aquaculture practices and socio-economic profile of the fish farmers of Indian Sundarbans delta. They said that majority of fish farmers have medium sized families (60%) and the aquaculture operations was dominated by male workers (98%). The fish farmers belong to low income group (69%) and their annual income lies within 785.75 USD and many farmers practice traditional type farming (74%) and polyculture is prevalent. The study revealed that the government, educational institutes and NGOs, was unsuccessful to develop sustainable aquaculture practice and methods. Disease outbreaks (61%), cyclones and storm surgery (53%), poor quality seed (52%), lack of extension services, technical knowledge, social issues like theft and poisoning are major issues in aquaculture. The reveals that strong technical, financial and extension services from government organisations and research institutions are urgently needed for sustainable development of aquaculture.

MATERIALS
AND
METHODS

Chapter – III

MATERIALS AND METHODS

3.1 Concepts

In any research, conceptualisation is essential for addressing a specific problem. The concepts would help to understand the objectives and the basic issues of the chosen study and permit comparisons with the concepts of similar studies. The concepts used in the present study followed by a short review of earlier studies are discussed in this chapter.

3.1.1 Capital investment

According to Syed et al. (2013), capital investment is the capital invested for land, construction cost of the farm, pipe line, bore well, pumps and motors, aerators and semi – permanent buildings. Chidambaram et al. (2016) refers capital investment to cost of land, pond construction, bund construction, farm accessories and farm structures.

In the present study, capital investment refers to the initial investment related to cost of land/lease value of land and pond construction, pumps and motors, pipe line, bore well, buildings and miscellaneous.

3.1.2 Fixed cost

Lipton and Harrell (1990) defined fixed costs are those that are not altered by a change in the level of production. They included depreciation of medium and long - term capital, opportunity cost of using medium and long - term capital, land rent, land revenue in case of owned land and wages for permanent labour. According to

Sivakumar et al. (2014), fixed cost (for seed rearing and farming of carps) includes cost for pond construction, pipelines and sluice gate. According to Chidambaram et al. (2016), fixed cost includes estimation of depreciation value for machineries, farm structures, farm equipment and farm accessories, interest on capital cost and variable cost and repairs and maintenance.

In the present study, fixed cost include depreciation for capital items such as buildings, pumps and motors, nets, interest on capital investment, repairs and maintenance, salary to permanent staff, watch and ward and miscellaneous expenditure.

3.1.3 Depreciation

Johl and kapur (1973) defined depreciation as “the decline in the value of a given asset as a result of the use, wear and tear and time obsolescence”. The amount of depreciation during a year equals the difference between the purchase price and the salvage value of the asset divided by its economic life. Jia et al. (2016) said that depreciation of the medium and long-term capital is the decline over time in the value of capital, primarily due to wear and tear.

In the present study, the straight-line method was used to compute depreciation for capital items like pumps and motors, pipelines, bore well, buildings and other farm accessories.

The formula used is,

$$\text{Depreciation} = \frac{\text{Purchase Value} - \text{Salvage Value}}{\text{Economic Life Period}}$$

The economic life of different farm equipments was assumed on average, as

Items	Economic life (Years)
Pump and motors	10
Nets	5
Bore well/well	15
Buildings	15

3.1.4 Variable cost

Variable inputs were those that change with level of production (Lipton and Harrell ,1990). The expenditure associated with variable inputs was called short – term capital. Total variable cost was the sum of short – term capital and opportunity cost of using short – term capital. Allah et al. (2014) calculated variable costs under pond preparation, feed, fertilizer, wages of staff and casual labour, fuel, repair and maintenance, food and drinks and other expenses. Sivakumar et al. (2014) calculated variable cost under pond preparation, fertilizer, stocking, feed, labour for feeding, harvesting charges, transport charges, watch and ward and other miscellaneous expenditure.

In the present study, variable cost refers to cost on pond preparation including ploughing, levelling, water filling, fertilization, stocking, feeding, power, fuel, harvesting charges, transport and miscellaneous expenditures.

3.1.5 Total cost

Saxena (2011) defined total cost as addition of variable costs and fixed costs. Tunde AB et al. (2015) included the fixed costs and the variable costs under total cost.

In the present study, sum of fixed costs and variable costs is considered as total costs.

3.1.6 Gross returns

Gross returns were the total monetary receipt generated by sales of all harvested fish (Yuvan, 2007).

In the present study, gross returns is calculated based on the total quantity of fish (GIFT) harvested multiplied by the unit price at the time of sale.

3.1.7 Net returns

Jia et al. (2016) considered net return on the basis of total cost was computed by finding the difference between gross returns and total costs. In the long run, net return over total cost and in short run net return over variable cost must be positive for the farm to be economically viable

In the present study, net return is obtained by deducting total cost from the gross returns.

3.1.8 Inputs

Input is the factor of production required to produce an output. Inputs can be either fixed or variable.

In the present study, land cost/lease value, pond construction, pumps and motors, bore well, buildings are considered under the fixed inputs and fish (GIFT) seed, feed, fertilizer, labour, fuel, electricity etc. are considered under variable inputs.

3.1.9 Output

In the present study, yield of fish (GIFT) from the farmer's pond is considered as output.

3.1.10 Benefit cost ratio

BCR is the ratio between the total returns divided by the total cost.

$$\text{BCR} = \frac{\text{Total Returns (TR)}}{\text{Total Cost (TC)}}$$

If the benefit cost ratio is greater than 1, the aquaculture production is profitable and if it is exactly 1, it means the aquaculture is at breakeven, i.e., neither making profit nor loss. When the ratio is less than 1, the project is operating at a loss.

3.1.11 Fish marketing

Fish marketing includes all those functions involved from the point of harvesting of fish to the final point of consumption. Marketing activities are diverse in nature and include technical marketing functions and commercial marketing functions.

3.1.12 Marketing channel

Senthiladeban and Rajakumar (2004) defined marketing channel as a route through which goods and services are moved from the place of production to the place of consumption.

3.1.13 Primary and secondary occupation

Primary and secondary occupation refers to an occupation from which the major and minor source of household income is obtained by a household and the same concept is used in the present study.

3.1.14 Production function

A production function is the functional relationship between the inputs and the output. It shows the maximum output which can be obtained for a given combination of inputs. It expresses the technological relationship between the inputs and the output of a product. In general, we can represent the production function for a firm as:

$$Y = f (x_1, x_2, \dots, x_n)$$

where Y is the maximum quantity of output, x_1, x_2, \dots, x_n are the quantities of various inputs, and “ f ” stands for functional relationship between the inputs and the output.

Items of output, such as yield from fish ponds and the inputs such seed cost, pond preparation, feed cost, manuring cost, labour cost, pumping cost, transport cost harvesting charges and miscellaneous are used for analysis in the present study.

3.2 Design of the study

Designing a suitable methodology is very important for meaningful analysis of any economic problem. This chapter describes the choice of the study area, sampling procedure, methods adopted in the selection of the respondents, collection of data and the types of statistical analysis carried out.

3.2.1 Choice of the study area

In Tamil Nadu, Krishnagiri and Thanjavur districts were selected as the study area where the GIFT culture is being practiced by a large number of farmers. They undertake tilapia farming continuously because of its profitability and economic viability.

3.2.2 Sampling procedure

The total sample size was fixed as 100 covering both the districts which was equally distributed as extensive and semi-intensive fish farms. The above stated fish farms were selected randomly for the data collection. A survey schedule was prepared based on the objectives of the study and used for collection of data from the farmers. The farmers were contacted individually and the objectives of the study were explained to them before commencing the data collection to ensure their co-operation. The collected data were tabulated and analysed using the appropriate statistical tools. The investigation was carried out between January and March, 2017.

3.2.3 Tools of analysis

The following tools were employed to analyse the collected data.

3.2.3.1 Descriptive analysis

Descriptive statistics attempts to analyse the general demographic characteristics of the farmers such as age, education, occupation, experience, family size, family type and source of income.

3.2.3.2 Percentage analysis

Percentage analysis was followed to analyse the socio – personal characteristics, details of the cost components and the returns from the GIFT tilapia farming (both semi-intensive and extensive). Economic analysis was also carried out to assess the profitability.

3.2.4 Ratio Analysis

3.2.4.1 Benefit cost ratio

$$\text{Benefit Cost Ratio (BCR)} = \frac{\text{Total Returns (TR)}}{\text{Total Cost (TC)}}$$

If the benefit cost ratio is greater than 1, the aquaculture production is profitable and if it is exactly 1, it means the aquaculture is at breakeven, i.e., neither making profit nor loss. When the ratio is less than 1, the project is operating at a loss.

3.2.5 Non – parametric analysis

3.2.5.1 Rank Based Quotient (RBQ)

Rank Based Quotient (RBQ) was used to quantify the production and marketing constraints encountered by GIFT tilapia fish farmers. The respondents were asked to identify the various constraints affecting the GIFT tilapia farming. According to the order of severity, ranks were given by them. For calculating the Rank Based Quotient (RBQ), the following formula was used. (Sabarathnam,1988)

$$R B Q = \frac{\sum F_i [(n + 1) - 1]}{N \times n} \times 100$$

where,

F_i = Number of farmers reporting a particular problem under i^{th} rank

N = Number of farmers

n = Number of problems identified

Based on the mean scores, all the factors were arranged in descending order and the most important factor was ranked first and the least important problem was ranked as the last.

3.3 Description of the study area

Farming technologies are location-specific and hence their performance has to be assessed by understanding the salient characteristics of the research location chosen for the study. In this chapter, an overall description of the study area which includes demographic characteristics, educational status, literacy rate, availability of water sources, rainfall and climatic conditions and the fisheries development are presented.

3.3.1 Thanjavur district

Thanjavur district is the rice bowl of Tamil Nadu because of its agricultural activities in the delta region of the Cauvery river (Ministry of MSME, Govt. of India, 2015-16) which lies in the eastern part of Tamil Nadu. The economy of the district is essentially from agriculture and allied sector (above 75%). Thanjavur district is located in the eastern coast of Tamil Nadu. In October 1991, Thanjavur was bifurcated into Thanjavur and Nagapattinam. Then in April 1997, Tiruvarur district was bifurcated from Nagapattinam district. Again, a part of Thanjavur area (Valangaiman block) was merged with the newly formed Tiruvarur district.

Languages : Tamil, Telugu and Thanjavur Marathi.

Religion : Hindus, Muslims and Christians.

3.3.1.1 Geographical location

Thanjavur district is situated between 10° 47' 13.1964" N latitude and 79° 8' 16.1700" E longitude. The present Thanjavur district was formed with a geographical area of 3411 sq. kms divided into 14 blocks. There are 589 villages and 4363 habitations in the district. Figure 1 shows the Thanjavur district map.

The district boundaries are:

East : Thiruvarur and Nagapattinam districts

West : Trichy and Pudukkottai districts

North : Ariyalur district

South : Pudukkottai district

Thanjavur district has nine taluks viz., Thiruvidaimarudur, Kumbakonam, Papanasam, Thiruvaiyaru, Orathanadu, Thanjavur, Pudukkottai, Budalur and Peravurani.

3.3.1.2 Demographic features

3.3.1.2.1 Population

According to 2011 census, the district has a total population of 2.4 million comprising 1.18 million males and 1.22 million females, respectively. Out of this, the rural and urban populations are 15,54,531 and 8,51,359, respectively accounting for 64.61% and 35.39% of the total population. The density of the population is 705 per sq. km. The population of females per 1000 males is 1035. The district has a total literacy rate of 82.64% among which the male literacy rate being 89.04% and the female literacy rate is 76.50%.

3.3.1.2.2 Water source

The district comes under Cauvery delta and has abundant ground water potential in the shallow aquifers, available for extraction by using centrifugal pumps. Cauvery river is the major source of water for most of the farms in the district. The overall water potential in the district, from shallow water wells to dug-cum bore wells system is good for aquaculture practices.

3.3.1.2.3 Climate and rainfall

The mean maximum temperature is normally 37.48°C during May to July and the mean minimum temperature is 20.82°C during November to January. While the north-east monsoon provides an average rainfall of 953.2 mm and southwest monsoon provides 303.1 mm on an average. During May, dust storms, whirlwind and dusty winds flow from various directions. The south west winds that set during April, become strong in June and continue till September and cyclonic storms of high velocity affect the district once in 3 or 4 years during November - December.

3.3.1.2.4 Transport

Transport facilities are well established in the district for transporting fish seeds, inputs and outputs. Road transport is the primary mode of transport for most of the places in the district.

3.3.1.2.5 Communication

. Postal and telecommunication services are the major sources of communication. Doordharsan television channel and All India Radio, Thiruchirapalli are the major mass media for disseminating information on fisheries activities, besides print media.

3.3.1.3 Agencies Connected with fish culture and fish seed production in the district

3.3.1.3.1 Commercial Banks

The district is having large number of government and private sector banks for serving fisheries sector. NABARD serves for those who want to undertake fish farming and hatchery operations.

3.3.1.3.2 State Fisheries Department (Inland), Thanjavur, Tamil Nadu

The Tamil Nadu State Fisheries Department is primarily concerned with the development of fish culture activities in the districts through FFDA and by providing extension services to seed producers and fish farmers. It is also involved in organizing fish farmers meet and training camps. Apart from these activities, the department undertakes supply of fry and fingerlings to the fish farmers.

3.3.1.3.3 Thanjavur Centre for sustainable Aquaculture (TCeSA), Soorakkotai.

The centre is functioning under the roof of Tamil Nadu Fisheries University. The centre is involved in research and extension services related to fisheries in the district for more than 27 years. It conducts regular on- campus and off- campus training programmes, farmers meet and provides technical advisory services to fish farmers. It educates the farmers to adopt improved techniques in fish culture and fish seed production in these districts.

