

Socio-Economic and Environmental Implications of Prawn Cultivation in Chilika Lake, Odisha

**A Thesis Submitted for the Partial Fulfillment of Master Degree in
Development Studies**

By

Srabani Nath

Roll No- 413HS1015

Under the Guidance of

Dr. Narayan Sethi



**Department of Humanities and Social Sciences
National Institute of Technology
Rourkela – 769008, Odisha, India**

May 2015

Dr. Narayan Sethi
Asst. Professor (Economics)
Department of Humanities and Social Sciences
National Institute of Technology
Rourkela – 769008
Odisha, India

Date:
Rourkela

CERTIFICATE

This is to certify that **Ms. Srabani Nath** has carried out the research embodied in the present dissertation entitled “**Socio-Economic and Environmental Implication of Prawn Cultivation in Chilika Lake**” under my supervision for the award of Master degree in Development Studies at the National Institute of Technology, Rourkela. This dissertation is an independent work and does not constitute part of any material submitted for any research degree or diploma here or elsewhere.

(DR. NARAYAN SETHI)
Research Supervisor

Acknowledgements

I would like to extend my heartfelt thanks to my research supervisor Dr. Narayan Sethi, without whose continuous support and able guidance; I would have not been able to complete the thesis work.

I would also like to thank all my faculty members for their support in the entire process of this work.

I am grateful to all the respondents for their support who took out time for me from their busy schedules.

I would like to express my special gratitude towards my parents, my brother and friends for the constant support and faith they bestowed upon me throughout the course of the thesis work and for the encouragement which helped me to complete my work.

Srabani Nath

Abstract

Prawn cultivation is a huge source of foreign exchange and income for the national economy but the effect it has on the people involved in it and its environmental impact is neglected. In Chilika Lake prawn cultivation has become a common sight. But the pattern of prawn cultivation and the methods used is not found to be sustainable. The small and poor farmers are also not the ones who gain huge profit and they remain deprived. This has adversely affected the living style of the poor fishermen. The impact is also on the social, cultural, environmental frontiers. So, this study is carried out in Chilika Lake where prawn cultivation has decreased over the years. The studies analyze the socio-economic condition of the people involved in prawn cultivation and examine its environmental impact. The previous studies in this area have not taken both the socio-economic and environmental consequences together. But, the study has been conducted with the help of schedule survey, personal interview and participation observation using random sampling method. Around 60% of the total population has been interviewed for this study. The primary data has been collected from primary source through questionnaire and secondary data has been collected from different secondary sources such as Directorate of fisheries, Govt of Odisha, research papers and reports. The present study finds that most of the prawn cultivators belonged to poor socio-economic condition and the cultivation in the area has resulted in environmental degradation of that place. The study suggest that, Govt should give more focus on implementing polices for the sustenance of their livelihood and take measures to conserve the environment around Chilika Lake.

CONTENTS

Certificate

Acknowledgements

Abstract

List of Tables and Charts

Chapter No.	Description	Page No.
I	Introduction and Objectives of the Study	1-13
1.1	Introduction	1
1.2	Socio-Economic Characteristics and Community Dependence on the Lake	4
1.2.1	Socio-Economic Characteristics and Community Dependence on the Lake	5
1.3	Environment Around Chilika Lake	6
1.4	Prawn Cultivation and Export from Orissa and from Chilika	7
1.5	Statement of the Problem	9
1.6	Significance of the Study	10
1.7	Relevance of Selecting Ganjam as Sample Area	11
1.8	Objective of the Study	12
1.9	Methodology of the Study	12
1.10	Organization of the Thesis	13
II	Review of Literature	14-19
2.1	Studies related to prawn cultivation, fishing community and their socio-economic conditions	14
2.2	Studies related to prawn cultivation and its environmental implications	16
2.3	Conclusion	19
III	Socio Economic Profile of Sample Area	20-35
3.1	Introduction	20
3.2	Demographic Profile of the Study Area	21
3.3	Circular Flow of Socio-Economic Condition of Prawn Cultivators	30
3.4	Conclusion	31

IV	Trends of Fish and Prawn Cultivation in Odisha	32-37
V	Environmental Implication of Prawn Cultivation	
5.1	Introduction	38
5.2	Prawn Cultivation and Its Effect on the Chilika Lake Environment	40
5.3	Prawn Gheri or the Bamboo Embankments	41
5.4	Traditional vs Scientific Prawn Cultivation	41
5.5	Environmental Degradation of Chilika	42
5.6	Socio-Economic Impact of Prawn Culture on the Lake Ecology and Upon the Community	44
5.7	Fishermen's Agitation: Its Nature and Growth	44
5.8	Conclusion	44
VI	Summary and Conclusion	46
	Scope for further research	50
	APENDIX-I	51
	Bibliography	52

List of Tables, Charts and Figures

Number	Title	Page No.
Chart 3.1	Sex Ratio of the Respondents	22
Chart 3.2	Family type of the respondent	26
Figure 3.1	Religion of the Respondents	22
Figure 3.2	Caste of the Respondents	23
Figure 3.3	Education of the Respondents	23
Figure 3.4	Public Facility given to the Respondents	24
Figure 3.5	Electricity available in the household	25
Figure 3.6	Sanitation Facility available in the household	25
Figure 3.7	House owned by the respondent	26
Figure 3.8	Number of females of the family involved in prawn Cultivation	27
Figure 3.9	Number of males of the family involved in prawn cultivation	27
Figure 3.10	Owner of Gheri	28
Figure 3.11	Other Activities Undertaken other than prawn Cultivation	29
Table 4.1	Year wise Fish production in Odisha in MT	32
Table 4.2	Year wise Resource wise brackish water Fish production (MT) in Odisha	33
Table 4.3	Year wise Percentage of Production of Fish in Chilika to that of total Fish Production in Odisha	34
Table 4.4	Fish Production from Chilika Lake (In Mt) Year Wise Data	36
Figure 4.1	Percentage of fish Production in Chilika to Odisha	35
Figure 4.2	Fish and Prawn Production from Chilika Lake (In Mt) Year Wise	37
Table 5.1	Characteristics of Traditional and Scientific Prawn Cultivation	42

Chapter I

Introduction and Objectives of the Study

1.1. Introduction

The largest brackish water lake of Asia is Chilika. Chilika Lake is formed in the shape of a pear. It was once a part of the sea and with time eventually it got separated by islands formed of silt and sand ridges. Chilika Lake is situated in the eastern coast of India linked to the Bay of Bengal. The major portion of Chilika Lake is in Puri district the other portion is by the madras national highway (NH 5). Chilika Lake is the only lake of Odisha to be announced as a wetland of international significance under the IUCN-Ramsar Convention (1971) in Egypt. The lake is renowned for its beauty and its rich ethnic bio diversity. The mesmerizing and soulful scenic peace has attracted many poets, writers and film makers to transform this natural piece of art into man made art through celluloids, poems and stories. Movie like Chilika Tire and Swapana Sagar are Oriya movies shot in Chilika Lake depicting the plight and socio economic conditions of people living in and around Chilika Lake. The beauty of Chilika is captured in many arenas but its hollow side is also not unseen. So was the story for poets as well. Eminent Odia poet Radhanath Roy has depicted 'Chilka' as a storehouse of beauty. It is not just one but many such eminent poet, artists and writers have described the beauty for some it was the memories of childhood, some described the celebrated past of odia fighter Krutibasha Patsani and some depicted the culture of Odisha through Chilika and their writing. A wonderful description has been done by Godabarisha Mishra in his poem 'Kalijai' has magnificently written about the roots of people living in and around Chilika and the experience and the connection with Odisha. Chilika was also the favorite destination of many famous Odia people like Rabi Singh, Gopabandhu Das. Chilika is not just an integral part of Odisha, but also is strongly tied to the roots of Odia culture, traditions and literature. Every Odia people have strong connection with Chilika.

Interesting stories and contrasts have been depicted about the Chilika. It is told that pirate King Raktabahhu came to conquer Puri with huge navy force. The furious king Raktabahhu insisted his army to attack the sea as it had betrayed him. Thus, the sea entered the sea bed to escape his wrath and in chase. Then the Chilika lagoon was formed. Many scripts say Chilika has always been a major area for maritime commerce. Some rocks in southern Chilika are seen by band of white which clearly indicates that it was coral and so, the lake was marine in nature.

Geological studies tell us that the shoreline extended along the western coast of Chilika in the Pleistocene era, and that the entire northeastern area above Chilika was under the sea. From the time then, the shoreline has moved considerably eastward (Chatterjee and Goswami, 1966). The Konark temple which was built in the shore is now away from it and around 3kms away now. The lagoons which are found now were formed thousand years ago. There was a gap in sea level rise and a small island formed which kept growing and the pear shaped Chilika Lake was formulated. A recent relic from the southwestern edge of the spit has been dated to about 3,500-4,000 years ago, which is some suggestion of how long ago the lagoon was formed (Venkatraman, 1970). The sand bar has been widening, and the location of the mouth constantly shifting, moving normally towards the northeast, the mouth was about 1.5 km wide in 1780, and had decreased to half of that in forty years. The mouth of the sea is being cut by the native fisher folk. These fisher men rely upon Chilika for their livelihood. Chilika is now silted up by rivers to form the convergence and the lagoons are now in a shallow state.

The then British settlement of Odisha also recorded the number of fishermen and about their community. Study reveals that there are different classes of fishermen namely Zamindari estates of Khallikote, Suna Bibi, Parikud, Mirza Taher Baig and the Chaudhury families of Bhungarpur and the Khas mahal region of Khurda, lying within the kingdoms of the Rajas of Khallikote and Parikud. Several castes of fisher folk developed a huge array of fishing techniques, nets and gear. After the eradication of zamindari in 1953, traditional fishing areas continued to be rented out to cooperatives of local fishermen. As fishing (particularly prawn fishing) became increasingly remunerative, outside interests began

inflowing the area. The rental system broke down completely in 1991 when the Odisha government outlined rental policy that would in essence have resulted in the sale of leases to the highest bidder. The cooperatives challenged the order in court, and the Odisha High Court directed the Government to make changes that would preserve traditional fishermen's interests. However, no new orders have been issued to date. As a result, chaos reigns and the native public are being marginalized by powerful outsiders (Das, 1993).

The most challenging issues faced by people staying near Chilika and also of the lake are:

- (i) Chilika lake is continuously shrinking due to the increase in siltation and the depth of the sea is also decreasing,
- (ii) Brackish water species such as fishes, prawn crab are decreasing day by day,
- (iii) Nalabana Island which is the hub of many migratory birds is being disturbed by tourists and causing problem to the birds and their strength is decreasing,
- (iv) There is an issue of missing and extinction of dolphins found in the outer channel of Chilika and Satapada region,
- (v) Motorized boat in the lake for transportation and tourist possess problem to the aquatic animals,
- (vi) Lake is the main source of revenue and livelihood for many fishermen folk,
- (vii) Illegal intruders and mafia for profitable prawn cultivation has resulting in transforming the socio economic conditions of people whose livelihood was entirely dependent on Chilika,
- (viii) The environment and ecology is under stress.

The community of the fishermen is increasing, yet the primary production of fishes especially a large part of it goes for export. With an aim to get higher profit margins more and more people are getting into the profession. The return for small farmers are diminishing as a large portion of cultivation is carried out by the large farmers or the mafias. With the advent of modernization, new methods of fishing techniques has come up such as use of nylon nets, motorized boats and semi intensive prawn culture. The fishing economy and the community has all together has been altered due to new methods of fishing. After the lease policy of 1991 for Chilika and then in 1994, a hue cry came for the

traditional fishermen which diminished the difference between established and traditional fisherman. There was a difference created between culture and capture group. The fishermen and the fishing community have been divided into many sub groups. There is entry of other people into the fishing community. The entry of non- fishermen to undertake prawn cultivation in and around Chilika Lake with the motive of high profit. The main of capturing fishes was not for consumption but also for commercial purpose. Most of the fishing community are scheduled caste and mostly are dominated by other, outside the fishing community who claim to earn high profits and exploit the poor local fishermen. The rise in incoming of outsiders has commercialized fishing in Chilika and leading to negative impact to the livelihood of the people.

1.2. Socio-Economic Characteristics and Community Dependence on the Lake

Chilika Lake has about 132 fishing villages and it is surrounded by around 273 villages. The population of the fishing villages is more than 0.15 million. The main occupation of the people living in the fishing village it amounts to about 30 percent of the village. Many others also have different other sources of income and many rely upon fisheries indirectly for livelihood. Each caste and community reflects its own pattern of fishing and related activities. The Chilika Lake is surrounded by rich biodiversity. The lake and the surroundings have a unique mixture of flora, fauna, fishes, forests and land. These together put an intrinsic effect on the community and they have a strong connection with it. There is no specific community who entirely earns its livelihood or has right over the lake. This makes it tough to implement lake conservation plan as it a common property resource. There is no specific geographic area to add it to implement the resource management plan of the lake. Farm lands and paddy fields are surrounded around the lake. The irrigation water with huge amount of pesticides and fertilizers go directly to the lake .the lake is the main source of resource for the local people for many activities. As the chemicals are into water, affects the people directly and indirectly and has adverse effect in the long run. The western side of the Chilika Lake to around 40 kms has the forest spread over it. People collect fuel woods and timber from the forest. This forms the siltation, which is harmful for the lake. Chilika is a place for people with different socio-economic profile and all stay together and are interdependent and linked with each other.

