ECONOMIC APPRAISAL OF INLAND FISH PRODUCTION IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH

MANGALAPURI PAVANI

B.Sc. (Hons.) Ag.

MASTER OF SCIENCE IN AGRICULTURE
(AGRICULTURAL ECONOMICS)

ANGRAU

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BY

MANGALAPURI PAVANI

B.Sc. (Hons.) Ag.

THESIS SUBMITTED TO THE
ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF

MASTER OF SCIENCE IN AGRICULTURE
(AGRICULTURAL ECONOMICS)

CHAIRPERSON: Dr. K. S. R. PAUL

ANGRAU

DEPARTMENT OF AGRICULTURAL ECONOMICS
AGRICULTURAL COLLEGE, BAPATLA
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
GUNTUR- 522 101, ANDHRA PRADESH

2022

DECLARATION

I, **MANGALAPURI PAVANI**, hereby declare that the thesis entitled **"ECONOMIC APPRAISAL OF INLAND FISH PRODUCTION IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH"** submitted to the Acharya N.G. Ranga Agricultural University for the degree of Master of Science in Agriculture is the result of original research work done by me. I also declare that no material contained in the thesis has been published earlier in any manner.

Place: (**MANGALAPURI PAVANI)**
Date: **I.D. No. BAM-20-46**

CERTIFICATE

Ms. MANGALAPURI PAVANI has satisfactorily pursued the course of research and that thesis entitled **"ECONOMIC APPRAISAL OF INLAND FISH PRODUCTION IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH"** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that neither the thesis nor its part thereof has been previously submitted by her for a degree of any university.

Place: (**K. S. R. PAUL)**
Date: **Chairperson**

CERTIFICATE

This is to certify that the thesis entitled **"ECONOMIC APPRAISAL OF INLAND FISH PRODUCTION IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH"** submitted in partial fulfilment of the requirements for the degree of '**Master of Science in Agriculture'** of the Acharya N. G. Ranga Agricultural University, Lam, Guntur is a record of the bonafide original research work carried out by **Ms. MANGALAPURI PAVANI** under our guidance and supervision.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all assistance received during the course of the investigations have been duly acknowledged by the author of the thesis.

Thesis approved by the Student Advisory Committee

Chairperson : **Dr. K. S. R. PAUL**
Senior Scientist (CCS)
Department of Agricultural Economics
Agricultural College
Bapatla-522 101.

Member : **Dr. P. KANAKA DURGA**
Assistant Director
Centre for management studies
MANAGE
Hyderabad-500 030.

Member : **Dr. V. SITARAMBABU**
Assistant Professor
Department of Agricultural Economics
Agricultural College
Bapatla-522 101

Member : **Dr. K. N. SREENIVASULU**
Assistant Professor
Department of Statistics & Computer Applications
Agricultural College
Bapatla -522 101

Date of Final Viva-Voce:

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Place:

Date: ***(M.Pavani …)***

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LIST OF SYMBOLS AND ABBREVIATIONS

AO’s	:	Agricultural Officers
AgGDP	:	Agricultural Gross Domestic Product
AAGR	:	Average Annual Growth Rate
CAGR	:	Compound Annual Growth Rate
CACP	:	Commission for Agricultural Costs and Prices
CFC	:	Composite Fish Culture
COVID-19	:	Novel Corona Virus Disease - 19
ESR	:	Expense Structure Ratio
et al.	:	And Associates
etc.	:	And so on
Fig	:	Figure
GRR	:	Gross Revenue Ratio
GDP	:	Gross Domestic Product
GVA	:	Gross value added
FDO	:	Fisheries Development Officer
FAO	:	Food and agriculture organization
FFDA	:	Fish farmers development agencies
Ha	:	Hectares
i.e.,	:	That is
ICAR	:	Indian Council for Agriculture
IMC	:	Indian Major Carps
Kg	:	Kilogram
No.	:	Number
Q	:	Quintal
ROR	:	Rate of Return
Rs	:	Rupees
S. No.	:	Serial Number
SHG	:	Self-help groups

T	:	Tonnes
VFAs	:	Village Fisheries Assistants
viz.,	:	Namely
$	:	United States Dollar
%	:	Per cent
&	:	And
/	:	Per
₦	:	Nigerian Naira
<	:	Less than
=	:	Equals to
>	:	Greater than
≤	:	Lesser than or equal to
≥	:	Greater than or equal to

ABSTRACT

Name of the Author	:	**MANGALAPURI PAVANI**
Title of the thesis	:	**ECONOMIC APPRAISAL OF INLAND FISH PRODUCTION IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH.**
Degree	:	**MASTER OF SCIENCE IN AGRICULTURE**
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Chair person	:	**Dr. K. S. R. PAUL**
University	:	**ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY**
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India is the third largest fish-producing and second largest aquaculture nation in the world after China which has a capacity of about 14.16 Metric million tonnes of fish production per annum. The percentage contribution of the fisheries sector to the Indian economy and Agriculture sector are 1.24 per cent and 7.28 per cent (GVA) respectively. In India, Andhra Pradesh is the highest inland fish-producing state with a production of 3.61 million tonnes and with an area of 0.33 million hectares.

In Andhra Pradesh, West Godavari district was the leading producer of inland fisheries with 1.28 million tonnes and area of 0.06 million hectares. In the study area, different types of inland fish species were cultivating by the farmers. The major species growing are Rohu (*Labeo rohita*), Catla(*Catla catla*), Mrigal(*Cirrhinus mrigala*), Silver Carp *(Hypopthalmichthys molitrix*), Grass Carp *(Ctenopharyngodon idella*) and Pangasius(*Pangasius pangasius)*. In order to understand whether inland fish farming is economically viable for inland fish farmers in West Godavari district, it is prudent to conduct a study on "Economic Appraisal of Inland Fish Production in West Godavari District of Andhra Pradesh".

A multistage sampling design was adopted for the selection of 90 sample respondents. Primary and Secondary data were collected and analyzed by using descriptive statistics, growth rates, profitable ratios, economic appraisal techniques, stochastic frontier production function and Garrett's ranking technique.

The growth rates revealed that the area and production of inland fisheries in Andhra Pradesh were growing significantly and the major share of GVA of fish production in Agricultural GDP was increased during the study period (2011-12 to 2019-20). The total cost of fish farming was Rs.597123.16/ha from

that the major cost occupied by the variable costs (Rs. 407105.87/ha) followed by the fixed costs (Rs.1,90,017.29/ha). The Break-even analysis showed profitability. The profitable ratios like ROR were 0.13, ESR was 0.45 and GRR was 0.80 which were found economically viable. The NPV was Rs.3,08,056.10/ha which was positive and greater than zero. The BCR was 1.09 which was greater than the one. The IRR was 31.12 per cent which was greater that the existing interest rate *i.e.*, 10 per cent. Hence, investment was considered as economically viable for inland fish farmers.

The stochastic frontier production function was employed to estimate factors influencing. It concluded that fingerlings and labour-man days showed positively significant at one per cent and 10 per cent levels respectively, while the cost of fertilizer was negatively significant at one per cent level. In the inefficiency factors, age was positively significant at one per cent while, education and extension contacts showed negatively significant at one per cent level.

The main constraints faced by the inland fish farmers were the non-availability of quality fingerlings, high disease attacks, and high cost of feed. By making availability of quality fish fingerlings to inland fish farmers the establishment of standardized and regulated fish fingerlings agencies to certify the quality of fish fingerlings.

Chapter – I

Introduction

Chapter - I

INTRODUCTION

Fish is a valuable source of food that is enriched with animal protein. Fish fulfils 20 per cent of animal protein requirements of around 50 per cent of world's population. Fish provides minerals *i.e.*, copper, phosphorous, sulphur, iodine and selenium and small fish, that is eaten with bones, are particularly enriched with calcium. Fish is one of the nature's best nutritional gifts. It has been noticed that the proteins from plant sources are deficit in one or more essential amino acids needed for sustained human development. Moreover, the most efficient utilization of plant proteins could be obtained, if animal protein is included in the human diet. Fish is the source of vitamin A & B and oils containing poly-saturated fatty acids which helps to check the cholesterol level of the blood. Fish has higher feed conserving rate, protein retention and low cholesterol content. About 35 per cent of Indian population are fish eaters and the per capita availability of fish is 9.0 kg against the recommended 13g by World health organization for nutritional security. Fisheries are the important source of food, income, nutrition and livelihood for millions of people around the world.

The volume of global fish production amounted to 174.6 million metric tonnes in 2020, from 148.1 million metric tonnes in 2010. China is leading in fish production with a contribution of 16 per cent to the total world contribution followed by India (14 per cent). Fish is one of the most widely consumed foods in the world and it is only becoming more popular over time. The international trade of fisheries and aquaculture products generated around USD 151 billion in 2020, down from the record high of USD 165 billion in 2018 mainly due to the outbreak of COVID-19. The European Union was the top exporter of fish and fishery products in the worldwide by 2020, at 36.2 billion U.S. dollars in export value (FAO, 2022). Global consumption of aquatic foods (excluding algae) has increased at an average annual rate of 3.0 percent since 1961. An estimated 58.5

million people were employed in the primary sector, about 21 percent were women, rising to about 50 percent for those employed in the entire aquatic value chain. FAO is committed to Blue transformation, a visionary strategy that aims to enhance the role of aquatic food systems in feeding the world's growing population by providing the legal, policy and technical frameworks required to sustain growth and innovation.

In India, Blue revolution had a pioneering impact on the fisheries sector which demonstrated more importance of fisheries and aquaculture sector. This sector is considered as a sunrise sector and is poised to play a significant role in the Indian economy in near future.

India is the third largest fish producing and second largest aquaculture nation in the world after China (FAO, 2022) which has a capacity of about 14.16 million metric tonnes of fish production per annum, with marine fish production of 3.72 million metric tonnes and inland fish production of 10.43 million metric tonnes (2019-20). The percentage contribution of fisheries sector to Indian agriculture sector was 7.28 per cent (GVA) (Hand book on fisheries statistics 2020). Presently, the country is on the threshold of massive development in fisheries and aquaculture sector, which contributing incredibly to improve food security and nutrition for Indians. Majority of aquaculture growth has taken place during 21st century, but still the potential of this sector has not been harvested completely. Globally, India stands second in fishery culture production. This sector has an immense potential in ushering economic prosperity of the country through doubling the income of the fishers and fish farmers.

India as a maritime country which has a vast potential of fishing resources comprising coastline length of 8,118 kilometers, Exclusive Economic Zone 2.02 million sq. km, continental shelf 0.53 million sq. km, reservoirs 3.15 million hectare area, length of rivers and canals 0.19 million hectare, tanks and ponds 2.36 million hectare area, brackish water 1.24 million hectare, fish landing centers 1537 and fishing villages 3432. The availability of these resources suggests huge scope for fisheries and aquaculture production in India.

A fishery is an activity leading to harvesting of fish. It may involve capture of wild fish or rising of fish through aquaculture. There are two main types of fisheries: inland fisheries and marine fisheries. The inland fishery deals with the fishery aspects of waters other than marine water. They pertain two types of waters, namely, the fresh water consists of irrigation canals, reservoirs, lakes, tanks, ponds, *etc*., while the brackish water includes estuaries, lagoons and mangrove swamps.

The different carp fish's dominant in aquaculture production across the globe are Grass carp, Silver carp, Nile tilapia, Common carp, Big head carp, Catla, *Carassius* spp, salmon, striped catfish, Pangasianodon and hypophthalmus. In India, the major carps like Catla, Rohu and Mrigal are the main stay of fresh water aquaculture. Apart from this some of the exotic major carps which are well adopted to Indian water are Common carp, Silver carp, Grass carp. The major carps are the most preferred farm fish because of their fast growth and higher acceptability to consumers.

In India, Andhra Pradesh is the highest inland fish producing state with a production of 3.61 million tonnes and area 0.33 million ha followed by West Bengal (1.60 million tonnes production and 0.26 million ha) and Chhattisgarh with (0.69 million tones production and 0.10 million ha) (Handbook of Fisheries, India, 2020). Around 28 million people are employed in the fisheries sector and contribute to the livelihood of people who are economically underprivileged section of the society. Andhra Pradesh took advantage of coastal zone and made more efforts to increase its economy from fisheries with introduction of the new technologies.

In Andhra Pradesh, West Godavari district is the leading producer of inland fisheries with 1.28 million tonnes followed by the Krishna district with 1.27 million tonnes (District at Glance of Andhra Pradesh, 2020). West Godavari district is well developed in fisheries with resources of fishery wealth in marine brackish, brackish water reservoir and inland fisheries. Blue revolution is well expressed in this district through a multi-pronged approach. It has coastline of 19 kms with total fresh water culture area of 0.06 million ha. It is the aqua hub of Andhra Pradesh.

1.1 PROBLEM STATEMENT

It is well known that inland fisheries are a component of an integrated farming system as a specialized enterprise, resulting in the highest returns when compared to the other farming systems. But there is an increase in the cost of production due to increase in the cost of fish feed which occupy major share in the cost of cultivation and an increase in the disease infestation of fish. Further, fluctuating market prices are affecting the incomes of fish farmers. Keeping in view of the above facts the present study entitled "**ECONOMIC APPRAISAL OF INLAND FISH PRODUCTION IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH STATE**" has been undertaken with the following objectives.

1.2 OBJECTIVES OF THE STUDY

1. to study the status of inland fish production and its share in gross value added of Agriculture in Andhra Pradesh

2. to study the economic viability of inland fish production in West Godavari district of Andhra Pradesh

3. to analyze the factors influencing the inland fish production in West Godavari district and

4. to identify the constraints faced by inland fish farmers in carrying out inland fish production and offer suggestions.

1.3 HYPOTHESIS

1. There is no profitability of inland fish production in West Godavari district of Andhra Pradesh.

2. There is no economic viability of inland fish production in West Godavari district of Andhra Pradesh.

3. There are no factors influencing the inland fish production in West Godavari district of Andhra Pradesh.

1.4 SCOPE OF THE STUDY

Based on the objectives mentioned above, the results of the study helps to provide adequate knowledge related to actual cultural practices adopted by the fish farmers, socio-economic status, cost & returns, and the economic evaluation of an investment in fish farming. It helps to make necessary decisions to invest in fish farming based on the Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR). This study helps to identify the factors influencing the inland fish production to obtain maximum outputs from a given set of inputs and identify the constraints faced by fish farmers. The result of this study may help the farmers in the cost effective production of fish and in planning the investments with deserved returns in the future.

1.5 LIMITATIONS OF THE STUDY

The limitations of the study were, it covers the fish farmer respondents in the West Godavari district only. The study was restricted to nine villages in West Godavari based on the area under inland fisheries. They do not keep farm records. Since the study area provided data, based on memory recall and this hampers its quality further, as the research work done on a small sample, it doesn't represent the larger area.

1.6 ORGANISATION OF THE STUDY

This study is presented under five chapters and each chapter has been a clear explanation of various aspects of the main theme.

CHAPTER I:	The first chapter covers introduction, problem statement, objectives of the study, hypothesis, scope and limitations of the study.
CHAPTER II:	The second chapter deals with the past and present review of literature pertaining to the present study.
CHAPTER III:	The materials, methods and terms and concepts used in the study were presented in third chapter.
CHAPTER IV:	The results and discussion of the present study were given in detail in chapter IV.
CHAPTER V:	The summary and conclusions along with the suggested policy implications were given in chapter V.

Chapter – II

Review of Literature

Chapter –II

REVIEW OF LITERATURE

A brief review has been collected on the present study and presented in this chapter. The literature has been reviewed under the following heads.

2.1. Studies on status of fish production

2.2. Studies on economic viability

2.3. Studies on factors

2.4. Studies on constraints

2.1 STUDIES ON THE STATUS OF FISH PRODUCTION

Lakra and Krishnan (2021) studied the status and future perspectives of fisheries and aquaculture development in India. The results revealed that inland aquaculture has been shown tremendous growth which contributed about 85-90 per cent of the cultured fish. In India, the aquaculture production has increased from 10.26 million tonnes in 2014-15 to 12.59 million tonnes in 2017-18. From the total aquaculture production, inland aquaculture has been shown tremendous growth during the study period (2014-15 to 2017-2018). Andhra Pradesh was the largest fish producer in the inland sector followed by West Bengal. The aquaculture sector was grown at an average growth rate of 5.86 per cent, with the marine and inland sectors growing at 2.42 and 9.01 per cent respectively for the study period 2007-08 to 2017-18.

Bhendarkar *et al.* (2020) studied the status and prospectus of fisheries and aquaculture in Maharashtra state of India. The results revealed that Maharashtra state was the seventh largest producer of fish. Total fish production increased from 1.48 lakh tonnes in 1962-63 to 5.67 lakh tonnes in 2018-19. Marine fisheries had always a major share compared to inland fisheries in the Maharashtra. Over the last two decades, marine sector has registered slow

growth in production from about 4.02 lakh tonnes in 2000-01 to 4.67 lakh tonnes in 2018-19, contributing 12.13 per cent of the total marine fish production.

Kumar *et al.* (2020) conducted a study on the present status of fresh water fishery resources in Uttar Pradesh state of India. The results revealed the vast potential of aquatic bio-researches which contributed to nearly 14.68 per cent of Indian fish biodiversity which exhibits rich genetic and vivid fresh water fish diversity. Fish production in the state is increasing continuously with the production of 632 thousand metric tonnes. Continuous growth is observed in fish production for several years with a slight decline in the year 2011-12. Share of culture fisheries occupied major portion of fish production compared to capture fisheries.

