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CAGE CULTURE OF TILAPIA (*Oreochromis niloticus*) SUITABLE LIVELIHOOD OPTION FOR RURAL WOMEN IN BATIAGHATA

A thesis

By

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CAGE CULTURE OF TILAPIA (*Oreochromis niloticus*): SUITABLE LIVELIHOOD OPTION FOR RURAL WOMEN IN BATIAGHATA

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Declaration

CAGE CULTURE OF TILAPIA (*Oreochromis niloticus*): SUITABLE LIVELIHOOD OPTION FOR RURAL WOMEN IN BATIAGHATA

The results submitted in this thesis are entirely of the candidate's own investigations and no part of the results has been accepted for any degree, nor is it being concurrently submitted for any degree

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DEDICATED TO

MY BELOVED PARENTS

ACKNOWLEDGEMENT

It is my great pleasure for being able to complete the thesis for which I am completely indebted to the Creator of this Universe, the **ALMIGHTY ALLAH.**

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My heartiest thanks are to the CSJSA (Cereal Systems Initiatives in South Asia) project, WorldFish centre, which have piloted this project of cage culture. Here it can be mentioned that, CSISA-BD is funded by USAID and is a part of the US President's 'Feed the Future' initiative. Feed the Future and CSISA-BD are closely aligned with the Government of Bangladesh's recently approved Country Investment Plan which focuses on advances in farming systems, increasing farming productivity and cropping intensity to support improved income and nutrition for farm households and greater food security in Bangladesh (The WolrdFish Centre, 2009). My cordial thanks also goes to MD. Mijanur Rahman, officer, CSISA project, WorldFish centre, Khulna hub for his cordial support and help on preparing this thesis. I would also like to thank Ashok Boiragy, Hotalbunia village for his help and cooperation during my field survey.

I would like to express my deepest gratitude to my beloved parents and my family for standing all the way by my side during the preparation of the project theses.

Novemer, 2012

Aysha Naznin

Abstract

This study contains the history of an adaptive cage culture of monsex tilapia (*Oreochromis niloticus*) introduced by CSISA (Cereal Systems Initiatives in South Asia) project, WorldFish Centre, Khulna hub. The study area was Hotalbunia village in Batiaghata upazilla of Khulna district. CSISA project selected nine female members of this village as participants for this adaptive research. CSISA has provided all the economical and technical facilities for the adaptive research project. The project objectives of this adaptive research were to develop suitability of cages, stocking densities as well as to provide an alternative means of income generating activities by the poor families using open water resources. The project provided all the necessary research inputs including cage. Seed and feed. The research cages were set-up in the canal of Hotalbunia. The present study was carried out to determine the suitability of cage culture of Nile tilapia (*Oreochromis niloticus)* in the southern region and to observe the status and changes in the socioeconomic properties of the people of the study area. As the first trial cycle, the end output of the research was really hopeful. In spite of some constraints, this research has clearly demonstrated the economic profitability of cage culture as well as the acceptability of the technique by the poor female members of the community. A short survey within 30 families of the village was also conducted to draw the picture of their social condition and their view about this project.

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List of abbreviation and non-English word

BIDS	Bangladesh Institute of Development Studies
BFDC	Bangladesh Fisheries Development Corporation
CSJSA	Cereal Systems Initiatives in South Asia
DoF	Department of Fisheries
FAO	Food and Agricultural Organization
GO	Government Organization
NGO	Non Government Organization
UNICEF	United Nations International Children's Educational Fund

CHAPTER ONE

INTRODUCTION

Introduction

Tilapias are a group of 'cichlid' fish, native to African countries. In the early days of the 20th century, tilapias were wild fish in the great lake and rivers of that continent. In the central African countries, farming of tilapias in pond was introduced after Second World War. After that the tilapia species were spread over most of the tropical and sub-tropical of the world (Vannuccini, 1998).

Although the important natural tilapia genetic resources are in Africa, the major aquaculture industries at present are in Asia. Among tilapia, Mozambique tilapia (*Oreochromis mossambicus*) was the first species, which was introduced into Bangladesh from Thailand through UNICEF in 1954 (Gurrero, 2002). Overall performance of Nile tilapia and other fast growing tilapias have proved that they are capable of meeting the protein requirement of our vast population. Tilapias have come to be known as 'aquatic chicken'. It is a popular species for aquaculture especially in developing countries for consisting of attractive attributes. Such as- fast growth, tolerance to a wide range of environmental conditions (temperature, salinity, pH, low dissolve oxygen etc), resistance to stress and disease, short generation period, feeding on low tropic level and acceptance of artificial feeds immediately after yolk sack absorption. These characteristics have also proved tilapia as a very suitable species for cage culture (Shelton, 2002).

Cage culture is when fish are reared from fry to fingerling, fingerling to table size, or table size to marketable size while captive in an enclosed space that maintains the free exchange of water with the surrounding water body. A cage is enclosed on all sides with mesh netting made from synthetic material that can resist decomposition in water for a long period of time. Cages are generally small, ranging in freshwater reservoirs from 1 square meter (m^2) to 500 m^2. Several small cages combined in a battery, are suited for even intensive culture.

The production of fish in cages has been practiced for many years in various countries Worldwide. The earliest record of cage culture dated back to the late 1800s in Southeast Asia, since the similar culture practices have been reported in both freshwater and marine environments, including open-ocean, estuaries, lakes, reservoirs, ponds and river (Eng and tech, 2002).

Unlike pond culture, fish culture in cages is not a traditional technology in Bangladesh. It is a relatively new technology in Bangladesh though it has successful history in many other

countries in Asia. In Bangladesh, the Bangladesh Fisheries Development Corporation (BFDC) was the pioneer in experimental cage culture of Nile tilapia (*Oreochromis niloticus*) in kaptai lake, Rangamati in the 1980s (Flexi, 1987). However, no production data is available. Subsequently, CARE Bangladesh conducted grow-out traits of BFRI super GIFT strain in cages in the Meghna river lagoon area near Munsigong in the 1990s.

Cage culture practices have numerous advantages over other culture system. By integrating the cage culture system into the aquatic ecosystem, the carrying capacity per unit area is optimized because the free flow of current brings in water to get rid off of numerous metabolic wastes, excess feed and fecal matter (Beveridge, 1983).

Today cage culture is capturing more attention by both researchers and commercial producers. Factors such as increasing consumption of fish, some declining wild fish stocks and a poor farm economy have produced a strong interest in fish production in cages. Moreover, cage culture is a suitable method as alternative livelihood or as the source of cheap animal protein for landless people.

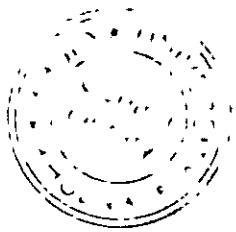
In our country, a large number of people are landless or do not possess enough land for aquaculture. Those who have access in open water like lake, beel, canal, and river etc can practice cage fish culture as a mean of alternative livelihood.

The present study was an adaptive research of WorldFish centre on the suitability of cage culture of Nile tilapia (*Oreochromis niloticus)* in the southern region of Bangladesh.

Objective

- ✓ To determine the suitability of cage culture of monosex tilapia (*Oreochomis niloticus*) in the canal of village Hotalbunia at Batiaghata upazila and to observe the livelihood status and socioeconomic properties of the people of the study area.

CHAPTER TWO



LITERATURE REVIEW

Review of literature

Cage fish culture involves the rearing of fish in a structure enclosed on all or all but the top sides by wooden, mesh or net screens, whilst maintaining a free movement of water (Beveridge, 1996). This practice of rearing fish in cages can be applied in existing bodies of water that cannot be drained or seined and would other- wise not be suitable for aqua-culture. These include lakes, large reservoirs, farm ponds, rivers, cooling water discharge canals, estuaries and coastal embayment.

According to the Fishery Statistical Yearbook of Bangladesh (DoF 2009), tilapia production in Bangladesh was about 66,767 tons in 2007. During 1999 to 2007, there was a tremendous progress in tilapia farming in this country. Production increased from 2,140 tons in 1999 to 66,767 tons in 2007. Due to the rapid expansion of hatcheries producing monosex all male seed, and farms within a span of 2 years (2005-2007), tilapia production increased more than three folds in Bangladesh.

Annual report of Dof 2010 shows, Tilapia contributes about 6.64% of total aquaculture production in Bangladesh (DoF, 2010).

M. G. Hussain (2009) studied about the cage culture of tilapia in Dhakatia River near Chandpur and Munshiganj region. He showed the stocking density and production of cage culture. In their operation, the stocking density varied from 200-350 fish/m3. After 8-9 months of culture, production ranged from 120 to 190 kg/m3, whereas the feed conversion ratio was around 2.00.

Food and Agriculture Organization of the United Nations (FAO) on the report of global status of cage culture in 2006, reviews the history of freshwater cage culture in sub-Saharan Africa3, highlights working examples in the region (specifically in Ghana, Kenya, Malawi, Uganda, Zambia and Zimbabwe), identifies problems facing the development of the industry and makes recommendations as to the way forward.

Guerrero (2002) found that, in Indonesia and Thailand, cage culture of *O. niloticus* and Red tilapias in rivers, irrigation canals and lakes/reservoirs and using the semi-intensive and intensive methods are practiced. Tilapia cage culture in Indonesia is mostly found in West Java, Jambi, South Sumatra and Kalimantan.