There are few communities who are affected due to economic and social backwardness. They are mostly dependent on the lake and other forest resources available. These are few divisions:

- The traditional fishermen,
- the modern, well equipped fishermen with technology,
- the farmers living around the place and
- the people who depend upon the forest resources for their livelihood and other requirement.

1.2.1. Traditional Fishermen's Caste and Status

In Chilika Lake the traditional fishermen are schedule caste; they are considered to be untouchables and known as 'harijans'. They are entangled in poverty as they belong to lower caste and have no social as they lack economic power.

Sub-caste of the fishermen

- 68% of the fishing community who traditionally did fishing with only nets are called Keutas.
- 14% of the fishing community is Kandara who use traps like dhaudi and thattas for catching prawns and crabs.
- 7% of the fishing community use bejas and menjhas which are the bamboo traps and they are called Tiara.
- 7% of the fishermen who are telgu catch fish near the mouth of the lake and they use drag nets and cast nets.
- 2.3% of the fishing community is Niary who use nets to catch fish.

All these above caste are different from each other and also denote a level of economic status. There is hardly any difference between Keutas and Tiara. Keutas claim to be the highest caste amongst them whereas Kondras are the lowest sub caste among all the fishing community. There is still prevalence of untouchability in the society of these

villages. But the intensity of this has decreased. Few years back, they were not even allowed to enter the Hindu village but now things are changing. Now, all of them celebrate festivals together and enjoy bathing and other activities. But still there are places where these fishermen community are not allowed. They have different tradition and rituals that they follow. They have different zones for drinking water and Hindus don't allow them to touch it. They also carry their bride for marriage and many more. Lack of awareness, illiteracy and economic impairment has led to such activities. So, it's time for government and people to act together to fight these social issues and enhance their social status.

1.3. Environment around Chilika Lake

Chilika Lake has been beautifully covered by forests with eucalyptus, cashews and casuarina near the shore. This initiative is taken by the government own social forestry programme and SIDA. Forest is the main source of resources other than the lake for fuel requirements and they also cut wood and sell it in the local market. Few tribal who live around are known for supplying bamboo to the fishermen to make fishing tools and also to make leaf plates. The fisherwomen do the work of selling the fishes around the village and then cut fuelwood for their domestic purposes. Women spend four to five hours to bring leaves for their requirement as fuelwood. Cutting and supplying of fuelwood is a job as it is short in supply. There is different style of bring in the fuel wood while Hindus bring it in cart and cycle loads, tribal and lower caste are seen to bring in head loads. The number of families lives exclusively on the forest. As the forests are being cut down, these families have to go deeper and deeper. These cutting down and clearing of forests leads to flood and sedimentation in the lake area. Thus, forests and the fishing community and people living in and around Chilika have a very strong bond and are closely interlinked and it contributes in many ways.

Cashew and paddy fields are found in dry and wetlands around the Chilika Lake which is not surrounded by humans and forests. The irrigated water with all sorts of pesticides and fertilizers pollute the waters of Chilika Lake and affects the life of human and the aquatic animals. The farmers take away the lands formed by shrinking of Lake and undergo agriculture and aquaculture. Here the role of higher caste plays as they dominate the lower

caste in terms of economic authority. These farmers also are seen lending money to the fishing community. They also help in fish marketing. Thus, there is creation different class. This gives entrance into the matter if fishermen. The non- fishing community has power them as they lend money and start having a say over them. There is now a conflict between the fishing community and the non-fishing community. But the non-fishing communities are found to be better off. These have given them to price the fishes and thus making fishing community poorer and poorer. Due to flooding, many farmers had to shift to fishing as they lost their cultivable lands. Even many fishermen changed their occupation to farming as they had very poor income from fishing. A shift of occupation was seen in few years. Though the farmers are interested to go back to farming if floods could be controlled and irrigation facilities are ensured. With the increase in high profits and commercialization of fishing and prawn culture many farmers tend to change their occupation. The high return from this commerce has attracted many farmers to take up fishing. The heavy dose of fertilizers and pesticides used often run into the lake. More than 80% of the fertilizer is nitrogen which is much more than potassium and phosphorus and thus resulted in formation of aquatic vegetation but has also negatively affected the lake. These fertilizers have become a cause for concern both for the fishing community and the fishermen folk as well as it deteriorates the quality of water which is used for various commercial and domestic purposes and also by the animals .

1.4. Prawn Cultivation and Export from Orissa and from Chilika

With the rise in demand of prawn in the global market resulted in commercialization of prawn cultivation. This gave rise to conflict between the fishing and the non-fishing community. The aim by the people to earn higher profits and earn dollars has adversely affected the environment and ecology of the lake, not only this it has also affected the traditional fishing community and their livelihood. The commercialization of prawn cultivation resulted in use of modernised techniques and motorized boats, nylon nets which affected the environment. The sustainability of the lake is at stake after use of semi intensive prawn cultivation methods. With advancing years there was exploitation of all the fishery resources and there was shrinking of the potential fishing zone .These zones were converted to area for prawn culture. Large bamboo embankments called gheries were

formed to do intensive prawn culture. These gheries have created lot of havoc for people living in the area of Chilika Lake. It has also created various environmental problems such as

- Formations of creeks inside Chilika and blockage of water
- Decrease in the depth of water as well the salinity is decreasing at higher rate
- Water logging
- Creation of landmass frequently
- Decline in beauty of Chilika Lake

Degradation of the environment and bio diversity relying on it. The entry of non-fishermen, outsiders, politicians, businessmen are denoted as prawn mafias who dominate the small and marginal fishermen and occupy the prawn culture for high end profits. From 1980s, outsiders have started to have control over the fishing community. They give lease to poor fishermen and extract all the resources and then pump money through prawn cultivation. Eventually the fishermen were thrown out of their occupation due to lack of economic strength and power, now they work only as marginal farmers. These outsiders are termed as mafia as they possess high amount of economic power and also physical strength and people with them which makes the poor fishermen difficult to fight against them. In recent years there were high end profits in the prawn cultivation which converted most of the lakes into bamboo embankments to form gheries to perform intensive prawn culture. It is mainly to undertake higher profits and earn dollars. With the greed of foreign exchange, Chilka has become a hub for foreign exports. Various prawn farms also have gained a huge sum of money and few fishermen's life completely changed and their standard of living. There were also fishermen who suffered a loss and could not cope with the situation. But with high hope of foreign exchange things have worsened down now, the amounts of prawns are decreasing and the earning is declining. The non-traditional agricultural exports in this area have resulted in rural poverty and conflict between different groups.

1.5. Statement of the Problem

India has already emerged as an important producer of cultured prawn and thus has been helping the fisheries sector to contribute substantially to GDP. Though the country earns foreign revenue by exporting prawn, its cultivation on crop land is exerting negative impact on the nearby villages and therefore aims at conducting a survey on the socio economic conditions of people involved in prawn cultivation and the environmental impact of prawn cultivation. The exponential increase in commercialization of prawn has invited many critics. The rise in semi intensive prawn cultivation has adverse impact in almost every sector from social to environmental and thus it is highly discouraged these days among the masses. Prawn cultivation gained popularity among the business class, politicians and others because of its high end profit margins and the earning of foreign dollars. But, it has very deep impacting negative effect on the ecology of Chilika Lake, which cannot be ignored in front of money as Chilika stands to be one of the most beautiful places of Odisha. Prawn cultivation also has a very hostile effect on the livelihood of the fishing community and everyone linked to it. Prawn cultivation affects both the ecology as well as the society as a whole. The social conclusions from the prawn cultivation is very dangerous it affects everyone from rich to poor and child to man. Which includes loss of social commodities, property, inheritance problems and ecological disorder and thus, this is burning issue of social equity to be questioned The use of heavy dose of chemicals and drugs used in the prawn cultivation results in siltation which hampers the growth of prawn and output after a stipulated period. It also hinders the further scope of aquaculture and cultivation. It contaminates the water used for daily and other agricultural activities. The expectation of gaining in dollars has temped people to use synthetic and artificial ways to boost production. These mechanism though are temporary in nature but the loss of biodiversity and resources are forever. Thus, proper precautions and awareness should be spread to conserve the ecology.

1.6. Significance of the Study

Yet much work remains to be done to put the socio-economic and environmental aspects of prawn cultivation together. There is a scarcity of good publication on the state of the traditional fishing community, agricultural labourers and their livelihoods. In spite of forming a large proportion of the population they have just been receiving minor reference in earlier studies. There are not many studies which focus on both the socio-economic as well as environmental aspect of prawn cultivation in Chilika Lake. This is because there is no particular official agency that publishes the data separately for the socioeconomic condition as well as the environmental implication of prawn cultivation. Most of the studies on environmental implications are based on secondary data and concentrate on the effects of siltation and destruction of ecology but the specific issues has not been cited as well as death of other aquatic animals living. There are very few studies to demonstrate the loss of beauty of Chilika Lake due to prawn cultivation and it also does not highlight upon the effects these artificial bamboo embankments has on the tourism of Chilika Lake While studies done on the socio economic condition of people involved in prawn cultivation has been done, little effort has been made to study the shift in the occupational pattern and what are the reasons behind the same. There is also no importance given to other occupations prevalent around Chilika Lake and the impact or prawn cultivation on them and their livelihoods. On the other hand the study on both the environmental and socio economic effects of prawn cultivation and the study of their interdependence is very important as it is related to livelihood of the entire population residing around Chilika Lake and the implication their lives. It is necessary to study the impact of prawn cultivation on the environment as well on the people who are involved as well as associated with it as prawn cultivation turns outs to be a high foreign exchange earner as well as contributes to the GDP of the country. The analysis of socio-economic and environmental implications of prawn cultivation would help in designing appropriate policies related to prawn cultivation and fisheries. This study will help to analyze the current situation of people involved in prawn cultivation .The economic wellbeing of both the fishing and non-fishing communities and if prawn cultivation has improvised their standard of living or is responsible for the deterioration. We can also determine the loopholes and thus facilitate in

order to improve the conditions of people involved in prawn cultivation if they have a lower standard of living. Apart from it we can also preserve the scenic beauty of Chilika Lake and examine the environmental implications of prawn cultivation, what are the major factors concerning the issues and what steps should be taken to stop the environmental degradation can be a major look out of the present study. This study will deal with the gaps in previous studies related to socio-economic conditions and environmental implication of prawn cultivation and will give a vivid picture of the process of cultivation. It will emphasize upon the living conditions of the people involved and the environmental issues which arise out of it.

1.7. Relevance of Selecting Ganjam as Sample Area

Ganjam is one of the oldest districts of Orissa having 22 Blocks and 3 Sub-Divisions. It is an under developed district and shares border with the Andhra Pradesh. Ganjam district is situated along the sea side of the state and broadly divided into two natural divisions'. The eastern side has the coastal plains whereas the western part is covered with hills and lands. The district is endowed with rich natural resources and a very beautiful bio diversity accompanies it. The main attraction of the district are Sun surf sand of Gopalpur Sea Beach, colourful Chilika lake, hot Sulphur spring water of Taptapani and hilly terrain of Taratarini. The abode of various rich resources is available yet the district has not managed to prosper and is considered as one of the backward districts of Odisha. In spite of the high foreign exchange through prawn cultivation, there is no development of the villages primarily focuses in prawn cultivation in Ganjam district. The living conditions and the per capita income of the people involved in prawn cultivation are poor as compared to the average per capita income of the state. As commercialization of prawn cultivation leads to high returns people are shifting from their traditional occupation to prawn cultivation but the result is not very encouraging and also the beauty of the environment surrounded around the Chilika Lake is deteriorating. Hence, Ganjam district has been chosen to study the socioeconomic and environmental implication of prawn cultivation.

1.8. Objectives of the Study

The present study broadly examines socio-economic and environmental implication of prawn cultivation in Chilika Lake. Specifically the objectives are:

- (1) To analyze the socio-economic condition of people involved in prawn cultivation.
- (2) To examine the environmental impact of prawn cultivation.

1.9. Methodology of the Study

To fulfill the motive of the study primary data was collected from 130 respondents of Rambha NAC, who were purposively selected. Both Qualitative and Quantitative techniques of research has been used for this study. The interviews has been qualitatively investigated, analyzed and construed. The information collected from the survey was analyzed using SPSS V20. This study was conducted in Rambha NAC and few villages were used for taking the samples such as Laxmipur, Humma, Kainthapalli, Gopinathpur, Poirasi, Jharapall and Borapalli. Data was collected through household survey, participant observation, rapid rural appraisal and case study on the people in the month of December 2014. Data is interpreted and analyzed in the month of February and March 2015.

Purposive sampling was used to collect the data. Collected data is analyzed in terms of various statistical techniques and presented through various tables, figures etc. In the socio-economic study, the most important variables are sex of the respondents, income, caste , religious status, housing, family size and for analyzing the environmental impact as well it is very much necessary to describe the variables for a better descriptive study.

Data have been collected both from primary and secondary sources. Primary data was collected from 130 respondents using semi-structured household interview schedules. Interview schedule contained 80 questions. The first part of the schedule dealt with socio-economic profile of the participant, second part dealt with questions regarding prawn cultivation and the third part dealt with open ended as well close ended questions regarding implication of prawn cultivation. Primary source that includes sample survey, participant

observation, Rapid Rural Appraisal (RRA) and case study. Secondary source: from various writings related to study, official documents, research documents etc.