Ngasotter *et al.* (2020) conducted a study on the current scenario of fisheries and aquaculture in India with special reference to Odisha state of India. The results revealed that India ranked second in aquaculture and third in fisheries production, contributing 1.07 per cent to the National GDP and 5.30 per cent to the AgGDP. Odisha is one of the major fish producing states which ranked fourth in total fish production in India. There has been a tremendous increase in fish production from 0.37 million tonnes in 2010-11 to 0.76 million tonnes in 2018-19, with an export of aquatic products of both fish and fish products reached 53,344 tonnes with foreign exchange earnings of Rs.31,000 million in 2017-18.

Bais (2018) studied fish scenario in India with emphasis on Indian major carps. The results revealed that in India, the major carps like Catla (*Catla catla*), Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus mrigala*) and the exotic major carps which were well adapted to Indian water like Common carp (*Cyprinus carpio*), Silver carp (*Hypopthalmichthys molitrix*) and Grass carp (*Ctenopharyngodon idella*).

Subramanyam and Prasad (2017) conducted a study on growth and development of aquaculture in Andhra Pradesh, India. The results revealed that among the states of India, the highest compound growth rate was recorded by

26.05 per cent in Maharashtra and lowest compound growth rate was recorded in Goa (-16.86 per cent). In case of Andhra Pradesh, the growth rate was recorded by 14.75 per cent which was 11 per cent at the aggregate growth of the states.

Paul and Basak (2015) conducted a study on present scenario, problems and prospects of inland fishing in West Bengal of India. The results revealed that a fluctuating growth rate was recorded. The highest annual growth rate was 8.72 per cent in 2006-07 and lowest annual growth rate was -4.11 per cent respectively which implied that there was no unique growth rate of fish production in West Bengal.

Atibudhi (2005) analyzed the production and marketing of fresh water fish in Orissa of India and reported that tanks and ponds were the major sources contributing 80.70 per cent of the state production of fresh water fish.

Kulkarni *et al.* (2005) studied inter-state fish production scenario in India and reported that inland fish production increased from 2.18 lakh tonnes (1950-1951) to 28.5 lakh tonnes (2000-2001). In case of inland fish production, West Bengal ranked first place (29.33per cent) followed by Andhra Pradesh (15.07per cent).

Panwar *et al*. (2005) conducted a study on trend analysis of fish production in India and reported eight-fold increase in inland fish production from 8.83 lakh tonnes in 1980-81 to 32.10 lakh tonnes in 2002-2003. Over the last four and half decades, the annual growth rate in inland fisheries was 11 per cent.

Nahatkar *et al.* (2004) analysed the present scenario and existing potential of fisheries production in different agro-climatic zones of Madhya Pradesh on the basis of average productivity of the pond fish culture in India. The time series data was used to work out the growth rates of fish production for the study period 1961-62 to 2003-04. The result of the study indicated that the overall growth of fisheries sector in the state was high at about 7.97 per cent. The average

productivity was 1139kg/ḥa/yr as compared to national average productivity of 2200kg/ha/yr pond culture.

2.2 STUDIES ON THE ECONOMIC VIABILITY

Ikpoza *et al.* (2021) indicated that, in the variable costs the cost of feed accounted for about ₦ 5,70,350 followed by the purchase of fingerlings ₦ 1,04,169 and labour cost ₦ 28,277. The net return was ₦ 5,08,317. The Rate of return was greater than one indicated that catfish production was profitable in Nigeria.

Sonvanee *et al.* (2021) conducted a study to analyze the Pangasius fish production in the plain area of Chhattisgarh in India. They concluded that per hectare the total cost was Rs.29,59,094.28, yield was 34.16 tonnes, gross return was Rs.32,45,200 and net return was Rs.2,86,105.72. The cost of production was Rs.866.24 per tonne and input-output ratio was 1:1.10.

Zafar (2021) studied the economic viability of inland fisheries in the Ranchi district of Jharkhand state in India. He observed that total cost was Rs.1,062,569/ha, total revenue Rs.22,777,732/ha, gross margin Rs.22,138,741/ha and net farm income was Rs.21,715,163/ha. The profitability ratios like the Benefit Cost Ratio, Rate of Return, Gross Revenue and Expense Structure Ratio were 21.4, 20.4, 0.5 and 0.7 respectively.

De *et al.* (2020) compared the economics of composite carp culture (CFC) and local fish culture in the Parganas district of West Bengal. They noticed that per hectare gross returns for CFC and local fish culture were Rs.2,62,233 and Rs.1,25,500 respectively. Net profit for CFC and local fish culture were Rs.1,44,067/ha and Rs.61,700/ha respectively. The Benefit Cost Ratio for CFC and local fish culture were 2.21 and 1.96 respectively.

Hussain *et al.* (2020) carried out a study on the economic feasibility of composite fish culture (CFC) in four multi-locational trials at farmer's fields in the East Siang district of Arunachal Pradesh. The results revealed that per hectare

total cost of production was Rs.1,46,667. The Benefit Cost Ratio was 2.16 which reflected that CFC was a profitable venture.

Natarajan and Joseph (2020) conducted a study on the adoption of small-scale coastal cage fish farming in South West coast of Kerala of India. The results revealed that the Net Benefit Earnings Ratio was 47 per cent, NPV was 6536 USD, BCR was 1.38 and IRR was 68 per cent. They suggested that based on the economic indicators, the small-scale cage fish farming in the coastal waters of Kerala was a profitable enterprise.

Kannika *et al.* (2019) conducted research on Indian Major Carp production (IMC) at Cauvery delta zone in Tamil Nadu. The results observed that the net income was Rs.45,512 per acre. The Benefit Cost ratio on total cost and total variable cost were 1.15 and 2.32 respectively. The profit margin was 13.41 per cent.

Oyebisi and Omonona (2019) analyzed the productivity of catfish production in Osun state of Nigeria. They showed that average gross margin was ₦ 788,823.54 per meter square and average profit was ₦ 413,012.27 per meter square and Benefit-Cost Ratio was 1.06 indicated that catfish farming was a profitable venture.

Aswathy and Imelda (2018) conducted a study on economic viability of cage farming of Asian sea bass in the coastal waters of Kerala. The results found that in Gothuruthu village the BCR and IRR were 1.04 and 21 per cent respectively. While in Pizhala village, the BCR and IRR were 1.26 and 47 per cent respectively which indicated that both villages the enterprise was financially viable.

Debnath *et al.* (2018) carried a study on economics of fish farming in ICAR Research Complex for North Eastern Hill(NEH) Region of Tripura. The net profit noticed that Rs.27,680/ha in nursery phase, Rs.16,110/ha in rearing phase and Rs.54,250/ha in grow-out phase. The Benefit Cost Ratio was highest in nursery (1.85) followed by grow-out phase (1.82) and rearing phase (1.40).

Ibeun *et al*. (2018) studied profitability of cultured fish farming in Kanji Lake basin of Nigeria. The result observed that the total variable cost was ₦ 442.14/kg. The cost of feed was highest *i.e.*, ₦ 351.14/kg while the cost of fingerlings was ₦ 45.38/kg. The gross margin and net farm income were ₦ 388.12/kg and ₦ 349.40/kg. The gross ratio was 0.57/kg implied that 57 per cent of the total revenue was sufficient to cover the total cost of producing kilogram of fish in Kanji Lake basin of Nigeria.

Mog *et al.* (2018) conducted a study on economic appraisal of fish culture in Matarbari and Kakraban villages of Gomoti district in Tripura. They noticed that the gross farm income was highest in case of large fish ponds followed by medium and small fish farms. The Benefit cost ratio was 2.13 for large fish farms followed by 1.91 for medium and 1.70 for small fish farms.

Sontakke and Haridas (2018) pointed out that the highest net income (Rs.4,86,015 per 0.05acre) was obtained from biofloc based system followed by traditional pond culture (Rs.2,81,123 per 0.05acre) and clear water system (Rs.2,81,123 per 0.05 acre). The biofloc based nursery rearing of milk fish was more economically viable and profitable than the clear water culture system and traditional pond culture.

Adeleke *et al.* (2017) investigated yield determinants among catfish farmers in the Epe Local Government area of Lagos state of Nigeria. They noticed that the Expense Structure Ratio (0.76), Benefit Cost Ratio (3.13), Gross Revenue Ratio (0.45) and Rate of Return (0.96) indicated that catfish farming enterprise was profitable in the study area.

Diatin *et al.* (2017) assessed additional financial benefit of production increment through stocking pattern followed Pokdakan PBC fish farm in Sukabhumi village of West Java province in Indonesia. They concluded that Net present value was 3,824 million, Benefit cost ratio was 4.96, Internal rate of return was 86 per cent and Payback period was 1.7 years.

Chidambaram *et al.* (2016) pointed out that the seed cost accounts 16.11 per cent followed by feed 13.58 per cent, interest on working capital 7.69 per

cent and manure 5.44 per cent to the total cost per ha. The average output was 586.75kg/ha/yr. The carp price was Rs.75/kg. The net income was Rs.23,623.35/ha in Krishnagiri district of Tamil Nadu in India.

Tunde *et al.* (2015) assessed the cost and returns of fish farming in Saki-East local government area of Oyo state in Nigeria. They concluded that per cycle total cost of production and total revenue were ₦ 1,29,379.52 and ₦ 244364.30 respectively. The Benefit Cost Ratio was 1.9 and Rate of Return on investment was 0.89 per cycle.

Devi *et al.* (2014) studied the economic analysis of fish production in Manipur state of India. They noticed that the cost A_1, cost A_2, Cost B and cost C accounts Rs.88467.03, Rs.884467.3, Rs,96455.6 and Rs.99107.9 respectively. The farm efficiency measures like gross farm income was Rs.129575.2, net farm income Rs.30467.26, family labour income Rs.41992.46, farm business Rs.44376.69 and farm investment income Rs.38823.84. The Benefit cost ratio was 1.31 which was found profitable.

Issa *et al.* (2014) studied the profitability of small-scale catfish farming in 4 Local Government Areas in Kaduna state of Nigeria. The results revealed that per one production cycle, the total cost was ₦ 279,665. Among total cost, the variable cost was 59.2 per cent and a fixed cost was 40.8 per cent. The net profit and gross margin were ₦ 581,451.02 and ₦ 774,223.05 respectively per square metre which implies that catfish farming was profitable.

Khan and Manzoor (2014) analyzed the economic viability of carp fish farming and its impact on the living standard of the inhabitants in the selected districts in Khyber Pakhtunkhwa province of Pakistan. They concluded that NPV, BCR and IRR were Rs.13991/ha, 1.03 and 12.67 per cent respectively. It indicated that enterprise was viable.

Das *et al.* (2013) assessed the economic viability of Aqua-model village scheme in West Tripura district of Tripura. They noticed that net income was (Rs.43,469 /ha/year) substantially higher in adopted villages compared to non-

adopted villages (Rs.30,243/ha/year). The NPV, BCR and IRR for adopted Aqua model village scheme were Rs.312.43 lakhs/ha, 1.35 and 53 per cent respectively.

Umamaheswari *et al.* (2013) calculated the economics of freshwater aquaculture farms in the Union Territory of Puducherry. They observed that feed cost was 19.29 per cent to the average cost C followed by human labour (14.08 per cent), seed (10.43 per cent) and input value of family labour (6.28 per cent). The price of fish was Rs.40/kg. The net income was Rs.31,485/acre.

Emokaro *et al.* (2010) analyzed the profitability and viability of cat fish farming in Kogi state of Nigeria. They noticed that per hectare the gross revenue, net profit and gross margin were ₦ 1079.15, ₦ 485.74 and ₦ 555.35 respectively. The Benefit cost ratio was 1.82 indicated that cat fish farming was a profitable enterprise.

Oladejo (2010) analyzed the economics of small scale catfish farming in Ido local government area of Oyo state observed that gross margin and net revenue were Rs.4,28,91,778 and Rs.3,70,15,440 per hectare respectively. Benefit cost ratio was 2.17 which implied that the cat fish farming was profitable enterprise.

2.3 STUDIES ON FACTORS INFLUENCING IN FISH FARMING

Ikpoza *et al.* (2021) analyzed the factors influencing the cat fish farming in Nigeria. The results revealed that fish feed, pond size were positively significant. The inefficiency factors like age and educational status of farmers were found significant. The mean technical efficiency was 53.49 per cent.

Singh and Devi (2020) conducted a study to assess the factors influencing carp production in Manipur by using stochastic frontier model. The results revealed that fish fingerling and feed were found significant. The mean efficiency was 72 per cent.

Baruwa and Omodara (2019) employed stochastic frontier production function for the technical efficiency of aquaculture system in Oyo state of Nigeria. The results revealed that pond size, feed and quantity of fingerlings stock were found positively significant. The mean technical efficiency was 74 per cent in the study area.

Oyebisi and Omonona (2019) employed stochastic frontier production function for estimating factors influencing the catfish production in Osun state of Nigeria. The results revealed that years of farming experience, quantity of feed and cost of hired labour were positively significant at 10 per cent, one per cent and one per cent levels respectively. While the stocking density, pond size, cost of fingerlings, type of water use, and cost of transportation have negative and significant influence on output of catfish production.

Ibeun *et al.* (2018) employed stochastic frontier production function for estimating the factors influencing the cultured fish farming in Kanji Lake basin of Nigeria. The efficiency factors like feed, stock density, fertilizer were significant at one per cent probability level while capital input was significant at 10 per cent probability level. The inefficiency factor like education, farming experience, credit access and extension service were significant at 10 per cent, one per cent and five per cent probability level respectively.

Ogunmefun and Achike (2018) found that labour cost and depreciation value were significant at five per cent level while fertilizer and stocking capacity were significant at 10 per cent level. The inefficiency factors like cooperative membership and gender of the fish farmer were found significant at five per cent level. The mean technical efficiency was 88 per cent in Lagos state of Nigeria.

Adeleke *et al.* (2017) investigated yield determinants among catfish farmers in Epe local government area of Lagos state of Nigeria. The results revealed that labour (man-days), quantity of fingerlings and total pond size were positive and significantly affects the catfish output while quantity of feed was negative and significant influence on the yield output of catfish.

Inoni *et al.* (2017) employed stochastic frontier production function for studying factors affecting the homestead catfish production in Delta state of Nigeria. The results indicated that pond size, feed, fingerlings and labour (man days) exerted positive significant effect on fish output. The inefficiency factors like household size was positively significant while age of the farmer, education and access to credit were negatively significant. The mean technical efficiency was 87 per cent.

Roy and Mazumder (2016) applied stochastic frontier production function for assessing the factors influencing the fish catch among traditional fishermen of the Sone Beel in Karimganj district of Assam. The results revealed that factors like labour (man days) and net boats were found positively significant. The socio economic factors like experience was found positively significant while education and income were found negatively significant. The mean technical efficiency was 68 percent.

Gbigbi *et al.* (2014) studied technical efficiency of artisanal fishery in the Niger-Delta of Nigeria. They concluded that the coefficients of labour, capital inputs and quantity of baits were positively significant. The variables like education, fishing experience and fishing distance were negatively significant influence on technical inefficiency while household size and age of respondents were positively significant. The mean technical efficiency was 64 per cent indicated that efficiency can be improved by 36 per cent.

Misra and Misra (2014) studied on the technical efficiency of fish farms in West Bengal and reported that an overall technical efficiency was 62.8 per cent. The variables like farm experience and ownership were the most important determinants of technical efficiency.

Umamaheswari *et al.* (2013) studied the technical efficiency of fresh water aquaculture farms in the Union Territory of Puducherry by using stochastic frontier production function. The results indicated that feed was positively

significant at 10 per cent on carp yield. The mean technical efficiency of carp farms was 61 per cent.

Alam *et al.* (2012) employed translog stochastic frontier production function for assessing the technical efficiency in tilapia farming of Bangladesh. The results revealed that fingerling size, labour, feed and fertilizers were positively significant at five per cent level while stocking density was negatively significant. The technical inefficiency factors like age of operator, culture length and green water color of the pond water were found positively significant, whereas annual income was negatively significant effect on technical efficiency. The mean technical efficiency was 78 per cent.

Ugwumba (2011) studied factors influencing the catfish production for the large and small farms in Anambra state of Nigeria by using the translog stochastic frontier production function. The results indicated that mean technical efficiency scores were 0.89 and 0.94 for large and small scale farms respectively, which implied that the small scale farms were technically more efficient than the large scale farms. The factors like household size and feeding method were negatively significant at five per cent level of probability for both large and small scale farms respectively.

Igwe *et al.* (2010) employed stochastic frontier production function to analyze the determinants of production and technical efficiency of fish in Abia state of Nigeria. They depicted that the fingerlings stock and the pond size were positively significant at 10 per cent level, while age and stock size were positively significant at five per cent and 10 per cent level respectively. The mean technical efficiency was 90 per cent and remaining 10 per cent chance of increasing the level of technical efficiency with the available technology at their disposal.

Ekunwe *et al.* (2009) used stochastic frontier production function to examine the factors influencing the catfish farmers in Kaduna state of Nigeria. The results indicated that experience and age were positively significant whereas

gender, household size and education were negatively significant. The mean efficiency was 85.4 percent.

Singh *et al.* (2009) employed stochastic production frontier approach to study the factors influencing the fresh water aquaculture and its determinants in Tripura. The factors like fingerlings stock, labour and lime were positively significant. The mean technical efficiency of fresh water aquaculture was 0.66.

Osawe (2008) assessed factors influencing the small scale fish farmers in Ibadan metropolis in Oyo state of Nigeria using stochastic frontier production function. The findings revealed that the factors like feed and stocking rate were found positively significant at five per cent level of significance while the pond size was found negatively significant at five per cent level of significance. The mean efficiency was 90 per cent.

