

Species Selectivity and Catch Composition of Different Gears in the Floodplain Areas of Gopalganj

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Gears in the Floodplain Areas of Gopalganj**

A Thesis

By

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Approved as to style and content by



Dr. Md. Ayaz Hasan Chisty

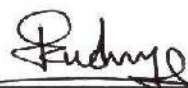
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November, 2015

Declaration

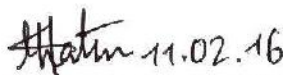
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Gears in the Floodplain Areas of Gopalganj**

The results presented in the thesis with the above mentioned title 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.....

Nayan Sarkar



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Abstract

The present study conducted to know the species selectivity, catch composition and total catch per gear per season in the floodplain of three Upazilla of Gopalganj district from May to October, 2015. A total of 17 different fishing gears were found to be used belonging to 4 categories viz. net, hook and line, traps and wounding gear comprising of 6 types of nets, 3 types of hooks and lines, 5 types of traps and 3 types of wounding gears respectively. About 30 different fish species were identified in the catches of different fishing gears. Detail description, mode of operation, fishing time and duration, fishing season, species selectivity and catch per gear per season of different gears were determined. Considering the species composition and species selectivity of different fishing gears, seine nets (Ber jal), cast net (Jhaki jal), lift nets (Veshal Jal), traps like Ghuni, Chalon, Polo, wounding gear were recorded as non-selective gears irrespective of species or size. Gill nets viz. Punti jal, Koi jal and Kholisha jal, traps like koi dughor, Kuchiya dughor were found highly selective depending on its name. However, hooks and lines were recorded as more or less selective fishing gears. Total catch among the gears varied widely ranging from 1.12 kg to 1390 kg/gear/season where ber jal represented significantly ($P < 0.05$) high amount (1390 ± 103.57 kg); may be detrimental in some cases.

Key words: Species selectivity, Total catch and catch composition, Fishing gear and Flood plain

Contents

Contents	Page
Acknowledgement	I
Abstract	II
Contents	III- IV
List of tables	V
List of figures	VI-VII
Chapters	
Chapter 1	1-5
1.1	Background of the study 1-5
1.2	Objectives 5
Chapter 2	Literature review 6-14
Chapter 3	Materials and methods 15-17
3.1	Selection of the study areas 15-16
3.2	Data collection 17
3.3	Cross-checking of data 17
3.4	Data Analysis 17
Chapter 4	Results 18-47
4.1	Nets 18-26
4.2	Hook and Line 26-30
4.3	Traps 30-35
4.4	Wounding Gear 36-38
4.5	Species selectivity 39-44
4.6	Total catch 44-47
Chapter 5	Discussion 47-58
5.1	Fishing gears 48
5.2	Species composition 48-50
5.3	Species selectivity 51-56
5.4.	Total catch 56-58
Chapter 6	Conclusion 59
Chapter 7	References 60-66



Chapter 8

Appendix

67-79

Appendix-I

67-68

Appendix -II

69

Appendix -III

70-72

Appendix -IV

73-77

Appendix –V: Photo Gallery

78-79

List of tables

Table no.	Title	Page
Table-1	Species selectivity of fishing gear with fishing type and species behavior	51
Table-2	Total catch (kg/gear/season) of different types of gear in the study area	57



List of figures

Figure No.	Title	Page
Figure 1	The study area showing in the map of Bangladesh	16
Figure 2	Species composition by Puntl Jal	19
Figure 3	Species composition by Kholisha Jal	21
Figure 4	Species composition by Koi Jal	22
Figure 5	Species composition by Jhaki Jal	23
Figure 6	Species composition by Veshal Jal	25
Figure 7	Species composition by Ber Jal	26
Figure 8	Species composition by Chasra Borsi	27
Figure 9	Species composition by Kecho Borshi	29
Figure 10	Species composition by Chuchra Borshi	30
Figure 11	Species composition by Ghuni	31
Figure 12	Species composition by Koi Dughor	32
Figure 13	Species composition by Kuchiya Dughor	34
Figure 14	Species composition by Juti	36
Figure 15	Species composition by Jhupi	37
Figure 16	Species composition by Fulkuchi	38
Figure 17	Species selectivity of Puntl Jal	39
Figure 18	Species selectivity of Kholisha Jal	40
Figure 19	Species selectivity of Koi Jal	40
Figure 20	Species selectivity of Chasra Borshi	41
Figure 21	Gear selectivity of Kecho Borshi (Nol/Dhap Borshi)	42
Figure 22	Species selectivity of Chuchra Borshi	42
Figure 23	Species selectivity of Kuchiya Dughor	43
Figure 24	Species selectivity of Koi Dughor	44
Figure 25	Total catch among the Gill Net	45
Figure 26	Total catch among Other Nets	45
Figure 27	Total catch among the Hooks and Lines	46
Figure 28	Total catch among the Traps	47
Figure 29	Total catch among the different Gears	47
Figure 30	Species selectivity of different types of Gill Net	52

Figure 31	Non Species selectivity of others Net	53
Figure 32	Species selectivity of different Hook and Line	54
Figure 33	Species selectivity of different Traps	55
Figure 34	Species selectivity of different Wounding Gear	56

CHAPTER ONE

INTRODUCTION

Introduction

Background of the study

Fisheries is one of the fastest-growing animal food-producing sectors. Fish and fishery products are among the most-traded food commodities worldwide. They are the primary source of protein for 17% of the world's population and nearly a quarter in low-income food deficit countries and fisheries supplies the world with about 154 million tonnes (mt) of fish (63.6 mt from only aquaculture) in 2011. Fisheries sector produces a record 130.8 mt of fish for human food - an average of 18.8 kg per person, providing more than 4.3 billion people with about 15% of their animal protein intake. This sector is a source of income for 55 million people. The livelihoods of 12% of the world's population depend directly or indirectly on them (FAO, 2012).

Fisheries sector plays an important role in providing income, employment, nutrition and foreign exchange earnings and also plays a great role in improvement of the socio-economic condition of fishermen in Bangladesh. The area of water resource is about 4.9 million hectare, which is about 34% of our total area of Bangladesh. About 1.25 crore people directly or indirectly depend on fisheries sector for their livelihood. In our country about 13.16 lakh fishermen lives on fishing as their main occupation (DoF, 2008). Fish alone supplies about 60% of animal protein. Fisheries sector supplement not only the food and nutrition sector but also the job sector. Bangladesh is a transitional zone of flora and fauna, because of its geographical settings and climate characteristics. The resources for fisheries in Bangladesh are critical to the national economy and livelihoods of millions of poor people in terms of nutrition, income generation, employment, and foreign exchange earnings of Bangladesh. Due to natural condition and geographical location, Bangladesh offers huge fisheries resources with the potential to boost fisheries production.

The country's fisheries resources are divided into two major groups such as inland (fresh water) fisheries and marine fisheries. Inland fisheries occupy an area of 4.69 million hectares and marine capture fisheries covers 1,66,000 km². Fresh water resources are broadly classified into open water fisheries and closed water resources with an area of 3.91 and 0.78 million ha, respectively.

Among the open water bodies 8.5 lakh ha are rivers and estuaries, 1.77 lakh ha Sundarbans, 1.14 lakh ha beel, 27.02 lakh ha floodplains and 68,800 ha Kaptai lake

(FRSS, 2014). The potential of the inland fishery of Bangladesh is considered to be one of the highest among the inland fisheries of the world. Out of 4.05 million ha of open water fisheries, the floodplains with an area of 2.8 million ha offer tremendous scope and potential for augmenting fish production by adopting aquaculture based enhancement techniques (WFC, 2005; DoF, 2005; Rahman, 2010). Haors (large deeply flooded depressions), baors (oxbow lakes) and beels (lakes) are the permanent and semi-permanent standing water bodies in the floodplain, which become inundated during the flooding season and support rich fisheries (Craig *et al.*, 2004). Approximately 260 species of freshwater fishes, 24 species of prawns, 50 species of reptiles, 24 species of mammals, 475 species of marine fishes and 36 species of shrimps are found in Bangladesh (Rahman, 1989; World bank, 1991; MAEP, 1996).

The total fish production including inland and marine resources is estimated at 34.10 lakh tonnes in 2012-2013 fiscal year. The contribution of inland fisheries is about 82.73% and the remaining comes from the marine resources. Among the inland capture fisheries the Floodplains comprises an estimated area of 27.02 lakh ha and production 7.01 lakh tonnes which is 24.87% of total inland fisheries. (DoF, 2014).

Floodplains are distinct, complex and diverse sub-systems of main rivers, which provide numerous lotic and lentic habitats. Floodplains provide temporary storage of excess water from the main river channel during monsoon, which tends to enhance the productivity of the flora and fauna of the riverine system manifold. Furthermore, floodplains establish connectivity between beels and rivers that leads to exchange of biomasses. During the wet season, the floodplain environment offers dramatically increased living space for the aquatic fauna and availability of resources. Changes in hydrology are probably the most crucial and important stimuli of the life cycles. The diversity and abundance of the fisheries of the country which are important in terms of economy and livelihood of our rural people depend substantially on the health of the floodplains (IUCN Bangladesh, 2004).

Floodplains have great biological and environmental importance in the fisheries sector of Bangladesh as it offers a unique habitat to support innumerable flora and fauna including the fish and shellfishes. Inland fisheries production in Bangladesh is strongly related to the highly productive floodplain areas inhabited by distinct flora and fauna. During the

rainy season floodplains become one of the best natural habitats for the indigenous fish species of different food habits. Most of the aquatic species especially the fish and prawn enter in the inundated areas of the floodplain from the adjoining rivers and canals to feed and grow during the monsoon months. These inundate floodplains are rich in nutrients and natural fish food and thus are excellent feeding, breeding and nursery grounds for fish and other aquatic organisms. Das (2002), reported that the beels and floodplains are extremely rich in nutrients being reflected by rich in organic carbon and high levels of available nitrogen and phosphorus in the soil system. This is reflected in higher biological productivity offering tremendous scope for augmenting culture and capture fisheries. As open water fisheries resources are still in infancy and offer enough scope for fish production, beels and floodplain comprise the major share of our open water resources and could contribute significantly in natural fish production with a little adoption of fisheries management practices in a sustainable way.

The floodplains inundated during the monsoon are nutrient rich and play a significant role for four to five months of the year. Larvae, juveniles and adults grow in this habitat, after which they migrate back to rivers or depressions at the end of the monsoon, when the waters recede (Welcomme, 1985; Bayley, 1988; Junk *et al.*, 1989). Furthermore, fishing during the monsoon is an important economic activity for people living adjacent to the floodplains (Payne, 1997; de Graaf *et al.*, 1994).

Different types and form of gears are operated in these floodplains areas to exploit wild fishes. The intensity of use of any form of gear in a floodplain is dependent on the intensity of target fish population presumed to be available in that river. Some of the gears are selective for a particular species, whereas other account for a number of species caught during operation giving multi-species nature of the fishing. Among them, many of these have been known to catch fingerlings before they grow to legal size and many of these responsible for sharp decline in the population of wild species from floodplains of the country.

On the other hand, every year the number of fishermen is increasing greatly due to the absence of employment opportunities for increasing population and easy access to this profession. On account of their poverty and social status, they are forced to depend on middleman and try to earn more money, resulting indiscriminate fishing in the floodplain area or from open water bodies. Thus uncontrolled fishing and highly destructive devices

of fish capture in floodplain deplete fisheries resources and are followed by great economic distress.

The selected area represents a typical floodplain ecosystem of Bangladesh. Open agricultural fields are encircled by villages consisting of adjoining homesteads. Every year, the open land experiences both aquatic and terrestrial phases. The area is initially fed by local rainfall during April-May, subsequently by the backwater of the Modhumoti river and monsoon rainfall. The river water enters the floodplains as early as Jun through the connecting canals. The further inundation of the area occurs due to the over spilling of the Padma. The peak flooding occurs in late August to early October. The water receding from end of October, and by January most of the area dries out. The number of floodplains in Gopalganj is 116, occupy an area of 23407 hectares. Almost every species of fresh water are found in the floodplains areas of Gopalganj like Puti (*Puntius sophore*), Taki (*Channa punctata*), Koi (*Anabas testudineus*), Shing (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Chingri (*Macrobrachium sp*), Mola (*Amblypharyngodon mola*), Tengra (*Mystus vittatus*), Gutum (*Lepidocephalichthys guntea*), and Shol (*Channa striata*), chela (*Chela cachius*) etc. Almost all fishermen have their own nets and boats. Some fishermen work with other who has boats and nets. The fishermen are not conscious about the sustainable catch of fish and habitats conservation. The peak season for fishing is mainly July to September. Relatively large numbers of fishing gears are operated during this time. The use of fishing gears gradually decrease from November and very few numbers or often no fishing gears are operated during December to January. Fishermen engage themselves with other work from January to April to manage their livelihood.

In the present study it was revealed that the fishermen of the floodplain areas use different types of gear to catch fishes from May to December. They did not harvest selectively i.e. they harvest fish of all sizes. Again, there was no practice of re- releasing of under sized harvested fish to the waters. Even they dried out the ponds adjacent to the floodplains and deepest part of the floodplains during dry season in where fish species take shelter. Indiscriminant, unplanned and destructive gears are being used by the fishers of floodplains. The harmful modern gears and technological advancement have negative impact over the situation. For this reason fish biodiversity are being declining day by day.

In the light of fishery management and the decline in the catch from capture fisheries should be investigated. There is a national need to look at how this decline can be halted or even reversed, considering not only the importance of maintaining fish yields but also the need for judicious harvesting of the resources. Therefore, sustainability of a fishery is very much dependent on the gears selection, intensity of fishing and level of exploitation. Only a few studies have been undertaken on the status of resources as well as the causes of declining resources in this unique floodplain area. Over 100 types of fishing gears of nine categories are found to be used in the floodplains of Bangladesh (Alam *et al.*, 1997). The intensity of fishing gears, mesh sizes and catch per unit effort are good indicators of the status of exploitation level of floodplain. There are many methods to assess resources and the level of its exploitation.

Many researchers in Bangladesh have studied gear selectivity and their impact on water body. However, there is no real data about the present status of different gears used and their efficiencies to evaluate the prevailing situation of the Floodplain. Therefore, a comprehensive study on the floodplain seems to be of timely value and immense necessity. Sustainability of a fishery is very much dependent on fishing practices, gear used, catch assessment and production of the floodplain. In view point of that, the present study is very much significant to make aware the development planners and policy makers to undertake initiatives to save the important natural resources through proper management strategy. To achieve sustainable fisheries it is essential to identify the gears, gear selectivity, catch per unit effort (CPUE), catch composition, species diversity and production of these floodplains.

Objectives: This study has been taken at a beel/ flood plain of Gopalganj to-

- Identification of different type of fishing gears used
- Identification of gear selectivity and
- Catch composition of different type of gear and its catch per unit gear per season.

CHAPTER TWO

LITERATURE REVIEW

REVIEW OF LITERATURE

The aim of this chapter is to review the previous research and survey works related to the present study. The literature on the study of selectivity of fishing gears and fish composition in floodplains of Gopalganj in order to manage the fisheries in most intelligently and efficiently is very scarce. This field was largely neglected because fishes were believed to be the gift of nature and ever abundant. But due to rapid growth of population, the natural fish production has declined very sharply with increased fishing pressure. Floodplain areas have received attention to researchers very recently because of its potentiality in respect of fish biodiversity and production. However, a little research and survey works that have been conducted in the recent past years and related to the current research are reviewed below:

Ahmed *et al.* (2002) studied from July to December, 2001 in the floodplain of the river Titas and Brahmaputra, on the gears used for fishing. During survey they found 3 kinds of gill nets, 14 kinds of seine nets, 5 kinds of long line and hook and 4 kinds of spears.

Chakraborty (2009) conducted an organized program for a long time from 2006- 2009 in Punuria Beel and found that during monsoon and post-monsoon season, fishers used lift net, current jal, cast net, traps, hook and line to catch fishes. Fishers also operated kata fishing by seine net (Ber jal and Komor jal) in winter and spring season. Many fish trap (vair, dugair, ghuni and polo etc.) and hook and line (barshi, fulkuichi, jhupi, aikra etc.) were used to capture different groups of aquatic lives. The percentages of catch of Punuria Beel by using prohibited current jal, ber jal and FAD were 27.50%, 14.20% and 9.20% in 2006; 30.10%, 16.40% and 10.10% in 2007; 33.76%, 19.30% and 11.80% in 2007 respectively.

Jewel (2006) reported a total 6 types of net, 4 types of trap and 1 type of wounding gears in the Padma River adjacent to the Boalia Upazila under the district of Rajshahi.

Khan *et al.* (2005) found that various types of nets and wounding gears used in capturing Indian major carps in the Kaptai Reservoir, such as lift net, large meshed gill net, small meshed gill net, seine net etc. and various types of wounding gears such as hooks, lines etc.

Akandha (2004) found 22 species of fishes in Baila beel which were found to be to be the highest dominant species of *M. lamarrei* (34.88%)

Haque *et al.* (2010) found a total of 16 types of fishing gears are operated by the fishermen in Beel Kumeri which is quite similar to the present study. And also found a total of 30 species of fishes of veshal jal during the study period.

Saha *et al.* (2005) conducted a survey in the Gawha Beel in Nawabganj and recorded 7 different types of gears of 3 categories (nets, traps and wounding gears) used by 2 categorized fishers in the beel. Nets are the dominating fishing gear in the beel followed by traps and wounding gears.

Haroon *et al.* (2002) reported eighteen types of fishing gears from the Sylhet subbasin and thirteen types from Mymensingh sub-basin.

Miah (2004) recorded 23 species of fishes in Savar Khagor Baria Zolkor beel 1 which were found to be the highest dominant species of *A. mola* (24.09%).

Rahman (2001) recorded a total of 38 fish in the catches of different gears used in the Baculiar Haor, Itna, Kishorgonj. Among the different types of nets the highest number of species (29) was recorded in the catch of seine net, which was followed by cast net (23) and relatively less number of species (9) were recorded in the catch of push net.

Hussain (1999) carried out an investigation on the fishing gears used to capture fish in the River Atrai in Rajshahi district and listed 7 types of nets, 2 types of traps, 5 types of hook and line and 4 types of wounding gears.

Chakraborty *et al.* (1995) described fishing methods in inland waters of Bangladesh along with the structural design of various types of fishing gear. The gears were grouped into nine major categories on the basis of their mode of operation and capabilities. They were classified into following types: 1) Dragged net, 2) Seine net, 3) Bag net or Scoop net, 4) Falling gear, 5) Lift net or Dip net, 6) Drift or Gill net, 7) Hook for line fishing, 8) Wounding gear and 9) Fish traps.

A study by **Dewan and Mazid (1994)** on the fishing techniques that are in use among the fishermen of Bangladesh listed the fishing into netting, angling, trapping, spearing, dewatering and hand picking. They also reported that about 91 gears are used in different waterbodies of the country. Among the gears, they found 28 gill nets, 21 seine nets, 8 drag and bag nets, 8 lift nets, 5 clasp, cast and push nets, 6 hooks and lines, 5 traps and 5 spears or harpoons. They also recorded 7 new gears during their study which are Photo jal, Paia jal, Dool-chot jal, Sruti jal, Bhuri jal and Gorla jal. Among the newly recorded jals, 3 are being used in beels and other 4 jals in rivers.

According to **Rahman *et al.* (1993)**, fishing gears are grouped into 4 types in Chanda, BSKB and Haldi beel. The groups are- a. fish net (7 types and 20 sub types), b. fish trap (5 types and 14 sub-types), c. hook and line (5 types) and spear/harpoon (4 types). About sixty species of fishes are identified in the catch composition by these fishing gears.

A survey conducted by **BCAS (1991)** identified approximately 30 different types of gears to be used in Haldi beel. The catch is composed of koi, shing, magur, boal, shol, raik, air, punti, baim, gazar, tengra, taki and various species of freshwater prawn.