1.10. Organization of the Thesis

This study is divided into six chapters including the present one. The chapter I introduces the study, history of Chilika and its fishing community, background of the research, spells out the scope and objectives, methodology, data sources and the period of study. The chapter II digs deep into the literature survey to find a gap and leakage in the earlier research studies. The chapter III deals with the socio-economic profile of the study area and the characteristics of the respondents in terms of education, sex, caste etc. and also explores evaluates the analysis and interpretation of data collected from the survey done in the area. The chapter IV discusses trends of fishing community over the years and also finds out the trend in increase and decrease of prawn cultivation. Chapter V identifies and discusses about the environmental issues due to prawn cultivation and the chapter VI sums up the major findings of the entire study and provides a scope for further research.

Chapter II

Review of Literature

This chapter explores into the available literature on prawn cultivation. A number of state as well as country based studies have been reckoned below. This helps in understanding the socio- economic impact and environmental implication of prawn cultivation in different states and countries. A few studies relating to socio-economic implication as well as environmental impact have also been included. This review points out that very few studies have focused on socio-economic as well as environmental impact together on Chilka Lake.

This section of the chapter is classified into two parts such as

- (a) Studies relating to prawn cultivation and its impact on socio-economic conditions.
- (b) Studies relating to prawn cultivation and its environmental implications.

2.1. Studies related to prawn cultivation, fishing community and their socio-economic conditions

Hussain (1994) analyzed that aquaculture development has been heavily promoted and subsidized by international and national lending agencies that often cite global food security needs as a justification. This is fallacious for the major portion of shrimp aquaculture which caters to luxury demand. The shrimp industry has become a main beneficiary of these subsidies and institutional supports while it is putting at risk the livelihoods and food security of many coastal populations. The cultivation of shrimp requires large amounts of natural, financial and technical resources. Countries which have important parts of their population in need of food, such as India and Bangladesh, are presently becoming the main areas of expanding coastal shrimp aquaculture. Indeed, the industry is now being promoted in less developed areas with the support of the host governments and transnational companies that are often from higher income Asian countries such as Thailand or Taiwan Province of China. These same enterprises have frequently already exceeded production, environmental and political acceptance limits in their home countries.

Mazid (1994) remarked aquaculture as a safe practice as it uses biodegradable wastes and helps in generating source of income .But, later he argued that prawn cultivation has negative impact on the environment and a major cause of water pollution.

Rao et al., (1994) explained that shrimp farming results in disturbance in the social starts of the society. The ease of accessing money through shrimp farms results in destroying the beauty of the area. The traditional fishermen lose their occupation and people tend to shift to shrimp farming for higher profit.

Baviskar (1995) explained that the shrimp/prawn producing unit in Bangladesh is locally known as “gher” farming. Gher farming is a combined form of aquaculture and agriculture. Shrimp/prawn gher farming system has significant impacts on agriculture and the economy of Bangladesh and has created many diversified local job opportunities like mud snail traders, prawn fingerlings traders, ice factory, depot owners, etc. A large number of male and female workers supply their labor in this sector. The basic components of one’s standard of living such as food consumption, medical care, education, housing, and clothing have improved after the introduction of the gher revolution. Now the people in this industry can have three meals a day which was not possible in the recent past. They can also afford to send their children to school for education

Samal and Meher (1999) stated that the average size of household among non-fishermen is greater than that of the fishermen. There are more illiterates among non-fishermen but their average year of schooling is higher than that of the fishermen. Then on-fishermen's position is comparatively better than that of the fishermen with regard to possession of assets. However, unevenness in the distribution of assets is more pronounced in case of the non-fishermen households as a whole.

Samal (2002) identified that the fish economy of the Chilika Lake underwent a series of dramatic changes from the early 1990s. Liberalisation that boosted exports and modernised

techniques has also seen shifts in the Chilika lease policy and the entry for the first time, of non-fishermen into the prawn culture industry.

Pattanaik (2006) stated that the local and ecological loss people residing in the prawn cultivation area are the major concern. Prawn cultivation destroys the ecosystem and the biodiversity. The people residing in the coastal area have a threat to their lives as well as their livelihood. The notable local level results include the establishment of highly capitalized, environmentally vulnerable and energy inefficient cultivation systems and the emergence of grassroots resistance movements of the poor.

2.2. Studies related to prawn cultivation and its environmental implications

Krutilla and Fisher (1985) stated that the Shrimp farming is blamed not only because of the expansion of shrimp farming is subject to criticism not only ecological degradation but also but for the difficulties faced by the local people. Use of heavy dose of chemicals and drugs has resulted in deposition of silt in the sea bed. The contamination of water in the lake does not let to use of crop rotation and thus, increasing the environmental degradation.

Pullin (1993) stated that according to an ICLARM report aquaculture development and innovations and indeed intervention of any kind in the agrarian system of developing countries must not cause economic shifts or changes in access to resources Intensive shrimp production hardly seems to meet these standards. Social and environmental changes resulting from expanding shrimp aquaculture in coastal areas are due in large part to the conversion into shrimp farms of land, water and forests formerly dedicated to other uses. Shrimp farms often expand at the expense of agriculture, aquaculture, forests and fisheries that are better suited in many places for meeting local food and employment requirements.

Barraclough and Finger-Stich (1996) looked at interrelated social and environmental impacts of shrimp aquaculture that have been largely neglected. The area of concern is commercial shrimp farming in Asia. A critical analysis based on available data and a few case studies is done. It is based on information from Geneva. Data which were frequently

partial, fragmentary, descriptive and probably not very comparable. They have placed available materials in an analytical framework that links environmental with social issues. They have focused on various actors in the shrimp industry, environmental and social impacts, conflicts and externalities and policy and institutional determinants. The conclusion drawn is even if new technologies are developed to overcome the problems of the industry's longer term social and ecological sustainability is difficult. Institutional, environmental and policy contexts differs in each locality and each country. It is not feasible to prescribe policies or institutional reforms to be applied everywhere in a mechanical fashion. A general rule is that governments should be made representative and accountable, basic human rights respected and property rights should be equitable, clear and secure. Low income customary natural resource users should as a minimum be compensated somehow for their losses, although this is very difficult when they are deprived of their livelihoods and autonomy. The interests of others who are negatively affected by externalities arising from shrimp farming (including future generations) should be taken fully into account. Policy and institutional reforms are required at all levels.

Clayton and Brennan (1999) reviewed the key sustainable development challenges facing shrimp aquaculture in the Mekong Delta, in the context of a shrimp aquaculture in the whole of Asia. Particular attention is given to the nature of the environmental impacts associated with shrimp farming. In this paper, the application of economics is investigated as a tool for addressing the environmental issues and guiding solutions to the sustainable development challenges facing shrimp aquaculture development. The main issues raised in the paper for sustainable development that have been raised in the brackish water region of the Mekong Delta include, sedimentation and salinization, seed stock availability and quality, production volatility, and further intensification. The paper thus suggests to look at the causes of market failure in shrimp production in regard to sustainable development and the application of environmental economics to bring an understanding of the nature of some of the decision-making problems that underlie the environmental and more broadly sustainability problems. It further suggests to explore the incentives at the micro-level, under which resource-use decisions are made and to design the policies to improve the decision making process.

Haque (1999) analyzed the environmental and socio economic impacts of shrimp cultivation in south-western Bangladesh. He identified some grave socio economic impacts such as conversion of agricultural land, salinization of water and soil, marginalization of social communities, socio economic conflicts which marks as an hindrance to social, cultural and economic development of western Bangladesh. The survey was carried out in 13 thanas of Satkhira, Khulna, Banger hat of south west Bangladesh. Participatory method was used to collect data through questionnaire. Thus it was concluded that shrimp cultivation had adverse consequences to a larger part of the community and it was profitable to only a few portion of the community. It was mainly due to unplanned shrimp cultivation expansion as well leads to loss of livelihood of famers and salination of land and thus affecting biodiversity and the environment as a whole. It was recommended to plan the shrimp cultivation so that the agricultural lands are not affected and good quality shrimp should be used as well better management of lands under shrimp cultivation should be encouraged.

Rajalaxmi (2002) comprehend that intensive shrimp farming leads to use of heavy dose of chemicals which salinizes land and spread of various diseases. The study concentrates on Asian countries. It also highlights the sustainability issues related to the environmental and ecological implications.

Pollnac (1992) takes a systems analysis approach to combines the environmental, economic and social aspects of intensive shrimp farming for a balanced, dynamic analysis. It takes the context of the Ninh Thuan, ranked as one of the poorest regions in Vietnam into the study. Since 1999, locals have turned to intensive shrimp farming as a way to improve their financial situation, but the question of intensive shrimp farming being able to alleviate poverty remains unanswered. It aims to prove that the practice of intensive shrimp farming is not sustainable for the Ninh Thuan region. Causal loop diagrams were constructed and translated into a model. The causal loop diagrams were based on literature review, interviews and data collection from non-governmental organizations, institutions, local farmers, officials and residents.

Bhattacharya (2009) compared the traditional and scientific methods of shrimp farming in West Bengal. It measures the net present value and the benefit cost ratio using time series analysis. It analyzes how does the scientific farming affect the farm produce and what are its externalities related to it. It explains the plight of small farmers and explains scientific farming should not be used by small farmers in order to avoid a massive loss following uncertainties in the international market as well as the disease outbreaks in the shrimp industry, the concerned authority should give enough emphasis on traditional shrimp farming by extending better farm management practices, rather than neglecting the farming system for its lower output.

Sohel and Ullah (2012) proposed an Eco hydrology based shrimp farming technique to reserve the degradation the coastal ecosystem. They further argue that the shrimp farmers and policy makers to develop a better understanding about interaction between biota and water of this coastal ecosystem. This includes the introduction of sequential ponds, buffer zone with halophytes and constructed wetland. They concluded that sustainable shrimp production can be implemented and can thus be successful if the width size of buffer zone, size of pond, sediment trap pond and constructed wetland.

2.3. Conclusion

The review of relevant literature has revealed that most of the studies have concentrated upon only specific to only socio-economic or just environmental consequences. There are not many studies developing casual linkage between socio-economic and environmental consequences of prawn cultivation. There are very few studies on Odisha and to be specific Ganjam district. The literature reveals various techniques of prawn cultivation and its consequences. Few of them analyze the cost benefit and net present value. Few literatures also look into the environmental implications.

Chapter III

Socio Economic Profile of Sample Area

This chapter will include the demographic profile of the respondents and analyse the socio economic characteristics of the respondents. The source of income of the household mostly depends on prawn cultivation whereas it is not the major source of income; people rely on other sources of income such as agricultural and non-agricultural work. The method of prawn cultivation and the procurement of seeds depend on the level of education and income. Most of the household had no improvement in the standard of living and lacked basic amenities. Most of the household used traditional method of prawn cultivation. Most of the household lacked the awareness and conscious efforts of safe disposal of equipment used for prawn cultivation.

3.1. Introduction

Prawn has begun to be a significant product in the global production of seafood. Asian countries have flourished well in this production. Many countries have evolved to be international producers of prawn cultivation. There is a huge gap between world demand and supply of prawn. To bridge the gap and gain profitability many countries have commenced intensive prawn cultivation with severe use of manures and enrichers to enhance the yield. These intensified methods in production of prawn had led to a remarkable increase in cultivation of prawn in the initial phase of nineties. This production mechanism has led to ruining of the resource which affected the prawn farms by spread of diseases especially in 1995-96 and caused eventually led to fall in cultivation of prawn in the entire world. As, prawn cultivation plays an essential role in the Indian economy. It contributes enormously to the national income of the country, and adds to the foreign exchange. So, the major concern is sustainability of prawn cultivation and its effect on the income, consumption and standard of living of people involved in prawn cultivation and further advancement of prawn cultivation as a money multiplier. It is to be concluded that proper socio-economic and policy framework can contribute meaningfully to the income

and living standard of a significant section of the cultivators. However, the lack of proper policies in this area limits their source of livelihoods.

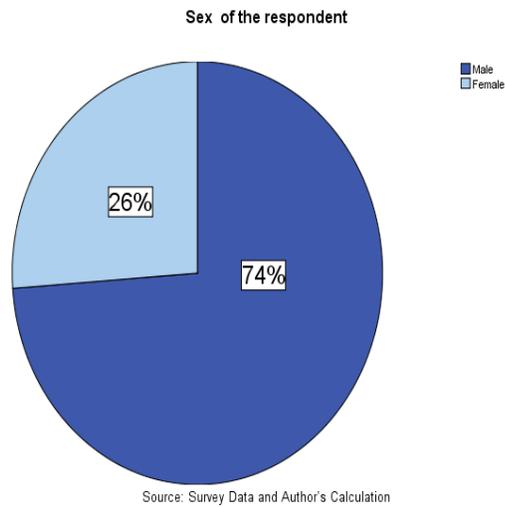
3.2. Demographic Profile of the Study Area

The demographic features play a vital role to determine the pattern of prawn cultivation, their income level, standard of living and practices after the cultivation is completed. Features like sex of the farmer, education level, size of the family, type of house and basic amenities available are few of the factors which have direct influence upon the cultivation pattern. The study was conducted in Rambha Notified Area Council (NAC) of Ganjam block in Ganjam district of Odisha. According to census report 2011, the total population of the district is 3,529,031, with male population 1,779,281 and female population is 1,749,813.

The study area is Rambha NAC, which has a population of 10,715 people with 5,376 male populations and 5,339 female populations. For the purpose of this study one hundred thirty participants were purposively surveyed. The data was collected from few villages namely Laxmipur, Humma, Kainthapalli, Gopinathpur, Poirasi, Jharapall and Borapalli. To have a brief idea about the socio-economic conditions of the people we need to figure out using pie charts, figures and flowchart.