3.3.1.3.4 Marine Products Export Development Authority (MPEDA)

The Marine Products Export Development Authority at Nagapattinam which provides subsidies, training programmes and technical support to shrimp/freshwater prawn farmers to develop export related activities in the study area.

3.3.1.3.5 Krishi Vigyan Kendra (KVK)

Krishi Vigyan Kendra, located near Chengipatti in Thanjavur district and at Needamangalam in Thiruvarur district, offers training programmes and technical guidance to fish and seed producing farmers in these districts.

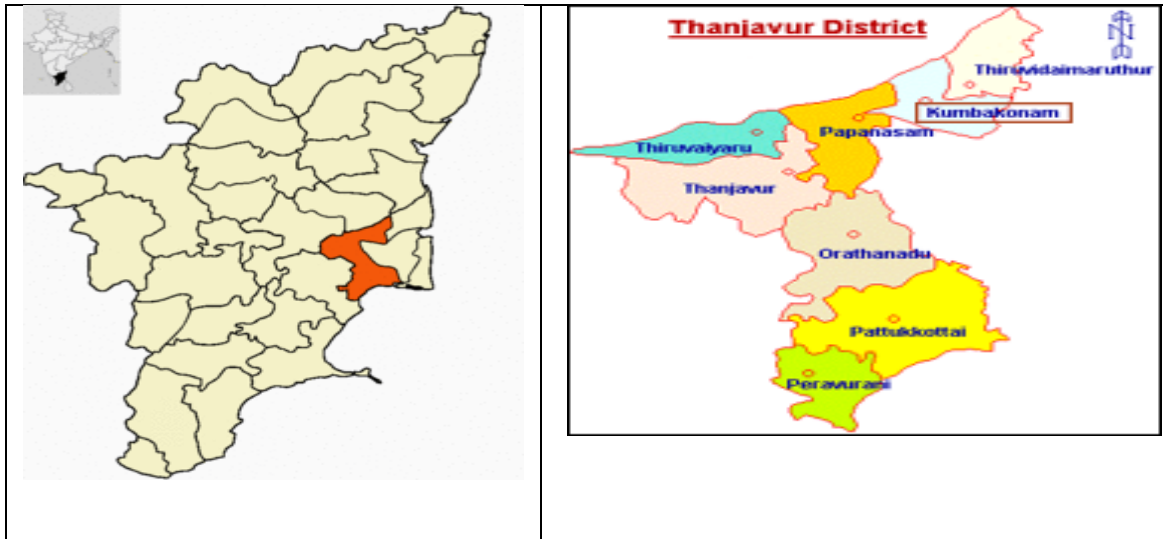


Fig: 1 Map showing the study area – Thanjavur district

3.3.2 Krishnagiri District

Krishnagiri district was formed by whittling out seven taluks and ten blocks of the previous complex Dharmapuri district as the 30th district of Tamil Nadu on 9th February 2004. This district is gifted with black granite hillocks and named as “Krishnagiri”. ‘Krishna’ refers to ‘black’ and ‘giri’ refers to ‘hill’. The society exhibit the confluence of different languages and religion (Ministry of MSME, Govt. of India, 2015-16). The people belonging to Hindu, Islam and Christian religion and speak Tamil, Telugu and Kannada languages.

3.3.2.1 Geographical Location

Krishnagiri district is elevated from 300m to 1400m above the mean sea level and served as gateway of Tamil Nadu. It is located between 12° 31’ 6.9996” N latitude and 78°12’ 49.4532” E longitude (Fig: 2 shows the study area map). The present Krishnagiri district was formed with a geographical area of 5143 sq. kms and the district boundaries are

East : Vellore and Tiruvannamalai district

West : Karnataka state

North : Andhra Pradesh state

South : Dharmapuri district

3.3.2.2 Demographic features

3.3.2.2.1 Population

According to 2011 census, the district has a total population of 1879809 out of which males and females were 0.96 million and 0.91 million, respectively. The rural and urban populations accounts for 77.21% and 22.79% to the total population. The density of the population is 367 per sq. km. The population of females per 1000 males is 958. The district has a total literacy rate of 71.46% among which the male literacy being 78.72% and the female literacy rate is 63.91%.

3.3.2.2.2 Water source

The main rivers that flow across the district are Cauveri and south Pennar, Krishnagiri Reservoir Project (KRP) Dam is the main water source in Krishnagiri district. Shoolagiri – Chinnar reservoir, Thangarai reservoir, Pambar reservoir, Kelevarapalli reservoir and Baarur lake/tank are the other important water sources for Krishnagiri district.

3.3.2.2.3 Climate and Rainfall

Eastern part of the district experiences hot climate and western part has a contrasting cold climate. The average rainfall in the district is 830mm per annum (Ministry of MSME, Govt. of India, 2015-16).

The period of various seasons are,

Summer : May to June

Rainy : July to November

Winter : December to February

3.3.2.2.4 Transport

Transport facilities are well established in the district for transporting fish seeds, inputs and output. Road transport is the prime mode of transport for most of the places in the district. Rail and bus transportations are very useful for the fish farmers.

3.3.2.3 Agencies connected with fish culture and fish seed production in the district

3.3.2.3.1 State Fisheries Department (Inland), Krishnagiri, Tamil Nadu

The State Fisheries Department is primarily concerned with the development of fish culture activities in the districts through FFDA and by providing extension services to seed producers and fish farmers. Also involved in organizing fish farmers meet and training camps. Apart from these activities, the department undertakes supply of fry and fingerlings to the fish farmers.

3.3.2.3.2 Krishnagiri Centre for Sustainable Aquaculture (KCeSA), Barur

KCeSA is located in Barur, Krishnagiri district with the exclusive mandate of developing tilapia breeding techniques, tilapia seed production, tilapia all male seed production and development of low cost grow out technology. The technical knowledge on tilapia farming is transferred to the farmers through periodical conduct of training and awareness programmes. The centre provides training/demonstration and awareness programme to the farmers of Krishnagiri, Dharmapuri, Salem, Vellore, Thiruvannamalai and other adjoining districts.

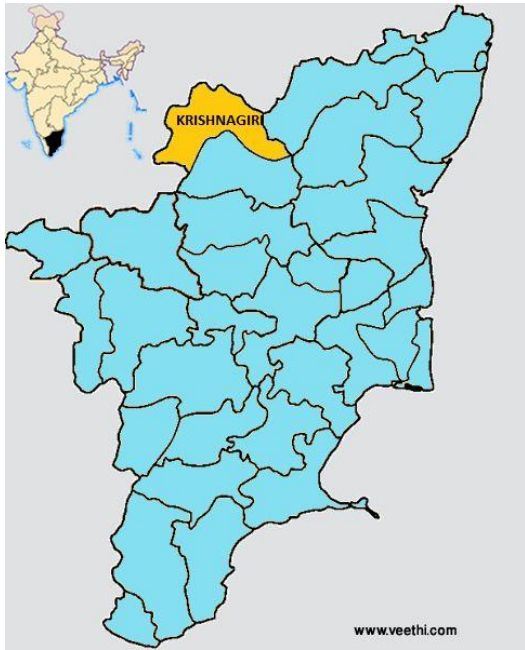


Fig: 2 Map showing the study area

RESULTS
AND
DISCUSSION

Chapter - IV

Results and Discussion

The results of the analyses of the data gathered from semi-intensive and extensive GIFT farmers in the study area and the inferences drawn are presented and discussed in this chapter.

The findings of the study under the following sub-heads are given below

4.1 Socio – economic profile of GIFT farmers

Information on the socio - economic characteristics of the GIFT farmers in the study area are detailed below:

4.1.1 Krishnagiri district

The demographic characteristics of GIFT fish farmers adopting semi -intensive and extensive farming practices are presented in Table 4.1.

In semi – intensive farming, majority (40%) of the GIFT farmers were aged between 40 and 49 years. But in extensive farming, 40% of the farmers were reported in age category of both 30-39 years and 40-49 years. The semi – intensive and extensive farmers belonging to the above age groups could be targeted while planning extension strategies for enhancing the GIFT tilapia production. The educational status of the semi – intensive farmers were found to have equal contribution under primary (20%), upper primary (20%) and high schooling (20%). Ninety six percentage of the extensive farmers were literates and 48% of them have studied upto high school level. About 88% of the farmers of both categories had a family size of upto 5 members. While semi – intensive farmers were following 92% nuclear and 8% joint type family, extensive farmers had 88% and 12%, respectively. All the semi – intensive farmers

belong to Hindu religion. The extensive farmers mostly belong Hindu religion (92%) and only 8% were Christian. Among the reported, 80% of the semi – intensive farmers and 72% of the extensive farmers had aquaculture farming experience up to 10 years.

Table: 4.1 Demographic characteristics of GIFT farmers

Particulars	Semi – intensive (n=25)		Extensive (n=25)	
	No. of fish farmer reported	Percentage (%)	No. of fish farmer reported	Percentage (%)
Age composition				
20-29	3	12.0	1	4
30-39	6	24.0	10	40
40-49	10	40.0	10	40
50-59	5	20.0	4	16
60 or above 60	1	4.0	-	-
Educational Status				
Illiterate	4	16.0	1	4
Primary (up to 5 th standard)	5	20.0	7	28
Upper primary (6 th to 8 th standard)	5	20.0	1	4
High school (9 th & 10 th standard)	5	20.0	12	48
Higher secondary (11 th & 12 th standard)	2	8.0	-	-
Graduates /Others	4	16.0	4	16

Family size				
Up to 5	22	88	23	92
More than 5	3	12	2	8
Family structure				
Nuclear	23	92	22	88
Joint	2	8	3	12
Religion				
Hindu	25	100	23	92
Muslim	-	-	-	-
Christian	-	-	2	8

Table 4.2 presents the occupational status and experience of the respondent farmers. About 80% of the semi – intensive farmers had agriculture as their primary occupation and the remaining (4%) farmers had aquaculture and other avocations (16%) as their primary occupation. From the table, it could be observed that 40% of the extensive farmers were engaged in aquaculture activities and 52% of them had agriculture as their primary occupation. About 84% of both farmers practiced aquaculture as their secondary occupation. This finding is in line with the findings of Chidambaram et al (2016).

Table: 4.2 Occupation and Experience of GIFT farmers

Occupation status	semi-intensive (n=25)				Extensive (n=25)			
	Primary		Secondary		Primary		Secondary	
	No. of fish farmer reported	%	No. of fish farmer reported	%	No. of fish farmer reported	%	No. of fish farmer reported	%
Agriculture	20	80	1	4	13	52	1	4
Aquaculture	1	4	21	84	10	40	21	84
Others	4	16	3	12	2	8	3	12

Farming experience	Aquaculture					
	No. of fish farmer reported	%		No. of fish farmer reported	%	
Up to 10 years	20	80		18	72	
Above 10 years	5	20		7	28	

4.1.2 Thanjavur district:

The demographic characteristics of the respondent - extensive and semi - intensive GIFT fish farmers of Thanjavur district is given in Table 4.3

It could be observed that 60% of semi – intensive farmers fell under 40-49 years age class followed by 50-59 years age class (24%). Most of the extensive farmers (48%) were aged below 30-39 years. All the reported semi – intensive farmers of Thanjavur district were literates. About 28% of them have studied upto primary level followed by graduation (24%). About 60% of the extensive farmers have studied upto high school level and none of the respondents were illiterates. From the table 4.3 it may be revealed that the composition of family members upto 5 and more than 5 members of semi – intensive and extensive fish farmers were 64% & 36% and 76% & 24%, respectively. With regard to family structure, majority of the farmers followed nuclear family (72% - semi-intensive and 76% - extensive farmers). While, 84% of the semi-intensive farmers belong to Hindu religion, 68% of the extensive farmers were Hindus followed by Christians (24%).

Table: 4.3 Demographic characteristics of GIFT farmers

Particulars	Semi – intensive (n=25)		Extensive (n=25)	
	No. of fish farmers reported	Percentage (%)	No. of fish farmers reported	Percentage (%)
Age composition				
20-29	1	4.0	-	-
30-39	1	4.0	12	48.0
40-49	15	60.0	10	40.0
50-59	6	24.0	2	8.0
60 or above 60	2	8.0	1	4.0
Educational Status				
Illiterate	-	-	-	-
Primary (up to 5 th standard)	7	28.0	4	16.0
Upper primary (6 th to 8 th standard)	2	8.0	-	-
High school (9 th & 10 th standard)	8	32.0	15	60.0
Higher secondary (11 th & 12 th standard)	2	8.0	1	4.0
Graduates / Others	6	24.0	5	20.0
Family size				
Up to 5	16	64	19	76
More than 5	9	36	6	24
Family structure				
Nuclear	18	72	19	76
Joint	7	28	6	24
Religion				
Hindu	21	84	17	68

Muslim	3	12	2	8
Christian	1	4	6	24

On the other hand, table 4.4 shows aquaculture is the primary source of income for semi-intensive farmers and agriculture is the primary source of income for 80% of the extensive farmers in Thanjavur district. Also, it was found that 56% of the farmers had more than 10 years of experience in semi-intensive farming. In extensive farming 44% of the farmers had more than 10% of experience and 56% of them had upto 10 years. This finding is in line with the findings of Vedhaviyasar (2010) and Hasib jeelani sayed (2011).