BCAS (1989a and 1989b) also reported different fishing gears used by the fisherman in the beels of Netrokona and Sunamganj districts. The gears were Jhaki jal, Uther jal, Veshal/Khora jal, Dal jal, Konaber jal, Tona jal, Goar jal, Pine jal, Sarda jal, Current jal, Ram jal and Chouhunda jal. In haor areas recorded gears were Kochal jal, Katha jal, Tonti jal, Koi jal, Punti jal, Jhaki jal and Fash jal.

Jhingran (1989) identified a rich assortment of traditional fishing gears both active and passive are used by the fisherman in beels. The big sized catfishes (*Wallago attu*) are generally caught by hook and line. The smaller fishes are bagged by dip nets and cast nets. The gill and drag nets are more efficient gears in low weed-infested beels during the winter season. Traps, chiefly made of bamboo are extensively used for catching fish in beels.

Khaleque and Islam (1985) conducted an experiment on the relative use and efficiency of fishing gears in the Chandpur Irrigation Project area during the period of 1977 to 1979. The use of gill nets and cast nets remained relatively constant throughout the entire period of study. The relative efficiency of the different gears for catching fish showed marked differences.

Rahman et al. (2012) conducted a survey on wild population of Ganges River and recorded traditional fishing gears including cast net, square lift net, conical trap, monofilament fixed gill net and fish barrier during February 2011 to January 2012. They recorded a total of 254 specimens ranging from 9.20-19.71 cm TL were caught by the gears and showed that the 16-16.99 cm TL size group was numerically dominant.

Czerwinski et al. (2009) studied species and size selectivity of the deep water longline traditionally used in commercial fishing of the black spot sea bream (*Pagellus bogaraveo*) in the Straits of Gibraltar with four sizes of hooks. They recorded that Black spot sea bream contributed up to 88% of the catch by number. Significant differences in average fish length between all hooks, except in one case, were found. The results of this study show that the fishing gear can be size selective depending on hook size.

Heikinheimo and Mikkola (2004) studied the effect of selective gill-net fishing on the length distribution of European Whitefish (*Coregonus lavaretus*) in the Gulf of Finland and found the stimulation with the current fishing effort and gill nets of 45 and 55 mm mesh sizes revealed an effective removal of larger individuals from the length distribution of the migratory whitefish. As a consequence, the mean length of the whitefish was about 9 cm lower in the population than in the gill-net catch.

Mazid et al. (1999) studied fishing gear selectivity in BSKB (Barnal-Selimpur- Kola-Bashukhali) Beel and reported that traditional fishing gears are now being used in Bangladesh to catch stocked carp before they attain minimal legal marketable size (23 cm). Several gears are selective and two trap types mainly caught carp, but several common non-selective gears caught more than 25% carp. The non-selective gears generally caught carp



below the legal minimize size, while the selective gears (excepting one trap type) caught carp averaging about the minimum legal size.

Erzini *et al.* (1996) investigated species and size selectivity of longlines using small hooks off the south coast of Portugal. With overall hook size differences of only 26.5 and 65% they found that the smallest hook caught more illegally sized fish (<25 cm) while the largest hook caught relatively more bigger fish. All three hooks caught fish ranging in size from less than 20 cm to more than 60 cm, and efficiency decreased with increasing hook size.

Paul *et al.* (1993) determined the L50% value and selective range for fash jal (9-12 cm), lift net, cast net and fish trap (bair) in Haldi Beel. The values recorded for fash jal were 24.15 cm and 22.03-26.27cm in catla, 23.99 cm and 21.13-26.86 cm in common carp and for lift net the values recorded were 9.29 cm and 6.99-11.6 cm in catla, 10.57 cm and 8.11-13.0 cm in mrigal, 10.86 cm and 8.75-13.0 cm in rui and 13.57 cm and 11.26-15.86 cm in silver carp. But for cast net the values determined were 16.82 cm and 13.61-18.94 cm for catla and 12.29 cm and 9.20-15.39 cm for rui.

Rahman *et al.* (1992) determined the L50% values and selectivity ranges (L25%- L75%) for gill nets viz., Punti jal (2.5-3.18 cm, mesh), and Koi jal (3.18-3.8 cm, mesh) and Cast net (1-1.5 cm, mesh) in Chanda Beel. The values recorded for Punti jal were 7.74 cm and 7.09-8.40 cm for punti, 6.84 cm for and 6.29-7.30 cm for Kholisha, 15.51 cm and 14.45-16.57 cm for shing, 12.11 cm and 10.56-13.65 cm for tengra, 12.34 cm and 11.13-13.55 cm for taki and 7.64 cm and 7.05-8.22 cm for koi and for Koi jal the values recorded were 8.82 cm and 8.08-9.54 cm for koi, 16.0 cm and 14.92-17.09 cm for shing and 15.95 cm and 14.26-17.63 cm for baila. But for the cast net the values recorded were 5.08 cm and 4.46-5.70 cm for punti, 5.48 cm and 4.96-6.60 cm for kholisha and 13.8 cm and 8.98-18.18 cm for tengra.

Amani *et al.* (2011) conducted a survey for 12 month period, from June 2008 to May 2009 based on the catch data to determine the catch composition of set bag net (SBN) that is laid down to catch *Acetes* shrimps that move along with the estuary of Merbok River in the state of Kedah, Peninsular Malaysia. The result showed that over a year period the total catches

were constituted of three major catch groups viz. *Acetes* shrimps (89%), juvenile fishes (9%) and other non *Acetes* shrimps (2%). The annual mean percentage composition of shrimps comprised of *A. japonicas*, *A. vulgaris* and *A. indicus* were found to be 89%, 7% and 4% respectively.

Dimitra et al. (2010) studied the seasonal variation of fish species composition and abundance in gillnet catches (14-90 mm knot-to-knot) from the Greek part of the transboundary Lake Doirani during the period 2006-2007. They recorded *Alburnus macedonicus* (46.78%), *Carassius gibelio* (2.44%), *Cyprinus carpio* (0.15%), *Pachychilon macedonicum* (5.18%), *Perca fluviatilis* (25.43%), *Rhodeus meridionalis* (15.08%), *Rutilus rutilus* (4.66%), *Scardinius erythrophthalmus* (0.18%) and *Squalius vardarensis* (0.10%).

An investigation was done by **Francis (2010)** on the species composition and gear characteristics of the Cross River Estuary, Nigeria. He reported that the multispecies *Macrobrachium* fishery is exploited with three main gears, namely beach seine, push net and trap and recorded one swimming crab (*Callinectes amnicola*) and two fish species (*Eleotris* sp. and *Pellomula leonensis*). The shrimp species identified included *Macrobrachium macrobrachion* (83.39% and 55.69% by number and weight, respectively), *M. vollehovenii* (9.66% and 37.18%), *M. equidens* (3.8% and 2.87%), juveniles-sub-adults of *Penaeus notialis* (1.11% and 1.3%), *M. dux*, *M. felicinum*, *Palaemonetes africanus*, *Palaemon maculatus*, *Palaemon elegans*, *Desmocarid sp.*, *Leander sp.*, *Nematopalaemon hastatus* and *Alpheus pontederiae*.

An organized sampling programme was carried by **Chakraborty (2009)** for a long time from 2006 to 2009 in Punuria Beel to get a true picture of the catch and catch composition of the beel. Fishing activity in the Punuria Beel indicated the presence of 91 aquatic lives (80 species of wild fishes, 4 species of prawn, 1 species of crab, 2 species of snails, 1 species of bivalve and 3 species of turtles) belonging to 51 genera and 24 families. The annual catch estimation of Punuria beel was around 96.65± 5.41; 74.88±4.07, 62.6±3.67 and 95.58± 5.44 mt in the year of 2006, 2007, 2008 and 2009 respectively represented by 10 groups of aquatic

fauna. Fishing pressure increased in the year 2006 to 2008. As a result, the production declined from 22.0% to 35.0% during the year 2007 to 2008.

A survey was conducted by **Ahmed (2008)** in Titas River in Brahmanbaria district and found 35 different kinds of fishing gears in the study area among which seine nets and gill nets were most frequently used. In terms of catch, set bag net was most productive gear followed by seine net and gill net. A total of 57 species of fish were recorded from the catch including two exotic species (*Hypophthalmichthys molitrix* and *Barbodes gonionotus*). More than 20% of total catch comprised of Cypriniformes (mostly carps) followed by Siluriformes 15.6% (catfish), Perciformes 13%, eels 5.4% and remaining 46% of catch consisted of small and medium sized fish.. As a single species, *Wallago attu* (9.1-11.1%), *Nandus nandus* (8.5-10.2%), *Gudusia chapra* (8.40%), *Glossogobius giuris* (5.2%) and *Puntius sophore* (5.1%) dominated the catch. Small prawns comprised seven species contributing 15.1-19.2% of total catch.

Rahman et al. (1999) stated with respect to species selectivity ber jal, khepla jal and vashal jal (net), charo, arinda and gll.uni (trap), dhawn and nol borshi (hook and line) were recorded non-selective gear both for species and size

Hossain et al. (2008) conducted a survey in Teknaf coast; Cox's Bazar and found that about 566 fishing fleet of two types, 1263 fishing gears of seven kinds, 6466 fishermen were being involved in fishing at Naaf River Estuary. The catch composition of the coastal fishing of Teknaf coast was found 52 finfish species with highly abundant *Escualosa thoracata* (7%), *Harpadon nehereus* (5.3%), *Arius* sp. (4.1%), *Leigonathus* sp. (3.7%), *Johnius argentus* (3.3%), *Cynoglossus* sp. (3.9%), where the least available species were *Mene maculate* (0.03%), *Nemipterus japonicus* (0.02%), *Priacanthus* sp. (0.02%), *Rachycentron canadus* (0.01%). Among the Penaeid shrimps, 10 species were identified as available of which *Penaeus monodon* was found as the most valuable and main target species to the fisherman due market demand as high valued commodity. But brown shrimps were found as the highest contributor in the total catch, which was about 70%.

Chakraborty and Mirza (2007) reported that a total number of 70 species of fishes, four species of prawns, one species of crab and five species of reptiles from the Gharial Beel. Increasing the rate of fishing pressure within five years by seine net (*moshari jal*) from 16.6 to 24.1% and gill net (*current jal*) from 23.5 to 36.1% were identified as detrimental gear. Within five years and the percentage of total production was sharply decreased from 21.88 to 59.25% over the same period. As a result, a number of commercially important fish species like as major carps, mohasher (*Tor tor*, Cyprinidae), nandina (*Labeo nandina*, Cyprinidae), sarpunti (*Puntius sarana*, Cyprinidae), gajar (*Channa marulius*, Channidae), and reptiles (*Kachuga kachuga*, Chelonia and *Morenia petersi*, Chelonia) become extinct from the beel.

A fisheries survey was conducted by **Azadi (2007)** in Halda River. He found 64 species of finfish under 13 orders, 5 species of shell fish, 1 species of turtle and 1 species of river dolphin (*susuk*) in the study area.

Akhanda (2004) recorded 14 fish species in the catch of Thela jal in Baila Beel including *Macrobrachium lamrrei* (Icha, 47.53%), *Macrognathus pancalus* (guchi, 10.49%), *Chanda ranga* (chanda, 6.79%), *Puntius ticto* (tit puti, 6.17%), *Esomus danricus* (darkina, 4.94%), *C. nama* (chanda, 2.47%) and *Heteropneustes fossilis* (shing, 1.23%).

Choudhury (1989) stated in his study that punti jal and koi jal are used for *Puntius* sp. and *Anabas* sp. Respectively.

Average floodplain production has been estimated to be 40-60 kg/ha/year by **Welcomme (1979; 1985)** from lightly exploited floodplain-river systems

Holder (2002) recorded 13 species and 16 species of fishes in Doba Beel and Chara Beel respectively including the catch composition of *C. lalius* (33.61%), *M. pancalus* (14.29%), *P. ticto* (10.93%), *L. guntea* (9.24%), *E. danricus* (6.72%) and *P. sophore* (5.88%) in Doba Beel and *C. lalius* (24%), *P. ticto* (12%), *E. danricus* (10%), *C. ranga* (9.33%) and *M. panculus* (8.76%) in Chara Beel.

Ahmed (2008) estimated a yield of 44 kg/ha/year based upon the survey in two fishing seasons (153 days each).

Alam et al. (2001) carried out a comprehensive study on the fisheries resources of the Sylhet basin during 1994-98. Barbs comprised 19%, catfish 18% and major carps 16% of the total catch. The highest daily mean catch was recorded in Gher jal (26.5 kg/day) and the lowest in Chandi jal (2.5 kg/day). Behundi jal was the most efficient (0.89 kg/man/hr) while Chandi jal was the least efficient (0.12 kg/man/hr) gear. Gill net (fash jal) seems to be the best selective gear.

Paul et al. (1993) conducted a survey and recorded 28 species of fish in the catches of lift net in Halti Beel. The contributions of dominant species in the catches of this gear recorded by them were carps (27.4%), chanda (22.02%), punti (12.13%), chela (8.9%), raikhor (7.77%) and tengra (5.67%). They recorded 9 species of fish in the catches of dhawn barshi in Halti Beel and dominant species caught were baim (30.85%), ghaira (19.1%), boal (13.65%), taki (12.85%) and tengra (9.7%). The dominant species recorded by them in the catches of nol borshi were taki (29.77%), shoal (25.58%), tengra (15.52%) and shing (13.58%) in Chanda Beel and taki (74.43%), koi (12%) and shing (7.87%) in Halti Beel. They also recorded baila (39.40%) was the most dominant species and major carp was the relatively less dominant species in the catch of spear/harpoon (wounding gear) in Chanda Beel and 8 species of fish in the catches of bhuti jal/bhuri jal in the same beel and dominant species were common carp (42.0%), rui (17.7%), catla (16.5%), silver carp (14.0%) and grass carp (5.6%).

Saha and Hossain (2002) reported that the average production of fish was recorded as 242.47 kg ha⁻¹ in Saldu beel of Tangail

Rahman et al. (1993) recorded 18 species of fishes in Halti Beel in the catches of seine net. The contributions of dominant species in this gear were tengra (31.71%), raikhor (22.60%), punti (14.24%), chanda (9.86%) and stocked fishes i.e. major carps (8.23%). But they recorded 28 species of fishes in the catches of cast net. The percent compositions of dominant species recorded by them in the same beel were 13.17-49.59% tengra, 20.28-40.72% punti and 3.4-24.5% baila from August to March. They also recorded punti (30.18%) as the most dominant species in Chanda Beel. The next dominant species recorded by them were kakila (20.08%), kholisha (8.8%), tengra (6.4%) and chanda (5.7%).



CHAPTER THREE

MATERIALS AND METHODS

MATERIALS AND METHODS

It is important to examine the study methods and data from different points of view to ensure a comprehensive approach to the research question. The study is based on field survey which refers to a method in which an overall picture is obtained by a systematic collection of all available data on the subjects. This chapter describes the research methodology followed to achieve the goals of the present study.

3.1. Selection of the study areas

To carry out the present study, 10 different villages adjacent to floodplain under 3 Upazilas of Gopalganj district were selected for the survey. The selected area was under 5 union named Gopalganj Sadar, Ragunathpur, Kathi, kajuliya, Hiron, Gopalpur with 10 villages those were Betangi, Vojergati, Roghunathpur, Kajuliya, Poilshar, Rupahati, Guyadhana Pathorghata, Joyariya, Gopalpur. The selected areas are located 20 km east from the Gopalganj town. The total area covered being slightly above 200-250 hectors during the flood period from May to December of the year. It is famous for its rich reserve of aquatic life. Most part of the year it remains under water, drying out only in a few months. From the month of June to October, it remains inundated with flood water to a depth of up to 2 to 5 feet. Fishermen use different types of gear to catch fishes from May to December. At the end of the December the entire area becomes dry, except for some natural deep pockets.

Study Area: Gopalganj

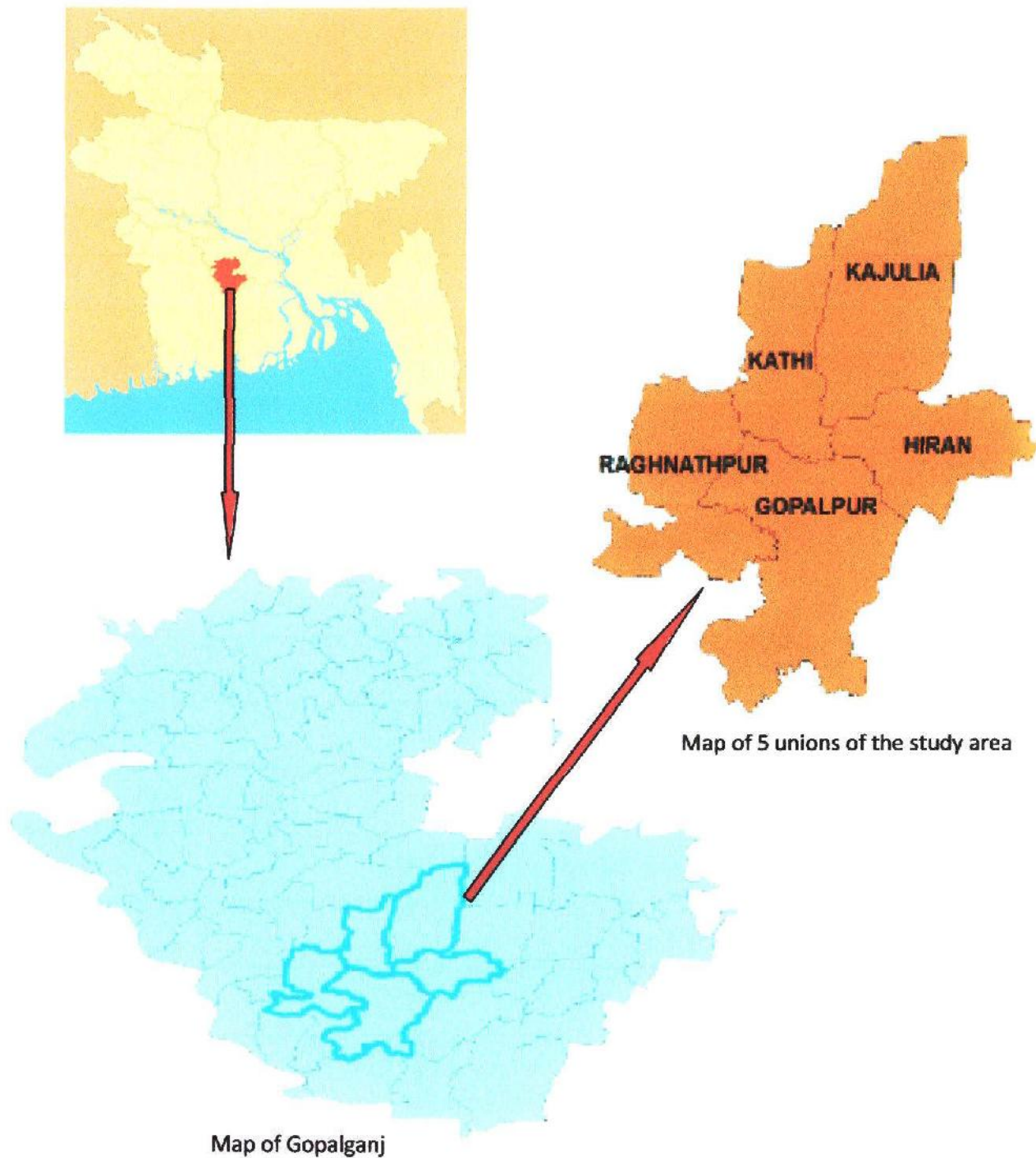


Figure-1: The study area showing in the map of Bangladesh and five union of Gopalganj District

3.2. Data collection

Data were collected from the ten villages of adjacent floodplains. Selections of the villages adjacent to floodplains were based on their location and physio-chemical and biological characters. The data were collected during the fishing season (May-July). Data collection period was different for the different places because of the differences in the fishing period followed in a particular floodplain. A sampling schedule for collection of data was maintained for collecting data from the fishing grounds directly. Data were collected from the fishermen with direct interviews by a pre-structured and pre-tested questionnaire landing centers also. The details descriptions of the nets (mesh size, size of the net, material used etc) were recorded. The different gears found to be used in the lakes were seine nets, drag nets, lift nets, gill nets, cast nets, different types of hooks and line, different types of traps and wounding gears of different types. Mode of operation (time, place, habitat, accessories etc) of the gears were recorded when they were in operation. Catch composition. (% by number of species) for each type of gear was recorded through the examination of 10-15% of the catch from the respective gear. In selecting the respondents, a stratified random sampling procedure was adopted. The respondents were selected randomly among the fishing areas and from the general fishermen who were involved in fishing in the floodplains.