The chart below describes the sex ratio of the population. It shows that mostly the respondents were male, they constituted around 74% whereas female were 26%.

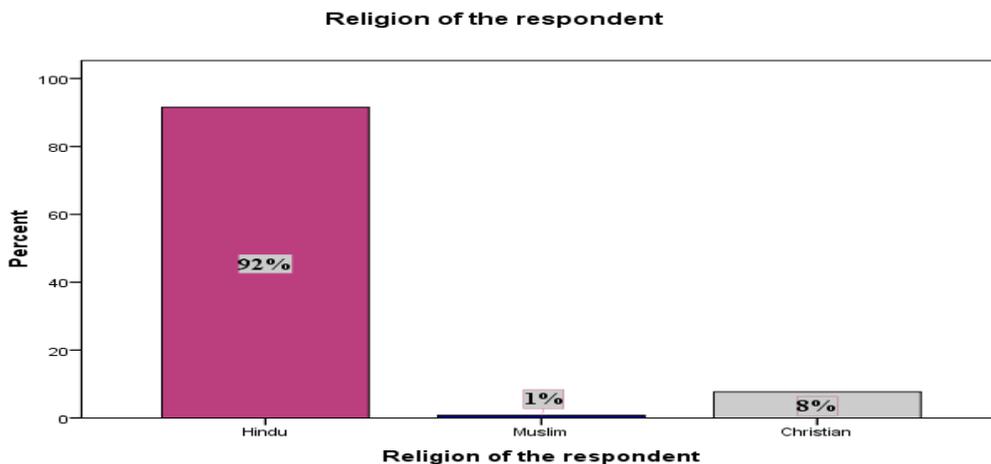
Chart 3.1: Sex Ratio of the Respondents



Source: Survey Data and Author's Calculation

The above chart shows that mostly male population was involved in prawn cultivation and constituted the incoming member of the family and women were involved in house hold and other ancillary activities.

Figure 3.1: Religion of the Respondents

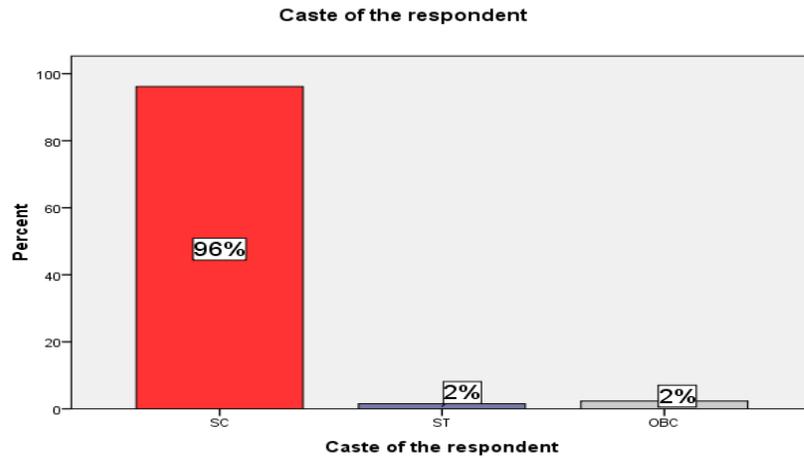


Source: Survey Data and Author's Calculation

In the above figure it is found that Hindus formed the 92% of the population, whereas other religion such as Christian and Muslim population are minor with 8% and 1% of the

population only. This shows that Hindus formed the majority. It can be figured that Hindus or any such religion has no impact on the methods of prawn cultivation or their socio-economic conditions. It was basically a Hindu dominant place.

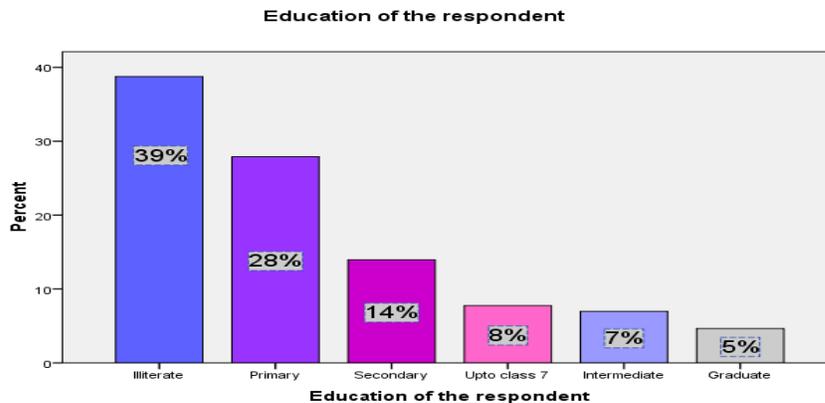
Figure 3.2: Caste of the Respondents



Source: Survey Data and Author's Calculation

The above figure shows that about 96% of the respondents are found to be Scheduled Caste and the village predominately had their population. This shows that mostly prawn cultivation is done by the Scheduled Caste community, other castes are not found to involve much in prawn cultivation. The rest 4% are ST and OBC who are not directly linked to prawn cultivation but participate in ancillary activities.

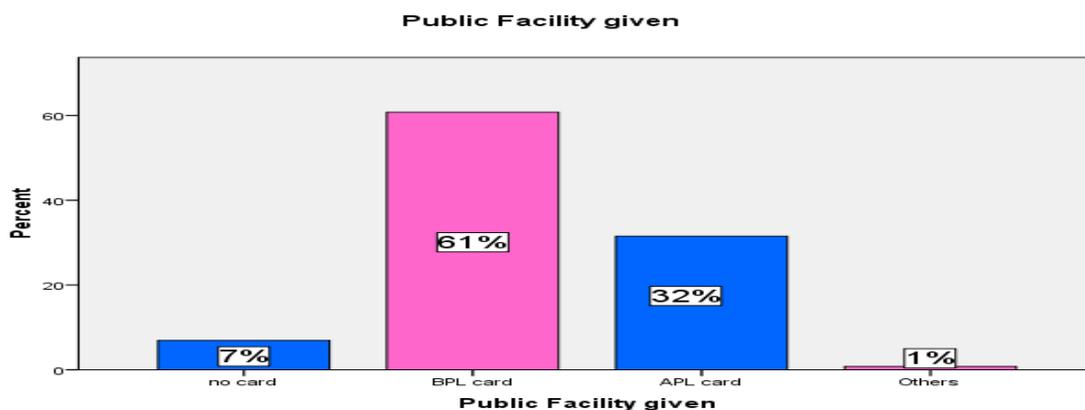
Figure 3.3: Education of the Respondents



Source: Survey Data and Author's Calculation

According to the survey analysis 39% of the populations are illiterate, 28% have completed primary school education, 14% have completed secondary education whereas 8% have completed up to class 7 and 7% and 5% have completed intermediate and graduation respectively. It can be concluded that most of the prawn cultivators are either illiterate or have completed primary education. This has adverse effect on the methods of prawn cultivation undertaken, as education proves to play a vital role.

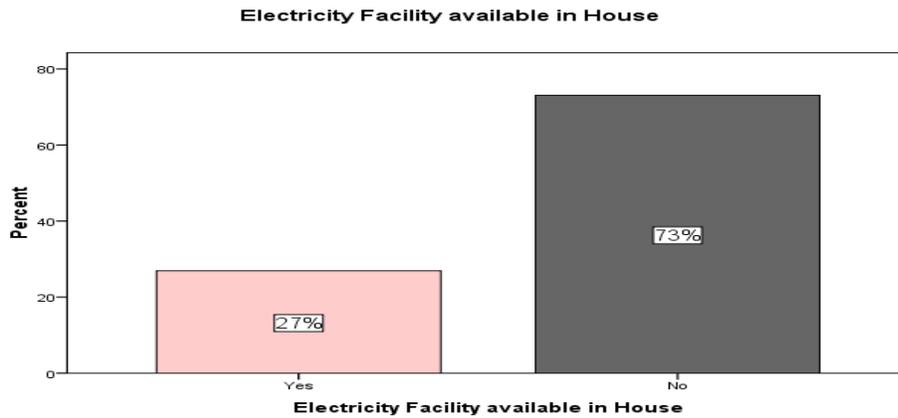
Figure 3.4: Public Facility given to the Respondents



Source: Survey Data and Author's Calculation

In the above figure, 61% of the households have BPL card and 32% of the households have APL card, there are few households who have no card as they were not aware about the benefits of holding a card and how to access it. Thus it can be found that mostly the poor households were part of the prawn cultivation and they were marginal farmers. Few of them were found to be small farmers who had APL card. A conclusion can be drawn that most of the respondents were from a poor economic background and thus were not capable of large holdings.

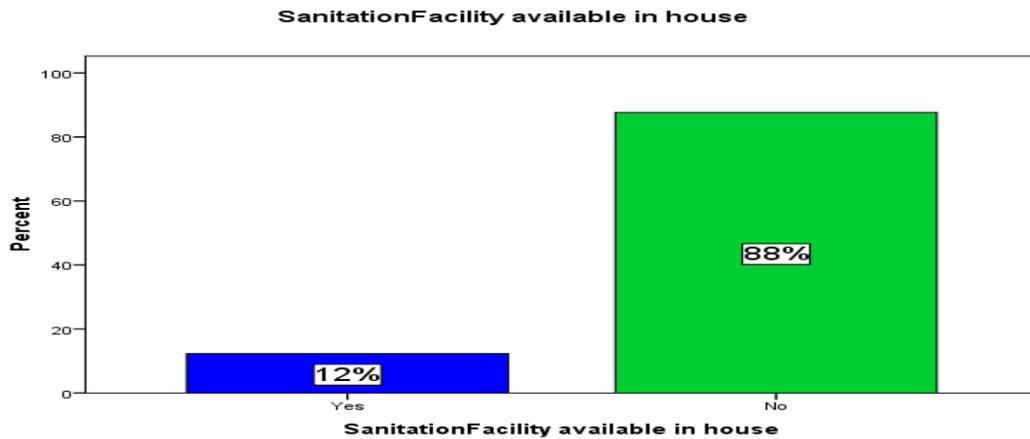
Figure 3.5: Electricity Available in the Household



Source: Survey Data and Author's Calculation

In the above figure, 73% of the households had no electricity connection and only 27% of the households managed to have electricity in their homes. Few of them were found to use electricity through illegal methods.

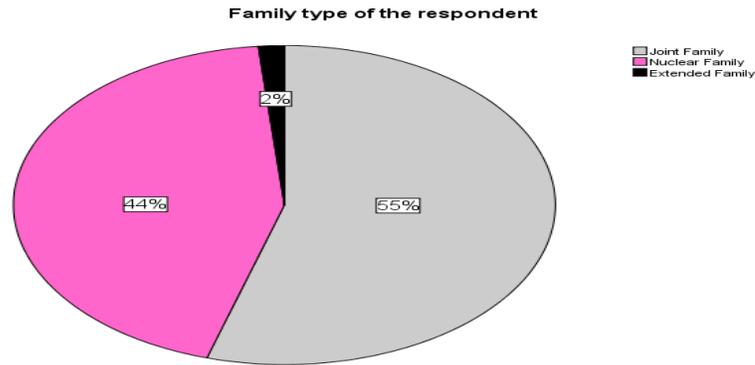
Figure 3.6: Sanitation Facility available in the Household



Source: Survey Data and Author's Calculation

In the above figure, most of the households (88%) did not have sanitation facilities in their households and only 12% of the households were having sanitation facility. This shows that most of the households did not have sanitation facility available and thus were living in an unhygienic condition. They were not aware about the hygiene practices and thus also did not practice it during the prawn cultivation.

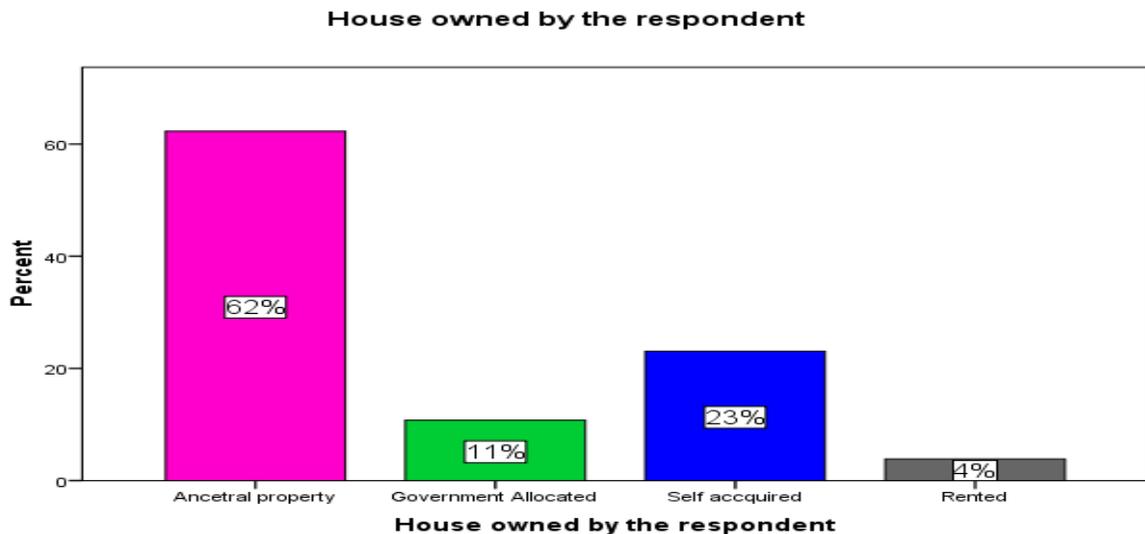
Chart 3.2: Family type of the respondent



Source: Survey Data and Author's Calculation

From the above chart it is found that out of 130 respondents 55% were living in a joint family, 44% were of a nuclear family and the other category constituted of 2% people. Almost there was an equal distribution between single household families who had less number of dependents and joint families who had more number of dependents.