Table: 4.4 Occupation and Experience of GIFT farmers

Occupation status	Semi - intensive (n=25)				Extensive (n=25)			
	Primary		Secondary					
	No. of fish farmer reported	%	No. of fish farmer reported	%	No. of fish farmer reported	%	No. of fish farmer reported	%
Agriculture	12	48	13	52	20	80	1	4
Aquaculture	13	52	12	48	2	8	21	84
Others	-	-	-	-	3	12	3	12
Farming experience	Aquaculture							
	No. of fish farmer reported	%			No. of fish farmer reported	%		
	Up to 10 years	11	44			14	56	
Above 10 years	14	56			11	44		

4.2 Economics of GIFT culture

The GIFT tilapia farming is emerging sector in aquaculture. This is the starting phase for GIFT tilapia farming in Tamil Nadu, most of the farmers were practiced GIFT tilapia farming in small size farm because of lack of awareness among the farmers about GIFT tilapia farming and less seed availability. As all the farmers had less than 1 ha farm size, all the samples were considered as small size farms in the present study. And also, the samples were not classified based on their farm size in this study. The economic analysis of GIFT farming was carried out for one crop with a culture period of 3-4 months for semi-intensive farming and 5-6 months for extensive farming. Only one crop in a year was undertaken by the GIFT farmers of the study area.

4.2.1 Semi-intensive (SI) GIFT farming in Krishnagiri and Thanjavur districts

4.2.1.1 Capital investment

In Krishnagiri district, capital items cost / lease value of land was worked out as 78.86% and the bore well/well, pumps and motors, pond construction, pipe lines, buildings and nets was found to be 12.99%, respectively. The total capital investment was estimated as ₹3,80,313.60 (Table 4.5). Similarly, in Thanjavur district, among the capital investment, cost / lease value of land was the single largest item of the capital investment contributing to 82.27%, followed by the bore well contributing to 11.09% and the remaining items such as pond construction, pumps and motors, buildings and pipe lines accounted to 6.62%. The total capital cost was worked out to ₹5,85,806.60. In both districts land cost contributed a higher percentage to the total capital investment followed by bore well.

4.2.1.2 Fixed cost

The various items of the average fixed cost in Krishnagiri district were salary to permanent staff (40.49%), interest on fixed /borrowed capital (33.59%), watch and

ward (17.19%), repairs and maintenance (5.21%) and depreciation (3.71%). The mean total fixed cost per annum was worked out to ₹1,47,147.62 / acre (Table 4.6).

Alternatively, in Thanjavur district the total fixed cost was worked out to ₹1,55,380.13 / acre / annum. The average fixed cost items include interest on fixed/borrowed capital contributing 45.24% followed by the salary to permanent staff (28.53%), watch and ward (44.77%), repairs and maintenance (6.18%) and depreciation (3.79%) (Table 4.6). In both districts, interest on fixed capital and permanent staff wages accounted high percentage to the mean total fixed cost.

4.2.1.3 Variable cost

The table 4.7 indicated that the average variable cost was ₹61,669 consisting of seed (31.35%) and feed (30.07%) which contributed 61.42% to the total variable cost. The remaining items include pond preparation (17.71%), organic and inorganic manuring (6.98%), hired labour (5.66%), water pumping (3.07%), harvesting (2.83%), transport (1.96%) and miscellaneous (0.31%) in Krishnagiri district

In Thanjavur district, feed and seed cost occupied the largest contribution (64.73%) the total variable cost and the remaining items of variable cost pond preparation (13.02%), fertilizers (7.97%), pumping cost (6.73%), labour (4.25%), harvesting (1.42%), transport (1.37%) and miscellaneous (0.82%)

The results of the study revealed that seed cost and feed cost had a greater contribution to the total variable cost in both the districts.

4.2.1.4 Economics of semi – intensive GIFT farming

The sum total of the total fixed cost and variable cost would give the total cost of the GIFT farming (Table 4.8). The estimated total cost of the GIFT farming was ₹1,10,718.18 per acre of which total fixed cost and total variable cost accounted for 44.30% and 55.69% in Krishnagiri district, respectively. The gross returns and average net returns were ₹1,53,556.79 and ₹42,838.61, respectively

In Thanjavur district, the total cost of the GIFT farming was estimated as ₹1,45,714.18 per acre of which total fixed cost and total variable cost accounted to 33.55% and 64.45%, respectively. The gross returns and net returns was estimated to be ₹1,78,502.47 and ₹32,788.35, respectively.

The benefit cost ratio on total cost basis was 1.38 and 1.22 for Krishnagiri and Thanjavur districts, which indicated that for every rupee of investment, a return of ₹1.38 and 1.22 for the respective districts were obtained. The semi – intensive GIFT farming was thus profitable in both the districts.

Krishnamurthy (2001) assessed the fish culture in borewell water storage ponds in Karnataka and inferred that an average yield of 1,250 kg of fish per hectare per year and a total income of 56 lakhs was obtained @ ₹30 / kg. and concluded fish culture as more beneficial venture for the farmers.

Table: 4.5 Items of capital investment of the GIFT farming

Items of Capital Investment	SI –Krishnagiri		SI - Thanjavur	
	Amount (₹/ acre)	Percentage	Amount (₹/acre)	Percentage
Cost of land/lease value of land	299930.31	78.86	481957.54	82.27

Pond construction	19599.30	5.15	19221.69	3.28
Pipe lines	2526.13	0.66	1466.98	0.25
Bore well/well	31010.45	8.15	64976.41	11.09
Pumps and motors	24006.96	6.31	12146.22	2.07
Nets	1742.16	0.45	1674.52	0.28
Buildings	1498.25	0.39	4363.20	0.74
Total	380313.60	100	585806.60	100

Table: 4.6 Items of fixed cost of the GIFT farming

Items of Fixed cost	SI - Krishnagiri		SI - Thanjavur	
	Amount (₹/acre)	Percentage	Amount (₹/acre)	Percentage
Depreciation	5454.24	3.71	5897.01	3.79
Interest on fixed/borrowed capital	49149.83	33.59	70296.80	45.24
Repair and Maintenance	7665.51	5.21	9610.85	6.18
Salary to permanent staff	59581.88	40.49	44339.62	28.53
Watch and ward	25296.17	17.19	25235.85	16.24
Total	147147.62	100	155380.13	100

Table: 4.7 Items of variable cost of the GIFT farming

Items of Variable cost	SI - Krishnagiri		SI – Thanjavur	
	Amount (₹/ acre)	Percentage	Amount (₹/ acre)	Percentage
Pond preparation	10923.35	17.71	12228.77	13.02
Manuring	4310.11	6.98	7488.20	7.97
Seed	19337.97	31.35	28147.16	29.96
Feed	18545.29	30.07	32665.09	34.77
Pumping cost	1898.95	3.07	5990.56	6.37
Harvesting	1749.13	2.83	1337.26	1.42
Transport cost	1212.54	1.96	1290.09	1.37
Temporary Labour	3494.77	5.66	3997.64	4.25
Miscellaneous	196.86	0.31	775.94	0.82
Total	61669	100	93920.75	100

Table: 4.8 Economics of semi-intensive GIFT culture

District Name	Total fixed cost (₹/ acre)	Total variable cost (₹/ acre)	Total cost (₹/ acre)	Gross returns (₹/ acre)	Net returns (₹/acre)	BCR
Krishnagiri	49049.20	61668.98	110718.18	153556.79	42838.61	1.38
Thanjavur	51793.37	93920.75	145714.12	178502.47	32788.35	1.22

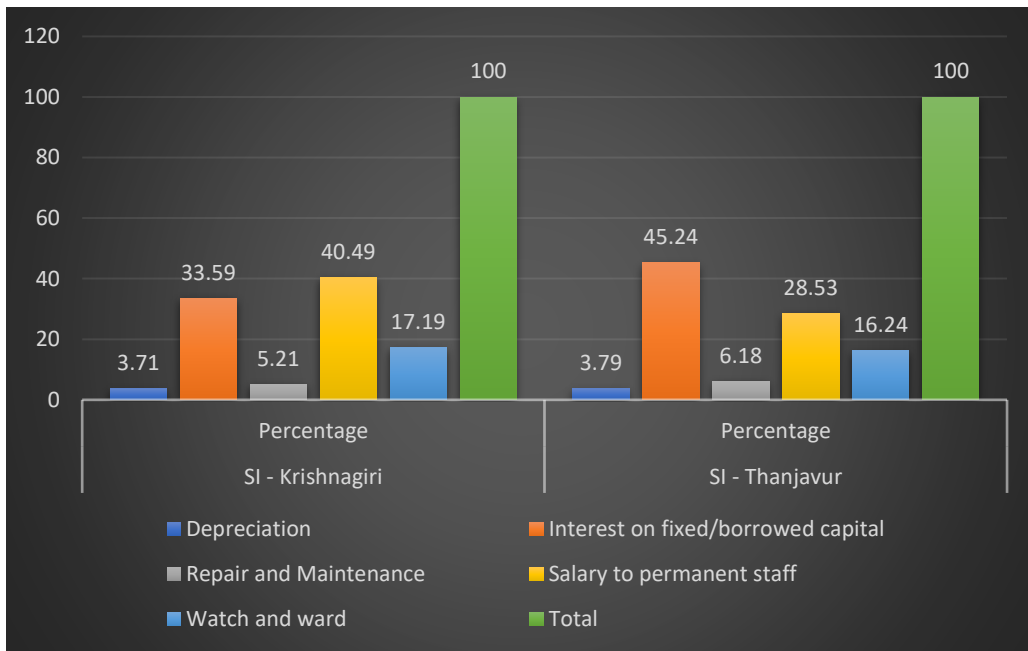


Fig:3 Fixed cost components in semi-intensive GIFT farming

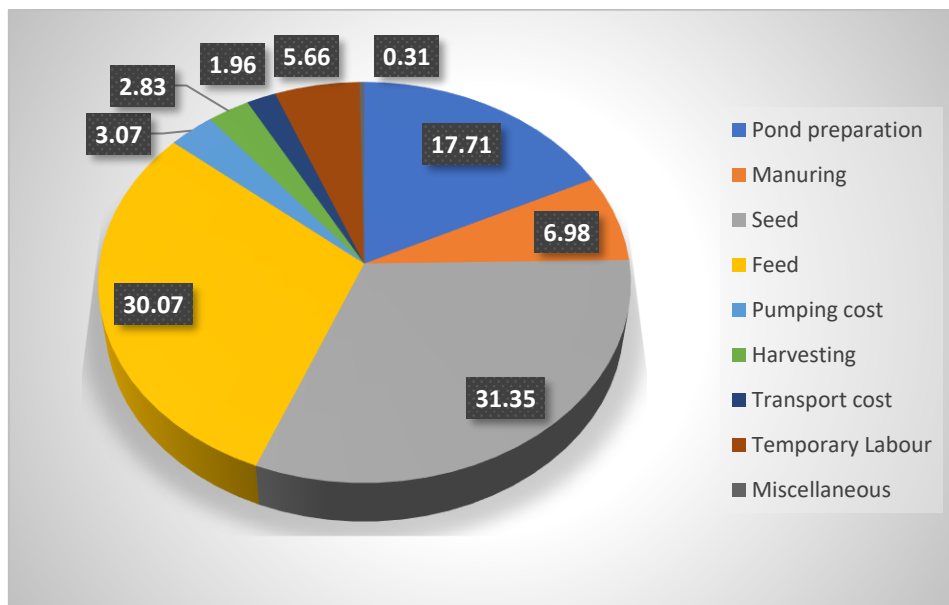


Fig:4 Distribution of Variable cost for semi-intensive GIFT farming in Krishnagiri district

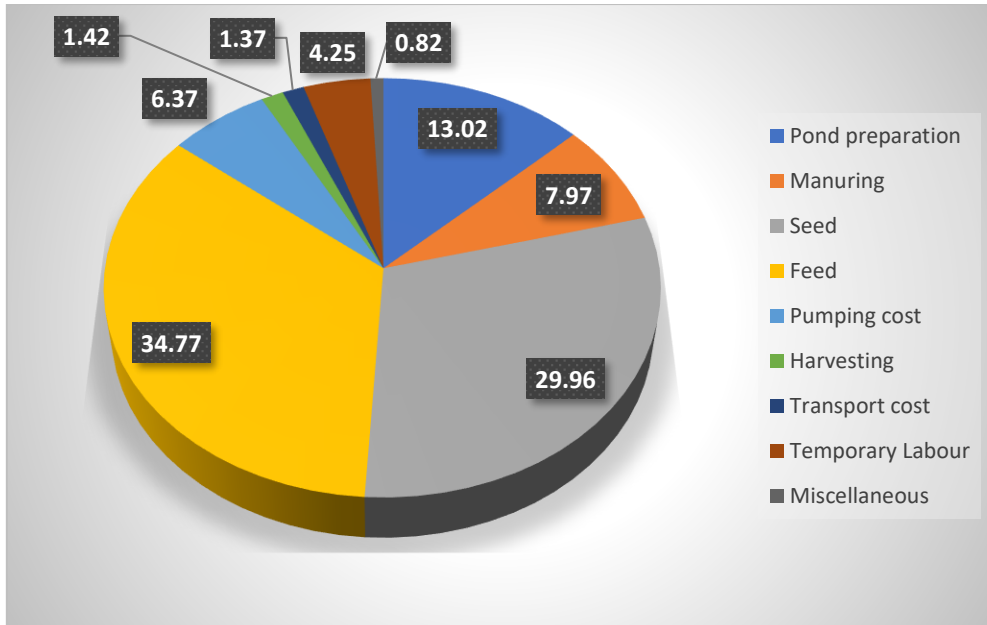


Fig:5 Distribution of variable cost for semi-intensive GIFT farming in Thanjavur district