3.3. Cross-checking of data

The Upazila Fisheries Officers (UFOs) and other stakeholders including fishers were interviewed about the use, pattern and intensity of different gears in the water body to know the real situation as well as cross checking the collected data. Finally, all the data were analyzed statistically. Also it was reviewed with the secondary data sources mainly reports of the Department of Fisheries (DOF), research reports, case studies, NGO reports, scientific journal articles and other published materials including internet resources.

3.4. Data Analysis

The percentage of catch composition of species for each gear was calculated. Data were analyzed by Microsoft excel software (version 5.0, Microsoft Inc, USA). One way single factor analysis of variance (ANOVA) followed by Tukey (HSD) Test for multiple comparisons were done using SPSS 17.0.

CHAPTER FOUR

RESULTS

Results

The result of the present study conducted to identify the gears, species selectivity, catch composition, and production (catch size) of selected floodplain areas in 10 villages of 5 Unions under 3 Upozilas of Gopalganj.

During the study period, the fishermen of the floodplains area of Gopalganj were found to catch fish by using different types of gear. About 17 different fishing gears which were broadly classified into 4 major categories namely nets, traps, wounding gears and hooks and lines each of which were also categorized into a number of sub-types. Generally in the floodplains fishing started just after entering the water in the naturally depressed land and remain for 5 to 6 months where the fish was caught using different types of gear. All the gears were not used by the fishermen of all selected villages at the same time.

4.1. Nets

In the study area, the fishermen used different types of nets for fishing. Among them, fishermen used 4 type nets viz. gill net, seine net, lift net and cast net.

4.1.1. Gill net

Gill nets are rectangular in shape with variable length and width depending on the size and depth of the water body. The mesh size of the net varied with the types and sizes of fish to be caught. They are made of mono-filamentous nylon twine or tier cord or double cotton twine.

In the present study 3-4 types of gill nets were found to be used by the fishermen for catching fish. These are locally known as Puntí jal, Kholisha jal, and Koi jal.

4.1.1.1 Puntí jal

This fishing net was made for catching various species of silver barbs (Puntí). It was rectangular in shape and usually 6-10 m long and 0.45-0.5 m wide. This net was made of monofilament or multifilament nylon twine. Weights/sinkers made of soil, circular in form, are attached at a regular interval at the ground line of the net. Total weight of each net was observed 400-500g with weight and 20-50 g without weight. Mesh size was found to vary from 2- 2.54 cm.

Mode of operation

The net was observed to set on or near the surface of water body. The ends of the head line of the net are tied up with pole and the gear fixed into open water during operation. Fish are collected from the net usually at 2-3 hours interval at daytime. Fishing duration was 5-6 hours/day for 6 months (June-November).



Mode of Operation of Puntí Jal

Species composition

This gear was designed to catch different silver barbs (Puntí). Small amount of other fish species were caught by this net. Catch consisted of Puntí 77.33%, Royna 4.33%, Koi .93%, Kholisha 13%, Tengra 1%, Shol .07%, Taki 2.73%, Bain 0.65 %, Chuchra 1%, Others 0.67% (Figure-2).

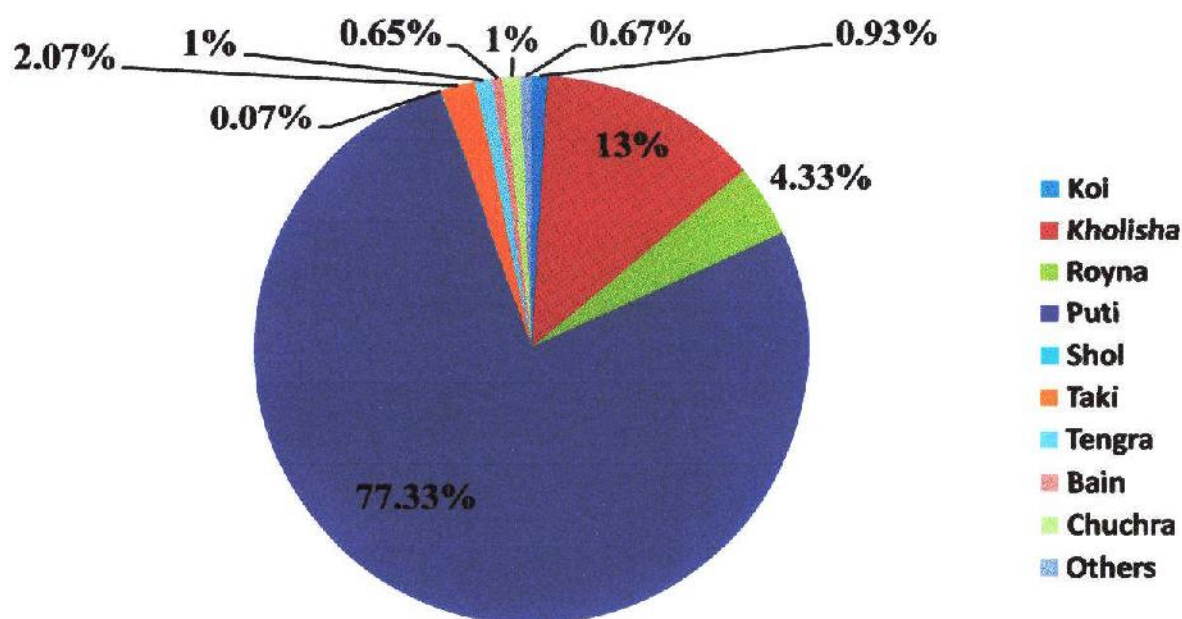


Figure 2: Species composition by Puntí Jal

4.1.1.2. Kholisha jal

This fishing net was made for catching various species of Kholisha fish. It is rectangular in shape and usually 6-10 m long and 0.45-0.5 m wide. This net is made of monofilament or multifilament nylon twine. Weights/sinkers made of soil, circular in form, are attached at a regular interval at the ground line of the net. Total weight of each net was observed 400-500g with weight and 25-50 g without weight. Mesh size was found to vary from 2.54- 3.2 cm.

Mode of operation

The net was observed to set on or near the surface of water body. The ends of the head line of the net were tied up with pole and the gear fixed into open water during operation. Fish are collected from the net usually at 2-3 hours interval at daytime. Fishing duration was 5-6 hours/day for 6 months (June-November).



Mode of Operation of Kholisha Jal

Species composition

This fishing net was designed to catch different species of Kholisha fish. Small amount of other fish species were caught by this net. Catch consisted of Kholisha 64.29% Punti 14.29%, Koi 11.71% , Shing 2%, Royna 3.86%, Tengra 1%, Shol 0.43%, Taki 1.14%, Bain 0.29 %, Others 0.86% (Figure-3).

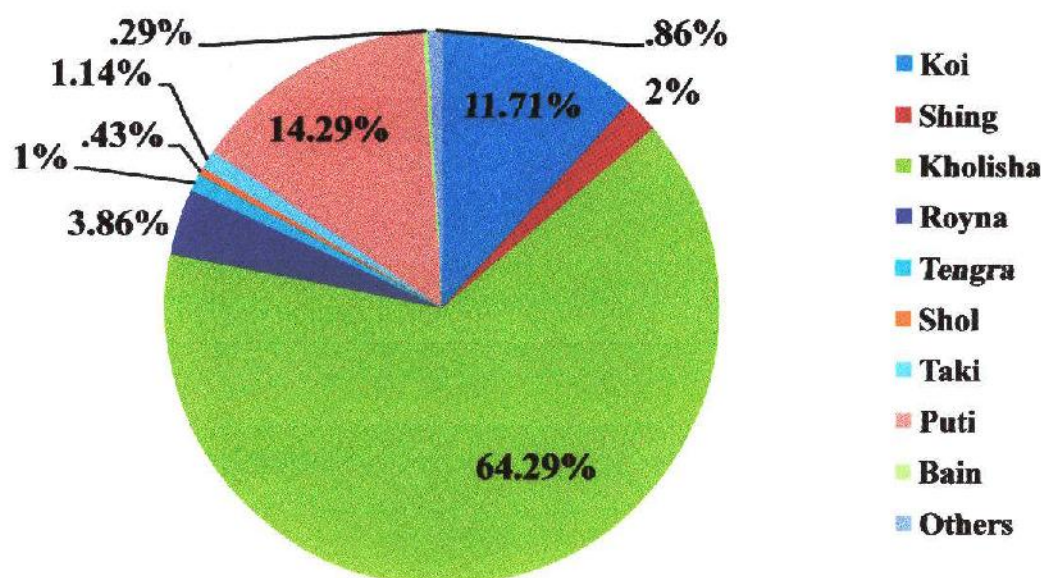


Figure 3: Species composition by Kholisha Jal

4.1.1.3. Koi Jal

The fishermen used this fishing net for catching species of Koi (*Anabas testudineus*) fish. . It was rectangular in shape and usually 4-6 m long and 0.6-0.7 m wide. This net was made of monofilament or multifilament nylon twine. Weights/sinkers made of soil, circular in form, were attached at a regular interval at the ground line of the net. This net had floating material attached to top portion of the net. Total weight of each net was observed 200-250g with weight and 20-40g without weight. Mesh size was found to vary from 3-3.8 cm.cm.

Mode of operation

The net was observed to set on or near the surface of water body. The ends of the head line of the net were not tied with pole cause it is passed though the beneath the water hyacinth or shaded water bodies with bamboo stick. Fish were collected from the net usually at 5-7 hours interval at daytime and 10-12 hours interval after setting net at evening for 6 months (June-November).



Mode of Operation of Koi Jal

Species composition

This gear was designed to catch to koi fish. Small amount of other fish species were caught by this net. A total of 10 major and some other species were recorded and species composition of koi jal were followed by Koi 72.22% , Kholisha 3.56% , Punti 1.11% , , Shing 13.89% , Magur 2.78%, Tengra 0.67%, Royna 1.89% Shol 1.22%, Taki 2.33%, Bain 0.44%, Others .33%(Figure-4).

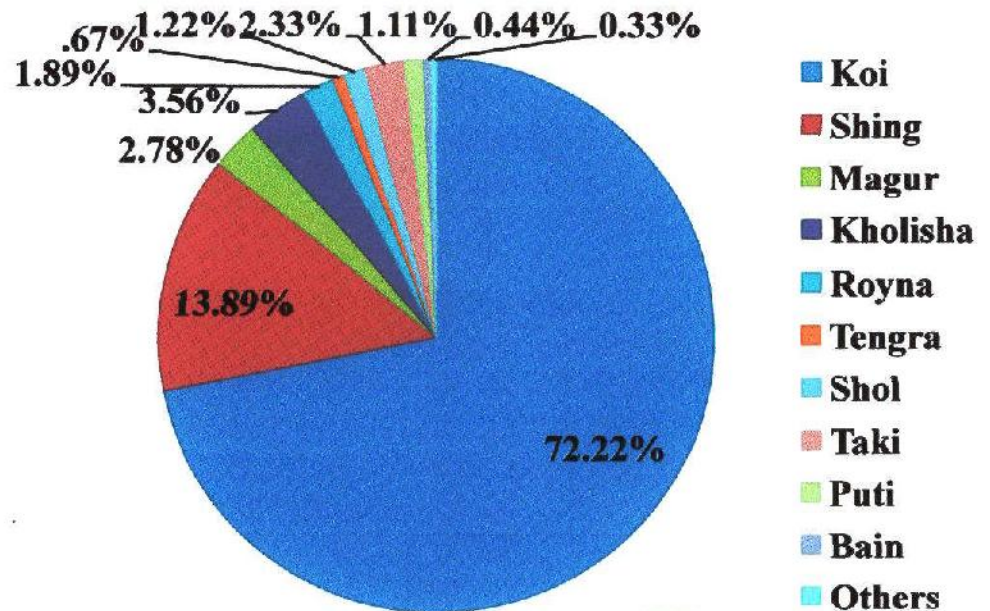


Figure 4: Species composition by Koi Jal



4.1.4 Jhaki Jal

Jhaki jal was a conical shaped circular net made of nylon or cotton twine. The mesh size varied from 0.5 to 1 inch depending upon the fish to be caught. The net was 3-6 m long from the anterior to the posterior end, with 6-12 m in diameter of the mouth. A long string about 5-7 meters was attached to the appendix of the cone. Iron/ lead weights in cylindrical form were attached at a regular interval attached at a regular interval at the ground line of the net. The string with the weight was attached to some upper meshes directly about 10-20 cm above the bottom forming pocket all along the circular end inside the net. When the net was cast it spreads out over the water surface circularly and when it was lifted it come out in conical form. Price of the net was 1000-3000 BDT.

Mode of Operation

Individual fisherman operated the net during fishing. With the rope tied to an arm of the operator, this gear thrown into the water from the bank or from boat. The net quickly reached and settle at the bottom circularly. Then it was pulled up slowly and fishes were entangled into its pockets. Each fishing attempt usually completed within 15 to 30 minutes. Fishing duration was 2-3 hours/day for 6-7 months (May-December).



Mode of operation of Jhakii Jal

Species composition

In the study areas fishermen used this net for fishing the miscellaneous small fishes. A total of 10 major and some other fish species were recorded and species composition of Jhaki jal was followed by Koi 2.29%, Shing 1.14%, Magur 0.57%, Kholisha 25.00%, Royna 3.86%, Tengra 2.97%, Shol 1.86%, Gojar 0.29%, Taki 4.29%, Puti 23.57%, Chela 14.29%, Bain 1.17%, Chuchra 17.14%, Others 1.90% (Figure- 5).

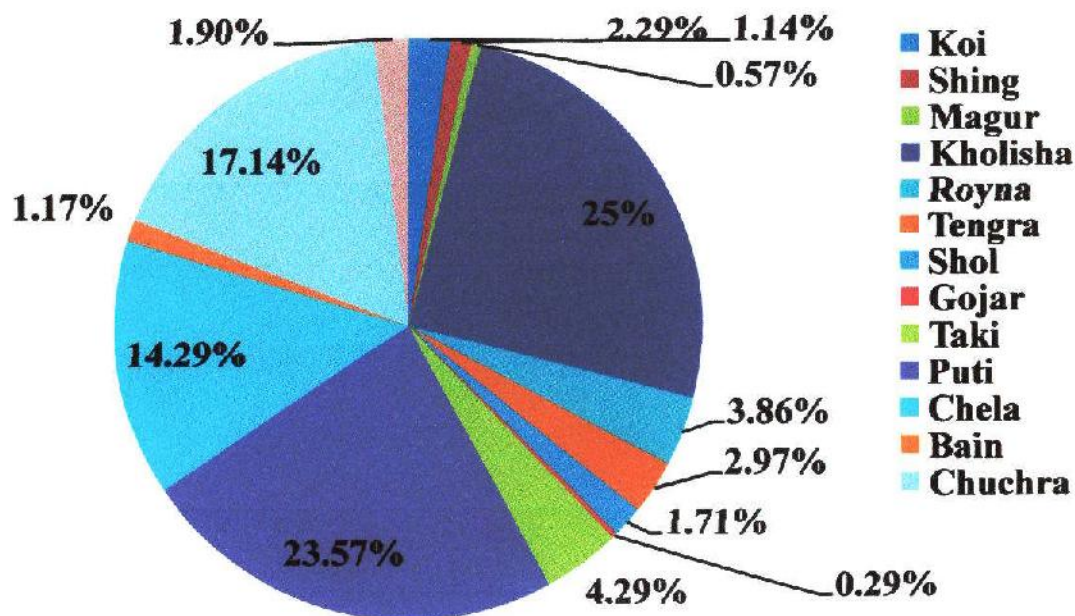


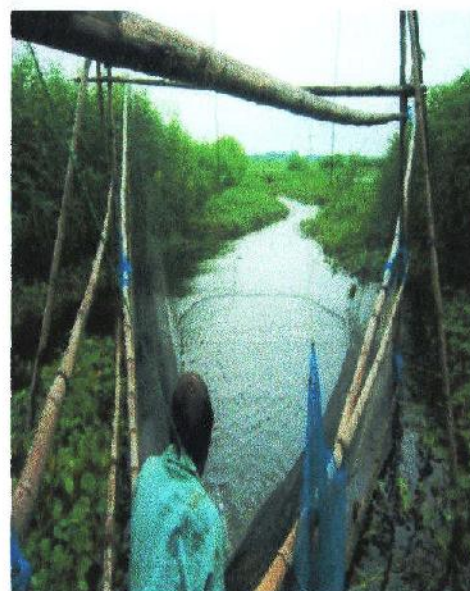
Figure-5: Species composition by Jhaki Jal

4.1.5. Veshal Jal

Locally the lift net was known as veshal/ khora Jal; mainly used for fishing not selected or specific species). It was triangular in shape, made of monofilament or multifilament nylon twine. The net was attached with a “V” shaped frame made of two bamboo poles. The two arms of the net were fastened to the bamboo poles fixed at the bottom of the water body. The two poles acted as fulcrum on two arms for dipping and lifting the net. There was a platform by the side of the cone-end from which fishermen operates the net. The mesh size of the net varied from .75 cm to 2.54 cm. The net measured 12 to 15 m in length and 10 to 12 m in breadth. Price of this net was 5000-7000 BDT.

Mode of operation

Fishermen generally used this net in slow following water in study areas for catching not selected fishes. Fisherman operated the net by dipping the front side into water against current while the con-end of the bamboo frame remain above the water. The pressure of the water current formed a bag at con-end of the net. The net was kept under the water depending on the presence of fishes in the net that about 20 to 30 minutes and then lifted by standing on the cone-end of the frame. Due to fulcrum action, the front side of the net rose above the water level as the result of pressure at the con-end, and the fisherman collected the fishes from the con-end. A small boat was always used for the operation. Fishing duration was 4-5 hours/day for 6 months (Jun-November).



Mode of Operation of Veshal Jal

Species composition

In floodplain areas fishermen used this net for fishing the miscellaneous small fishes. This gear was designed to catch 12 major and some fish species were recorded and catch consisted of Koi 0.8% , Kholisha 13% , Punti 33%, Chuchra 25% , Shing 0.8% , Magur 0.6%,Tengra 2%, Royna 1.8% Shol 0.8%, Taki 0.8%, Bain1%, Chela 18% ,Others 2.40% (Figure- 6).

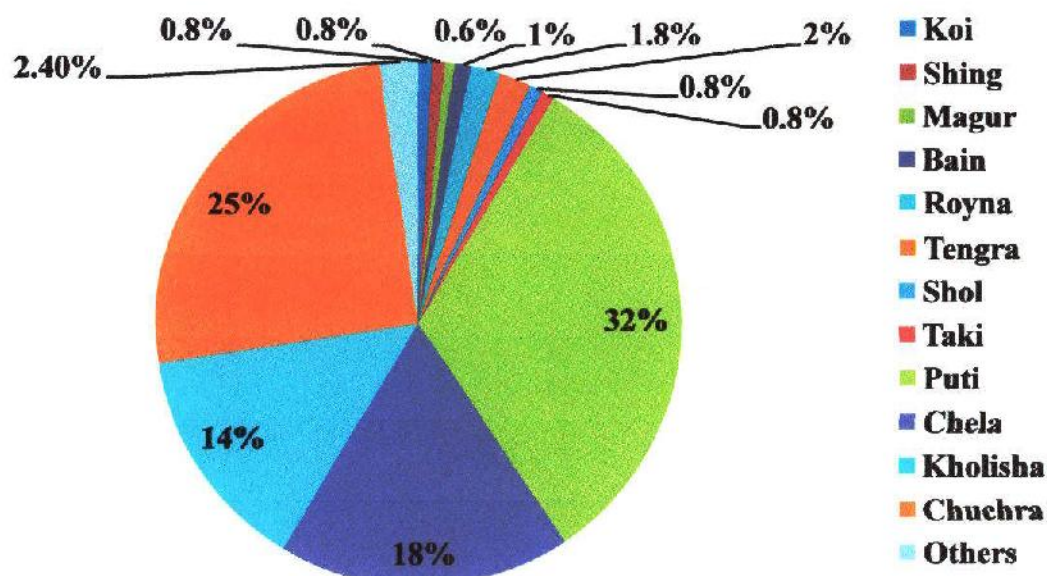


Figure- 6: Species composition by Veshal Jal

4.1.6. Ber Jal

This was not the usual method of harvesting in Floodplain. It was rectangular in shape, made of monofilament or multifilament nylon twine. Weights/sinkers made of soil, circular in form, were attached at a regular interval at the ground line of the net. This net had floating material attached to top portion of the net. It was usually 30-35 m long and 10-15 m wide. Total weight of each net was observed 10-15 kg with weight and Mesh size was found to vary from 2- 2.54 cm.