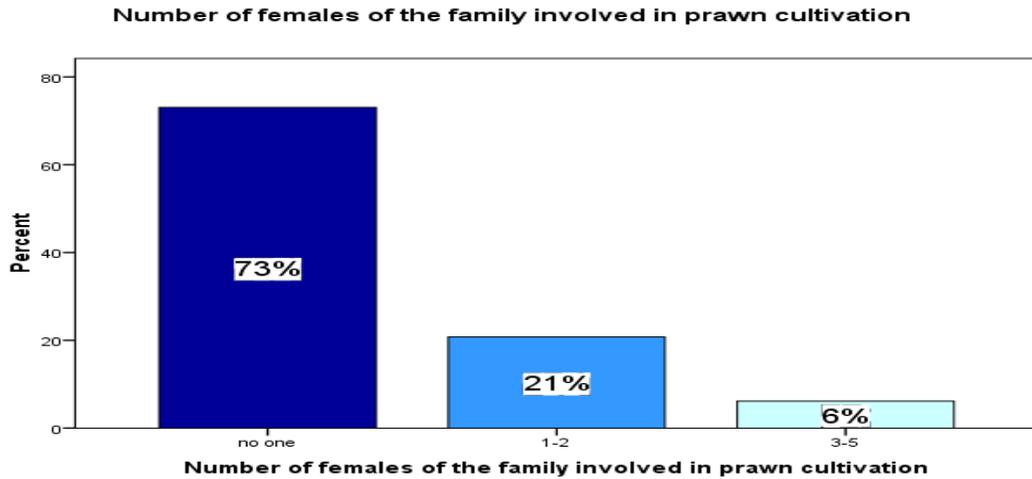
Figure 3.7: House Owned by the Respondent



Source: Survey Data and Author's Calculation

In the above figure, 62% of the household are ancestral property, 11% are government allocated, 23% are self-acquired and 4% are rented. Thus, people were poverty stricken from a long time and have not acquired any property yet.

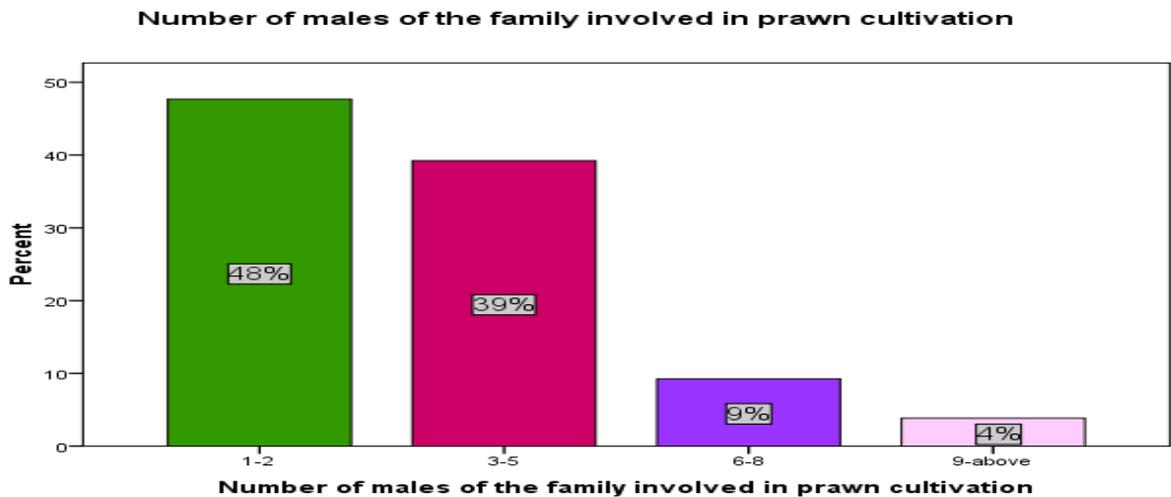
Figure 3.8: Number of females of the family involved in prawn cultivation



Source: Survey Data and Author's Calculation

The survey clearly depicts that only 27% of females from the families are involved in prawn cultivation. 73% of the females are not involved in prawn cultivation. It shows that most of the prawn cultivators are males and the work is basically other occupation and not involved in prawn cultivation.

Figure 3.9: Number of males of the family involved in prawn cultivation

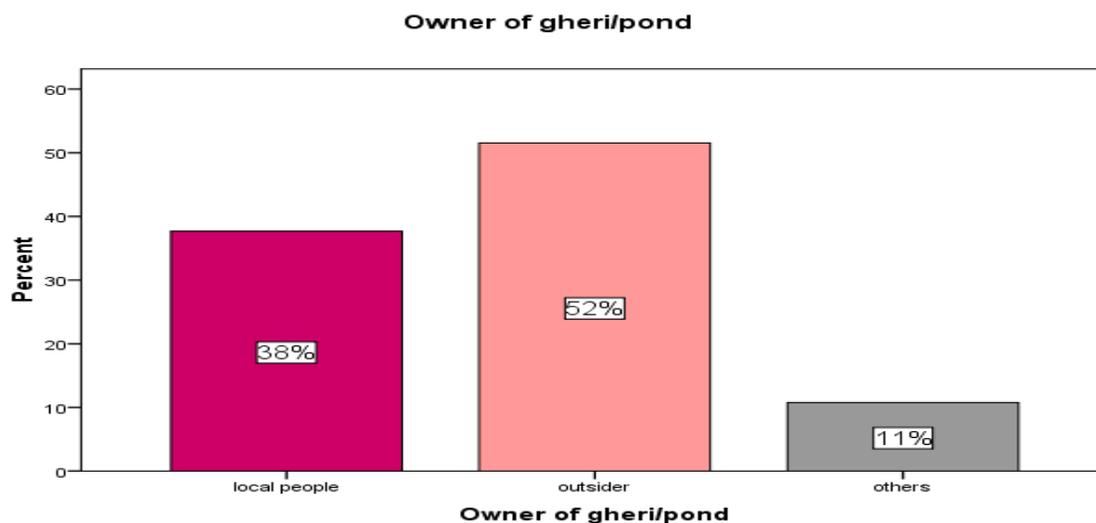


Source: Survey Data and Author's Calculation

From 100% of the respondents it is found that each family is involved in prawn cultivation and from each family there are few male members who are involved in the prawn

cultivation. It can be concluded that minimum number of males involved in the prawn cultivation is around 1-2 whereas maximum is 9 and above male members from each family.

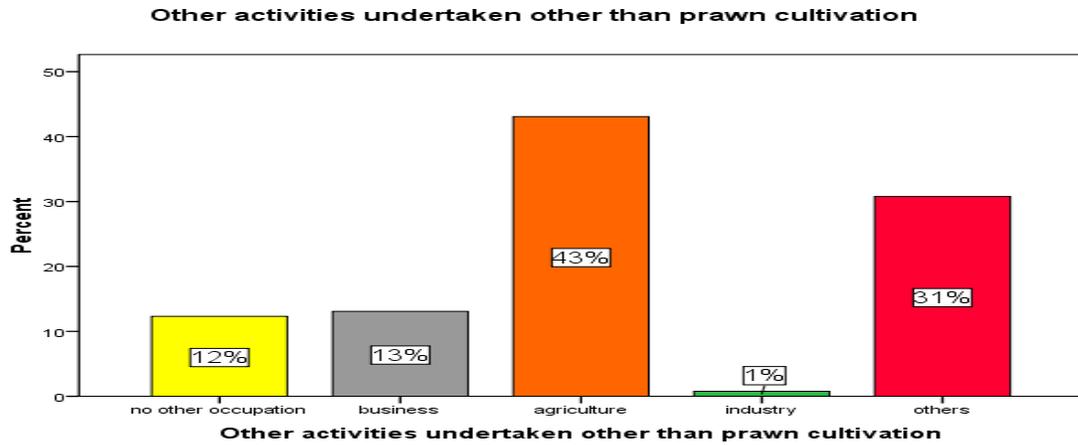
Figure 3.10: Owner of Gheri/Pond



Source: Survey Data and Author's Calculation

In the above figure, 52% of the owner of the Gheri/pond is found to be outsider and 36% of the owner of the Gheri/pond was found to be local people whereas only 11% are found to be others. This shows that most of the respondents who are prawn cultivators are working for outsiders as marginal farmers and the owners who are local people are also small farmers as according to the survey says the yield of the prawn cultivation is less and also the methods and techniques of production used is not apt for large production. Thus, mostly the farmers worked as marginal farmers or as contractual farmers.

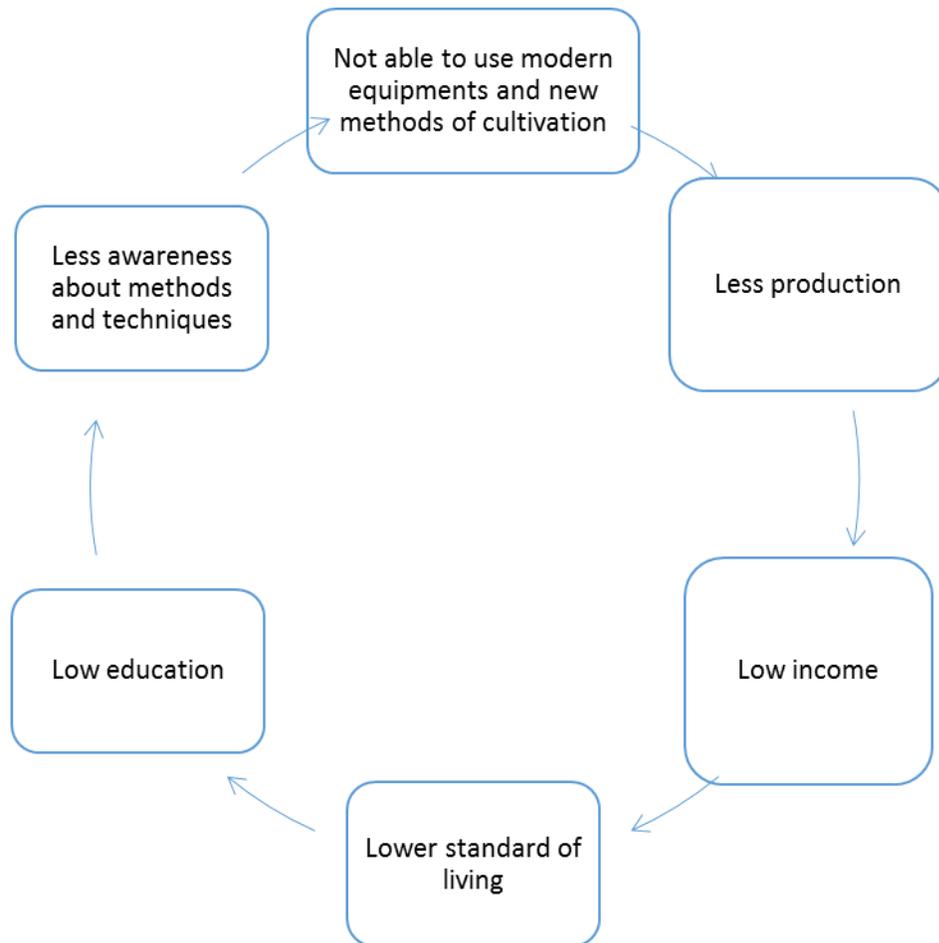
Figure 3.11: Other Activities Undertaken other than prawn Cultivation



Source: Survey Data and Author's Calculation

In the above figure, it shows that 43% of the people are involved in agriculture but are marginal and contractual labourers. 31% people who say they do other jobs than prawn cultivation work as labourers in different cities away from their hometown. Only 13% and 1% people are involved in business and industry and thus it says two occupations which are dominated in the village are prawn cultivation and agriculture together.

3.3: Circular Flow of Socio-Economic Condition of Prawn Cultivators



After the data analysis and computing author's calculation it is found that the socio economic conditions of the prawn cultivators can be drawn into a continuous cycle which is engulfed into each other. According to the analysis, it was found that most of the cultivators were illiterate and thus it created a ripple effect, there were not aware of the techniques to be used for effective prawn cultivation and to carry out in a sustainable manner. As they were not educated enough to understand the new mechanism evolved to do prawn cultivation they continued doing the same in the old traditional method and few farmers used modern methods which were not suitable for the environment. Due to less awareness about the methods and techniques, the output of prawn cultivation is less and it is not in lump sum amount thus leads to low income, now the cycle continue as the prawn cultivators have very low income, they are not able to buy modern equipment for the

prawn cultivation and undergo new methods or techniques of the production that is to be undertaken, this further results in less production. As there is less amount of production, this leads to low level of income and hence low level of income results in lower standard of living and lower standard of living then continues the circle again. When the farmers have a lower standard of living then they have poor access to all the basic amenities and thus are not able to have proper education and even due to poor economical background are not able to educate their children. Thus this continues for generations as well. This cycle is interrelated and also passes on to new generations and making them poor and poorer for years together.