Irz *et al.* (2003) evaluated the profitability and the factors influencing the aquaculture systems in Pampaanga city of Philippines by using stochastic frontier production function. The results revealed that technical efficiency of brackish water and fresh water aquaculture was 53 percent and 83 percent respectively.

Sharma and Leung (2000) examined the levels and determinants in carp pond culture in India by employing the stochastic production frontier technique. The results indicated that the factors like fingerlings, chemical fertilizers, organic manure, feed and other inputs were found positively significant at five per cent level of significance while inefficiency factors like water management and feed management were found negatively significant for the semi intensive farms. For the extensive farms, factors like fingerlings and organic manure found positively significant at five and 10 per cent level respectively, while the inefficiency factors like primary activity and feed management found negatively significant at five per cent and 10 per cent level respectively and fish management found positively significant. The mean technical efficiencies for semi-intensive and extensive farms were 0.80 and 0.65 respectively.

2.4 STUDIES ON THE CONSTRAINTS

Lakra and Gopalakrishnan (2021) conducted a study on status and future perspectives and aquaculture development in India. The results revealed that depleted stocks due to habitat degradation, over exploitation, poor governance, climate change in addition to harvest and post-harvest losses were the major constraints faced in capture fisheries production. The low average productivity due to low adoption of technology, disease prevalence, non-availability of quality seed and cost effective feed for desired species were the major constraints faced in culture fisheries production.

Priyanadh and Kumar (2021) observed that the major constraints in inland fish production in West Godavari district of Andhra Pradesh. The results revealed that the high cost of seed, lack of information about government scheme and subsidies, frequent disease attack, high initial investment, fluctuating temperature, high cost of medicines, high cost of fertilizer, high cost of labour, non-availability of labour during peak period, high cost of manure, non-availability of skilled labour, lack of irrigation facilities and non-availability of quality seedling, shortage of fertilizer and irregular electric supply.

Sonvanee *et al.* (2021) noticed that high construction and initial cost, high seed and feed cost, lack of insurance facilities for farming of fish, lack of financial support, insufficient funds, non-availability of labour, irrigation facilities and frequent disease attack were the major constraints of Pangasius fish production in plain area in Chhattisgarh state of India.

De *et al. (*2020) analyzed the constraints perceived by the fish farmers in Paraganas district of West Bengal state of India. The results revealed that high cost of supplementary feed, disease outbreak, lack of access to credit facilities, high lease value of pond, lack of need based training, lack of exposure to mass media, poaching and non-availability of bigger size fingerling were major constraints.

Kumar *et al.* (2020) studied the constraints in fish production in Dharwad and Belagavi districts of North Karnataka of India. The results observed that the lack of training facility, non-availability of quality fingerlings, water scarcity, lack of institutional credit, natural predator problem and oxygen deficiency for fish were the major constraints.

Oyebisi and Omonona (2019) identified that poor access to credit facility, high cost of feed and unorganized market for producer and marketer relationship were the major constraints of cat fish production in Nigeria.

Aswathy and Imelda (2018) found that water pollution, inadequate financial capital, climate change impacts, high feed cost and lack of insurance facilities were the major constraints in cage fish farming in Kerala state of India.

Digun-Aweto and Oladel (2017) identified that lack of capital was major constraint among the catfish farmer in Lagos state of Nigeria followed by lack of technical expertise, non-availability of inputs, difficulty of handling, expensive to maintain, poor dissemination, inadequacy of technical support and immediate and long term benefits.

Lytan (2017) identified the constraints faced by fish farmers of Ri-Bhoi district of Meghalaya and reported that lack of fish seeds, non-availability of inputs, fish mortality during transportation, lack of technical knowledge on scientific fish farming practices and use of ponds for dual purpose were the problems faced by the fish farmers.

Munish (2017) reported that lack of awareness regarding fisheries schemes, non-availability of quality seed and feed, lack of water, misuse of subsidy, lack of proper exposure visits including institution credit, non-availability of insurance cover and discrimination in allocation of ponds were the main constraints faced by fish farmers in the Kashmir valley of India.

Ogunmefun and Achike (2017) revealed that cost of feed, lack of capital/finance, high cost of inputs, poor hatching techniques, pest and diseases

and lack of water supply were the major constraints faced by fish farming enterprise in Lagos state of Nigeria.

Umamaheswari *et al.* (2017) found that disease outbreak and tough competition were the major constraint faced by the farmers in ornamental fish production and marketing in Madurai district of Tamil Nadu in India.

Chidambaram *et al*. (2016) observed that the non-availability of credit, non-availability of adequate quality seed and improper guidance were major constraints in resource and production management respectively in carp farming in Krishnagiri district of Tamil Nadu in India.

Karki *et al.* (2016) analyzed the constraints faced by fish farmers in Nepal. The major constraints faced by the sample fish farmers were shortage in fingerlings supply, lack of marketing infrastructure, disease problems and lack of skilled human resources in the fishery sector.

Kanaga *et al.* (2015) revealed that lack of adequate knowledge in production and extension, lack of encouragement in cohesion, lack of funds in finance, performance of SHGs and lack of marketing skill in the marketing were the major constraints faced by the fisher women in Thoothkudi district of Tamil Nadu, India.

Paul and Basak (2015) conducted a study on present scenario, problems and prospects of inland fishing of West Bengal. The results revealed that poaching, water availability and capital were the major problems faced by the fish farmers in West Bengal.

Phukan *et al.* (2015) observed the major problems like lack of funds, availability of skilled labour for pond preparation, lack of facilities for soil and water testing and availability of quality fish seed in Cachar district of Assam state of India.

Devi *et al.* (2014) observed that lack of drainage during rainy season, lack of training facilities relating to new technology, non-availability of funds

from institutional source, scarcity and untimely availability of good quality fingerlings and its high price, shortage of manure, feed and fertilizers, high wage rate of labour, high cost in other inputs such as tools and implements, lack of contact with competent fishery extension personnel and difficulties in technical operations were the major constraints faced by fish farmers in Imphal-West district in Manipur of India.

Das *et al.* (2013) adoption of improved fish culture practices under the Aqua-model village scheme in Tripura. The results observed that the major constraints in adopted villages were feeding, pond management, pond preparation, pond construction. Whereas pond preparation, feeding, pond construction, pond management were in non-adopted villages.

Rahaman *et al.* (2013) found that major fish production constraints in Birbhum district of West Bengal in India. The results revealed that theft and pilferages, non-availability of quality fish seeds, lack of natural feed, lack of government support, lack of resource, lack of extension services, gas formation during rainy and summer season, quarrel and litigation among the owners of the pond, distance from the house, adoptability of fish seed is very low in new environment, diseases of fish and productivity of the soil of the pond were the major constraints.

Pandey and Dewan (2006) observed that inadequate/no finance was the major problem for borrowers and non-borrowers of FFDA project in Uttar Pradesh of India.

Chapter – III

Material and Methods

Chapter - III

MATERIAL AND METHODS

This chapter deals with the description of methodology adopted, sampling procedure for selection of district, mandals, villages and respondents, method of data collection and analytical tools employed in analyzing the data to arrive at the results of the study. This chapter is presented under the following heads.

3.1. Sampling design

3.2. Collection of data

3.3. Tools of analysis

3.4. Terms and concept

3.1 SAMPLING DESIGN

Multi-stage sampling design was adopted for the study as detailed below.

3.1.1 Selection of State

Andhra Pradesh state was purposively selected for the study as it stands at first place in the inland fish area with a 0.33 million hectares and production with a 3.61 million tonnes in India. (Handbook of Fisheries, Andhra Pradesh. 2019-2020).

3.1.2 Selection of the District

West Godavari district was purposively selected for the present study as it stood highest in area under inland fish farming in Andhra Pradesh. *i.e.,* 0.06 million hectares with a production of 1.28 million tonnes (Fisheries Department, Andhra Pradesh, 2019-2020).

3.1.2 Selection of Mandals

All the mandals in the West Godavari district were arranged in descending order based on inland fish area and top three mandals *viz.*, Bhimvaram, Kalla, Nidamarru were selected.

3.1.3 Selection of Villages

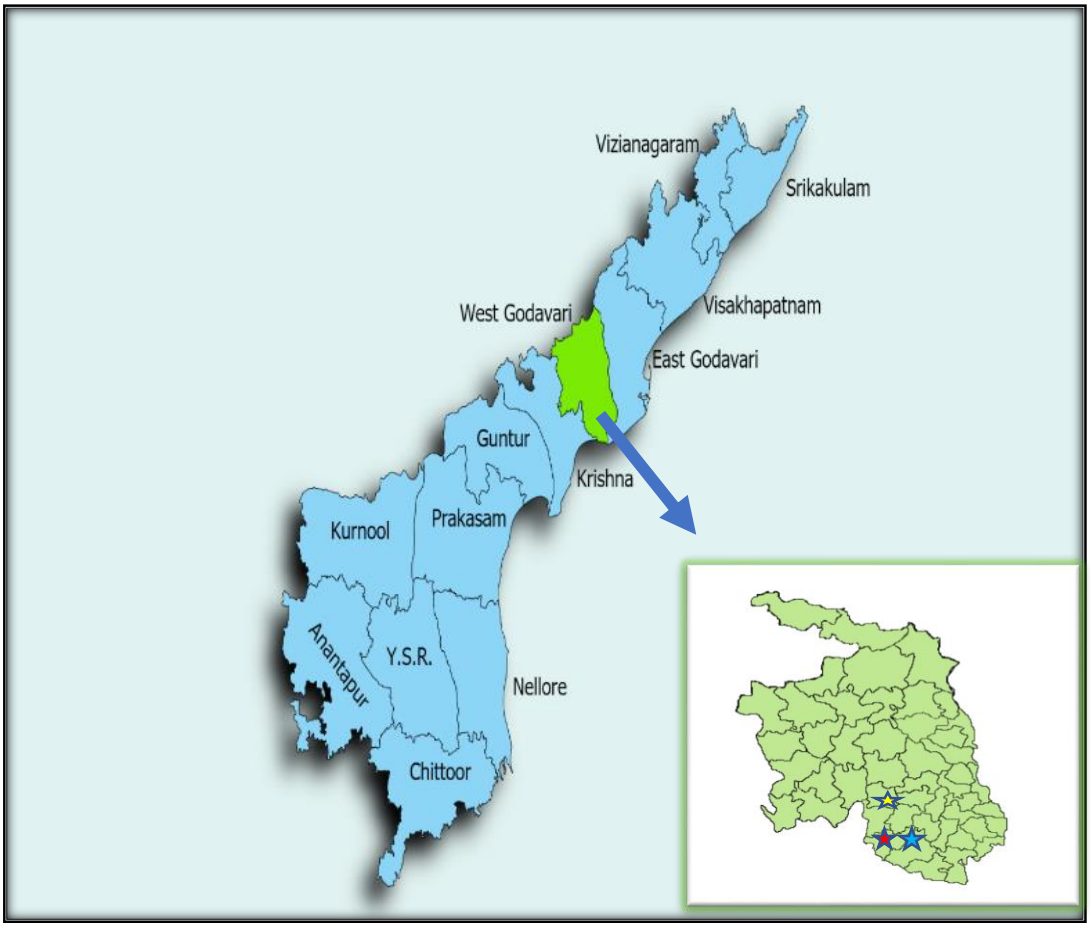
All the villages which had maximum area under inland fish area were arranged in descending order from each selected mandal and top three villages were selected to make the total sample of nine villages.

3.1.5 Selection of Respondents

The final sample respondents were selected randomly from each selected village of their respective mandals based on simple random sampling. A total of ten sample respondents were selected randomly from each of the nine villages, thus making the final sample of ninety respondents in the study.

Table 3.1. Selected list of mandals, villages and number of respondents

S. No.	Name of the mandal	Villages selected	No. of respondents selected
1	Bhimvaram	1)Losari	10
		2)Anakoderu	10
		3)Vempa	10
2	Kalla	1)Bondada	10
		2)Seesali	10
		3)Kalavapudi	10
3	Nidamarru	1)Chinanidrakolu	10
		2)Baviapalem	10
		3)Nidamarru	10



☆ - **Selected District and Mandals**

Selected mandals	
★	Bhimavaram
★	Kalla
★	Nidamarru

Figure 3.1. Map showing selected district with Mandals

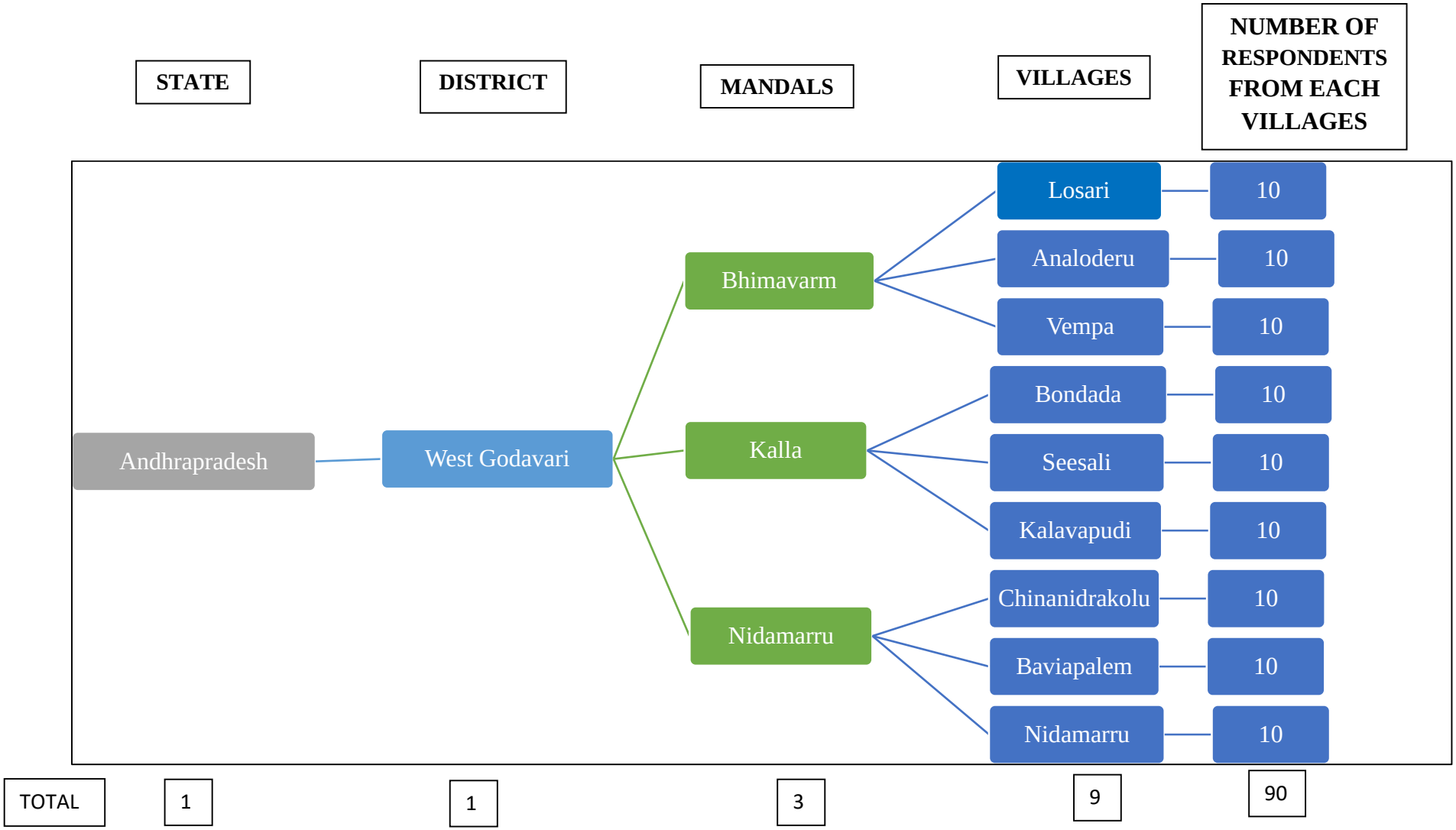


Figure 3.2. Flow chart showing selection of Sample Respondents

3.2 COLLECTION OF DATA

Primary and Secondary data were collected to fulfill the designed objectives.

3.2.1 Primary Data

The personal interview method was adopted for the collection of data from the selected respondents pertaining to the Agricultural year 2021-22. A well-structured schedule was prepared and pretested. The revised schedule was personally administered to obtain the relevant information regarding inland fish farming *i.e.,* initial investment, farm size, inputs used in cultivation of fish farm. The data included the detailed information regarding cost of fish farming, yield, returns and constraints in fish farming of inland fish *etc.*

3.2.2 Secondary Data

The area and production of inland fisheries in the district, mandals and villages were collected from Andhra Pradesh Fisheries Department (Vijayawada) and Joint Director of Fisheries (Eluru).

3.3 TOOLS OF ANALYSIS

The data collected were subjected to conventional (simple tabulation) as well as functional analysis to arrive at valid conclusions. The following tools of analysis were employed to analyse the collected data. The methods of analysis followed are presented under the following subheads.

1. Descriptive statistics
2. Economic Appraisal techniques
3. Stochastic frontier production function
4. Garett ranking technique

3.3.1 Descriptive statistics

The collected data was presented in tabular form to facilitate easy comparisons. Tabular analysis was employed for estimates. The costs & returns and socio-economic characteristics of sample respondents. The data were summarized with the aid of statistical tools like averages, percentages, average annual growth rate, compound annual growth rate *etc.*, to obtain the meaningful results.