Mode of Operation

The groups of fishermen were involved in the fishing. Two boats became separated to encircle a certain area when the net was released from both the boats. Fishermen became divided into two groups and pulled the net from one end to other end made a circle. The fish were surrounded by the net. To protect the fish from jumping out from the encircled net, the fisherman at this stage made sounds in the water with bamboo sticks. The net was then further pulled to narrow down the circle when the fishermen lifted net with the entangled fish in it.



Observation of Ber Jall

Species Composition

Fishermen used this net for fishing the miscellaneous small fish throughout different areas of floodplain. A total of 10 major and some other fish species were caught and catch consisted of Koi 16.67% Shing 3.67%, Magur 1.50%, Kholisha 26.67% Royna 6.67%,Tengra 1% Shol 5%, Gojar 1%, Taki 13.33%, Puti 23.33%, Bain 1%, Others 1.33% (Figure- 7).

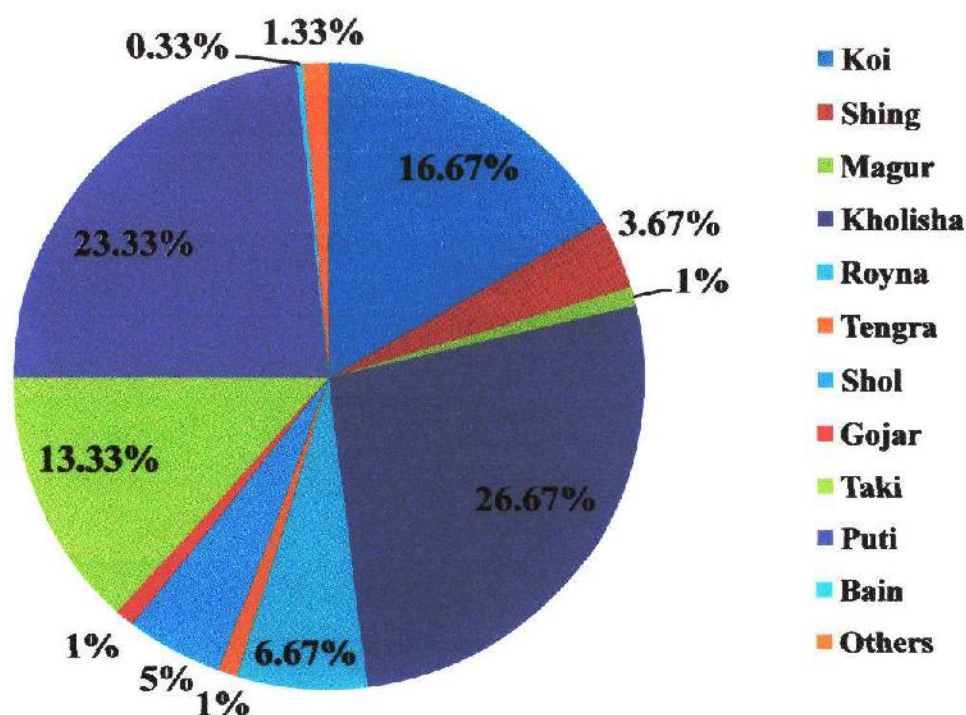


Figure 7: Species composition by Ber Jal

4.2. Hook and Line

Hook and line fishing was a general type of fishing in flood plain areas of Gopalganj. During the study period different types of hooks and lines were found in the study area namely Chasra borshi, Kecho Borsi (Nol/Dhap), Chuchra Borshi. Fishermen use different types of bait in the hook to attract fish.

4.2.1. Chasra Borshi

Chasra Borshi consisted of a stalk of water-hyacinth of length 20-25cm, a string or nylon tread (60-100 cm) was attached at the middle portion of the stalk, other end of the string was attached with narrower bamboo split which could be bent. Grasshopper was used as bait.

Mode of Operation

The operator bent the narrower bamboo stick and head portion of splitting the grasshopper were attached with bent bamboo stick as a bait. Then fishermen placed it into the water. Desired sinking depth of bait was maintained. When fish ate the bait; the bamboo stick became straight and target species were being caught. The time of operation was at 2-3 AM. They set several Borshi in a series of spots by replacing the water-hyacinth late night. Fish were collected after 2-4 hours, generally at morning.



Mode of Operation of Chasra Borshi

Species Composition

A total of 5 major and some other fish species were observed and species composition of Chasra Borshi was followed by Koi 78.21%, Shing 8.07%, Magur 3.07%, Shol 7.14%, Taki 2.29 %, Others 1.83% (Figure- 8).

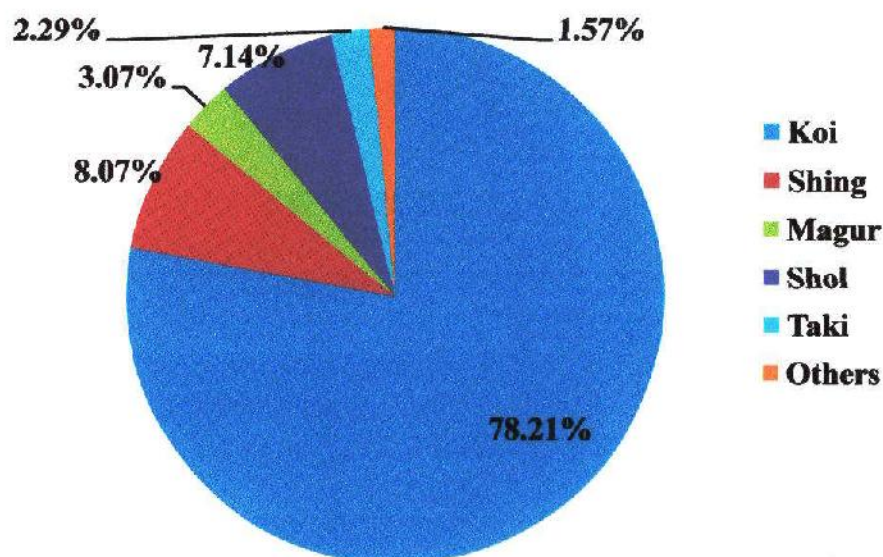


Figure-8: Species composition by Chasra Borsi

4.2.2. Kecho Borshi (Nol/ Dhap Borshi)

Kecho Borshi consisted of a stalk of water-hyacinth of length 20-25cm, a string or nylon tread (60-100 cm) was attached at the middle portion of the stalk, other end of the string was attached with a hook. Earthworm was used as bait.

Mode of operation:

The operator of hooks and lines added bait with the hook and placed the hook into the water. Earthworms were used as bait to attract target species. Desired sinking depth of bait was maintained by adjusting the position of float on twine. At the time of operation generally in evening they set several borshi in a series of spots by replacing the water-hyacinth evening. Fish were collected after 10-12 hours, generally at morning for 6 months (June-November).



Mode of Operation of Kecho Borshi

Species Composition

A total of 5 major and some other non major fish species were observed and species composition of Kecho Borshi were followed by Koi 9.55%, Shing 5.03%, Magur 3.18%, Shol 32.00%, Taki 47.50%, Others 3.70% (Figure- 9).

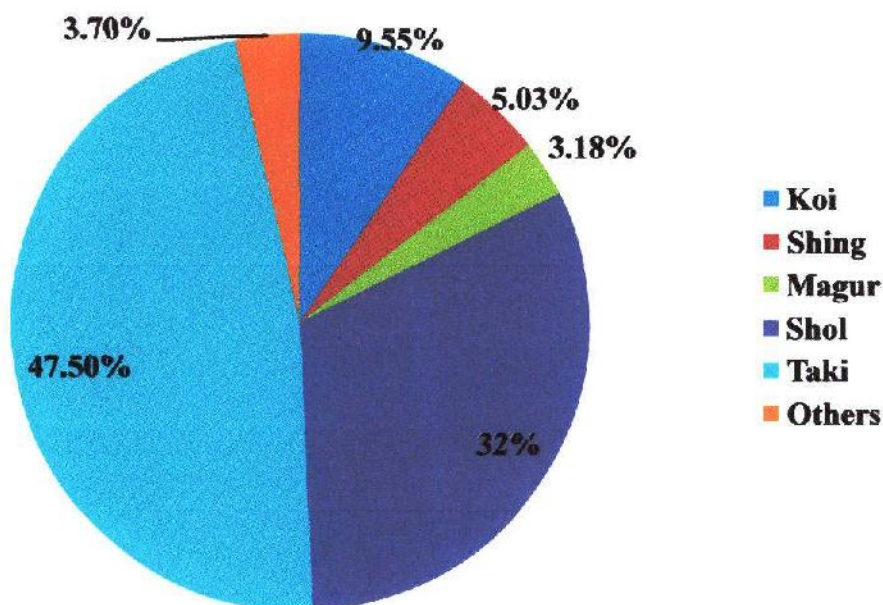


Figure-9: Species composition by Kecho Borshi

4.2.3. Chuchra Borsi

Chuchra Borshi consists of a stalk of water-hyacinth of length 20-25cm, a string or nylon tread(60-100 cm) is attached at the middle portion of the stalk, other end of the string is attached with a hook. Chuchra is used as bait.

Mode of operation:

The operator of hooks and lines added bait with the hook and places the hook into the water. Chuchra (*Colisa labiosa*) was used as bait to attract target species. Desired sinking depth of bait was maintained by adjusting the position of float on twine. At the time of operation generally in evening they set several Borshi in a series of spots by replacing the water-hyacinth evening. Fish were collected after 10-12 hours, generally at morning. Operation period is Jun-November.



Mode of operation of Chuchra Borshi

Species Composition

A total of 3 major and some other species were found and species compositions of Chuchra Borshi were followed by Shol 45%, Taki 44.17%, Gojar 6.00%, Others 4.83% (Figure-10).

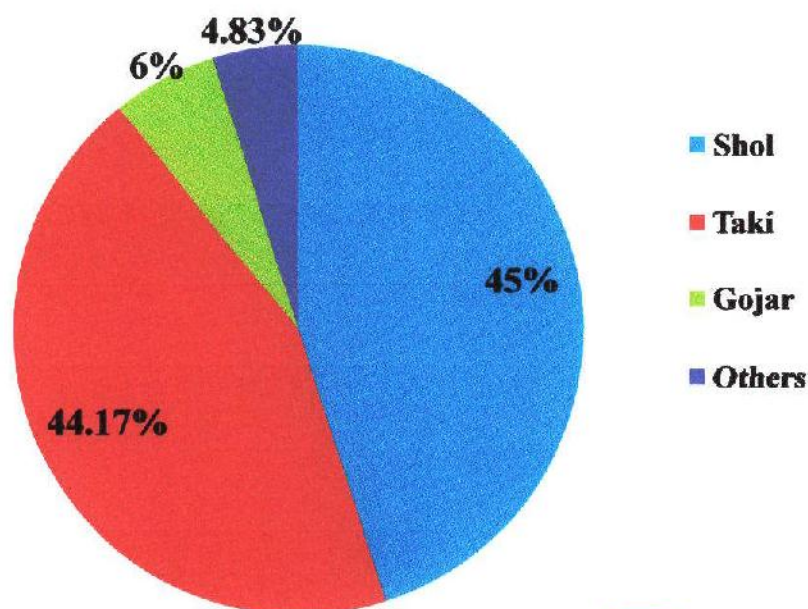


Figure-10: Species composition by Chuchra Borshi



4.3. Traps

Different types of trap were used by various fishermen for fishing as a source of income. A total of 5 types of trap were recorded during the period of study. The following were the description of all the traps that were seen to be operated in the floodplain areas. The traps were locally known as Ghuni, Khuchia Dughor, Koi Dughor, chalon and polo. Bamboo splits, cane materials, metallic wire or rope are used to make the traps.

4.3.1. Ghuni

Ghuni was made of bamboo split and it is a rectangular trap of variable size. The length, range from 40-45cm, breadth 30-35 cm, respectively. The space between the bamboo splits ranges from 0.2- 0.5 cm. There were 1-3 trap entrances on one side and 1 – 2 trap entrances on the opposite side. The mouth of the entrance extended from base to the apex. There was an opening on the top of the trap for collecting fish.

Mode of operation

It was set either in stagnant or running shallow water. It was placed on the demarcation line of the two ridges. It was also used by setting in line on the artificially made ridges across water bodies. The trap was set in the Morning to evening and lifted after 2-3 hours for harvesting fishes. Fishing duration was 8-10 hours/day for 6-7 months (May-November).



Mode of operation of Ghuni

Species Composition

A total of 4 major and some other fish species were captured and species composition of Ghuni were followed by Chuhra 26.35%, Chela 19.43%, Puti 23.59%, chanda 11.38% and Others 26.35% (Figure- 11).

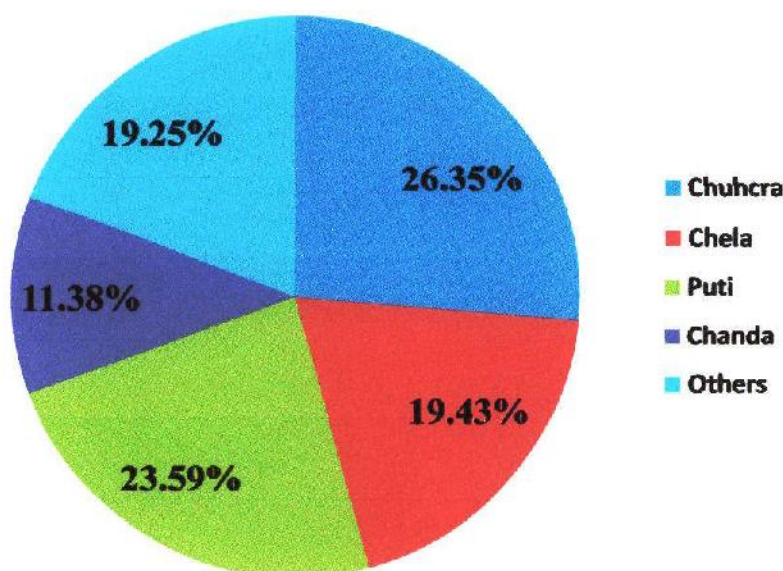


Figure-11: Species composition by Ghuni

4.3.2. Koi Dughor

Koi Dughor was a rectangular trap, broad at the base and narrow at the apex. The length range from 50-60 cm. breadth 15-20 cm. It was provided with three entrances two of which were situated at the base of the front side, one at each corner and another located in the middle portion of the rear side of the trap. The space between the bamboo splits varied from 1.5 – 2.5 cm.

Mode of operation

During operation, this gear was placed below the surface of water usually at 1-2 feet depth. It was generally used in the paddy field. When the fish species entered in the dughor throw entrance, then they couldn't get out. The traps were either set in the evening and lifted in the morning or set in the morning and lifted in the evening. Generally fishing duration: 8-12 hrs/day for 5 month (July to November).



Mode of Operation of Koi Dughor

Species Composition

A total of 3 major and some fish species were captured and species composition of Koi Dughor were followed by Koi 81.67% , Magur 4.50%, Shing11.67%, and Others 3.67% (Figure- 12).

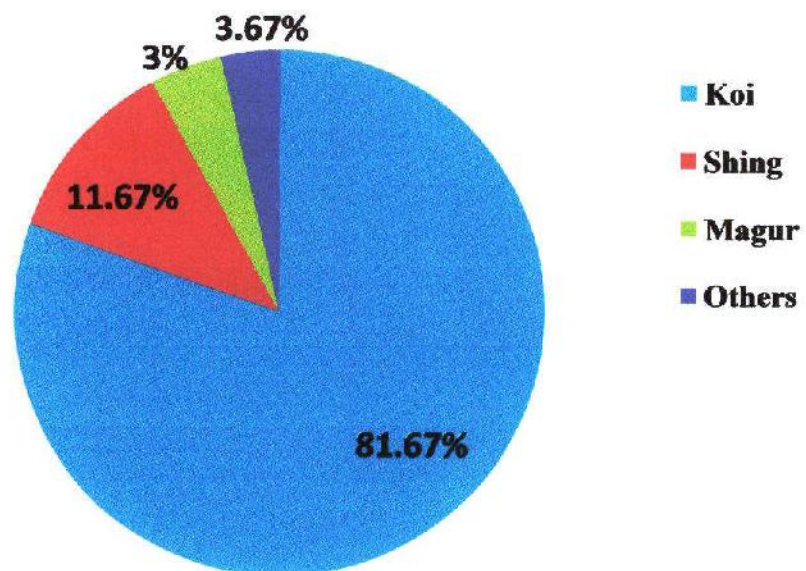


Figure-12: Species composition by Koi Dughor

4.3.3. Kuchiya Dughor

Kuchiya Dughor was also rectangular trap and box shaped but relatively small in size. The length range varied from 30-35 cm. breadth 20-25 cm. There were two trap entrances running from the base to the apex, lying one behind the other. At the top of the trap there was an opening for collecting fish. The space between the splits varied from 1 – 1.5 cm.

Mode of operation

During operation, earthworm used as bait and this gear is placed below the surface of water usually at 1-2 feet depth. It was generally used in the paddy field and the water bodies full of weeds. When the fish species entered in the Dughor throw entrance, then they can't get out. The traps were either set in the evening and lifted in the morning or set in the morning and lifted in the evening. Generally fishing duration: 8-12 hrs/day for 5 month (July to November).



Mode of operation of Kuchiya Dughor

Species Composition

A total of 4 major and some other species were caught and species composition of Kuchiya Dughor were followed by Kuchiya 82.12% Koi 6.94%, Shing 6.35%, Bain 4.74%, and Others 3.09% (Figure- 13).



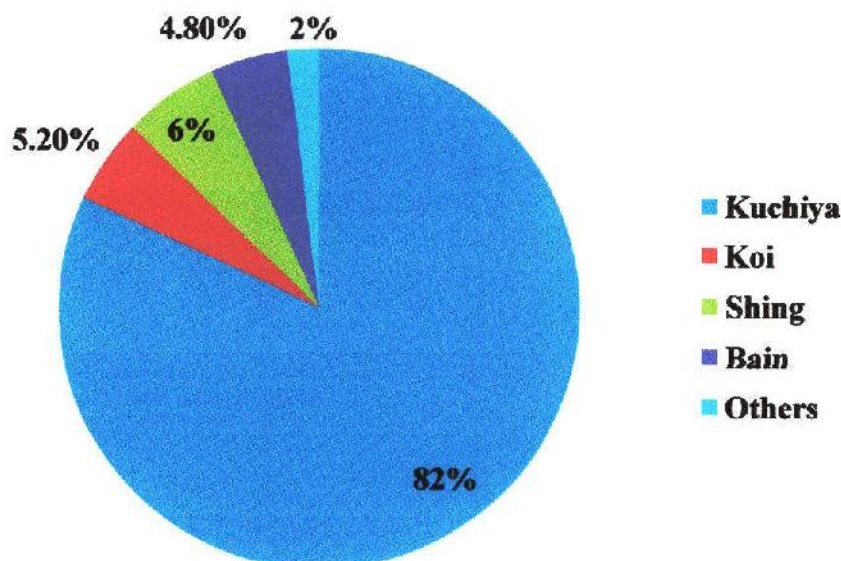


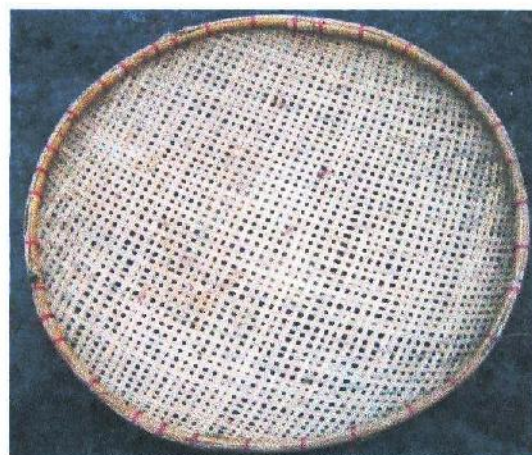
Figure-13: Species composition by Kuchiya Dughor

4.3.4. Chalon

Chalon was an circular shaped gear. It was made of bamboo fileet. Nylon sting or steel wire were used to bind. Its length range varied from 50-150 cm.

