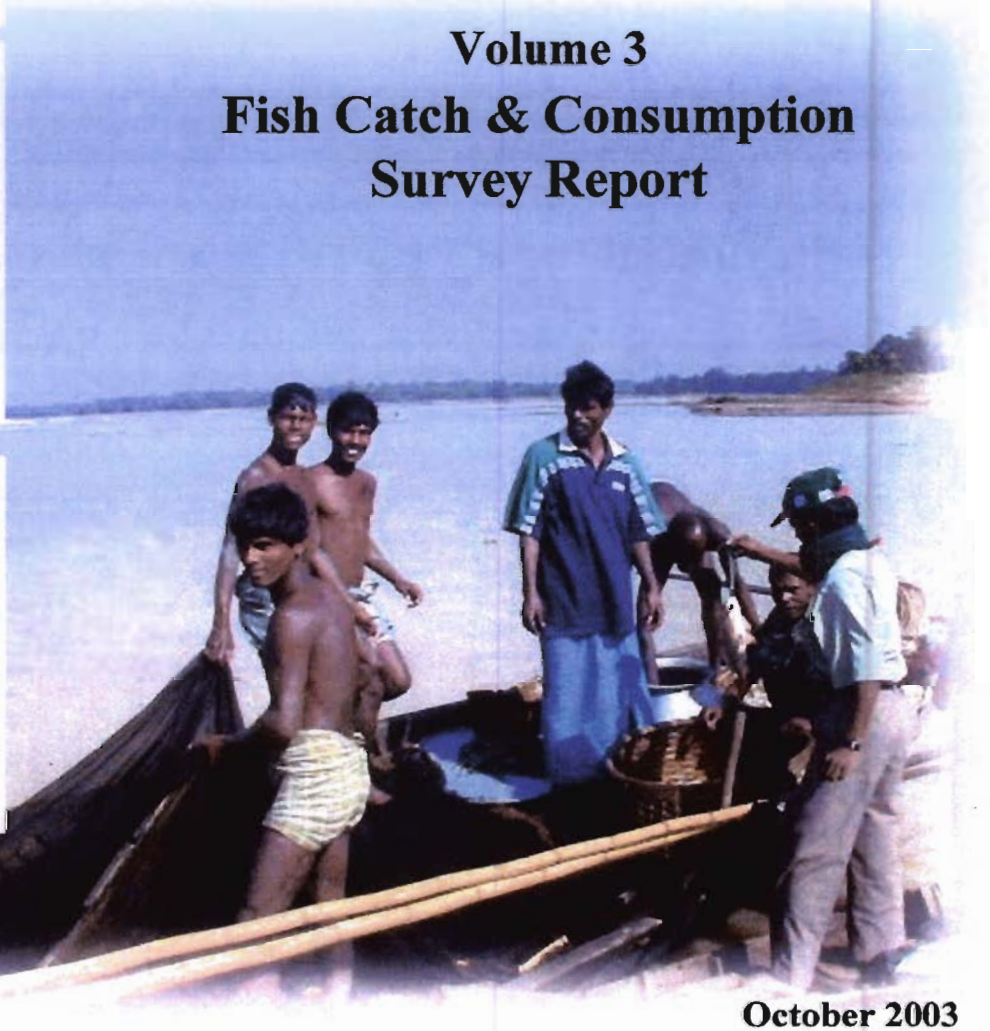
MACH
Completion Report

Management of Aquatic Ecosystems through Community Husbandry

Volume 3
Fish Catch & Consumption Survey Report



October 2003

A project of the Government of Bangladesh
Supported by USAID
Project Partners:
Winrock International
Bangladesh Centre for Advanced Studies (BCAS)
Center for Natural Resource Studies (CNRS)
CARITAS Bangladesh

TABLE OF CONTENTS

PREFACE i

EXECUTIVE SUMMARY ii

1. THE MONITORING METHODLOGY 1

1.1. BACKGROUND 1
1.2. FISHERIES 1
1.2.1. Introduction 1
1.2.2. Habitat Stratification 1
1.2.3. Monitoring Location Selection 2
HABITAT TYPES 2
1.2.4. Sampling Protocol 2
1.2.5. Monitoring Parameters (Fisheries) 3
1.2.6. Data Analysis 3
1.3. FISH CONSUMPTION 4
1.3.1. Introduction 4
1.3.2. Sample Households 5
1.3.3. Sampling protocol 5
1.3.4. Monitoring Parameters 5
1.4. AQUATIC VEGETATION 5
1.5. WILDLIFE 5
1.6. STATISTICAL ANALYSIS 6

2. MONITORING FINDINGS 7

2.1. FISH CATCH MONITORING 7

2.1.1. HAIL HAOR SITE 7
2.1.1.1. CPUA IN HAIL HAOR 7
2.1.1.2. Gear Effort 8
2.1.1.3. Gear Wise Catch 9
2.1.1.4. CPUE 10
2.1.1.5. Seasonal Catch 11
2.1.1.6. Fish Species Diversity 11
2.1.1.7. Ranking of species by quantity of catch 12
2.1.2. TURAG-BANGSHI SITE 12
2.1.2.1. CPUA IN TURAG-BANGSHI 12
2.1.2.2. Gear Effort 13
2.1.2.3. Gear Wise Catch 14
2.1.2.4. CPUE 15
2.1.2.5. Seasonal Catch 15
2.1.2.6. Fish Species Diversity 16
2.1.2.7. Ranking of species by quantity of catch 16
2.1.3. KONGSHAW-MALIJHEE SITE 17
2.1.3.1. CPUA in Kongshaw-Malijhee 17
2.1.3.2. Efforts by gear type 18
2.1.3.3. Gear Wise Catch 18
2.1.3.4. CPUE 19
2.1.3.5. Seasonal Catch 20
2.1.3.6. Fish Species Diversity 20

2.1.3.7. Ranking of species by quantity of catch *20*

2.2 . FISH CONSUMPTION MONITORING **21**

2.2.1. HAIL HAOR SITE *21*
2.2.1.1. Per capita fish consumption by months *21*
2.2.1.2.Non fish high protein consumption *22*
2.2.1.3. Consumption by species groups *23*
2.2.2. TURAG-BANGSHI SITE *24*
2.2.2.1. Per capita fish consumption *24*
2.2.2.2. Non-fish high protein food consumption *25*
2.22.3. Sources of fish caught and fish bought *25*
2.2.3. KONGSHAW-MALIJHEE SITE *26*
2.2.3.1. Per capita fish consumption *26*
2.2.3.2. Non-fish high protein food consumption *27*
2.2.3.3. Sources of fish caught and fish bought *27*
2.3. HYDROLOGY AND FISH CATCH (HAIL HAOR SITE) *28*
2.4. VEGETATION AND WILDLIFE MONITORING *30*
2.4.1. VEGETATION DIVERSITY *30*
2.4.2. WILDLIFE DIVERSITY *30*

3. SELECTED CONCLUSIONS **33**

LIST OF TABLES

TABLE 1: AVERAGE CPUA (KG/HA) THREE SITES ii
TABLE 2: GEAR EFFORT (NO./DAY) OBSERVED BY COMMON GEARS IN THREE SITES iii
TABLE 3: CPUE(KG/DAY/GEAR) OBSERVED BY COMMON GEARS IN THREE SITES iv
TABLE 4: BIO-DIVERSITY OBSERVED BY SITES v
TABLE 5: PER CAPITA FISH CONSUMPTION (G) BY THREE SITES vi
TABLE 6: PERIODS OF ASSESSMENT OF THE THREE SITES 1
TABLE 7: MONITORING LOCATIONS, HABITATS AND AREAS IN THREE MACH SITES 2
TABLE 8: PERIODS OF ASSESSMENT OF FISH CONSUMPTION AT THE THREE SITES 5
TABLE 9: CPUA (KG/HA) BY SAMPLING LOCATIONS AND BY YEARS 8
TABLE 10: GEAR EFFORT (NO./DAY) IN HAIL HAOR IN 7 MONITORING LOCATIONS AT THE BASELINE AND IMPACT YEARS 8
TABLE 11: TOTAL CATCHES OF MONITORING LOCATIONS BY MAJOR GEAR TYPES AND BY YEARS IN HAIL HAOR 9
TABLE 12: CPUE (KG/DAY/GEAR) OF SELECTED FISHING GEARS 10
TABLE 13: FISH SPECIES DIVERSITY IN THE HAIL HAOR BY MONITORING LOCATIONS AND BY YEAR 12
TABLE 14: CPUA (KG/HA/Y) BY SAMPLING LOCATIONS AND BY YEARS 13
TABLE 15: GEAR EFFORT (NO/DAY) IN 8 MONITORING LOCATIONS OF TURAG-BANGSHI SITE 14
TABLE 16: TOTAL FISH CATCH OF MONITORING LOCATIONS BY GEAR TYPES AND BY YEARS IN TURAG-BONGSHI 14
TABLE 17: CPUE (KG/DAY/GEAR) OF SELECTED GEARS IN TURAG-BANGSHI SITE 15
TABLE 18: FISH SPECIES DIVERSITY IN THE TURAG-BONGSHI BY MONITORING LOCATIONS AND BY YEAR 16
TABLE 19:: CPUA (KG/HA/Y) BY SAMPLING LOCATIONS AND BY YEARS 17
TABLE 20: EFFORT BY GEAR TYPE (NO./DAY) IN 8 MONITORING LOCATIONS AT KM SITE 18
TABLE 21: TOTAL FISH CATCH IN KANGSHA-MALIJHEE BY GEAR TYPES AND BY YEARS 19
TABLE 22: CPUE (KG/DAY/GEAR) OF SELECTED GEARS IN KANGSHA-MALIJHEE SITE 19

TABLE 23: FISH SPECIES DIVERSITY IN KANGSHA-MALIJHEE SITE....20
TABLE 24: PER CAPITA FISH CONSUMPTION (G) IN HAIL HAOR SITE....21
TABLE 25: OTHER NON-FISH PROTEIN CONSUMPTION (G/H/D) IN HH SITE....22
TABLE 26: FISH CONSUMPTION BY SOURCES (%) IN HH SITE....23
TABLE 27: FISH SPECIES GROUP WISE CONSUMPTION (%) IN HH....23
TABLE 28: PER CAPITA FISH CONSUMPTION (G) IN TB SITE....24
TABLE 29: PER CAPITA NON-FISH PROTEIN CONSUMPTION (G)....25
TABLE 30: FISH CONSUMPTION BY SOURCES (%) IN TB....25
TABLE 31: FISH SPECIES GROUP-WISE CONSUMPTION (%) IN TB SITE....26
TABLE 32: PER CAPITA FISH CONSUMPTION (G) IN KM SITE....26
TABLE 33: PER CAPITA NON-FISH PROTEIN CONSUMPTION (G)....27
TABLE 34: FISH CONSUMPTION BY SOURCES (%) IN KM SITE....27
TABLE 35: FISH SPECIES GROUP-WISE CONSUMPTION (%) IN KM SITE....28
TABLE 36: RELATIONSHIP OF CPUA AND EXTENT OF FLOOD....29
TABLE 37: SPECIES OF AQUATIC VEGETATION IN BASELINE, IMAPCT-1 AND IMPACT-2 IN THREE SITES....30
TABLE 38: WILDLIFE SPECIES RECORDED IN BASELINE, IMPACT -1, IMPACT -2 IN MACH SITES....31

LIST OF FIGURES

FIGURE 1: CPUA IN BASELINE AND IMPACT YEARS IN HAIL HAOR....7
FIGURE 2: TOTAL CATCH IN TONS IN HAIL HAOR....7
FIGURE 3: DISTRIBUTION OF SEASONAL CATCH (%) IN HH....11
FIGURE 4: CPUA IN BASELINE & IMPACT YEARS....12
FIGURE 5: TOTAL CATCH IN TONS IN TB SITE....13
FIGURE 6: SEASONAL CATCH (%) IN TB....16
FIGURE 7: CPUA IN BASELINE AND IMPACT YEARS IN KM SITE....17
FIGURE 8: TOTAL CATCH IN TONS IN KM SITE....17
FIGURE 9: SEASONAL CATCH (%) IN KM SITE....21
FIGURE 10: FISH CONSUMPTION (G/H/D) BY PROJECT YEARS (BY ALL CLASSES)....22
FIGURE 11: PER CAPITA FISH CONSUMPTION IN HAIL HAOR OVER THE PROJECT YEARS....21
FIGURE 12: FISH CONSUMPTION (G/H/D) BY PROJECT YEARS (BY ALL CLASSES)....24
FIGURE 13: PER CAPITA FISH CONSUMPTION OVER THE PROJECT YEARS IN TB SITE....25
FIGURE 14: FISH CONSUMPTION (G/H/D) BY PROJECT YEARS (BY ALL CLASSES)....26
FIGURE 15: PER CAPITA FISH CONSUMPTION OVER THE PROJECT YEARS IN KM SITE....27
FIGURE 16: HAIL HAOR THE ONSET OF PRE-MONSOON FLOODING IN RELATION TO TOTAL FISH YIELD....28
FIGURE-17: REGRESSION ANALYSIS OF CPUA (KG/HA) AND WATER AREA IN HAIL HAOR SITE 29

LIST OF MAPS

MAP 1: CPUA OF TURAG BONSHI IN DIFFERENT LOCATION....34
MAP 1: CPUA OF HAIL HAOR IN DIFFERENT LOCATION....35
MAP 7: CPUA OF KONGSHOW MALIJHEE IN DIFFERENT LOCATION....36
MAP 2: DIVERSITY OF HAIL HAOR IN DIFFERENT LOCATION....37
MAP 5: DIVERSITY OF TURAG BANGSHI IN DIFFERENT LOCATION....38
MAP 8: DIVERSITY OF KONGSHOW MALIJHEE IN DIFFERENT LOCATION....39
MAP 3: CONSUMPTION OF HAIL HAOR IN DIFFERENT VILLAGE....40
MAP 6: CONSUMPTION OF TURAG BONGSHI IN DIFFERENT VILLAGE....41
MAP 9: CONSUMPTION OF KONGSHOW MALIJHEE IN DIFFERENT VILLAGE....42

LIST OF APPENDIXES

APPENDIX 1: FISH CATCH MONIORING FORM.....44
APPENDIX 2: FISH CONSUMPTION MONITORING FORM.....45
APPENDIX 3.1: ANALYSIS FOR VARIANCE FOR CPUA.....46
APPENDIX.3.2: ANALYSIS FOR PER CAPITA CONSUMPTION OF HAIL HAOR.....47

APPENDIX 3.3: ANALYSIS FOR PER CAPITA CONSUMPTION OF TURAG BANGSHI.....48
APPENDIX 3.4: ANALYSIS FOR PER CAPITA CONSUMPTION OF KONGSHOW MALIJHEE.....49
APPENDIX 3.5: CONFIDENCE INTERVAL OF PER CPITA CONSUMPTION.....50
APPENDIX 4.1: SPECIES DIVERSITY COMPARISON BY DIFFERENT INTERVENTION OF HAIL HAOR.....51
APPENDIX 4.2: SPECIES DIVERSITY COMPARISON BY DIFFERENT INTERVENTION OF TURAG BANGSHI.....54
APPENDIX 4.3: SPECIES DIVERSITY COMPARISON BY DIFFERENT INTERVENTION OF KONGSHOW MALIJHEE 57
APPENDIX 5.1: HAIL HAOR TOP 20 SPECIES CAUGHT.....60
APPENDIX 5.2: TURAG BANGSHI TOP 20 SPECIES CAUGHT..... 62
APPENDIX 5.3: KONGSHOW MALIJHEE KONGSHOW MALIJHEE TOP 20 SPECIES CAUGH64
APPENDIX 6: PER CAPITA NON FISH PROTEIN CONSUMPTION.....67
APPENDIX 7.1: TOP 20 FISH CONSUMPTION IN HAIL HAOR.....70
APPENDIX 7.2: TOP 20 FISH CONSUMPTION IN TURAG BANGSHI.....72
APPENDIX 7: 3:TOP 20 FISH CONSUMPTION IN KONGSHOW MALIJHEE.....74

PREFACE

The completion report that follows represents a summary of activities and achievements of the Management of Aquatic-ecosystems through Community Husbandry (MACH). The project was initiated in September of 1998 and the contents of this completion report contain activities and achievements through August 31, 2003. The fieldwork of MACH began at two sites (Hail Haor in Srimangal and the Turag-Bangshi site in Kaliakor) in June of 1999 after an initial inception period. Fieldwork at a third site (Kongshaw-Malijhee in Sherpur) began July the following year in 2000. This report represents the achievements in the field of 4 years in the case of two sites and 3 years in the case of the Sherpur site.

This volume 3 has been created to be able to display fully the monitoring program and its results on fish catch and that of household fish consumption. It also contains the results of many thousands of samples that may be useful to future programs or studies in the areas where MACH worked. This volume provides more detail on both the methods and results than could be provided in the main report. The field work and the write up for this volume was largely done by MACH partner CNRS or the Center for Natural Resource Studies.

This completion report has been broken up into 5 volumes, each of which has been listed below:

Volume 1 – Main Report
Volume 2 – Appendices
Volume 3 – *Fish Catch and Consumption Survey Report*
Volume 4 – Performance Monitoring Report
Volume 5 – Geospatial Data Portfolio

Executive Summary

To provide the information required by the MACH SO6 indicators, MACH (Management of Aquatic Ecosystem through Community Husbandry) Project developed a robust monitoring program in the areas of fish catch and household consumption.

The main purpose of MACH monitoring has been to assess project intervention impacts with the primary focus on fish and related production outcomes. The project developed baseline on fish production, bio-diversity and per capita fish consumption and continued monitoring to measure changes due to project management interventions.

This report covers baseline and subsequent years of monitoring of fish catch, fish consumption, aquatic vegetation and the wildlife of Hail Haor, Turag-Bangshi and Kongshaw-Malijhee sites for the period 1999-2003.

Fish Catch Monitoring

1. Catch per Per Unit Area (CPUA)

Overview

Catch per unit area increased in all sites (Table1). MACH from its inception has been concerned over the accuracy of this data as catch is also dependent on the area of water coverage and timing of the annual monsoon floods. In addition MACH data analysis has taken into account the relationships between hydrological events and fish production. Field data and subsequent analysis has shown a very high correlation between the timing and the extent of flooding on fish production: the earlier the inundation and the larger the flood the greater the overall fish production.

Table 1: Average CPUA (kg/ha) in three sites

Sites	Baseline years (kg/ha)	Average of 3 Impact years (kg/ha)	Increment of CPUA observed (kg/ha)
Hail Haor	171.08	227.69	56.61
Turag Bangshi	57.80	123.20	65.40
Kongshaw-Malijhee	150.16	211.27	61.11

Hail Haor Site: Catch Per Unit Area (CPUA) was found to be 205.05 kg/ha; 190 kg/ha and 287.28 kg/ha in the impact years –1, 2 and 3 respectively while it was only 171.08 kg/ha at pre intervention (baseline period). The highest CPUA was in impact year 3 (287.28 kg/ha). The low CPUA in the 2nd impact year CPUA may have been because there was less fishing due to political pressure on poor fisher's community during major fishing time (post monsoon and dry season khatha fishing). This mainly occurred in the Gopla River and Balla Beel areas.

Turag Bangshi Site: In T-B site Catch per Unit Area (CPUA) increased significantly during the intervention years. Estimated CPUA in impact years 1, 2 and 3 were 124.75 kg/ha, 104.78 kg/ha and 140.08 kg/ha respectively while it was only 57.8 kg/ha at baseline period. The highest CPUA 140.08 kg/ha was in impact year 3. According to the results, catch quantity increased dramatically by the 1st impact year. This was a highly degraded beel area and the

project is fairly confident that these increases are a direct result of program interventions. These interventions have been the establishment of sanctuaries in Kalidaha Beel and the kum sanctuary (Lalkha Kum and Galachipa Kum) in Turag River as well as effort control during fish breeding period. Overall CPUA in the Turag Bangshi site increased by about 113% from baseline period.

Kongshaw-Malijhee: In the KM site, data on CPUA are available only for three years, from baseline to impact year-2. The CPUA in this site was 150.16 kg/ha at base period, 149.16 kg/ha in impact year-1 and then increased to 273.37 kg/ha in impact year-2. The increase in the last year may have been due to establishment of fish sanctuaries in Katakhali, Darabashia (private land), and Kewta and in Bailla Bailsa beel along with the improved management strategies of the MACH project over the two year period.

2. Fishing effort

Hail Haor Site: The overall fishing effort (measured as number of a specific gear used per day) of almost all the major gears decreased during the intervention years except for the veshal jal and traps. The usage of these two gears increased since the baseline period. Veshal jal effort increased to 8.18 from 5.8 at baseline, while thela jal came down to 9.3 from 22.74. Thela Jal is generally used by the subsistence fishers. Use of current jal also decreased from 888.36 (baseline) to 639 (impact year-3). The suta jal usage too decreased by impact year 3.

Turag-Bangshi Site: In the 3rd impact year fishing efforts of all type of gears were observed to increase except dharma jal and current jal. Effort increased as a result the large increase in available fish.

Kongshaw-Malijhee: In KM site the commonly used gears recorded were thela jal, ber jal, current jal, traps, jhaki jal, bana, veshal jal, hand picking and hooks. The use of ber jal substantially reduced in recent years.The use of current jal went up in impact years than in the baseline. However, in Takimari-Darabashia it was almost completely stopped.

Table 2: Gear Effort (No. /Day) observed by common gears in three sites

Gears	Hail Haor		Turag Bangshi		Kongshow Malijhee	
	Baseline Period	Overall Impact Period	Baseline Period	Overall Impact Period	Baseline Period	Overall Impact Period
Ber jal	6.26	4.99	1.72	3.23	18.42	4.40
Thela jal	22.74	9.3	5.96	8.28	31.27	33.40
Current jal	881.36	639.24	85.14	91.16	86.35	207.35

3. Fish catch by gear

Hail Haor Site: The amount of fish caught by the current jal was reduced to 38% during the impact years. The catch from the ber jal increased by more than 46% over that of baseline. In katha fishing, fish catch increased more than 300%.

Turag-Bangshi Site: The overall fish catch in impact year-3 was higher than in the baseline period. The contribution of current jal was reduced to 10% in impact year-3 from 24.73% at the baseline period while that of the ber jal increased to 43.96% in impact year-3 from 23.74% at baseline situation the contribution of jhaki jal and veshal jal also increased, which are mainly used by subsistence fishers. Project interventions ensuring establishment of

sanctuaries and management by the community's organization with support from MACH project helped increase the fish production during the intervention years.

Kongshaw-Malijhee: Ber jal and current jal contributed to 42% of total catch, which indicates that current jal was still contributing a substantial catch in impact years. More motivation is needed regarding the ues of harmful gears such as current jal and fishing through de-watering. The RMOs began work in the reduction of destructive fishing in the 2nd intervention year

4. Catch per Unit Effort (CPUE)

Hail Haor Site: The CPUE of veshal and ber jals increased to 6.21 kg/day/unit gear and 10.54 kg/day/unit gear respectively from 5.34 kg/day/unit gear and 6.8 kg/day/unit gear in the baseline. These increases are likely to be the result of increased fish production.

Table 3: CPUE (kg/day/gear) observed by common gears in three sites

Gears	Hail Haor		Turag Bangshi		Kongshow Malijhee	
	Baseline Period	Overall Impact Period	Baseline Period	Overall Impact Period	Baseline Period	Overall Impact Period
Ber jal	6.87	10.54	1.91	3.37	0.92	2.50
Thela jal	1.31	2.65	0.50	0.76	0.66	0.71
Current jal	0.18	0.20	0.03	0.02	0.04	0.09

Turag-Bangshi Site: The average number of fishing hours decreased. CPUE of current jal was either reduced or increased only slightly. In the 3rd year the government issued a circular to stop the use of the current jal. Further community motivation and enforcement are needed.

Kongshaw-Malijhee: CPUE of ber jal increased substantially from 0.92 kg/day/unit gear in the baseline to 2.52 kg/day/unit gear in the impact years. The CPUE of current jal decreased from 0.04 kg to 0.02 kg at impact year-1. The use of current jal has been officially banned by the government.

5. Seasonality

Hail Haor Site: There are seasonal variations in quantity of fish caught. Most fish are caught in the periods October-March. About 35% of all fish are caught in the dry season (January to March), with the post monsoon season catch accounting for 33% (October to December) when the fish begin moving from floodplain to beels and beels to rivers. A total of 25% of the catch was obtained in the monsoon, much of it by subsistence fishers.