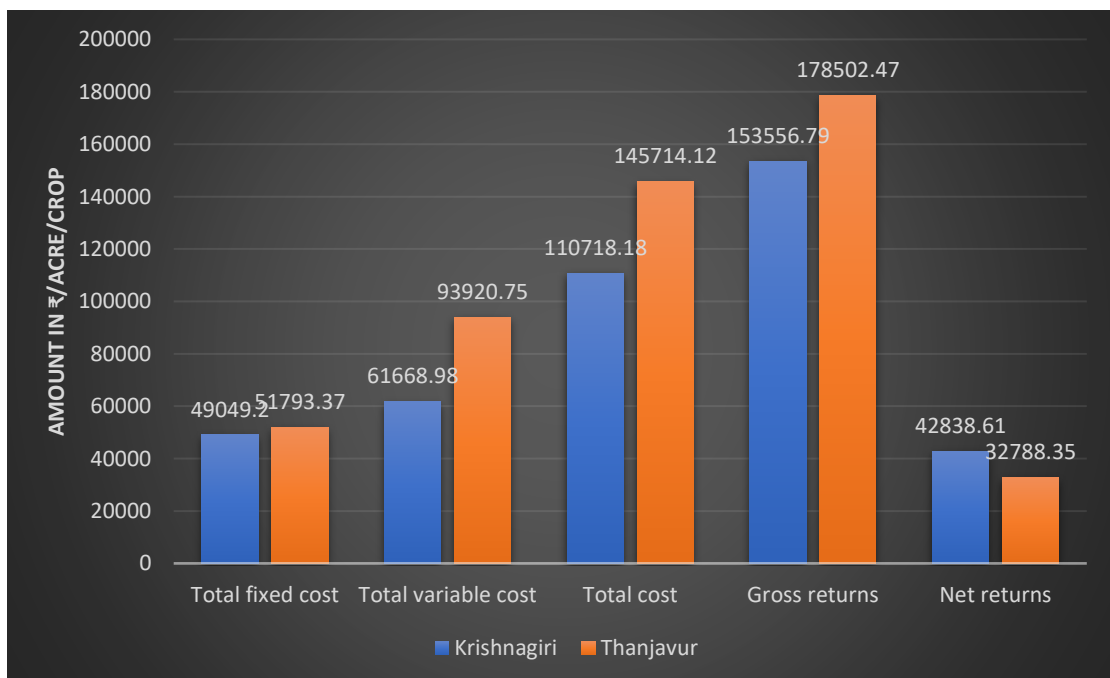


Fig: 6 Economics of semi-intensive GIFT tilapia farming

4.2.2 Extensive GIFT farming in Krishnagiri and Thanjavur districts.

4.2.2.1 Capital investment

Among the items of capital investment, cost of/lease value of land was the single largest item of the capital investment contributing to 89.52% and the remaining items such as pond construction (4.69%), pumps and motors (4.5%), bore well/well (0.90%), pipe lines (0.34%). The total capital investment was worked out to ₹4,47,081.87 in Krishnagiri district (Table 4.9).

Similarly, in Thanjavur district among the capital investment, cost of/lease value of land was the single largest item of capital investment contributing to 84.68%, followed by the pond construction contributing to 6.62%, pipe lines (0.58%), bore well/well (4.74%), pumps and motors (3.35%). The total capital investment of GIFT farmer respondents was estimated as ₹4,03,553.39/acre

In both districts, cost towards land and pond construction had a greater contribution to the total capital cost.

4.2.2.2 Fixed cost

The total fixed cost per annum was calculated at ₹1,06,097.84 in Krishnagiri district. Among the fixed cost items, interest on fixed/borrowed capital contributed to 50.56% followed by salary to permanent staff (26.06%), watch and ward (17.05%), repairs and maintenance (4.26%) and depreciation (2.45%) (Table 4.10).

Alternatively, in Thanjavur district, the estimated total fixed cost per annum was ₹1,10,553.546 consisting of interest on fixed/borrowed capital (43.80%) followed by salary to permanent staff (35.10%), watch and ward (14.10%), repairs and maintenance (4.54%) and depreciation (2.45%).

In both districts, interest on fixed capital and wages for permanent staff contributed much towards the total fixed cost.

4.2.2.3 Variable cost

Among the items of variable cost, seed cost was the only item which contributed 30.93% to the total variable cost. The remaining items of variable cost such as pond preparation, organic and inorganic manuring, temporary labour cost, water pumping cost, harvesting charges, transport charges and miscellaneous accounted for 69.02% of total variable cost in Krishnagiri district.

Similarly, in Thanjavur district seed and pond preparation costs were the items which had a greater contribution (44.97%) to the total variable cost and the remaining items of variable cost such as pond preparation, fertilizers, pumping cost, labour, harvesting, and transport and miscellaneous accounted to 54.99%.

From the analysis, it may be found that feed cost was low in extensive farming when compared to semi – intensive farming. On the other hand, seed cost and pond preparation accounted high values in both farming practices.

4.2.2.4 Economics of extensive GIFT culture

The total fixed cost and the variable cost was calculated as ₹53,048.93 and ₹43,910.06, respectively with a total cost of ₹96,958.99 per acre. The gross returns and the net returns was estimated as ₹1,38,378.52 and ₹41,419.53 for Krishnagiri district (Table 4.12).

In Thanjavur district, the estimated total cost of ₹1,06,769.14 per acre include the total fixed cost and the variable cost of ₹55,276.77 and ₹51,492.37, respectively.

The gross returns and the net returns was estimated as ₹1,44,726.76 and ₹37,957.62, respectively

The BCR estimated on the basis of total cost was worked out to 1.4 and 1.3 respectively, in Krishnagiri and Thanjavur districts which indicated the profitability of extensive GIFT farming in both the districts. Setty Ajay (2001) assed the economics of freshwater aquaculture in Thanjavur district, Tamil Nadu and inferred that BCR was 1.29. It indicates GIFT farming was more profitable than carp farming.

Gurunathan and Raghuram (2011) studied the profitability of Inland fish farms in Thanjavur district in Tamil Nadu. The study indicated that on an average ₹1,20,120 per ha was net returns assuring GIFT farming was a more profitable venture when compare to the carp farming.

The present comparative study indicated that a net return per acre was high in Krishnagiri district when compared to Thanjavur district. Fig 4 Indicated economics of extensive GIFT farming in Kriahnagiri and Thanjavur districts.

Table: 4.9 Items of capital investment of the GIFT farming

Items of Capital Investment	EXT –Krishnagiri		EXT - Thanjavur	
	Amount in (₹/ acre)	Percentage	Amount in (₹/ acre)	Percentage
Cost of land/lease value of land	400268.45	89.52	341747.57	84.68
Pond construction	20993.28	4.69	26740.63	6.62
Pipe lines	1551.67	0.34	2374.47	0.58
Bore well/well	4026.84	0.90	19140.08	4.74
Pumps and motors	20241.61	4.5	13550.62	3.35

Nets	-	-	-	-
Buildings	-	-	-	-
Total	447081.87	100	403553.39	100

Table: 4.10 Items of fixed cost of GIFT farming

Items of Fixed cost	EXT - Krishnagiri		EXT - Thanjavur	
	Amount in (₹/ acre)	Percentage	Amount in (₹/ acre)	Percentage
Depreciation	2179.59	2.05	2709.66	2.45
Interest on fixed/borrowed capital	53649.82	50.56	48426.40	43.80
Repairs and Maintenance	4523.48	4.26	5020.80	4.54
Salary to permanent staff	27651.00	26.06	38807.21	35.10
Watch and ward	18093.95	17.05	15589.45	14.10
Total	106097.84	100	110553.54	100

Table: 4.11 Items of variable cost of GIFT farming

Items of Variable cost	EXT - Krishnagiri		EXT – Thanjavur	
	Amount in (₹/ acre)	Percentage	Amount in (₹/ acre)	Percentage
Pond preparation	10604.02	24.14	9126.21	17.72
Manuring	4456.37	10.14	7780.85	15.11
Seed	13583.89	30.93	14036.06	27.25
Feed	7852.34	17.88	8599.16	16.69
Pumping cost	2281.87	5.19	4160.88	8.08
Harvesting	1774.49	4.04	2080.44	4.04
Transport cost	985.23	2.24	920.94	1.78
Temporary Labour	2220.13	5.05	3911.23	7.59
Miscellaneous	151.67	0.34	876.56	1.70
Total	43910.01	100	51492.37	100

Table: 4.12 Economics of extensive GIFT culture

District Name	Total fixed cost (₹/ acre)	Total variable cost (₹/ acre)	Total cost (₹/ acre)	Gross returns (₹/ acre)	Net returns (₹/ acre)	BCR
Krishnagiri	53048.93	43910.06	96958.99	138378.52	41419.53	1.4
Thanjavur	55276.77	51492.37	106769.14	144726.76	37957.62	1.3

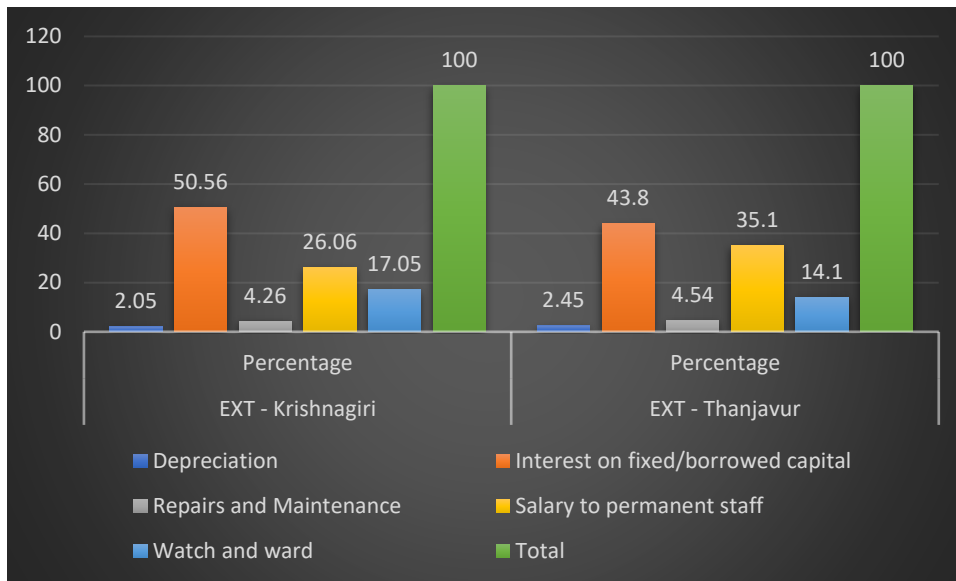


Fig: 7 Fixed cost components in extensive GIFT farming

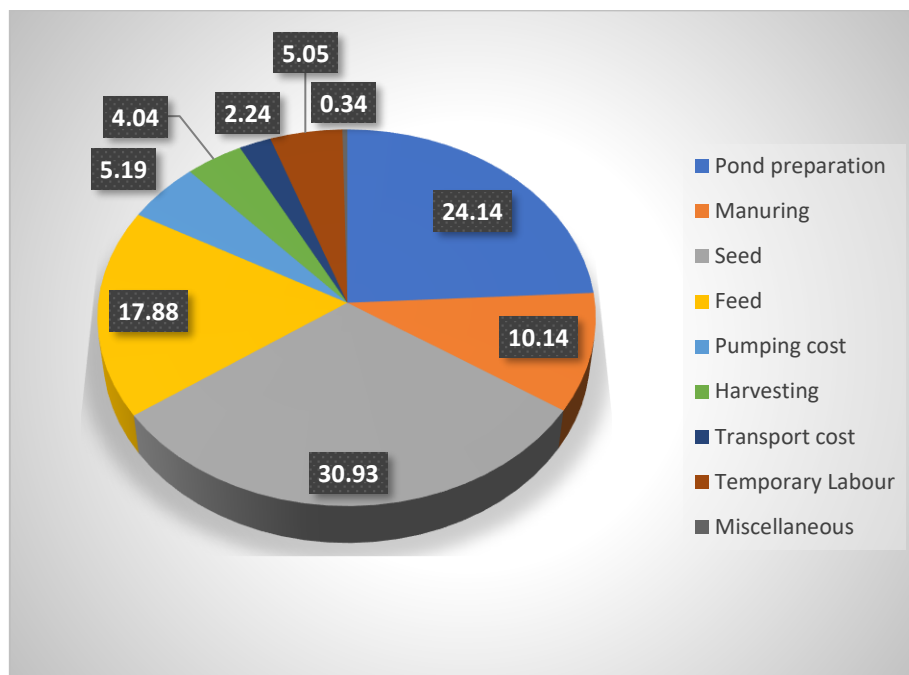


Fig: 8 Distribution of variable cost for extensive GIFT farming in Krishnagiri district

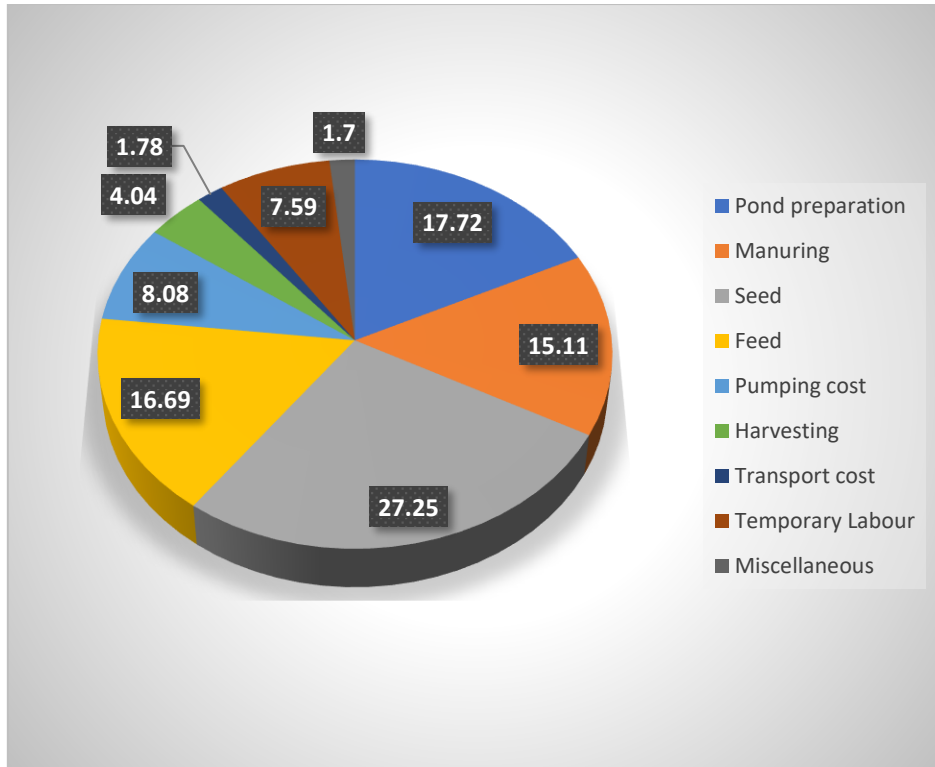


Fig: 9 Distribution of variable cost for extensive GIFT farming in Thanjavur district