Mode of operation:

Generally one or more people were needed to operate the gear depend on size. Fishermen passed the gear beneath the water hyacinths or shaded water bodies shaded with weeds and quickly lift the gear. Then the water hyacinth or weeds were moved from the gear by the fishermen and collected the fishes from the gear. It was operated in the shallow water. Time of operation of the gear was 3-5 hours from Jun to December.



Observation of Chalon

Species Composition:

The major fish species caught were Koi, Taki, Shing, Kholisha, Puti, Chuchra, Chanda, Bele, Royna, Bain, Chela, Chingri, Mola, Others.

4.3.4. Polo

Fishing made by polo was usually done for fisherman's household consumption. Polo was a bell shaped fishing trap made of bamboo splits, lower part of this gear was cylindrical and upper portion is conical which was tied with bamboo rings.

Mode of operation:

During fishing, fisherman passed this trap to the mud bottom in shallow water and put his hand through the top opening to search fish in the trap and if any fish was entangled, the operator could know by its movement. The trapped fish was taken out through the upper opening.



Mode of Operation of Polo

Species Composition

Catch composition by Polo depends on place of operation, abundance of fish, fishing season and time. The major fish species caught were shing, magur, taki, cheng, Shol, Koi, Royna, puti, guchi etc.

4.4. Wounding Gear

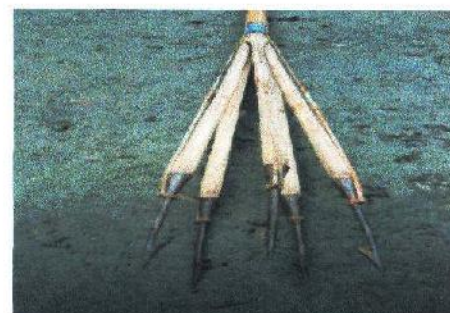
The wounding gears like Koach, Juti, and Fulkuchi were common in fishing in floodplain of Gopalganj. The gears consisted of either bamboo/iron shafts (handle) with forks or group of pointed iron spike firmly fixed at one end of it.

4.4.1. Juti

The Juti consisted of a bamboo handle or shaft. A bunch of 5-7 split bamboo pieces were firmly fixed with one end of the handle and the diverging free and pointed end of each split was covered with a sharp iron point. The pointed end of bamboo splits is attached with the detachable barbed points. The iron points attached to the shaft by cords.

Mode of Operation

The juti is thrown at the fish with great force while wounding the fish. It is normally operated by the fishermen from a boat or shore/embankment.



Observation of Juti

Species Composition

Juti was used for catching large types of species. A total of 4 major and some other fish species were captured and species composition of Juti were followed by Boal 42.5%, Chitol 16.25%, Gojar 16.25%, Shol 13.75%, and Others 11.25% (Figure- 14).

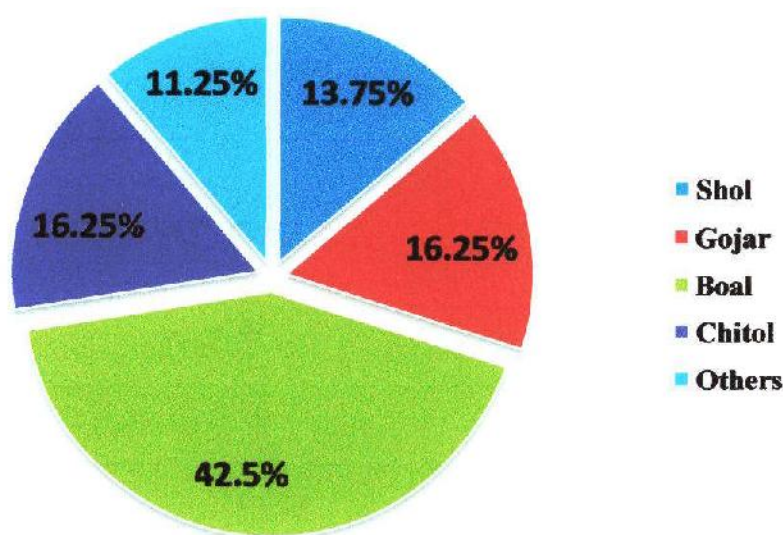


Figure-14: Species composition by Juti

4.4.2. Jhupi

Jhupi consisted of a bamboo handle. A bunch of 7-12 relatively long and sharp pointed iron rod was firmly attached with one end of the bamboo handle. The sharp edge of the rods was provided with barbs.

Mode of Operation:

The Jhupi was thrown at the fish with great force while wounding the fish. It is normally operated by the fishermen from a boat or shore/embankment.



Mode of operation of Jhupi

Species Composition

Jhupi was used for catching medium size of species. A total of 3 major and some other species were caught and species composition of Jhupi were followed by Taki 4.2%, Gojar 24%, Shol 62%, and Others 9.80% (Figure- 15)

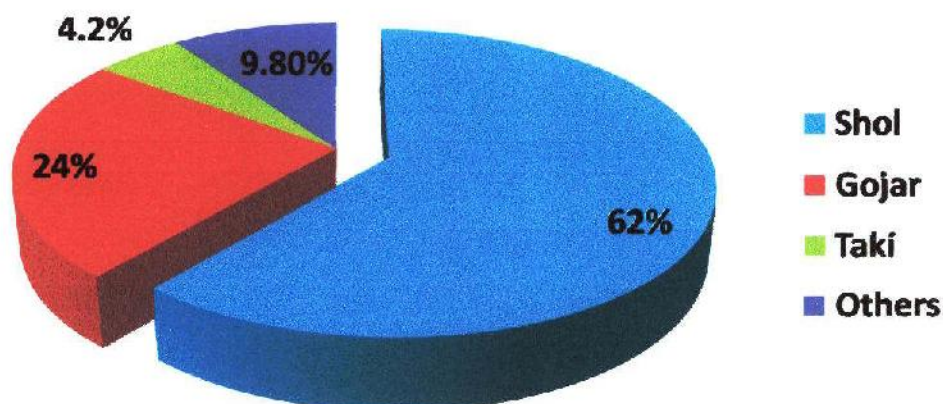


Figure-15: Species composition by Jhupi

4.4.3. Fulkuchi

Fulkuchi consists of 10-15 sharp pointed iron rods (spokes of umbrella or ricksaw) tied in a bunch and fixed to a bamboo handle. It was thrown with a great force at the moving shoal of relatively small fishes.

Mode of Operation

Fulkuchi was thrown at the fish with great force to wounding the fish. It is normally operated by the fishermen from a boat or shore/embankment.



Mode of Operation of Fulkuchi

Species Composition

Fulkuchi was used for catching large types of species. A total of 6 major and some other fish species were observed and species composition of Fulkuchi were followed by koi 11.60%, Shing 18.40%, Magur 16.40%, Bain 8.25%, Royna 7.60%, Taki 22%, and Others 15.40% (Figure- 16).

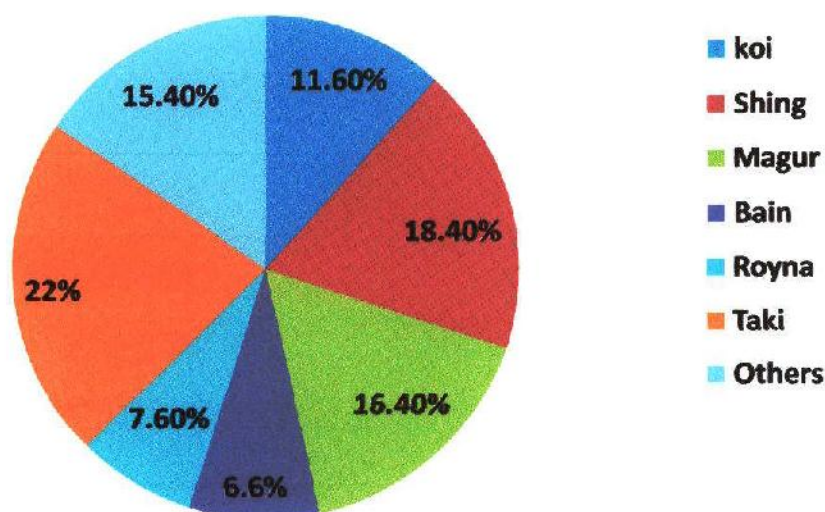


Figure-16: Species composition by Fulkuchi

4.5. Species Selectivity

During the study period a total of 17 different fishing gears were found to be used in the study areas of Gopalganj District. All of the fish nets, hook and lines, traps, wounding gear were not selective. Among the gears 8 numbers were selective gear and rest of the gear from study area were non-selective.

4.5.1. Nets

In the study area 4 types of fish net like-gill net, seine net, lift net, cast net were found. Operation method, and catch composition of species were not same of the gears. Different types of species were caught by the different fish nets. From the 4 types fish net only gill nets were selective gear.

4.5.1.1. Gill Nets

Three types of gill nets were found to be used by the fishermen for catching fish. Gill nets were more or less selective and fisherman used them to catch target species. These are locally known as punti jal, kholisha jal, and koi jal.

4.5.1.1.1. Punti Jal

This gear was designed to catch small fish in which most dominant species was puti and small amount of other fish species were caught by this net. Puti jal was a selective gear to catch puti almost 77.33% and other species was 22.67% (Figure- 17).

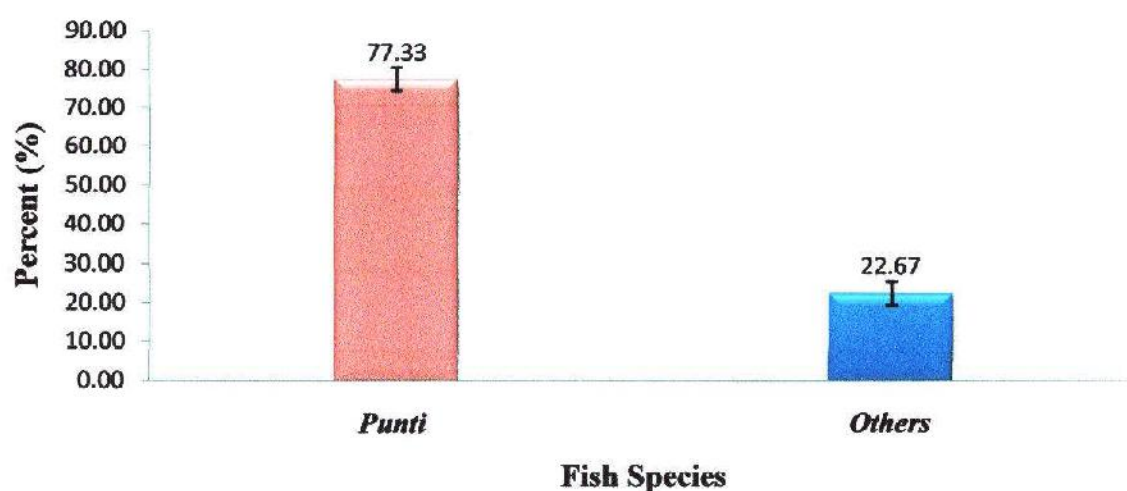


Figure-17: Species Selectivity of Punti Jal

4.5.1.1.2. Kholisha Jal

During this study period it was found that Kholisha jal was more selective to catch small fish in where kholisha fish was dominant and small amount of other fish species were caught by this net. It was too selective gear to catch Kholisha almost 64.29% and other species was 35.71% (Figure- 18).

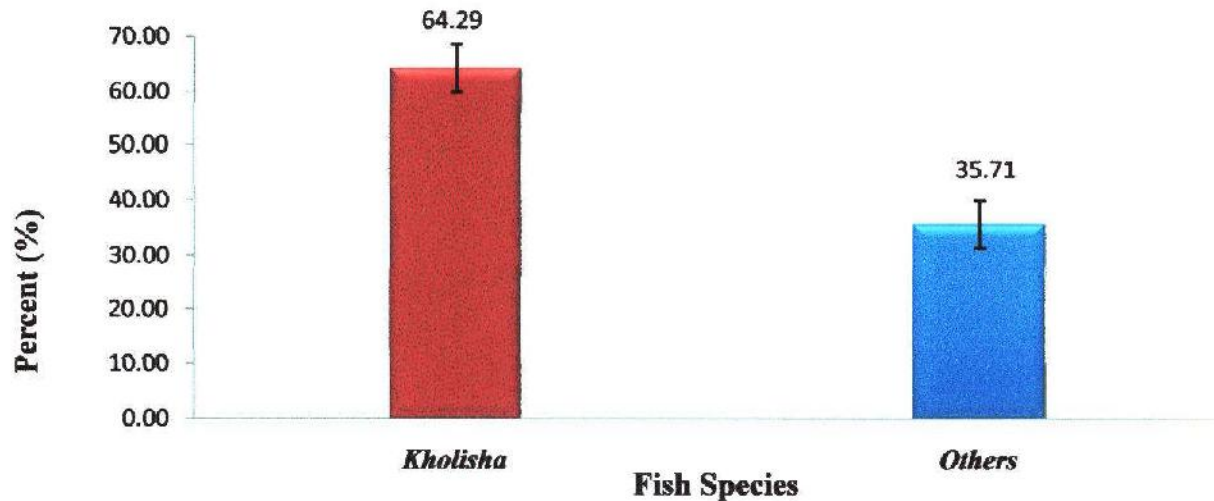


Figure-18: Species Selectivity of Kholisha Jal

4.5.1.1.3. Koi Jal

Koi Jal was designed to catch small fish in which most dominant species was koi and Small amount of other fish species were caught by this net. It was too selective gear to catch koi almost 72.22%, and other species was 27.78% (Figure- 19).

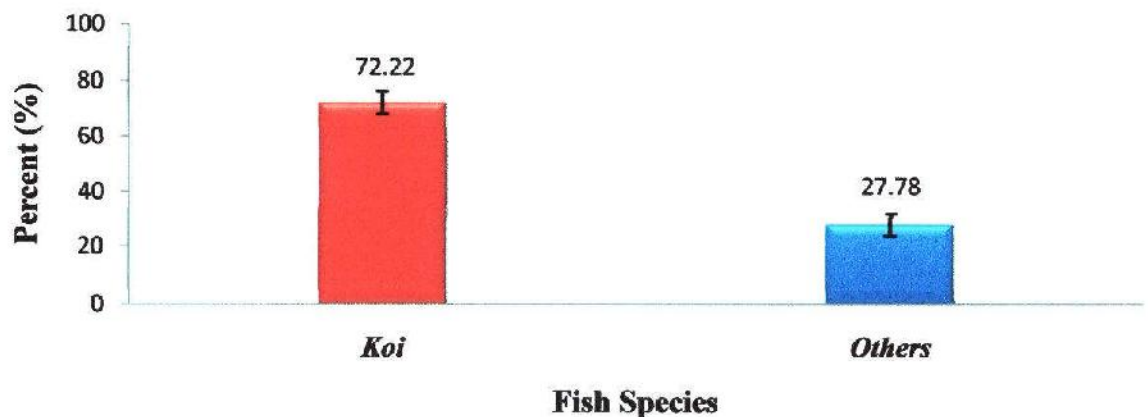


Figure-19: Species Selectivity of Koi Jal

4.5.2 Hook and Line

Hook and line fishing is a most common type of fishing in floodplain areas of Gopalganj. During the study period different types of hooks and lines were found in the study area namely Chasra borshi, Kecho Borsi(Nol/ Dhap), Chuchra Borshi. All of the hook and lines that were used in the study area were selective to catch specific species.

4.5.2.1. Chasra Borshi

Chasra borshi was the specific type of gear which operation method was interesting and used to catch specific species. Chasra borshi was used to catch only for Koi species and small amount of other species was caught by the Chasra borshi. It was about 78.21% koi species and 21.79% other species were caught by the chasra borshi (Figure- 20).

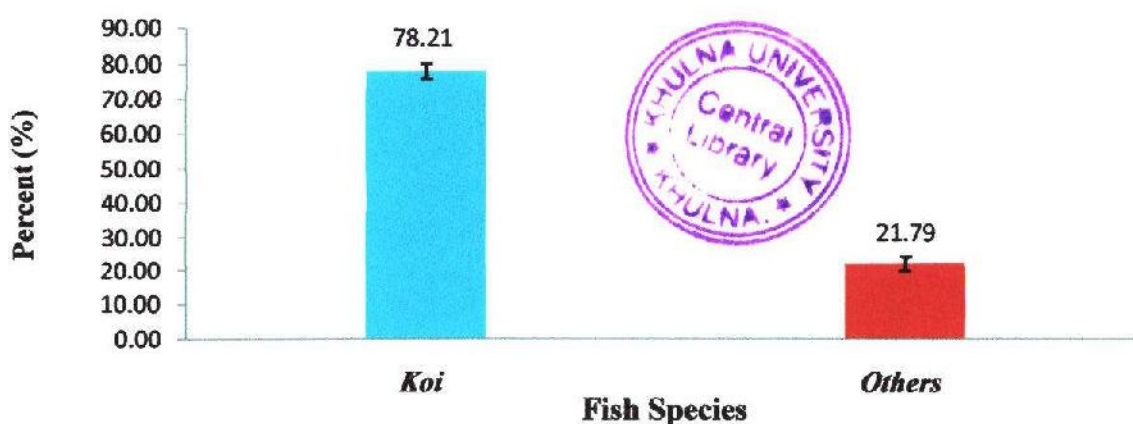


Figure-20: Species Selectivity of Chasra Borshi

4.5.2.2. Kecho Borshi (Nol/Dhap Borshi)

This gear was designed to catch specific type of species which were earthworm loving that's why earthworm (kecho) were used as a bait. Kecho borshi was used to catch fish in which most dominant species were shol, taki and Small amount of other fish species were caught by this gear. From that selective gear 32% shol, 47.50% taki and 20.50% other species were caught (Figure- 21).

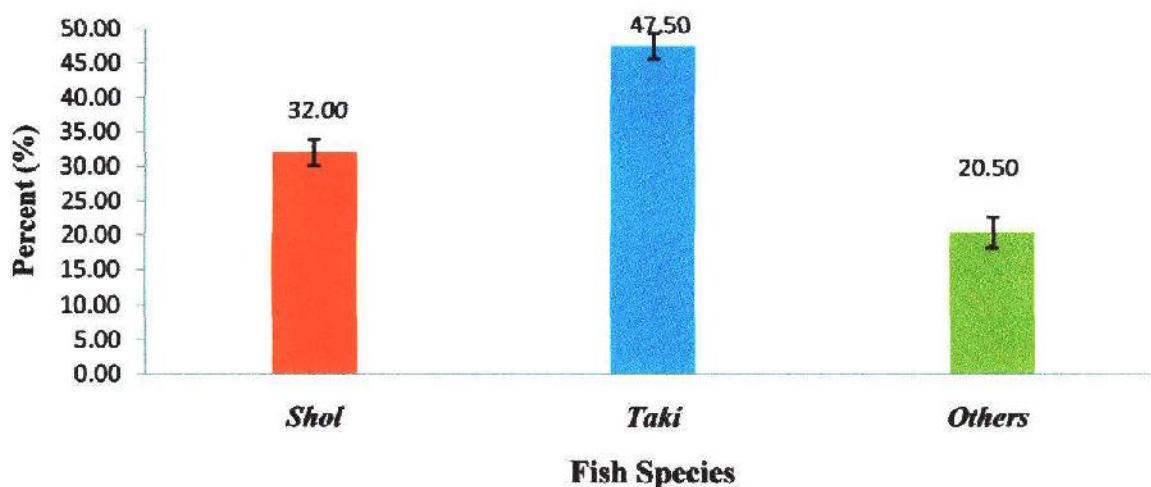


Figure-21: Gear Selectivity of Kecho Borshi (Nol/Dhap Borshi)

4.5.2.3. Chuchra Borshi

In the study period it was seen that alive Chuchra species were used as bait to attract target species in Chuchra borshi. Generally carnivore species were caught by this gear in where shol, taki were dominant and some other species were caught by this gear. This gear was selective to catch 45% shol, 44.17% taki and 10.83% other species (Figure- 22).