Turag-Bangshi Site: The highest catch 54% was observed in the post monsoon season (October to December) followed by 20% in the monsoon and 15% in the dry season (January to March). During the post monsoon, fish start to move from the open flooded land to perennial beels and to the rivers. Only small amounts of water remain in late February with most fishing completed by or before January. In TB site there was less scope for katha fishing in the beels as many of the beels dry up.

Kongshaw-Malijhee: The catch was the highest during the monsoon period which was different from that of the other two sites. There is likely more subsistence fishing in the KM site due to the poverty level in this site compared to the other two.

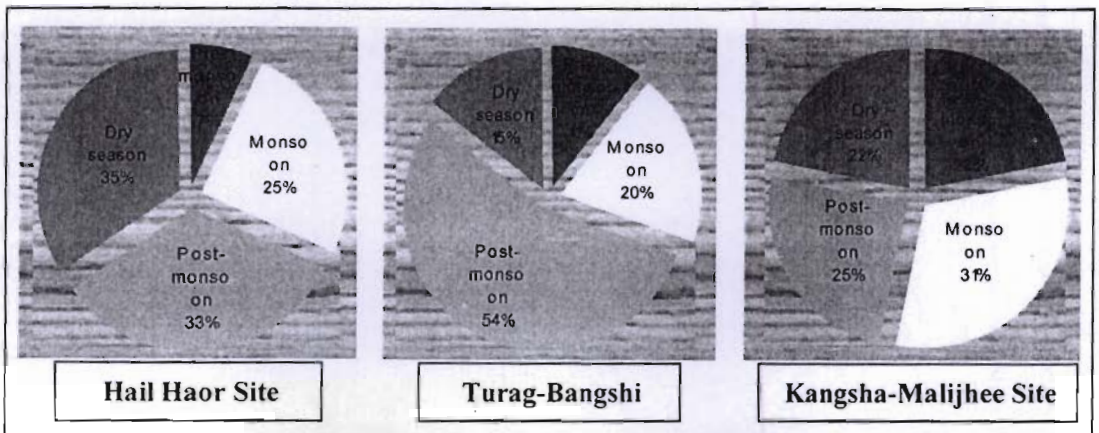


Figure A: Seasonal catch distribution (%) in MACH sites

6. Bio-diversity

Hail Haor Site: The number of fish species found during the baseline period was 71 while it was 76 in impact year -3. In impact year -1 and year-2 there were variations in the number of species. The variation has been attributed mainly to observation of some species in one year, but not the other year. However, combining all impact years, a total number of 85 species has been recorded. Diversity has been maintained or increased at this site over the duration of the Phase I.

Table 4: Bio-diversity observed by sites

Sites	Baseline	Overall Impact Years
Hail Haor	71	85 (3 yrs)
Turag Bongshi	82	95 (3 yrs)
Kongshow Malijhee	64	78 (2 yrs)

Turag-Bangshi Site: 82 species were identified in the baseline period while 91 were observed at impact year –3. Within the impact years there was a variation in number of species. However, combining all impact years, a total number species diversity observed was 95.

Kongshaw-Malijhee: Species diversity was higher in impact years than that of the baseline situation. Fish Species identified were 67 and 71 in impact year-1 and impact year-2 respectively compared to 64 in the baseline period. However considering two impact years, a total of 78 fish species was recorded. At this site the RMOs have taken the initiative and introduced locally rare species which were available there in the past. RMOs also took initiative to conserve rare species.

B. Fish Consumption

As shown in the table below overall fish consumption increased significantly in all sites. Major findings indicate that small beel and wetland resident fish and prawns constitute the main fish consumed for all households and particularly for poorer households.

BEST AVAILABLE COPY

Table 5: Per Capita Fish Consumption (g) by three Sites

Sites	Baseline years	Last Impact year	% of change compared to baseline and impact yr-3
Hail Haor	46.90	60.89 (yr 3)	29.82
Turag Bangshi	27.32	37.14 (yr 3)	35.94
Kongshow- Malijhee	22.00	26.58 (yr 1)	20.82

The vast majority (55-75%) of fish consumed in these sites and throughout the country are purchased in local markets. Studies by Helen Keller International indicate that over 50% of all fish consumed in rural Bangladesh are purchased.

Hail Haor: Per capita fish consumption for all social classes increased significantly from 46.90 g/day in the baseline period to 60.89 g/day in impact year-3. The highest increase, 40%, in fish consumption occurred among marginal farmers followed by 32% and 29% for medium and landless farmers respectively. Per capita fish consumption of large farmers was not very different, in fact a little less, 50.00g compared to the baseline situation, 52.47g. Increasing production in the haor and involvement of the poor fishers and others in AIG activities to help raise family income is expected to sustain these levels at a minimum.

Fish consumption varied significantly by season and followed the fish effort shown and discussed above. The highest quantity of fish was consumed in the post monsoon months (October to December), that is the period when fish catch and availability are at their highest. The lowest per capita consumption was in April, the driest month of the year. The monthly variation of fish consumption largely depends on the availability of fish and the purchasing capacity of the people.

Consumption by species shows that small fish, prawns and snake heads, both in the baseline and during the impact years, constitutes the main wetland fish consumed. The "Gura icha" (small prawn) contributed more in impact years (7.16% year-1, 6.87% year-2 and 5.67% year-3) than that of baseline situation (3.92%).

Turag Bangshi: Per capita fish consumption for all social classes significantly increased from 27.32g at baseline to 37.14g by impact year-3. The highest 61.32% increase in fish consumption was among the large farmers followed by 43.51% and 35.85% for small and medium farmers respectively. In the case of marginal farmer the rate of fish consumption was less compared to others groups. At the end of 3rd impact year fish consumption had increased overall by about 36%.

In line with other parts of the country, the largest amounts of fish consumed were in the post monsoon months (October to December) when fish catch was at its highest. The lowest per capita consumption period was found in April, the driest month of the year. During April availability of capture fishes is significantly reduced in the market.

As in other sites small fish, prawns and snakeheads were most preferred species consumed in all the years from baseline through the impact years. Consumption of gura icha (small prawn) increased from the baseline of 3.92% to 9.29% in impact year 1. In impact year 2 there was an 8.56% and in year-3 a 4.77% increase over the baseline year. The majority of the fish consumed are purchased in village markets.

Kongshaw-Malijhee: Per capita fish consumption was observed to be 26.58 grams/day in impact year-1 which increased from 22grams/day during the baseline period. Increase of per

capita fish consumption for landless classes was 20% and it was only 7% for the large farmers group.

Per capita consumption of fish by months varied significantly. As in other sites and throughout the country the highest per capita consumption was found in December while the lowest in April.

7. Aquatic Vegetation

The numbers of aquatic plant species observed were 107 and 51 in Hail Haor and Turag-Bangshi sites respectively. These numbers increased to 117 and 60 in the respective sites in the impact years. In Kongshaw-Malijhee, 55 species observed at baseline which after intervention increased to 72.

These differences may not be eventually due to project interventions but year to year variation in the number of aquatic vegetation species due to fluctuating water levels and varying flooding patterns. Reduced netting during the late dry season and early monsoon likely had some impact as well.

1. THE MONITORING METHODOLOGY

1.1. Background

At the out set of project implementation, provisions were made to carry out a monitoring program to capture changes in fish catch, species diversity and household level fish consumption. Some measurable indicators were set and a baseline was established for the three project sites. The fish catch a nd household fish consumption m onitoring continued over the entire project period.

Besides fish catch monitoring, species of aquatic vegetation and wildlife presence and absence in the project sites was also monitored. However, wildlife and vegetation monitoring was discontinued from the t hird y ear o f t he project. Detailed monitoring m ethodology a pplied in collecting data & information and analysis is described in the following section of the report.

1.2. Fisheries

1.2.1. Introduction

To measure the changes in the fisheries indicators such as CPUA (catch per unit of area), CPUE (catch per unit of effort), and diversity of species have been considered. Prior to project interventions, baselines on such indicators were assessed. The impact assessment has been made on a yearly basis against the baseline data on selected indicators.

Prior to starting the baseline monitoring, some essential aspects related to fisheries monitoring were accomplished. These were habitat stratification, monitoring location selection, development of data collection protocol and standardization of catch efforts. The fisheries data (production and species diversity) were collected through fish catch assessment (monitoring and measuring) survey and for this purpose semi-structured questionnaire was used (Appendix 1). Field level data collection started from April 1999 in Hail Haor, from May 1999 in Turag-Bangshi and from August 2000 in Kangsha-Malijhee sites. Since then data collection has continued in an attempt to access impacts.

Table 6: Periods of assessment of the three sites

Sites	Baseline years	Impact year 1	Impact year 2	Impact year 3
Hail Haor	April 1999 - March 2000	April 2000 – March 2001	April 2001 – March 2002	April 2002 – March 2003
Turag Bangshi	May 1999 – April 2000	May 2000 – April 2001	May 2001 – April 2002	May 2002 – April 2003
Kongshow Malijhee	August 2000 – July 2001	August 2001 – July 2002	August 2002 – July 2003	-

Table 7 shows the periods designated as baseline and the impact years for the various sites. The impact years are referred to as impact year 1, 2 and 3 or the years after the baseline. The Kangsha-Malijhee baseline monitoring started later than the other two sites and comparisons have been made only for the period that the data is available.

1.2.2. Habitat Stratification

Biological productivity is a function of ecological conditions of habitats, which is governed by the landscape and hydrological regime of the area and human practices. The spatial and temporal variations in the project sites are high and fishing and gear techniques vary considerably at different habitat locations. In order to portray a fish catch scenario that represents area of the project interventions, habitats have been stratified into rivers, canals, beels and floodplains. The selection criteria also included the geographical distributions over

the project intervention sites, inundation regime and biological importance of the area. The baseline data of some conditions have been used in some cases to measure the changes after project interventions and also as indicators to understand the usefulness of the future implementation of fisheries management. The changes are local (in a specific habitat) and global (throughout the project areas). Accordingly, a number of locations and habitats were selected and monitored.

1.2.3. Monitoring Location Selection

The locations were selected prior to the baseline study following the wetland inventory and resource-mapping exercises conducted by MACH. The impact assessment monitoring program continued in the same locations. Monitoring locations included diverse water bodies including beel, floodplain, canal and river (Table 7).

Table 7: Monitoring locations, habitats and areas in three MACH sites

Monitoring locations	Monitoring area (ha)	Habitat types
	Hail Haor Site	
Jethua Beel (I)	67.95	Beel,Canal, Floodplain
Gopla River	41.23	River
Boulashir floodplain	234.38	Floodplain
Chiruadubi	30.40	Beel
62-Beel Complex	419.48	Beel, floodplain
Rustompur beel Complex	221.73	Beel, Canal, Floodplain
Balla Beel	159.09	Beel, Floodplain
Total	**1174.26**	
	Turag-Bangshi Site	
Mokash Beel South(I)	100.00	Beel
Mokash Beel North	100.00	Floodplain
Kali-daha Beel (I)	50.00	Beel
Mokash Khal (I)	0.70	Canal
Turag River (I)	14.00	River
Aowla Khal	1.02	Canal
Aowla Beel (I)	100.00	Beel
Bangshi River	17.00	River
Total	**382.72**	
	Kangshow-Malijhee Site	
Baila Beel (I)	44.10	Beel, floodplain
Takimari Beel (I)	34.75	Beel, floodplain
Kewta Beel (I)	33.07	Beel
Nijla Beel	63.92	Beel ,floodplain
Bagadubi Khal	4.20	Canal
Malijhi River (Baharalir kur)	5.00	River
Aowra Bowra Beel	69.33	Beel
Bailasha Beel (I)	13.35	Beel ,floodplain
Total	**267.72**	

1.2.4. Sampling Protocol

Floodplain fisheries, with their spatial and temporal variations in fish and water abundance, are complex and dynamic. The type of fishing gear used affects a fisher's catch within a specific habitat. A sample unit was considered to be one set of gear used for a catch attempt. The effectiveness of the fishers and their motivations are also significant in setting parameters for recording data from sample units. The selection of sample fishing units while recording catch data is crucial and requires skilled judgment of the fisheries biologist and monitoring staff. Accordingly, attempts have been made to be consistent in technique and reporting so that the best possible estimates can be made from the collected data.

To offset any bias from the spatial distribution of fishing gear used the field biologist collected data from different locations at the monitoring locations. For each gear type at least three fishing units were monitored. If there were more than 30 fishing units of one particular gear type operating in a day, data was collected from not less than 10 percent of the operating fishing units. Irrespective of catch data from individual fishing gear use, all fishing units in operation were counted during the catch monitoring day. This was taken as the total effort for that day. At the end of the day a list of fishing units by gear type was prepared. In order to accommodate for possible temporal variations in a single month the sampling intensity was set at 10-day intervals and so data was collected three times a month from the selected locations. Gear of the same type with differing dimensions was standardized at the time of data analysis and output generation to 100 feet (MACH, Baseline report on fisheries, vegetation, wildlife and protein consumption).

1.2.5. Monitoring Parameters (Fish Catch)

Fish catch assessment monitoring collected data on fishing intensity, species diversity and catch composition, fishers by category and fishing gears using a semi-structured form already mentioned earlier. The terminology used in fish catch monitoring are defined as follows:

Fishing gear and fishers:

- fishing gear type and effort intensity, net area and mesh size
- Fishers' type, sex, age, village and distance from fishing ground
- fishing intensity

Time and duration of fishing:

- fishing starting and ending times
- Probable fishing duration

Fish catch:

- Species by number and weight

Fishing rights:

- The fisher's access to the fishing ground

1.2.6. Data Analysis

The fish catch can vary spatially, temporally, and on the basis of the ecological condition of the habitat. In order to incorporate these variations and to monitor parameters, the data has been analyzed on the basis of the monitoring locations, habitats and gear types, types of fishers and seasonal variation. Fishing intensity, duration of fishing, total catch, catch by species and the number of species with their abundance have been analyzed. Catch per Unit of Effort (CPUE) has been analyzed and along with other mentioned parameters has been used to determine the Catch per Unit Area (CPUA) which has been considered as one of the indicators of fish yield changes. Each year's data was handled in exactly the same way from year to year. Formulas and definitions are given below.

Seasonal variation: For presentation the year was divided into four seasons. These are Pre-Monsoon (April-June), Monsoon (July-Sept.), Post-Monsoon (Oct.-Dec.) and Dry (Jan.-March).

Fishing gear: The types of fishing gear found in operation during the monitoring year were recorded with their dimensions. Current *jal* and *Ber jal* Gear of the same type with differing dimensions were standardized to 100 feet to analyze Catch per Unit of Effort (CPUE).

Fishing intensity and duration of fishing: Fishing intensity describes the member of gear used during the monitored day. This has been calculated from an average of three sampling days. Gear numbers of all types are counted and then extrapolated for that month. Fishing duration was recorded for all the operated gear and the average duration of fishing was calculated for each specific gear type.

Catch per Unit of Effort (CPUE): Average catch in kilograms/per unit gear per day of operation.

Calculation of CPUE

- Conversion of Sub-Sample Catch into Sample Catch
- Conversion of Observed Time Catch into Day Catch
- Current Jal & Ber Jal is standardized on Length = 100 ft.

CPUE = (Total Catch of a specific gear type observed during monitored days by habitat for a month)/ (No. of observed gears for a specific gear type during those monitoring days by habitat for that month) = Kg/Gear/Day

Catch per Unit of Area (CPUA): The total catch of all gear per unit area over a certain period estimated from sample data.

Calculation of CPUA

Total Catch of a specific gear for one day = CPUE x No. of operated gears of that type in a day.

Then, Total Catch of all types of gears operated = Σ Total Catch of a specific gear for one day.

Total Catch for a month = Total Catch of all types of gears operated x No. of days of a month.

Finally, **CPUA** = estimated total catch of the monitoring area of a year ÷ Area of a Monitoring Location = Kg/ha/year

Catch composition: The catch composition was analyzed for the obtained species and the total catch of a specific habitat.

1.3. Fish Consumption

1.3.1. Introduction

It is expected that due to MACH interventions such as sanctuary creation, there would be qualitative and quantitative changes in the wetland productivity and biodiversity. These changes may have impact on household level fish consumption pattern. On this assumption fish consumption monitoring has continued in all the three sites. Data has been collected from selected households from the selected villages located within the impact area of the project intervention.

1.3.2. Sample Households

Fish consumption data have been collected from 490 households from 14 villages in the Hail Haor site, 280 households from 8 villages in Turag-Bangshi site and 280 households from 7 villages in Kangshow-Malijhee site. From each sample village, 35 sample households have been drawn from Hail Haor and Turag-Bangshi site and 40 drawn from Sherpur site covering various social classes, viz. landless, marginal farmers, small, medium and large farmers.

1.3.3. Sampling protocol

Data was collected at three-day intervals from the sample households using the forms shown in Appendix-2. Fish brought for household consumption during survey periods were weighed by species. Local trained women have been assigned as Resident Monitors (RMs) to collect the data from sample households. The field staff of CNRS-MACH supervised and assisted the RMs in data collection as well as checking the data forms and resolving problems and inconsistencies. Later at the site level office, data forms are reviewed, coded and edited by the concerned Field Officers which are then sent to MACH head office for computer processing and analysis.

Household fish consumption monitoring started at Hail Haor site from September 1999, in Turag-Bangshi from October 1999 and from January 2001 in Kangsha-Malijhee site (Table 9).

Table 8: Periods of assessment of fish consumption at the three sites

Sites	Baseline years	Impact year 1	Impact year 2	Impact year 3
Hail Haor	September 1999 - April 2000	September 2000 – April 2001	September 2001 – April 2002	September 2002 – April 2003
Turag Bangshi	October 1999 – April 2000	October 2000 – April 2001	October 2001 – April 2002	October 2002 – April 2003
Kongshow Malijhee	January 2001 – December 2001	January 2001 – December 2002	January 2002 – December 2003	-

1.3.4. Monitoring Parameters

To compare the changes of fish consumption in terms of quantity and species diversity at the baseline period with that of the impact years, the following parameters have been considered:

- Per capita fish consumption by land classes
- Per capita fish consumption by months
- Number of species consumed by the people
- Ranking of species by quantity consumed
- Per capita non fish protein consumption by the people

1.4. Aquatic Vegetation

Data was collected by direct field observation and by interview. Quadrate qualitative (for aquatic vegetation) and quadrate quantitative (for terrestrial vegetation) methods were used in this survey. After visiting the field, transects were drawn across habitat types. For the aquatic vegetation study $2m^2$ quadrates from each transect were examined. For aquatic vegetation type, habitat, cover and use were examined.

1.5. Wildlife

The methodology used for the wildlife survey (data for both dry and wet seasons) were as follows:

- Transect lines were drawn across the delineated representative habitats.
- Monitors recorded the occurrence of the species along both sides of transects out to a distance of 5 meters.
- Droppings counted for mammals and predatory birds.
- Flashing for nocturnal animals.
- Photography, call marking, and trapping of specimens for taxonomic confirmation.
- Interviewed local people (fishers, boatmen, forest wood collectors and other professionals).

The IUCN Bangladesh Red Book, 2000 was used in identification of the wildlife species recorded. The reconnaissance survey was conducted to draw transects covered all habitat types in the respective sites.

The habitats of Hail Haor included *beels*, paddy fields, homestead & riparian areas vegetation, lemon gardens, tea gardens, rubber plantations, forest plantations and natural forests. The transects taken were:

- Transect 1 included two types of habitats- beel and paddy field (from a palm tree near Shamshergonj road at Bhunabir to north-east of Balla beel).
- Transect 2 (from Foyzabad hill's wood bridge to ending of Jaita Chhara) included the homestead areas, riparian areas, lemon gardens and tea gardens.
- Transect 3 (from the south of #10 section of Burburi-Chhara tea garden to West of Magurchhara Khasia-punji) contained the rubber plantations, natural forest and forest plantations.

In Turag-Bangshi site three transects were drawn covering all the major habitats viz. *Beel*, River, Floodplain, Sal forest, Riparian zone, Paddy field and settlements. The transects taken were:

- Transect 1 covers from Bastali Primary School (North of Turag River) to West of Sinabaha bazaar.
- Transect 2 covers from west of Baraibari bazaar to Kalidaha Bridge.
- Transect 3 covers from Boalia village to Turag riverside.

Three transects were drawn at Kangsha-Malijhee river basin covering all the major habitats. The transects taken were:

- Transect-1 covered beels, homestead areas and paddy fields.
- Transect-2 and Transect 3 contains natural forest and plantation areas.

1.6. Statistical Analysis

To draw the statistical inferences on the monitoring data a number of statistical tests were done using SPSS program. Statistical analysis is given in Appendix 3.

2. FINDINGS

2.1. Fish Catch Monitoring

2.1.1. Hail Haor Site

2.1.1.1. CPUA in Hail Haor

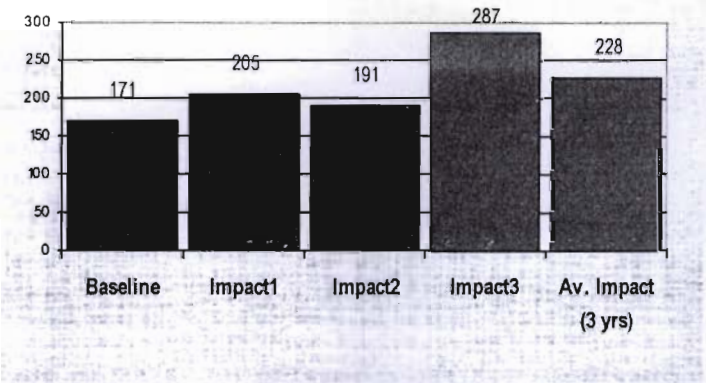


Figure 1: CPUA in baseline and impact years in Hail Haor

Data for all the years from baseline to impact year 3 as well as the average impact are shown on figure 1. It can be seen that there has been an overall increase in the catch per unit of area (CPUA) over the impact years compared to the baseline year. The CPUA for all the monitoring locations of HH site were 171.08 kg/ha in the baseline year, which it increased to 205.05 kg/ha, 190.75 kg/ha and 287.28 kg/ha in impact year-1, year-2 and impact year-3 respectively (Figure 1). These are significant in an environment of continued reductions due to poor use and degradation of the resource. The trend in the past was downward for these natural fisheries.

The project management years (impact years) data indicates a steady enhancement in catch since the baseline. The increase in catch quantity as expressed in kg/ha in monitoring locations has gained 67.92% increase in the impact year -3 compared to the baseline situation. On average, the CPUA for the three impact years stands at 227.69 kg/ha, which is 33% higher than that of the baseline catch.

As in the case of increased CPUA, the total quantity of catch also increased in the impact years (Figure 2). In the baseline year, the total catch was 200.89 tons increased to 240.78 tons, 223.99 tons and 337.34 tons in the impact-1, impact-2 and impact-3 years respectively. The average total catch of the three impact years was found 267 tons, which was about 33% higher than that of the baseline catch (Figure 2).

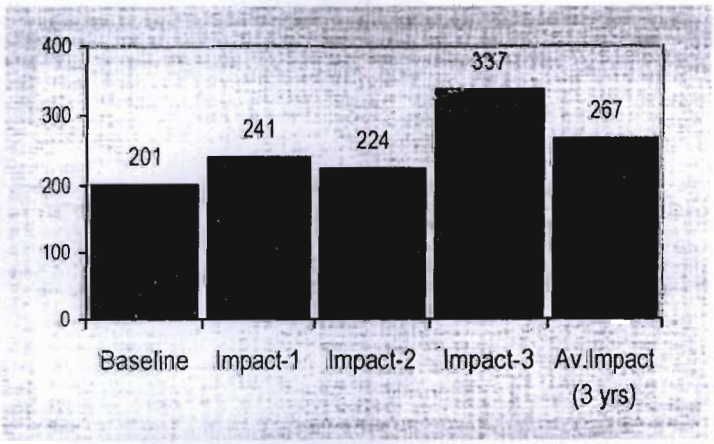


Figure 2: Total catch in tons in Hail Haor

Both the CPUA and total catch in the monitoring locations of the Hail Haor was found highest in impact year-3.

It is noted that the catch in each of the 7 monitoring locations in Hail Haor was found to vary among the locations as well as over the years due to various reasons. Table 10 shows that the overall CPUA combining the 7 locations was 171.08 kg/ha at the baseline year while it varied by location from a minimum of 35.60kg/hs in Balla Beel to a maximum of 393.67 kg/ha in Gopla River. The overall CPUA increased to 205.05 kg/ha in the impact year-1. Except for Rustampur Beel, CPUA in other locations increased in the impact year1 compared to the baseline figure. CPUA in Balla Beel was two times higher than the baseline in the impact year-1 (86.84 kg/ha) and more than four times higher in the impact year 3 than that of the baseline year (35.60 kg/ha).