Jamu (2001) reported that cage culture systems which exist as pilot or fully operational especially in Southern and West Africa have not significantly contributed to actual tilapia production. However, a few have become successful in their cage culture operations and the largest is found in Northern Zimbabwe.

In terms of pond yields, Dey (2001) reported that overall, the average yield of pond farming in Taiwan is very high (12 to 17mt/ha) while ponds in Bangladesh, China, the Philippines, Thailand and Vietnam produce around 1.7, 6.6., 3.0, 6.3 and 3.0mt/ha, respectively.

Guerrero (2001) however claimed that in Philippines, the semi-intensive culture of *O. niloticus* in earthen ponds (0.25-1 ha, 1 meter depth) yields 4-8 mt (average size of 150-250g) per crop in 3-4 months with 80-90% survival.

Fitzsimmons (2001) and Alceste and Jory (2002) reported that, at an average salinity of 17ppt and a stocking density of 0.2fish/m2, the farmers have increased the gross profitability of each production unit by over US$ 6.00 per day per hectare, in a 120 day-cycle.

DOF annual report 2010 shows that, cage aquaculture has been identified as a means of livelihoods for landless people (DoF, 2010). Northwest fisheries extension project (NFEP) in Parbatipur, Dinajpur and Patuakhali-Barguna Aquaculture Extension Project (PBAEP) demonstrated cage aquaculture as pilot basis. The production achieved through cage culture was encouraging and satisfactory but the activities were discontinued due to socio-economic of the farmer and some constraints. It is also reported that, recently cage culture of monosex tilapia is being practiced in Laxmipur and proved commercially viable. There exists tremendous opportunities for expanding commercial cage culture in tide water of bay and tributaries throughout the country.

CHAPTER THREE

MATERIALS & METHODS

Results and discussion

In case of Cage 8 and cage 9, the culture procedure was interrupted due to some problems. If the data of new stock were included to the final report, the overall data would loss the continuity. So, during the final analysis, the data of cage-8 and cage-9 were omitted.

Size of the cage : 3m X 2m X 1.5m

Fry size : 3 inch

Initial weight : 5.55 gm/ piece (average)

Price/piece fry : 2.5 taka

Water pH : 8

Salinity : 0.0 ppt

Temperature : 32°C

Table 2: Mean weight, survival, harvesting weight, FCR and production of tilapia in different cages.

Cage	Fry in initial stock	Mean initial wt (gm)	Mean harvesting Wt (gm)	Survival (%)	FCR	Total production (kg)
Cage-1	3200	5.5 ±0.25	178.5	89.06	1.40	289.87[a]
Cage-2	3200	5.5 ±.26	110.65	87.5	2.25	275[a]
Cage-3	3200	5.5 ±.30	134.56	88.2	1.86	239[a]
Cage-4	2500	5.55 ±25	128.78	88	1.70	187.79[b]
Cage-5	2000	5.55 ±20	145.7	90.23	1.37	172[c]
Cage-6	2000	5.55 ±25	120.6	89.8	1.65	175.5[c]
Cage-7	2500	5.5 ±.30	178	86.7	1.23	170[b]

a, b, c superscripts indicate that there is no significant difference between the same superscripts but there is significant difference between different superscripts.

The highest survival rate (90.23%) was found in cage-5, which initial stock was 2500 fry. Lowest survival rate (86.7%) was found in cage-7, which initial stock was also 2500 fry. It is possible that, stocking density may have an effect on survival rate. Over crowded stock in cage may lead to higher rate of fry mortality (El- Sayed, A.M., 2002). But in case of this study, the highest and lowest survival was found in same stocking density. This difference might happen due to the different quality or health condition of fry. One way ANOVA test

3.4 Fish sampling

Sampling was done at 15 days (2 weeks) interval and random samples of 20 fish were collected by seine net from each cage to assess the growth and health condition for calculating growth performance and feed adjustment.

3.5 Questionnaire survey

To collect data on various aspects of socio economic status and alternative livelihood of the selected area, questionnaire preparation is crucial important. Before the final questionnaire, a draft questionnaire was prepared keeping in view the specific objectives of the study. Then the final questionnaire was developed in logical sequences, so that the people can answer chronologically.

3.6 Indicator used

3.6.1 For the cage culture:

To achieve more precise data, the following indicators were used to analyze the suitability of cage culture of monosex tilapia at the study area.

- Weight
- Length
- Stocking density
- Feeding rate and feeding frequency
- Temperature
- pH
- Salinity

The salinity of the selected water-body changes slightly during December. Normally, the water is fresh water, but due to having a connection with nearby river, the salinity starts to increase in at the beginning of winter season. This may have an effect on the growth of tilapia. So, salinity was also used as an indicator.

3.6.2 For livelihood status of the farmers:

To capture the real image of the livelihood and socio-economic condition of the cage farmers, the following parameters were collected.

- Family type
- Family size
- Educational status
- School going children
- Family condition
- Housing condition
- Ownership of livestock and poultry
- Main occupation
- Food and nutrition intake
- Association with organization
- Sanitation status
- Pre experience related this type of culture:
- View of their neighbors: willingness to get involved

3.7 Data collection

In order to fulfill the objectives of the study, relevant information were collected from the CSISA (Cereal Systems Initiatives in South Asia) project, Worldfish centre, Khulna hub. Data about the research were assembled through field survey at the area on fortnightly basis by using a structural monitoring report sheet. Livelihood data were collected by a structural questionnaire and taking interview with the nine farmer and their other family members.

3.8 Analysis and calculation of experimental data

The collected information from the survey then were accumulated, grouped and interpreted according to the objective as well as parameters. Some data were contained numeric and some containing narrative facts. Data were analyzed using the statistical package SPSS, MS excel. ANOVA was performed on all the dependent variables to find out whether stocking density had any significant effect on growth. The data were then presented in graphs and tabular forms.

3.9 Preparation of the cages:

Materials:

- Black nylon net for fish culture (mesh size:0.5 inch)
- G.I. pipe for the box like structure of the cage
- Bamboo
- Plastic cord
- Small mesh size net

Total construction cost for each cage: 4500 TK.

3.10 Installation of cage:

Constructed cages were installed in the selected khal (canal) keeping the top edge 1 feet above water. The top cover facilitates with the opportunity to open up for collecting sample fish. Bamboo poles placed into the bottom of the water body were tied with the 4 edges of the cage to support them during current flow and to keep them up from the bottom. Top side of the cages was also supported with net cover to protect the fish from jumping out and the predator birds. Small mesh size net was used as side covers for 1st one month to prevent the washing out of small pellet starter-2 feed.

3.11 Stocking of hatchery produced fry in the cages:

Monosex tilapia (Oreochromis niloticus) fry were collected from nearby hatchery and released to the cages early in the morning. Three types of stocking density were maintained to observe that which density shows the most growth rate of the fish.

Serial no	Name of the farmer	No of fry stocked
1	Gurudasi Boiragi	3200
2	Madhuri Roy	3200
3	Bijoli Mistry	3200
4	Anaroti Boiragi	2500
5	Amori Sarkar	2000
6	Shikha Boiragi	2000
7	Shyamoli Roy	2500
8	Ratna Sarkar	2000
9	Kakoli	2500

Table-1: Initial fish stocking density of the culture cages

3.12 Feed and feeding:

Feeding was done with floating pellet feed containing 30% crude protein @ 4-10% of body weight. First one month, feed was given twice a day. During this period, starter-2 fish feed were given. After 1 month, grower feed were given 2/3 times per day for faster growth performance. 15 days before harvesting, finisher pellet feed were given for better weight gain. However, feeding rate was observed and maintained as per fishes' feed intake frequency and appetite. Feeding rate was comparatively lower during the winter season.

3.13 Harvesting after culture period:

After 120 days of rearing, the fish were harvested from all the cages. Primarily the harvesting of fish was performed by repeated netting using a seine net and final harvesting was done by lifting up the cages. During harvest, all fishes were counted and weighed from each cage to assess the survival rate and production.

CHAPTER FOUR

RESULTS & DISCUSSION

Methodology

3.1 Selection of the study area

Hotalbunia is a village at Batiaghata in the southern region of Khulna district. The wide canal which salinity level fluctuates is the experiment spot for the study. The area represents different degree of social aspects. Moreover, no other study has done yet about the cage culture system in this area. So it was logical to select this area as "study area." The experimental research was conducted for a period of fourteen weeks (4 months) from September 2011- December 2011.

3.2 Target group

The target group of this research project was the rural women. A total of nine (9) women were given with cages from the project and involved with rearing of tilapia (monosex) in cages. These women are housewives. Their families live almost below the poverty line. They have the problems of empowerment in the family. Two of them are widowed. is this situation, introduction of cage aquaculture among them and provide them all the facilities to carry out the project is a very timely idea.