3.3.1.1. Average Annual Growth Rate (AAGR):

AAGR was used to study the status of inland fish production in Andhra Pradesh. It merely gives the percentage increase over the previous year *i.e.*,

$$G = \frac{K_t - K_{t-1}}{K_{t-1}} * 100$$

Where,

G = Growth Rate,

K_t, K_{t-1} are the values of variables,

K in year's t and t-1 respectively

3.3.1.2. Compound Annual Growth Rate (CAGR):

CAGR was used to calculate the trends in inland fish production of Andhra Pradesh *i.e.*,

$$Y=ab^x$$

Where,

Y= dependent variable in period

a= intercept

b=Regression coefficient

x=Year which takes values (1, 2...n)

It has been estimated as linear equation after taking the log for both sides.

$$\text{Log } y = \log a + x (\log b)$$

$$\text{Growth rate (\%)} = [\text{Antilog } (\log b) - 1] * 100$$

3.3.2 Economic viability techniques

3.3.2.1 Cost concepts

Cost concepts were used to estimate the cost of inland fish farming and to derive the farm efficiency measures such as farm business income, family labour income, net income and farm investment income. The cost concepts *viz.*, cost A_1 cost A_2, cost B_1, cost B_2 and cost C_1, cost C_2 and cost C_3 were used in the present study and these are derived as follows:

1. Cost A_1 : This includes cash and kind expenses actually incurred by cultivator like acquiring manures and fertilizers fish seed, artificial feed, wages paid for human labour, electricity/fuel charges, land revenue, depreciation charges, interest on working capital and miscellaneous charges *etc*.
2. Cost A_2 : Cost A_1 + Rent paid for the leased-in land.
3. Cost B_1 : Cost A_2 + Interest on fixed assets (excluding land)
4. Cost B_2 : Cost B_1 + Rental value of the owned land
5. Cost C_1 : Cost B_1 + Imputed value of family labour
6. Cost C_2 : Cost B_2 + Imputed value of family labour
7. Cost C_3 : Cost C_2 + 10% of Cost C_2

Farm efficiency measures

1. Gross returns: This gross returns are calculated based on the total quantity of fish harvested multiplied by the unit price at the sale of time during the season valued at prevailing market prices.
2. Net returns: Gross returns – cost C_3

3. Farm business income: Gross returns - cost A_1

4. Farm investment income: Farm business income – imputed value of family labour

5. Farm labour income: Gross returns – cost B_2

3.3.2.2. Profitability ratios

Simple profitability ratios were used to access the viability of the fish production.

1. Rate of Return (ROR) = $\frac{\text{Net returns}}{\text{Total cost}}$

2. Expense Structure Ratio (ESR) = $\frac{\text{Fixedcost}}{\text{Variablecost}}$

3. Gross Revenue Ratio (GRR) = $\frac{\text{Total Cost}}{\text{Gross returns}}$

3.3.2.3. Break even analysis

Profitability was studied with the help of management tool like break-even analysis. It locates the level of output that equates total revenue to the total cost. The formula used to derive the break-even point was

$$\text{Break-even output} = \frac{\text{Total fixed cost Rs/ha}}{\text{Price} - \text{Average variable cost}}$$

3.3.2.4 Economic appraisal techniques

Net Present Value, Benefit Cost Ratio and Internal Rate of Return were employed to study the economic viability of inland fish production.

1) Net Present Value (NPV): It is the discounted value of net cash flow of the inland fish farming during its life time. It is computed as,

$$\text{NPV}=\sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+r)^t}$$

Where,

B_t= Benefits in period t

C_t = Cost in period t

r = Discount rate

t = Project life

NPV should be positive, and then the investment considered as viable.

2) Benefit Cost Ratio (BCR): It is the ratio of discounted value of all cash inflows to the discounted value of cost outflows during the life of project. It computes as,

$$\text{BCR}= \frac{\sum_{t=1}^{n} B_t\left((1+r)\right)^{-n}}{\sum_{t=1}^{n} C_t(1+r)^{-n}}$$

Where,

B_t= Benefits in period t

C_t = Cost in period t

r = Discount rate

n = No. of years

BCR is should be greater than one, and then investment is considered feasible**.**

3) Internal Rate of Return (IRR): The internal rate of return is rate of discount at which NPV is zero. It is calculated by using following formula.

$$\text{IRR}=\left[\begin{array}{c}\text{Lower}\\ \text{discount rate}\end{array}\right]+\left[\begin{array}{c}\text{difference between}\\ \text{the two discount}\end{array}\right]\left[\frac{\begin{array}{c}\text{present worth of the cash flow}\\ \text{at the lower discount rate}\end{array}}{\begin{array}{c}\text{absolute difference between the present worth}\\ \text{of the cash flow at the two discount rate}\end{array}}\right]$$

If IRR is greater than prevailing rate of interest, then investment is feasible.

3.3.3. Stochastic Frontier Production Function (SFPF)

This analysis was used to analyse the factors influencing the inland fish production. The stochastic frontier model as defined is Aigner *et al.* (1977) and Meeusen and Van Den Broeck (1977) is as

$$\ln (Y_i) = \beta_0 + \beta_1 \ln (X_{1i}) + \beta_2 \ln (X_{2i}) + \beta_3 \ln (X_{3i}) + \beta_4 \ln (X_{4i}) + \beta_5 \ln (X_{5i}) V_i - U_i$$

Subscripts ij refer to the j^{th} observation of i^{th} farmer

ln = the natural logarithm

Y_i = Total amount of fish produced (Kg/ha).

X_1 = Fingerlings (No/ha).

X_2 = Fish feed (Kg/ha)

X_3 = Lime (Kg/ha)

X_4 = Cost of fertilizers (Rs/ha)

X_5 = Labour in man-days (Man-days/ha).

β_0 = Constant

$\beta_1 - \beta_5$ = Parameters estimated

V_i = Random noise

U_i = Inefficiency effects which are non-negative with half normal distribution.

Where U_i is specified as:

$$U_i = \alpha_0 + \alpha_{1i} Z_{1i} + \alpha_{2i} Z_{2i} + \alpha_{3i} Z_{3i} + \alpha_{4i} Z_{4i} + \delta_{5i} Z_{5i}$$

α_0 = Constant

$\alpha_1 - \alpha_5$ = Parameters estimated

Z_1 = Age (No. of years)

Z_2 = Experience (No. of years)

Z_3 = Education (1=illiterate, 2=primary, 3=secondary, 4=intermediate, 5=degree)

Z_4 = Extension contacts (No. of extension contacts)

Z_5 = Credit access (1=No, 2=Yes)

The factors influencing and the parameters of the model was estimated by the method of maximum likelihood, using the computer program, FRONTIER version 4.1.

3.3.4 Garett Ranking Technique

The respondents were asked to rank the problems encountered by them in fish production. These ranks were converted into percentage position by using the formula,

$$\text{Percentage position} = \frac{100(R_{ij}-0.5)}{N_j}$$

Where,

R_{ij} = Rank given for the i^{th} item by the j^{th} individual

N_j = Number of items ranked by the j^{th} individual

The percent position of each rank is converted to scores by referring to tables given by Garett and Woodworth (1969), by referring to the Garett's table, the percentage of positions estimated were converted in to score. Thus, for each problem the mean score was estimated. The problem with the highest mean value was considered as the most important one and the others followed in that order.

3.4 TERMS AND CONCEPTS USED IN THE STUDY

1. Depreciation Charges: Depreciation on each capital equipment and machinery owned by the farmers and used for cultivation of fish farm was calculated for individual farmer based on the purchase value using the straight line method.

$$\text{Depreciation} = \frac{\text{Purchase value of asset} - \text{junk value}}{\text{Expected life}}$$

2. Discount rate: The discount rate is the interest rate used to determine the present value of future cash flows in a discounted cash flow (DCF) analysis. This helps determine if the future cash flows from a project or investment will be worth more than the capital outlay needed to fund the project or investment in the present.

3. Fish farm: Fish farms are very small and shallow bodies of quiet standing water with only slight wind action if any, in which extensive occupancy by higher aquatic plants is 23 common characteristics. No exact limits of area and depth have been laid down for a pond.

4. Fish farming: It means to promote or improve growth and thus produce fish for commercial use by protection and nurture.

5. Fish feed: To grow the fish farms de-oiled rice bran, ground nut cake and artificial feed farm were valued at prevailing market price paid by the fish farmers.

6. Fish fingerlings: The fish fingerlings were purchased from the local or distant fish hatcheries at prevailing market price.

7. Gross returns: Per hectare gross returns was calculated based on the market prices for the produce in rupees.

8. Human labour: The total number of male and female labourers measured in terms of number of man days or women days. The labour cost of family labour and hired labour was converted to common physical unit (1man day = 8 working hours). The family labour was considered separately and added to the hired labour to calculate the total labour requirement.

9. Interest on fixed capital: Fixed capital includes the expenses on total fixed assets excluding land. The interest was calculated on this investment @ 12 per cent per annum.

10. Interest on Working Capital: The interest on working capital is charged at seven per cent of total variable cost total variable cost multiplied with half of the crop period. the crop period is 8 months' duration.

Interest on working capital =

$$\text{Total variable cost} \times \text{Half of the crop period} \times \frac{7}{100}$$

11. Land revenue: Actual land revenue paid by the farmers to the government was considered.

12. Manures and fertilizers: The cow dung is used as manures in the fish farm was valued at prevailing market price whereas chemical fertilizers like urea, single super phosphate, potash were used in the fish farm were valued at actual price paid by the fish farmers.

13. Net returns: It was calculated by taking into account gross returns subtracting the total cost.

14. Rent paid on leased in land: Rental value of leased-in land is valued according to the available current market price for inland fish farm.

15. Rental value of own land: Rental value of own land is valued at the current market price for inland fish farm.

16. Yield: The total yield of fish farm obtained by farmers was expressed in terms of kgs per hectare.

Chapter – IV

Results and Discussion

Chapter –IV

RESULTS AND DISCUSSION

In the earlier chapters, a brief review of past studies, relevant methodology adopted and the general description of the study area were presented. With that background, the primary data was collected from the sample respondents and analysed using the tools of analysis specified for the study. The results obtained have been discussed in harmony with the objectives under the following subheads.

4.1 SOCIO-ECONOMIC CONDITIONS OF SAMPLE INLAND FISH FARMERS

Before going into the analysis of the results, the study on socio-economic characteristics of the respondents gives an insight into the general characteristics of respondents on age, education level, experience in farming, family size, type of family and source of credit access *etc.* These characteristics are discussed here under.

4.1.1 Age of the respondents

The age of the respondents is also considered as a factor that could influence an individual's decisions. The distribution of age of the sample respondents is presented in Table 4.1 and Figure 4.1. It can be observed from the table that the majority of the respondents belong to the age group of 31- 40 years (35.56 per cent) followed by the age group 21-30 years (26.67 percent), 41- 50 years age group (25.55 per cent) and greater than 50 years (12.22 per cent).

Table 4.1. Distribution of sample farmers according to age

Age group	Frequency	Percentage
21 to 30	24	26.67
31 to 40	32	35.56
41 to 50	23	25.55
>50	11	12.22
Total	**90**	**100.00**

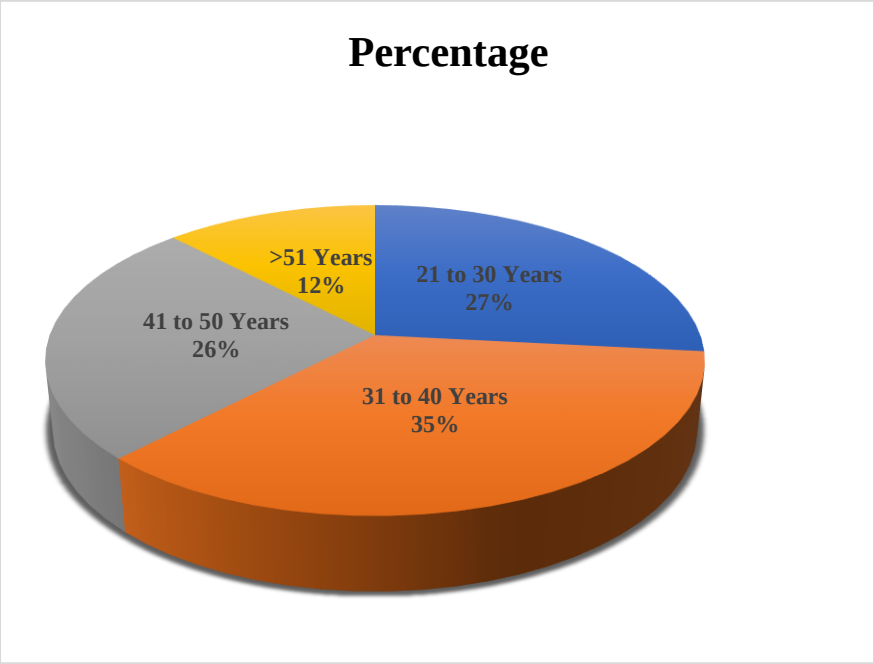


Figure 4.1. Classification of sample farmers according to age (%)

4.1.2 Educational Level

The educational level of respondents is furnished in Table 4.2 and Figure 4.2. From the table, it was noticed that majority of fish farmers were educated up to college level (36.67 per cent) followed by primary school (15.56 per cent), illiterate's (18.89 per cent), intermediate (16.67 per cent) and high school category (12.21 percent).

Table 4.2. Educational level of respondents

Education	Frequency	Percentage
Illiterates	17	18.89
Primary school	14	15.56
High school	11	12.21
Intermediate	15	16.67
College	33	36.67
Total	**90**	**100.00**

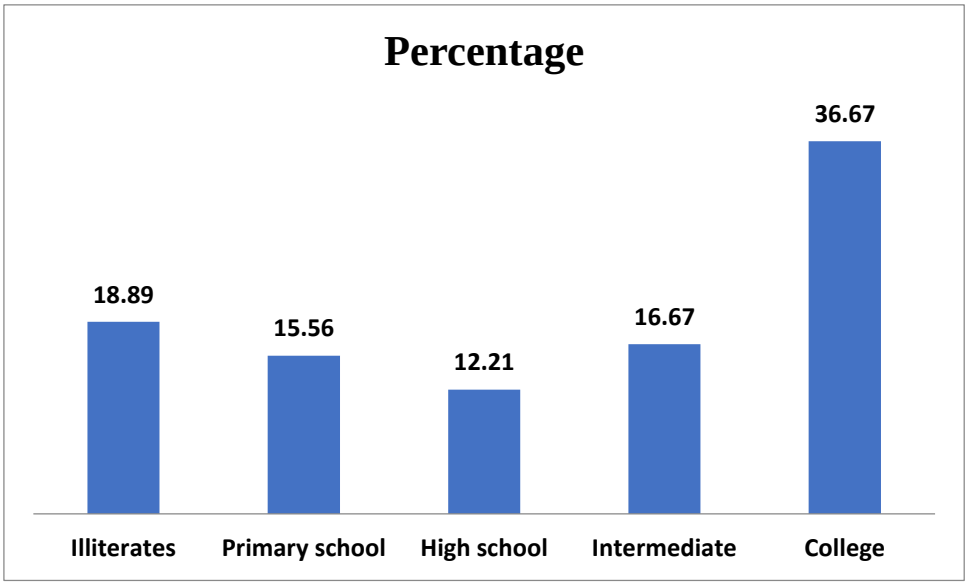


Figure 4.2. Educational level of respondents (%)

4.1.3. Farming Experience

Fish farming experience might give a sign of the purposeful evidence that he has gained on how he can beat certain fundamental farm making and reception issues. Experience is also a determining factor in fish production. Hence, the experience of the respondents was estimated and the results are presented in Table 4.3 and Fig 4.3. It can be observed from the table that 63.33 per cent of farmers have less than 10 years of farming experience followed by 22.22 per cent of farmers have 11-20 years of farming experience, 11.12 per cent of farmers have 21-29 years of farming experience and followed by 3.33 per cent of farmers have greater than or equal to 30 years of farming experience.

Table 4.3. Farming experience of respondents

Farming experience	Frequency	Percentage
<10	56	63.33
11 to 20	20	22.22
21 to 29	10	11.12
≥30	3	3.33
Total	**90**	**100.00**

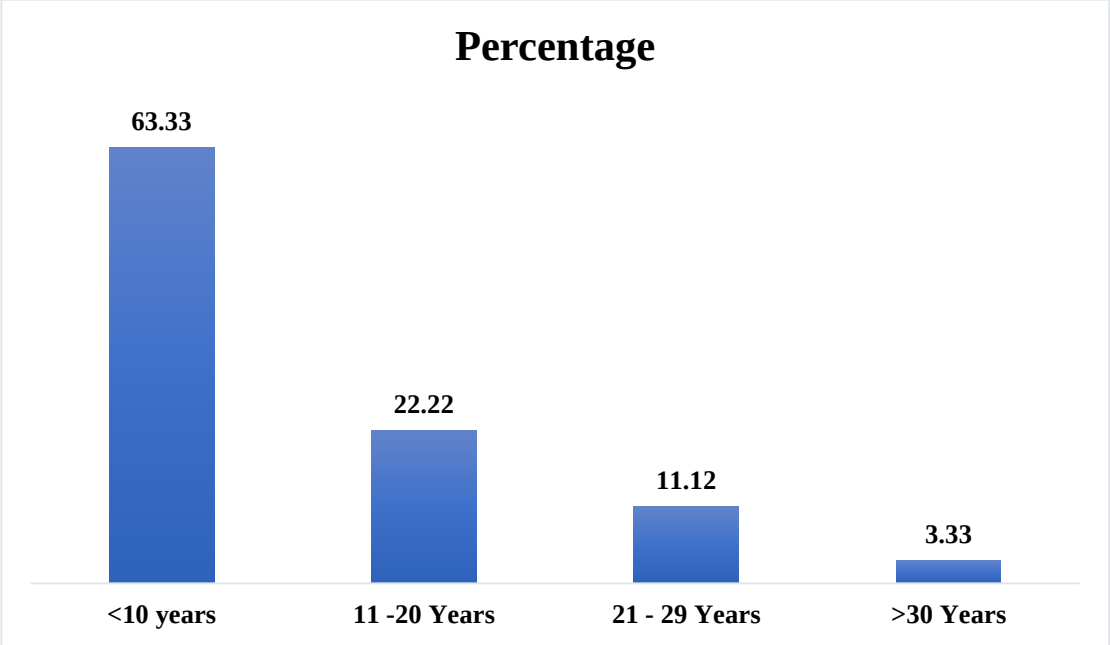


Figure 4.3. Classification of Farming experience of respondents (%)

4.1.4. Family size

It is noticed from the table 4.4 and figure 4.4 that 52.22 per cent of respondents belong to small size (5 to 6 members) followed by 32.22 per cent respondents belong to nuclear size (1 to 4 members) and 15.56 per cent of the respondents belong to large size (>6 members).