The overall CPUA among the impact years was 227.69 kg/ha. Lower catch in the impact year-2 was due to lower CPUA in the Boulashir Floodplain, 62-Beel Complex and Rustampur Beel than that in the impact year-1. The CPUA again increased in impact year-3 which was highest and about 68% higher than that of the baseline year. Except in the Boulashir Floodplain, CPUA in all locations increased.

Table 9: CPUA (kg/ha) by sampling locations and by years

Monitoring locations	Baseline	Impact-1	Impact-2	Impact-3	Impact years (3 years)	% Change compared to baseline
Jetua Beel	121.58	190.55	160.08	154.91	168.52	38.61
Gopla river	393.67	465.73	490.00	732.72	562.82	42.97
Boulashir floodplain	69.82	78.01	62.03	57.28	65.77	-5.80
Cheruadubi Beel	278.31	322.97	619.49	482.94	475.13	70.72
62-Beel Complex	263.75	315.80	256.89	448.29	340.33	29.04
Rustompur Beel	159.09	154.43	144.86	253.96	184.42	15.92
Balla Beel	35.60	86.84	123.57	151.76	120.72	239.10
Overall HH site	**171.08**	**205.05**	**190.75**	**287.28**	**227.69**	**33.09**

Statistical analysis of the impacts of hydrology on production has been done. Bi-variate (CPUA and water level) regression analysis indicates that there is a positive correlation (R=0.87) between CPUA and retention of water level during the dry season (April-June). It reflects that there is increasing trend of CPUA during the project period (R^2=0.76). It explains that 76% variation of CPUA depends on dry season water level. However, four years data are not sufficient to draw definitive conclusions.

Analysis of variance (ANOVA) shows that CPUA change significantly during the monitoring periods (p value < 0.05) (Appendix-3).

2.1.1.2. Gear Effort

Table 10: Gear Effort (No. /day) in Hail Haor in 7 monitoring locations at the baseline and impact years

Gear types	Total Gears Per Day				
	Baseline	Impact-I	Impact-II	Impact-III	Overall Impact (3 years)
Veshal jal	5.8	8.16	10.92	5.81	8.18
Ber jal	6.26	8.71	1.22	5.38	4.99
Thela jal	22.74	6.34	14.80	7.15	9.3
Current jal	881.36	487.87	669.27	791.79	639.24
Suta jal	232.86	31.93	217.76	199.28	147.74
Long line	24,998.39	15,039.83	15,456.76	14,628.63	14,797.13
Traps	383.25	546.37	748.98	723.61	662.53
Other gears	3.35	9.73	119.40	78.07	68.31

Gear effort in terms of number of different fishing gears operated per day in the monitoring locations of the Hail Haor is calculated from the sampling data. The commonly operated gears as recorded in Hail Haor during the monitoring period included *veshal jal, ber jal, thela jal, current jal, suta jal, long line/kathi borshi,* traps and other minor gears. The efforts by gear type in the baseline and impact years is presented in Table 11.

Changes in the average gear effort were observed in the monitoring locations of the Hail Haor in the baseline and impact years. There is a slight reduction in the effort of various gear types in the impact years from that of the baseline situation except for traps and *veshal jal* (Table 11). Increased effort in the use of traps was observed to be significant in the impact year-3, from 383.25 in the baseline to 546.37, 748.98 and 723.61in the impact year-1, impact - 2 and 3 respectively.

The efforts of *current jal* and *ber jal* have gone down compared to that of the baseline year. These gears are generally more harmful to the fishery during certain times of the year as these gears are very efficient in catching undersized fishes. In fact the *ber jal (Moshari jal/kafri jal)* can even catch certain types of fish eggs.

The effort of *veshal jal* has increased slightly in impact year-3. Use of long line as observed reduced significantly compared to the baseline situation. The average effort of long line was nearly 25,000, which was reduced to around 15,000 in the impact years (Table11).

2.1.1.3. Gear Wise Catch

Quantity and quality of catch varies by gears types and fishing methods. Table 11 shows that the majority of the catch 35% (70,891 kg of the total catch) in the baseline year was accomplished by the current jals while in the impact year-1 the catch was dominated by the *ber jal* constituting over 31% (75,102 kg) of the total catch. The catch of *current jal,* was reduced to about 33,000 kg (13.63% of the total catch) in the impact year-1.

Fishing by dewatering of beels constituted only over 3% of the total catch in baseline year. This increased over the impact years. The increase was by 20% (47,410 kg) of the total catch in the impact year-1, 24.6% (55,113 kg) and 28.18% (95,076 kg) in impact years 2 and 3 respectively (Table 11). Dewatering of beel in the dry season for fishing in the Hail Haor is the normal practice and it is mostly done by the leaseholders though it is illegal. The Government needs to be stronger in limiting this practice. Within the managed areas under RMO however dewatering has totally stopped.

Table 11: Total catches of monitoring locations by major gear types and by years in Hail Haor

Name of gears/fishing methods	Baseline		Impact-1		Impact-2		Impact-3		Av. Impact years	
	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	(%)
Current jal	70,890.99	35.29	32,829.91	13.63	38,935.87	17.38	59,578.66	17.66	43,781.48	16.37
Long line	40,513.74	20.17	15,479.47	6.43	21,162.89	9.45	28,578.46	8.47	21,740.27	8.13
Ber jal	28,550.23	14.21	75,101.65	31.19	5,917.61	2.64	44,230.72	13.11	41,749.99	15.61
Thela jal	16,034.85	7.98	6,823.2	2.83	1,4530.1	6.49	6,945.12	2.06	9,432.81	3.53
Suta jal	15,728.73	7.83	19,04.27	0.79	19,347.33	8.64	14,311.14	4.24	11,854.25	4.43
Veshal jal	10,200.26	5.08	18,526.63	7.69	16,022.55	7.15	12,841.72	3.81	15,796.97	5.91
Traps	7,435.7	3.70	25,059.98	10.41	27,872.27	12.44	31,325.3	9.29	28,085.85	10.50
Dewatering	6,556.17	3.26	47,410.1	19.69	55,112.91	24.60	95,076.36	28.18	65,866.46	24.63
Katha	2,828.85	1.41	6,849.14	2.84	9,445.02	4.22	24,727.09	7.33	13,673.75	5.11
Other gears	1,557.05	0.78	2,038.96	0.85	6,368.33	2.84	15,304.74	4.54	7,904.01	2.96
Pagars	596.67	0.30	6,895.33	2.86	3,595.06	1.60	2,142.33	0.64	4,210.91	1.57

Name of gears/fishing methods	Baseline		Impact-1		Impact-2		Impact-3		Av. Impact years	
	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	(%)
BRMO	0	0.00	1,861.8	0.77	5,681.79	2.54	2,283.33	0.68	3,275.64	1.23
Total	**200,893.24**	**100.00**	**240,780.47**	**100.00**	**223,991.74**	**100.00**	**337,344.98**	**100.00**	**267,372.39**	**100.00**

The increase in fish production can be attributed to establishment of sanctuaries along with other management initiatives by RMOs with project support.

Ber jal is another commonly used gear in the Hail Haor mostly operated in the monsoon and the catch of this gear also considerable. Initially ber jal contributed to 14.21% (28,550 kg) of the baseline catch which went on to increase almost more than double in the impact year-1 (over 75,000 kg) forming over 31% of the total catch. However, the *ber jal* catch dropped substantially in impact year-2 (2.64%) but increased again in impact year-3 making up for over 13% (44,231 kg) of the total catch. The average catch of the *ber jal* in 3 impact years constitutes about 16% of the total catch.

The Catch of traps was found to be significant in the overall catch of the Hail Haor. Table 12 shows that trap catch contributed only 3.7% of the total catch (7,436 kg) while it increased to over 25,000 kg in the impact year-1 (10.41% of the total catch) and further to 27,872 kg (12.44%) and 31,325 kg (9.29%) in the impact year-2 and 3 respectively. The average trap catch constituted 10.5% of the total catch in the overall average impact years (3 years).

2.1.1.4. CPUE

Catch per unit of effort is expressed as kg/day/unit of effort of specific gears. Usually it is calculated as catch per gear per day and expressed in kg and standardized as the catch per hour. From the catch data six common gears have been selected for determining the CPUE viz. *veshal jal* (dip net), *ber jal* (seine net), *thela jal* (push net), *current jal* (monofilament nylon gill net), traps and *suta jal*.

Table 12 shows the CPUE of six gears in the Hail Haor and revealed that all the six common gears operated in the Hail Haor has increased over the impact years compared to that of the baseline year. There have been negligible changes in the average fishing hours of commonly used gears observed in the baseline and impact years.

Table 12: CPUE (kg/day/gear) of Selected Fishing Gears

Gear types	Baseline	Av. Fishing hours	Impact-1	Av. Fishing hours	Impact -2	Av. Fishing hours	Impact-3	Av. Fishing hours	Overall Impact (3 years)	Av. Fishing hours
Veshal	5.34	16.20	7.39	16.28	4.91	13.27	6.37	14.22	6.21	14.60
Ber jal	6.87	9.63	11.70	5.19	7.54	6.16	9.55	9.24	10.54	6.80
Thela jal	1.31	5.47	2.26	5.32	2.88	5.13	2.70	5.74	2.65	5.39
Current Jal	0.18	10.80	0.15	11.58	0.25	10.80	0.20	11.33	0.20	11.24
Traps	0.06	12.36	0.12	18.86	0.10	15.46	0.10	15.23	0.11	16.50
Sutajal	0.17	13.41	0.18	17.95	0.28	11.10	0.20	14.20	0.23	13.39

2.1.1.5. Seasonal Catch

The catch composition and quantity varied over the seasons mainly due to changes in the inundation regimes, gear use, fishing pattern and intensities. Usually, in floodplain perennial beels, fish catch peaked in the post monsoon (October-December) and dry season (January-March).

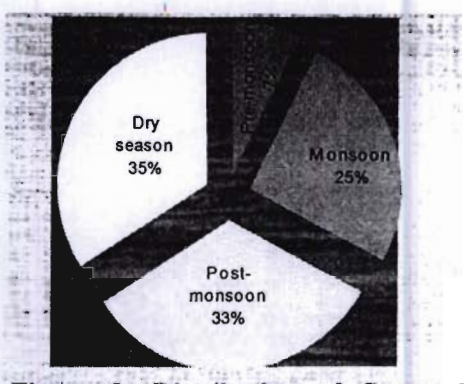


Figure 3: Distribution of Seasonal Catch (%) in HH

There are two major catches during this time, the post monsoon draw down catch and dry season katha, pagar and dewatering catch. These catches usually form the bulk of the annual catch in floodplain environments. A similar trend has been observed in Hail Haor where more than 65% of the annual catch is done in post monsoon and in the dry season (Figure-3). Combining the catch data of four years in the Hail Haor showed that 34.57% of the annual catch is done in Dry season (January-March) and 32.5% in the post monsoon (October- December).

The minimum catch is done in the pre-monsoon months (April-June), which formed only 7.5% of the total annual catch. However, one fourth of the annual catch (25.46%) is done in the monsoon months (July-September). Similar trend was found in both the base line and impact situations.

2.1.1.6. Fish Species Diversity

Fish species diversity in a wetland ecosystem involves various factors. Some of these are connectivity with other wetlands, particularly with river systems, fishing practices, dry season water area and depth, and reintroduction of species. Of these factors, connectivity is a key factor affecting species diversity as this facilitates fish migration among wetland habitats.

In Hail Haor site limited progress was made in re-establishing connectivity with the Kushiara river system However, other possible measures such as, closed periods to control fishing effort, wetland sanctuary and rehabilitation of semi-degraded wetlands under project management was done. Technically, all these interventions is expected to have a positive effect on species diversity over a longer period.

In the case of Hail Haor, an increasing trend in fish species diversity was observed in the monitoring locations compared to that of the baseline year. Table 14 shows that in the baseline year a total number of fish species was recorded, 71 while the number increased to 77 by the end of impact year 2 (combining impact years 1 and 2).

The total number of fish species combining the impact years 1, 2 and 3 was recorded as 85, which is 9 higher than that of the baseline situation. However, diversity of species was observed remained same in the impact year-1 (71) and a bit low in impact year-2 (69) and it again increased to 76 in impact year-3 (Table 13). This has been due to presence of some species in one year but not found in another year. Some species was not observed in baseline year, impact year 1 & 2 but observed in impact year 3, while some species were observed in the baseline year but not found in the impact years and 2. A list of species observed in different periods is presented in Appendix-4.

BEST AVAILABLE COPY

Table 13: Fish Species diversity in the Hail Haor by Monitoring Locations and by Year

Monitoring locations	Number of Fish Species observed					
	Baseline	Impact-1	Impact-2	Impact-1 & 2 combined	Impact-3	Impact-1, 2 & 3 combined
Jethua Beel	38	48	47	56	47	59
Gopla River	54	44	49	51	55	60
Boulashir FP	50	51	51	57	50	61
Chiruadubi Beel	46	44	52	53	50	56
62- Beel	59	59	61	67	63	71
Rustampur Beel	50	51	50	56	62	68
Balla Beel	39	55	50	60	55	67
Overall	**71**	**71**	**69**	**77**	**76**	**85**

2.1.1.7. Ranking of species by quantity of catch

In Hail Haor site during the monitoring period there was variation observed by fish species. The continuation of the top 20 species in the annual catch contributed 94.49%, 86.33%, 78.45% and 80.14% in baseline, impact year-1, impact year-2, and impact year-3 respectively (see Appendix-5) Data also shows that in impact-1 the contribution of *mola* was the highest (23%) of the annual catch. Among the 20 top ranked species, 5 highly ranked species were also found to vary their contributions in the four monitoring years.

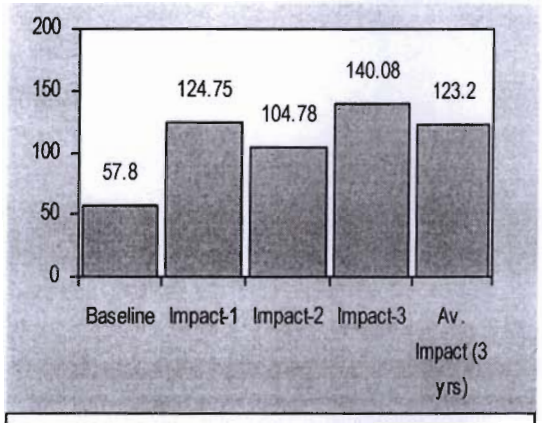


Figure-4 CPUA in baseline and impact years

2.1.2. TURAG-BANGSHI SITE

2.1.2.1. CPUA in Turag-Bangshi

Figure 4 shows the CPUA in the Turag-Bangshi (TB) site from the baseline years through the impact years and the average impact result.

The data shows an increase in overall fish catch in the monitoring locations in TB over the impact years compared to that of the baseline year. The overall CPUA for all the monitoring locations was recorded as 57.80 kg/ha/yr in the baseline year. This increased while increasing to 124.75 kg/ha/yr, 104.78 kg/ha/yr and 140.08 kg/ha in impact years 1, 2 and 3 respectively (Figure 4).

The catch data shows a sharp increase in the impact year-1 from 58 kg/ha to 125 kg/ha, which is 116% higher than that of the baseline catch. Although, a little lower catch was observed in impact year-2 (104.78 kg/ha), this too was about 81% higher than the baseline catch (57.80 kg/ha). The highest rate of increase in catch was observed in impact year-3, which was 142% higher compared to the baseline catch. On an average, the CPUA for the three impact years stand at 123.20 kg/ha, about 113% higher than that of the baseline catch.

As in the case of increased CPUA, the total quantity of catch also increased in the impact years. In the baseline year, the total catch was 22 tons in the monitoring locations covering 382.72 ha. The total yield which has been raised to 48 tons, 40 tons and 54 tons in the impact years1, 2 and 3 respectively. The average total catch of the three impact years was 47 tons, which is about 114% higher than that of the baseline catch (Figure 5).

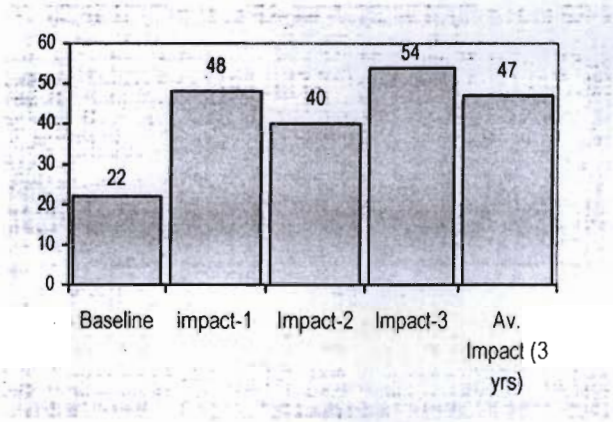


Figure 5: Total catches in tons in TB

Like Hail Haor, both the CPUA and total catch in the monitoring locations of the TB site was found highest in impact year 3 compared to that of the baseline and other impact years.

The catch in each of the 8 monitoring locations in the TB site varied among the locations as well as over the years. Table 14 shows that the overall CPUA when the 8 locations are combined was 57.80 kg/ha/yr at the baseline year. Data shows that CPUA in all the monitoring locations has increased in the impact year-1 compared to that of the baseline situation. Highest rate of increase in CPUA (5 times higher) was recorded in Mokosh khal in impact year 3 (3,696 kg).

The overall CPUA in the impact year-2 (104.78 kg/ha) was a bit lower than that of the impact year-1 (124.75 kg/ha) but higher than the baseline figure (57.80 kg/ha). Lower catch in the Mokosh khal and Awola khal in the impact year-2 contributed to overall lower CPUA in this year. The CPUA again increased in impact year-3 and was highest (140.08 kg/ha) over the four years, which was about 142% higher than that of the baseline year.

Table14: CPUA (kg/ha/y) by sampling locations and by years

Monitoring Locations	Baseline	Impact-1	Impact-2	Impact-3	3 Impact years combined	% of change compared to baseline
Mokash Beel (South)	42.03	98.25	79.80	103.86	93.97	123.58
Mokash Beel (North)	33.48	104.68	104.46	149.42	119.52	256.99
Kaliadaha Beel	62.40	140.97	69.34	169.17	126.49	102.71
Mokash/Solhati Khal	790.88	2380.99	1404.94	3696.42	2494.12	215.36
Turag River Section	144.47	217.23	251.54	253.07	240.61	66.55
Aowla Khal (Canal)	627.68	1485.30	858.07	1091.74	1145.04	82.42
Aowla Beel	65.78	77.84	104.96	76.12	86.31	31.21
Bangshi River Section	97.34	376.12	137.04	292.27	268.48	175.81
Overall	**57.80**	**124.75**	**104.78**	**140.08**	**123.20**	**113.15**

The regression analysis (R=.84) indicates a positive relationship between CPUA and the project intervention periods. The linear bi-variate regression determines that (R^2 = 0.67) 67% variation in CPUA could be explained by the project interventions. The trend of the CPUA was found positive during the project period.

Analysis (Appendix-3) of variance (ANNOVA) shows that CPUA changed significantly during the monitoring periods (p value < 0.05)

2.1.2.2. Gear Effort

Gear effort in terms of number of different fishing gears operated per day in the monitoring locations of TB site was monitored The commonly operated gear in the TB site during the monitoring period included the *veshal jal, ber jal, moi jal, thela jal, dharma jal, jhaki jal, current jal, hat* borshi, long line, traps and other minor gears. The gear efforts in the sampling location are presented in Table 15.

Table 15: Gear Effort (No/day) in 8 monitoring locations of Turag-Bangshi site

Gear Types	Total Gears Per Day				
	Baseline	Impact-1	Impact-2	Impact-3	Overall Impact (3 years)
Veshal Jal	0.42	0.50	0.29	0.90	0.56
Ber Jal	1.72	2.40	4.41	2.89	3.23
Moi Jal	16.66	20.45	30.10	57.92	36.16
Thela Jal	5.96	8.47	9.57	6.78	8.28
Dharma Jal	11.09	1.39	1.63	4.64	2.55
Jhaki Jal	8.13	13.71	18.99	20.85	17.85
Current Jal	85.14	170.17	68.16	35.14	91.16
Hat Borshi	10.25	14.45	67.57	17.19	33.07
Long line	153.79	426.51	1146.95	1216.94	930.13
Traps	52.80	52.42	105.13	249.08	135.55
Others	2.15	3.47	25.57	4.84	11.29

Data shows that except *current jal* and *dharma jal,* effort of other gears in the TB site increased in the impact years compared to that of the baseline year.

Average effort of *current jal* increased from 85 in the baseline year to over 170 in the impact year-1 but it reduced to 68 in the impact year-2 and further reduced to about 35 in the impact year-3. The current jal is considered a harmful gear by the Government to fisheries production and biodiversity. Such reduction in the use *current jal* might be further possible through more awareness, motivational and other support activities undertaken by MACH project through RMOs and RUGs.

Effort of *dharma jal* was over 11 in the baseline but it reduced to less than 2 in impact year-1 and year-2. In the third impact year there is a slight increase (4.64) in the *dharma jal* effort. The effort of long line increased nearly triple (426.51) in the impact year-1 from 154 in the baseline and reached 1,147 in the impact year-2 and increased to 1,217 in the impact year-3 (Table 15).

No significant change was observed in the effort of *veshal jal* between the baseline and impact years. As slight increase in the effort of *thela jal* was observed in the impact years. However, use of traps was observed to increase significantly in the impact years (135 in the overall impact years) compared to 53 in the baseline year.

2.1.2.3. Gear Wise Catch

Quantity of fish catch varies by gear types and fishing methods. Table 16 shows that catch of *ber jal* and *current jal* constituted over 50% of the catch in all the four years of the first phase of project. However, in the baseline year catch of *current jal* and *ber jal* was observed almost equal but in the impact years, the catch of *ber jal* was found dominant and formed over 40% of the total catch

The catch of current jal, was found more or less unchanged over the project period of four years with a little higher in the impact year-1 but remained within the range of 5,000-6,000 kg/yr.

Table 16: Total fish catch of monitoring locations by gear types and by years in Turag-Bongshi

Name of Gears/fishing methods	Baseline		Impact-1		Impact-2		Impact-3		Av. Impact years	
	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%
Current jal	5469.78	24.73	5971.83	12.51	4978.00	12.41	5511.96	10.28	5487.26	11.64
Ber jal	5250.24	23.74	20087.15	42.07	19160.12	47.78	23565.92	43.96	20937.73	44.41

Name of Gears/fishing methods	Baseline		Impact-1		Impact-2		Impact-3		Av. Impact years	
	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%
Moi jal	2755.02	12.45	3555.14	7.45	2368.96	5.91	3441.60	6.42	3121.90	6.62
Dharma jal	1857.53	8.40	426.36	0.89	353.38	0.88	1144.09	2.13	641.28	1.36
Traps	1829.15	8.27	1233.54	2.58	1473.08	3.67	2944.97	5.49	1883.86	4.00
Jhaki jal	1670.27	7.55	3567.28	7.47	2920.42	7.28	5288.44	9.86	3925.38	8.33
Hat Borshi	1430.00	6.46	1586.81	3.32	1831.65	4.57	1950.91	3.64	1789.79	3.80
Thela jal	1005.24	4.54	2482.58	5.20	2609.06	6.51	2176.49	4.06	2422.71	5.14
Others	494.62	2.24	7864.48	16.47	2965.35	7.39	3612.98	6.74	4814.27	10.21
Long line	260.83	1.18	595.39	1.25	1400.53	3.49	2013.47	3.76	1336.46	2.83
Veshal jal	97.25	0.44	372.65	0.78	39.14	0.10	407.19	0.76	272.99	0.58
Trap in boat	0.00	0.00	0.00	0.00	0.00	0.00	124.46	0.23	41.49	0.09
Pais jal	0.00	0.00	0.00	0.00	0.00	0.00	5.31	0.01	1.77	0.00
Katha	0.00	0.00	0.00	0.00	0.00	0.00	1423.50	2.66	474.50	1.01
Total	**22119.95**	**100.00**	**47743.21**	**100.00**	**40099.69**	**100.00**	**53611.28**	**100.00**	**47151.39**	**100.00**

Jhaki jal is an important gear in the TB site, which constituted between 7-10% of the total catch (ranged from 1,670 kg – 5,288 kg) in the monitoring locations. In the impact year-3, *jhaki jal* catch formed 10% of the total catch (Table 16).