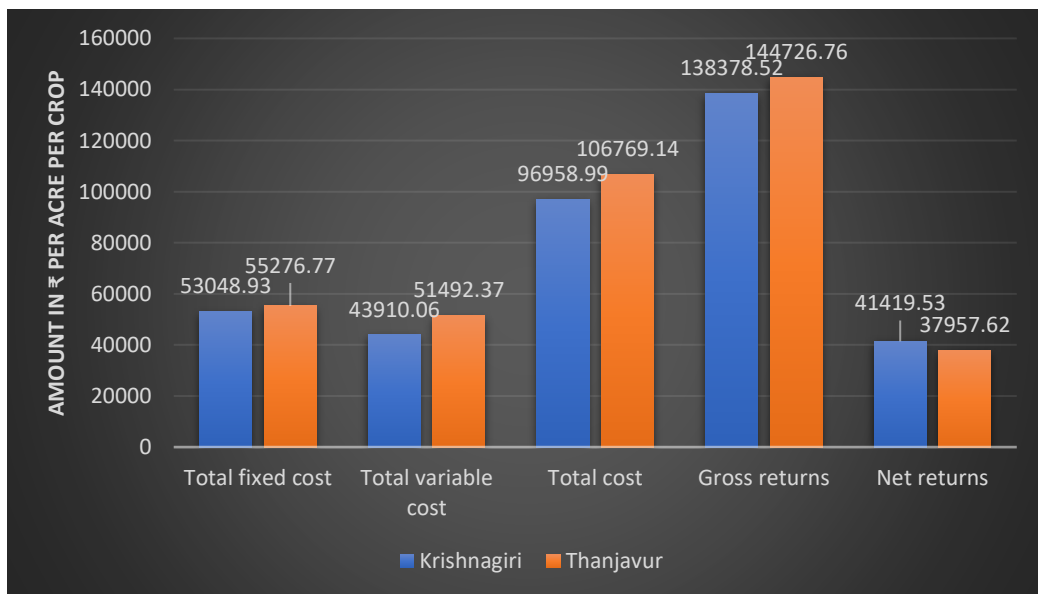


Fig: 10 Economics of extensive GIFT farming

4.2.3 Production function analysis of semi-intensive GIFT farming

The factors determining the profitability of semi – intensive GIFT farming in Krishnagiri district was studied by production function analysis. The linear regression model was analysed using SPSS statistical package (SPSS 16.0) and the estimated function for the GIFT tilapia farming is presented below:

$$Y_1 = f (x_1, x_2, \dots\dots\dots x_9)$$

Where,

(Y₁ – Total returns, X₁ – pond preparation, x₂ – manuring, x₃ – stocking cost, x₄ – feeding cost, x₅ – pumping cost, x₆ – harvesting charges, x₇ – transport cost, x₈ – temporary labour cost and x₉ – miscellaneous expenditure)

The estimated production function of Krishnagiri district is

$$\begin{aligned}
 Y_1 = & 39382.924 + 0.140X_1^{NS} - 0.239X_2^{NS} + 1.151X_3^* + - 0.080X_4^{NS} \\
 & (47164.035) \quad (1.378) \quad (-1.404) \quad (3.753) \quad (-0.245) \\
 & -0.041X_5^{NS} - 0.172X_6^{NS} + 113X_7^{NS} - 0.022X_8^{NS} \\
 & (-0.342) \quad (-0.825) \quad (0.661) \quad (-0.210) \\
 & + 0.288X_9^* \\
 & (2.945)
 \end{aligned}$$

$$R^2 = 0.911$$

$$F \text{ value} = 16.985$$

$$N = 25$$

Note: Figures in parentheses indicate standard error

* Significant at 5 % level

NS = Not significant

The partial regression co-efficient of seed cost and miscellaneous were positive and significant at $p = 0.05$. The regression co-efficient of other independent variables were not significant in the estimated function in the case of semi-intensive GIFT tilapia farming in Krishnagiri district.

Based on the linear regression analysis, it was found that seed cost and miscellaneous cost influence the total returns. Hence, it is concluded that reduction of seed cost and miscellaneous cost will increase the total returns and net returns.

$$Y_2 = f (X_1, X_2, \dots, X_9)$$

Where,

(Y_2 – Total returns, X_1 – pond preparation, x_2 – manuring, x_3 – stocking cost, x_4 – feeding cost, x_5 – pumping cost, x_6 – harvesting charges, x_7 – transport cost, x_8 – temporary labour cost and x_9 – miscellaneous expenditure)

The estimated production function of Thanjavur district is

$$\begin{aligned}
 Y_2 = & 8261.317 - 0.017 X_1^{NS} + 0.028 X_2^{NS} + 0.443 X_3^* + 0.489 X_4^* \\
 & (49005.912) \quad (2.413) \quad (4.360) \quad (0.720) \quad (0.579) \\
 & - 0.174 X_5^{NS} + 0.009 X_6^{NS} + 0.194 X_7^{NS} + 0.094 X_8^{NS} \\
 & (3.075) \quad (54.719) \quad (22.988) \quad (5.580) \\
 & - 0.041 X_9^{NS} \\
 & (19.324)
 \end{aligned}$$

$$R^2 = 0.946$$

$$F \text{ value} = 29.096$$

$$N = 25$$

Note: Figures in parentheses indicate standard error

* Significant at 5 % level

NS = Not significant

The partial regression co-efficient of seed cost and feed cost were positive and significant at $p = 0.05$. The regression co-efficient of other independent variables were not significant in the estimated function in the case of semi-intensive GIFT farming in Thanjavur district.

Based on the above, it is concluded that seed cost and feed cost influence the total returns and hence reduction of seed cost and feed cost in semi – intensive will increase the total returns and net returns.

4.2.4 Production function analysis of extensive GIFT tilapia farming

$$Y_3 = f (X_1, X_2, \dots, X_9)$$

Where,

(Y_3 – Total returns, X_1 – pond preparation, x_2 – manuring, x_3 – stocking cost, x_4 – feeding cost, x_5 – pumping cost, x_6 – harvesting charges, x_7 – transport cost, x_8 – temporary labour cost and x_9 – miscellaneous expenditure)

The estimated production function of Krishnagiri is

$$\begin{aligned} Y_3 = & -8766.286 + 0.315 X_1^* + 0.023 X_2^{NS} + 0.183 X_3^* + 0.240 X_4^{NS} \\ & (20018.300) \quad (1.583) \quad (4.312) \quad (0.991) \quad (1.468) \\ & + 0.240 X_5^* - 0.211 X_6^{NS} + 0.240 X_7^{NS} + 0.110 X_8^{NS} \\ & (2.517) \quad (9.714) \quad (38.923) \quad (18.197) \\ & + 0.091 X_9^{NS} \\ & (22.435) \end{aligned}$$

$$R^2 = 0.951$$

$$F \text{ value} = 32.319$$

$$N = 25$$

Note: Figures in parentheses indicate standard error

* Significant at 5 % level

NS = Not significant

The partial regression co-efficient of seed cost, pond preparation cost and pumping cost were positive and significant at $p = 0.05$. The regression co-efficient of other independent variables were not significant in the estimated function.

The results of the linear regression analysis showed that seed cost, pond preparation cost and pumping cost influence the total returns. Which indicate that reduction of the above three items will increase the total returns and net returns in extensive GIFT farming of Krishnagiri district.

$$Y_4 = f(x_1, x_2, \dots, x_9)$$

Where,

(Y_4 – Total returns, X_1 – pond preparation, x_2 – manuring, x_3 – stocking cost, x_4 – feeding cost, x_5 – pumping cost, x_6 – harvesting charges, x_7 – transport cost, x_8 – temporary labour cost and x_9 – miscellaneous expenditure)

The estimated production function of Thanjavur district is

$$\begin{aligned} Y_4 = & -19488.729 + 0.395 X_1^{NS} + 0.111 X_2^{NS} + 0.486 X_3^* + 0.459 X_4^{NS} \\ & (60932.764) \quad (3.127) \quad (3.912) \quad (1.097) \quad (5.897) \\ & + 0.533 X_5^{NS} + 0.282 X_6^{NS} - 0.753 X_7^{NS} - 0.515 X_8^{NS} \\ & (7.584) \quad (21.753) \quad (58.258) \quad (6.787) \\ & + 0.212 X_9^{NS} \\ & (31.514) \end{aligned}$$

$$R^2 = 0.621$$

$$F \text{ value} = 2.734$$

$$N = 25$$

Note: Figures in parentheses indicate standard error

* Significant at 5 % level

NS = Not significant

The partial regression co-efficient of seed cost was positive and significant at $p = 0.05$. The regression co-efficient of other independent variables were not significant in the estimated function which indicate that seed cost had a greater influence over the total returns. In case of extensive GIFT farming in Thanjavur district.

4.3 Marketing of farmed GIFT in the study area

Marketing is an important aspect of any production venture. Marketing is one of the most important aspects in fish production as it is a highly perishable commodity. The marketing aspects such as the marketing channel, marketing cost and physical flow of GIFT farmer respondents in Krishnagiri and Thanjavur districts are detailed as follows.

In both districts, GIFT farmers followed different marketing channel. However, following are some of the important factors that influence the choice of marketing channel.

- ❖ Price and quality of fish
- ❖ Demand for fish
- ❖ Distance between the farm and nearby established marketing centres
- ❖ Timing and number of market
- ❖ Profitability of the channel and
- ❖ Occupation status of the farmers etc

4.3.1 Krishnagiri district

In Krishnagiri district, four type of marketing channels were observed among the farmers.

Channel 1: Fish farmer/Producer → Consumer (16%)

Channel 2: Fish farmer/Producer → Retailer → Consumer (24%)

Channel 3: Fish farmer/Producer → Wholesaler → Retailer → Consumer (48%)

Channel 4: Fishfarmer/Producer → Wholesaler → Vendor → Consumer (12%)

Among the observed marketing channels, channel 3 was adopted frequently by the GIFT farmers of Krishnagiri district. Moreover, In Krishnagiri district, large quantity of farmed GIFT was distributed to Krishnagiri, Dharmapuri, Hosur and Okanacal with a very less distribution of fishes to nearby local market and farm gate sales. This finding is in line with the findings of Chidambaram et al (2016).

4.3.2 Thanjavur district

The information collected from the GIFT farmers revealed the following marketing channels in Thanjavur district.

Channel 1: Fish farmer/Producer → Consumer (30%)

Channel 2: Fish farmer/Producer → Retailer → Consumer (25%)

Channel 3: Fish farmer/Producer → Wholesaler → Retailer → Consumer (15%)

Channel 4: Fish farmer/Producer → Wholesaler → Vendor → Consumer
(10%)

Channel 5: Fish farmer/Producer → vendor → consumer (10)

Channel 6: Fish farmer/Producer → Wholesaler-Cum-commission agent →
consumer (10)

These six types of marketing channels were commonly observed in Thanjavur district and among them, channel 1 (30%) and channel 2 (25%) were adopted frequently by the GIFT farmers in the study area.

While small quantity of farmed GIFT was found to be distributed in local market and farm outlets in Krishnagiri district, large quantity of farmed GIFT was moved to nearby local market and farm direct sales in Thanjavur district. The rest of farmed GIFT fish was taken to Thanjavur, Kumbakonam, Papanasam and Thiruvaiyaru.

Jayaraman (2000) studied the marketing of cultured carps in Thanjavur district, Tamil Nadu and four types of channels were identified and also Nagoor Meeran (2005) accessed marketing behaviour of fish farmers in the district. He revealed that majority of the respondents (76.67%) marketed their produce through producer → consumer channel.

4.4 Constraints of GIFT farmers

The constraints of the GIFT farmers practising semi – intensive and extensive farming of Krishnagiri and Thanjavur districts are presented in Table 4.13 and 4.14. Rank based Quotient method (RBQ) was used to inter judge the consensus among the GIFT farmers in ranking the 14 constraints affecting the GIFT farming.

4.4.1 Semi - intensive

Among the constraints reported, Inadequate availability of quality GIFT seeds was reported by all the semi- intensive GIFT farmers in Krishnagiri district (Table 4.13) representing 31.05. followed by high cost of supplementary/pelleted feed (30.57), poor quality of GIFT seeds (30.29), unavailability of skilled labour (24.76) and low farm gate price (21.24) (Table 4.13).

Alternatively, in Thanjavur district poor quality of GIFT seeds (28.67), high cost of supplementary/pelleted feed (28.38), unavailability of quality GIFT seeds (28.29), short supply of water (28.10) and fish poaching (24.38) was the major five constraints faced by GIFT farmers (Table 4.13).

Theft and pilferages, non-availability of fish seeds, lack of government support both technically and financially, quarrel and litigations among the owners of the pond, poor adaptability of fish seed in new environment, labour crisis, cut throat competition, inconsistent supply of fish, lack of storage facilities etc. were major constraints faced by fish farmers of West Bengal, reported by Rahaman et al. (2013) and Prithwiraj jha et al. (2004) identified constraints of fish farming in West Bengal, they inferred that training should be given to the farmers for their success in fish farming.