3.4. Conclusion

This chapter can be concluded on a note that the socio economic conditions of the prawn cultivators were found to be poor. Most of prawn cultivators were found to be males. Most of them were illiterate which resulted in less awareness. They also did not have proper electricity and sanitation facilities. Most of them used various public facility cards and survived in house of their ancestors. Most of the respondents who were prawn cultivators were working for outsiders as marginal farmers and the owners who were local people were also small farmers as according to the survey says the yield of the prawn cultivation was less and also the methods and techniques of production used was not apt for large production. Thus, mostly the farmers worked as marginal farmers or as contractual farmers. Thus, effective socio-economic awareness and policies can help the cultivators to raise their income as well as increase their standard of living and live a better life with decent income. However, the lack of proper policies in this area limits their source of livelihoods.

Chapter IV

Trends of Fish and Prawn Cultivation in Odisha

This chapter deals with the trends of the prawn cultivation in Odisha. The pattern of fish production is to be looked into. The year wise data of fish and prawn production is enquired.

Table 4.1: Year wise Fish production in Odisha in MT

Year	Fresh Water	Brackish Water	Total Inland	Marine	Grand Total
2000-01	125114	13442	138556	121086	259642
2001-02	147400	20660	168060	113893	281953
2002-03	154237	19964	174201	115009	289210
2003-04	165594	24477	190071	116880	306951
2004-05	170091	23776	193867	121929	315796
2005-06	179740	23495	203235	122214	325449
2006-07	191632	22951	214583	128141	342724
2007-08	195747	22969	218716	130767	349483
2008-09	213003	26332	239335	135487	374822
2009-10	215803	25508	241311	129332	370643
2010-11	224956	27750	252706	133479	386185
2011-12	237470	30062	267532	114296	381828
2012-13	261919	29914	291833	118311	410144
2013-14	263862	30007	293869	120020	413889

Source: www.orissafisheries.com

According to the table it can be seen there are various methods of fish production in Odisha which are fresh water, brackish water, total inland and marine and they together amount to be the total fish production. It can be seen that over the years the fish production in Odisha has increased, almost in every method of production there has been increase in the production of the fish. Highest amount of fish produced is in the total inland in comparison to the year 2013-2014 and the minimum fish produced is from the brackish water in the current year.

Table No. 4.2: Year wise Resource wise brackish water Fish production (MT) in Odisha

Year	Culture Shrimp	Estuaries	Chilika	Total
2000-01	6430	2029	4983	13442
2001-02	7204	1467	11989	20660
2002-03	7171	1899	10894	19964
2003-04	8112	2312	14053	24477
2004-05	78775	2641	13260	23776
2005-06	8390	2880	12225	23495
2006-07	9654	3341	9956	22951
2007-08	10187	2735	10047	22969
2008-09	11659	3971	10702	26332
2009-10	10979	2514	11955	25508
2010-11	11629	3056	13065	27750
2011-12	11976	3858	14228	30062
2012-13	13227	4220	12467	29914
2013-14	12610	4461	12936	30007

Source: www.orissafisheries.com

The table provides a brief idea about the resource wise brackish water fish production in Odisha. Brackish water fish production amounts to be from various methods. The methods include from culture shrimp, estuaries and Chilika where Chilika gives the largest production of fish in the year 2013-2014 among the brackish water resource of fish production.

Table No. 4.3: Year wise Percentage of Production of Fish in Chilika to that of total Fish Production in Odisha

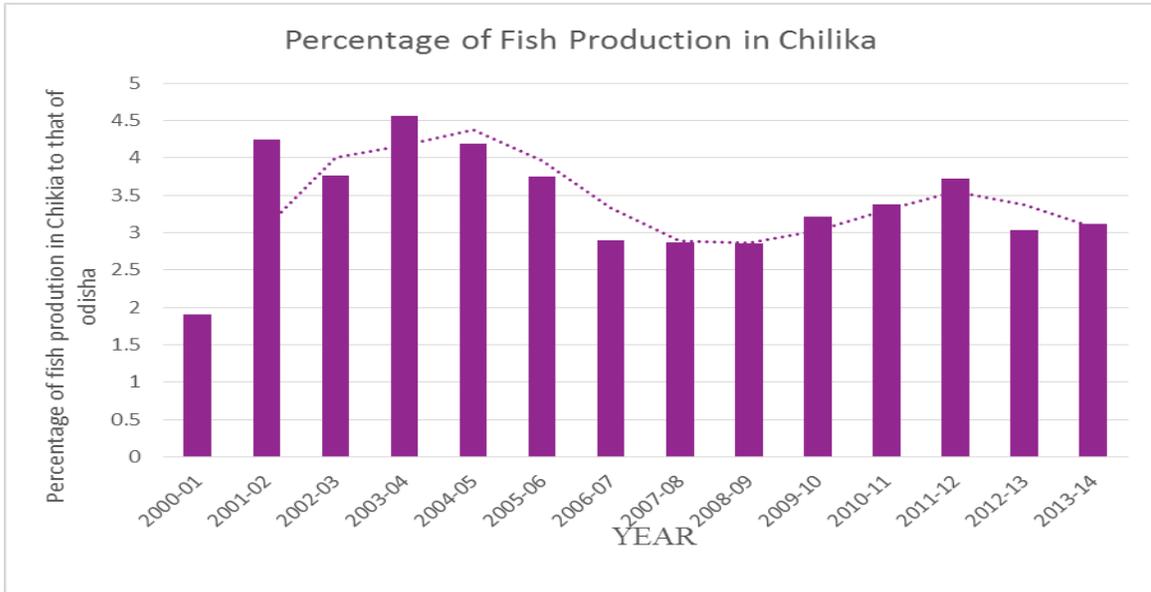
SlNo	Year	Production of Fish in Chilika	Total Fish Production in Odisha	Percentage of Fish Production in Chilika
1	2000-01	4983	259642	1.91
2	2001-02	11989	281953	4.25
3	2002-03	10894	289210	3.76
4	2003-04	14053	306951	4.57
5	2004-05	13260	315796	4.19
6	2005-06	12225	325449	3.75
7	2006-07	9956	342724	2.90
8	2007-08	10047	349483	2.87
9	2008-09	10702	374822	2.85
10	2009-10	11955	370643	3.22
11	2010-11	13065	386185	3.38
12	2011-12	14228	381825	3.72
13	2012-13	12467	410144	3.03
14	2013-2014	12936	413889	3.12

Source: www.orissafisheries.com

The table shows that the fish production in Chilika to that of the total fish production is very less and it contributes only around 3 %, but the percentage of production increased eventually over the years and then showed a declining trend. From the year 2005-2006, the

trend started declining and then it fluctuated from 3%. It remained around 3% from the year 2009 to 2014, but it is not a steady growth.

Figure No 4.1: Percentage of fish Production in Chilika to Odisha



Source: Author's Calculation & www.orissafisheries.com

The above shows the trend line of the fish production in Chilika to that of total fish production in Odisha. It is seen that fish production reached its peak in the year 2003-04 and it was lowest in the year 2008-09. After the year 2003-04, fish production never reached heights of this year and started declining until the year 2009-10. There was increase in fish production but again it declined in the year 2012-2013. The reason for the decline for fish production is the semi intensive prawn production and the mechanized techniques used to produce prawn. The overall rate of fish production which was high once upon a time is decreasing as the non-sustainable production is killing the seeds of other fishes.

The semi-intensive techniques of production not only affect prawn cultivation but also the ecology of the lake and various other species are vanishing and dying. Thus, leading to decrease in the production of prawn.

Table No. 4.4: Fish Production from Chilika Lake (In Mt) Year Wise Data

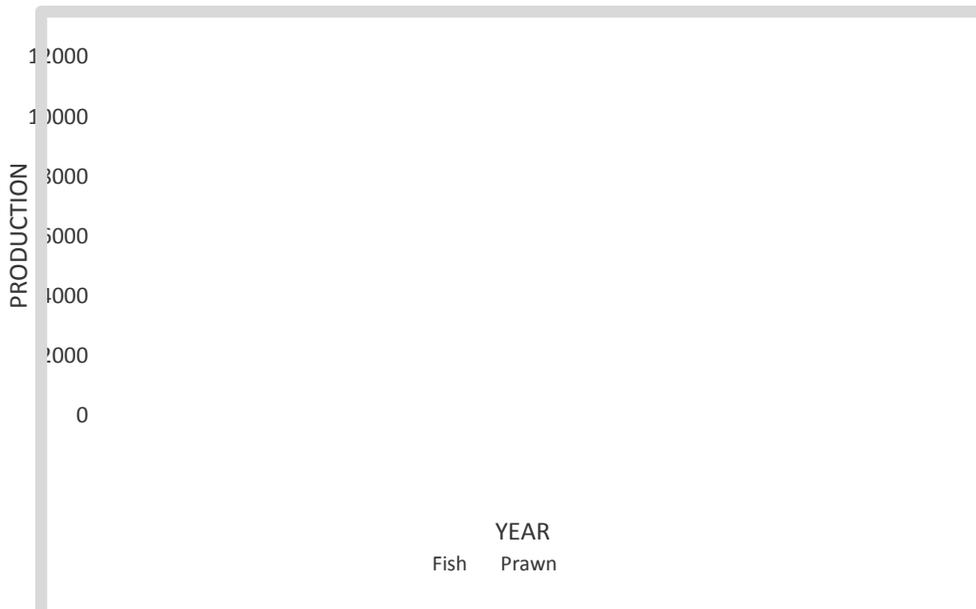
Year	Fish	Prawn	Crab	Total
2000-01	3817.81	1071.38	93.60	4982.79
2001-02	9530.03	2347.78	111.07	11988.88
2002-03	8265.16	2478.82	149.81	10893.79
2003-04	10286.34	3611.37	155.51	14053.22
2004-05	8097.77	5000.71	161.89	13260.37
2005-06	7774.81	4296.02	154.08	12224.91
2006-07	6463.92	3368.97	122.94	9955.83
2007-08	6610.23	3298.08	139.12	10047.43
2008-09	6534.85	3929.68	237.50	10702.03
2009-10	7892.98	3851.49	210.89	11955.36
2010-11	7736.54	5043.18	285.90	23065.62
2011-12	7456.03	6413.91	358.26	14228.20
2012-13	7114.30	5034.05	318.58	12466.93
2013-14	7699.71	4927.66	308.97	12936.34

Source: www.orissafisheries.com

The above table explains the pattern of fish production from Chilika Lake. It further explains using a year wise data analysis from the year 2000 to 2014. It shows that there is maximum production of fish followed by prawn and then crab. According to the table the total production has been fluctuating over the years. The prawn productions show a

declining trend and it also has been fluctuating over the years.

Figure No. 4.2: Fish and Prawn Production from Chilika Lake (In Mt) Year Wise



Source: Author's Calculation & www.orissafisheries.com

The above table shows the fish and prawn production in Chilika. The table explains that fish production in Chilika is affected by the prawn production taking in that place. The more there is prawn production the less is the production of fishes. The increase in prawn production in the Chilika Lake has resulted in decline of fish production. The reason behind this is in order to trap prawn for cultivation, the small seeds of fishes are getting captured and then they die. The main aim of the cultivators who have made gheries is to cultivate prawn so they do not see to the effects that prawn cultivation inculcates on the fish production.

Conclusion

The prawn cultivation in Chilika has started showing a declining trend because of the production techniques used for cultivation. The output increases for a stipulated time but then the particular area after few years cannot be used for further purposes. The embankments also lead to lowering the production of other species of fishes.

Chapter V

Environmental Implication of Prawn Cultivation

5.1. Introduction

Sustainability, preserving and conserving resources has been the main intention of many Asian countries (Kalland and Persoon, 1998). There are several ways of degradation and exploitation of the natural resources in all the Asian countries. The over exploitation of the wealth and natural resources of many countries around Asia has been from time immemorial. The environmental degradation and over use of resources has devastated the livelihood and the living conditions of many poor farmers and fishermen. Their source of income and quality of life has been affected adversely by over exploitation of resources (Omvedt, 1993). The advent of new and modern technologies led to the rapid exploitation of the natural resources and environmental degradation. The introduction of the fresh and new mechanism of resource extraction has led to exploitation and extraction of resources at an exceptional level. Prawn cultivation can be one of the types of such extraction which has led to environmental depletion. For example, Blue revolution which is rampant in many Asian countries especially India has adverse impact in comparison to the green revolution. This blue revolution has resulted in economic and social misbalance of the societies involved in it.

The unbalanced increase in prawn culture in the coastal belt of the Asian countries has prompted struggle between the poor and the rich class of the cultivators, farmers and the fishermen. In India, the prawn cultivation has resulted in conflicts at various levels. The conflict is at various spheres from micro to macro level in the prawn industrial chain. Stonich (1998) argued that maximum amount of the cultured prawns are cultivated in the Third World which refers to the developing countries and mostly in the coastal belt which is then heavily exported to the developed countries mostly to countries like Europe, U.S.A and Japan. This leads to an alarming question about the well-being and nutritional benefits of the poor population raising questions about the capacity of the needy people. The

objective of the fishermen involved in prawn cultivation is high end profits and earning dollars from the production.

Prawn cultivation is rampant in India with a motive of earning higher international exchange currency. The techniques of prawn cultivation used such as semi intensive and pond culture has polluted the water resources and the chemicals in water has a high risk to get into the food chain of humans and animals. As the water resources are unhygienic women and girl children walk down kilometers to collect water (Quoted in Stonich, 1998). With the introduction of semi-intensive and modern techniques of prawn cultivation the source of income of the traditional fishermen has diminished and they are now in search of new job which has resulted in change in the occupational pattern of the traditional fishermen. The poor fishermen have lost their source of livelihood and the fight for resources has started. The communities which are better off have ease of access to all the resources and the poor remain in poverty and are getting trapped into more and more.