2.1.2.4. CPUE

From the catch data six common gears have been selected for determining the CPUE in the TB site. These gear included *ber jal* (seine net), moi jal, *thela jal*, jhaki jal, current jal (monofilament nylon gill net), and dhore *jal*.

Table 17 shows the CPUE of six gears in the TB and exhibits that CPUE of all the six gears operated has increased over the impact years compared to that of the baseline year. The CPUE of *ber jal* increased from 1.91 kg/day in the baseline year to 3.37 kg/day after impact period of 3 years. There have been changes in the average fishing hours of these six gears observed between the baseline and impact years. Although CPUE was found higher for all gears, average fishing hours for all gears was found less in the impact years compared to baseline situation except for the dhore jal (Table 17).

Table 17: CPUE (kg/day/gear) of Selected Gears in Turag-Bangshi site

Gear	Baseline	Av. Fishing Hours	Impact-1	Av. Fishing Hours	Impact-2	Av. Fishing Hours	Impact-3	Av. Fishing Hours	Overall Impact	Av. Fishing Hours
Ber Jal	1.91	5.88	3.93	4.18	2.36	3.66	3.89	3.32	3.37	3.73
Moi jal	1.50	4.82	1.84	3.98	1.60	4.50	1.81	4.61	1.76	4.33
Thela Jal	0.50	2.63	0.74	2.18	0.73	2.49	0.85	2.48	0.76	2.36
Jhaki Jal	0.49	3.47	0.70	2.40	0.50	2.08	0.67	2.29	0.62	2.26
Current Jal	0.03	5.48	0.01	4.55	0.02	6.95	0.06	6.11	0.02	5.69
Dhore Jal	0.04	3.49	5.87	4.18	0.71	2.49	2.83	8.55	2.88	4.72

Note on standardization of current and ber jal.

2.1.2.5. Seasonal Catch

The catch composition and quantity vary over the seasons mainly due to changes in the inundation regimes, gear use, fishing pattern and intensities. In a floodplain beel situation composed of seasonal beels, as in the TB site, fish catch peaks in the post monsoon (October-December). By December, most of the fish from the beels are caught during draw down and the major fishing is done by the draining khals. Then the beel bed is used for boro (winter rice) cultivation, which starts from January.

During the dry season (January- March), water is retained in the river and the water surface area in the beels rapidly declines at the end of the dry season. The pre-monsoon (April-June) is a very crucial time of the year in TB site as the area of water coverage becomes very limited. Habitat for broodfish is limiting in the peak dry season.

During the pre-monsoon time of the year fish availability in the area therefore is at its lowest level. Figure 6 describes the bulk of the catch in the post-monsoon (54%) and the least catch in the pre-monsoon of 11%.

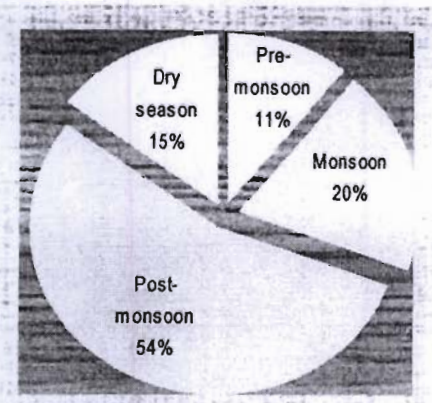


Figure 6: Seasonal catch (%) in TB

2.1.2.6. Fish Species Diversity

Species diversity of fish in the TB site showed an increasing trend in the impact years compared to that of the baseline year. However, diversity of species was observed in the baseline as 82 and 81 in impact year-1 which increased to 86 in impact year 2, and further increasing to 91 in impact year-3 (Table 18).

Table18: Fish Species diversity in the Turag-Bongshi by Monitoring Locations and by Year

Monitoring Locations	Number of Fish Species observed					
	Baseline	Impact-1	Impact-2	Impact-1 & 2 combined	Impact-3	Impact-1, 2 & 3 combined
Mokash Beel (South)	55	58	51	63	57	69
Mokash Beel (North)	58	56	62	69	52	72
Kaliadaha Beel	59	54	49	59	54	67
Mokash Khal/Solhati Khal	39	46	51	59	50	69
Turag River Section	54	55	58	67	71	79
Aowla Khal (Canal)	50	46	46	58	49	64
Aowla Beel	59	58	59	68	66	75
Bangshi River Section	67	70	67	79	75	86
Overall	**82**	**81**	**86**	**89**	**91**	**95**

The total number of fish species in the combined impact years 1, 2 and 3 was 95, which is about 16% higher than that of the baseline situation. Establishment of wetland sanctuaries is likely to have positively contributed to species richness in an environment where there is acute shortage of dry season fish refuge area. The effort control measures undertaken by RMOs during the early monsoon flooding in the beels is also likely to have contributed to the enhancement of the catch and species diversity. A list of species observed in different periods is presented in Appendix-4.

2.1.2.7. Ranking of species by quantity of catch

In the Turag Bangshi site there was a variation in species diversity observed between the baseline year and impact years. Species wise contribution in the total catch (85.64%, 83.18%, 82.31% and 80.34% in baseline, impact year-1, impact year-2 and impact year-3 respectively) was also found to vary. In both baseline and impact years, the top 20 species contribution in total catch is given in Appendix-5..Data shows that at baseline period contribution of *gura icha* was the highest about (14%) while it was the 2nd highest at impact year-1 and impact year-3 but its contribution was found the highest (11%) in the total catch in impact year-2.

2.1.3. KONGSHAW-MALIJHEE SITE

2.1.3.1. CPUA in Kongshaw-Malijhee

Figure 7 shows the CPUA (of all the monitoring locations combined) from baseline to impact year 2 and the overall average of the impact years.

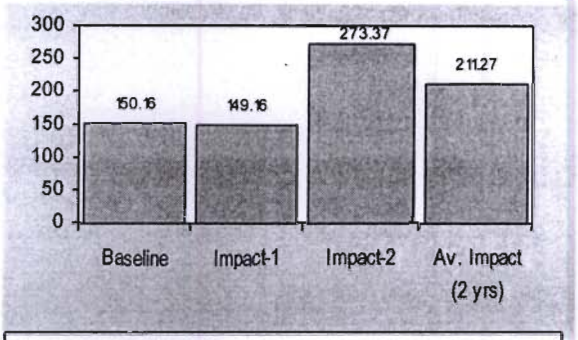


Fig 7: CPUA in baseline & impact years in KM site

Data indicated an increase in overall fish catch in the monitoring locations in Kangsha-Malijhee over the impact years compared to that of the baseline year. The overall CPUA in the baseline period for all the monitoring locations combined was 150.16 kg/ha/year, while the CPUA was observed increased to 273.37 kg/ha/year in the impact year-2 (Figure 7). Slightly lower CPUA was observed in the impact year-1 (149.16 kg/ha/y) which was due to lower water level in the impact year-1 (2001-2002) compared to that of the baseline (2000-2001) and impact year-2 (2002-2003). Similar catch trend in relation to hydrology was also observed in other two project sites (Hail Haor and Turag-Bangshi) where the CPUA in impact-2 was lower than impact-1. It is noted that the impact-1 in Kangsha-Malijhee site corresponds with the impact-2 in Hail haor and Turag-Bangshi sites as the project started one year later in the Kangsha-Malijhee site.

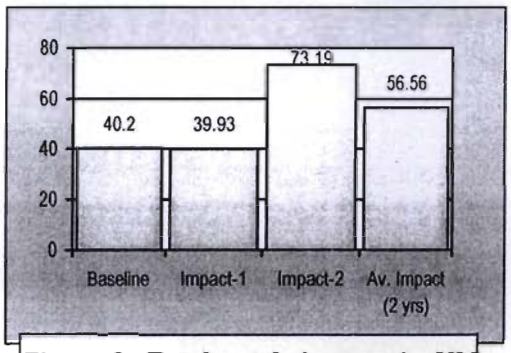


Figure 8: Total catch in tons in KM

The rate increase of CPUA in the overall impact period of 2 years was recorded to be over 40% more than the baseline year (Table 19).

The increased CPUA also reflected in the total catch in the impact years. The total catch was 40.2 tons in the monitoring locations of 267.72 ha during the baseline year. The total catch then increased to over 73 tons in the impact year-2 and the average catch of the overall impact period of two years was 56.56 tons (Figure 8).

The high CPUA in Bogadubi Khal was due to the fact that the khal acts as passage for fish for migrating in and out from rivers to the beels complexes. As such the khal is the main harvest point of a large floodplain area.

Table 19: CPUA (kg/ha/y) by sampling locations and by years

Monitoring Locations	Baseline	Impact-1	Impact-2	Av. Impact (2 years)	% change compared to baseline
Bailla Beel	134.27	144.23	333.71	238.97	77.98
Takimari Beel	179.98	146.96	422.37	284.67	58.16
Kewta Beel	250.77	186.60	369.66	278.13	10.91
Nijla Beel	104.33	174.78	155.95	165.37	58.50
Bagadubi Khal (Canal)	1305.54	847.28	2128.45	1487.87	13.97
Baharali Kur (Malijhee River)	271.17	441.92	973.73	707.83	161.03
Aowra Bowra Beel	39.55	28.76	38.01	33.39	-15.59
Bailsha Beel	260.88	251.66	386.13	318.90	22.24
Overall	**150.16**	**149.16**	**273.37**	**211.27**	**40.69**

The regression analysis (R=0.86) indicates a positive relationship between CPUA and the project intervention periods. The linear bi-variate regression determines that (R^2=0.74) 74% variation in CPUA could be explained by the project interventions. The trend of the CPUA was found positive during the project period.

Analysis (Appendix-3) of variance (ANOVA) shows that CPUA changed significantly during the monitoring periods (p value < 0.05)

2.1.3.2. Efforts by Gear type

Table 20: Effort by gear type (No./day) in 8 monitoring locations at KM site

Gear Type	Total Gears Operated Per Day			
	Baseline	Impact-1	Impact-2	Av. Impact (2 years)
Thela jal	31.27	21.21	45.58	33.40
Fash jal	20.41	5.70	0	2.85
Ber jal	18.42	4.69	4.11	4.40
Current jal	86.35	172.62	242.08	207.35
Traps	340.25	509.11	907.42	708.27
Hooks & lines	382.66	314.44	574.24	444.34
Jhaki jal	7.49	8.35	9.61	8.98
Dharma jal	6.20	6.20	8.55	7.38
Bana/Bara	2.05	5.44	0.73	3.09
Veshal jal	1.46	0.72	0.68	0.70
Hatani	11.47	0.45	2.14	1.30
Dewatering	0.94	0.11	0.25	0.18
Others	3.12	10.06	2.02	6.04

The commonly operated gears in Kongshaw-Malijhee site during the monitoring period included *thela jal, fash jal, ber jal, current jal,* bamboo traps, hooks & long lines, *jhaki jal, dharma jal, bana/bara, veshal/khara jal, hatani,* dewatering and other minor gears. The effort by gear in the sampling location are presented in Table 20.

Effort of the *thela jal, current jal,* traps, hooks & lines, *jhaki jal* was observed to increase in impact years, while efforts of *fash jal, ber jal, veshal jal,* dewatering was observed to be reduced in the impact years. It is noted that use of the *ber jal* was discouraged in the early monsoon in RMO managed beels to allow fish to spawn and rear.

Although use of *current jal* was also discouraged in RMO managed water-bodies, there is still resistance to follow this in some areas, it was experienced that control of use of *ber jal* was easier than current *jals. Ber jal* is large, needs a boat and 4-6 people to operate, so it is quite visible when and where the *ber jal* is in operation. The *current jal* on the other hand is used individually and fixed under water and so is more difficult to monitor and control. It is also noted that many farmers use *current jals* in monsoon season who are reluctant to maintain the conservation norms as they do fishing on part-time basis.

There is still further need to conduct motivation campaigns through RMOs and RUGs to continue to promote the reduction in use of harmful gear in this site.

2.1.3.3. Gear Wise Catch

The quantity of catch was found to vary by gear types and by year. Table 21 shows the gear wise catch contribution in the site combining all monitoring locations. The *ber jal* contributed the highest (19%) of the total annual catch of the site at the baseline year followed by *thela*

jal (nearly 17%) and *current jal* (12%). Bamboo traps were also found an important gear as it contributed over 10% of the total annual catch. Unlike Hail Haor, dewatering catch is lower in the area and contributed to only about 8% of the annual total catch in the baseline year.

Table: 21 Total fish catch in Kangsha-Malijhee by gear types and by years

Name of Gears/fishing methods	Baseline		Impact-1		Impact-2		Av. Impact (2 years)	
	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%	Wt. (kg)	%
Thela jal	6,768.47	16.84	4,035.63	10.11	14,531.76	19.86	9,283.70	16.41
Fash jal	741.33	1.84	421.64	1.06	0	0.00	210.82	0.37
Ber jal	7,631.22	18.98	10,163.56	25.45	10,861.66	14.84	10,512.61	18.59
Current jal	4,894.97	12.18	11,716.17	29.34	15,898.65	21.72	13,807.41	24.41
Traps	4,179.59	10.40	4,364.74	10.93	7,525.31	10.28	5,945.03	10.51
Hooks & lines	2,278.06	5.67	1,394.35	3.49	3,816.39	5.21	2,605.37	4.61
Jhaki jal	2,861.31	7.12	3,459.68	8.66	6,758.91	9.24	5,109.30	9.03
Dharma jal	3,502.10	8.71	1,358.70	3.40	5,495.01	7.51	3,426.86	6.06
Bana/Bara	262.07	0.65	354.56	0.89	239.93	0.33	297.25	0.53
Veshal jal	652.44	1.62	501.03	1.25	481.53	0.66	491.28	0.87
Hatani	1,477.14	3.67	58.88	0.15	312.56	0.43	185.72	0.33
Dewatering	3,151.13	7.84	678.11	1.70	378.14	0.52	528.13	0.93
Others	1,487.51	3.70	1,051.12	2.63	1,548.62	2.12	1,299.87	2.30
Pagar	256.30	0.64	373.89	0.94	0	0.00	186.95	0.33
Katha	57.63	0.14	0	0.00	5337.09	7.29	2,668.55	4.72
Total	**40,201.27**	**100.00**	**39,932.04**	**100.00**	**73,185.58**	**100.00**	**56,558.81**	**100.00**

Like the baseline year, *ber jal, current jal, thela jal* and traps continued to dominate the catch in the two impact years and catch increased with those gear.

2.1.3.4. CPUE

Catch per unit of effort is expressed as kg/unit of effort of each gear type. Usually it is calculated as catch per gear per day and expressed in kg. From the catch data 6 commonly used gears have been selected for determining the CPUE in the site. These gears include *ber jal, thela jal, dharma jal, jhaki jal, current jal* and traps.

Table 22 shows the CPUE of six gears in the Kangsha-Malijhee site. The CPUE of all the six gears operated increased in impact year-2 and the combined impact period (2 years) except for traps. CPUE of *thela jal, dharma jal, jhaki jal* and *current jal* was less in impact year-1 compared to that of the baseline year.

The CPUE of *ber jal* increased substantially from 0.92 kg/day at the baseline year to 2.5 kg/day in the impact years 1 and 2. The CPUE of the *current jal* reduced from the baseline figure of 0.04kg/day to 0.02 kg/day in the impact year-1, but it again increased in the impact yrear-2.

Table: 22 CPUE (kg/day/gear) of Selected Gears in Kangsha-Malijhee site

Gear	Baseline		Impact-1		Impact-2		Av. Impact (2 years)	
	CPUE	Av. Fishing Hours	CPUE	Av. Fishing Hours	CPUE	Av. Fishing Hours	CPUE	Av. Fishing Hours
Ber Jal	0.92	5.80	2.56	4.75	2.45	5.33	2.50	5.08
Thela jal	0.66	3.98	0.54	2.93	0.85	3.05	0.71	3.00
Dharma Jal	1.46	9.29	0.62	10.14	1.83	10.66	1.23	10.40
Jhaki Jal	1.27	5.64	1.15	3.96	1.96	4.05	1.53	4.00
Current Jal	0.04	8.98	0.02	9.30	0.16	10.59	0.09	9.93
Traps	0.03	17.74	0.03	18.38	0.02	17.92	0.02	18.13

puti ranked 2nd in each year in its contribution to the annual catch. The 3rd ranked species were found to vary in their contribution during the monitoring period.

2.2. FISH CONSUMPTION MONITORING

2.2.1. Hail Haor Site

The objective of the fish consumption monitoring program was to measure the changes in fish consumption patterns at the household level. It was done as this data could be gathered and analyzed with a great deal of confidence and low variability of data. In Hail Haor data was collected from a total of 450 sample households in 14 sample villages. Sample households were selected from different social classes including landless, marginal, small, medium and large farmers.

2.2.1.1. Per capita fish consumption

Table-24 presents data on per capita fish consumption by land classes at the baseline and impact years. Data shows that there is an increasing trend in per capita fish consumption (g) over the impact years compared to that of the baseline situation.

Table 24 : Per Capita Fish Consumption (g) in Hail Haor Site

Land classes	Baseline	Impact year-1	Impact year-2	Impact year-3	% of change compared to baseline and year-3
Landless	45.97	51.48	52.14	59.40	29.21
Marginal	46.76	53.89	58.14	65.55	40.14
Small	47.17	51.08	53.40	57.20	21.26
Medium	49.99	61.22	66.90	68.16	32.35
Large	52.47	57.32	57.31	50.00	(-4.70)
All classes	**46.90**	**53.05**	**54.98**	**60.89**	**29.82**

Fish consumption was found to vary by social classes in the baseline and impact years. In the baseline situation, lowest per capita consumption was recorded among the landless households (45.97g) and highest (52.47g) among the large farmers.

The highest rate of increase in per capita consumption of 40.14% was recorded among the marginal households followed by medium farm households (32.35%), and then among the landless households (29.21%). Lowest rate of increase of 21.26% was observed among the small farm households.

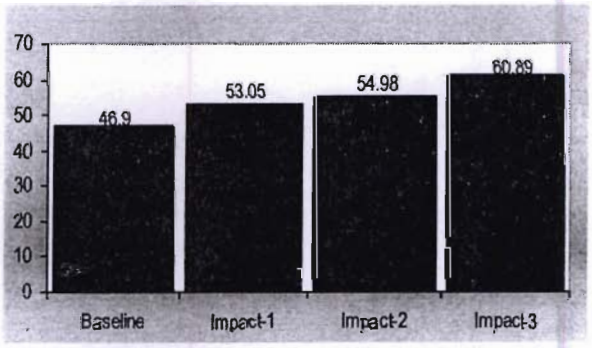


Figure 10: Fish consumption (g/h/d) by project years (by all classes)

Table 24 and Figure 10 show that per capita fish consumption in Hail Haor site increased from 46.90g at the baseline year to 53.05g, 54.98g and 60.89g at impact years 1, 2 and 3 respectively.

As one would expect fish consumption by household was found to vary by month. Changes in the quantity of fish consumption by months vary due to seasonal abundance of fish, market price, access to fishing and fishing practices in a given area. Figure-11 presents the trend of per capita fish consumption by months and by project years. Usually, the rate of consumption was found higher in the draw down period and post monsoon when floodplain fish catch is higher. Lowest fish consumption was recorded in the dry months, which corresponds with

2.1.3.5. Seasonal Catch

The catch composition and quantity show variation over the seasons as in the other sites. This is mainly due to changes in the inundation regimes, gear use, fishing pattern, fishing intensities and availability of fish.

Combining the catch data of 2 years in the site showed that 31% if the annual catch was caught in the monsoon season (July-September), 25% in the post-monsoon (October-December), 22% in the dry season (January-March) and 22% in the pre-monsoon (April-June). In other sites, post-monsoon catch was the highest while in the KM site the monsoon catch is greater.

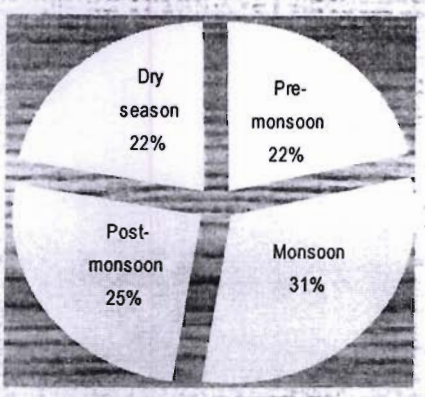


Figure 9: Seasonal catch (%) in KM

2.1.3.6. Fish Species Diversity

Diversity of fish species in the Kangsha-Malijhee site showed an increasing trend over the impact years compared to that of the baseline year. It can be seen in Table 23 that the diversity of fish species was 64 at the baseline, and increased to 67 and 71 in impact years 1 and 2. The total number of fish species recorded on average during the impact period was 78.

Table23: Fish Species diversity in Kangsha-Malijhee site

Monitoring Locations	Number of Fish Species observed in Monitoring Locations			
	Baseline	Impact-1	Impact-2	Av. Impact (2 years)
Bailla Beel	46	43	41	49
Takimari Beel	44	41	39	46
Kewta Beel	39	45	42	56
Nijla Beel	37	48	42	52
Bagadubi Khal (Canal)	46	46	47	56
Baharali Kur (Malijhee River)	32	40	37	45
Aowra Bowra Beel	21	31	25	36
Bailsha Beel	36	41	35	48
Overall	**64**	**67**	**71**	**78**

Although the overall species diversity has been increased in the area as a whole some monitoring locations had lower diversity of species compared to that of the baseline period. Out of 8 monitoring locations, higher species diversity was observed in 5 locations and lower in two locations. A detailed list of species observed in different periods is shown in Appendix-4.

The effort control measures undertaken by the RMOs during the early monsoon flooding in the beels may have helped to enhance production and species diversity in the areas. In addition, it is thought that establishment of sanctuaries and re-introduction of locally threatened species also contributed to increased diversity of species within the project managed water-bodies which spread over the floodplain.

2.1.3.7. Ranking of species by quantity of catch

Top 20 species are ranked according to their contribution in the annual catch which is given at Appendix-5. It shows that in each year the contribution of *gura icha* was found to be highest the highest (19% baseline year, 14% in impact year-1 and 18% in impact year-2). *Jat*

March through June each year. When most of the water-bodies are dry or nearly dry and major fishing is completed, there is a shortage of available fish in wetlands as well as in the markets. Figure-11 shows that the lowest consumption was recorded in the month of April-May. However, in the baseline year, the lowest consumption recorded was in June and this continues up to August.

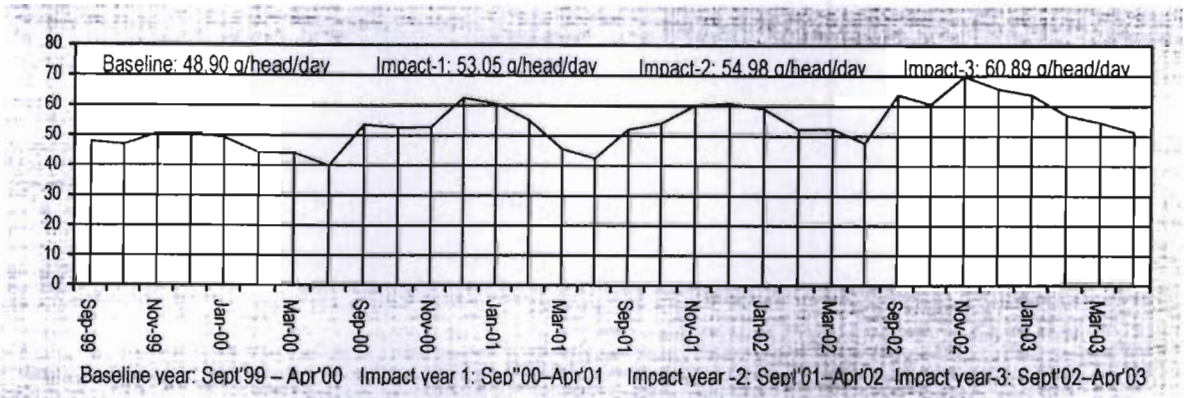


Figure 11: Per capita fish Consumption in Hail Haor over the project years

Fish consumption started to increase from June onwards and continued to rise over the monsoon months and peaked in the post-monsoon in November-December. During the monsoon, when the beels are flooded, local people catch fish in the seasonally flooded lands with various gear. In the post-monsoon, fish catch is also higher as in this time major fishing in the beels is done through dewatering, katha and pagar fishing. Monitoring data for the baseline and impact years also confirmed the general trend in monthly consumption rate in all the project years.