3.3 Field survey and observation

- For the collection of data, several field surveys were conducted on fortnightly basis.
- The weight and length of fish were measured regularly using weight balance and scale.
- For calculating average length and weight of the fish, 20 fish were selected randomly from the stock of each cage on every single survey.
- Water-quality of the water-body where cages have been set-up was collected by using thermometer, pH meter and salinity meter.
- Various aspects of livelihood issue, field surveys were made in the several families through questioner.

results clearly indicate that there is significant difference ($P = 0.009 < 0.05$) in total production between different treatments (at 3 different stocking densities) at 5% level of significance.

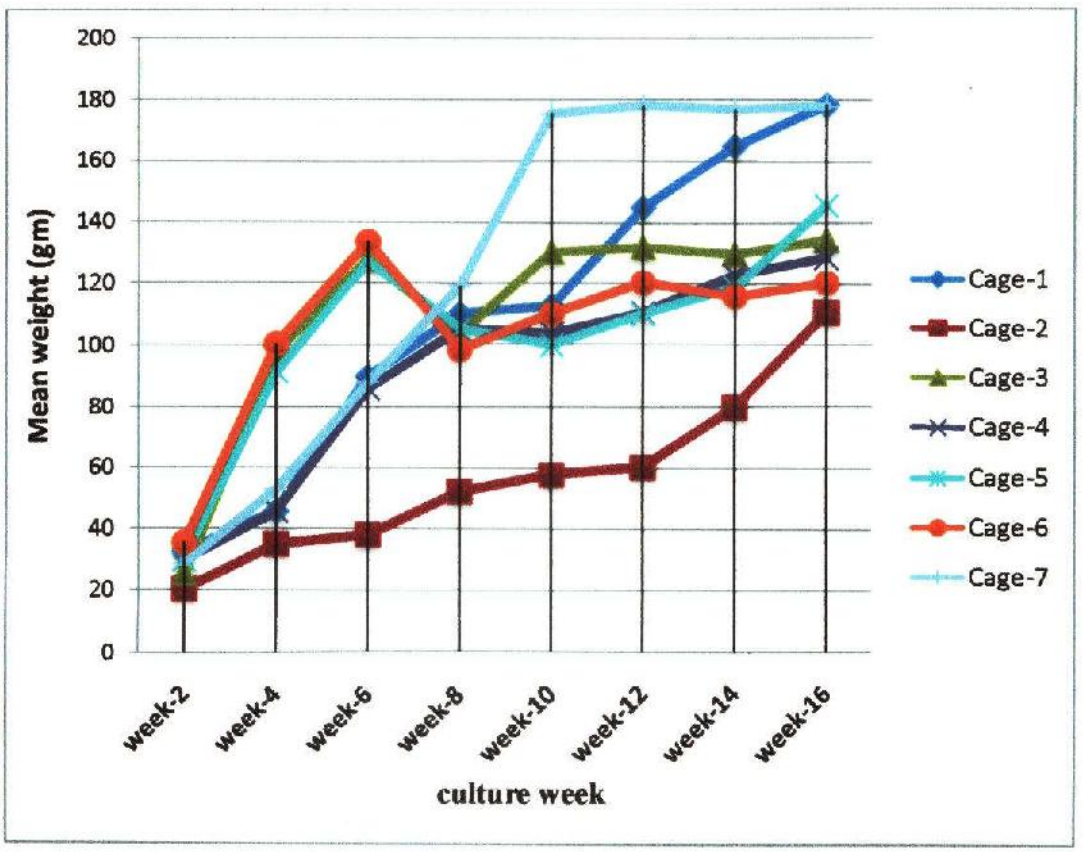


Figure-1: Mean weight gain of monosex tilapia in different cages.

The highest harvesting weight was recorded 178.5 gm in an average. On the other hand, the mean lowest harvesting weight was found 110.65 gm. The cause of the lower growth rate may be the lower FCR and lack of monitoring of feeding. Past studies showed, growth of the hybrid tilapia is10-29% faster than Mozambique tilapia and Nile tilapia, respectively (Lai, 2003). However, in cage culture, Nile tilapia can gain up to 300-350 gm in intensive culture (Li, S.F, Li, C.H. and Li, J.L. 1998).

Highest output:

Highest output was gained from cage-1, farmer name is Gurudashi Boiragi. The input cost was 13000tk and the return was 17500tk. Net benefit was 3500/-

Lowest output:

The lowest benefit came out from cage-3, farmer name is Bijoli Mistry. The growth performance of the fishes of this cage was satisfactory. But there were lack of uniformities of growth among the stock and, the mortality was also high in this cage. So, it resulted the lowest benefit of taka 800/- from the total of taka 14300.

4.1 Cage-wise growth performance data:

Individual cage-wise mean weight and length changes of tilapia are graphically presented below:

Cage-1: Gurudasi Boiragy

The average weight and length gain of the fishes of this cage was kind of satisfactory. The maximum average weight was recorded 178.5 gm and the length was 21 cm at the end of the culture period.

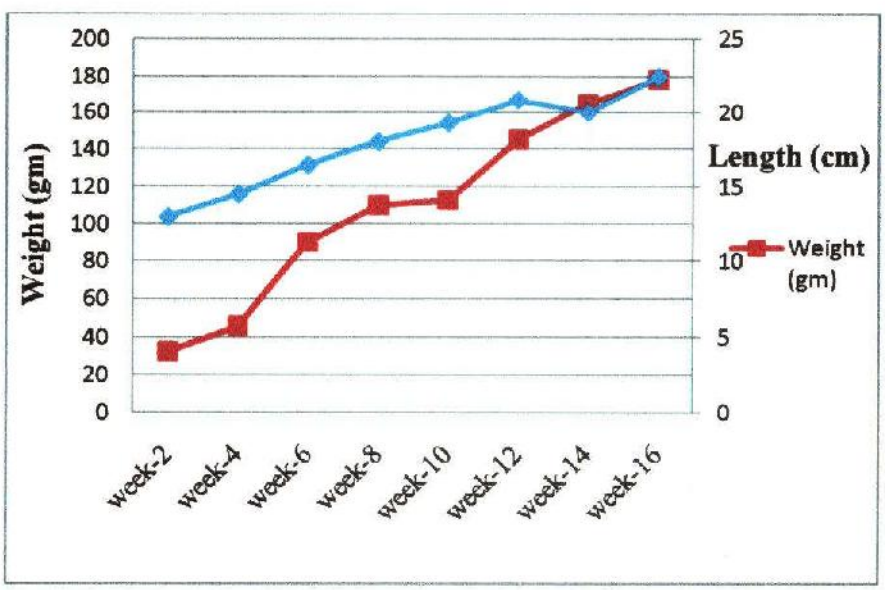


Fig-2: Average length and weight gain of the fishes of cage-1

Cage-2: Madhury Roy

The growth of the fishes of this cage was comparatively lower than the cage-1. The highest average weight was recorded as 110gm and average length 20 cm.

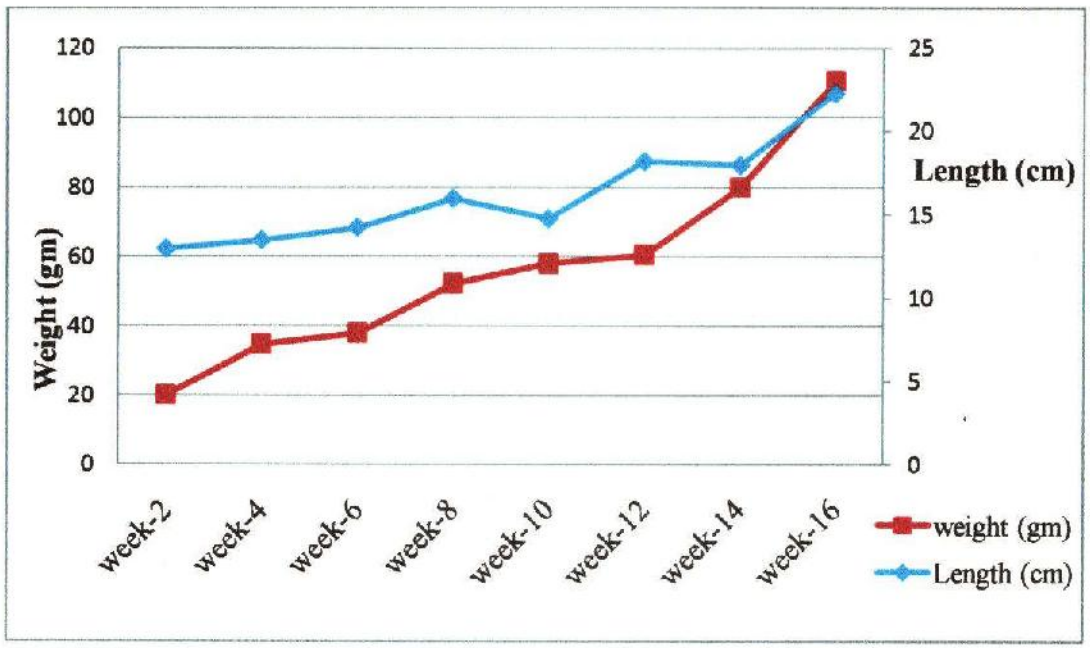


Fig-3: Average length and weight gain of the fishes of cage-2

Cage-3: Bijoli Mistry

The highest average length was found 18.7 cm and weight was 134.2 gm. Fluctuation of average weight and length is found here. One of the causes of this may be the random selection of sample fish.