Table 4.4. Family size of sample respondents

Family Size	Frequency	Percentage
Nuclear (1 to 4)	29	32.22
Small (5 to 6)	47	52.22
Large (>6)	14	15.56
Total	**90**	**100.00**

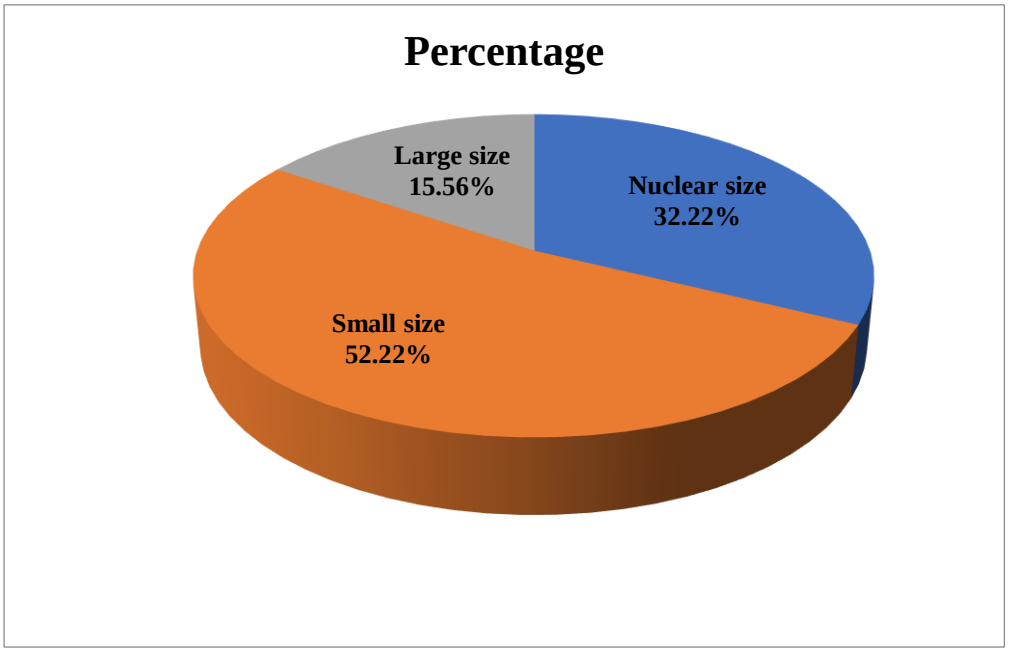


Figure 4.4. Classification of family size of sample respondents (%)

4.1.5 Land holding particulars

It is noticed from the table 4.5 and figure 4.5, that majority of the respondents were belong to small size farm (28.89) followed by medium size farm (23.33), semi-medium size farm (21.11 per cent), large size farm (14.45) and marginal size farm (12.22).

Table 4.5. Farm size particulars of the respondents

Farm size (in ha)	Frequency	Percentage
Marginal (> 1ha)	11	12.22
Small (1 to 2ha)	26	28.89
Semi-medium (2 to 4ha)	19	21.11
Medium (4 to 10ha)	21	23.33
Large (≥10 ha)	13	14.45
Total	**90**	**100.00**

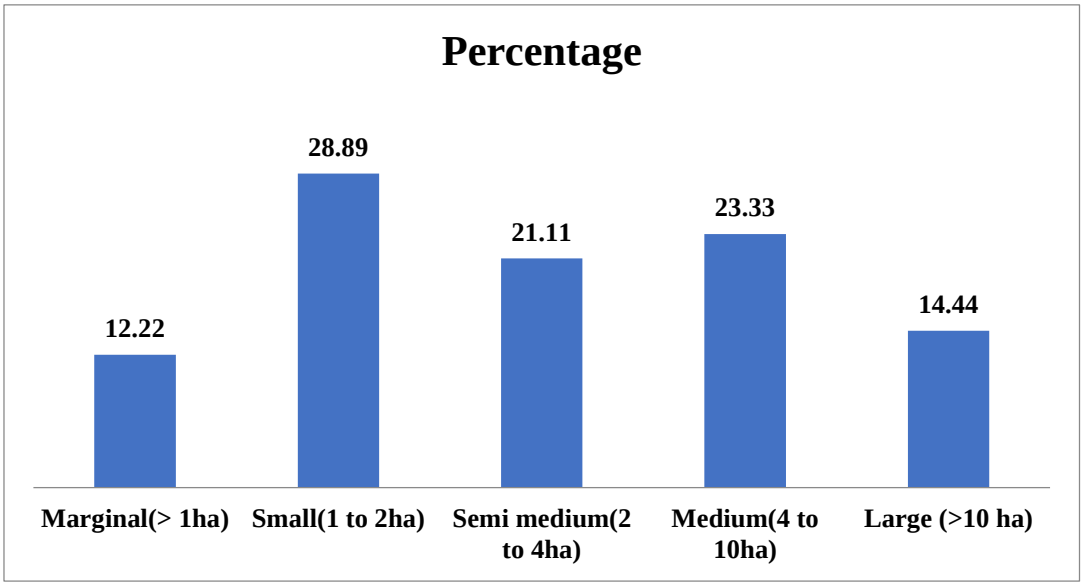


Figure 4.5. Farm size particulars of the respondents (%)

The tenurial status of sample respondents are presented in the table 4.6 and figure 4.6. It can be observed from the table that the majority of the farmers had their own land *i.e.*,71.11 per cent of the respondents followed by tenants (28.89 per cent).

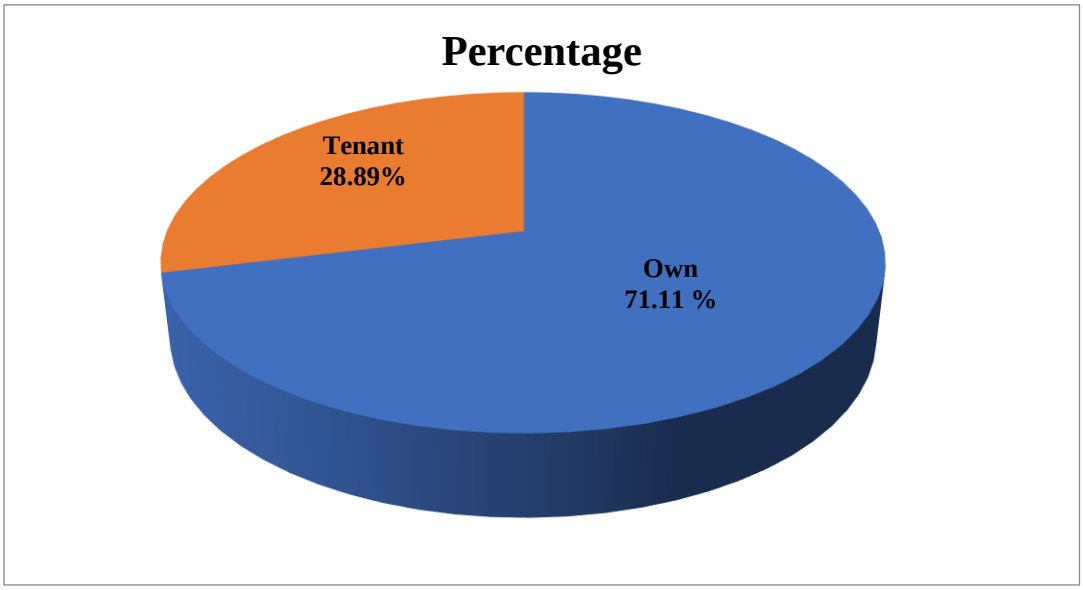


Figure 4.6. Classification according to the tenurial status of the respondents (%)

Table 4.6. Tenurial status of the sample respondents

Category	Frequency	Percentage
Own	64	71.11
Tenant	26	28.89
Total	**90**	**100.00**

4.1.6. Source of credits

From the table 4.7 and figure 4.7, it can be observed that 45.56 per cent of the sample farmers had access to institutional credit followed by non-institutional credit with 40.00 per cent. 14.44 per cent of the farmers had not taken any credit either from institutional or non-institutional agencies *i.e.*, they bearded all their expenses from their own capital.

Table 4.7. Source of credit of sample respondents

Category	Frequency	Percentage
Institutional (Commercial Bank, co-operative Bank)	41	45.56
Non-Institutional (Landlord, relatives' friends)	36	40.00
None	13	14.44
Total	**90**	**100.00**

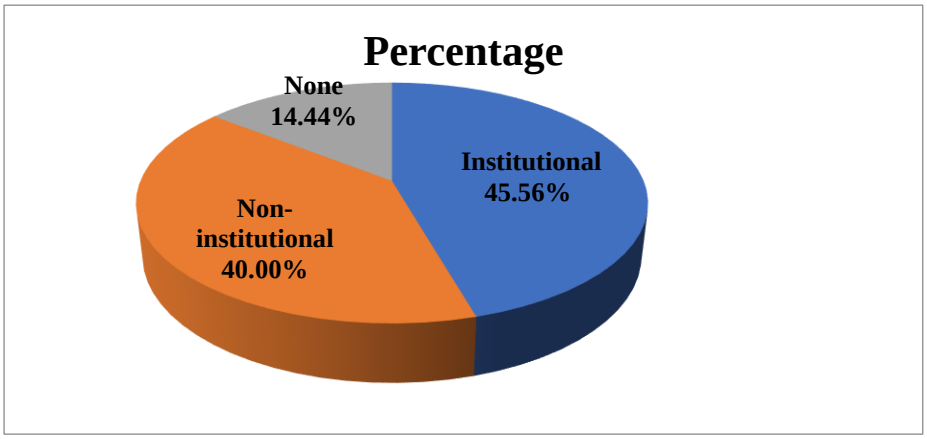


Figure 4.7. Classification of respondents according to the source of credit

5.1.8 Cultivated species

It is noticed from the table 4.8 and Fig 4.8 that majority of the respondents were cultivating Rohu, Catla species (67.78 percent) followed by Rohu, Roop chand species (16.66 per cent), Rohu, Roop chand, Catla, Pangasius (7.78 per cent), Rohu, Roop chand, Catla, Mrigal (5.56 per cent) and Rohu, Rohu, Roop chand, Catla, Grass carp (2.22 per cent).

Table 4.8. Cultivated species

	Frequency	Percentage
Rohu, Catla	61	67.78
Rohu, Roop chand	15	16.66
Rohu, Roop chand, Catla, Pangasius	7	7.78
Rohu, Roop chand, Catla, Mrigal	5	5.56
Rohu, Roop chand, Catla, Grass carp	2	2.22
Total	**90**	**100**

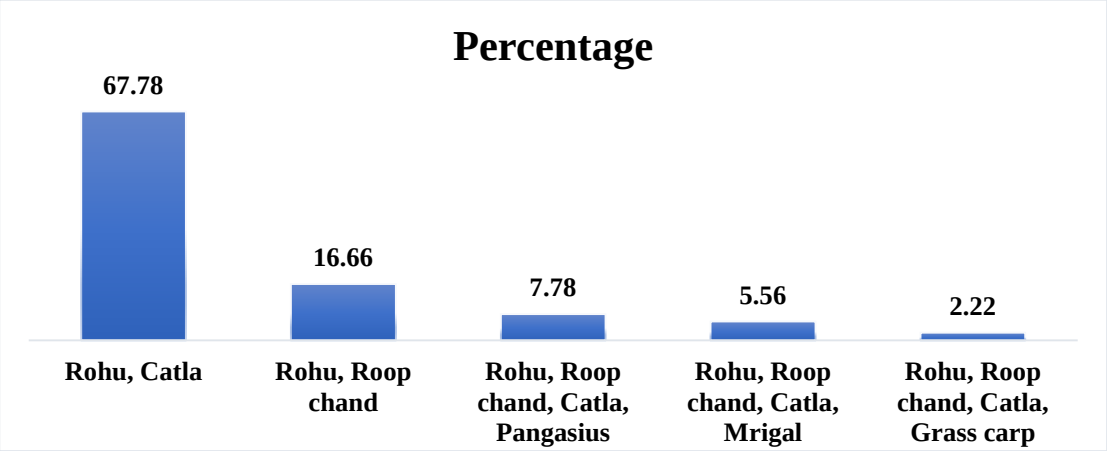


Figure 4.8. Classification of respondents according to the cultivated species (%)

It can be concluded that farmers in the selected area were small farmers having 1 to 2 ha and majority of the farmers were having own land. The average size of the family was 5 to 6 members. Majority of the farmers were in the age group of 31 to 40 years and educated up to college level. Majority of the respondents met their credit from institutional agencies.

4.2. The status of inland fish production and its share in Gross Value Added (GVA) of Agriculture in Andhra Pradesh

4.2.1 The status of inland fish area and production of Andhra Pradesh

To study the status of inland fish area and production of Andhra Pradesh, the area and production of fresh water fish and shrimp and brackish water shrimp were considered. The average annual growth rate and compound annual growth rates were worked out and presented in Table 4.9 and Fig 4.9.

Table 4.9. Percentile growth of area and production of inland fisheries in Andhra Pradesh (2010-11 to 2019-20)

Year	Area (Million ha)	Percentage change in area	Production (Million tonnes)	Percentage change in production
2010-11	0.100	---	0.010	---
2011-12	0.108	6.93	0.011	8.43
2012-13	0.109	0.93	0.013	19.15
2013-14	0.113	3.67	0.015	13.34
2014-15	0.123	8.85	0.018	14.11
2015-16	0.127	3.25	0.018	21.89
2016-17	0.139	9.45	0.021	19.32
2017-18	0.154	10.79	0.028	30.15
2018-19	0.157	1.95	0.033	19.19
2019-20	0.165	5.10	0.036	6.46
Overall growth rate (2010-2020)	**63.36**		**234.57**	
CAGR%	**5.87*** **		**14.87*** **	

(Source: Department of A.P. fisheries, Vijayawada)

Note ***=1 % level significant

Based upon the results depicted in Table 4.9 and Figure 4.9, it can be found that there was unique growth rate during the study period. The area of inland fisheries increased from 0.10 million hectares in 2010-11 to 0.165 million

hectares in 2019-20. The area increased by 63.37 per cent during the study period (2010-11 to 2019-20). The inland fish production was increased with 234.57 per cent which increased three times greater than the area of inland fisheries during the study period (2010-11 to 2019-2020). It was also observed that the percentile growth of production in Andhra Pradesh was fluctuated as the lowest growth rate by 6.46 in 2019-20 due to the pandemic Covid -19 effect and highest growth rate by 30.15 in 2017-18 due to the increase of area and the introduction of new cultivar in Andhra Pradesh.

CAGR for inland fisheries area and production were found significant at one per cent level with 5.87 and 14.87 per annum respectively.

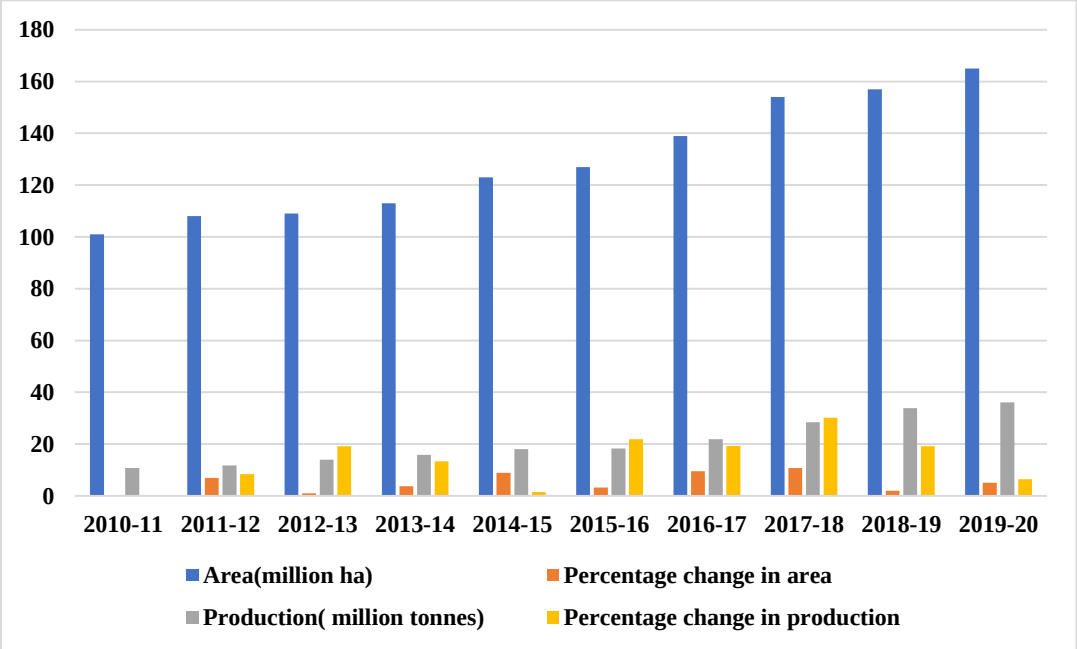


Figure 4.9. Graphical presentation of AAGR of area and production of inland Fisheries

4.2.2. Share of fisheries sector in GVA of Agriculture in Andhra Pradesh

The share of fisheries sector in GVA of Agriculture in Andhra Pradesh are presented in Table 4.10.