The Lake is surrounded with people whose motive does not goes beyond the level of just earning foreign exchange and it affects the living of the people living around Chilika Lake. The Socio economic conditions have forced them to use methods of prawn cultivation which are not hygienic in nature and thus lead to outbreak of various diseases. The people involved in prawn cultivation are not aware about the safe practices of prawn cultivation and also the sustainable measures to be taken.

Moreover, they live the bamboo embankments, nets and other disposed things as it is the Gheri, which leads to polluting the water resources over there and thus depleting the quality and the nature of water and diminishing its further use. The use Gheri or embankments leads to reduction in the salinity of water and thus affects the growth of other fish in that area and the fishermen are now not able to earn their livelihood from fishing. The prawn cultivation is now a major hindrance to all those fishermen who depend upon fishes for their survival. During cyclone and heavy rain, it becomes difficult for the fishermen to save themselves when they are inside the water. The water enclosed in the bamboo embankments results in separation of water from the entire Lake resource and this

water becomes contaminated and further reduces the salinity of the water results in poor quality of water.

Prawn cultivation not only affects the beauty of Chilika Lake but also degrades the environment around the Chilika Lake. The gheries have resulted in sedimentation in around the area and salinity of the water is lost resulting in lowering the growth of other fish in those area. The chemical, manures, fertilizers and feed used remain in the ground level of water making the water toxic in nature. Thus, it not only questions the environmental sustainability but also the economic sustainability as because of these practices the production of prawn cultivation goes on decreasing day by day in the long run and making it difficult to make it the only source of livelihood.

5.2. Prawn Cultivation and Its implication on the Environment around Chilika

Heavy dose of feeding used for prawns in the prawn culture popularly called as prawn Gheri contaminates the environment. These feeds have many adverse effects on the surrounding areas. The Gheri or the prawn culture uses both types of water. The semi intensive prawn cultivation has contaminated the water resources which has resulted in pollution of water resources the contaminated water is not potable and also cannot be used for other domestic as well as agricultural purposes (UN Report 1995). The heavy doses of fertilizers and chemicals have contaminated the water resources. The bamboo embankments in Gheri prevent the natural flow and movement of water which results in logging of water. Salt water is the main source of growth of various species in prawn cultivation and this water is used in the Gheri for many days with time to time recycling. The salt water which is blocked in the Gheri for a long period results in salination of the neighboring agricultural lands and hence there is loss in the agricultural production. Hence, the quality of soil in those cultivable lands is declined (Samal and Meher Report, 1999). Semi-intensive Gheri lasts only for few years of time. Then this gheries are left as it is with only limited options of using it for other types of fishing activities. The water of that area is so contaminated that other species of fishes cannot breed in those area and prawn cannot be cultivated as well in those area. With the rise in demand for the prawn juveniles in market and the rise in prawn cultivation, the hatcheries are not able to produce it in lump

sum amount. These juveniles cannot be collected through net bags and over exploitation of natural juveniles occurs mostly in Odisha, Andhra Pradesh and West Bengal. As these juveniles cannot be collected through nets, children are found to collect it. Both children and men when they collect these juveniles they tend to throw all other seedlings of other species of fishes, thus decreasing the stock of other species.

5.3. Prawn Gheri or the Bamboo Embankments

The rise in salinized water, reduction in the level of oxygen and disruptions in the tides are caused by formation of bamboo embankments and gheries in the lake area. The natural growth of the prawn seedlings is hampered and natural way of fishing also becomes difficult due to the bamboo embankments. The bamboo embankments lead to killing of various other species of fishes and also stunting the growth of few fishes thus reduces the stock of overall fish production. The catchment of fish has decreased because of this reason. During weather fluctuations it becomes difficult for fishermen to save themselves. There is also obstacle to 'bahani'. These bamboo embankments in Chilika lead to:

- Water movement is hindered due to formation of bamboo embankments.
- prawn and other fish seedlings are not able to flow from sea to lake,
- the loss of feeding area for the seedlings and
- formation of silt trap and rapid siltation in lake area.

The bamboo embankments or gheries results in blockage of water in the shore which creates salination of water and reduces the growth of prawn. The traditional methods of fishing are vanishing day by day and use of high definition technologies and methods are introduced. The use of nylon nets such as zero nets has increased which pollutes the water.

5.4. Traditional vs Scientific Prawn Cultivation

The traditional as well scientific methods of prawn cultivation both have negative effects on the area of water blocked for prawn cultivation. The protein based prawns are not good to consume and injurious to health. The use of heavy dose of chemicals has resulted in wide spread diseases among the prawn cultivators and also affected other marine animals.

Table No 5.1: Traditional vs. Scientific prawn cultivation

Traditional Prawn Cultivation	Scientific Prawn Cultivation
<ul style="list-style-type: none"> ● Tides are fully fed ● Salinity varies according to monsoon ● Seedling of various species from neighboring canals by the method of auto stocking ● Stock of natural seedling ● Reliability on the natural food ● Tide determines water intake ● The gates are used to manage drainage ● Periodic harvesting through full moon and new moon period ● Collection through trap and bag nets. 	<ul style="list-style-type: none"> ● Ponds are manured ● Ponds are fertilized ● Use of heavy dose of chemicals and fertilizers ● Water filling and exchange done by pumping ● Use of high enrichers ● Usage of aerators ● Harvesting at the end of one crop season, 120 days.

Source: Bhattacharya Poulomi: Economics of Shrimp Farming: A Comparative Study of Traditional Vs. Scientific Shrimp Farming in West Bengal (2009)

5.5. Deterioration of the Ecosystem of Chilika

The semi-intensive prawn cultivation on the banks of Chilika Lake has hampered the ecosystem of Chilika Lake. The formations of Gheri or the bamboo embankments in the lake are made in those places which are flooded in the monsoons. The Gheri formations have resulted in loss of feed for the juveniles. The natural food available for the seedlings is lost, so their population is also decreasing. The formations of Gheri have resulted in formation of barriers for flood water and sedimentation in the following ways:

- The deposits of nearby rivers get deposited in the Lake,
- formation of silts, salination of water and bamboo embankments are the main reasons for blocking the passage of water into the lake,
- siltation and prawn cultivation activities have affected the bird sanctuary at Nalabana and
- decreasing fish output, declining salinity, shrinking of Lake and dense soil erosion leads to siltation of the Lake.

Prawn cultivation has adversely affected the ecology of the lake. The effects include conversion of the agricultural lands, decrease in the agricultural production, salination of lands; depletion of water, pollutants from the prawn cultivation affects the water resources which are used for agricultural and domestic purposes (Primavera 1991, Pillay, 1992, Rajalakshmi, 2002).

Prawn cultivation has not only affected the ecology but The extension of prawn cultivating is liable to criticism not just due to the offsite ecological components mentioned above, additionally for its on location difficulties. Improper and excessive utilization of chemicals, manures and deposition of excess feed at the bottom of the pond makes the soil acidic and improper for any further utilization either for cultivation or other fish culture, in any event in the short run. This gives rise to the issue of irreversibility (Krutilla and Fisher, 1985) of bad environmental impact made by a specific economic activity. Additionally, extreme utilization of chemicals, manures and antibiotics translate into the disease outbreaks in prawn gheri and henceforth create money related danger to the prawn agriculturists.

The adverse implications of prawn cultivation in the environment is because of the methods of production techniques used such as semi intensive prawn cultivation and formation of bamboo embankments which hinders the flow of water and breeding of the seedlings.

The intensive prawn cultivation leads to environmental and deteriorates the quality of water. The externalities by the prawn cultivation also raise questions about the sustainability of the land and water resources. The production mechanism hampers the yield of prawn in a future date.

5.6. Impact of prawn cultivation on the community

The poor farmers whose only source of livelihood was Chilika suffered a lot due to the contamination of water and land resources. These fishermen belonged to the lower caste and no social status. The able bodied and money making people entered the fishing business and took away their source of income. Moreover, they started using modern

techniques to increase the output which resulted in loss of profit for poor traditional farmers. They used heavy dose of chemical which also contaminated the ecology of the Lake. The bamboo embankment not only affected the fishermen but also the farmers and local people who relied on the water resources for day to day activities and irrigation. The community was now divided into rich and poor class. These poor people now started looking for new job opportunities which led to change in the occupational pattern.

5.7. Protest by the fishing community

The fishermen were agitated with the liberalization policy and started protests against the government and it was named Chilika Banchao Andolan. The small and marginal farmers fought for their right of livelihood. It started in September 1991 against prawn farm project. The conflict was between the government and local people to decide who will own the Chilika Lake. Once the conflict was resolved outsiders such as the mafias came to occupy the prawn cultivation for huge profit. The ecology was exploited to earn foreign dollars and the traditional fishermen suffered in terms of economic as well as social imbalance.

5.8. Conclusion

The methods of prawn cultivation undertaken are to be looked into. Awareness should be spread amongst the people living in and around the lake premises as well as the prawn cultivators about the future threat of such practices. The overall production of prawn is also not very high as compared to the past years and this proves the techniques used for prawn production results in deteriorating the quality as well as the quantity of prawn production. It can be also concluded that the Gheri or embankment formed results not only hampering the quality of water but also the scenic beauty of Chilika Lake. Due to ecological imbalances occurring because of the prawn cultivation other species of fish are also not found in the lake. Prawn cultivation has not only managed to spoil the quality of lake but has also led to outbreak of various diseases among the cultivators and its impact is seen in the long run. So, it should be seen that the prawn cultivation is carried out in a sustainable manner and also the main aim should be to protect the degraded environment.

Chapter VI

Summary and Conclusion

This short study helps to have an overall idea about the ongoing prawn cultivation in Chilika Lake, for a precise survey NAC Rambha was taken as the sample area. The objective of the study is to analyze the socio-economic condition of people involved in prawn cultivation and to examine the environmental impact of prawn cultivation. The hypothesis taken was that the socio-economic conditions of people involved in prawn cultivation is poor and there is adverse impact of prawn cultivation on the environment which was later proved to be true.

The socio economic conditions of the prawn cultivators were found to be poor. Most of prawn cultivators were found to be males. Most of them were illiterate which resulted in less awareness. They also did not have proper electricity and sanitation facilities. Most of them used various public facility cards and survived in house of their ancestors. Most of the respondents who were prawn cultivators were working for outsiders as marginal farmers and the owners who were local people were also small farmers as according to the survey says the yield of the prawn cultivation was less and also the methods and techniques of production used was not apt for large production. The socio economic conditions of the prawn cultivators can be drawn into a continuous cycle which is engulfed into each other. According to the analysis, it was found that most of the cultivators were illiterate and thus it created a ripple effect, there were not aware of the techniques to be used for effective prawn cultivation and to carry out in a sustainable manner. As they were not educated enough to understand the new mechanism evolved to do prawn cultivation they continued doing the same in the old traditional method and few farmers used modern methods which were not suitable for the environment. Due to less awareness about the methods and techniques, the output of prawn cultivation is less and it is not in lump sum amount thus leads to low income, now the cycle continues as the prawn cultivators have very low income, they are not able to buy modern equipment for the prawn cultivation and undergo new methods or techniques of the production that is to be undertaken, this further

results in less production. As there is less amount of production, this leads to low level of income and hence low level of income results in lower standard of living and lower standard of living then continues the circle again. When the farmers have a lower standard of living then they have poor access to all the basic amenities and thus are not able to have proper education and even due to poor economical background are not able to educate their children. Thus this continues for generations as well. This cycle is interrelated and also passes on to new generations and making them poor and poorer for years together. Thus, mostly the farmers worked as marginal farmers or as contractual farmers. Thus, effective socio-economic awareness and policies can help the cultivators to raise their income as well as increase their standard of living and live a better life with decent income. However, the lack of proper policies in this area limits their source of livelihoods.

The methods of prawn cultivation undertaken are to be looked into. Awareness should be spread amongst the people living in and around the lake premises as well as the prawn cultivators about the future threat of such practices. The overall production of prawn is also not very high as compared to the past years and this proves the techniques used for prawn production results in deteriorating the quality as well as the quantity of prawn production. It can be also concluded that the Gheri or embankment formed results not only hampering the quality of water but also the scenic beauty of Chilika Lake. Due to ecological imbalances occurring because of the prawn cultivation other species of fish are also not found in the lake. Prawn cultivation has not only managed to spoil the quality of lake but has also led to outbreak of various diseases among the cultivators and its impact is seen in the long run. So, it should be seen that the prawn cultivation is carried out in a sustainable manner and also the main aim should be to protect the degraded environment.

As these issues are complex in nature and interdependent, the resolutions to these issues are also not in independence. These problems are interlinked and also its solutions are to be found out in the same way. The economic and social issues that are faced by people of Chilika is challenging in nature. The fishermen of this are mostly schedule caste and economically poor in nature. For the survival of the poor fishermen whose livelihood and source of income is dependent on Chilika, it should be protected. Illegal and unauthorized

prawn cultivation through prawn culture should be banned. This ban will lead to increase in the income of these fishermen. The economic, ecological, environmental as well as social conditions of Chilika are under threat. It is necessary to build a proper equation between each sector in order to protect Chilika.

During the survey and after author's calculation, few recommendation and suggestions were provided to save Chilika and the fishing community. Few of the suggestions are described below which will improve the standard of living of the poor fishermen as well to protect Chilika Lake from environmental degradation.