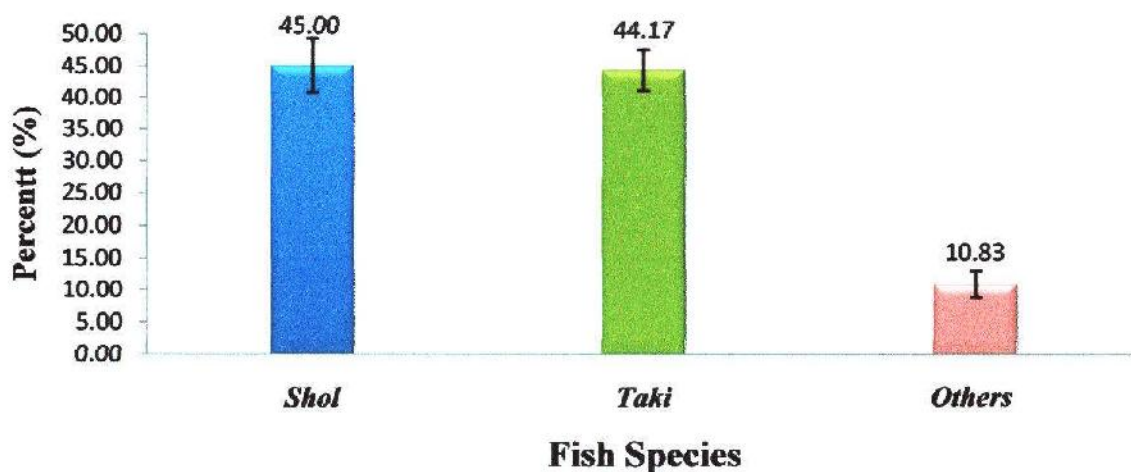


Figure-22: Species Selectivity of Chuchra Borshi

4.5.3. Traps

During the study, 5 types of trap were recorded which were Ghuni, Khuchiya Dughor, Koi Dughor, chalon and polo. Among the traps ghuni, chalon, polo were non-selective gear for specific species and khuchiya dughor, koi dughor were selective gear for specific species.

4.5.3.1. Kuchiya Dughor

This gear was designed to catch specific type of species in which earthworm (kecho) was used as a bait. A total of 4 major and some other non major fish species were captured in where kuchiya was the most dominant species. It was about 82% kuchiya species and 18% other species were caught by the Kuchiya Dughor (Figure- 23).

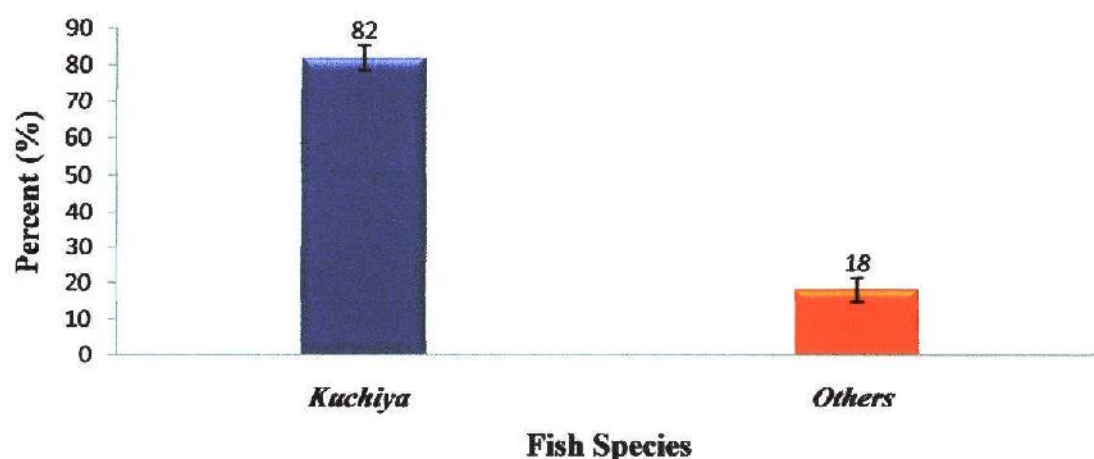


Figure-23: Species Selectivity of Kuchiya Dughor

4.5.3.1. Koi Dughor

In the study period it was found that koi dughor was designed to catch specific type of species in which earthworm (kecho) was used as bait. It was more selective to catch about 81.67% koi species and 18.33% other species were caught by the Koi Dughor (Figure- 24).

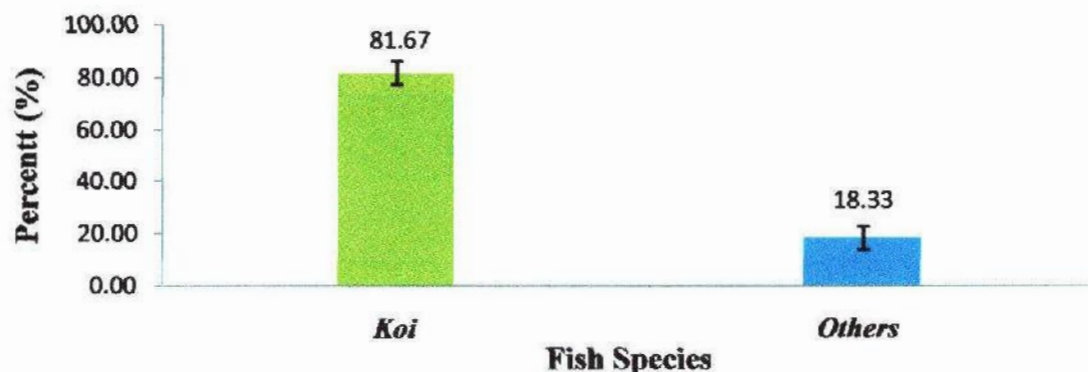


Figure-24: Species Selectivity of Koi Dughor

4.6. Total Catch

In the study period it was noticed that different types of gear were used to catch fishes in the study area. Due to increasing of water from Jun to October, gear were used widely in the floodplain areas and then decreased gradually with the decrease in water level during rest of the months but the use of wounding gears increased which were generally used by the subsistence fishermen.

4.6.1. Fish Net

Though 4 types of fish net like-gill net, seine net, lift net, cast net were found but catch from all the gear were not same due to size and length, species, operation method, availability of water flow etc. Among the nets catch varied between 35.17 kg and 1390 kg where highest amount in ber jal was observed (Figure-25 and Table-2).

4.6.1.1 Gill Net

Three types of gill net were found which designed to catch different species of small fish species. In puti jal the total catch was 55.70 ± 2.15 kg per unit gear per season where puti was the most dominant species (----%). In Koi jal the total catch was 35.17 ± 2.10 kg per unit gear per season where koi was the most dominant species. Kholisha jal designed to catch much amount than other gill net was 62.14 ± 5.23 kg per unit gear per season (Figure- 25).

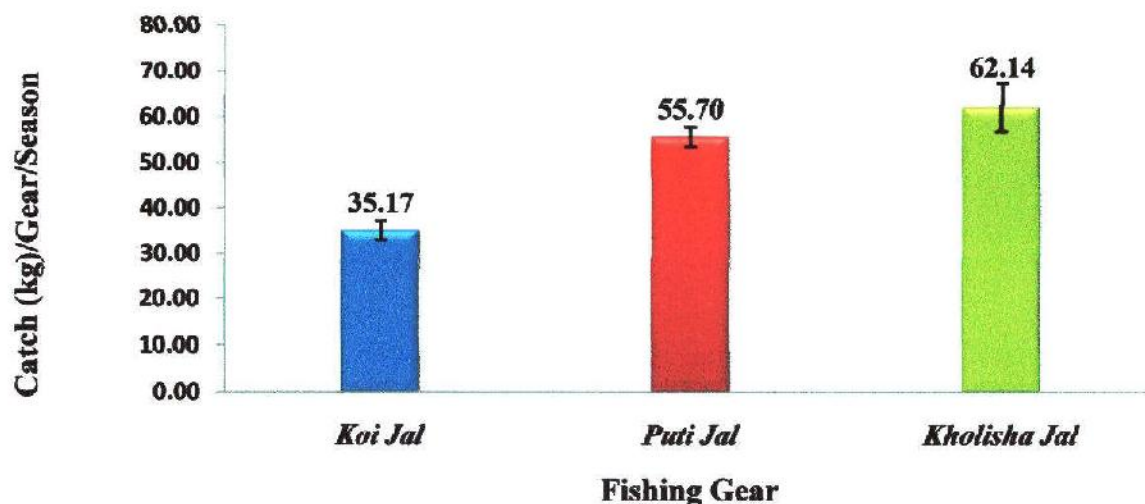


Figure-25: Total Catch Among The Gill Net

4.6.1.2 Others Net

Three types of other net were found which designed to catch different species. Ber jal represented most catch than any other net that was 1390 ± 103.57 kg per unit gear per season. The total catch of jhaki jal was 480.75 ± 134.54 kg per gear per season which was non selective gear. Veshal jal used to catch different types of fish species with every size that caught 711 ± 63.18 kg per gear per season (Figure- 26).

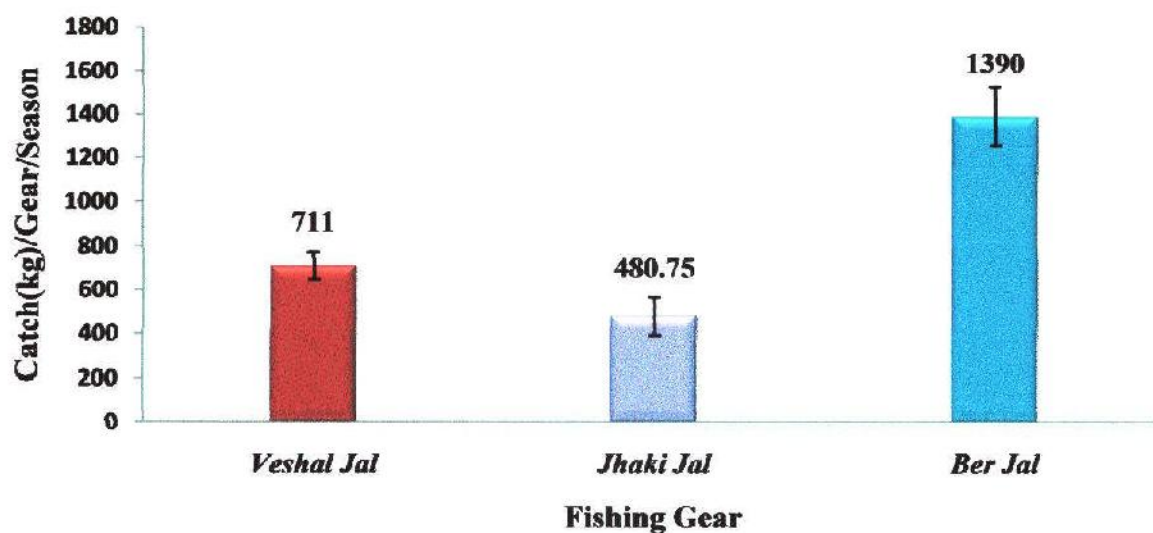


Figure-26: Total Catch Among Other Nets

4.6.2. Hook and lines

The present study represented that three types of hooks and lines were found in the study area where every types used different bait to catch selected species. Chasra borshi, Chuchra borshi and kecho borshi(Nol/Dhap) designed to catch 1.12 ± 0.05 , 1.46 ± 0.17 , 1.76 ± 0.11 kg/gear/season(Figure- 27).



Figure-27: Total catch among the Hooks and Lines

4.6.3. Traps

During the study, 5 types of trap were recorded but 3 types were commonly used to catch regularly and others were for occasionally. Total catch counted from Ghuni 93.5 ± 7.89 kg/gear/season in where non selective small species were caught. Kuchiya Dughor designed to catch Kuchiya where 70.2 ± 9.39 kg/gear/season were caught. Total catch counted from Dugor. $23.00 \pm .50$ kg per gear per season (Figure- 28).

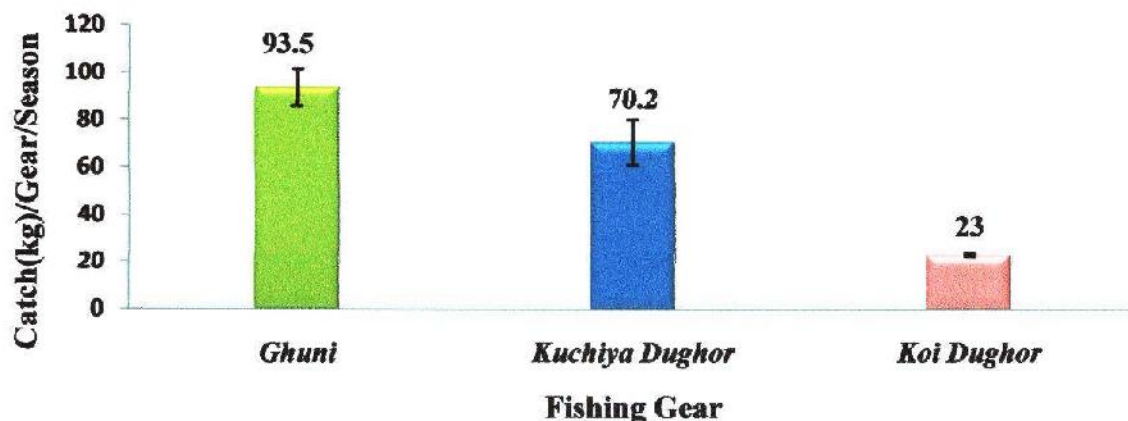


Figure-28: Total Catch Among The Traps

4.6.4. Total Catch among the Gears

The average catch for all fishing gears in floodplains area of Gopalganj varied widely ranging between 1.12 kg and 1390 kg/gear/season. Figure-28, represents the average catch for all fishing gears per season used in study areas of the floodplains of Gopalganj. The total catch values ranged between 35.17 kg and 1390 kg/gear/season for fishing nets, between 23 kg and 93 Kg/gear/season for traps, and between 1.12 kg and 1.76 kg/gear/season for hooks and line fishing. The mean Total catch from Gillnet, Other nets, Traps, Hooks and line was 51.19 ± 2.52 , 739.35 ± 103.57 , 70.07 ± 8.64 , 1.40 ± 0.075 Kg/gear/season respectively (Figure- 29).

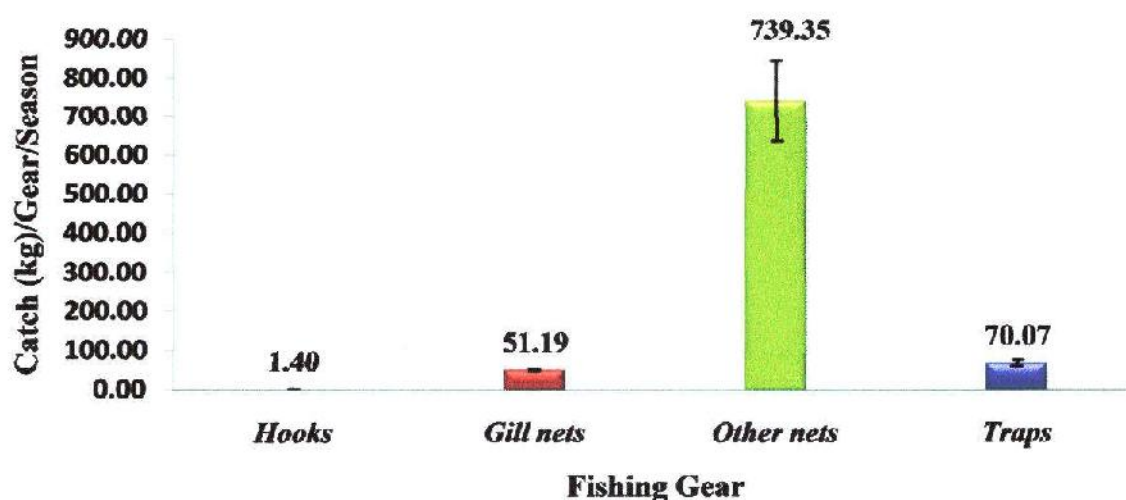


Figure-29: Total catch among the Different Gears

CHAPTER FIVE

DISCUSSION



Discussion

5.1. Fishing gears

The study conducted to know the species selectivity, catch composition and its catch per unit gear per season of fish species of floodplain areas of Gopalganj district. A total of 17 different fishing gears were found to be used in this study area. All the gears were broadly classified into 4 major categories namely nets, traps, wounding gears and hooks and lines each of which were also categorized into a number of sub-types. Fish net have 4 sub types-gill net, seine net, lift net, cast net. Fish traps are classified as box trap and basket trap. Hook and lines and wounding gear are considered as two sub types. Again most of these sub-types have different forms. Gill nets were mainly of 3 forms- Punti jal, koi jal, kholisha jal. In the selected area seine net, lift net, cast net were known as Ber jal, veshal, jhaki jal respectively. Similarly hook and line have 3 forms and wounding gears have 3 forms (Appendix-II). Haque *et al.* (2010) found a total of 16 types of fishing gears are operated by the fishermen in Beel Kumeri which is quite similar to the present study. Chakraborti (2009) found lift net, current jal, cast net, traps, hooks and lines to be used by fisherman in Punuria Beel. Saha *et al.* (2005) classified 7 different types of gear into 3 categories (nets, traps and wounding gears) used by 2 categorized fishers in the Gawha Beel in Nawabganj. Ahmed *et al.* (2002) found 3 kinds of gill nets, 14 kinds of seine nets, 5 kinds of long line and hook and 4 kinds of spears in the floodplain of the River Titas, Brahmaputra during survey. BCAS (1991) also reported that fishermen use approximately 30 different types of fishing gears in Halti Beel. However the fishing techniques that were followed by the fishermen in BSKB beel have been categorized into netting, trapping, angling, spearing dewatering and hand picking (Dewan and Mazid, 1994).

5.2. Species composition

In the study period around 30 species were found where Gill net consisted of 12 major species and some other fishes were found(Appendix-III). Species composition of Puti jal was Puti (77.33%), Royna (4.33%), Koi (.93%) , Kholisha (13%), Tengra (1%), Shol (0.07%), Taki (2.73%), Bain (0.65 %), Chuchra (1%), Others (0.67%) species; species composition of Koi jal was Kholisha jal caught Kholisha (64.29%) Punti (14.29%), Koi (11.71%), Shing (2%), Royna (3.86%), Tengra (1%), Shol (0.43%), Taki (1.14%), Bain (0.29 %), Others (0.86%). and species composition of Koi jal was followed by Koi (72.22%) , Kholisha (3.56%) , Punti 1.11%, , Shing (13.89%) , Magur (2.78%),Tengra

Bain (1%), Others (1.33%). Miah (2004) and Akandha (2004) recorded 23 & 22 species of fishes in Savar Khagor Baria Zolkor beel and Baila beel which were found to be the highest dominant species of *A. mola* (24.09%) and *M. lamarrei* (34.88%) respectively. Haque *et al* (2010) found a total of 30 species of fishes of veshal jal during the study period.