Table 4.10. Share of fisheries sector in Gross value added of Agriculture in Andhra Pradesh (2011-12 to 2019-20)

Year	State GDP (Rs. in crores)	AgGDP (Rs .in crores)	Fisheries sector (Rs. in crores)	Percentage of fish in State GDP	Percentage of fish in AgGDP
2011-12	349753	94008	11877	3.40	12.63
2012-13	379477	111864	14519	3.82	12.98
2013-14	426722	128956	18573	4.35	14.40
2014-15	487709	148196	22707	4.66	15.32
2015-16	556421	173167	32085	5.77	18.53
2016-17	624503	210863	42190	6.76	20.01
2017-18	725226	259046	58721	8.10	22.67
2018-19	784606	275984	67885	8.65	24.60
2019-20	879821	320218	76309	8.67	23.83

(Source: Directorate of Economics and statistics, Andhra Pradesh)

It is clear from the table 4.10, that the share of the fisheries sector in the State Gross Domestic Product (at current prices) had increased robustly from 3.40 per cent in 2011-12 to 8.67 per cent in 2019- 20. Similarly, the share of fisheries in Agricultural GDP (AgGDP) was increased from 12.63 per cent in 2011–12 to 23.83 per cent in 2019-20. The fisheries sector contributed Rs.76,309 crores to the State GDP during the financial year 2019-20. The sector had been showing steady growth rate in the total and accounts 23.83 GVA per cent share to the AgGDP in the financial year 2019-20.

From the above discussions, it can be concluded that the area and production of inland fisheries were growing significantly during the study period. The major share of GVA to fish production in agriculture was increasing during the study period. The results were found similar with Subramanyam and Prasad (2017), reported that Andhra Pradesh had unique growth rate during the study period (2005-06 to 2014-15).

4.3 ECONOMIC VIABILITY OF INLAND FISH PRODUCTION

Before calculating the economic viability of inland fish farming, the cost of production was calculated to know the cost structure of inland fish farming.

4.3.1 Human labour utilization

Human labour was one of the factors of production and also a major cost component that influences the cultivation of any enterprise. Successful completion of every operation requires some amount of human labour. The human labour depends on the nature and size of the enterprise. Keeping this in view, an attempt had been made to examine the magnitude and pattern of labour used in inland fish farming. The operation wise labour utilization in inland fish farming is presented in Table 4.11 and Fig.4.10.

Table 4.11 Operation wise human labour utilization per ha in inland fish farm

Particulars	Labour man days/ha	Percentage to the total
Pond preparation	1.96	1.43
Fingerling stocking	0.21	1.15
Feed management	63.91	46.59
Water management	5.20	3.79
Watch and ward	50.86	36.07
Harvesting	15.05	10.97
Total	**137.19**	**100.00**

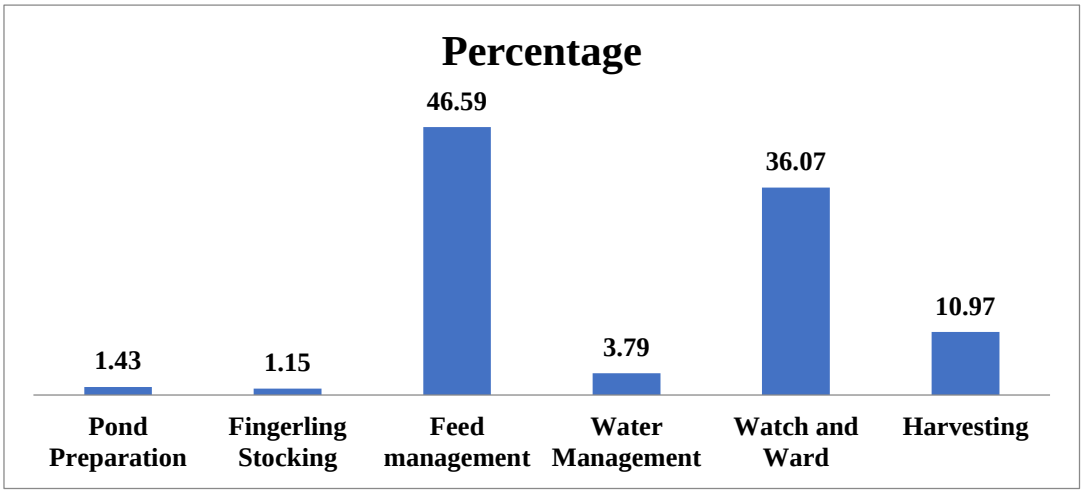


Figure 4.10. Graphical representation of Labour man-days/ha (%)

It can be seen from the table that the total labour utilization for inland fish farming was 137.19 man days per hectare. Feed management was the most labour absorbing operation requiring 63.91 labour man-days per hectare (46.59 per cent) of total human labour used in inland fish farming followed by watch and ward operation 50.86 labour man-days (36.07per cent), harvesting operation 15.05 labour man-days (10.97 per cent), water management 5.20 labour man-days (3.79), pond preparation 1.96 labour man-days (1.43 per cent) and fingerlings stocking 0.21 labour man-days (1.15 per cent) respectively.

4.3.2 Cost of cultivation of inland fish production

The profitability of any enterprise depends upon costs and returns. Generally, costs in any economic study were discussed under two heads *viz.*, variable costs and fixed costs. In general, variable costs alone were reckoned as the cost of cultivation by the farmer's profit and loss was worked out ignoring the fixed costs. But, in the economic analysis of any business enterprise, the fixed costs were also taken into account to arrive at total costs and compute net profits**.**

The variable costs of inland fish farmers include cost on fingerlings, feed, lime, medicines, fertilizers, fuel/electricity charges, transport charges, repairs and maintenance, hiring charges of implements. The fixed costs include the land revenue, depreciation charges, permanent labour charges, rental value of owned land and interest on fixed capital assets. The particulars of the cost of cultivation of inland fish farms and share of different variable costs and total fixed costs per hectare are presented in Table 4.12.

Table 4.12. Cost of cultivation of inland fish farm in West Godavari district of Andhra Pradesh (Rs/ha)

Particulars	Rs/ha	Percentage to the total cost
A. Variable costs		
1). Hired labour	17442.80	2.96
2). family labour	46905.00	7.95
Sub total	64347.80	10.91
Fingerlings cost	55281.62	9.37
Feed cost		
1.De-oiled Rice Bran	192022.22	32.54
2.Ground Nut Cake	29458.04	4.99
3.Pellet Feed	13479.76	2.28
Sub total	234960.02	39.81
Lime cost	2699.44	0.46
Medicines cost	18343.11	3.11
Fertilizers cost	8471.50	1.44
Fuel/Energy	5715.90	0.96
Transport charges	3104.01	0.53
Miscellaneous charges	3340.77	0.57
Repairs and maintenance	1742.58	0.29
Rental charges	893.12	0.15
Interest On Working Capital@7 per cent	8206.00	1.39
Total variable costs(A)	**407105.87**	**68.99**
B. Fixed costs		
Land Revenue	1250.00	0.21
Depreciation Charges	3655.00	0.62
Rental value of owned land	157075.00	25.43
Permanent Labour cost	23240.09	3.94
Interest on Fixed Capital@12 per cent	4797.20	0.81
Total fixed costs(B)	**190017.29**	**31.01**
C. Total cost(A+B)	**597123.16**	**100.00**

A perusal of Table 4.12 revealed that per hectare the total cost of inland fish farming was Rs.5,971,123.16 of which operational costs stood at Rs. 4,07,105.87 (68.99 per cent) and fixed costs stood at Rs.1,90,017.29 (31.01 per cent).

Among operational costs, expenditure on feed constituted 39.81 per cent (Rs.2,34,960.02) of total cost of fish farming followed by human labour 10.91 per cent (Rs.64,349.00) and the fingerlings cost 9.37 per cent (Rs.55,281.62). Similarly, in fixed costs, rental value of own land accounted lion' s share *i.e.*,25.43 per cent (Rs.1,57,075.00) followed by permanent labour cost 3.94 per cent (Rs.23,240.09) of total cost structure. For calculation of the rental value of the own land, the existing rate in the study area was taken into consideration. The results were similar with the Sonvanee (2021) reported that the variable cost accounts 75.79 per cent and fixed cost accounts 24.21 per cent.

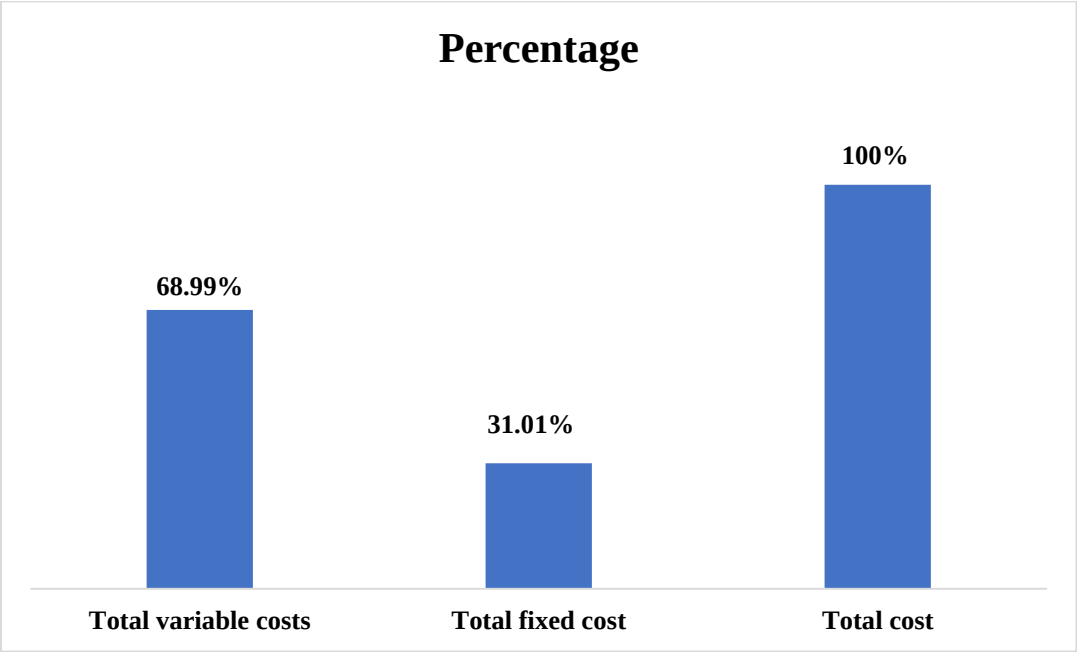


Figure 4.11. Graphical presentation of Variable costs, Fixed costs and Total costs (%)

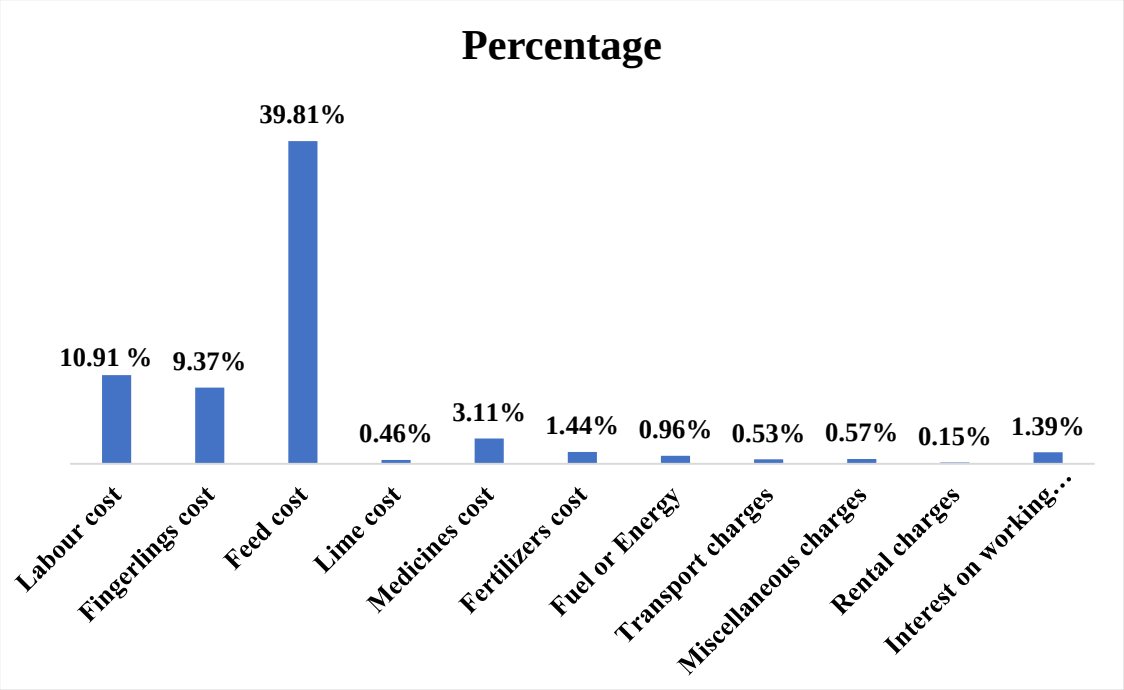


Figure 4.12. Graphical presentation of variable costs (%)

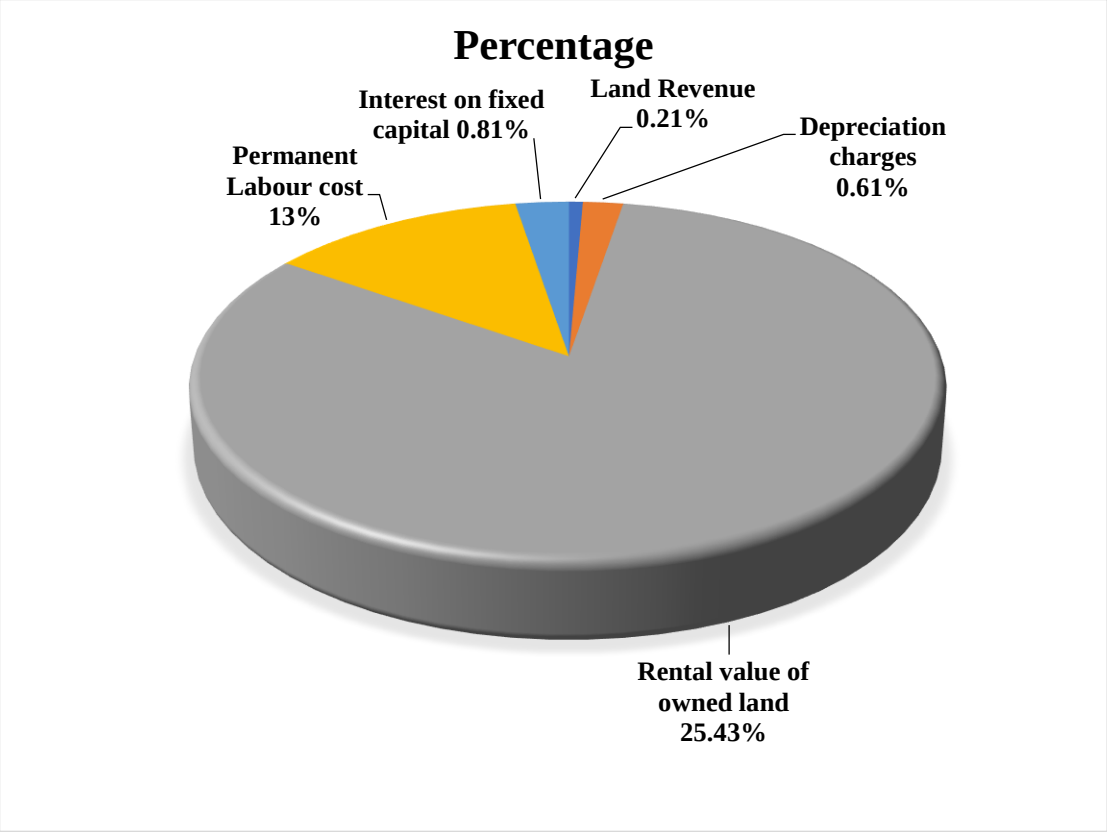


Figure 4.13. Graphical presentation of fixed costs (%)

COST CONCEPTS

Cost of cultivation of inland fish farming was not uniquely defined on account of the fact that various components of cost differ in their economic significance and therefore, it becomes necessary to work out aggregate cost in differing by using standard cost concepts. The cost of cultivation was also dealt by adopting the cost concepts which were suggested by the CACP. The cost concepts namely A_1, A_2, B_1, B_2, C_1, C_2 and C_3 were worked out in the study

Of all the cost concepts, cost C_2 was the most compressive cost as it covers all the variable costs and fixed costs. The total cost of inland fish farming according to cost concepts were worked out and presented in Table 4.13. In the study area, the rent paid for leased-in land and rent paid for own land were the same.