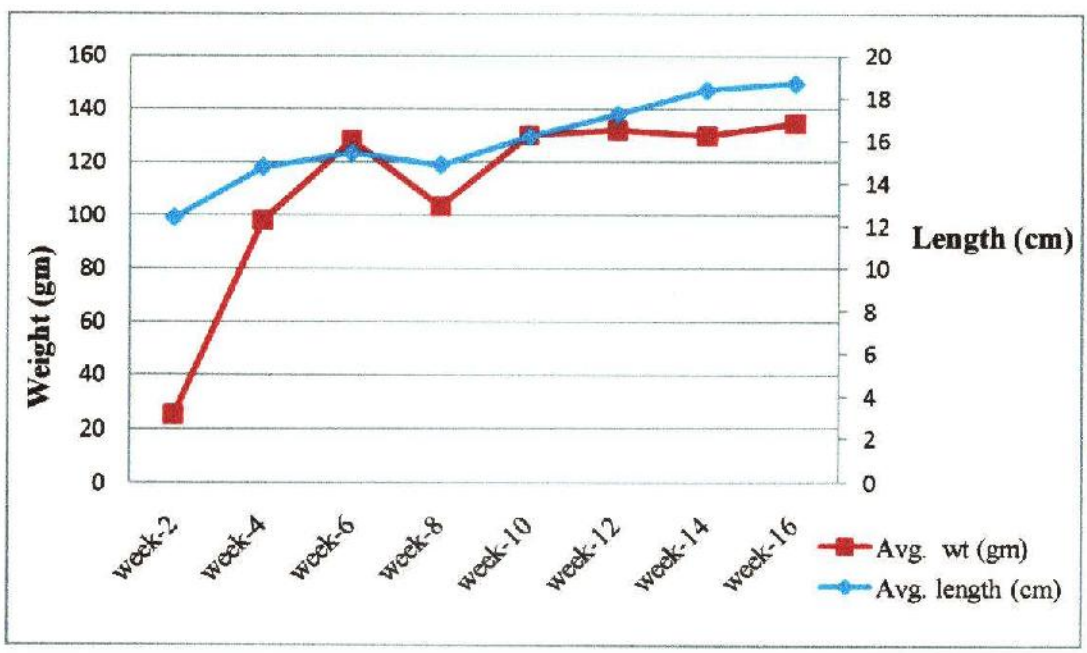


Fig4: Average length and weight gain of the fishes of cage-3

Cage-4: Anaroti Boirgi

The highest average weight at the end of the culture period was 128.78 gm and length was 21.5 cm. shown in figure-5.

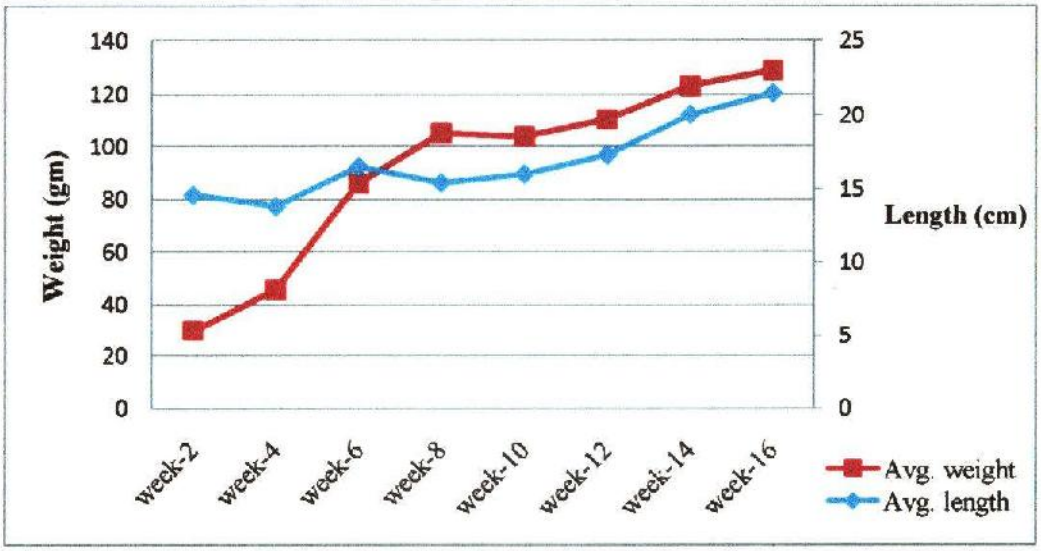


Fig-5: Average length and weight gain of the fishes of cage-4

Cage-5: Amori Sarkar

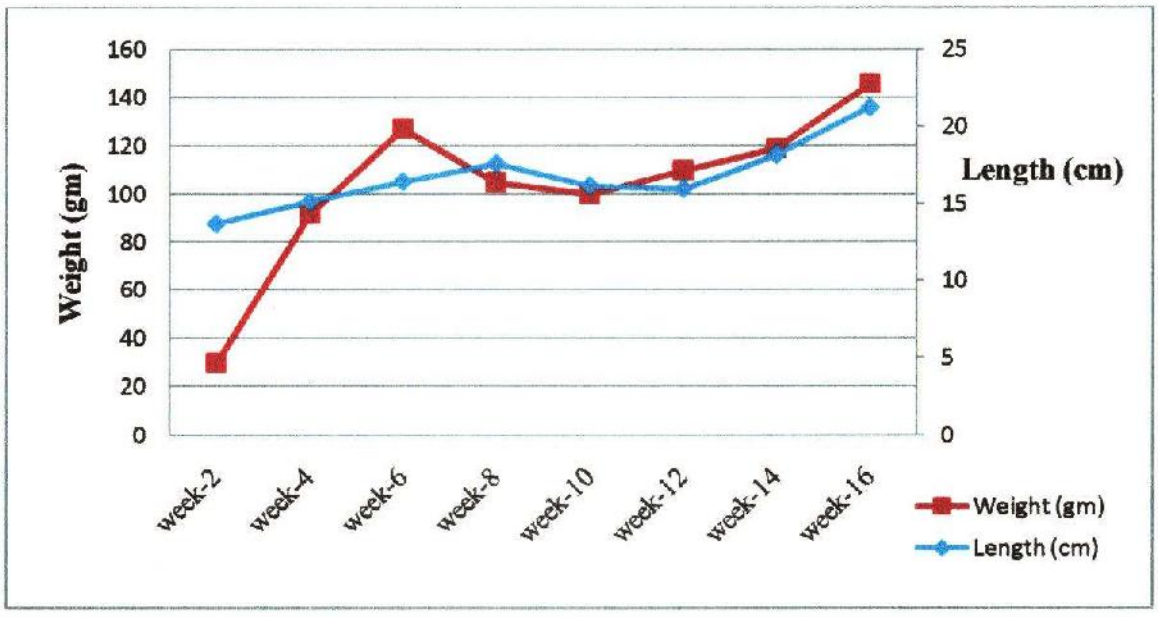


Fig-6: Average length and weight gain of the fishes of cage-5

Fig-6 demonstrates the average wt-length gain data of fishes of cage-5. The highest obtained weight was 145 grams from the beginning of the culture period.

Cage-6: Shikha Boiragy

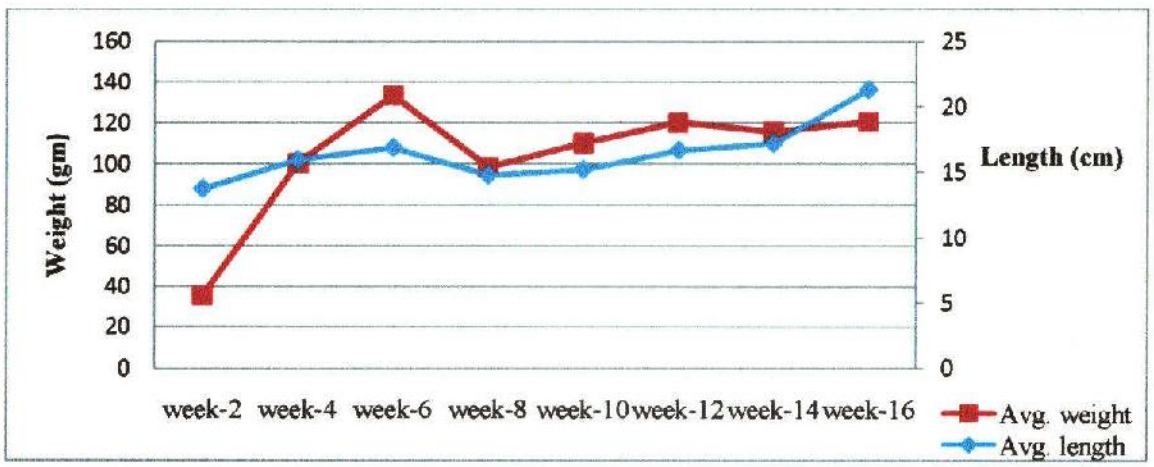


Fig-7: Average length and weight gain of the fishes of cage-6

Figure-7 shows the highest average length as 21cm and the highest average weight as 121 grams. Fluctuation in weight data was caused due to poor growth of some fish randomly selected for sampling.