Baseline Fish consumption data was collected for 8 months from October 1999 to April 2000. So that the consumption could be compared from the baseline to the impact years in line with the fish consumption (Fish Catch Baseline ends April 2000) 8 months consumption records for the identical periods were compared. It was found that there was highly significant difference of per fish consumption from the baseline to the impact years by months and periods (p-value < 0.05) Appendix-3.

2.2.1.2. Non-fish high protein food consumption

Besides fish, people also consumed other high protein food in their diet including meat, pulses, and eggs. Data on other non-fish high protein consumption was also collected from the sample households. Table 25 and Appendix-6 present the data on non-fish protein consumption by sample households. Consumption of pulses was found less during the impact years compared to that of baseline year. The consumption of meat and other food was observed higher over the impact years (Table 18) than that of baseline year. Negligible changes in the consumption of egg and milk were observed in the baseline and impact years.

Table 25: Other Non-Fish Protein Consumption (g/h/d) in HH site

Items	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Pulses	11.57	10.78	9.99	10.37
Meat	4.92	6.72	6.89	8.66
Egg (No.)	0.04	0.05	0.06	0.06
Milk	5.96	3.75	3.71	5.51

In rural areas, people collect and consume fish mainly from two sources, either they catch fish themselves or they buy fish from local markets or from fishers. The villagers also get a very small amount of fish from their relatives and neighbors as gifts. Consumed fish by sources whether bought, caught or gift is presented in Table 26.

Table 26: Fish Consumption by sources (%) in HH Site

Sources	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Caught	31.34	27.79	26.97	24.63
Bought	66.49	69.97	71.32	73.18
Gift	2.17	2.23	1.72	2.19

Consumed fish by sources whether bought or caught and gift is presented in Table 29.

A slightly higher figure for caught source at the baseline year was possibly due to control of fishing efforts in the water-bodies managed under RMOs formed under MACH project. People who get AIGA (alternative income generating activities) support from MACH are able to increase purchasing and so the poor people bought a higher quantity of fish for consumption.

2.2.1.3. Consumption by species groups

In Bangladesh people consume a variety of fish species over the seasons. However, it depends on the availability of fish in the market and price. From the monitoring made in the selected households, in Hail Haor the sample households consumed 107 species of fish during the baseline year, while 110, 110 and 88 species of fish were consumed in the impact year 1, 2 and 3 respectively.

Table27: Fish Species Group Wise Consumption (%) in HH

Species groups	Baseline	Impact-1	Impact-2	Impact -3
Small Fishes	55.98	44.78	38.04	39.87
Snakeheads	14.85	16.18	21.33	21.25
Small Cat Fishes	9.36	10.22	7.80	8.78
Dry fishes	4.46	4.35	3.57	2.95
Prawns	3.92	7.16	6.87	5.67
Major Carps	2.84	3.86	4.66	4.21
Exotic Species	2.11	3.33	4.99	5.94
Hilsha	1.70	3.90	5.06	2.42
Large Cat Fishes	1.51	1.91	3.38	2.74
Eels	1.26	1.18	0.84	1.16
Minor Carps	1.14	1.39	1.96	2.07
Knife Fishes	0.86	1.71	1.45	2.95
Others	0.01	0.01	0.04	0.00
Overall	**100.00**	100.00	**100.00**	**100.00**

All fish species recorded during the fish consumption-monitoring period were classified into 13 groups. The quantity (by 90) consumed by species groups is presented in Table 30. Data shows that species in the small fish group contributed the most in consumption both in baseline as well as in impact years. The small fish group contributed 55.98% in the baseline year but was less in the impact years (44.78% in impact year-1, 38.04% in impact year-2 and 39.87% in impact year-3.

The four species of Snakeheads ranked second in the list of species groups consumed by the sample households in Hail Haor site. In the baseline year, snakeheads contributed 14.85% while it increased over the impact years and contributed over 21.25% in the impact year-3.

The percentage of consumed fish in all other groups was found to be higher than that of the baseline situation. It indicates that abundance of different species is now more available in the rural markets. However, there are many factors that influence the quantity of fish species consumed such as price and purchasing power to name a couple.

2.2.2. TURAG-BANGSHI SITE

Household fish consumption monitoring was started in October 1999 in Turga-Bangshi and data were collected from 280 sample households comprising of different land classes of 8 sample villages within the project area.

2.2.2.1. Per capita fish consumption

An increase in per capita fish consumption in the Turag-Bangshi site has been observed in the impact years compared to that of the baseline situation (October'99 through April'00). The overall quantity of per capita fish consumption is lower in T-B site compared that of the Hail Haor site, which might be due to higher availability of fish in Hail Haor area due to the size of the fishery in the haor.

Table 28: Per Capita Fish Consumption (gram/day) in TB site

Land classes	Baseline (Oct'99-Apr'00)	Impact-1 (Oct'00-Apr'01)	Impact-2 (Oct'01-Apr'02)	Impact-3 (Oct'02-Apr'03)	% of change compared to baseline & impact y-3
Landless	27.64	29.32	30.46	37.56	35.89
Marginal	27.10	29.34	29.39	34.53	27.42
Small	26.73	27.57	27.85	37.80	43.51
Medium	28.17	30.44	35.54	38.27	35.85
Large	25.18	28.10	33.81	40.62	61.32
All classes	**27.32**	**29.18**	**30.61**	**37.14**	**35.94**

Table 28 and figure 12 show per capita fish consumption by the households of different land classes during the baseline and impact years at Turag Bangshi site

An increase in fish consumption was observed among all land size classes in the impact year-3 compared to that of the baseline year. On an average, combining all the households, a 36% increase in per capita fish consumption was observed in the impact year-3. However, there were variations in the rate of increase among the different land size classes. The highest rate of increase of about 61% was observed among the large farm households and the lowest (27.42%) among marginal farm households (Table 31). Significant rate of increase (about 36%) was also observed among the landless poor households in the impact year-3 compared to the baseline year.

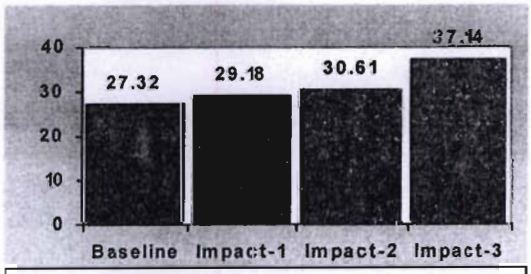


Figure-12 Fish Consumption (gram/day) by project years (by all classes)

Monthly per capita fish consumption data is presented in Figure-13. The general trend, for fish consumption rate was found lowest at the end of the dry season-early monsoon (March through May). It is at this time that the rate of consumption was increased as the monsoon started and the trend continues to increase peaking at the post-monsoon period in October-November. From December the rate of consumption again started to fall and in the dry

months of March & April reached its lowest point.

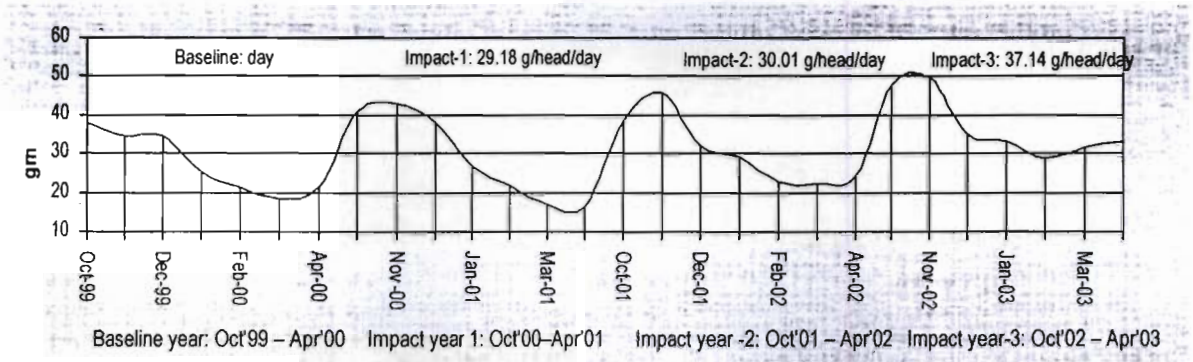


Figure 13: Per capita fish consumption over the project years in TB site

The rate of fish consumption by months or season follows the seasonal fish production trend, which is largely governed by the hydrological regimes. During the dry season, most of water-bodies in the area become dry except for a very small part in Kalidaha and Aola Beel. The water flow in the Turag-Bangshi River also reached its lowest level during the dry months. During the dry months water is retained in the kums only.

2.2.2.2. Non-fish high protein food consumption

Data collected on other non-fish protein consumption from the households can be seen on table 29. The consumption of pulses was found to be less during the impact years 1 and 2 compared to the baseline year. However, a slightly higher consumption of pulses was observed in impact year 3 but that was still less than baseline situation (Table 29 and Appendix-6). During the impact years, meat and milk consumption was found higher compared to that of the baseline situation.

Table29: Per Capita non-fish protein Consumption (g)

Items	Baseline	Impact -1	Impact-2	Impact-3
Pulses	14.83	9.69	11.01	13.19
Meat	8.65	11.08	15.08	14.27
Egg (No.)	0.04	0.04	0.06	0.06
Milk	17.07	20.81	25.59	30.76

2.2.2.3. Sources of fish caught and fish purchased

Table 30: Fish Consumption by sources (%) in TB

Sources	Baseline	Impact-1	Impact-2	Impact-3
Caught	26.95	23.23	17.98	18.5
Bought	69.33	72.27	77.48	76.52
Gift	03.62	4.49	4.54	4.98
Others	00.10	00.02	0.00	0.00

The data on consumed fish by sources is seen in Table 30. Data shows that there was an increasing trend of percentage of bought fish from baseline to impact years. The lowest percentage was 69.33% at baseline and the highest, 77.48% recorded in the impact year-2. 2.2.2.4 Species group wise consumption. All recorded species consumed were classified into 13 groups. The quantity in terms of % fish consumed by species groups is presented in

Table 30.

Table31: Fish Species Group-wise Consumption (%) in TB Site

Species groups	Baseline	Impact-1	Impact-2	Impact -3
Small Fishes	41.24	40.25	26.52	27.01
Major Carps	16.34	19.29	21.05	24.54
Exotic Species	13.90	12.08	17.67	20.29
Prawns	8.14	9.29	8.56	4.77
Small Cat Fishes	4.45	2.78	3.29	1.83
Snakeheads	4.16	5.13	3.92	4.58
Eels	3.60	1.99	1.85	1.70
Large Cat Fishes	3.30	4.29	12.58	12.50
Hilsha	3.13	3.60	3.24	0.96
Dry Fishes	0.88	0.69	0.70	0.96
Minor carps	0.42	0.26	0.10	0.16
Knife Fishes	0.35	0.30	0.38	0.55
Others	0.09	0.04	0.14	0.15
Overall	**100.00**	**100.00**	**100.00**	**100.00**

The data indicates that the contribution of consumed small fish was less than (27.01%) in impact year-3 compared to the baseline. While major Carps, Exotic Species, Snakeheads, Large Cat fishes, Dry fishers and Knife fishesconsumption increased by 24.54%, 20.29%, 4.58%, 12.50%, 0.96% and 0.55% from 16.34%, 13.90%, 4.16%, 3.30%, 0.88%and 0.35% respectively. In TB site dry fish consumption increased.

2.2.3. KONGSHAW-MALIJHEE SITE

Household fish consumption monitoring in Kongshaw-Malijhee site was carried out in 280 sample households comprising of different land classes of 7 selected villages within the project area.

2.2.3.1 Per capita fish consumption

An increase in per capita fish consumption in Kangsha-Malijhee site has been observed in the impact-1 (January'02 through December'02) compared to that of the baseline situation.

Table 32: Per Capita Fish Consumption (g) in KM site

Land classes	Baseline	Impact-1
Landless	22.05	26.43
Marginal	22.67	29.19
Small	20.92	23.02
Medium	21.12	25.92
Large	21.69	23.34
All classes	**22.00**	**26.58**

Table 32 and Figure 14 present per capita fish consumption by the households of different land classes for baseline and impact years of the KM site. Compared to the baseline year, there is an increase in per capita fish consumption in the impact-1 (Figure 14).

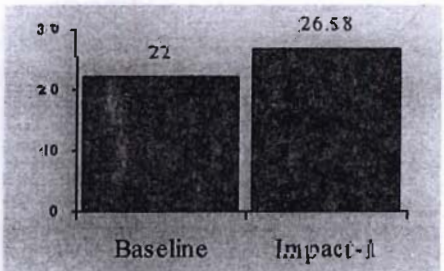


Figure 14: Fish Consumption (g/h/d) by project years (by all classes)

Monthly per capita fish consumption data in Figure 15 shows that rate of fish consumption was higher in August in impact year and also a bit higher in November while at baseline higher rate was found in January than that of other months.

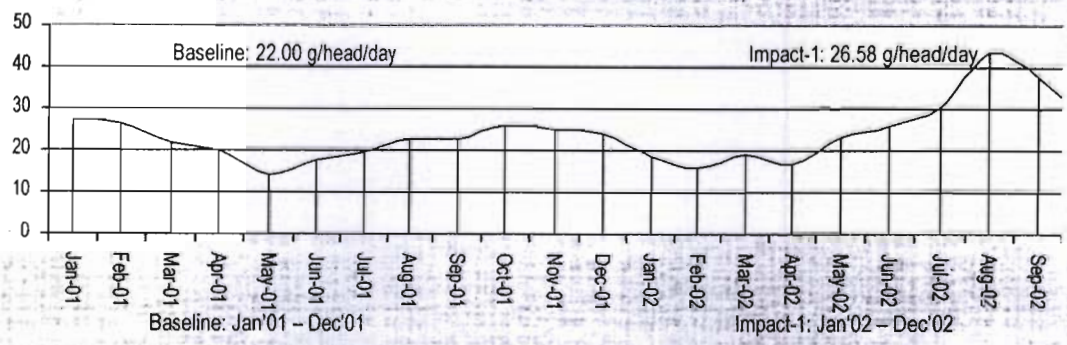


Figure 15: Per capita fish consumption over the project years in KM site

2.2.3.2. Non-fish high protein food consumption

Table33: Per Capita non-fish protein Consumption (g)

Items	Baseline	Impact Y-1
Pulses	5.99	5.29
Meat	8.42	8.21
Egg (No.)	0.05	0.07
Milk	14.42	13.82

The consumption of non fish protein such as pulses, meat and milk was less during the impact year-1 compared to baseline (Table-33 and Appendix-7). During impact years consumption of egg was found to be higher compared to that of the baseline situation.

2.2.3.3. Sources of fish caught and fish bought

Table34: Fish Consumption by sources (%) in KM Site

Sources	Baseline	Impact-I
Caught	43.32	39.52
Bought	51.85	55.07
Gift	04.80	05.41
Others	0.02	0.00

The data on the fish consumed by sources is presented in Table 34. The highest percentage of fish source (51.85%) was purchased by households in baseline year. This trend continued in the impact years as well with the purchasing of fish increasing.

Statistical analysis showed that there was highly significant difference within land classes and between the sources caught and bought (P-value =.000 < .05). Among the periods, sources caught & bought were almost same, test shows that the difference was highly in significant (P-value = 0.997 > .05) (Appendix-3).

2.2.3.4. Species group wise consumption

Table35: Fish Species Group-wise Consumption (%) in KM Site

Species groups	Baseline	Impact -1
Small Fishes	44.68	46.55
Snakeheads	10.97	9.92
Prawns	9.40	8.45
Exotic Species	8.05	12.38
Dry fishes	6.18	3.90
Major Carps	6.01	8.55
Hilsha	5.72	2.70
Small Cat Fishes	3.24	2.90
Eels	2.89	2.27
Large Cat Fishes	2.59	1.98
Minor Carps	0.13	0.09
Knife Fishes	0.03	0.10
Others	0.11	0.21

2.3. HYDROLOGY AND FISH CATCH (HAIL HAOR SITE)

Based on 5 years of hydrology data, it is observed that the water levels of Hail Haor begin to rise in April and May. The date of pre-monsoon flood commencement is one of the major factors which impacts yearly fish production as this is the fish breeding time. The earlier the flood-water level rises in April, the more breeding is likely to take place with more production to be expected if other conditions remain unchanged.

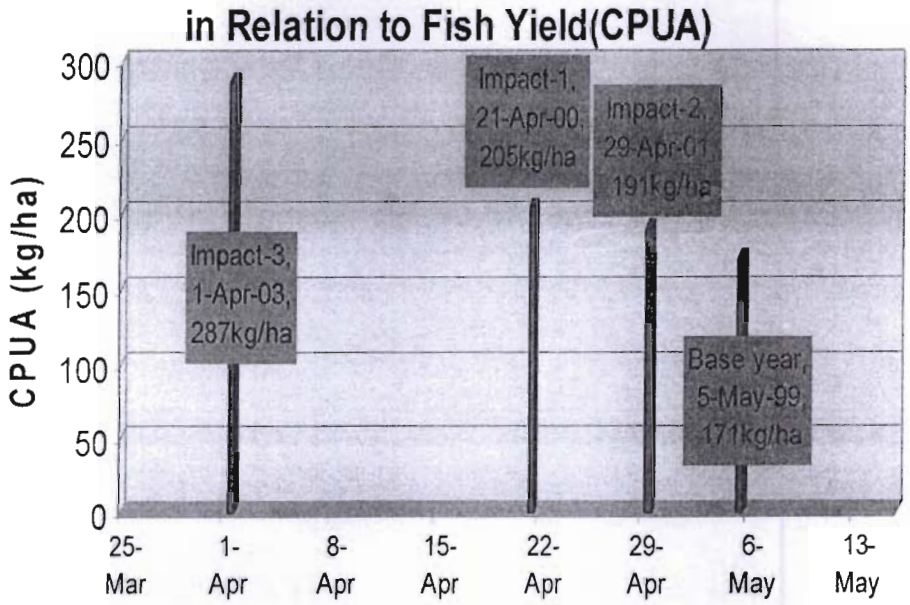


Figure-16: Hail Haor: The onset of pre-monsoon flooding in relation to total fish yield

BEST AVAILABLE COPY

Bi-variate (CPUA and water level) regression analysis indicates that there was positive correlation (R=0.85) between CPUA and retaining of water level during dry season (March-April)

Another regression analysis shows that there is high correlation (R=0.99) between onsets of the flooding time with fish catch yield, CPUA (kg/ha) and the value of R^2 = 0.98 indicates that the CPUA explained 98% variation with onset of pre-monsoon flooding time.

Table36: Relationship of CPUA and extent of flood

Monitoring period	Highest Water Extent Of Hail Haor (ha)	CPUA (kg/ha)
Baseline	-	171.08
Impact-1	13063 (June, 2000)	205.05
Impact-2	12215 (June, 2001)	190.75
Impact-3	13964 (June, 2002)	287.28

Table 36 shows that there was a relation of fish catch with extent of flood. It reflects that the highest CPUA (kg/ha) was recorded in the impact year-3 which corresponds to the higher flooding in that year.

The regression analysis shows that is highly correlation (R = 0.93) between CPUA (kg/ha) with extent of flooded/inundated area (ha) in Hail Haor site. The value of R^2 = 0.87 explained that CPUA about 87% variation with the extent of flood area.

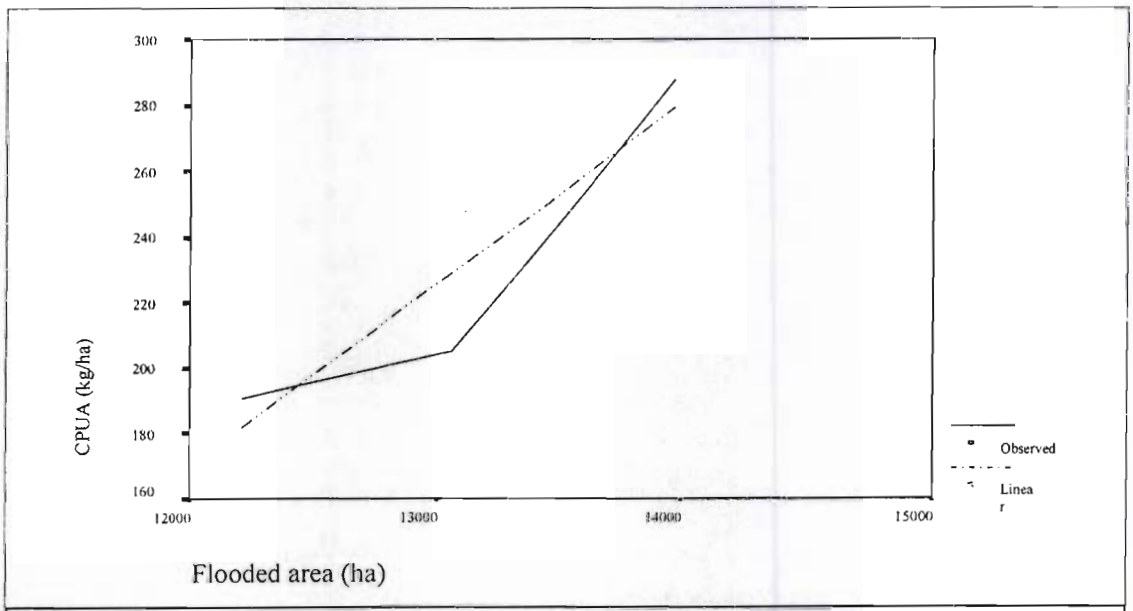


Figure-17: Regression analysis of CPUA (kg/ha) and water area in Hail Haor site

2.4. VEGETATION AND WILDLIFE MONITORING

2.4.1. Vegetation Diversity

In MACH project sites a transect based vegetation survey was conducted to understand the status of the flora in the area MACH is working in terms of number of species. The survey was conducted twice a year once during the dry season and once during the wet season. The MACH project started activities in the Kangsha-Malijhee site one year later than the other two sites. The vegetation survey of the KM site was therefore done for the baseline and impact year-1 only. Comparative data of vegetation survey in three sites is given in Table 40 below.

Total number of aquatic species was recorded as 107 at the baseline period combining the dry and wet seasons in the Hail Haor. The number of species reduced to 98 in the impact year and again observed to increase to 117 in the impact year-2.

Abundance of aquatic vegetation was found to be lowest in the Turag-Bangshi site compared to that of Hail Haor. A total of 51 species was observed during the baseline period followed by 48 in impact year-1 and 60 in impact year-2. Compared to the Turag-Bangshi site, diversity of habitats and surface area is larger in Hail Haor.

The Kangsha-Malijhee site, vegetation ranged from 55 species in the baseline year to 72 in the impact year-1. Data was not collected in the Kangsha-Malijhee for the impact year-2

Table37: Species of Aquatic Vegetation in Baseline, Imapct-1 and Impact-2 in three sites

Project Sites	Baseline			Impact-1			Impact-2		
	Dry	Wet	Total	Dry	Wet	Total	Dry	Wet	Total
Hail Haor	85	84	107	83	92	95	91	98	117
Turag-Bangshi	19	39	51	31	41	48	44	53	60
Kangsha-Malijhee	47	43	55	58	64	72	-	-	-

Variation in the number of aquatic vegetation species from year to year is partly due to annual fluctuation in water level and flooding pattern. It was observed that in a year when early flood contributed to sudden rise of water, vegetation cover and diversity is less than in the year when water level rises gradually.

2.4.2. Wildlife Diversity

In all the three MACH sites a very gross wildlife survey was carried out to document the abundance of wildlife population in the area. The monitoring was done twice a year, once in the dry season and the other in the wet season following selected transects through the majority of the habitats at each site.

Field data were collected through direct observation along the transect lines as well as through interviews with local people with knowledge of the local wildlife. The project started one year later in the Kangsha-Malijhee site, where the results have been incorporated for two years only while three years findings are presented for Hail Haor and Turag-Bangshi sites. A summary of wildlife monitoring data for three sites is presented in Table 41.

Hail Haor Site: In the Hail Haor site, 6 species of amphibians have been recorded over the three-year monitoring period. During baseline and impact year-2, 5 species were observed

while in the impact year-1, 6 species were recorded along the same transect.. No seasonal variation in the abundance of amphibian species was observed.

Abundance of reptile fauna ranged from a minimum of 19 in the impact year-1 to a maximum of 21 in impact year-2 with a baseline figure of 20. No seasonal variation in the abundance of reptiles was observed in the area.