The present study represented that 3 types of Hooks and line found a total of 8 major and some other species in where species composition Chasra Borshi were Koi (78.21%), Shing (8.07%), Magur (3.07%), Shol (7.14%), Taki (2.29 %), Others (1.83%) ;species composition of Kecho Borshi(NI/Dhap) were Koi (9.55%), Shing (5.03%), Magur (3.18%), Shol (32%), Taki (47.50%), Others (3.70%) and species composition Chuchra Borshi was followed by Shol (45%), Taki (44.17%), Gojar (6%), Others (4.83%). Paul *et. al.* (1993) reorded 17 species of fish at Chanda beel in the catches of dhaon borshi in which dominant spesces taki (27.2%) shoal (18.8%) tengra (14.55%) but in Haltibeel 9 species were recorded in which dominant species baim (30.85%) ghaira (19.1%) boal (13.15%). Haque *et al* (2010) recorded 11 species of fishes in the catches of Nol borshi during the study period.

About 15 major and some other non major fish species were captured in 3 types of Traps and species composition of Ghuni were Chuchra (26.35%), Chela (19.43%), Puti (23.59%), chanda (11.38%) and Others (26.35%) ; species composition of Koi Dughor were (Koi 81.67%) , Magur (4.50%), Shing (11.67%), and Others (3.67%) and species composition of Kuchiya Dughor were Kuchiya (82.12%) Koi (6.94%), Shing (6.35%), Bain (4.74%), and Others (3.09%). Miah (2004) recorded were *L. guntea* (23.33%) *G. giuris* (20.0%) *M. vittatus* (16.66%), and *P. sophore* (8.33%) in Savar Khagobaria Zolkor beel and Rahman (1996) recorded 26 species where dominant species punti (13.05%), baim (11.05), taki (1030%), kholisha (9.63%), tengra (9.22%), rui (7.48%) in the BSKB beel by using traps.

In the study period 3 types of Wounding gear found a total of 15 major and some other non major fish species like Boal, Chitol, Gojar, Shol, Taki, koi, Shing, Magur, Bain, Royna and Others. Haque *et al* (2010) recorded 3 types of wounding and 13 species of fishes were found to in Beel Kumari during the study period which resembled the study.

5.3. Species Selectivity

Gear selectivity includes the species composition of different gears which constitute percentages of fish caught. During the study period a total of 17 different fishing gears were found to be used in the study areas of Gopalganj District that were classified in to 4 categories. Among the categories some were highly selective and some were not. Eight gears were observed as selective gear and rest 9 were non-selective (Table-1). With respect to species selectivity ber jal, khepla jal and veshal jal (net), charo, arinda and ghuni (trap), dhawn and nol borshi (hook and line) were recorded non-selective gear both for species and size (Rahman et al, 1999). Punti jal, koi jal, fash jal and bhuti jal (net), klladom and tubo (trap), chip borshi and chasra (hook and line) and all hand harpoons were recorded more or less selective gears (Rahman et al, 1999).

Table-1: Species selectivity of fishing gear with fishing type and species behavior

Gear	Type of fishing	Selective Species	Behavior
Koi Jal	Day & Night Fishing	Koi	Generally Nocturnal
Kholisha Jal	Day Fishing	Kholisha	Diurnal
Punti Jal	Day Fishing	Punti	Diurnal
Jhaki Jal	Day Fishing	Non Selective	-
Veshal	Day Fishing	Non Selective	-
Ber Jal	Day Fishing	Non Selective	-
Chasra Borshi	Night Fishing	Koi	Nocturnal
Kecho Borshi	Night Fishing	Taki, Shing, Koi, Shol	Nocturnal
Chuchra Borshi	Day & Night Fishing	Shol, Taki	Generally Nocturnal
Ghuni	Day Fishing	Non Selective	-
Koi Dughor	Night Fishing	koi	Nocturnal
Kuchiya Dughor	Night Fishing	Kuchiya	Nocturnal

In the present study 4 type's fish net only gill nets were selective gear. In case of gillnet, Puti jal was a selective gear to catch punti almost 77.33% and other species 22.67%; Kholisha jal was found to catch Kholisha almost 64.29% and other species was 35.71%

that represented kholisha was more dominant species and almost 72.22% koi were caught by the Koi jal which indicated koi jal was selective to catch koi species (Figure- 30). Rahman *et al.* (1999) found that among these gears, punti jal was found to catch mainly *Puntius* sp.(49.61 %), and koi jal mainly *Anabas* sp. (45.62%) along with other resident species to a lesser extent. Choudhury (1989) also stated in his study that punti jal and koi jal are used for *Puntius* sp. and *Anabas* sp. respectively.

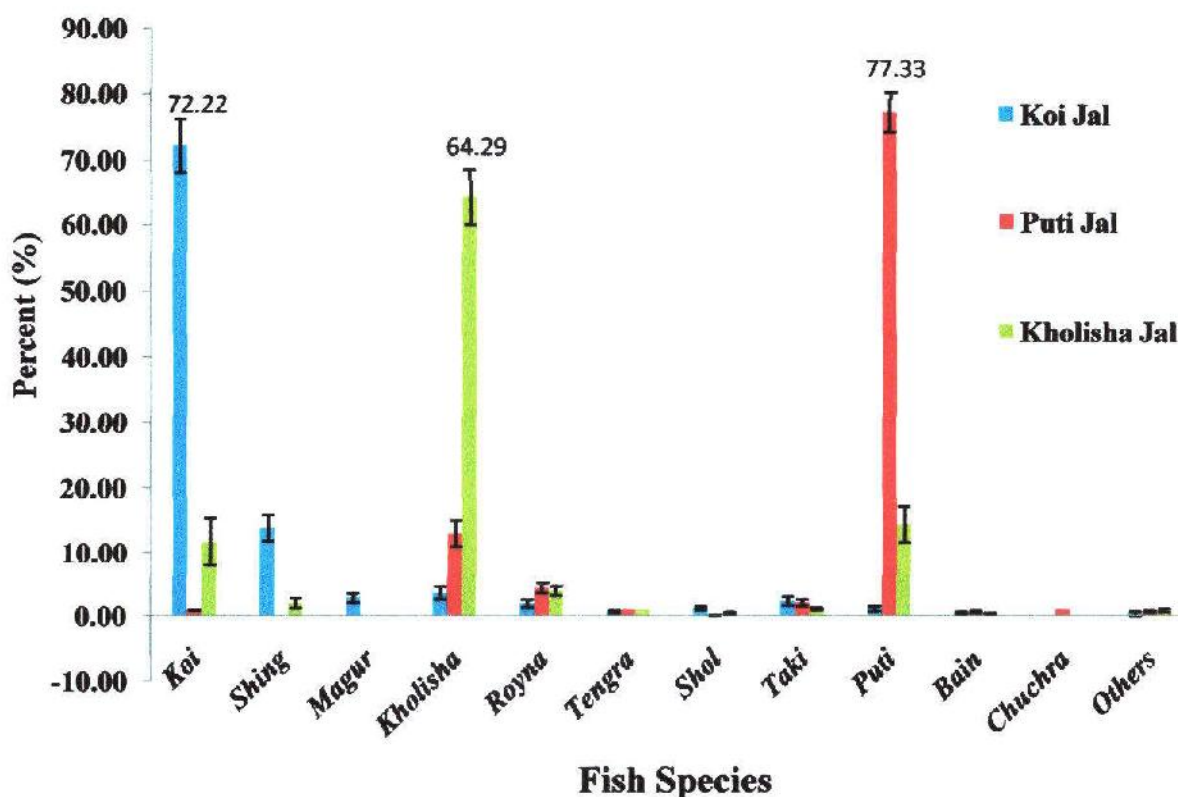


Figure -30: Species selectivity of different types of gill net

During the study it was about 20 types of species found in Others Net (Ber jal, Jhaki Jal, Veshal Jal) but all the nets were not species selective (Figure-31). There was no domination of specific species in catch composition and were found to contribute insignificantly quantity to the catch. Rahman *et al.* (1999) stated with respect to species selectivity ber jal, khepla jal and vashal jal (net), charo, arinda and gll.uni (trap), dhawn and nol borshi (hook and line) were recorded non-selective gear both for species and size.

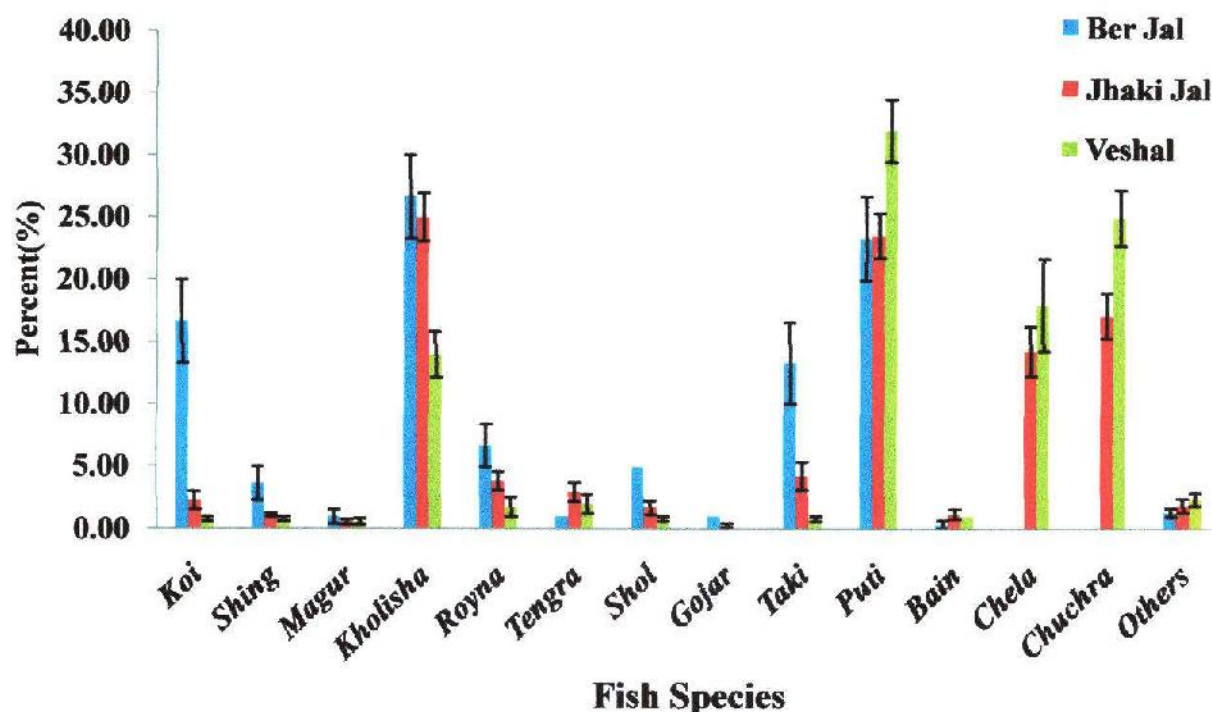


Figure -31: Non Species selectivity of Others Net

In case of hooks and lines Chasra borshi, Kecho Borsi(Nol/ Dhap), Chuchra Borshi were used in the study area to catch specific species. It was about 78.21% koi species and 21.79% other species were caught by the chasra borshi that indicates this gear was more selective to catch koi species. Bamboo made hook-chasra was recorded as a gear of restricted species (koi, lata and shol) among all the gears studied. By the Kecho Borsi (Nol/ Dhap) 32% shol, 47.50% taki and 20.50% other species were caught which showed selectiveness about catch species. It was about 45% shol, 44.17% taki and 10.83% other species were caught by the Chuchra Borshi that represented selectiveness about species (Figure- 32). Rahman *et al.* (1999) found a total of 11 species of fishes in the catches of Nol borshi during the study period. Among them the highest and the lowest dominant species was about Taki (52.76%) and common carp (0.85%).

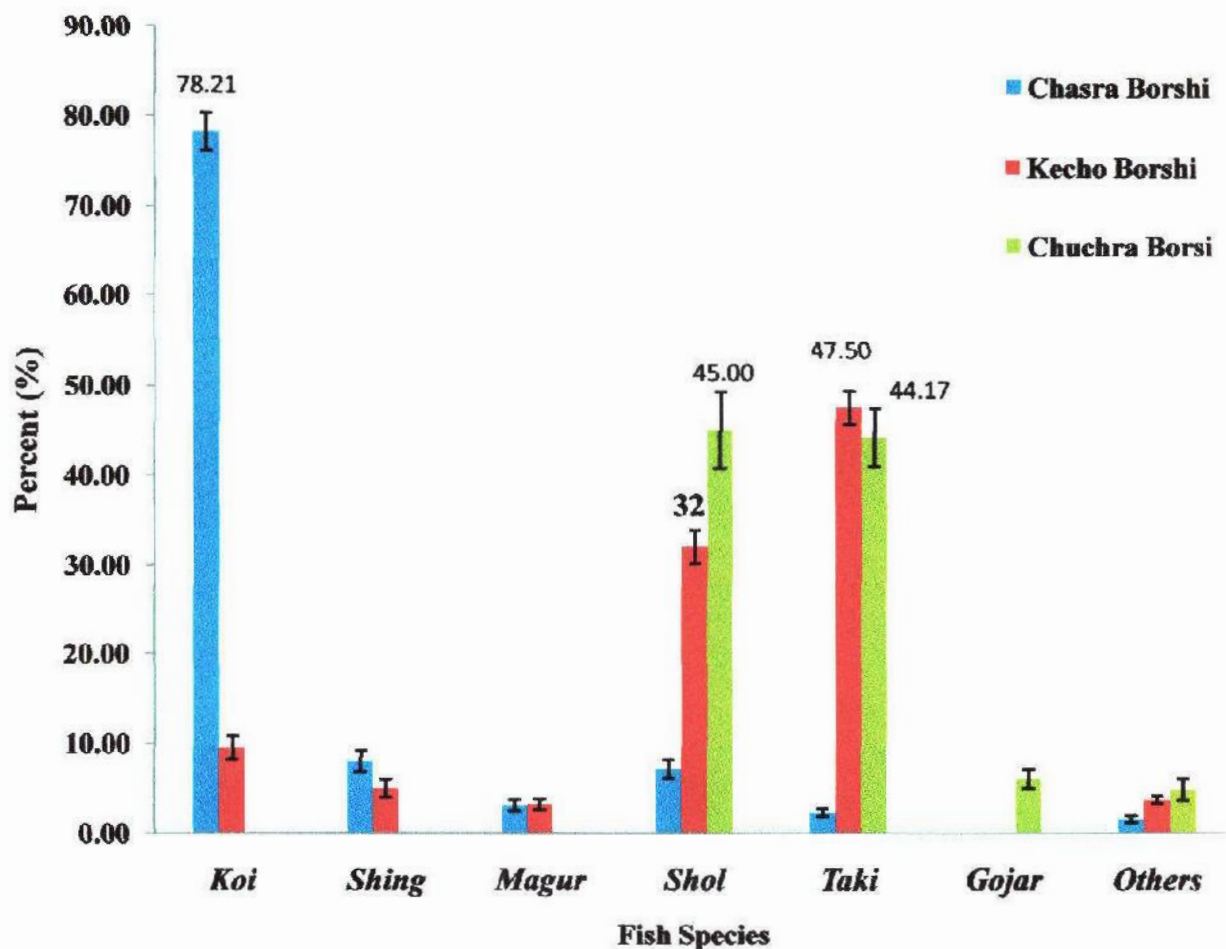


Figure-32: Species Selectivity of different Hook and Line

Among the traps khuchiya dughor, koi dughor were selective gear for specific species. It was more selective to catch about 81.67% koi species and 18.33% other species were caught by the Koi Dughor. It was about 82% kuchiya species and 18% other species were caught by the Kuchiya Dughor that represented the selectiveness. (Figure- 33).

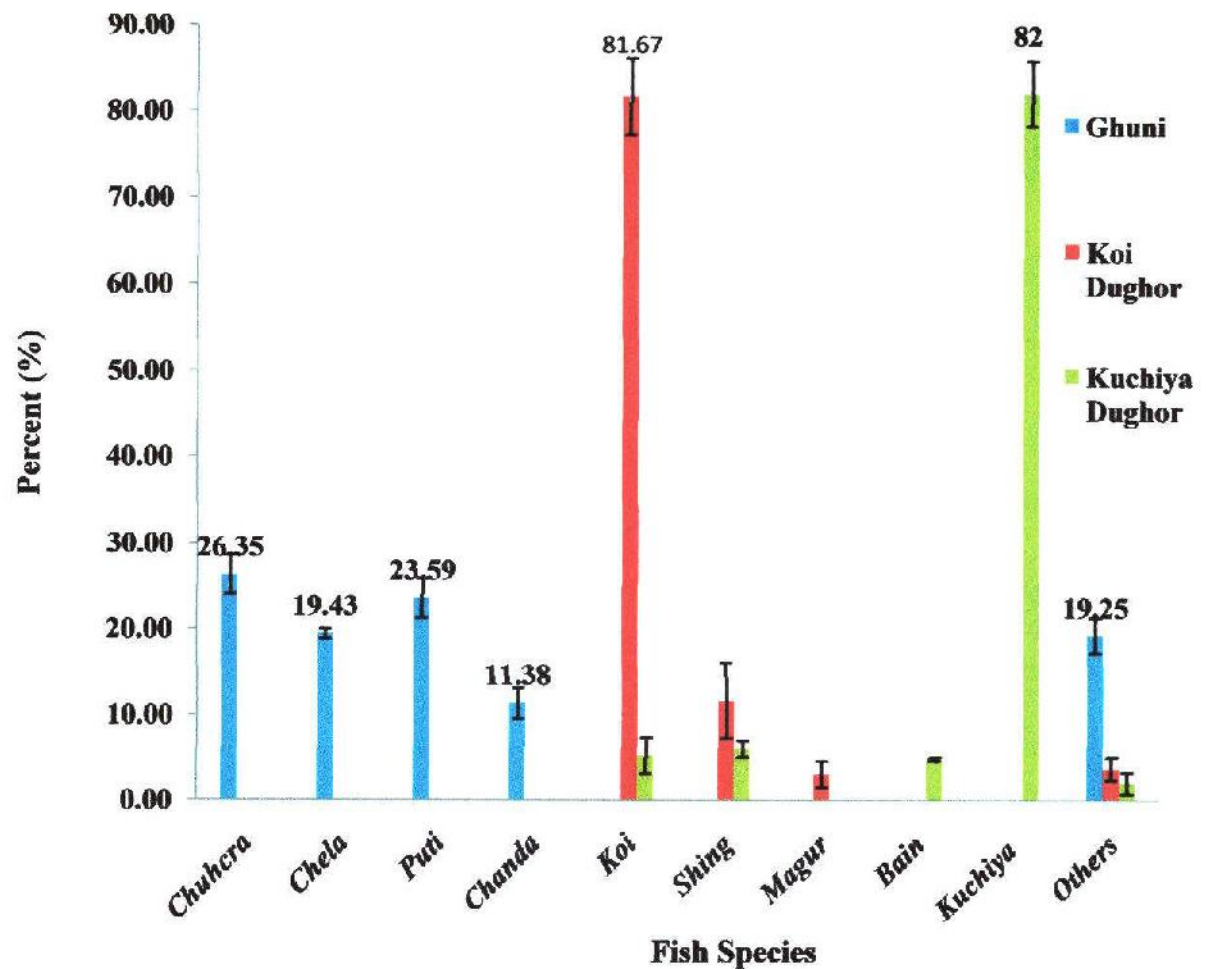


Figure-33: Species Selectivity of Different Traps

The wounding gears like Jhupi, Juti, and Fulkuchi were used to catch different types of species. Fulkuchi was used for small species catching, Jhupi for larger species than Fulkuchi and finally Juti was used for larger species. Among the wounding gear Jhupi was comparatively specific for catching shol that indicate selectiveness. But in case of Fulkuchi and Juti there was no domination of specific species in catch composition and were found to contribute insignificantly quantity to the catch(Figure- 34).