Cage-7: Shyamoli Roy

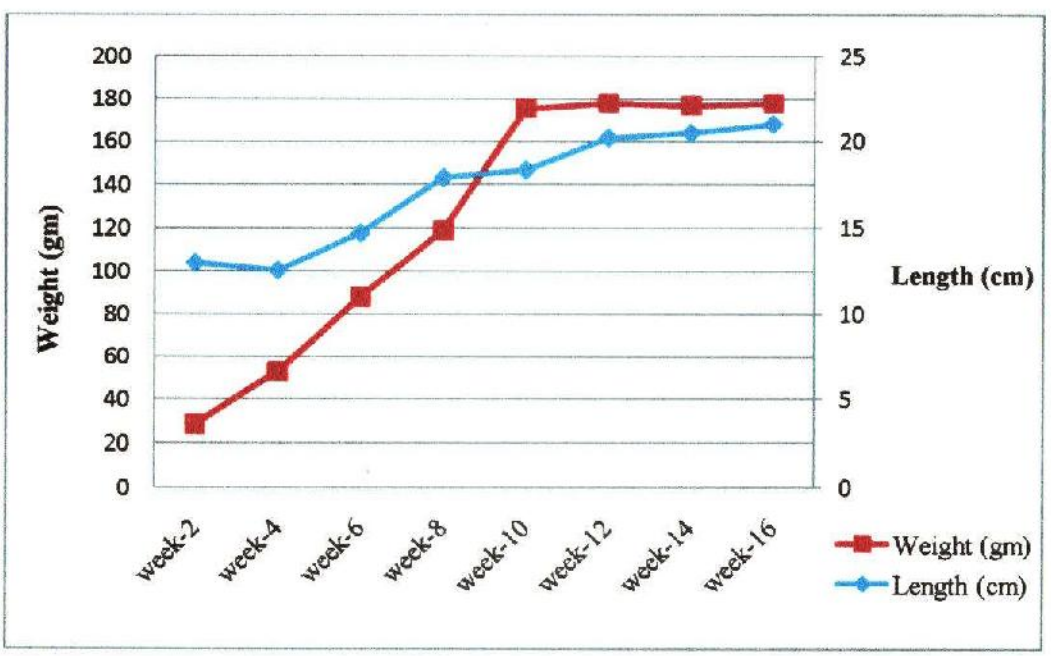


Fig-8: Average length and weight gain of the fishes of cage-7

4.2 Water quality:

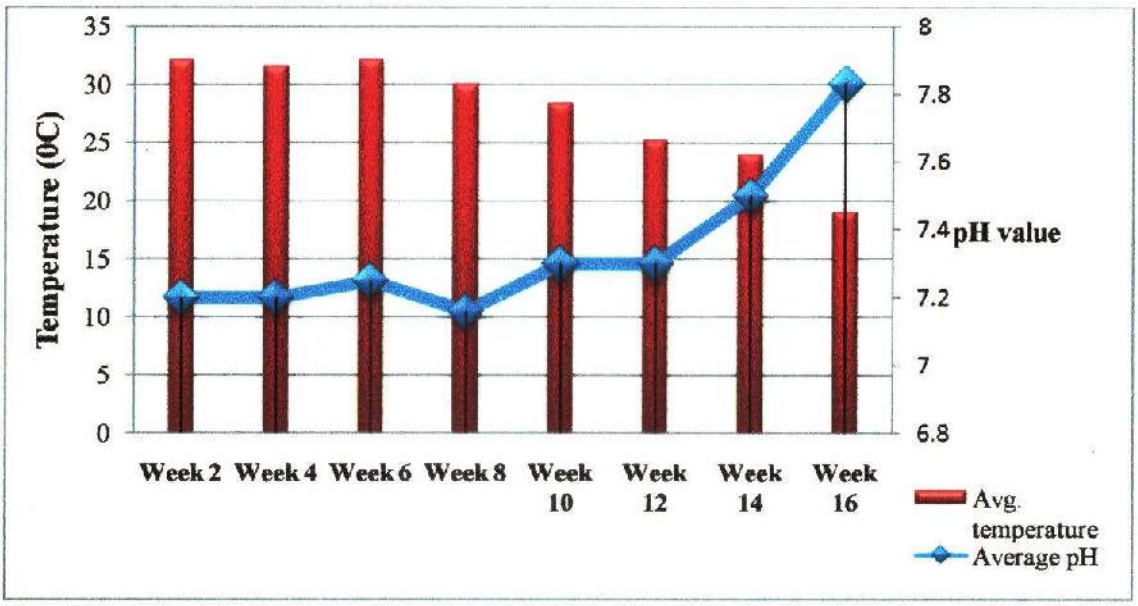


Figure-9: Change of average water temperature and pH with time

Figure-9 shows the change of water pH of the culture water body and the change of water temperature with time. At the time of beginning of the culture, the water temperature was recorded 32°C and at the end, it was found 19°C at an average. The initial pH value at 32°C temperature was recorded 7.2. At the last session, at 19°C temperature, it was found as 7.83. So, no significant change in pH level was found during the culture period. Here it can be mentioned that, this unchanged pH value is an advantage of cage culture. The access of free flow of water inside the cages allows the fecal matters to wash out and thus the ammonia and other toxic materials do not accumulate and the water quality remains stable.

Change in water temperature was due to the upcoming winter season and it was natural. No sudden change in temperature was found.

4.3 Socioeconomic issue:

It was a short survey to find out the basic livelihood condition and the view about this adaptive cage culture of the people of the study area. It was conducted among 30 families within the neighborhood of the nine (9) female who were selected as the beneficiaries for the cage culture. Almost all of them are Hindus. Only a few Muslim families live in the village. The findings of the survey are graphically presented below:

4.3.1 Family condition

In the present study, a family was defined as the total number of person living together and taking meals from the same kitchen. The family is considered as a unit for income, generation, reproduction and social interaction.

4.3.2 Family type

In rural Bangladesh, families are classified into two types:

1. Nuclear family- married couples with children.
2. Joint family-group of people related by blood or by law.

In the study area, it was found that 64% lived with joint families and 36% lived with nuclear families.

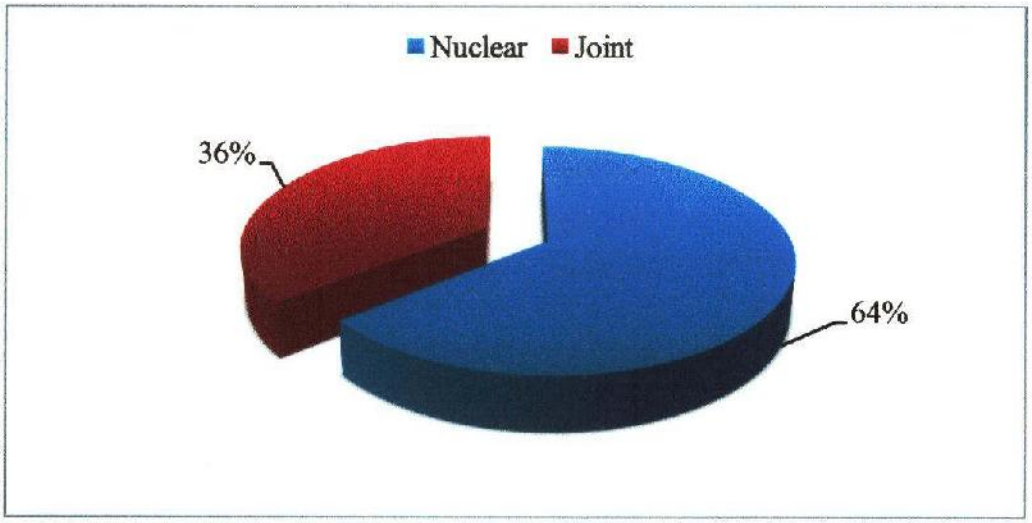


Fig-10: Family type.

4.3.3 Family size

Information was collected on the family size of the people. The highest percentage obtained in the 7-8 members' family (47.67%) . the lowest percentage was obtained in the 1-2 members family (1.27%). 6% people lived in 3-4 members family, 30.06% people lived in 5-6 members in a family. 15% people lived in more than 8 members family.