Table 4.13. Cost of cultivation according to cost concepts in inland fish farm (Rs/ha)

Particulars	Rs/ha
Cost A_1	388345.96
Cost A_2	545420.96
Cost B_1	393143.16
Cost B_2	550218.16
Cost C_1	440048.16
Cost C_2	597123.16
Cost C_3	656835.48

It can be seen from the table 4.13 that cost A_1, cost A_2, cost B_1, cost B_2, cost C_1, cost C_2 and cost C_3 were Rs.3,88,345.96, Rs.5,45,420.96, Rs.3,93,143.16 Rs.5,50,218.16, Rs.4,40,048.16, Rs.5,97,123.16 and Rs.6,56835.48 per hectare respectively.

OUTPUT AND RETURNS

Data pertaining to unit cost and productivity are presented in Table 4.14.

Table 4.14. Output and returns of inland fish farm

Particulars	Units	Value
Yield	Kg/ha	7343.06
Total cost	Rs/ha	597123.16
Cost of production	Rs/kg	81.31
Price per kg	Rs/kg	99.36
Gross returns	Rs/ha	729606.44
Net returns	Rs/ha	72771.94

From the above Table 4.14, it can be noticed that the yield per ha was 7,343.06kgs. The gross returns and net returns were Rs.7,29,606.44 and Rs.72,771.94 per hectare respectively. The cost of production per kg was Rs.81.31.

FARM EFFICIENCY MEASURES

An important aspects of farm business management and decision making relates to the manner in which the available resources were allocated. The measuring rod is necessary to avoid the optimal usage of resources. To achieve this various farm efficiency measures were computed and are presented in Table 4.15.

Table 4.15. Farm efficiency measures

Particulars	Rs/ha
Net returns	72771.94
Farm business income	341261.46
Family labour income	179389.26
Farm investment income	294356.46

Farm business income

Farm business income implies returns on owned resources like land, labour and capital was Rs.3,41,261.46/ha indicates positive and sufficiently higher to need the operational expenses of the farmer.

Family labour income

Family labour income was another measure of farm efficiency representing the returns from farmer's own labour or family labour. It was worked out to be Rs.1,79,389.26/ha which was more than opportunity cost of various resources like rent of land, interest on owned fixed capital along with cost A_1 expenses.

Farm investment income

Farm investment income, a measure of returns on fixed capital. It was Rs.2,94,356.46/ha.

An over view of the above analysis draws our attention to point that the gross income, net income, farm business income, family labour income and farm investment income in inland fish farming were substationally high.

4.3.3. PROFITABILITY RATIOS OF INLAND FISH FARM

Simple profitability ratios are used to access the viability of the inland fish farming. The various profitability ratios were worked and presented in table 4.16.

Table 4.16 Profitability ratios

Profitability ratios	Ratios
Rate of return	0.13
Expense structure ratio	0.45
Gross revenue ratio	0.80

Rate of Return (ROR)

It can be seen from the table 4.16, that the ROR was 0.13. It implies that for every one rupee invested, 13 paisa was gained by the respondent. Hence, fish farming was profitable enterprise.

Expense Structure Ratio (ESR)

It can be seen from the table 4.16, that the ESR was 0.45 which implies that the fixed cost component accounted for 4.5 per cent of the total cost incurred. This makes the business worthy since the increase in variable cost of the product will increase the total revenue leaving the fixed cost unchanged.

Gross Revenue Ratio (GRR):

It can be observed from the table 4.16, GRR was 0.80 implies that for every one rupee return to the fish farm when 80 paisa was spent by the fish farmers. The results were similar with Zafar (2021), profitability ratios which were found viable with rate of return 20.4, expense structure ratio 0.7 and gross revenue ratio 0.5 respectively. Hence, the hypothesis *i.e.*, no profitability in inland fish production was rejected.

4.3.3. BREAK-EVEN ANALYSIS

It was an important tool to study the profitability of any enterprise. In fact, this technique was used to locate the point of breakeven output which is the minimum output that has to be produced in order to continue the production without loss. The break-even analysis was worked out and is presented in the Table 4.17 and Figure 4.14.

Table 4.17. Break-even analysis of inland fish production in West Godavari district of Andhra Pradesh

Particulars	Value
Total fixed cost (Rs/ha)	190017.29
Sale price per unit (Rs/Kg)	99.36
Variable cost per unit (Rs/Kg)	55.44
Yield (Kg/ha)	7343.06
Break-even point (Kg/ha)	4326.52

From the table it is clear that the break-even output was 4,167.13 kgs/ha and breakeven price was Rs.55.44/kg. This indicates that the actual production was much higher than the break-even point output to cover the fixed cost involved in fish production activity. The results were consistent with the Himabindu (1995) break even output revealed that of inland fish farms were 1,664.04 kgs/ha which was less than the average output (3,892.24 kgs/ha) which was concluded as fish farming was in profit zone.

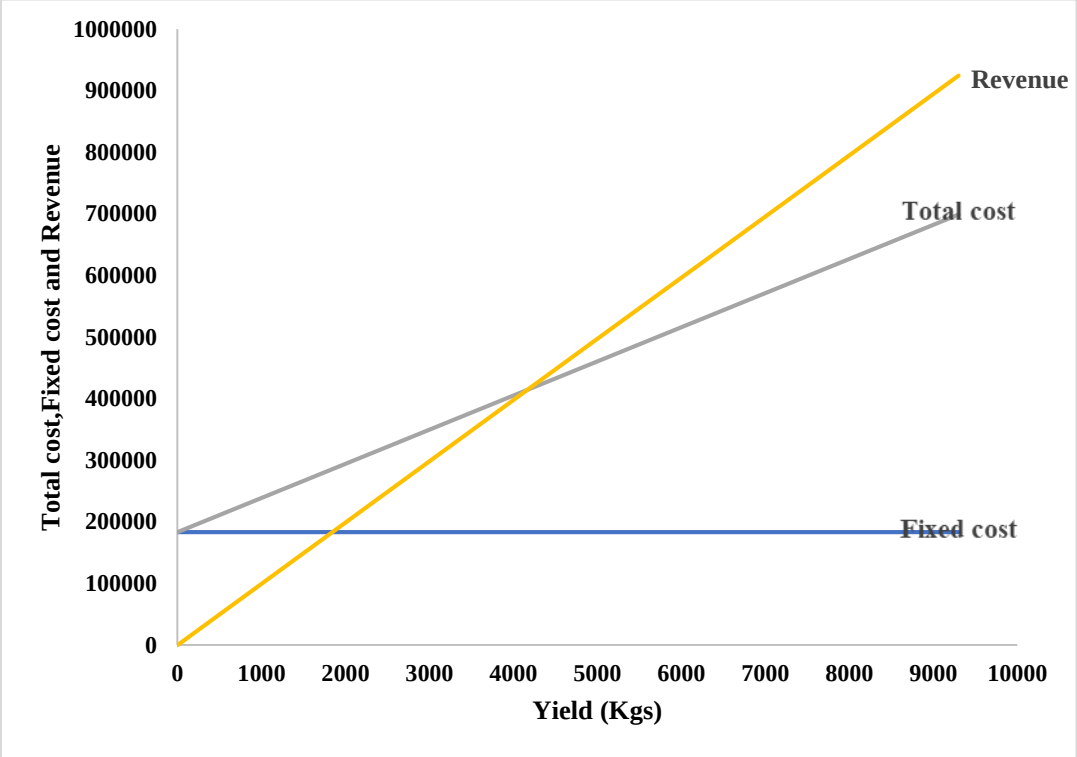


Fig. 4.14. Break-even analysis Graph

4.4. STUDIES ON ECONOMIC VIABILITY OF INLAND FISH PRODUCTION

To study the economic viability of the inland fish production, the economic appraisal techniques like NPV, BCR, and IRR were used. In this analysis, the investment cost like pond construction cost per hectare also included. The economic life of fish farm was taken as 10 years. To study the economic feasibility, the cost and returns were discounted at the rate of 10 per cent. The results are presented in Table 4.18.

Table 4.18. Economic viability of inland fish farming in West Godavari district of Andhra Pradesh

S No.	Economic viability criteria	Value
1	Net Present Value	Rs.3,08,056.10/ha
2	Benefit Cost Ratio	1.09
3	Internal Rate of Return	31.12%

From the table 4.18, the NPV was Rs.3,08,056.10/ha which was positive and greater than zero at 10 per cent discount rate. Hence, investment was profitable. The BCR was 1.09 which was greater than the one, the investment considered as feasible. The IRR was 31.12 per cent implies that for every one-rupee investment on the produce will earn 0.31 net returns right from period of investment. Hence, investment was profitable. These results were consistent with the Das *et al.* (2013) NPV and BCR positive at 15 per cent discount rate and IRR found 53 per cent.

From the above discussion, it was concluded that, in the total cost of cultivation, the major share occupied by the variable cost followed by the fixed cost. From farm efficiency measures the gross returns, net returns, farm business income, family labour income and farm investment income of inland fish farming were substantially high. From the ROR, ESR and GRR, fish farming was found profitable. The actual production was much higher than the breakeven point output to cover the fixed costs involved in inland fish farm. The NPV was positive, BCR was greater than one and IRR greater than cost of capital. Hence, the inland fish farm was economically viable. The hypothesis *i.e.*, there is no economic viability in inland fish farming, but in the study area inland fish farming was profitable. Hence, it was rejected.

4.4. THE FACTORS INFLUENCING THE INLAND FISH PRODUCTION

The Maximum Likelihood Estimates (MLE) of the stochastic frontier production parameters for fish farming is presented in Table 4.19. In the result, except fish feed and lime, all the factors like fish fingerlings, lime and labour man-days were found significant.

Table 4.19. Maximum likelihood estimates for parameters of stochastic and inefficiency model for inland fish farming in West Godavari district of Andhra Pradesh (N=90)

Variable	Parameters	Coefficient	Standard-Error	T-Ratio
Production Function				
Constant	(β_0)	4.35***	0.99	4.37
Fingerlings (Nos)	(β_1)	0.54***	0.09	5.56
Feed (Kgs)	(β_2)	-0.02	-0.02	-0.83
Lime (Kgs)	(β_3)	-0.06	0.09	-0.64
Cost of Fertilizers (Rs)	(β_4)	-0.02***	0.01	-2.82
Labour man-days(man-days)	(β_5)	0.11*	0.05	1.93
Inefficiency Model				
Constant	(δ_0)	-1.63***	0.52	-3.13
Age(years)	(δ_1)	0.01***	0.005	3.45
Experience(years)	(δ_2)	0.006	0.006	1.01
Education	(δ_3)	-0.30***	0.07	-4.01
Extension contacts	(δ_4)	0.19	0.04	0.45
Credit access	(δ_5)	-0.10***	0.17	-6.28
Sigma –squared	(σ^2)	0.10***	0.01	6.69
Gamma	(γ))	0.68***	0.08	8.19
Log Likelihood		13.00		
LR test		18.23		

Note: ***and * denote that the coefficients are significant at 1 per cent and 10 per cent levels of significance respectively.

Number of fish Fingerlings

The coefficient of fingerlings was highly significant and positive effect at one per cent level. Hence, if the quantity of fish fingerlings was increased by one per cent, the yield from fish farming could be increased by 0.54 per cent keeping all other variable constant.

Cost of fertilizers:

The cost of fertilizers coefficient was found significant and negative effect on yield at one per cent level. Hence, if the cost of fertilizers were increased by one percent, the yield from fish farming could be decreased by 0.02 per cent keeping all other variable constant.

Quantity of labour man-days

The coefficient of labour man-days had positive significant effect at 10 per cent level. Hence, if the labour man-days were increased by one percent, the yield from fish farming could be increased by 0.11 per cent.

Quantity of fish feed and lime were not found statistically significant which shows that it was not an important factor to explain changes in output of inland fish farming.

Determinants of inefficiency model

Examination of inefficiency provides a good basis for determining the sources of inefficiencies in fish production. For technical inefficiency analysis age, experience, education, extension contacts and credit access in fish farming were considered. A negative coefficient means that the variable reduces inefficiency, while positive coefficient on the other hand implies that the variable increases inefficiency. The result showed that education and credit access in fish farming showed negative effect while age of the respondents showed positive effect on technical inefficiency. The results revealed that one per cent increase in age of the respondents will increase technical inefficiency of fish farms by 0.01. The results were similar with Ikapoza *et al.* (2021) observed that the age of farmers was a significant determinant of technical inefficiency at one per cent level significance with a coefficient 0.934.

As one percent increases in education and credit access will decrease technical inefficiency of fish farms by 0.30 and 0.10 respectively. The results

were found similar with the Gbigbi *et al.* (2018) concluded that education found significant in aquaculture of Nigeria.

It was evident from the table 4.19 that sigma squared (0.10) was statistically significant and different from zero at one per cent level. This indicates a good fit and the correctness of the distributional form assumed for the composite error term. The estimated value of variance parameter (γ) has been found close to one (0.68) and highly significant at one per cent level. This implies that 68 per cent variation in the output was due to the differences in technical efficiencies of fisheries households, while the remaining 32 per cent was due to the effect of disturbance term or random factors, which are beyond the control of fish farmers. Hence, the hypothesis *i.e.*, there are no factors influencing inland fish farming was rejected.

Technical efficiency of Fishery Farmers

Stochastic production frontier model has a very useful advantage in estimating technical efficiencies by individual and farm specificity.

Table 4.20. Range of technical efficiency of inland fish farms

Technical Efficiency Level	Frequency	Percentage
40-50	2	2.22
50-60	1	1.11
60-70	3	3.33
70-80	7	7.78
80-90	12	13.33
90-100	65	72.22
Total	90	100
Min (TE)	48.87%	
Max (TE)	97.57%	
Mean (TE)	90.12%	

Efficiency distribution

As shown in Table 4.20 technical efficiency varied in levels across farms. The results revealed that the range was between 48.80 per cent and 97.57 per

cent with about 90.12 per cent on average. This implies that relatively the majority of the fish production farms in the study area operate with a high level of technical efficiency. Average technical efficiency suggests that mean inland fish output was performing below the maximum possible production level by a shortfall of about 48.87 per cent. About 72.22 per cent of farmers have efficiency scores ranging between 90 to 100 per cent. The similar results were found same with the Singh *et al.* (2020) technical efficiency ranges between 21 to 98 per cent with a mean efficiency of 72 per cent implying that the average fish farmers in the study area were performing below the maximum possible production level by a short fall of about 28 per cent.

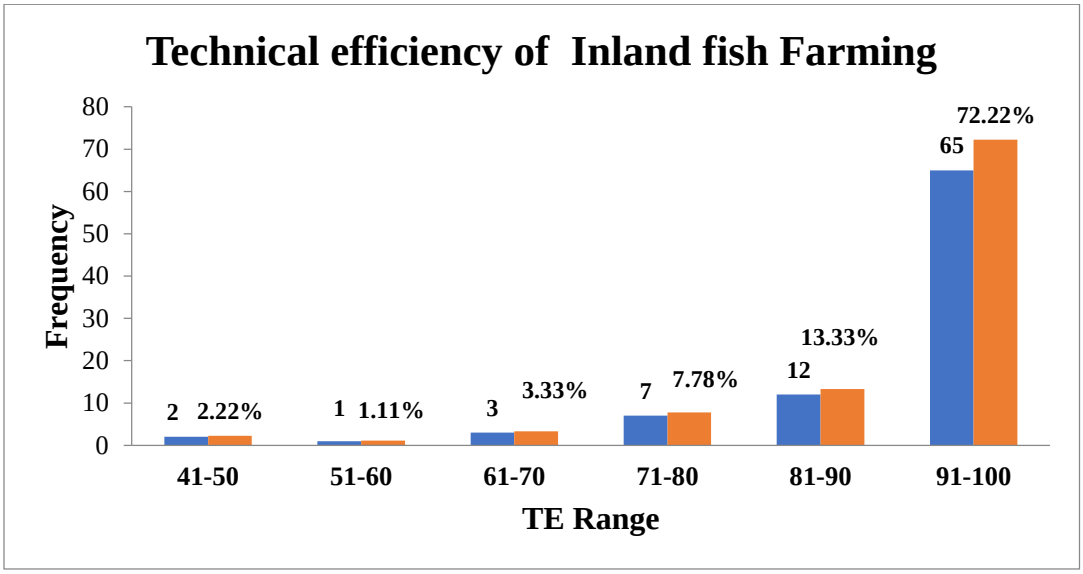


Figure 4.15. Frequency distribution of technical efficiency estimates

From the above discussions, it can be observed that all variables except the feed and lime in production function, experience and extension contacts in the inefficiency model all were found significant. In production function, fingerlings and labour man days showed a positive effect on yield and the cost of fertilizers showed a negative effect on inland fish yield. In the inefficiency model education and credit access showed a positive effect on the efficiency of inland fish farms and the age of the respondents showed a negative effect on the efficiency of respondents. The majority of the respondents found in the 90-100 range of efficiency level.

4.6. CONSTRAINTS FACED BY THE INLAND FISH FARMERS IN FISH FARMING

Constraints faced by the farmers in inland fish farming are ranked by using Garrett's ranking method. The results were presented in Table 4.21. The non-availability of quality fingerlings (72.54) which was identified as the major constraint faced by inland fish farmers followed by high disease attacks (72.02), high cost of feed (66.52), high cost of fish fingerlings (57.07), high labour cost (46.33), lack of capital (45.63), price fluctuation (41.80) and lack of equipment (37.32).