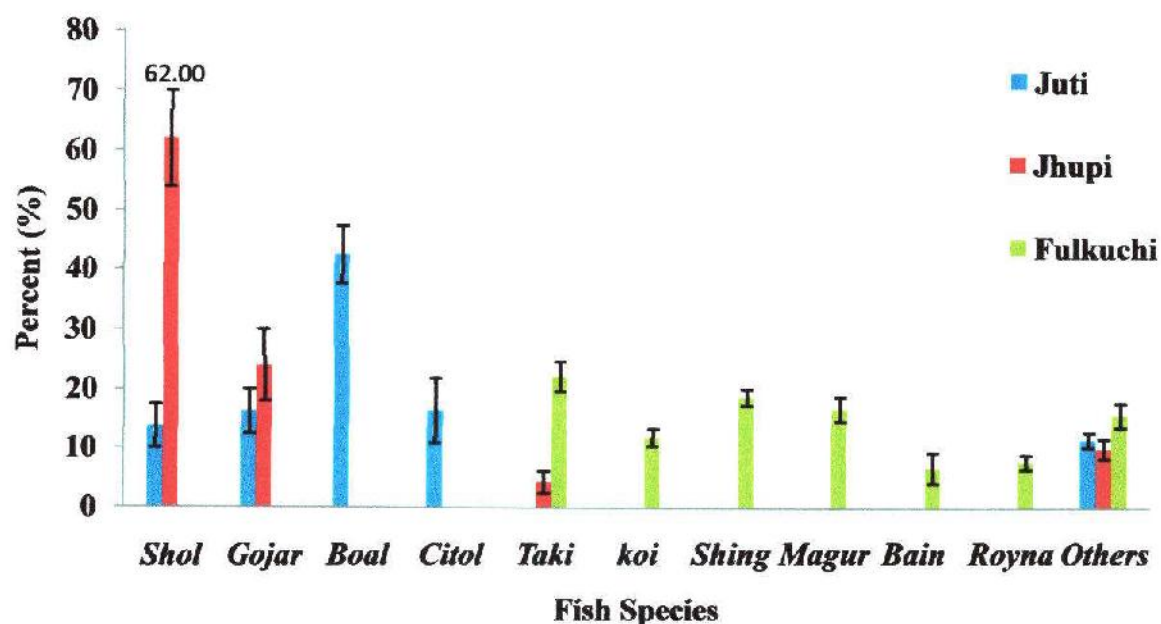


Figure-34: Species Selectivity of different Wounding Gear

5.4. Total Catch

Inland fisheries production in Bangladesh is strongly related to the highly productive floodplain areas inhabited by distinct flora and fauna. During the rainy season floodplains become one of the best natural habitats for the indigenous fish species of different food habits. Different types and form of gears have been operated in these floodplains areas to exploit wild fishes. In Bangladesh, fishers use over 100 different types of fishing gears of nine categories (Alam *et al.*, 1997). The intensity of use of any form of gear in a floodplain is dependent on the intensity of target fish population presumed to be available in that river. The abundance and production of fish species were tightly bound to the flooding pattern during the monsoon season (Ahmed, 1991). The yearly inundation connects all the aquatic areas into one large production system for up to four to five months (June to Dec). Total Production can be varied because of the availability of species, breeding ground, catching method, size of gear, water flow, transparency of water, food availability etc. Table-2 represents the average catch for all fishing gears per season used in study areas of the floodplains of Gopalganj.

The average catch for all fishing gears in floodplains areas of Gopalganj varied widely ranging between 1.12 kg and 1390 kg per gear per season where ber jal represented highest amount. In case of gill net total catch values ranged between 35.17 ± 2.10 and 62.14 ± 5.23 kg where kholisha jal found most effective. There was no significant difference ($P > 0.05$) between Punti jal and Kholisha jal but found difference ($P < 0.05$) with koi jal (Table-2).

In case of Others net total catch values were 711 ± 63.18 , 480.75 ± 134.54 , 1390 ± 103.57 for Veshal jal, Jhaki jal, Ber jal respectively. Here total catch of ber jal highest than other gears because of its length, mesh size, operation method. There was no significant difference ($P > 0.05$) between Veshal jal and Jhaki jal but found difference ($P < 0.05$) with Ber jal (Table-2).

Table-2: Total catch (kg/gear/season) of different types of gear in the study area

Total catch (kg/gear/season)			
Gear Type			
Gill nets			
	Koi Jal	Puti Jal	Kholisha Jal
	$35.17^b \pm 2.10$	$55.70^a \pm 2.15$	$62.14^a \pm 5.23$
Other nets			
	Veshal Jal	Jhaki Jal	Ber Jal
	$711^b \pm 63.18$	$480.75^b \pm 134.54$	$1390^a \pm 103.57$
Hooks			
	Chasra Borsi	Chuchra Borshi	Nol Borshi
	$1.12^b \pm 0.05$	$1.46^{ab} \pm 0.17$	$1.76^a \pm 0.11$
Traps			
	Ghuni	Kuchiya Dughor	Koi Dughor
	$93.5^a \pm 7.89$	$70.2^a \pm 9.39$	$23.00^b \pm .50$
	Gill nets	Other nets	Hooks
	$51.19^b \pm 2.52$	$739.35^a \pm 103.57$	$1.40^b \pm 0.075$
			Traps
			$70.07^b \pm 8.64$

Values are the Mean $\pm$ SE. Different superscripts in the same row show significant difference ($P < 0.05$).

Total catch of Chasra borshi, Chuchra borshi and kecho borshi (Nol/Dhap) was found 1.12 ± 0.05 , 1.46 ± 0.17 and 1.76 ± 0.11 kg/gear/seasons respectively. Highest catch was observed in Kecho borshi (Nol/Dhap) that showed significant difference ($P < 0.05$) with Chachra borshi (Table-2).

Total catch counted from Ghuni 93.5 ± 7.89 kg/gear/per season, Kuchiya Dughor designed to catch kuchiya where 70.2 ± 9.39 kg per gear per season were caught. Total catch counted from Koi Dughor 23.00 ± 0.50 kg per gear per season. There was no significant difference ($P > 0.05$) between Ghuni and Kuchiya Dughor but found difference ($P < 0.05$) with Koi Dughor (Table-2).

Among the gear the mean Total catch from Gillnet, Other nets, Traps, Hooks and line were 51.19 ± 2.52 , 739.35 ± 103.57 , 70.07 ± 8.64 , 1.40 ± 0.075 kg/ gear/season respectively. No significant difference ($P > 0.05$) among gill net, hooks and traps was observed but significantly ($P < 0.05$) higher catch was obtained in the category of other net (Table-2).

The average production from inland open water in the present study was $281.86 \text{ kg ha}^{-1}$ against the national average of $246.32 \text{ kg ha}^{-1}$ (FRSS, 2008). Saha and Hossain (2002) reported that the average production of fish was recorded as $242.47 \text{ kg ha}^{-1}$ in Saldu *beel* of Tangail. Ahmed (2008) estimated a yield of 44 kg/ha/year based upon the survey in two fishing seasons (153 days each). Average floodplain production has been estimated to be $40\text{-}60 \text{ kg/ha/year}$ by Welcomme (1979; 1985) from lightly exploited floodplain-river systems. However no authentic report is available on total catch of the studied gears.

CHAPTER SIX

CONCLUSION

Conclusion

The findings of this study lead to conclude the followings:

- 1) Seventeen different type of gears belonging to 4 major categories viz. Hooks and Line, Net, Trap and Wounding gear are used in the flood plain of Gopalganj
- 2) Among the categories all the gears belonging to Hooks and line are selective.
- 3) Gill nets, belonging to the category of Net, are highly selective gear depending on its name. However, other net such as Ber jal (Seine net), Veshal (Lift net) and Jhaki jal (Cast net) are non selective.
- 4) Within the category of trap Koi Dughor and Kuchia Dughor are found selective and the rest are non selective.
- 5) Among wounding gears Jhupi is selective.
- 6) A total of 30 species are found to be caught in this flood plain may indicates that these are the major sp. available in this area.
- 7) Among all the categories of gear, highest catch is obtained by Ber jal, highly efficient gear, may be detrimental in some cases.



CHAPTER SEVEN

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CHAPTER EIGHT

APPENDIX

Appendix

Appendix-I: Questionnaire prepared for the interviews during study on species selectivity and catch composition of different gears in floodplain areas of Gopalganj

A) General Information

1. Date of interview :
2. Place of Interview :
3. Name of the Respondent :
4. Name of Respondents Fathers/Husbands
Name :
5. Respondents Address:

Village: Union:.....

Thana:..... District:.....

6. Respondents Age :

7. Respondents Educational status :

(Illiterate: 1, Can sign: 2, Class one to five: 3, Class six to ten: 4, S.S.C to H.S.C: 5, above H.S.C: 6)

B. Occupation

1. Main Occupation :
(Fishing: 1, Fish Farming: 2, Fishing & Fish Farming: 3, others: 4)

2. Information about gears

Which types of gears used				
Local Name:				
Shape:				
Length:				
Mesh size (Net)/ Type (Trap):				
Weight of Gear:				

Construction Material:				
Cost (Tk)				
Water Depth				
Transparency(cm/ft)				
Gear Specificity:				
Other Species:				
Amount of Catch per unit Gear Per Haul (kg):				
Time of operation:				
Duration(hour/ day)				
Gear Using period(Jan to Dec)				
Operation Method:				

Mobile No of the Respondent:

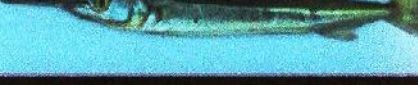
Signature of the Interviewer:

Appendix-II: Different of Fishing Gear with details used in the Study area of Gopalganj

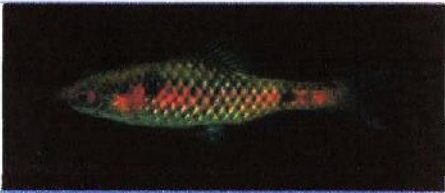
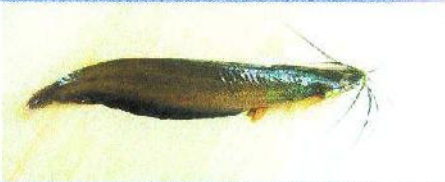
Category	Types of Gear	Name of Gear	Size		Mesh Size (Cm)	Shape	Materials used	Bait used	Nature (selective / non)	Target Species	Fishing Period
			Length (m)	Breadth (m)							
Fish Net	Gill Net	Puti Jal	6-10	.45-.5	2-2.54	Rectangular	Nylon twine	-	Selective	Puti	Jun-Nov
		Kholish Jal	6-10	.45-.5	2.54-3.2	Rectangular	Nylon twine	-	Selective	Kholisha	Jun-Nov
		Koi Jal	4-6	.5-.7	3.0-3.8	Rectangular	Nylon twine	-	Selective	Koi	Jul-Nov
	Cast Net	Jhaki Jal	6-10	6-10	2-2.54	Circular	Cod/ Nylon twine	-	Non	All	May-Nov
Traps	Lift Net	Veshal Jal	12-15	10-12	2-3.8	Triangular	Cod/ Nylon twine	-	Non	All	May-Nov
	SeineNet	Ber Jal	30-35	10-15	3-3.8	Rectangular	Cod/ Nylon twine	-	Non	All	July-Nov
		Ghuni	40-45	30-35	-	Box	Bamboo split, wire	-	Non	SIS	Jun-Nov
		Koi Dughor	50-60	15-20	-	Cylinder	Bamboo split, wire	-	Selective	Koi	July-Nov
		Kuchia Dughor	30-35	20-25	-	Box	Bamboo split, wire	Earthworm	Selective	Kuchiya	Jun-Nov
	Chalon	50-150	50-150	-	Circular	Bamboo split, wire	-	Non	SIS	Jun-Dec	
Hook and Lines		Polo	-	-	-	Basket	Bamboo split, wire	-	Non	Big fish	May-Dec
		Chasra Borshi	-	-	-	-	Nylon twine/wire Bamboo spilt	Grassop-her	Selective	Koi	July-Nov
		Kecho Borshi	-	-	-	-	Nylon twine/wire Bamboo spilt	Earthworm	Selective	Carnivore	Jun-Nov
		Chuchra Borshi	-	-	-	-	Nylon twine/wire Bamboo spilt	Chuchr-a	Selective	Carnivore	Jun-Nov
Wounding Gears		Juti	3-5	-	-	-	Iron rod, bamboo	-	Selective	Floating	July-Nov
		Jhupi	4-5	--	-	-	Iron rod, bamboo	-	Selective	Floating	Jul-Nov
		Fulkuchi	3-5	-	-	-	Iron rod, bamboo	-	Non	All	Jun-Dec
Others		Hand Fishing	-	-	-	-	-	Non	SIS	Nov-Apr	



Appendix-III: Available species found in the study area of Gopalganj

Local name	Common name	Scientific Name	Picture
Bele	Scribbled goby	<i>Awaous grammepomus</i>	
Bhut bele	Dusky sleeper	<i>Eleotris fusca</i>	
Boal	Wallago	<i>Wallago attu</i>	
Chela	Silver razorbelly minnow	<i>Salmostoma acinaces</i>	
Foli/Chitol	Bronze featherback	<i>Notopterus notopterus</i>	
Darkina	Flying barb	<i>Esomus danricus</i>	
Tengra	Striped dwarf catfish	<i>Mystus vittatus</i>	
Gutum	Annandale loach	<i>Lepidocephalichthys annandalei</i>	
Kakila	Freshwater garfish	<i>Xenentodon cancila</i>	
Khailsha	Banded gourami	<i>Colisa fasciata</i>	
Chuchra	Thick-lipped gourami	<i>Colisa labiosa</i>	

Koi	Climbing perch	<i>Anabas testudineus</i>	
Kuchiya	Swamp eel	<i>Monopterus albus</i>	
Chanda	Elongate glass-perchlet	<i>Pseudambassis baculis</i>	
Lal canda	Indian glassy fish	<i>Parambassis ranga</i>	
Magur	Walking catfish	<i>Clarias batrachus</i>	
Mola	Mola Carplet	<i>Amblypharyngodon mola</i>	
Pabda	Pabda catfish	<i>Ompok pabda</i>	
Bhadi puti	Pool barb	<i>Puntius sophore</i>	
Punti	Swamp barb	<i>Puntius chola</i>	
Teri punti	Onespot barb	<i>Puntius terio</i>	

Tit punti	Ticto barb	<i>Puntius ticto</i>	
Shorpunti	Olive barb	<i>Puntius sarana</i>	
Shingi	Stinging catfish	<i>Heteropneustes fossilis</i>	
Taki	Spotted snakehead	<i>Channa punctata</i>	
Gozar	Great snakehead	<i>Channa marulius</i>	
Shol	Snakehead murrel	<i>Channa striata</i>	
Baim	Zig-zag eel/Tire track eel	<i>Mastacembelus armatus</i>	
Tara baim	Lesser spiny eel	<i>Macrognathus aculeatus</i>	
Tepa	Ocellated pufferfish	<i>Tetraodon cutcutia</i>	

Appendix-IV: Total Catch Comparison Among The Gears (Kg) (One-Way Anova)

1.1. Total Catch Comparison Among The Gears (Kg) (Descriptive)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Koi Jal	9	35.1667	6.31343	2.10448	30.3137	40.0196	26.25	45.00
Puti Jal	15	55.7000	8.31049	2.14576	51.0978	60.3022	45.00	72.00
Kholisha Jal	7	62.1429	13.82544	5.22553	49.3565	74.9293	45.00	90.00
Total	31	51.1935	14.00977	2.51623	46.0547	56.3324	26.25	90.00

1.2. Homogeneity Test (Tukey HSD) Of Total Catch Among Gill Net

Treatment	N	Subset for alpha = 0.05	
		1	2
Koi Jal	9	35.1667	
Puti Jal	15		55.7000
Kholisha Jal	7		62.1429
Sig.		1.000	.309

2.1. Total Catch Comparison Among The Others Net (Kg) (Descriptives)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Veshal Jal	5	7.1100E2	141.27599	63.18054	535.5827	886.4173	506.25	810.00
Jhaki Jal	7	4.8075E2	231.63266	87.54891	266.5255	694.9745	231.00	945.00
Ber Jal	3	1.3900E3	233.02360	1.34536E2	811.1373	1968.8627	1200.00	1650.00
Total	15	7.3935E2	401.11722	1.03568E2	517.2187	961.4813	231.00	1650.00

1.2. Homogeneity Test (Tukey HSD) Of Total Catch Among Others Net

	N	Subset for alpha = 0.05	
		1	2
Jhaki Jal	7	480.7500	
Veshal Jal	5	711.0000	
Ber Jal	3		1.3900E3
Sig.		.259	1.000



3.1. Total Catch Comparison Among Hooks And Line (Kg) (Descriptives)

					95% Confidence Interval for Mean			
					Lower Bound	Upper Bound		
	N	Mean	Std. Deviation	Std. Error			Minimum	Maximum
Chasra Borsi	14	1.1186	.18806	.05026	1.0100	1.2272	.90	1.50
Nol Borshi	10	1.7640	.35799	.11321	1.5079	2.0201	1.44	2.52
Chuchra Borshi	6	1.4600	.41163	.16805	1.0280	1.8920	.90	2.16
Total	30	1.4020	.41171	.07517	1.2483	1.5557	.90	2.52

3.2. Homogeneity Test (Tukey HSD) Of Total Catch Among Hooks And Line

1-3	N	Subset for alpha = 0.05	
		1	2
Chasra Borsi	14	1.1186	
Chuchra Borshi	6	1.4600	1.4600
Nol Borshi	10		1.7640
Sig.		.061	.104

4.1. Total Catch Comparison Among Traps (Kg) (Descriptives)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ghuni	6	93.5000	19.31745	7.88632	73.2276	113.7724	61.20	113.40
Kuchiya Dughor	5	70.2000	21.01071	9.39628	44.1118	96.2882	49.50	99.00
Koi Dughor	3	23.0000	.86603	.50000	20.8487	25.1513	22.50	24.00
Total	14	70.0714	32.31307	8.63603	51.4144	88.7284	22.50	113.40

4.2. Homogeneity Test (Tukey Hsd) Of Total Catch Among Traps

1-3	N	Subset for alpha = 0.05	
		1	2
Koi Dughor	3	23.0000	
Kuchiya Dughor	5		70.2000
Ghuni	6		93.5000
Sig.		1.000	.191

5.1. Total Catch Comparison Among Different Gears (Kg) (Descriptives)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Hooks	30	1.4020	.41171	.07517	1.2483	1.5557	.90	2.52
Gill nets	31	51.1935	14.00977	2.51623	46.0547	56.3324	26.25	90.00
Other nets	15	739.3500	401.11722	103.56800	517.2187	961.4813	231.00	1650.00
Traps	14	70.0714	32.31307	8.63603	51.4144	88.7284	22.50	113.40
Total	90	152.2300	309.69499	32.64472	87.3613	217.0900	.90	1650.00

5.2. Homogeneity Test (Tukey HSD) Of Total Catch Among Different Gears

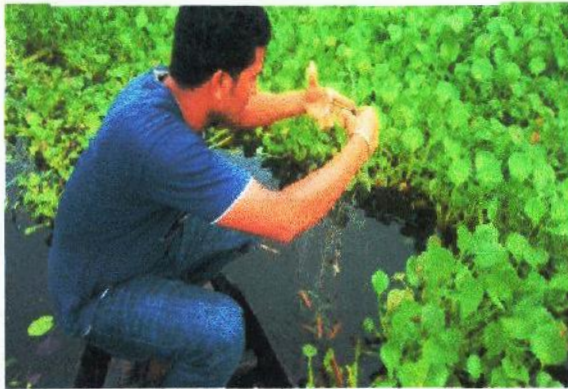
1-4	N	Subset for alpha = 0.05	
		1	2
Hooks	30	1.4020	
Gill nets	31	51.1935	
Traps	14	70.0714	
Other nets	15		739.3500
Sig.		.550	1.000



Fishing Operation By Net



Fishing Operation By Hooks & line



Observation of Fishing Through Net



Fishing Operation By Wounding Gear



Observation Length of Cast Net



Observation Mesh Size of Net



Observation fishing With Lift Net



Observation Species Composition of Trap