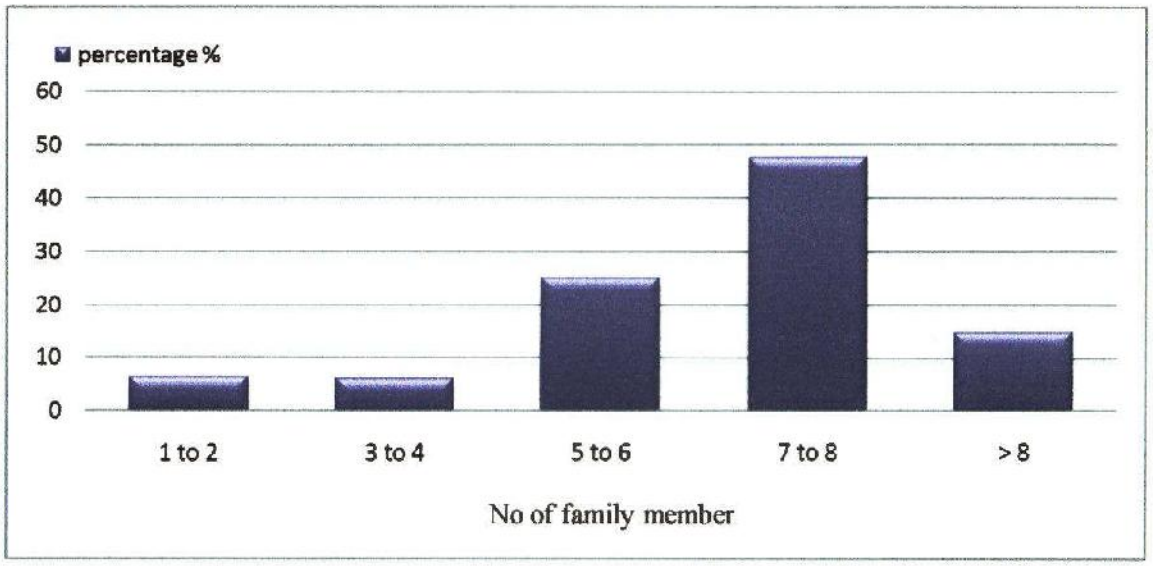


Fig-11: Family size.

4.3.4 Educational status

Most of the people were illiterate. However, ability of signing was considered as literate and such percentage (36%) was greater than other was. There were minimum people who had passed S.S.C.-H.S.C. (12%), 16% had passed 6-10. Literacy rate was evidently max in the village Hotalbunia.

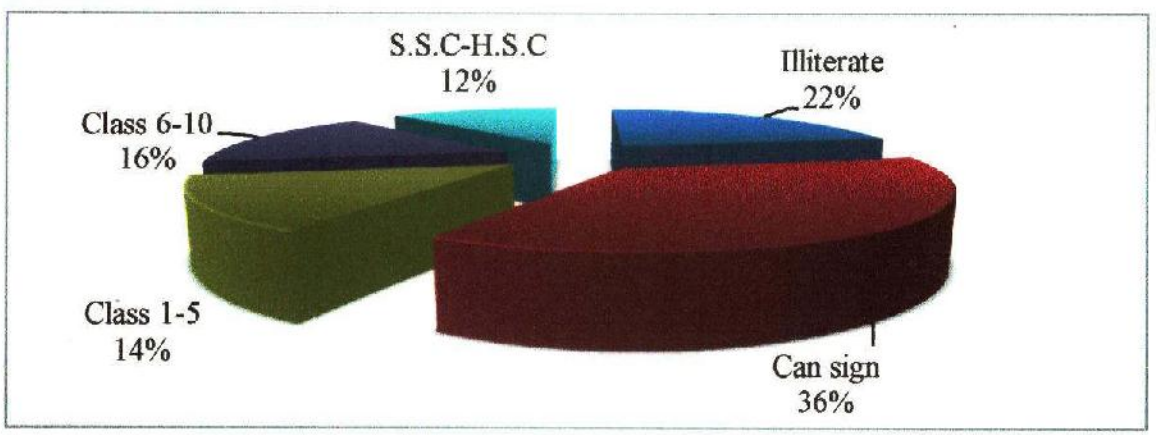


Fig-12: Educational status.

4.3.5 School going children

It has been found that the maximum children going to school. The findings of the survey showed that out of total school going children 54% were boys and 46% were girls.

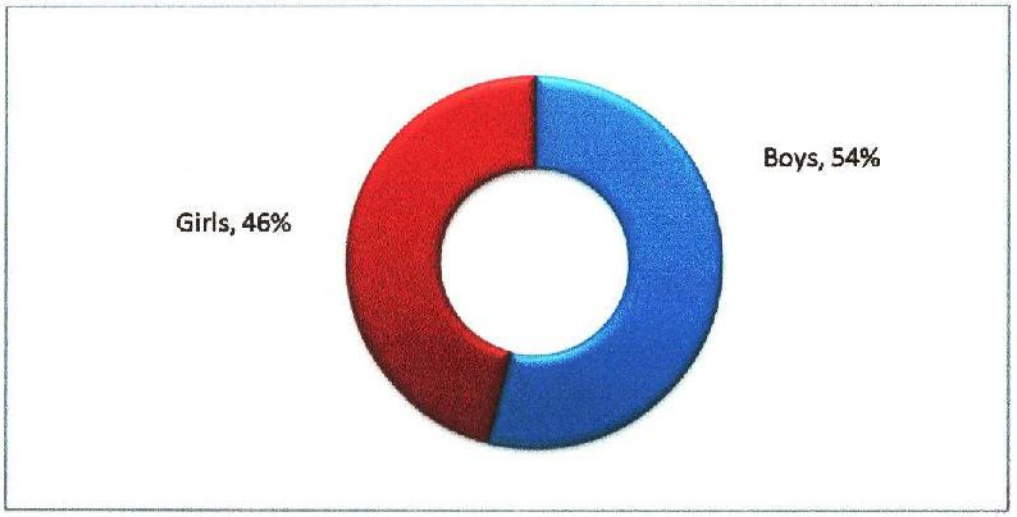


Fig-13: School going children.

4.3.6 Housing condition

During the survey, attempts were made to find out the condition of living house of the people. It was found that 68% lives in kactha house, 26% lives in semi pacca house and 6% lives in pacca house.

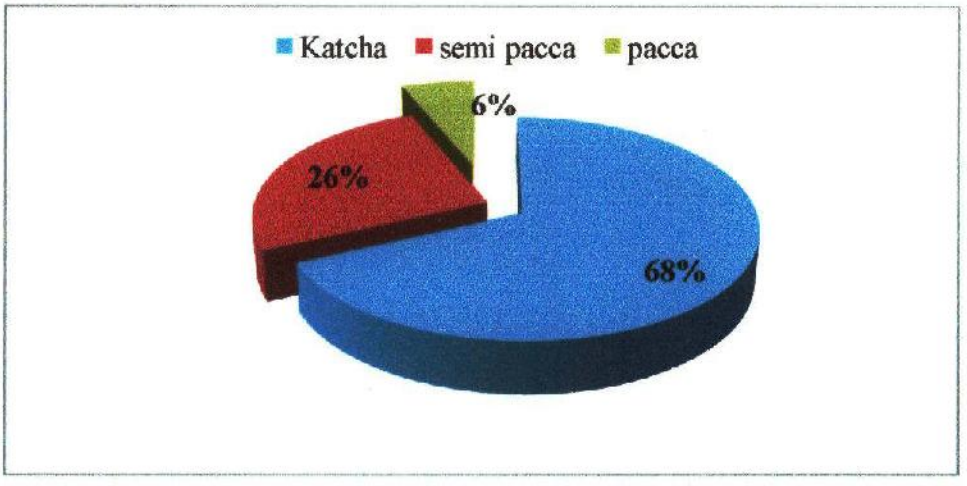


Fig-14: Housing condition

4.3.7 Main occupation

Occupation is defined as the activity that the people pursue for earning their living. As the survey focused that, agriculture was their main or primary occupation. From the fig-13 , it was revealed that the main occupation of 41% people were farmer, while 22% were van pooler, 15% gher labor, 12% were involved with business, 7% had government and non government jobs and 2% were student.

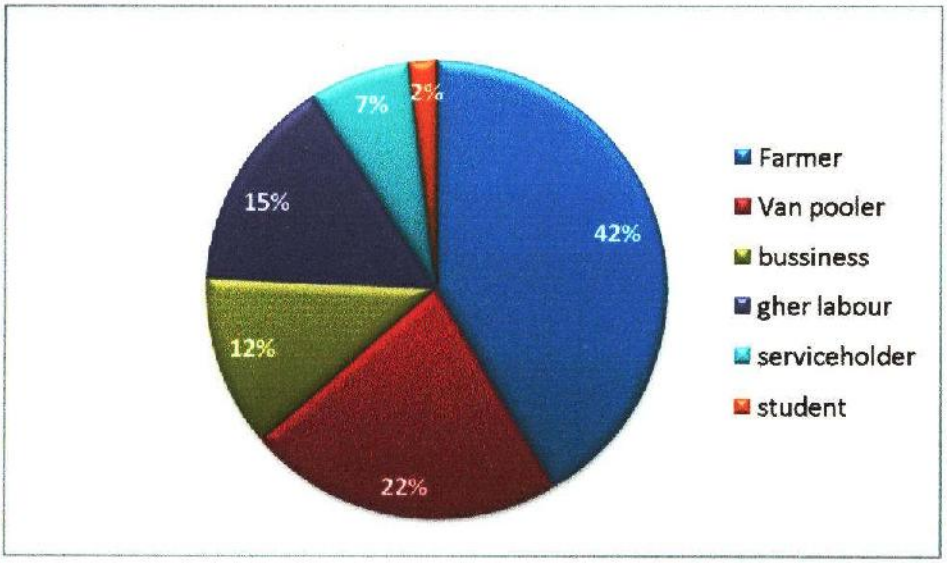


Fig-15: main occupation

4.3.8 Ownership of livestock and poultry

The study showed an encouraging picture regarding ownership and observed rearing of livestock and poultry by their households. Most of the families had cow and poultry in their possession. The study raveled that there were (64%) who had possessed cow in their possession. The (24%) possessed goat, (10%) possessed duck/hen and the rest 1 household (2%) possessed pig in their possession.