4.4.2 Extensive

While ranking the constraints high cost of supplementary/pelleted feed (33.52), unavailability of quality GIFT seed (30.67), poor quality of GIFT seed (29.24), low farm gate price (26.19) and problem of direct selling to buyers (20.76) were the top five constraints of extensive GIFT farmers in Krishnagiri district (Table 4.14).

In Thanjavur district, unavailability of quality GIFT seed (28.38), Poor quality of GIFT seeds (26.48), Short supply of water (25.71), High cost of supplementary / pelleted feed (24.00) and Poaching (22.76) were the major five constraints

Panday and Dewan (2006) analysed the constraints in fish farming practices in Uttar Pradesh, India. They concluded that financial, social and technical constraints was adversely affecting the farmers expected yield and income.

Table: 4.13 Constraints of semi-intensive GIFT farmers

Constraints	SI –Krishnagiri		SI - Thanjavur	
	Mean score	Rank	Mean score	Rank
Inadequate availability of quality GIFT seeds	31.05	i	28.29	iii
Short supply of water	13.43	xi	28.10	iv
High cost of supplementary / pelleted feed	30.57	ii	28.38	ii
High cost of electricity Tariff	13.81	ix	18.38	vii
Non-availability of skilled labour	24.76	iv	18.57	vi
Prevalence of disease outbreak in culture ponds	16.10	vii	11.24	x
Low farm gate price	21.24	v	6.19	xiii
Low net returns	14.86	viii	7.62	xii
Problem of direct selling to buyers	18.48	vi	17.81	viii
Poor quality of GIFT seeds	30.29	iii	28.67	i
Tied sale	13.71	x	15.14	ix
High mortality during culture period	9.52	xiii	4.48	xiv
Low total Productivity	9.81	Xii	10.38	xi
Poaching	-	-	24.38	v

Table: 4.14 Constraints of extensive GIFT farmers

Constraints	EXT –Krishnagiri		EXT - Thanjavur	
	Mean score	Rank	Mean score	Rank
Inadequate availability of quality GIFT seeds	30.67	ii	28.38	i
Short supply of water	12.57	x	25.71	iii
High cost of supplementary / pelleted feed	33.52	i	24.00	iv
High cost of electricity Tariff	16.48	viii	15.05	vii
Non-availability of skilled labour	19.81	vi	13.52	viii
Prevalence of disease outbreak in culture ponds	9.14	xii	11.52	xii
Low farm gate price	26.19	iv	12.76	ix
Low net returns	12.00	xi	11.52	xi
Problem of direct selling to buyers	20.76	v	21.05	vi
Poor quality of GIFT seeds	29.24	iii	26.48	ii
Tied sale	19.52	vii	11.33	xiii
High mortality during culture period	7.81	xiii	11.05	xiv
Low total Productivity	13.62	ix	12.19	x
Poaching	-	-	22.76	v

SUMMARY
AND
CONCLUSION

Chapter - V

Summary and Conclusion

5.1 Summary

The present study was carried out to analyse the comparative evaluation of extensive and semi-intensive GIFT culture practices in Krishnagiri and Thanjavur districts, Tamil Nadu. The specific objectives of the study were to study the present status of GIFT farming practices adopted by the fish farmers, to analyse the cost and returns of extensive and semi-intensive GIFT farming, to examine the marketing aspects of the harvested GIFT and to identify the constraints and to formulate strategies for the overall development of GIFT farming.

Krishnagiri and Thanjavur districts were chosen as the study area and the total sample size was fixed as 100 for the present study which was equally distributed as 25 semi-intensive and 25 extensive fish farms in both districts. The sample fish farms were selected randomly for the data collection in the present study.

5.1.1 Socio – economic profile

5.1.1.1 Krishnagiri district

In semi – intensive farming, majority (40%) of the GIFT farmers were aged between 40-49 years. But in extensive farming, 40% of the farmers were reported in age category of both 30-39 years and 40-49 years. The semi – intensive and extensive farmers belonging to the above age groups could be targeted while planning extension strategies for enhancing the GIFT tilapia production.

The educational status of the semi – intensive farmers were found to have equal contribution under primary (20%), upper primary (20%) and high schooling (20%). 96% of the extensive farmers were literates and most (48%) of them have studied upto high school level.

About 88% of the farmers of both categories had a family size of upto 5 members. While semi – intensive farmers were following 92% nuclear and 8% joint type family, extensive farmers had 88% and 12%, respectively.

All the semi – intensive farmers belong to Hindu religion. The extensive farmers mostly belong to Hindu religion (92%) and only 8% were Christian. Among the reported, 80% of the semi – intensive farmers and 72% of the extensive farmers had aquaculture farming experience up to 10 years.

About 80% of the semi – intensive farmers had agriculture as their primary occupation and the remaining farmers had aquaculture (4%) and other avocations (16%) as their primary occupation. About 40% of the extensive farmers were engaged in aquaculture activities and 52% of them had agriculture as their primary occupation.

5.1.1.2 Thanjavur district

In semi – intensive farming, majority (60%) of GIFT farmers were under 40-49 years age class followed by 50-59 years age group (24%). Most of the extensive farmers (48%) were aged below 30-39 years.

All the reported semi – intensive farmers of Thanjavur district were literates. About 28% of them have studied upto primary level. About 60% of the extensive farmers studied upto high school level and none of the respondents were illiterates.

The composition of family members upto 5 and more than 5 members of semi – intensive and extensive fish farmers were 64% & 36% and 76% & 24%, respectively.

In family structure, majority (72% - semi-intensive farmers and 76% - extensive farmers) of the farmers followed nuclear family. While 84% of the semi-intensive farmers belong to Hindu religion, 68% of the extensive farmers were Hindus followed by Christians (24%).

Aquaculture is the primary source of income for semi-intensive farmers and agriculture is the primary source of income for 80% of the extensive farmers in Thanjavur district. Also, 56% of the farmers had more than 10 years of experience in semi-intensive farming. In extensive farming 44% of the farmers had more than 10 years of experience and 56% of them had farming experience of upto 10 years.

5.1.2 Economics of GIFT culture

5.1.2.1 Semi-intensive farming system in Krishnagiri and Thanjavur districts

In Krishnagiri district, land cost / lease value of land was worked out as 78.86% and the bore well/well, pumps and motors, pond construction, pipe lines, buildings and nets was found to be 12.99%, respectively. The total capital investment was estimated as ₹3,80,313.60.

In Thanjavur district, among the capital investment, cost / lease value of land was the single largest item of the capital investment contributing to 82.27%, followed by the bore well/well contributing to 11.09% and the remaining items such as pond construction, pumps and motors, buildings, nets and pipe lines accounted to 6.62%. The total capital cost was worked out to ₹5,85,806.60.

The various items of the average fixed cost in Krishnagiri district were salary to permanent staff (40.49%), interest on fixed /borrowed capital (33.59%), watch and ward (17.19%), repairs and maintenance (5.21%) and depreciation (3.71%). The mean total fixed cost per annum was worked out to ₹1,47,147.62 / acre.

Alternatively, in Thanjavur district the total fixed cost was worked out to ₹1,55,380.13 / acre / annum. The average fixed cost items include interest on fixed/borrowed capital contributing to 45.24% followed by the salary to permanent staff (28.53%), watch and ward (44.77%), repairs and maintenance (6.18%) and depreciation (3.79%). In both districts, interest on fixed capital and permanent staff wages accounted high percentage to the mean total fixed cost.

Average variable cost was ₹61,669 consisting of seed (31.35%) and feed (30.07%) which contributed 61.42% to the total variable cost. The remaining items include pond preparation (17.71%), organic and inorganic manuring (6.98%), hired labour (5.66%), water pumping (3.07%), harvesting (2.83%), transport (1.96%) and miscellaneous (0.31%) in Krishnagiri district.

In Thanjavur district, feed and seed cost shared the highest contribution (64.73%) to the total variable cost and the remaining items include pond preparation (13.02%), fertilizers (7.97%), pumping cost (6.73%), labour (4.25%), harvesting (1.42%), transport (1.37%) and miscellaneous (0.82%).

The sum total of the total fixed cost and variable cost would give the total cost of the GIFT farming. The estimated total cost of the GIFT farming was ₹1,10,718.18 per acre out of which total fixed cost and total variable cost accounted for 44.30% and 55.69%, respectively in Krishnagiri district. The gross returns and average net returns were ₹1,53,556.79 and ₹42,838.61, respectively.

In Thanjavur district, the total cost of the GIFT farming was estimated as ₹1,45,714.18 per acre of which total fixed cost and total variable cost accounted to 33.55% and 64.45%, respectively. The gross returns and net returns were found to be ₹1,78,502.47 and ₹32,788.35, respectively.

The benefit cost ratio on total cost basis was 1.38 and 1.22 for Krishnagiri and Thanjavur districts, respectively. Which indicated that for every rupee of investment, a return of ₹1.38 and 1.22 for the respective districts were obtained. The semi – intensive GIFT farming was thus profitable in both districts.

5.1.2.2 Extensive farming system in Krishnagiri and Thanjavur district

Among the items of capital investment, cost of land/lease value of land was the single largest item of the capital investment contributing to 89.52% and the remaining items include pond construction (4.69%), pumps and motors (4.5%), bore well/well (0.90%) and pipe lines (0.34%) with the total capital investment of ₹.4,47,081.87 in Krishnagiri district.

The total capital investment of GIFT farmer respondents was estimated as ₹.4,03,553.39/acre in Thanjavur district and among the capital investment, cost of land/lease value of land was the single largest item of capital investment contributing to 84.68%.

The total fixed cost per annum was calculated as ₹1,06,097.84 in Krishnagiri district while it was ₹1,10,553.546 in Thanjavur district. In both the districts, interest on fixed/borrowed capital contributed a major share followed by salary to permanent staff, watch and ward, repairs and maintenance and depreciation.

Among the items of variable cost, seed cost was the only item which contributed 30.93% to the total variable cost. The remaining items of variable cost such as pond preparation, organic and inorganic manuring, temporary labour cost, water pumping cost, harvesting charges, transport charges and miscellaneous accounted to 69.02% of the total variable cost in Krishnagiri district.

Similarly, in Thanjavur district, seed and pond preparation cost were the items which had a greater contribution (44.97%) to the total variable cost and the remaining items of variable cost such as pond preparation, fertilizers, pumping cost, labour, harvesting, transport and miscellaneous accounted to 54.99%.

The total fixed cost and the variable cost was calculated as ₹53,048.93 and ₹43,910.06, respectively with a total cost of ₹. 96,958.99 per acre. The gross returns and the net returns was estimated as ₹1,38,378.52 and ₹41,419.53 for Krishnagiri district.

In Thanjavur district, the estimated total cost was ₹1,06,769.14 per acre consisting of the total fixed cost and the variable cost of ₹55,276.77 and ₹51,492.37, respectively. The gross returns and the net returns was estimated as ₹1,44,726.76 and ₹37,957.62, respectively.

The BCR estimated on the basis of total cost was worked out to 1.4 and 1.3 respectively, in Krishnagiri and Thanjavur districts. which indicated the profitability of extensive GIFT farming in both the districts.

5.1.3 Production function analysis

The factors determining the GIFT production was estimated by production function analysis using linear regression model. Eight explanatory variables namely

pond preparation, manuring, seed cost, feed cost, pumping cost, harvesting charges, transport cost and miscellaneous were included in the empirical model.

5.1.3.1 Semi-intensive GIFT farming in Krishnagiri and Thanjavur districts

The partial regression co-efficient of seed cost and miscellaneous were positive and significant at $p = 0.05$. The regression co-efficient of other independent variables were not significant in the estimated function in the case of semi-intensive GIFT farmers in Krishnagiri district. The co-efficient of multiple determinations (R^2) of the estimated function was found to be 0.911 implying that 91.10% of the variation in total GIFT returns was explained by the cost of variable inputs in the function. Based on the linear regression analysis, it was found that seed cost and miscellaneous cost influence the total returns. Hence, it is concluded that reduction of seed cost and miscellaneous cost will increase the total returns and net returns.

The partial regression co-efficient of seed cost and feed cost were positive and significant at $p = 0.05$. The regression co-efficient of other independent variables were not significant in the estimated function in the case of semi-intensive GIFT farming in Thanjavur district. The co-efficient of multiple determination (R^2) of the estimated function was found to be 0.946 implying that 94.60% of the variation in total GIFT was explained by the cost of nine independent variables in the function. Based on the above, it is concluded that seed cost and feed cost influence the total returns and hence reduction of seed cost and feed cost in semi – intensive will increase the total returns and net returns.

5.1.3.2 Extensive GIFT farming in Krishnagiri and Thanjavur districts

The partial regression co-efficient of seed cost, pond preparation cost and pumping cost were positive and significant at $p = 0.05$. The regression co-efficient of

other independent variables were not significant in the estimated function. The coefficient of multiple determination (R^2) of the estimated function was found to be 0.951. The results of the linear regression analysis showed that seed cost, pond preparation cost and pumping cost influence the total returns which indicate that reduction of the above three cost will increase the total returns and net returns in extensive GIFT farming of Krishnagiri district.

The partial regression co-efficient of seed cost was positive and significant at $p = 0.05$. The regression co-efficient of other independent variables were not significant in the estimated function which indicate that seed cost had a greater influence over the total returns. In case of extensive GIFT farming in Thanjavur district. The coefficient of multiple determination (R^2) of the estimated function was found to be 0.621 implying that 62.10% of the variation in total GIFT returns was explained by the cost of nine independent variables in the function.