Table 4.21. Constraints faced by the inland fish farmers in fish farming in West Godavari district of Andhra Pradesh (N=90)

S. No.	Constraints	Mean Scores	Rank
1.	Non-availability of quality fingerlings	72.54	I
2.	High disease attack	72.02	II
3.	High cost of Feed	66.52	III
4.	High labour cost	57.07	IV
5.	Lack of capital	46.33	V
6.	Lack of extension services	45.63	VI
7.	Price fluctuation	41.80	VII
8.	Lack of equipment	37.32	VIII

From the above discussions, it can be concluded that the establishment of standardized and regulated fish fingerlings agencies can certify the quality of fish seeds which helps to make the quality of fish fingerlings available to inland fish farmers.

Chapter – V

Summary and Conclusions

Chapter V

SUMMARY AND CONCLUSIONS

Fish is a vital source of food for people. It is man's most important single source of high quality protein, which provides 16 per cent of animal protein consumed by the world's population. The fishery sector occupies a very important place in the socio-economic development of the country. Fisheries are next to agriculture in terms of providing employment and food supply. In India, Andhra Pradesh is the highest inland fish producing state with a production of 3.61 million tonnes and area 0.33 million ha followed by West Bengal (1.60 million tonnes production and 0.26 million ha) and Chhattisgarh with (0.69 million tones production and 0.10 million ha). Keeping the facts given above, the present study entitled **"ECONOMIC APPRAISAL OF INLAND FISH PRODUCTION IN WEST GODAVARI DISTRICT OF ANDHRA PRADESH"** has been proposed the following objectives:

5.1 OBJECTIVES

1. to study the status of inland fish production and its share in gross value added of Agriculture in Andhra Pradesh.
2. to study the economic viability of inland fish production in West Godavari district of Andhra Pradesh.
3. to analyze the factors influencing the inland fish production in West Godavari district and
4. to identify the constraints faced by inland fish farmers in carrying out inland fish production and offer suggestions.

5.2 SAMPLING DESIGN

Multi-stage sampling design was adopted for the selection of sample respondents at different levels of mandals and villages for the present study. In India, Andhra Pradesh state was selected purposively for the present research study. In Andhra Pradesh, West Godavari district was selected for the study as it possessed the highest area under inland fish area. Three mandals were selected

and from each selected mandal, top three villages were selected based on the highest area under inland fish production making a total of nine villages. From each village, 10 farmers were randomly selected thus comprising a total of 90 farmers. Primary data was collected from the selected sample of farmers through a pre-tested questionnaire developed as per the objectives of the study. The data regarding socio-economic characteristics, initial investment, farm size and inputs used in the fish farming. The data included detailed information regarding the cost of cultivation, yield, cost and returns and constraints in the cultivation of inland fish. Secondary data was collected from the Andhra Pradesh Fisheries Department (Vijayawada) and the Joint Director of Fisheries (Eluru).

5.3 TOOLS AND TECHNIQUES OF ANALYSIS

To compute the socio-economic profile of inland fish farmer's descriptive statistics was used. AAGR and CAGR were used to calculate the status of inland fish production. The tabular analysis is used to compute the economic viability of inland fish farming. To study the factors influencing inland fish farming, the stochastic frontier production function was used and garrett ranking method was used to prioritize the constraints faced by the inland fish farmers.

5.4. SOCIO-ECONOMIC PROFILE OF SAMPLE FARMERS

The socio-economic characteristics of the inland fish farmers revealed that the majority of the respondents belonged to the age of 31-40 years category. The majority of the respondents were educated up to the college level. Most of the respondents have experience of <10 years and half of the respondents belongs to 5-6 family members. Most of the respondents have small-sized farms. More no. of the respondents have their own farm land. The major share of credit access to farmers was received from institutional credit and about a major percentage of the respondents were cultivated species combinations like Rohu and Catla.

5.5 STATUS OF INLAND FISH PRODUCTION AND ITS SHARE IN GVA OF AGRICULTURE

In Andhra Pradesh, the area and production of inland fisheries were found unique growth rate during the study period (2010-11 to 2019-20). The inland area increased by 63.37 per cent during the study period with a CAGR of 5.87 which was found positively significant at one per cent. The inland fish production was increased by 234.57 per cent which was increased three times greater than the area of inland fisheries during the study period. It was also observed that the percentile growth of production in Andhra Pradesh fluctuated as the lowest and highest growth rate by 6.46 in 2019-20 due to the Covid -19 pandemic effect and 30.15 in 2017-18 due to the increase of area in Andhra Pradesh. The share of fisheries in AgGDP was increased from 12.63 per cent in 2011–12 to 23.83 per cent in 2019- 20. The fisheries contributed Rs.76,309 crores to the State GDP during the financial year 2019 -20.

5.5 ECONOMIC VIABILITY OF INLAND FISH PRODUCTION

The total labour utilization for inland fish farming was 137.19 man-days per hectare. Feed management was the most labour-consuming operation requiring 63.91 labour man-days per hectare (46.59 per cent) of total human labour used in inland fish farming. From the total cost of cultivation, the variable costs accounted for 68.99 per cent followed by the fixed costs at 31.01 per cent. In the variable costs and fixed costs, the major share occupied by the feed (39.81) and rental value of owned land (25.43) respectively.

By working out the cost concepts, the results revealed that the cost C_2 was Rs.5,91,123.16/ha and the cost C_3 was Rs.6,56,835.48/ha. From the farm efficiency measures, the farm business income, family labour income, farm investment income were Rs.3,41,261.46, Rs.1,79,389.26 and Rs.2,94,356.46 per hectare respectively.

The ROR, ESR and GRR were 0.13, 0.45 and 0.80 respectively. The Break-even analysis resulted that break-even point of production was 4,167.13Kgs/ha, and breakeven price was Rs.55.44/Kg.

From the economic viability techniques NPV, BCR and IRR were Rs.3,08,056.10/ha, 1.09 and 31.12 per cent respectively and hence, inland fish farming was considered economically viable.

5.7 FACTORS INFLUENCING THE INLAND FISH FARMING

In factors influencing inland fish farming except the fish feed and lime, all the factors like number of fish fingerlings and labour man-days were found positively significant at one and 10 per cent levels respectively, whereas the cost of fertilizers was negatively significant at one per cent level. Thus, there was a potential of increasing fish production by either increasing or decreasing the levels of these inputs.

Among all the inefficiency factors, education and credit access negatively significant at one per cent level and concluded that the higher educated and higher credit access farmers were more technically efficient as compared to the less educated and less credit access fish farmers. Whereas, the age of fish farmers was positively significant at one per cent level indicated a negative effect on technical efficiency

5.8 CONSTRAINTS FACED BY INLAND FISH FARMERS IN CARRYING OUT INLAND FISH PRODUCTION

The major constraints faced by the inland fish farmers were the non-availability of quality fingerlings followed by high disease attacks, high cost of feed, high labour cost, lack of capital, lack of extension services, price fluctuation and lack of equipment on prioritized basis.

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5.9 CONCLUSIONS

The following conclusions were emerged from the study:

- About 35.56 per cent of the respondents were belonged to middle age 31-40 years.
- Over 36.67 per cent of the respondents were educated up to college level.
- Majority of the respondents had farming experience <10 years with 63.33 per cent.
- Average family size of the household was 5 to 6 members.
- Majority of respondents were found small farmers (1-2 ha) with 28.89 per cent.
- About 71.11 per cent of respondents had their own fish farm.
- Institutional credit sources were highly preferred by the respondents which was about 45.56 per cent**.**
- Majority of the inland fish farmers cultivated the species of Rohu and Catla with 67.78 percentage.
- In Andhra Pradesh, the inland area and production of fisheries were found unique growth rate during the study period (2010-11 to 2019-20).
- The percentile growth of production in Andhra Pradesh was recorded with the lowest growth rate of 6.46 in 2019-20 due to the pandemic Covid -19 effect and highest growth rate of 30.15 in 2017-18 due to the increase of area in Andhra Pradesh.
- The share of fisheries in AgGDP had shown increasing growth rate during the study period (2011-2012 to 2019-2020). The fisheries sector had been showing steady growth rate in the total GVA of Andhra Pradesh.
- The per hectare, total labour utilization for inland fish farm was 137.19 labour man-days. The feed management was the most labour absorbing operation.

- In the total cost of cultivation, majority of the share occupied by the variable costs followed by the fixed costs. In the variable costs, feed cost and in fixed costs, the rental value of owned land contributed the major share.
- The yield was 7,343.06 kg/ha and cost of production per kg was Rs.81.31.
- The farm efficiency measures were substantially high.
- The Break-even analysis was found in a profit zone for inland fish farming.
- The profitable ratios like ROR, ESR and GRR were found viable.
- The NPV, BCR and the IRR were found positive and economically viable for inland fish farmers. Hence, investment was profitable and viable.
- In the production factors, the fingerlings and labour man days were positively significant, whereas the cost of fertilizers was negatively significant. From the inefficiency factors, education and credit access were negatively significant and age of the fish farmers was found positively significant.
- Major constraint faced by the inland fish farmers was the non-availability of quality fish fingerlings.

5.10. POLICY IMPLICATIONS

- The Government needs to establish an agency to certify the quality of fish seeds. This will go a long way in helping newly established hatcheries and secure a market for their products as potential customers will have little fear in certified fingerlings.
- The establishment of disease diagnosis and treatment labs or mobile labs in coastal villages could control the diseases in fish farming. Disease diagnosis and treatment measures are to be simplified and popularized by the State Fisheries Department concerned and they could play a vital role in providing skill development training among the fish farmers to disease diagnosis and treatment measures.

- Encourage the establishment of cooperative union that will assist the farmers to purchase inputs in bulk and increase the availability of inputs to farmers and improve marketing distribution channels. Other areas of concern are the creation of enlightenment on the establishment of fish farms with a conductive environment and technical support facilities.

- Awareness and training programmes are needed on pond management, especially on the importance of feed, choice of species, stocking density, the importance of fertilizers and water management.

- Train the farmers on feed preparation and encourage them to make their own feed, so that they can reduce the feed cost.

- An improved monitoring framework (Extension services) and a finance scheme development for rural fish farming are needed.

- Establishment of additional sales outlets for live fish and product development and training to diversify the ways in which fish can be sold.

- Government should subsidize the cost of inputs such as fish feed, fish fingerlings, fertilizers and water testing kits.

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Note: The pattern of literature is cited presented above is in accordance with the "Thesis Guidelines" prescribed by Acharya N.G. Ranga Agricultural University, Guntur.

Appendices

ANNEXURE -I

CALCULATION OF NET PRESENT VALUE(NPV)

YEAR	COSTS	RETURNS	NET RETURNS	DISCOUNT @10 %	DISCOUNT*NET RETURNS
1	832491.67	568032.05	-264459.62	0.91	-240417.84
2	552328.77	638767.12	86438.36	0.83	71436.66
3	566008.06	616129.03	50120.97	0.75	37656.62
4	592924.53	656603.77	63679.25	0.68	43493.78
5	567045.45	666022.73	98977.27	0.62	61457.10
6	527083.33	644791.67	117708.33	0.56	66443.29
7	509722.22	634722.22	125000.00	0.51	64144.76
8	495148.08	569038.46	73890.38	0.47	34470.41
9	513888.89	691666.67	177777.78	0.42	75395.13
10	512500.00	756250.00	243750.00	0.39	93976.18
				SUM	308056.10
				NPV	**308056.10**

CALCULATION OF BENEFIT COST RATIO(BCR)

YEAR	COSTS	RETURNS	DISCOUNT @10 Per cent	NPV COSTS	NPV BENEFITS
1	832491.67	568032.05	0.91	756810.61	516392.77
2	552328.77	638767.12	0.83	456470.06	527906.71
3	566008.06	616129.03	0.75	425250.24	462906.86
4	592924.53	656603.77	0.68	404975.43	448469.21
5	567045.45	666022.73	0.62	352090.61	413547.71
6	527083.33	644791.67	0.56	297524.80	363968.09
7	509722.22	634722.22	0.51	261568.10	325712.86
8	495148.08	569038.46	0.47	230990.23	265460.64
9	513888.89	691666.67	0.42	217939.05	293334.19
10	512500.00	756250.00	0.39	197590.94	291567.11
			SUM	3601210.06	3909266.16
				BCR	**1.09**

CALCULATION OF INTERNAL RATE OF RETURN

YEAR	COSTS	RETURNS	DISCOUNT @31.06	NPV @31.06	DISCOUNT @31.20	NPV @31.20
1	832491.67	568032.05	0.76	-201785.15	0.76	-201569.83
2	552328.77	638767.12	0.58	50322.96	0.58	50215.62
3	566008.06	616129.03	0.44	22264.30	0.44	22193.10
4	592924.53	656603.77	0.34	21583.27	0.34	21491.29
5	567045.45	666022.73	0.26	25596.74	0.26	25460.46
6	527083.33	644791.67	0.20	23226.63	0.20	23078.32
7	509722.22	634722.22	0.15	18819.97	0.15	18679.84
8	495148.08	569038.46	0.11	8488.42	0.11	8416.22
9	513888.89	691666.67	0.09	15582.82	0.09	15433.80
10	512500.00	756250.00	0.07	16302.08	0.07	16128.96
			SUM	402.02	SUM	-472.21
	IRR=31.12					

ANNEXURE II

SCHEDULE OF DATA COLLECTION FROM THE SAMPLE FARMERS

ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY

Department of Agricultural Economics

AGRICULTURAL COLLEGE, BAPATLA

Title: Economic Appraisal of Inland Fish Production in West Godavari District of Andhra Pradesh.

General Information of the respondent

1. **Name: ……Age (in years): ……Gender.....**
2. **Village ……..……**
3. **Mandal…… District ……**
4. **Education: Illiterate / Primary / Middle / High school / College**
5. **Experience: .....Family size(no's).....**
6. **Total pond area under inland fish farming…….**
7. **Source of Irrigation: canal/Bore well**
   I. **If bore well, what was year of the establishment and cost establishment.....**
8. **License fee……**
9. **Land ownership**

Particulars	Own land	Lease land		Total value
		From private owner	From government or chief	
Area of land				
Annual rent				
Lease in				
Lease out				
Length of lease (years)				

10. **Whether he/she raised Nursery pond: Yes /no**
11. **Source of fish fingerlings:**
12. **Size of fish fingerlings:**
13. **If, there is no nursery, what was the source of fingerlings?**
14. **size of fish fingerlings:**
15. **Rearing pond(s):**

Pond No	**Area (ha)**	**Capacity of pond**	**Method of construction**	**Year Constructed**	**Cost of construction**
1.					
2.					
3.					

16. **Rearing equipment**

S. No.	**Equipment**	**Please tick if available**	**Nos**	**Year purchased**	**Initial cost**	**Economic life (years)**	**Maintenance Cost (per year)**
1.	Aerators						
2.	Basket						
3.	Boats						
4.	Bucket						
5.	Nets						
6.	Pelleting machine						
7.	Pumps						
8.	Shovels						
9.	Store house						
10.	Vehicles						
11.	Others						

17. Types of culture species grown

No	Species	No	Species
1		4	
2		5	
3		6	

18. Duration of crop

19. Financing

i. **What was the initial invested amount……?**

ii. **Source of funds: Bank /Self / Family/Friends /Others**

iii. **What is the Interest rate payable on the loan per annum? …….**

20. Feed

i. **Source of feed:**

ii. **Frequency of feed/day:**

iii. **Feeding ratio:**

21. Input-Cost

S. No.	Input	Main pond		
		Qty. (Per ha.)	Rate (cost/unit)	Qty. (Per ha.) Rate (cost/unit)
1	Fish fingerlings			
2	Lime			
3	Probiotics			
4	Medicines			
5	Feeding materials a) b) c)			
6	Organic fertilizers			
7	Inorganic fertilizers			
8	Fuel/Electricity charges			
13	Farm protection cost			

14	Harvesting cost	
15	Transporting cost	
16	Marketing cost	
17	Other, if any	

22. Farm operation and labor employed (per ha.)

S. No.	Operations	Family labour				Hired labour			
		Men		women		Men		Women	
		No. of days	Rs./day	No. of days	Rs./day	No. of days	Rs./day	No. of days	Rs./day
1.	Land preparation								
2.	Probiotics application								
3.	Medicines application								
4.	Liming								
5.	Irrigation								
6.	Feeding								
7.	Processing								
8.	weeding								
9.	Farm protection								
10.	Harvesting								
11.	transport								
12.	Miscellaneous								

23. If any permanent labour present, what was the labour cost/month

24. How often do you harvest your fish?

Quarterly /Twice yearly / Yearly/ No specific schedule / others (specify)

25. On which months do you harvest your fish?

Jan	**Feb**	**Mar**	**April**	**May**	**June**
July	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**

26. What are the sizes of the fish, at harvest (number per kilogram) and their prices?

S. No.	Species	Size of fish at harvesting time	Total yield(kgs)	Price/kg

27. Extension services: yes /no

28. Constraints faced by the inland fish farmers

S. No.	Constraints	Rank given by the farmer
1.	Non-availability of quality fingerlings	
2.	High cost of feed	
3.	Lack of capital	
4.	High disease attack	
5.	High labour cost	
6.	Lack of extension services	
7.	Price fluctuations	
8.	Lack of equipment	

29. To calculate Benefit cost ratio(BCR), Net Present value(NPV) and Internal Rate of return

Year	Costs	Returns