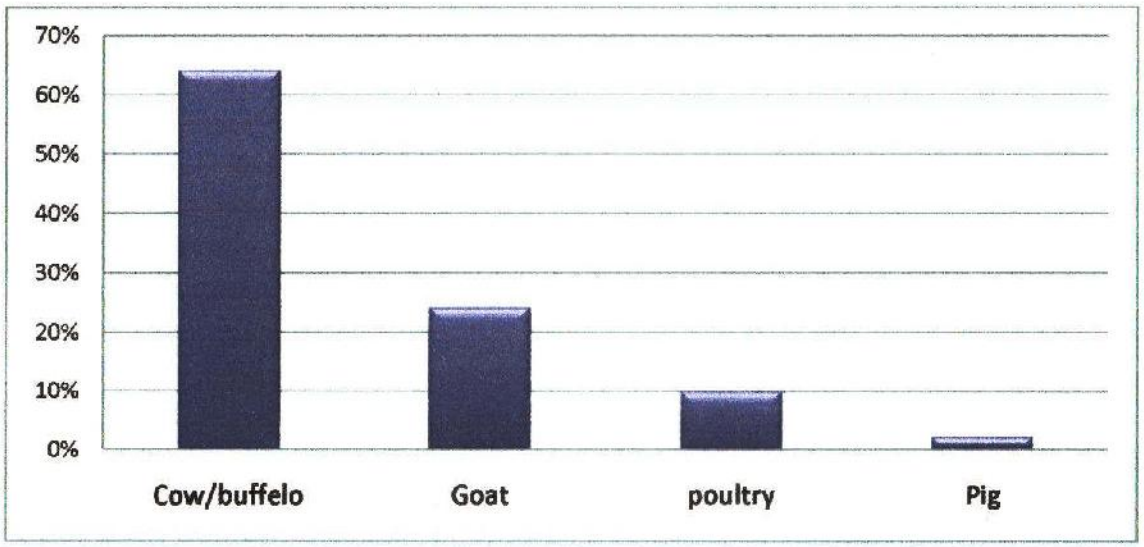


Fig-16: Ownership of livestock and poultry

4.3.9 Food and nutrition intake

It was attempted to collect information on extent of food and nutrition intake which for socio-economic assessment of the people, heath in particular. Investigation was carried out on intake of some major food item like fish,, meat, vegetable, dal, milk and egg. It was recorded that 63% people intake fish in their meal and other food items dal (12%), vegetable 14%, meat 5%, egg 4% and milk only 2%.

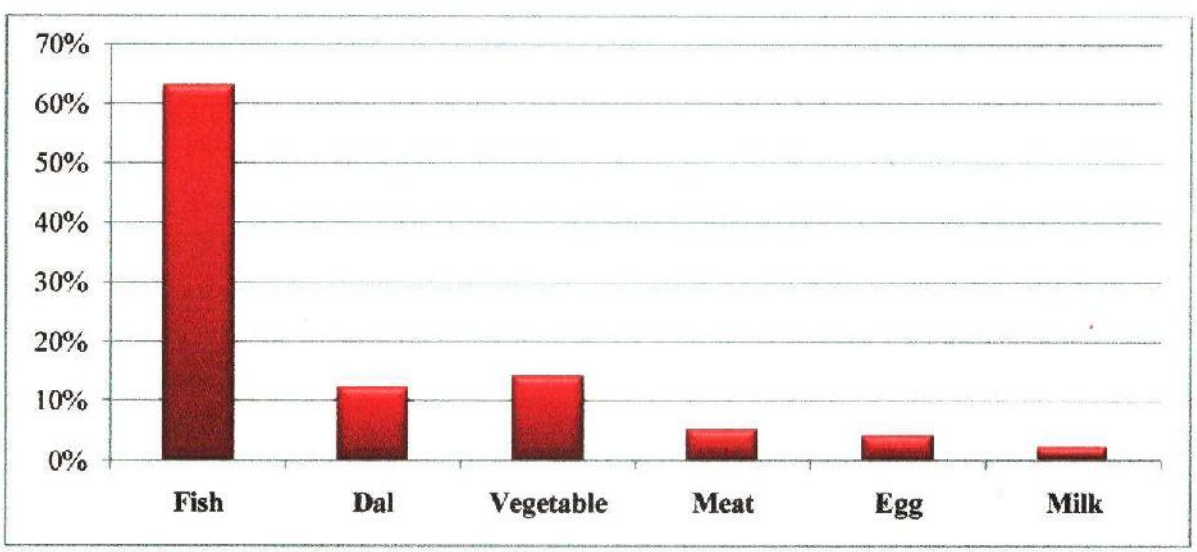


Fig-17: Food and nutrition intake.

4.3.10 Sanitation status

The sanitation status found poor in most cases. The finding of the survey revealed that on the average 21 (42%) households used closed pit latrines, 15 households (30%) used katcha latrines, 11 households (22%) used sanitary latrines and the rest 3 households (6%) used open hole.

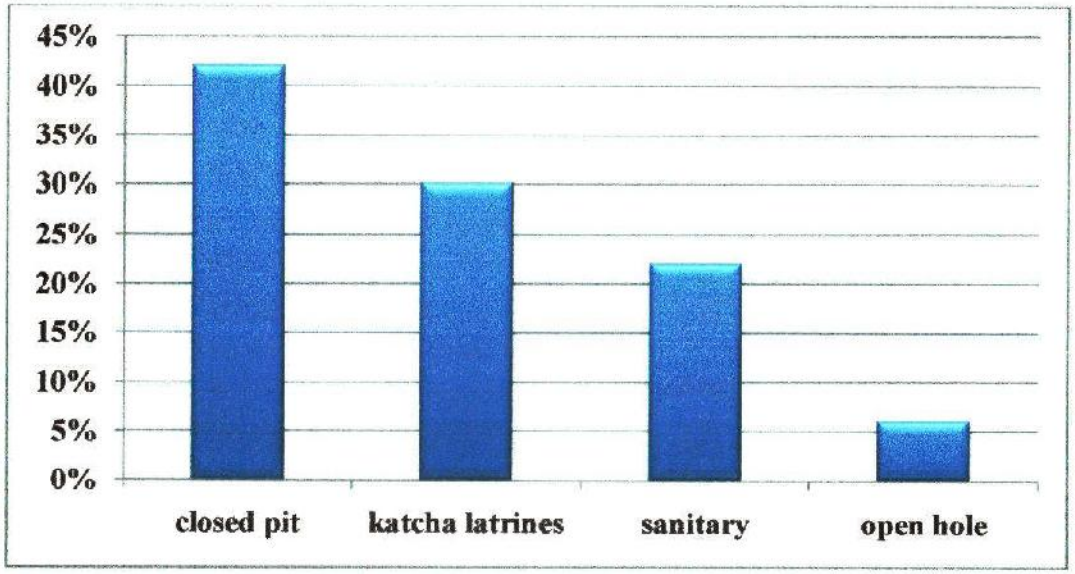


Fig-18: Sanitation status of the people.

4.3.11 Association with organization

From the survey, it was found that amongst the involved women, about 44% female associated with somity, 35% female with NGOs and rest 26% with bank. Mainly ASSA, Prosika, BRAC NGO, Grameen Bank provide load to them.

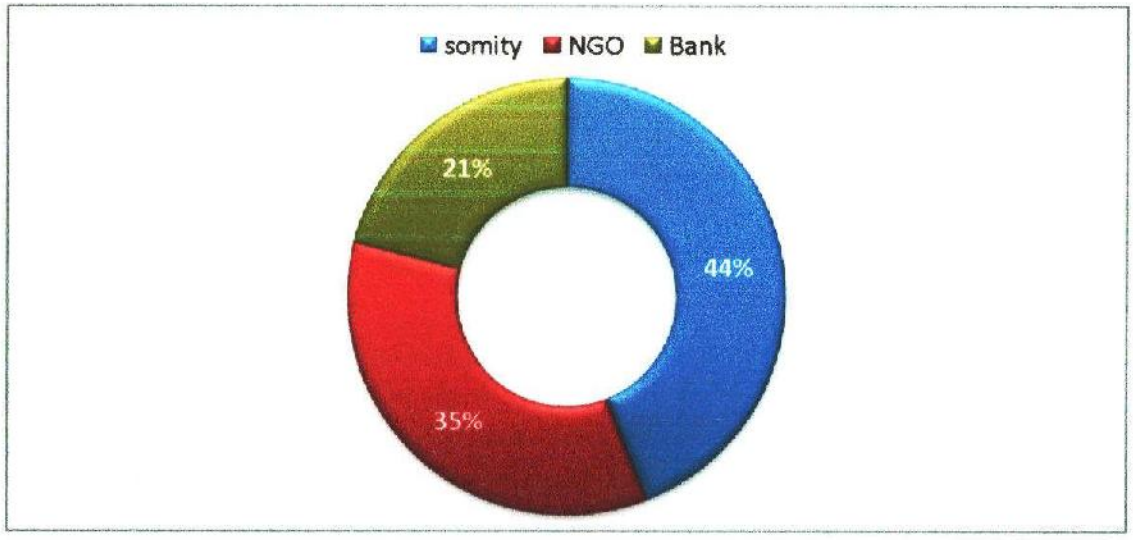


Fig-19: Association with organization.