5.1.4 Marketing aspects of GIFT

In the present study, the marketing aspects such as the marketing channels and physical flow which are involved in the GIFT marketing in Krishnagiri and Thanjavur districts are presented. The factors which influenced the choice of marketing channels are fish price, demand for fish, distance between the farms and nearby established marketing centres, timing and quantity of harvest, occupational status of the farmer and profitability of the marketing channels.

The four marketing channels that are preferred by the GIFT farmers are fish farmer to consumer (16%), fish farmer to retailer to consumer (24%), fish farmers to wholesalers to retailers to consumers (48%) and fish farmers to wholesalers to retailers to consumers through vendors (12%). Among the observed marketing

channels, Channel 3 was adopted frequently by the GIFT farmers of Krishnagiri district. Moreover, in Krishnagiri district, large quantity of farmed GIFT was distributed to Krishnagiri, Dharmapuri, Hosur and Okanacal with a very less distribution of fishes to the nearby local market and farm gate sales.

In Thanjavur district, six marketing channels were preferred by the GIFT farmers. It has been found that channel 1 & 2 (fish farmer → consumer (30%) and fish farmer → retailer → consumer (25%) were widely followed by the GIFT farmers. In case of physical flow, large quantity of farmed GIFT was moved to nearby local market and farm direct sales. The rest of farmed GIFT fish was taken to Thanjavur, Kumbakonam, Papanasam and Thiruvaiyaru.

5.1.5 Constraints

Rank based Quotient method (RBQ) was used to identify the constraints encountered by the GIFT farmer respondents. In the present study, 14 constraints were reported for both types of farming practices which include Inadequate availability of quality GIFT seeds, short supply of water, high cost of supplementary/pelleted feed, high cost of electricity tariff, non-availability of skilled labour, Prevalence of disease outbreak in culture ponds, low farm gate price, low net returns, problem of direct selling to buyers, poor quality of GIFT seeds, tied sale, high mortality during culture period, low total productivity and poaching. The selected GIFT farmer respondents were asked to rank the 14 constraints affecting the GIFT farming activity according to the order of severity. The major constraints to GIFT production as reported by the respondents in Krishnagiri district were ranked and listed.

5.1.5.1 Semi-intensive GIFT farming

Among the constraints reported, inadequate availability of quality GIFT seeds was reported by all the semi- intensive GIFT farmers in Krishnagiri district (31.05), followed by high cost of supplementary/pelleted feed (30.57) and poor quality of GIFT seeds (30.29). Alternatively, in Thanjavur district poor quality of GIFT seeds (28.67), high cost of supplementary/pelleted feed (28.38) and unavailability of quality GIFT seeds (28.29), was found to be the major constraints faced by GIFT farmers.

5.1.5.2 Extensive GIFT farming

While ranking the constraints, high cost of supplementary/pelleted feed (33.52), unavailability of quality GIFT seed (30.67) and poor quality of GIFT seed (29.24) were the major constraints in Krishnagiri district. In Thanjavur district, unavailability of quality GIFT seed (28.38), poor quality of GIFT seeds (26.48) and short supply of water (25.71), were reported as the major constraints.

5.2 Conclusion

The present study was carried out with a comparative economic analysis of extensive and semi-intensive farming of GIFT in in Krishnagiri and Thanjavur districts of Tamil Nadu. Based on the results, the following conclusions could be drawn.

1. The Benefit Cost Ratio (BCR) of semi-intensive GIFT farming was 1.3 and 1.2 on the basis of total cost in Krishnagiri and Thanjavur districts, respectively. Similarly, the BCR for extensive GIFT farming was 1.4 and 1.3 in Krishnagiri and Thanjavur district, respectively.
2. The partial regression co-efficient were positive for seed and miscellaneous and significant at $p = 0.05$ in the case of semi-intensive GIFT farming in Krishnagiri

district and in Thanjavur district, the partial regression co-efficient of seed cost and feed cost were positive and significant at $p = 0.05$.

3. While, the partial regression co-efficient were positive for seed, pond preparation and pumping and significant at $p = 0.05$ in Krishnagri district the partial regression co-efficient was positive for seed cost in Thanjavur district at 5% level of significance.
4. Four types of marketing channels were commonly observed in Krishnagri district. Among the marketing channels, channel 3 (fish farmer → wholesaler → retailer → consumer) was adopted frequently (48%) by the GIFT farmers.
5. In Thanjavur district, six types of marketing channels were followed by the GIFT farmers. Among them channel 1 & 2 (fish farmer → consumer and fish farmer → retailer → consumer) were adopted frequently by the GIFT farmers in the study area.
6. Fourteen major constraints were reported by the semi-intensive GIFT farmers, among which unavailability of quality GIFT seed scored highest value followed by high cost of supplementary/ pelleted feed, in Krishnagri district. Poor quality of GIFT seeds (28.67) was reported as major constraint by the semi – intensive GIFT farmers in Thanjavur district.
7. In extensive GIFT farming, high cost of supplementary/pelleted feed (33.52) was reported as the foremost constraints in Krishnagri district. In Thanjavur district, unavailability of quality GIFT seed (28.38), were reported as the major constraints.

5.3 Recommendations for the development of GIFT tilapia farming in Tamil Nadu

1. More number of GIFT hatcheries may be established to meet the shortage of GIFT seeds.
2. As supplementary feed/pellet feed plays a prominent role in GIFT farming, efforts have to be made by the Government to supply the supplementary feed/pellet feed at subsidised rate to GIFT farmers.
3. High seed and feed cost are the major hindrances for the development of aquaculture. Hence seed and feed may be provided at concessional rate to GIFT farmers in order to encourage increased GIFT production.
4. The government should create awareness programmes about GIFT farming in Tamil Nadu as it helps to improve the socio – economic status of the farmers and to enhance the fish production at state level.
5. Co-operative societies have to be established and the government has to encourage the farmers to sell the harvested GIFT through the co-operative societies
6. Government has to take proper steps to provide direct market facilities for the farmers to sell the harvested GIFT
7. Large number of retail outlets should be established at convenient locations for the immediate disposal of GIFT to the consumers

REFERENCES

Chapter – VI

References

- Acharya, S.S., Agarwal, N.L., 2011. Agricultural marketing in India. Published by Oxford and IBH publishing Co. Pvt. Ltd., New Delhi: 205.
- Adebayo, O.O., Daramola, O.A., 2013. Economic analysis of catfish (*Clarias gariepinus*) production in Ibadan metropolis. *Discourse Journal of Agriculture and Food Sciences*, 1(7), 128-134.
- Ali, M.M., Hossain, M.B., Minar, M.H., Rahman, S., Islam, M.S., 2014. Socio-economic aspects of the fishermen of Lohalia River, Bangladesh. *Middle-East Journal of Scientific Research*, 19(2), 191-195.
- Amita Sexena., 2011. Fisheries Economics. Daya publishing house, Delhi: 290-291.
- Anane-Taabeah, G., Frimpong, E.A., Amisah, S., Agbo, N., 2011, April. Constraints and opportunities in cage aquaculture in Ghana. In Better Science, Better Fish, Better Life. Proceedings of the ninth International Symposium on Tilapia in aquaculture, Shanghai, China. 409p (158-165).
- Antwi, D.E., Kuwornu, J.K., Onumah, E.E., Bhujel, R.C., 2017. Productivity and constraints analysis of commercial tilapia farms in Ghana. *Kasetsart Journal of Social Sciences*.
- Bannor, R.K., Bentil, J.K., 2012. Comparing the Profitability of Tilapia Farming to Maize Farming on A Hectare of Land in The Agona West Municipality of Ghana.

- Baruwa, O.I., Tijani, A.A., Adejobi, A.O., 2012. Profitability and constraints to fishery enterprises: A case of artisanal and aquaculture fisheries in Lagos State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, 8(1), 52-58.
- Basavakumar, K.V., Devendrappa, S., Srenivas, S.T., 2012. A study on profile of fishing community of a village in Karnataka. *Karnataka Journal of Agricultural Sciences*, 24(5).
- Bhatta., 2004. Socio economic profile of stakeholders in the fisheries sector. National workshop on strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor households in India. *Fishing Chimes*, 24(1). 154-155.
- Bora, J., Das, A.K., 2013. Costs and returns of integrated fish farming in Jorhat district of Assam. *Agricultural Science Digest*, 33(4), 289-293.
- Bora, J., Das, A.K., 2013. Integrated Fish Farming in Jorhat District of Assam: Problems and Policy Options. *Economic Affairs*, 58(4), p.405.
- Brief industrial profile, Krishnagiri district. 2015-16. Ministry of MSME, Govt. of India.
- Central Institute of Freshwater Aquaculture., 2011. Grow out carp culture-India development gateway, pp. 1-3.
- Chidambaram, P. and Umamaheswari, T., 2016. A Techno-Economic Analysis of Improved Fish Seed Rearing Practice through Application of Seaweed Extract. *International Journal of Innovative Research and Development*|| ISSN 2278-0211, 5(6).

- Das, S. K., Sahoo, J. K and Naik, D., 1991. Impact of selective variable on the market price of carp—A case study in Berhampur (Orissa) fish market. In: Proceedings of the Workshop on Aquaculture Economics., November 20-22, p69-72.
- Devi, S.Z., Singh, R.N., Singh, N.A., Laxmith, 2014. Fish production in Manipur- an economic analysis. *Journal of Crop and Weed*, 10(2):19-23.
- Dubey, S.K., Chand, B.K., Trivedi, R.K., Mandal, B., Rout, S.K., 2016. Evaluation on the prevailing aquaculture practices in the Indian Sundarban delta: an insight analysis. *Journal of Food, Agriculture & Environment*, 14(2), pp.133-141.
- Earth trends 2003. Capture and Aquaculture Tamil Nadu. Production Totals for Marine and Inland fisheries. http://earthtrends.wri.org/pdf_library/data_tables/coa_2_2003.pdf. Technical Notes. 2003.
- Eknath, A.E., M.T. Melchor, S. Marietta, C. Palada-de Vera, A.R. Danting, E.E. Ruben, B. Dionisio, H.L. Capili, T.A. Bolivar, A.V. Abella, H.B. Circa, G. Bentsen, T. Bjarne, and R.S.V. Pullin, 1993. Genetic improvement of farmed Tilapias: The growth performance of eight strains of *Oreochromis niloticus* tested in different farm environments. ICLARM Contribution No. 709. *Elsevier Science Publishers B.V., Amsterdam* 111: pp. 171-188.
- Gopakumar. k. et al., 1999. Freshwater aquaculture development plan, *Institute of Freshwater Aquaculture*, Bhubaneshwar, pp.75
- Goswami, M., Sathiadhas, R., Goswami, U.C., Ojha, S.N., 2002. Socio-economic dimension of fish farming in Assam. *Journal of the Indian Fisheries Association*, 29, 103-110.

- Goswami, S.N., Patil, N.G., Chaturvedi, A., Hajare, T.N., 2013. Small scale pond fish farming in a tribal district of India: an economic perspective. *Indian J Fish*, 60(2), 87-92.
- Goswami. C. and Dr. Zade. V.S., 2015. Statistical Analysis of Fish Production in India, *International Journal of Innovative Research in Science, Engineering and Technology*.4(2), 294-299.
- Gurunathan, S., Raghuram, P., 2011. Profitability of inland fish farms in Thanjavur district in Tamil Nadu. *Fishing Chimes*, 30(10&11). pp. 78-82.
- Hasib Jeelani Sayed., Senthiladeban, R., Rajakumar, M., 2013. An Economic Analysis of Shrimp culture in Nellore district, Andhra Pradesh. *Indian Journal of Fisheries Economics and Development*. XIV, 9-16.
- Hussain, M.G., Kohinoor, A.H.M., Islam, M.S., Mahata, S.C., Ali, M.Z., Tanu, M.B., Hossain, M.A. and Mazid, M.A., 2000. Genetic evaluation of GIFT and existing strains of Nile tilapia, *Oreochromis niloticus* L., under on-station and on-farm conditions in Bangladesh. *Asian Fisheries Science*, 13(2), pp.117-126.
- Jacob, O.O., Olubukola, O.A., 2012. Economic analysis of fish hatchery operations in Ogun State, Nigeria. *International Journal of Fisheries and Aquaculture*, 4(4), 63 - 70.
- Jayaraman, R., 1996. Manual on Fisheries Economics, Fisheries College and Research Institute, TANUVAS, Tamil Nadu, FCRI, Thoothukudi, pp.84-86.
- Jayaraman, R., 1998. An economic analysis of carp culture in Thanjavur District,

Tamil Nadu State, India. Proceedings of the Ninth Conference of the International Institute of Fisheries Economics and Trade held during 8-11 July, 1998 at the Norwegian College of Fisheries Science, Tromso, Norway. pp. 71-82.

Jayaraman, R., 2000. Marketing of aquacultured carps in Thanjavur district, Tamil Nadu. In: R. Jayaraman and P. Selvaraj (Editors), Workshop on Rural Fish Marketing, September 11-13, 2000. Thoothukudi, India, pp. 42-49.

Jayaraman, R., 2000. Measurement of technical efficiency in culture carp production-frontier approach, *Indian Journal of Fisheries*. 47(2). pp. 129-134.

Jayaraman, R., 1995. An Economics Analysis of carp culture in Thanjavur district Unpublished Ph.D Thesis, Department of Aquaculture, Tamil Nadu Veterinary and Animal Science University, Fisheries College and Research Institute Thoothukudi, 176p.

Johl, S.S., T.R. Kapur, 1973. Fundamentals of Farm Business Management, Kalyani Publishers, New Delhi, pp. 284-290.

Karunakaran, N., Economic Analysis of Fish Cultivation in Kerala. EDITORIAL BOARD, p.54.

Krishna Murthy, B.V., 2001. Fish culture in borewell water storage ponds in Karnataka. *Fishing Chimes*, 21(5). p. 58.