- i) The mouth and canal of Chilika Lake should be dug up time to time in order to facilitate proper exchange of water between the Lake and sea. It will help to check siltation and will allow free passage to the juveniles of prawn.
- ii) Prawn cultivation should be banned and strict action should be taken to check the net enclosures or bamboo embankments that are done. This will prevent disruption of tidal flushing, the decrease in salinity and allow the seeds to have natural food. The process of siltation can also be checked by following these steps.
- iii) The unethical accumulation of wild shrimp should be banned as they cause hindrance to the other fishery resources in the Lake.
- iv) The use of modern and mechanical boats inside the lake should be stopped as it creates problem for the breeding of fishes and pollutes the water resources.
- v) The use of 'zero net' should be stopped as it captures and destroys other juvenile fishes, crab and prawns.
- vi) The use of trawlers for fishing should be banned in the Bay of Bengal as they block the movement of fishes and prawn from sea to Lake.
- vii) Weeds and siltation should be prevented as it hampers the movement of boats and hinders the growth of prawn and other fishes.

These suggestion and recommendations if implemented will help in improving the environmental conditions of Chilika Lake and also the socio-economic conditions of the fishermen. These factors will also help in maintaining sustainability of the environment

around Chilika Lake and will help to boost up fish production. These solutions need to be implemented soon in order to provide a better future to the fishing community.

The main question arises who has control over Chilika? Is Chilika a common property resource? If it is a common property resource, who are the people who can have control over it. The external agencies like the government, the commercial people or the people residing in Chilika who should have right over the water resource of Chilika should be the main concern. The next issue is if Chilika is a common property resource then how it should be dealt with? Common property resource includes various rules, set of norms, regulations and procedures to be followed while using it. If Chilika is to be considered under common property resource, then it should be handed over to independent, self-directed and sovereign bodies including the local fishermen. These local bodies can work with technical and financial aid from the government. These bodies can impart knowledge and skills to improve the techniques of fishing and also conduct surveys if it is being carried out in a systematic way or not. The people living in and around Chilika should be given the sole right and responsibility to manage and protect the resources as well as the biodiversity of the region. The local bodies can take initiative to educate the local fishermen about the necessity to conserve the resource and how to optimally use the available resources. The traditional fishing community can thus be protected and their livelihood can be improved.

It is not always about conserving the natural resources and protecting it, we need to adopt sustainable measure to keep these resources for the future generation as well. The balance between each sector of the society needs to maintain. Chilika Lake has a rich biodiversity and is strongly connected to the local people. People living around Chilika Lake benefit from it economically, culturally as well as socially. The balance between these sectors is required to be maintained. Chilika should be conserved on the basis of sustainability. Adequate steps should be taken to save, protect and conserve the Lake from environmental degradation and over exploitation. Commercialization of fishing, use of modern technique and heavy dose of fertilizers should be banned. The poor and traditional fishermen should be taught about various skills. The local fishermen should be given the

right to fish and they should be abided by rules and norms framed by the local bodies. The traditional fishermen who lived in and around Chilika for thousand years should be given the fishing rights. The local body that will be formed as Chilika is a common property resource should have the local people, government and fishing community all together taking decisions and acting as active members. On a concluding note, it should be ensured that all people associated with Chilika should take a pledge to save this natural beauty of the states as well as the nation.

Scope for Further research

The study undertaken is only restricted to a very small area and is not exhaustive or extensive in nature. It cannot be generalized to the entire district or implied to the state. The view of 130 respondents may not reflect the view of the entire district or state. The socio-economic conditions of the people involved in prawn cultivation are to be looked upon as it is an area of major concern. The environment impact of the prawn has resulted in degrading the area under cultivation. The widespread diseases are to be analyzed which is infected due to improper techniques of prawn production. The beauty of Chilika Lake is also hampered which needs attention. Government and local people should join hands to spread awareness and implicate effective measures of prawn cultivation.

Appendix I

Definition of Key Terms

Gheri/ Bandha: These words are alternatively used for the bamboo embankments made to catch prawn. These are local odia words.

Juveniles: These are the small seedlings of various species of fishes and prawns.

Kalijai: Kalijai is a temple located on the island of Chilika Lake. it is said to be the abode of goddesses' kali.

Konark temple: It is the famous sun temple built around the thirteenth century in Odisha. It is also called as black pagoda.

Mafia: These are the rich or business class people with a strong political connection and money back up who exploit small fishermen and own most of the prawn cultures illegally.

Nalabana: It is a bird sanctuary in the middle of Chilika Lake, a beautiful place for bird watchers.

Harijan: Untouchables in India are called as Harijan, a term popularized by Mahatma Gandhi which means child of Vishnu. It was used to stop the discrimination against them as untouchables.

Siltation: Siltation is the contamination of water by fine particles of sand or sand like materials such as clay or silt . The residue remains in water which decreases the further usage of water.

Salination: Increase in the percentage of amount of soil in the water or land is called as salination.

Zero net/Disco net: These nets are modernised nets mostly made up of nylon or synthetic fibers to catch prawns.

Bibliography

- Acharya A.K. and C.L. Murray (1997), 'Economic Appraisal of Eradication Programs: The Question of Infinite Benefit', in W.R. Dowle and D.R. Hapkins (ed.), "The Eradication of Infectious Diseases", pp.75-90, Report of Dahlem Workshop, Berlin, Chichester, UK, Jhon Willey and Sons. (Cited in: Shaw A.P.M., 2003, 'Economic Guidelines for Strategic Planning Of P. Trypanosomiasis Control in West Africa', PAA Technical and Scientific Series, FAO, Rome).
- AIR (All India Reporter) (1997), Supreme Court 811, Kuldeep Singh and S. Saghir Ahmed, JJ, writ-Petition (C) No. 561 of 1994, Ltd., 11-12-1996. S. Jagannath, Petitioners Vs Union of India and Others, respondents.
- Algarswamy, K. (1999), 'Country Report, India', www.fao.org
- Baviskar, A (1995), In the Belly of the River: Tribal Conflicts over Development in the Narmada Valley. Oxford University Press, Delhi.
- Bogaert, M.V.D (1992), Introduction. Saving Chilika Lake: Saving the People of Chilika. Xavier Institute of Management, Bhubaneswar.
- Bhattacharya Poulomi (2009), Economics of Shrimp Farming: A Comparative Study of Traditional Vs. Scientific Shrimp Farming in West Bengal
- Chatterjee, A. B. and Goswamy, S. B., Geographical Review of India, 1966, 1– 20.
- CDA. Achievement Report. Chilika Development Authority (CDA), Government of Orissa, Bhubaneswar (2004).
- Clayton Brennan (1999), A review of economic issues for sustainable shrimp farming in the Mekong delta in vietnam

Chilika-A Living Lagoon: Chilika Development Authority, Bhubaneswar (2003).

Das, B.B.: Chilika (1996), The Nature's Treasure, Will it be Allowed to Die? Orissa Krushak Mahasangha, Bhubaneswar

Das, G.S.: The Report of the Fact Finding Committee on Chilika Fisheries Submitted to Orissa High Court on 16.8.1993 (1993).

Gadgil, Madhav and Guha, Ramchandra: This Fissured Land: An Ecological History of India. Oxford University Press, Delhi (1992).

Gadgil, Madhav and Guha, Ramchandra: Ecology and Equity: The Use and Abuse of Nature in Contemporary India. Penguin, New Delhi (1995).

Government of Orissa. Directorate of Fisheries: Handbook on Fisheries Statistics, Orissa. Cuttack (2000-2001).

Government of Orissa. Directorate of Fisheries: Handbook on Fisheries Statistics, Orissa., Cuttack (1996-1997).

Guha, Ramchandra and Martinez-Alier, Juan: Varieties of Environmentalism: Essays North and South. Oxford University Press, Delhi (1998).

Hussain, M.M. 1994. Status of development of the fishery and seafood processing industry in Bangladesh. In: Sustainable development of marine fisheries resources in Bangladesh. Mymensingh, Fisheries Research Institute.

Haque, S.M. 1994. Annual report of Bangladesh Frozen Foods Exporters Associations (BFFEA). Dhaka, BFFEA Special Bulletin, January, 1994.

- Krutilla, J and A.Fisher (1985), 'The Economics of Natural Environments', Wasington DC: Resources for the Future
- Kalland, Arne and Persoon, Gerard (Eds.): Environmental Movements in Asia. Surrey, Curzon (1998).
- Mazid, M.A. 1994. Environmental issues and aquaculture development in Bangladesh. Country Paper, presented at the Final Workshop, FAO (Food and Agriculture Organization of the United Nations) Regional Office for Asia and the Pacific.
- Mishra, Ashutosh: Law on Culture Fishing: A ray of hope for Chilika Fisher-folk. The Pioneer, Weekly, April 2, 2003 (2003).
- Mohanty, B. and Das, B. P.: Chilika fishing and ecological balance. Unpublished paper.
- NEERI. First Report. April 23, 1995. National Environmental Engineering Research Institute, Nagpur (1995).
- NEERI.: Second Report. July 10. 1995, National Environmental Engineering Research Institute, Nagpur (1995).
- Omvedt, Gail. Reinventing Revolution: New Social Movements and the Socialist Tradition in India. An East Gate Book, New Youk (1993).
- Pillay T. V. R. (1992), Aquaculture and Environment. Fishing News Books, pp. 108-115.
- Primavera, J.H. (1991), 'Intensive Prawn Farming in the Philippines: Ecological, Social and Economic Implications', *Ambio*, 20(1), pp. 28-33.
- Pullin, Roger S.V. Aquaculture and Biodiversity, paper presented at the Centenary Symposium of the Port Erin Marine Biological Station, University of Liverpool

(Isle of Man, 1718 September 1992), International Center for Living Resources Management (ICLARM), Metro Manila, 1992

Pollnac, Richard B. "Multi-use conflicts in aquaculture: Socio-cultural aspects", *World Aquaculture*, Vol. 23, No. 2, June 1992, pp. 16-19.

Pattanaik, Sarmishta: *Environmental Movements in a Global Context: A Case Study of Chilika Lake in Orissa*. M. Phil. Dissertation (Unpublished), University of Delhi, Delhi (2000).

Pattanaik, Sarmishta: Tradition, development and environmental movement of the marginalized. *Indian Anthropologist*, 33(1): 55-70 (2003).

Ram, Rahul. N. RamaRao, K.V., and Ghosh, A.: *Ramsar Sites of India: Chilika Lake*, WWF for Nature, India, New Delhi (1994).

Rajalakshmi N. (2002), 'Conflicts of Water and Soil resources over Aquaculture Production in Coastal Tamilnadu and, Pondicherry', EERC Working Paper Series: MES-2.

Reddy V.R., P. P. Reddy and U.H. Kumar (2004), 'Ecological and Economic Aspects of Shrimp Farming in Andhra Pradesh', *Indian Journal of Agricultural Economics*, 20(1), pp. 435 Sathirathai.

Samal, Kishore: Shrimp culture in Chilika Lake: Case of occupational displacement of fishermen. *Economic and Political Weekly*, 37(18): 1714-18 (2002).

Samal, Kishore and Meher, Shibalal: Fishing communities on Chilika Lake: Comparative socio-economic study. *Economic and Political Weekly*, 38(31): 3319-3325 (2003).

- Samal, Kishore and Meher, Shibalal: Socio-Economic survey of villages in and around Chilika: A Report. Navakrishna Choudhury Centre for Development Studies (NCCDS), Bhubaneswar (1999).
- Stonich, Susan: Greening the blue revolution: A natural assets perspective. Draft paper presented at International Centre on Natural Assets, Political Economy Research Institute and CSE. The Philippines, 8-11 January (2003).
- Stonich, Susan: Violence, Environment and the Blue Revolution. Paper written for the Workshop on Violence and the Environment. Institute of International Studies, University of California, Berkley. California, September 24-26 (1998).
- Stonich, Susan: The Promotion of Non-traditional Agricultural Exports in Honduras: Issues of Equity, Environment and Natural Resource Management. *Development and Change*, 22(4): 725-55 (1991).
- Sub-Committee of the House Committee of Orissa Legislative Assembly on Prawn Culture in Chilika Lake.: Draft Report (Recommendation), (Mimeo) (1996).
- Solon Barraclough and Andrea Finger-Stich (1996) Some Ecological and Social Implications of Commercial Shrimp Farming In Asia
- Supreme Court case Finder. Centre for Environment Law, WWF, India. EBC Publishing House, New Delhi (2000).
- Usharani G., Chandra Reddy T. and Ravindranath (1993), 'Economics of Brackish Water Prawn Farming in Nellore District of Andhra Pradesh', *Indian Journal of Aquaculture*, 8, pp. 220 -230
- Victor, P.A. (1991), 'Indicators of Sustainable Development: Some Lessons from Capital Theory', *Ecological Economics*, 4, pp. 191-213.

Viswakumar M. (1992), 'Technical and Economic Consultations for Shrimp Culture in Andhra Pradesh', Fishing Chimes, 6, pp. 30 – 40.

World Bank (2000), 'Shrimp Farming and the Environment: Can Shrimp Farming be Undertaken Sustainably?'” A discussion paper designed to assist in the development of Sustainable shrimp aquaculture, World Bank, Washington DC.

Web references as accessed from 2.04.2015 to 4.05.2015

<http://www.ganjam.nic.in/RSVY.pdf>

<http://ganjam.nic.in/BRGF-0708.pdf>

<http://en.wikipedia.org/wiki?curid=32863689>

<http://en.wikipedia.org/wiki?curid=39111182>