4.3.12 Pre experience about cage culture system

95% of them had never involved with this type of cage culture, they are familiar with hatchery activity and gher culture. Only approximate 5% of them have heard about cage culture. However, a 3 days' workshop was conducted by CSISA to give them basic knowledge about this cage culture.

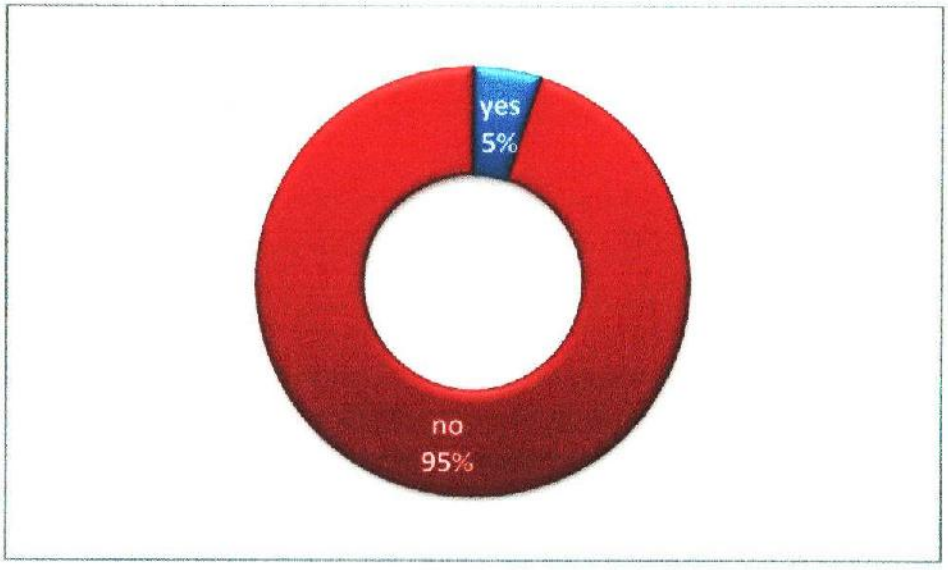


Fig-20: Pre experience related this type of culture

4.3.13 View of their neighbors: willingness to get involved

Most of the participant was positive about the cage culture. Almost 70% of them think that, they may get involved if they are provided enough economical and technical facilities. 15% of them answered that, they are actually worried about the benefit. They were hopeful but wanted to wait for the result of the ongoing culture. They said, if the result comes out positive, they may get involved. However, some of them showed no interest about such kind of work.

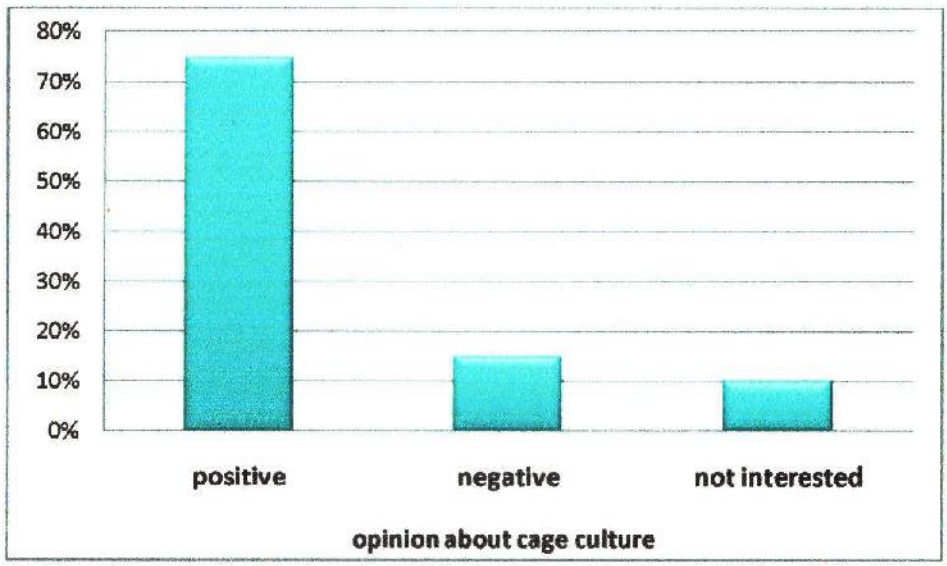


Fig-21: View of their neighbors: willingness to get involved

CHAPTER FIVE

PROBLEMS AND RECOMMENDATIONS

Problems and recommendation

Though the result of the adaptive research cage culture of tilapia was not very satisfactory, but it was hopeful. However, there were some problems. Such as-

- Inadequate knowledge of biological, technical and environmental factors of tilapia culture among the farmers.
- It was only the starter cycle. So the farmers were not expert about the overall culture procedure.
- Technical and economical support was given by the project, but there were some problems in feeding and other maintenance.
- The fry quality was not very good; it's also a reason for poor yield. Moreover, the price was also high.

Other socio-economic problems:

- Lack of knowledge about the benefits of culture fishery instead of capture.
- Lack of technical knowledge about the livestock and poultry farming.
- Maximum families are conscious about their children and their schooling. However, many of them are not able to send their children due to unavailability of money
- Lack or shortage of funds and technical assistance to promote any self employing activities.
- The continuous increase in the cost of cage culture material such as feed, fertilize, fingerlings, cage construction materials etc. is also a reason for lack of interest of the poor people.
- Poor extension programs in the rural areas where the cage culture of tilapia is expected to expand.

Recommendation:

- After the completion of one cycle of the culture, the farmers have already gained some practical knowledge and experience. Now, it is necessary to arrange extension programs to make them more fit for the management of cage culture.
- Technical and fund raising facilities should be given to poor people.
- Various types of demonstration activities should be launched to draw the attention of people and make them interested about the cage aquaculture.

- NGO's can provide low cost fry, feed, fertilizer and cage construction materials to increase the practice of cage culture.
- It is necessary to make the people aware about the high nutritional value of tilapia and relatively low cost to meet their protein requirements.

CHAPTER SIX

CONCLUSION

Conclusion

In the recent past all over the Asia, the inland and marine capture fisheries have registered a gradual decline due to deterioration of aquatic environments and over fishing. Thus aquaculture is seen as the most promising option of filling the pending void in the aquatic food supply. Among the available farmed fish species, the tilapias are among the best candidates for culture because of their desirable qualities (Guerrero 2002). In spite of bright and promising future of tilapia farming in the developing countries of this part of Asia like Bangladesh, India, Nepal, Pakistan and Sri Lanka, until recently the Governments of these nations have not yet taken it seriously. Diversified and frontier aquaculture development with short cycled fish species like tilapias can overcome all the above-mentioned situations and have access to all existing aquatic ecosystems, which will certainly benefit the nation like ours in providing income for small-scale farmers and large producers and helping the country to alleviate shortfalls in fish production.

Moreover, cage culture system also have many advantages like, many types of water resources can be used, including lakes, reservoirs, ponds, strip pits, streams and rivers which could otherwise not be harvested, relatively low initial investment is all that is required in an existing body of water, allows the use of the pond for sport fishing or the culture of other species.

So, introduction of cage culture of tilapia in the village Hotalbunia is un-doubtfully an excellent enterprise to develop the condition of rural deprived community.

The cage culture is still going on the study area. They had some lacking during the first culture cycle. Hope, they will be able to overcome those problems this time and will gain a better return of their hard work.

CHAPTER SEVEN

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CHAPTER EIGHT

ANNEX

Annex

Table-3: ANOVA test results for some descriptive statistical parameters between 3 different groups.

Descriptives

Production

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
2000	2	1.7375E2	2.47487	1.75000	151.5141	195.9859	172.00	175.50
2500	2	1.7889E2	12.57943	8.89500	65.8733	291.9167	170.00	187.79
3200	3	2.6796E2	26.15618	15.10128	202.9811	332.9322	239.00	289.87
Total	7	2.1559E2	51.56497	19.48973	167.9046	263.2839	170.00	289.87

Table-4: Test of homogeneity of variances between different treatments.

Test of Homogeneity of Variances

Production

Levene Statistic	df1	df2	Sig.
3.086	2	4	.155

Table-5: One Way ANOVA table for finding significant/insignificant differences between treatments.

ANOVA

Production

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14421.020	2	7210.510	18.818	.009
Within Groups	1532.658	4	383.165		
Total	15953.679	6			

Table-6: Results of the Post-Hoc test for Multiple Comparisons between 3 different treatments.

Post Hoc

Multiple Comparisons

Dependent Variable:Production

	(I) Stocking	(J) Stocking	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Games-Howell	2000	2500	-5.14500	9.06551	.858	-149.8225	139.5325
		3200	-94.20667*	15.20234	.043	-181.3001	-7.1133
	2500	2000	5.14500	9.06551	.858	-139.5325	149.8225
		3200	-89.06167*	17.52625	.031	-163.5503	-14.5731
	3200	2000	94.20667*	15.20234	.043	7.1133	181.3001
		2500	89.06167*	17.52625	.031	14.5731	163.5503

*. The mean difference is significant at the 0.05 level.