Abundance of bird species was found higher in the Hail Haor ranging from a minimum of 110 in the impact year-1 to a maximum of 133 in the impact year-2. Record of impact year-1 revealed an abundance of 110 bird species. Seasonal variation was observed in abundance of birds, higher numbers of birds was observed in dry season except in the baseline year.

Mammalian diversity ranged from a minimum of 22 at the baseline period to a maximum of 26 in the impact year-2. No seasonal variation was observed in abundance of mammalian fauna in the area.

Total diversity of wildlife fauna in Hail Haor site ranged from a minimum of 158 in the impact year-1 to a maximum of 185 in the impact year-2. The number of wildlife species recorded in the baseline period was 166.

Turag-Bangshi Site: Six amphibian species were recorded in the Turag-Bangshi site over the monitoring period of three years. Six species were recorded in the baseline year while 5 species were observed in the impact years. No seasonal variation was observed in amphibian diversity except that the 6 species were observed during wet season in the TB site.

Table38: Wildlife species recorded in Baseline, Impact -1, Impact -2 in MACH sites

Organism	Baseline			Impact-1			Impact-2		
	Dry	Wet	Both	Dry	Wet	Both	Dry	Wet	Both
Hail Haor Site									
Amphibians	5	5	5	6	6	6	5	5	5
Reptiles	18	17	20	19	19	19	21	21	21
Birds	56	88	119	110	96	110	132	101	133
Mammals	17	19	22	22	23	23	26	26	26
Total	**96**	**129**	**166**	**157**	**144**	**158**	**184**	**153**	**185**
Turag-Bangshi Site									
Amphibians	5	6	6	5	5	5	5	5	5
Reptiles	14	16	19	16	16	16	16	16	16
Birds	75	70	101	89	81	96	106	88	107
Mammals	14	16	19	18	16	19	21	21	21
Total	**108**	**108**	**145**	**128**	**118**	**136**	**148**	**130**	**149**
Kangsha-Malijhee Site									
Amphibians	5	5	5	5	5	5	0	0	0
Reptiles	17	18	18	19	19	19	0	0	0
Birds	83	83	84	108	93	108	0	0	0
Mammals	17	17	17	16	16	16	0	0	0
Total	**122**	**123**	**124**	**148**	**133**	**148**	0	0	0

The species of birds in the area ranged from a minimum of 96 observed in the impact year-1 to a maximum of 107 in the impact year-2. The abundance of bird species in the baseline period (101 species) was a bit higher than that of the impact year-1 but lower than impact year-2 (Table 38). Higher abundance of birds was observed in the dry season in the monitoring years than in the wet season.

Manual species recorded in the area ranged from a minimum of 19 in the baseline and impact year-1 to a maximum of 21 in the impact year-2. Higher abundance of mammalian fauna was observed in the impact year-2 compared to the baseline and impact year-1. No seasonal variation in the abundance of species was observed.

In the Turag-Bangshi site 145 wildlife species were recorded at the baseline period and 149 species in the impact years. Combining all classes of species, higher abundance of wildlife fauna was recorded in the impact years.

Kangshow-Malijhee Site: Five species of amphibians were recorded both in the baseline and impact year. No seasonal variation was observed in the number of species sighted of amphibians over dry and wet seasons.

Number of reptile species ranged from 18 in the baseline period to 19 in the impact year. No seasonal variation in the sighting of reptiles was observed.

The number of bird species sighted were observed less in the Kangsha-Malijhee site compared to Hail Haor and Turag-Bangshi sites. A total of 108 species of birds were observed in the area during the monitoring period of two years, of which 84 was observed in the baseline year and 108 in the impact year. Higher abundance of birds observed in the dry season.

Fewer mammalian species were found less in the area compared to two other sites. Presence of 17 species was recorded in the baseline year while 16 were observed in the impact year. No seasonal variation was observed in case of mammalian fauna.

The overall number of wildlife fauna observed was higher in the impact year than in the baseline year. At the baseline period 124 species were sighted which increased to 148 in the final years of measured impact. As temporal data is limited and variability of year to year conditions great, it is difficult to draw firm conclusions with regard to impacts of the project. There did appear to be maintaining or increasing trends in species present. Continued long-term management actions and habitats protection are required to enhance and conserve the wildlife in any given area.

3. Selected Conclusions

MACH has demonstrated a co-management approach for sustainable management of wetland resources. The approach involves the community, local government, upazila, district and national administration. The project has been implemented in three different wetland ecosystems. MACH has emphasized data collection and analysis with sufficient rigor to demonstrate trends in the wetland resources before and during interventions. The followings are selected conclusions drawn:

Fish yield and biodiversity

1. The variation in the Catch per Unit of Area (CPUA) of the different wetland types is thought to be attributable to varied habitat and varied fishing practices and management.

2. There was significant variation of fishing effort as well as quantity of fish catch by seasons as expected.

3. Species diversity (fish) found in the project sites ranged from 64 to 82 in baseline period and 78 to 95 in the impact years. Varieties of small fish species and prawns make up the bulk of the annual production. Project interventions demonstrated positive impacts on biodiversity as a number of species have been re-established.

4. CPUA increased by 33% in Hail Haor, 113% in Turag-Bangshi and 41% in KM site during the impact years compared to that of the baseline year.

5. Both from data indicators and anecdotal evidence it is estimated that co-managed sanctuaries as well as restricted fishing during critical periods contributed to increase fish production and bio-diversity in the project areas.

Fish consumption

6. Per-capita fish consumption increased in all three sites (20-35%) when compare the averaged impact years with that of the baseline.

7. The beel resident fish contribute significantly to the diet of the very poor.

8. Major part of the fish consumed (55-75%) by the households are purchased from local markets

9. Rate of per capita fish consumption peaked in the post-monsoon period corresponding with the higher catch from wetlands during that period.

10. Per capita fish consumption was found to be higher in project villages than that of the national average. This is likely was to the location of villages inclose proximity to wetlands where people enjoy better access to fishing and fish availability.

Aquatic plants and wildlife

11. Species diversity of aquatic vegetation and wildlife were found to be higher during the impact period compared to that of the baseline period.

12. The wetlands of Hail haor continued 107-117 species of aquatic plants.

13. Wildlife population and diversity was found higher in Hail Haor site possibly due to diversity of physical features, large perennial water body and surrounding forests.

Production and Hydrology

14. Quantity of fish catch was found to have positive correlation to the hydrology of a given year.

15. Highest CPUA (kg/ha/year) recorded in the year corresponds with higher flooding extents.

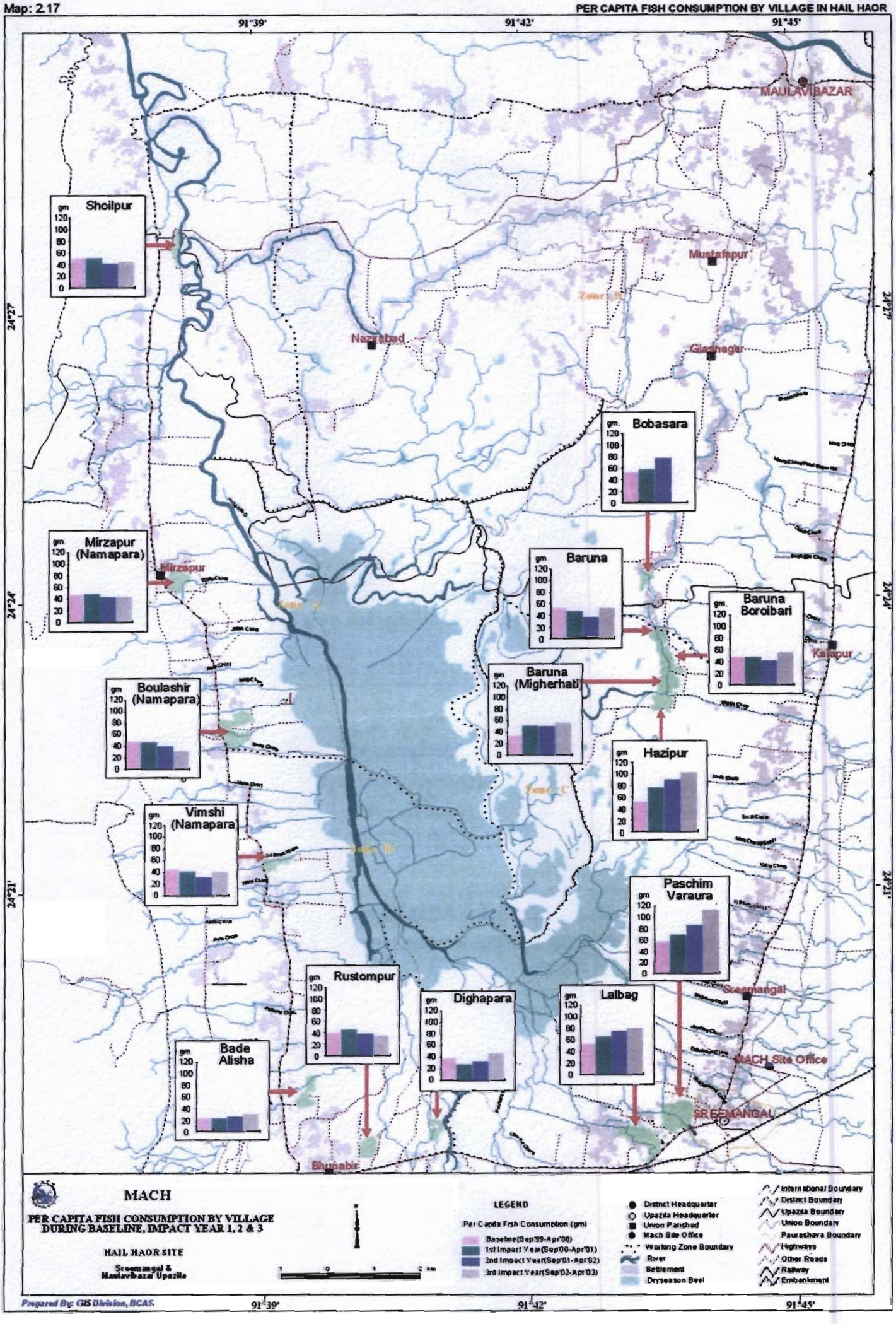
16. Higher annual fish production corresponds with early inundation of wetlands with the onset of pre-monsoon flooding

17. There is further study required to determine the appropriate area of sanctuary to wetland to ensure the maximum sustainable yields from this type of intervention.

18. Further study is needed to continue to determine the relationship between the hydrology and fish production and to suggest options for water management for having floodplain sustainable fisheries yield and biodiversity.