Kujur, N., Prasad, C.M., Singh, A.K., Singh, S.K., 2005. Economic analysis of integrated pig-cum-fish farming in Jharkhand. *Indian Journal of Animal Research*, 39(1), pp.73-75.

Kumar, B.G., Datta, K.K., Joshi, P.K., Katiha, P.K., Suresh, R., Ravisankar, T., Ravindranath, K. and Menon, M., 2008. Domestic fish marketing in India-changing

structure, conduct, performance and policies. *Agricultural Economics Research Review*, 21(2008).

Kumar, H. and Singh, R., 2013. Economic analysis of freshwater aquaculture production: a comparative analysis of different production systems. *Russian Journal of Agricultural and Socio-Economic Sciences*, 13(1).

Lekhi, R.K., Joginder Singh., 2011. *Agricultural Economics*. Kalyani Publication, New Delhi: 124.

Lipton D.W., Harrell R.M., 1990. Figuring production costs in finfish aquaculture. Maryland Sea Grant Extension Program. Finfish Aquaculture Workbook Series, UM-SG-MAP-90-02, College Park, Maryland.

Mahanath, P.C., 2000. Fish Seed Production and Strategy for Marketing in the North-East Region with particular reference to Assam, p.26-28. In Dos (Eds.). Proceedings of the state-level workshop on current status and future of the fish seed production industry in the state of Assam April 8, 9 1999. Spec.Publ.3,39 pp. College of Fisheries Assam. Assam Agricultural University, Raha, Assam, India

Mohammed, S.T., Ghide, A.A., Zindam, P.L., 2014. Analysis of socio-economic factors affecting artisanal fishermen around Lake Alau, Jere Local Government Area of Borno State, Nigeria.

Nagoor Meeran, M., 2005. Marketing behaviour of fish farmers in the composite – Thanjavur district. *Journal of Extension Education*, 16(3&4), pp. 3837-3838.

Nandeesh, M.C., Sentilkumar, V., Antony Jesu Prabhu, P., 2013. Feed management of major carps in India, with special reference to practices adopted in Tamil Nadu. On-

farm feeding and feed management in aquaculture. *FAO Fisheries and Aquaculture Technical Paper*, (583), pp.433-462.

Narayanakumar, R., Krishnan, M., 2013. Socio-economic assessment of seaweed farmers in Tamil Nadu-A case study in Ramanathapuram District. *Indian Journal of Fisheries*, 60(4), pp.51-57.

Nasr-Allah, A.M., Dickson, M.W., Al-Kenawy, D.A.R., Ahmed, M.F.M., El-Nagger, G.O., 2014. Technical characteristics and economic performance of commercial tilapia hatcheries applying different management systems in Egypt. *Aquaculture*, 426, pp.222-230.

Nath, K., 2015. Production and market efficiency for inland fisheries in North East India: The empirical study of Lohit and Lower Subansiri districts of Arunachal Pradesh.

Okpeke.,2015. Analysis of the Profitability of fish Farming in warri south local Government Area of delta, Nigeria. *ZOSR Journal of Agriculture and veterinary science*,8(12), 45-51.

Pandey, D.K., Upadhyay, A.D., 2012. Socio-economic profile of fish farmers of an adopted model aquaculture village: Kulubari, West Tripura. *Indian Research Journal of Extension Education*, 55-58.

Patil, S.R., Patil, S.S., Sathe, T.V., Comparative analysis of cropping pattern and socio-economic status of fisherman and farmers in five major wetlands from Ajara tahsil, Kolhapur district (ms), India.

Penda, S.T., Unaji, G. P., Odoenmenem, I. U., 2013. Profitability Analysis of Fish Production from Concrete Pond System in Benue State, Nigeria. *International Journal of Research in Social Sciences*,2(4), 7.

Policy Notes. 2016-2017 preparation Of Animal Husbandry, dairying and Fisheries.
Government of India.

Pravakar, P., Sarker, B.S., Rahman, M., Hossain, M.B., 2013. Present status of fish farming and livelihood of fish farmers in shahrasti upazila of Chandpur district, Bangladesh. *American-Eurasian Journal of Agricultural and Environmental Science*, 13(3), pp.391-397.

Prithwiraj Jha, Sudip Barat and Rapden F.hepcha., 2004. Jhora fishery of Darjeeling hills. *Fishing Chimes*, 24(3). 9-10.

Rahaman, S.M., Bera, B.K., Ananth, G.S., 2013. A study on problems and constraints in production and marketing of fish in West Bengal. *Journal of Crop and Weed*, 9(1), 110-113.

Rahaman, S.M., Bera, B.K., Ananth, G.S., 2013. A study on problems and constraints in production and marketing of fish in West Bengal. *Journal of Crop and Weed*, 9(1), pp.110-113.

Rajeev, M., Bhandarkar, S., 2016. A Study of Domestic Marketing Channels of Fisheries in Bangalore City.

Raju, M.S., 2002. Semi-intensive shrimp farming system of Kerala, India: a production function analysis. *Journal of the Indian Fisheries Association*, 29, 23-36.

Rao, P. S., Prasad, D. N., 1978., Some price analysis of inland fishes in Patna city market and its variations. *Seafood Export Journal*, 10(4), pp. 11-21.

Rao, P.S., 1983. Fish Marketing and Management. Pioneer publisher and distributor, Bombay, pp. 197-214.

- Raveendran, N., Karuna Karan, K. R., Sivakumar, S. D., Muniyandi, B., 2000. An analysis and marketing of inland fish in central Tamil Nadu, In: R. Jayaraman and P. Selvaraj (Editors), Workshop on Rural Fish Marketing, September, 11- 13, 2000, FCRI, Thoothukudi, India, pp. 23-32.
- Roy, N., 2007 Marketing of farmed carps in Thanjavur district, unpublished M.F.Sc. thesis submitted to Tamil Nadu Veterinary and Animal Science University, Fisheries College and Research Institute Thoothukudi, 2p.
- Sabarathanam, V.E., 1988. Manuals of Field Experience Training for ARS Scientists. NAARM, Hyderabad. 21p.
- Sahar, M., Mandal, M. K., 2004. Status of fish market in Jammu. *Fishing Chimes*, 24(6), pp. 27-28.
- Salim.S.S., Biradar, R.S., Pandey, S.K., 2004. Economic Analysis of Fisheries Projects. CIFE, Versova, Mumbai. pp. 125-135
- Senthiladeban, R., M. Rajakumar, 2004. Manual of fisheries marketing, Fisheries College and Research Institute, TANUVAS, Thoothukudi. p.86.
- Setty. Ajay., 2001. Economics of freshwater aquaculture in Thanjavur district, Tamil Nadu, India, Unpublished M.F.Sc. Thesis, submitted to Tamil Nadu Veterinary and Animal Sciences University, Fisheries College and Research Institute, Thoothukudi, p.75.
- Shaha, D.C., Kundu, S.R., Hasan, M.N., 2015. Production of organic grass carp (*Ctenopharyngodon idella*) and GIFT tilapia (*Oreochromis niloticus*) using napier grass, *Pennisetum purpureum*. *Journal of Fisheries*, 3(1), pp.233-238.
- Shang, Y.C., 1984. Economics aspects of aqua farm construction and maintenance, *Inland Aquaculture Engineering*, Rome, FAO, p. 545.

Shivakumar, M., Bala, S., Rajanna, C., Naveenkumar, B.T., 2013. Economics of seed rearing and farming of carps. *Labour*, 1, pp.08-750.

Singh, D.R., Vasisht, A.K., Kumar, S., 2015. Profitability and technical efficiency of aquaculture in Punjab, India. *Indian J. Fish*, 62(2), pp.49-55.

Sites related; <http://earthtrends.wri.org>.(country profile online).

Sultana, R., Kohinoor, A.H.M., Islam, M.S., Mazid, M.A. and Hussain, M.G., 1997. Comparative studies on growth of fry of GIFT and existing strain of Nile tilapia (*Oreochromis niloticus* L.). *Bangladesh Journal of Fisheries Research*, 1(1), pp.25-30.

Tunde, A.B., Kuton, M.P., Oladipo, A.A., Olasunkanmi, L.H., 2015. Economic analyse of costs and return of fish farming in Saki-East Local Government Area of Oyo State, Nigeria. *Journal of Aquaculture Research & Development*, 6(2), p.1.

Wang, M., Lu, M., 2015. Tilapia polyculture: a global review. *Aquaculture Res.* doi, 10.

World fisheries review, 2012. Part I, FAO.

Yuan, X.H., 2007. Economics of aquaculture feeding practices in China. in: Hasan, M.R. (ed.), Economics of aquaculture feeding practices in selected Asian countries, *FAO Fisheries Technical Paper*. No.505. Rome. pp. 65–98.

Yuan, X.H., Xun, Y., 2009. Comparison and analysis on aquaculture production cost and return. *Chin. Fish. Econ.* 28 (3), 118–124.

APPENDICES



**TAMIL NADU FISHERIES UNIVERSITY, NAGAPATTINAM,
FISHERIES COLLEGE AND RESEARCH INSTIUTE,
THOOTHUKUDI – 08,
DEPARTMENT OF FISHERIES ECONOMICS.**

Research Topic: A comparative economic analysis of extensive and semi - intensive farming of Genetically Improved Farmed Tilapia (GIFT) in Tamil Nadu

SURVEY SCHEDULE

Details of farmer

A. General information

1. Name :
2. Address :
3. Age :
4. Level of literacy/ Education :
5. Religion :
6. Occupational status :

1.	Primary	
2.	Secondary	
3.	Tertiary	

7. Experience in farming :

Type of farming	Experience
Semi intensive	
Extensive	

8. Number of family members :
9. Family structure :
10. Types of house :

- 11. Training undergone :
- 12. Membership in organization :
- 13. Source of information :
- 14. Any other :

B. Details of the farm

- 1. Name of the farm :
- 2. Location :
- 3. Total area (acre) :
- 4. Total water spread area :
- 5. Details of ownership :

Owned	
Leased	

- 6. Lease value (acre) :
- 7. Source of water :
- 8. Months of water availability :
- 9. No of culture ponds with details:

S. No	No of ponds	Area (acre)

10. Stocking density details

No of GIFT seeds stock in each culture ponds

Pond	Date of stocking	Stocking size	No of GIFT seeds	Amount (Rs)

i. Details of capital investment

Sl.no	Items	Amount (Rs)
1.	Land	
2.	Pond Excavation	
3.	Pipe Lines	
4.	Bore well	
5.	Pumps & Motors	
6.	Nets	
7.	Buildings, if any	
	(i) Permanent	
	(ii) Temporary	
8.	Others	
Total Capital Investment		

III. Information Regarding Depreciation on Capital Items

Sl. no	Items	Year of Purchase	No	Purchase Value/unit	Total Value	Economic Life	Salvage Value	Depreciation value
1.	Motors							
3.	Buildings							
4.	Nets							
5.	Bore well							
6.	Any others							

IV. Items of Fixed cost (per annum)

Sl.no	Items	Amount in Rs
1.	Depreciation for Capital Items	
	(a) Buildings	
	(b) Ponds	
	(c) Motors	
	(d) Nets	
	(e) Others (specify)	
2.	Interest on fixed capital/Borrowed capital	
3.	Repairs & Maintenance	
4.	Taxes Paid, if any	

5.	Insurance Premium paid, if any	
6.	Consultancy charges	
7.	Salary to Permanent staff	
8.	Watch and ward	
9.	Others	
Total Fixed Cost per annum		
Total Fixed Cost per crop		

V. Items of Variable cost per crop

Sl. No	Items	Ponds				Quantity (kg)	Rate/kg	Total Cost
		1	2	3	4			
(a)	Pond Preparation							
	1. Liming							
	2. De weeding							
(b)	Fertilisation							
	1. Organic manures							
	(i)							
	(ii)							
	(iii)							
	2. Inorganic manure							
	(i) Urea							
	(ii) DAP							
	(iii) Potash							
	(iv) Any others							
(c)	Feeding							
	1. Pelleted feed							
	2. Any others							
(d)	Labour Cost							
	➤ Labour wage							
	(i) Skilled							
	(ii) Semi – skilled							
	(iii) Unskilled							
	Pumping cost							

(e)	1. Electricity				
	2. Diesel				
(f)	Harvesting charges				
(g)	Transport cost				
(h)	Others				
Total Variable cost per crop					

(VI) Yield and Returns

Pond No	Species harvested		Yield (kg)	Farm gate price (Rs/kg)	Total Returns
	GIFT tilapia	Others species			
1					
2					
3					
4					
Total					
Gross Returns					

(VII) Marketing Details

a) Marketing channel

- 1.
- 2.
- 3.
- 4.

b) Fish sales (GIFT tilapia)

Marketing channel	Quantity sold (kg)	Price / kg	Market margin to farmer
1.			
2.			
3.			
4.			

c) Settlement of sales proceeds:

Immediate/2-5 days/5-10 days/any other

d) Physical flow

Sl. no	Species	Destination	Distance(km)	Mode of travel	Duration	Cold chain
1.	GIFT tilapia					

e) Any other information :

VIII. General constraints to farming

Sl. No	Constraints	Ranking
1.	Inadequate availability of quality GIFT tilapia seeds	
2.	Short supply of Water	
3.	High cost of Supplementary/ Pelleted Feed	
4.	High cost of Electricity Tariff	
5.	Unavailability of Skilled Labour	
6.	Prevalence of disease outbreak in Culture Ponds	
7.	Low farm gate Price	
8.	Low Net Returns	
9.	Problem of direct selling to buyers	
10.	Poor quality of GIFT tilapia seeds	
11.	Tied sale	
12.	High mortality during culture period	
13.	Low Total Productivity	
14.	Poaching	

❖ Suggestions to constraints 1- 13

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)
- 12)
- 13)