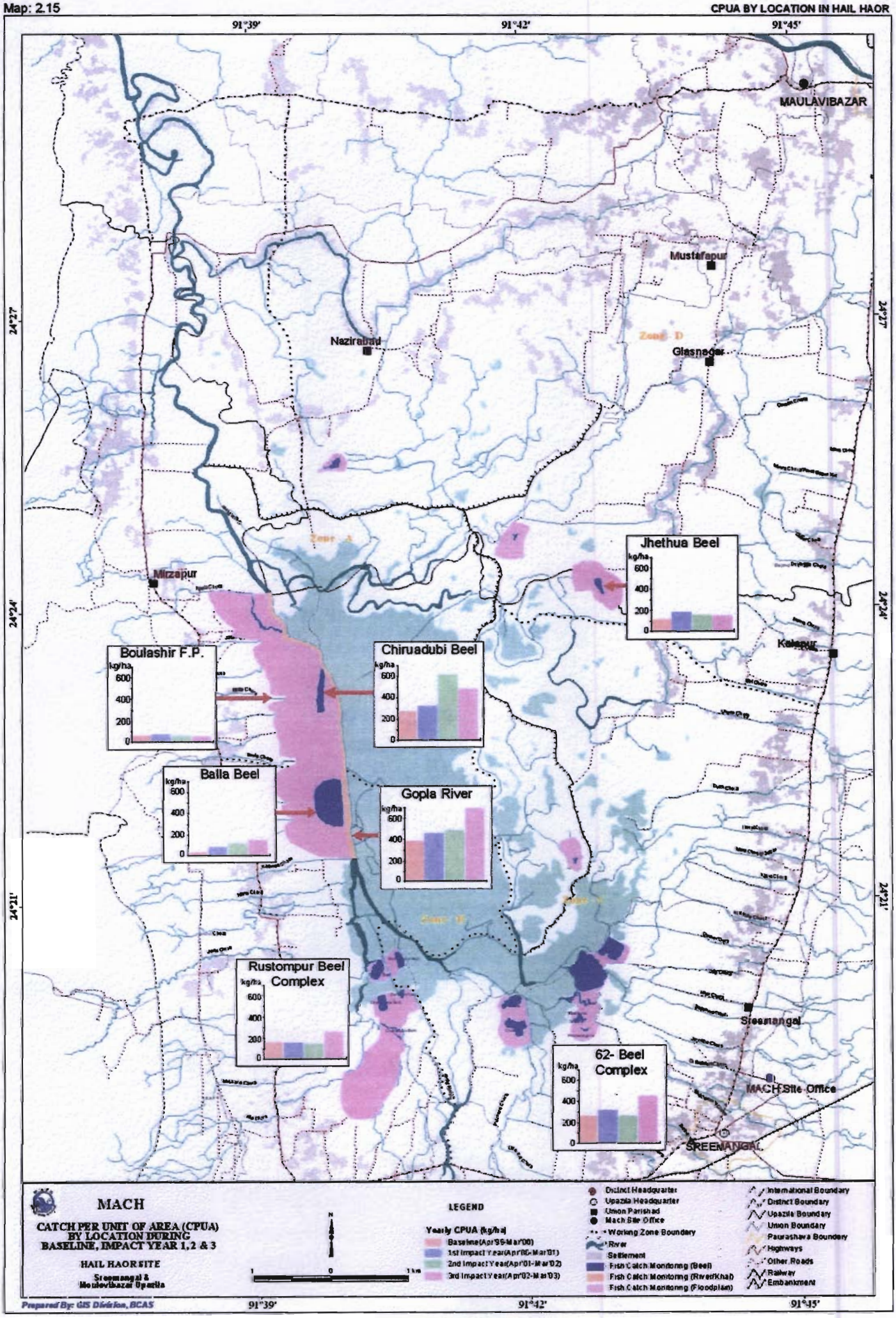
Map: 2.17

PER CAPITA FISH CONSUMPTION BY VILLAGE IN HAIL HAOR



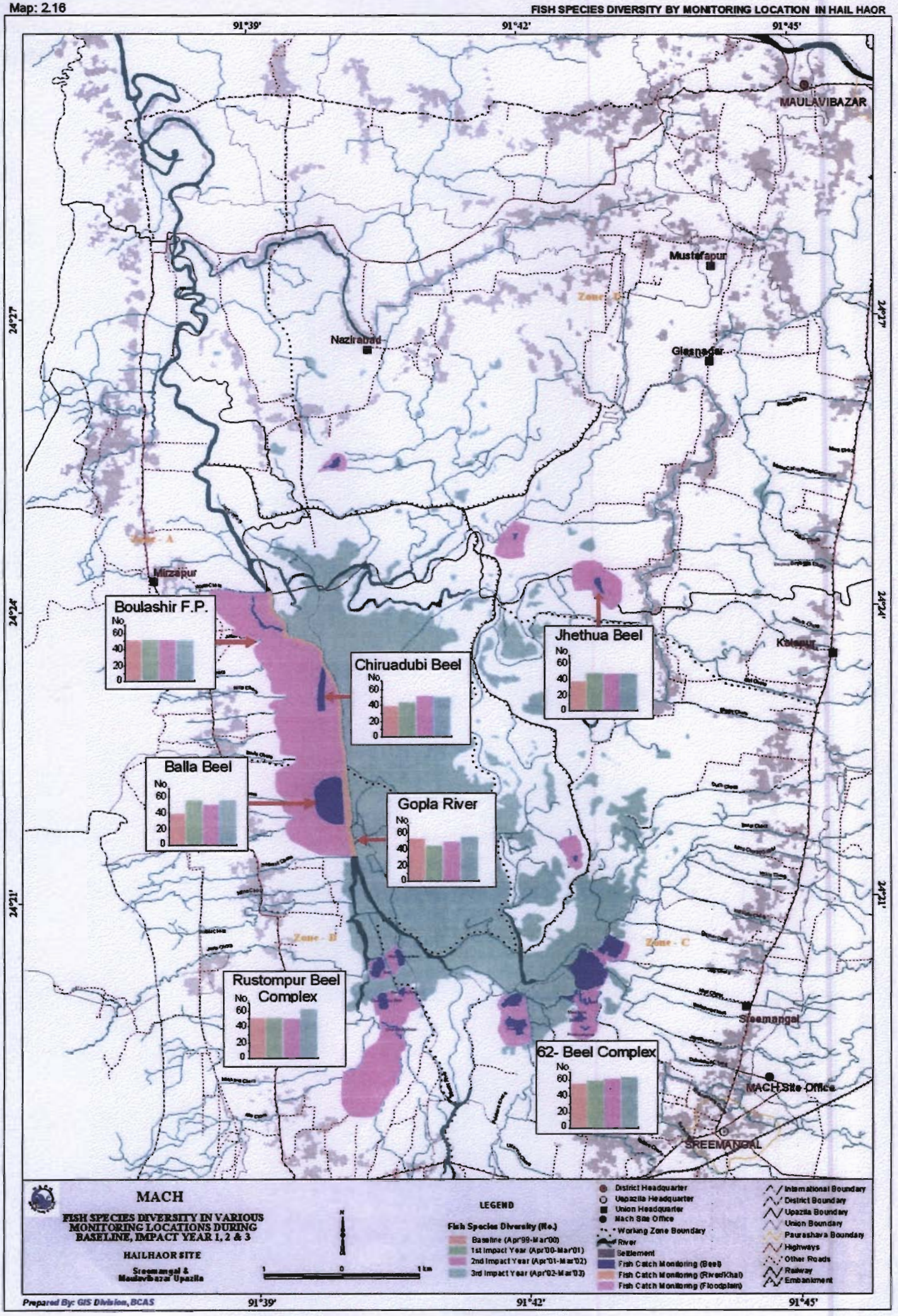
Map: 2.15

CPUA BY LOCATION IN HAIL HAOR



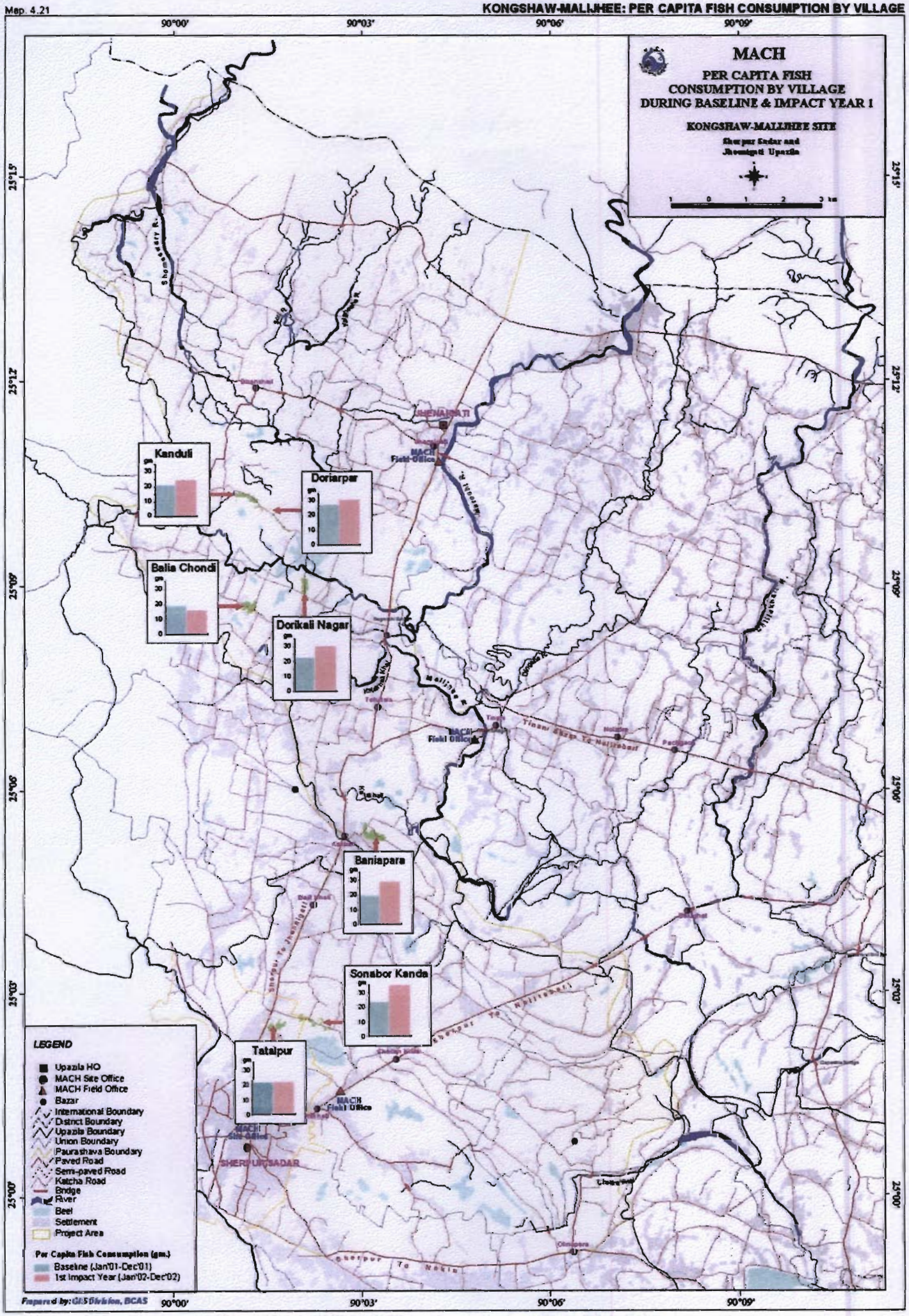
Map: 2.16

FISH SPECIES DIVERSITY BY MONITORING LOCATION IN HAIL HAOR



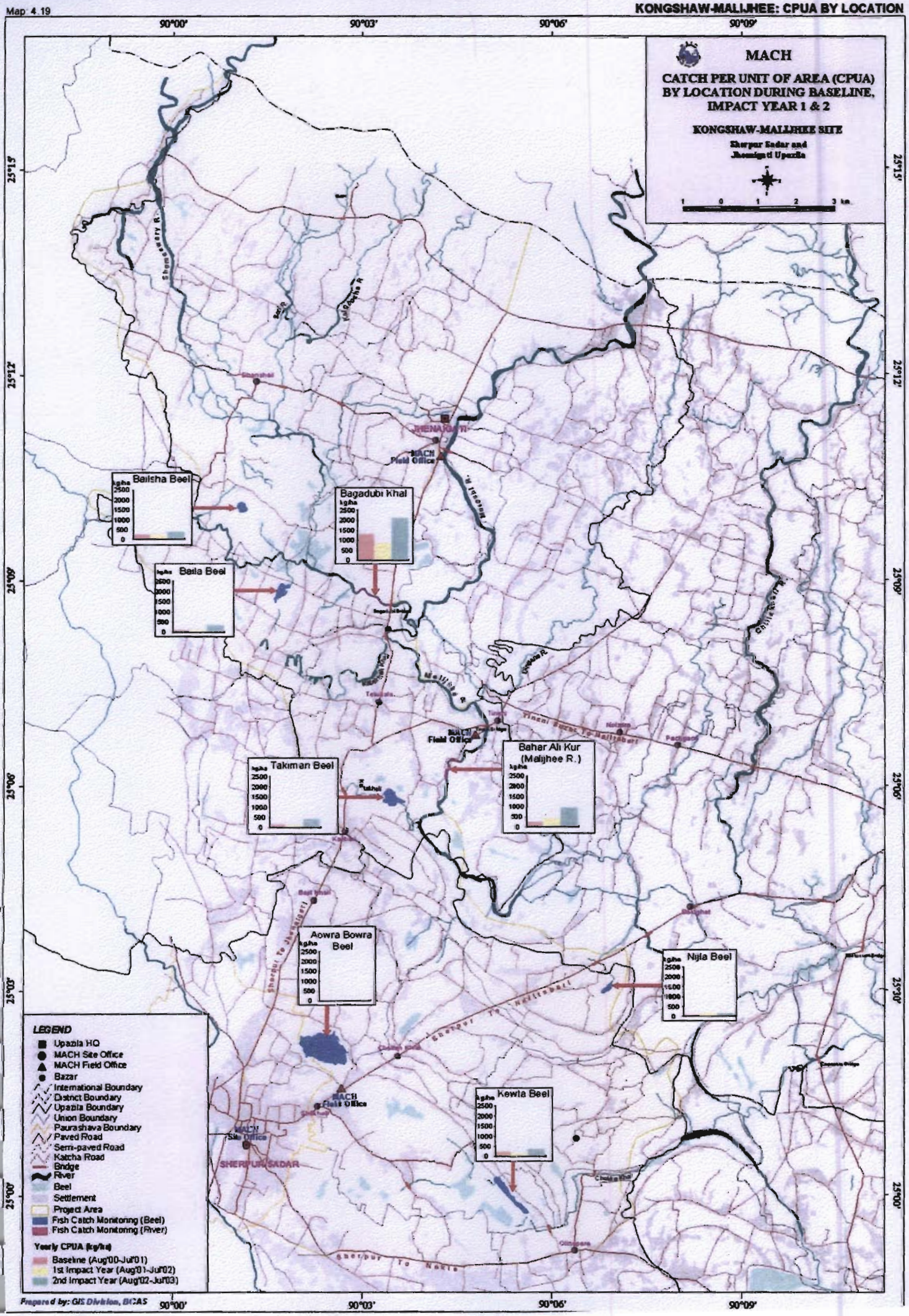
Map. 4.21

KONGSHAW-MALIJHEE: PER CAPITA FISH CONSUMPTION BY VILLAGE



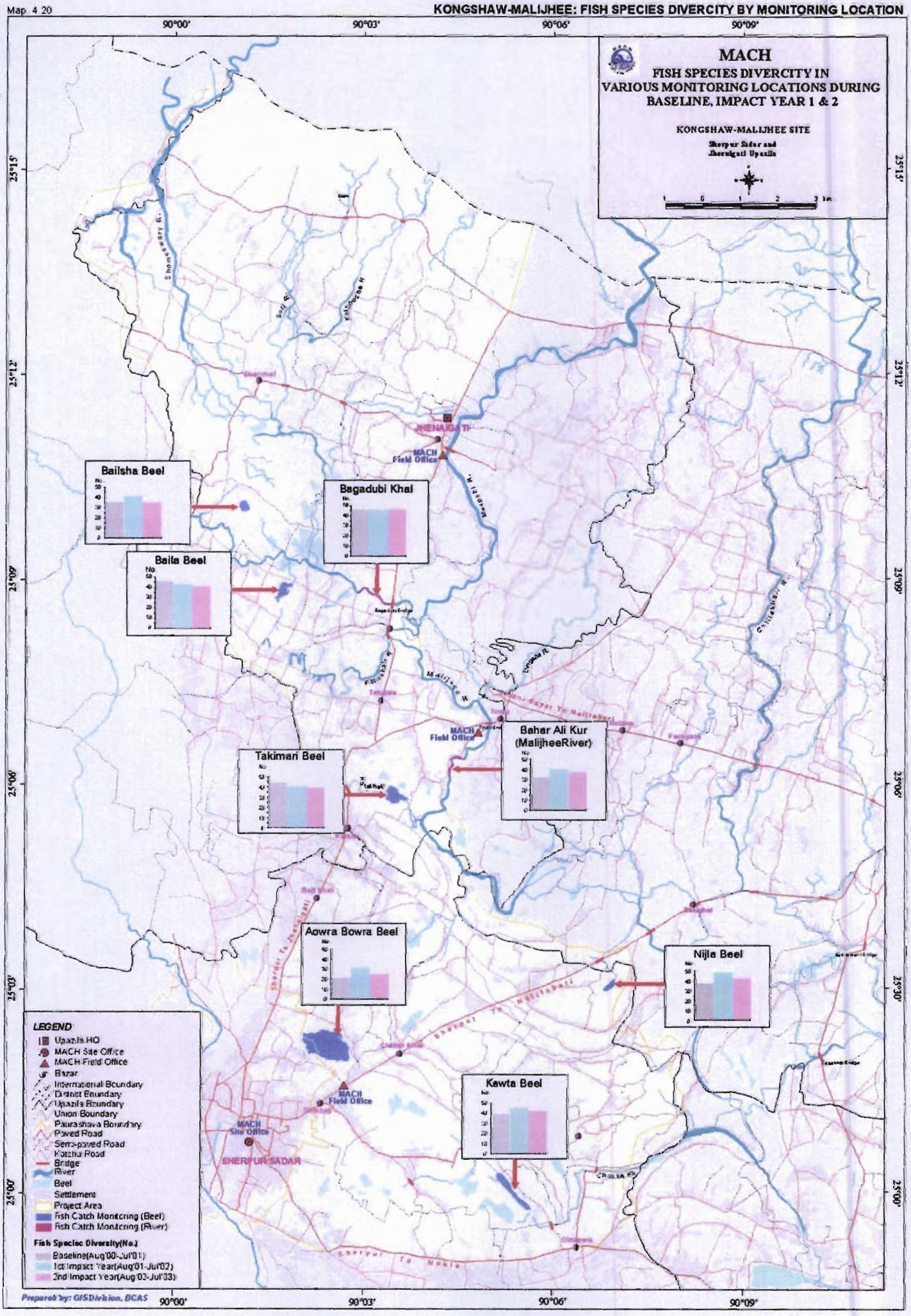
Map: 4.19

KONGSHAW-MALIJHEE: CPUA BY LOCATION

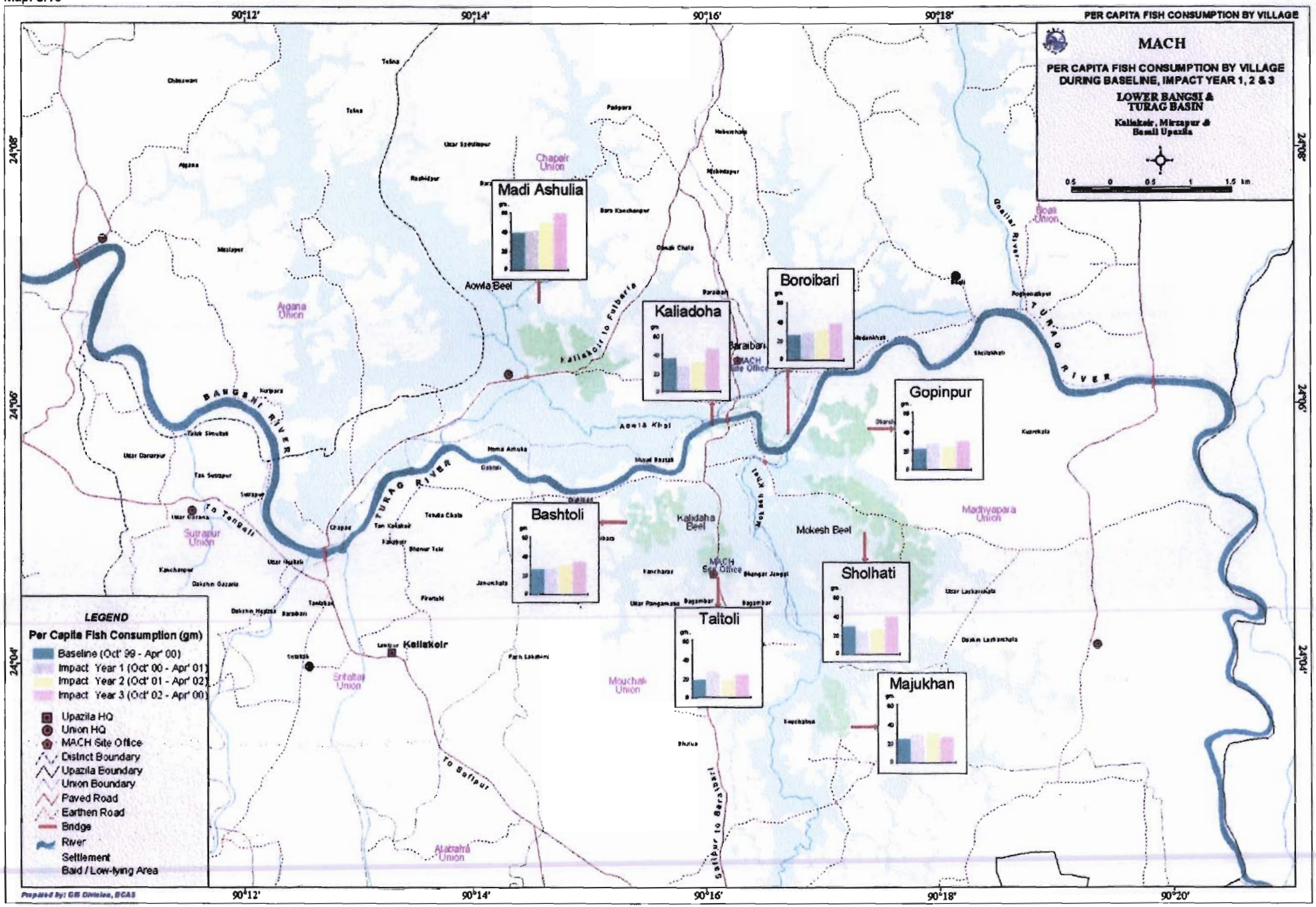


Map 4.20

KONGSHAW-MALIJHEE: FISH SPECIES DIVERCITY BY MONITORING LOCATION

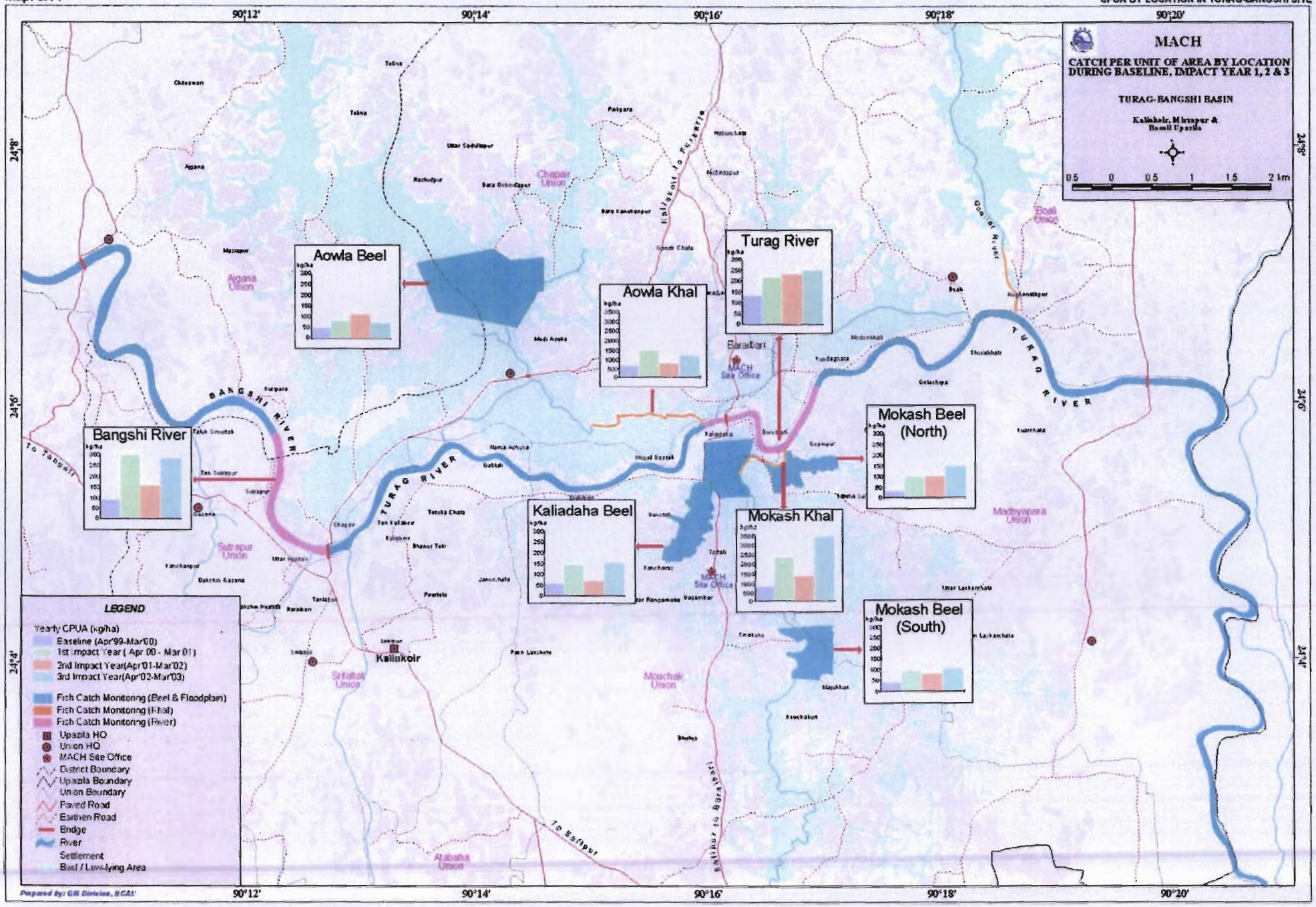


Map: 3.16


PER CAPITA FISH CONSUMPTION BY VILLAGE
MACH
PER CAPITA FISH CONSUMPTION BY VILLAGE DURING BASELINE, IMPACT YEAR 1, 2 & 3
LOWER BANGSI & TURAG BASIN
Kalliakoir, Mirzapur & Basail Upazila
Madi Ashulia
Boroibari
Kaliadoha
Gopinpur
Bashtoli
Sholhati
Taltoli
Majukhan
BANGSHI RIVER
TURAG RIVER
Aowla Beel
Kaliadaha Beel
Mokesh Beel
Kalliakoir
Chapair Union
Argana Union
Sutrapur Union
Madhyapara Union
Mouchak Union
Srifatar Union
Alabahra Union
LEGEND
Per Capita Fish Consumption (gm)
Baseline (Oct' 99 - Apr' 00)
Impact Year 1 (Oct' 00 - Apr' 01)
Impact Year 2 (Oct' 01 - Apr' 02)
Impact Year 3 (Oct' 02 - Apr' 03)
Upazila HQ
Union HQ
MACH Site Office
District Boundary
Upazila Boundary
Union Boundary
Paved Road
Earthen Road
Bridge
River
Settlement
Bald / Low-lying Area
Prepared by: GIS Division, BCAS
90°12'
90°14'
90°16'
90°18'
90°20'
24°08'
24°06'
24°04'

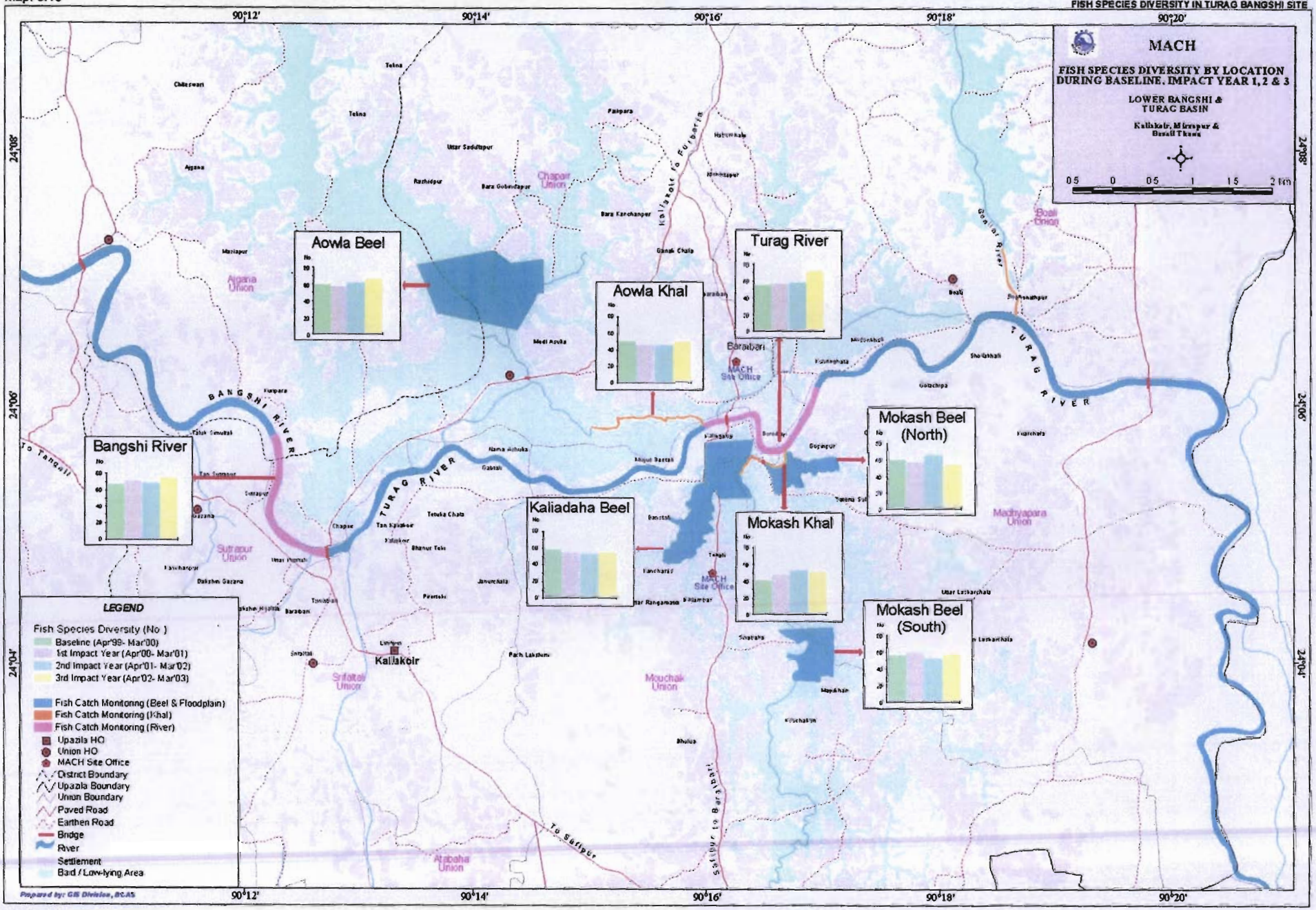
Map: 3.14

CPUA BY LOCATION IN TURAG-BANGSHI SITE



Map: 3.15

FISH SPECIES DIVERSITY IN TURAG BANGSHI SITE



Appendix-1

APPENDICES

MACH

Fish Catch Monitoring Form

Date ☐☐ ☐☐ ☐☐

M M D D Y Y

Habitat ☐

1. Information about Gear and Fishermen type:

1.1 Gear: 1.2 No. of Gear: 1.3 Length (m): ☐☐☐ ☐☐

1.4 Width (m): ☐☐ 1.5 Diameter (m): ☐☐ ☐☐ 1.6 Mesh size (mm): ☐☐☐

1.7 Fishermen type: ☐ 1.8 Involve person 1.9 Villages: _____

Age	Sex	Age	Sex

1.10 Distance from village to habitat (km): ☐☐ ☐☐

1.11 Total number of this type of gear operated today: ☐☐

2. Fishing time:

2.1 Fishing began at: ☐☐ ☐☐ 2.2 Time spent for present catch: ☐☐ ☐☐

2.3 Expected to end at: ☐☐ ☐☐ 2.4 Expected fishing hour: ☐☐ ☐☐

3. Species, number and weight of caught fish (g):

Species	Number	Weight	Species	Number	Weight

Total weight (sample) [in case of sub-sample]: ☐☐☐☐☐☐

5. Fishing rights (code): ☐☐ Name of Enumerator: _____

Appendix – 2

MACH (Form-2) HH Code

Fish Consumption and Natural Resource Collection Monitoring Form

Project Area: _____ Village: _____ Date: _____

Head of Household: _____ HH Members:_____ Name of Enumerator:_____

1. Fish Consumption Related Information

Today Morning: Meal Number.....				Today Noon: Meal Number.....				Today Night: Meal Number.....			
Species	Weight (g)	Measured (1)/ Estimated (2)	Source of Fish	Species	Weight (g)	Measured (1)/ Estimated (2)	Source of Fish	Species	Weight (g)	Measured (1)/ Estimated (2)	Source of Fish
Members eaten		M.....F.....Children....		Male.....Female.....Children.....				Male.....Female.....Children...			
(When Method: 1. Self 2. Estimated. Source: 1. Catch 2. Buy 3. Gift 4. Others (Mention)											

2. Other Protein Consumption

Today (Morning: breakfast)		Today (Noon: lunch)		Today (Night: dinner)	
Name of Food	Weight (g)/No.	Name of Food	Weight (g)/No.	Name of Food	Weight (g)/No.
Consuming members: Male:.....Female.....Children.....		Male:.....Female.....Children.....		Male:.....Female.....Children.....	

3. Fish Catch Data

Who fished	Age	Sex	Gear Used	Fishing Duration (Hours)	Weight (g) of Fish Caught	Fish sold		Fish Eaten	Habitat
						Weight (g)	Taka	Weight (g)	

4. Other Natural Resources Harvesting Data: (If any member of your HH collect other natural resources as aquatic vegetation, bird, wild animal, frog etc. from Haor/Beel/River/Khal etc.)

Reeds			Fodder/Grass			Mollusks			Birds		
Who	Quantity	purpose	Who	Quantity	Purpose	Who	Quantity	Purpose	who	Quantity	Purpose

Other resources: specify

Who	Quantity	purpose	Who	Quantity	Purpose	Who	Quantity	Purpose	who	Quantity	Purpose

5. Income from Selling of other Natural Resources

Reeds											
Qty. sold	Taka	Qty. sold	Taka	Qty. sold	Taka	Qty. sold	Taka	Qty. sold	Taka	Qty. sold	Taka

Comments _____

Appendix-3.1

Analysis of variance for CPUA and intervention at Hail Haor

Sources	Sum of Squares	d.f.	Mean Square	F	P-value
Baseline-Intervention periods	1858329.487	4	464582.372	13.497	.000
Error	826095.060	24	34420.628		
Total	2684425	28			

Analysis of variance for CPUA and intervention at Turag-Bongshi

Sources	Sum of Squares	d.f.	Mean Square	F	P-value
Baseline-Intervention periods	8797079.237	4	2199269.809	3.370	.023
Error	18271982.776	28	652570.813		
Total	27069062	32			

Analysis of variance for CPUA and intervention at Kongsha-Malijhee

Source	Sum of Squares	d.f.	Mean Square	F	P-value
Baseline-Intervention periods	4317462.485	3	1439154.162	6.271	.003
Error	4819141.600	21	229482.933		
Total	9136604	24			

Results of ANOVA shows that CPUA change significantly (p-value <.05) during the monitoring periods in all three project sites.

Appendix-3.2

Hail Haor Site

Table 1: ANOVA (Analysis of Variance) for per capita consumption of different land classes

Source	Sum of Squares	df	Mean Square	F	P-value
Land classes	239.185	4	59.796	3.536	.040
Monitoring years	372.883	3	124.294	7.350	.005
Error	202.933	12	16.911		
Total	815.001	19			

The ANOVA for per capita shows that there was significant difference within the land classes (P-value <0.05). In case of periods (base and impact years) the per capita consumption of fish was found that there was also highly significant difference (P-value <0.05).

Table 2: ANOVA for per capita consumption in different months

Source	Sum of Squares	df	Mean Square	F	P-value
Month	693.154	7	99.022	14.390	.000
Monitoring years	797.795	3	265.932	38.645	.000
Error	144.509	21	6.881		
Total	1635.458	31			

Fish consumption data at the baseline situation collected only for 8 months. But during the impact years consumption monitoring data collected round the years. ANOVA did for comparable period only. There was also highly significant difference for per capita fish consumption among months as well monitoring years, p-value < .05.

Table 3: ANOVA for sources of fish at Hail Haor

Source	Sum of Squares	df	Mean Square	F	P-value
Caught-Bought	3622.282	1	3622.282	230.874	.001
Period	.09134	3	.03045	.002	1.000
Error	47.068	3	15.689		
Total	3669.441	7			

ANOVA reflects the highly significant different between caught and bought of consumption of fish (P-value< .05). While considered different years, the p- value strongly reflects that there was no significant difference of sources of fish within comparable years (P-value>.05).

Appendix-3.3

Turag Bangshi Site

Table 1: ANOVA for per capita consumption of different land classes at Turag-Bangshi Site

Source	Sum of Squares	df	Mean Square	F	P-value
Land classes	27.323	4	6.831	1.940	.168
Monitoring years	329.707	3	109.902	31.212	.000
Error	42.253	12	3.521		
Total	399.283	19			

ANOVA shows that per capita consumption within the land classes was very insignificant (P-value >.05). Per capita consumption between the comparable monitoring years (base and impact situation) was found to be highly significant (p-value <.05).

Table 2: ANOVA for per capita consumption in different months at Turag-Bangshi

Source	Sum of Squares	df	Mean Square	F	P-value
Month	1807.869	6	301.312	27.549	.000
Monitoring years	365.506	3	121.835	11.139	.000
Error	196.871	18	10.937		
Total	2370.246	27			

ANOVA shows that there was highly significant difference of per capita fish consumption by months and monitoring years (base & impact), p-value < .05.

Table 3: ANOVA for sources of fish at Turag-Bongshi

Source	Sum of Squares	df	Mean Square	F	P-value
Caught-Bought	5456.990	1	5456.990	169.143	0.001
Monitoring years	.412	3	.137	.004	1.000
Error	96.788	3	32.263		
Total	5554.19	7			

ANOVA reflects highly significant different between caught and bought of consumption of fish (P-value<0.05). While considered different years, the p- value strongly shows there was no significant difference of fish consumption among the comparable Monitoring years (P-value>0.05).

Appendix-3.4

Kongsha-Malijhee Site

Table 1: ANOVA for per capita consumption of different land classes at Kongsha-Malijhee

Source	Sum of Squares	df	Mean Square	F	P-value
Land classes	19.346	4	4.836	2.387	.210
Period	37.830	1	37.830	18.674	.012
Error	8.103	4	2.026		
Total	**65.279**	**9**			

ANOVA shows that per capita consumption within the land classes was insignificant (P-value >.05). There was a significant change in per capita consumption between the comparable period (base and impact situation) since P-value <.05.

Table 2: ANOVA for per capita consumption in different months at Kongsha-Malijhee

Source	Sum of Squares	df	Mean Square	F	P-value
Month	509.758	11	46.342	.991	.506
Period	106.176	1	106.176	2.270	.160
Error	514.428	11	46.766		
Total	**1130.362**	**23**			

ANOVA shows that the per capita fish consumption among months and periods (base & impact) was insignificant (P-value > .05).

Table 3: ANOVA for sources of fish at Kongsha-Malijhee

Source	Sum of Squares	df	Mean Square	F	P-value
Caught-Bought	144.962	1	144.962	11.766	0.181
Period	0.084	1	0.084	0.007	0.948
Error	12.32	1			
Total	**157.37**	**3**			

Two years data are not sufficient for statistical interpretation in terms of ANOVA. However, analysis of variance reflects that the variation of sources among themselves were insignificant since p-value =0.181 >.05 and the variation of sources among the period were highly insignificant since p-value = 0.948 > 0.05) in Sherpur site.

Appendix-3.5

Confidence Interval of per capita consumption

Table: Confidence interval of per capita consumption in different period at HH site

Period	Per capita consumption	95% Confidence interval
Baseline	46.79g	46.79±3.12
Impact-1	53.22g	53.22±5.65
Impact-2	54.86g	54.86±3.95
Impact-3	60.81g	60.81±5.14

It has already mentioned earlier that the per capita consumption very at different situations (baseline and impact years). Table represents the value of observed per capita fish consumption at 95% confidences interval. At baseline per capita consumption was found to be fish 46.79±3.12. The values 53.22±5.65, 54.86±3.95 and 60.81±5.14 were observed in impact year-1, year-2 and year-3 respectively.

Table: Confidence interval of per capita consumption in different period at TB site

Period	Per capita consumption	95% Confidence interval
Baseline	27.57g	27.57±7.19
Impact-1	27.48g	27.48±5.54
Impact-2	27.82g	27.82±5.37
Impact-3	34.96g	34.96±5.76

Table shows that at baseline situation the value of per capita fish consumption observed at 95% confidence interval was found to be 27.57±7.19 while it was 27.82±5.37 and 34.96±5.76 observed at impact year-1, year-2 and year-3 respectively.

Table: Confidence interval of per capita consumption in different period at KM site

Period	Per capita consumption	95% Confidence interval
Baseline	22.33	22.33±2.45
Impact-1	26.54	26.54±5.62

Table showing that in KM site the observed per capita fish consumption at 95% confidence interval was found to be 22.33±2.45. Impact years 1 it was observed 26.54±5.62.

Appendix 4.1

Hail Haor Site

Species Diversity Comparison by different Intervention

Species Name(Bengali)	Scientific Name	Baseline	Impact-1	Impact-2	Impact-3
Jat Puti	*Puntius sophore*	√	√	√	√
Kanchan Puti	*Puntius conchonius*	√	√	√	√
Tit Puti	*Puntius ticto*	√	√	√	√
Jhili Puti	*Puntius gelius*	√	√	√	√
Futani Puti	*Puntius phutunio*	√	√	√	√
Teri Puti	*Puntius terio*	√	X	X	√
Mola Puti	*Puntius guganio*	X	X	√	√
Shar Puti	*Puntius sarana*	X	X	√	√
Chola Puti	*Puntius chola*	√	√	X	√
Thai Shor Puti	*Puntius gonionotus*	√	√	√	√
Bagha Puti	*Puntius stigma*	X	X	X	√
Mola	*Amblypharyngodon mola*	√	√	√	√
Chela	*Oxygaster pholo*	√	√	√	√
Chep Chela	*Chela laubuca*	√	√	√	√
Ranga Chanda	*Chanda ranga*	√	√	√	√
Lamba Chanda	*Chanda nama*	√	√	√	√
Gol Chanda	*Chanda baculis*	√	√	√	√
Chapila	*Gudusia chapra*	√	√	√	√
Khalisha	*Colisa fasciatus*	√	√	√	√
Lal Khalisha	*Colisa lalius*	√	√	√	√
Chuna Khalisha	*Colisa laboisa*	√	√	√	√
Dankina	*Rasbora daniconius*	√	√	√	√
Meni/Bheda	*Nandus nandus*	√	√	√	√
Koi	*Anabas testudineus*	√	√	√	√
Kali/Napti Koi	*Badis badis*	√	√	√	√
Bele	*Glossogobius giurius*	√	√	√	√
Rani	*Botia Dario*	√	√	√	√
Kachki	*Corica soborna*	√	X	X	X
Kaikla	*Xenentodon cancila*	√	√	√	√
Poa	*Pama pama*	X	√	X	√
Gutum	*Lepiodocephalus guntea*	√	√	√	√
Khalla/Kharshulla	*Mugil corsula*	X	X	√	X
Tin Chokha	*Aplocheilus panchax*	√	√	√	√
Boro Baim	*Mastacembelus armatus*	√	√	√	√
Guchi Baim	*Mastacembelus pancalus*	√	√	√	√
Tara Baim	*Macrognathus aculeatus*	√	√	√	√
Kuicha	*Cuchia cuchia*	√	√	√	√

Species Name(Bengali)	Scientific Name	Baseline	Impact-1	Impact-2	Impact-3
Taki	*Channa punctatus*	√	√	√	√
Shol	*Channa striata*	√	√	√	√
Gojar	*Channa marulius*	√	√	√	√
Cheng	*Channa gachua*	√	√	√	√
Vangra	*Labeo boga*	√	X	√	X
Goinna	*Labeo gonius*	√	√	√	√
Tatkini	*Crossocheilus latius*	X	√	X	X
Raek	*Cirrhinus reba*	X	X	X	√
Air	*Mystus aor*	√	√	X	√
Bajri Tengra	*Mystus tengara*	√	√	√	√
Golsa	*Mystus cavasius*	√	√	√	√
Tengra	*Mystus vittatus*	√	√	√	√
Kabasi Tengra		X	X	X	√
Bacha	*Eutropiichthys vacha*	√	√	√	√
Baspata/Kazuli	*Danio devario*	X	X	X	√
Boal	*Wallago attu*	√	√	√	√
Pangas	*Pangasius pangasius*	X	X	X	√
Kani Pabda	*Ompok bimaculatus*	√	√	√	√
Pabda/Madhu	*Ompok pabda*	√	√	√	√
Pabda/Kowakata/Ghorakata					
Chaka/Gangina/Kowakata	*Chaka chaka*	√	√	√	√
Shing	*Heteropneustes fossilis*	√	√	√	√
Magur	*Clarius batrachus*	√	√	√	√
African Magur	*Clarias gariepinus*	X	√	X	X
Chital	*Notopterus chitala*	X	X	X	√
Foli	*Notopterus notopoterus*	√	√	√	√
Telapia	*Oreochromis (Telapia) mossambicus*	√	√	√	√
Rui	*Labeo rohita*	√	√	√	√
Catla	*Catla catla*	√	X	√	√
Mrigel	*Cirrhinus mrigala*	√	√	√	√
Kalibaush	*Labeo calbasu*	√	√	√	√
Silver Carp	*Hypophthalmichthys molitrix*	X	√	X	√
Grass Carp	*Ctenopharyngodon idellus*	√	√	√	√
Miror Carp	*Cyprinus carpio*	X	√	X	X
Comon Carp/Karfu	*Cyprinus carpio*	√	√	√	√
Bighead Carp	*Aristechthys nobilis*	X	X	X	√
Gura Echa	*Macrobrachium lamrrei*	√	√	√	√
Narkeli Chela	*Oxygaster bacalia*	√	√	√	√
Naftani/Berkul	*Osphronemus(Ctenops) nobilis*	√	√	√	√

Species Name(Bengali)	Scientific Name	Baseline	Impact-1	Impact-2	Impact-3
Ghaura	*Clupisoma garua*	√	X	X	X
Tepa/Futkora	*Tetraodon cutcutia*	√	√	√	√
Buth Koi/Bali					
Chata/Balitora	*Nemacheilus batia*	X	√	√	X
Satka Chingri	*Macrobrachium*	X	X	√	√
Dimua/Kathalia Echa		√	√	X	√
Thengua Echa	*Macrobrachium birmanicus*	√	√	√	√
Elong		√	X	X	X
Gora Gutum/Ganga					
Shagor		√	√	√	X
Boiragi Echa		√	X	X	X
Reckha Kholisha		√	√	√	√
Sheild Kholisha	*Colisa labiosus*	√	√	√	X
Kecho Bime	*Ophichthys boro*	√	X	X	X
Potka	*Tetraodon patoca*	√	√	√	√
Senia (Eusufi)	*Gagata cenia*	X	√	√	X
Moa	*Rohtee cotio*	X	√	√	√
Total		**71**	**71**	**69**	**76**

Appendix 4.2

Turag Bongshi

Species Diversity Comparison by different Intervention

Species Name(Bengali)	Scientific Name	Baseline	Impact-1	Impact-2	Impact-3
Jat Puti	*Puntius sophore*	√	√	√	√
Kanchan Puti	*Puntius conchonius*	√	√	√	√
Tit Puti	*Puntius ticto*	√	√	√	√
Jhili Puti	*Puntius gelius*	√	√	√	√
Futani Puti	*Puntius phutunio*	√	X	X	X
Chola Puti	*Puntius chola*	√	√	√	√
Thai Shor Puti	*Puntius gonionotus*	√	√	√	√
Bagha Puti	*Puntius stigma*	√	√	√	√
Mola	*Amblypharyngodon mola*	√	√	√	√
Dhela	*Amblypharyngodon microlepis*	√	√	√	√
Chela	*Oxygaster pholo*	√	√	√	√
Chep Chela	*Chela laubuca*	√	X	X	X
Ranga Chanda	*Chanda ranga*	√	√	√	√
Lamba Chanda	*Chanda nama*	√	√	√	√
Gol Chanda	*Chanda baculis*	√	√	√	√
Chapila	*Gudusia chapra*	√	√	√	√
Khalisha	*Colisa fasciatus*	√	√	√	√
Lal Khalisha	*Colisa lalius*	√	√	√	√
Chuna Khalisha	*Colisa laboisa*	√	√	√	√
Dankina	*Rasbora daniconius*	√	√	√	√
Koi	*Anabas testudineus*	√	√	√	√
Kali/Napti Koi	*Badis badis*	√	√	√	√
Bele	*Glossogobius giurius*	√	√	√	√
Rani	*Botia Dario*	√	√	√	√
Kachki	*Corica soborna*	√	√	√	√
Kaikla	*Xenentodon cancila*	√	√	√	√
Poa	*Pama pama*	√	√	√	√
Gutum	*Lepiodocephalus guntea*	√	√	√	√
Khalla/Kharshulla	*Mugil corsula*	√	√	√	√
Peali	*Aspidoparia morar*	√	√	√	√
Tin Chokha	*Aplocheilus panchax*	√	√	√	√
Fesha	*Raconda russeliana*	√	X	X	√
Boro Baim	*Mastacembelus armatus*	√	√	√	√
Guchi Baim	*Mastacembelus pancalus*	√	√	√	√
Tara Baim	*Macrognathus aculeatus*	√	√	√	√
Kuicha	*Cuchia cuchia*	√	√	X	√
Taki	*Channa punctatus*	√	√	√	√

Species Name(Bengali)	Scientific Name	Baseline	Impact-1	Impact-2	Impact-3
Shol	*Channa striata*	√	√	√	√
Cheng	*Channa gachua*	√	√	√	√
Vangra	*Labeo boga*	√	√	√	X
Tatkini	*Crossocheilus latius*	√	√	√	√
Air	*Mystus aor*	√	√	√	√
Guzi air/Guzkata	*Mystus seenghala*	√	X	√	√
Bagha Air	*Bagarius bagarius*	√	√	√	√
Batasi	*Clupisoma (Pseudentropious) atherrinoides*	√	√	√	√
Golsa	*Mystus cavasius*	√	√	√	√
Tengra	*Mystus vittatus*	√	√	√	√
Bacha	*Eutropiichthys vacha*	√	√	√	√
Baspata/Kazuli	*Danio devario*	√	√	√	√
Boal	*Wallago attu*	√	√	√	√
Rita	*Rita rita*	√	√	√	√
Silong	*Silonia silondia*	√	√	√	√
Kani Pabda	*Ompok bimaculatus*	√	√	√	√
Pabda/Madhu Pabda/Kowakata/Ghorakata	*Ompok pabda*	√	√	√	√
Chaka/Gangina/Kowakata	*Chaka chaka*	√	√	√	√
Shing	*Heteropneustes fossilis*	√	√	√	√
Magur	*Clarius batrachus*	√	√	√	√
Foli	*Notopterus notopoterus*	√	√	√	√
Hilsha (Jatka)	*Tenualosa ilisha*	√	√	√	√
Telapia	*Oreochromis (Telapia) mossambicus*	√	√	√	√
Rui	*Labeo rohita*	√	√	√	√
Catia	*Catla catla*	√	√	√	√
Mrigel	*Cirrhinus mrigala*	√	√	√	√
Kalibaush	*Labeo calbasu*	√	√	√	√
Silver Carp	*Hypophthalmichthys molitrix*	√	√	√	√
Comon Carp/Karfu	*Cyprinus carpio*	√	√	√	√
Gura Echa	*Macrobrachium lamrrei*	√	√	√	√
Golda Echa	*Macrobrachium rosenbergii*	√	√	√	√
Narkeli Chela	*Oxygaster bacalia*	√	X	X	X
Naftani/Berkul	*Osphronemus(Ctenops) nobilis*	√	X	X	X
Ghaura	*Clupisoma garua*	√	√	√	√
Tepa/Futkora	*Tetraodon cutcutia*	√	√	√	√
Buth Koi/Bali Chata/Balitora	*Nemacheilus batia*	√	√	√	√

Species Name(Bengali)	Scientific Name	Baseline	Impact-1	Impact-2	Impact-3
Satka Chingri	*Macrobrachium*	√	√	√	√
Putul	*Botia lohachata*	√	X	X	X
Dimua/Kathalia Echa		√	√	√	√
Gora Gutum/Ganga					
Shagor		√	√	√	√
Gugri Bila		√	√	√	√
Potka	*Tetraodon patoca*	√	√	√	X
Nayan bali		√	√	√	√
GangChela/Ghora Chel		√	X	√	√
Peashi	*Aspidoparia jaya*	√	√	√	√
Mola Puti	*Puntius guganio*	X	X	√	√
Shar Puti	*Puntius sarana*	X	X	X	√
Meni/Bheda	*Nandus nandus*	X	√	√	√
Gojar	*Channa marulius*	X	√	√	√
Goinna	*Labeo gonius*	X	X	X	√
Bajri Tengra	*Mystus tengara*	X	X	√	√
Kabasi Tengra		X	X	√	√
Pangas	*Pangasius pangasius*	X	X	√	X
African Magur	*Clarias gariepinus*	X	√	X	√
Chital	*Notopterus chitala*	X	X	X	√
Grass Carp	*Ctenopharyngodon idellus*	X	√	√	√
Miror Carp	*Cyprinus carpio*	X	√	√	√
Bighead Carp	*Aristechthys nobilis*	X	X	X	√
Gang Tengra	*Gagata viridescens*	X	X	√	X
Tengra (Batasio)	*Batasio batasio*	X	√	X	√
Senia (Eusufi)	*Gagata cenia*	X	X	√	√
Mamoli Chapila		X	√	√	√
Chenua		X	X	X	√
Total		**82**	**81**	**86**	**91**

Appendix 4.3

Kongshow Malijhee

Species diversity comparison of Kongshow-Malijhee by different Intervention

Bengali Name	Scientific Name	Baseline	Impact-1	Impact-2
Jat Puti	*Puntius sophore*	√	√	√
Kanchan Puti	*Puntius conchonius*	√	√	√
Tit Puti	*Puntius ticto*	√	√	√
Jhili Puti	*Puntius gelius*	√	X	X
Futani Puti	*Puntius phutunio*	X	X	√
Mola Puti	*Puntius guganio*	√	X	X
Shar Puti	*Puntius sarana*	√	√	√
Chola Puti	*Puntius chola*	√	X	√
Thai Shor Puti	*Puntius gonionotus*	√	√	√
Bagha Puti	*Puntius stigma*	X	√	√
Mola	*Amblypharyngodon mola*	√	√	√
Dhela	*Amblypharyngodon microlepis*	√	√	√
Chela	*Oxygaster pholo*	√	√	√
Chep Chela	*Chela laubuca*	√	√	√
Ranga Chanda	*Chanda ranga*	√	√	√
Lamba Chanda	*Chanda nama*	√	√	√
Gol Chanda	*Chanda baculis*	√	√	√
Chapila	*Gudusia chapra*	√	√	√
Khalisha	*Colisa fasciatus*	√	√	√
Lal Khalisha	*Colisa lalius*	√	√	√
Chuna Khalisha	*Colisa laboisa*	√	√	√
Dankina	*Rasbora daniconius*	√	√	√
Meni/Bheda	*Nandus nandus*	X	X	√
Koi	*Anabas testudineus*	√	√	√
Kali/Napti Koi	*Badis badis*	√	√	√
Bele	*Glossogobius giurius*	√	√	√
Rani	*Botia Dario*	√	√	√
Kaikla	*Xenentodon cancila*	√	√	√
Poa	*Pama pama*	X	√	√
Gutum	*Lepiodocephalus guntea*	√	√	√
Tin Chokha	*Aplocheilus panchax*	√	X	√
Boro Baim	*Mastacembelus armatus*	√	√	√
Guchi Baim	*Mastacembelus pancalus*	√	√	√
Tara Baim	*Macrognathus aculeatus*	√	√	√
Kuicha	*Cuchia cuchia*	√	√	√
Taki	*Channa punctatus*	√	√	√
Shol	*Channa striata*	X	√	√
Gojar	*Channa marulius*	X	√	√

Bengali Name	Scientific Name	Baseline	Impact-1	Impact-2
Cheng	*Channa gachua*	√	√	√
Bata	*Labeo bata*	√	√	√
Vangra	*Labeo boga*	√	X	√
Goinna	*Labeo gonius*	X	√	√
Tatkini	*Crossocheilus latius*	√	√	√
Raek	*Cirrhinus reba*	X	√	√
Nandil	*Labeo nandina*	√	√	√
Air	*Mystus aor*	√	X	X
Guzi air/Guzkata	*Mystus seenghala*	X	X	√
Bagha Air	*Bagarius bagarius*	√	X	X
Batasi	*Clupisoma (Pseudentropious) atherrinoides*	√	√	√
Bajri Tengra	*Mystus tengara*	X	X	√
Golsa	*Mystus cavasius*	√	√	√
Tengra	*Mystus vittatus*	√	√	√
Kabasi Tengra		X	√	X
Boal	*Wallago attu*	√	√	√
Pangas	*Pangasius pangasius*	X	√	√
Silong	*Silonia silondia*	X	X	√
Kani Pabda	*Ompok bimaculatus*	√	X	X
Pabda/Madhu Pabda/Kowakata/Ghorakata	*Ompok pabda*	√	√	√
Shing	*Heteropneustes fossilis*	√	√	√
Magur	*Clarius batrachus*	√	√	√
African Magur	*Clarias gariepinus*	X	√	X
Foli	*Notopterus notopoterus*	√	√	√
Hilsha (Jatka)	*Tenualosa ilisha*	X	√	√
Telapia	*Oreochromis (Telapia) mossambicus*	X	√	√
Rui	*Labeo rohita*	√	√	√
Catla	*Catla catla*	√	√	√
Mrigel	*Cirrhinus mrigala*	√	√	√
Kalibaush	*Labeo calbasu*	√	√	√
Silver Carp	*Hypophthalmichthys molitrix*	√	√	√
Grass Carp	*Ctenopharyngodon idellus*	√	√	√
Miror Carp	*Cyprinus carpio*	√	√	√
Comon Carp/Karfu	*Cyprinus carpio*	√	√	√
Bighead Carp	*Aristechthys nobilis*	X	X	√
Gura Echa	*Macrobrachium lamrrei*	√	√	√
Golda Echa	*Macrobrachium rosenbergii*	√	√	X

Bengali Name	Scientific Name	Baseline	Impact-1	Impact-2
Naftani/Berkul	*Osphronemus(Ctenops) nobilis*	X	√	X
Ghaura	*Clupisoma garua*	√	√	X
Tepa/Futkora	*Tetraodon cutcutia*	√	√	√
Gora Gutum/Ganga Shagor		√	√	√
Gugri Bila		X	X	√
Potka	*Tetraodon patoca*	√	X	X
Senia (Eusufi)	*Gagata cenia*	X	√	X
GangChela/Ghora Chel		√	X	√
Batai		√	√	X
		64	**67**	**71**

Appendix-5.1

Hail Haor Top 20 Species caught in Baseline

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Jat Puti	Puntius sophore	28670.77	14.27
2	Khalisha	Colisa fasciatus	27405.98	13.64
3	Meni/Bheda	Nandus nandus	25677.14	12.78
4	Koi	Anabas testudineus	17285.39	8.60
5	Boal	Wallago attu	17214.30	8.57
6	Taki	Channa punctatus	16419.21	8.17
7	Mola	Amblypharyngodon mola	15564.51	7.75
8	Tengra	Mystus vittatus	6708.62	3.34
9	Shol	Channa striata	6173.42	3.07
10	Shing	Heteropneustes fossilis	4819.26	2.40
11	Chuna Khalisha	Colisa laboisa	3696.42	1.84
12	Guchi Baim	Mastacembelus pancalus	3080.75	1.53
13	Lal Khalisha	Colisa lalius	2872.78	1.43
14	Kaikla	Xenentodon cancila	2863.97	1.43
15	Tara Baim	Macrognathus aculeatus	2613.37	1.30
16	Gura Echa	Macrobrachium lamrrei	2418.78	1.20
17	Foli	Notopterus notopoterus	1950.30	0.97
18	Dankina	Rasbora daniconius	1849.02	0.92
19	Gojar	Channa marulius	1335.38	0.67
20	Magur	Clarius batrachus	1195.42	0.60
	Total			94.49

Hail Haor Top 20 Species caught in Impact1

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Mola	*Amblypharyngodon mola*	56457.06	23.45
2	Jat Puti	*Puntius sophore*	39849.67	16.55
3	Meni/Bheda	*Nandus nandus*	16084.78	6.68
4	Taki	*Channa punctatus*	11990.25	4.98
5	Tengra	*Mystus vittatus*	10318.25	4.29
6	Khalisha	*Colisa fasciatus*	8528.61	3.54
7	Foli	*Notopterus notopoterus*	8129.11	3.38
8	Kaikla	*Xenentodon cancila*	7518.10	3.12
9	Guchi Baim	*Mastacembelus pancalus*	5959.15	2.48
10	Thengua Echa	*Macrobrachium birmanicus*	5450.03	2.26
11	Ranga Chanda	*Chanda ranga*	5345.27	2.22
12	Shol	*Channa striata*	4329.84	1.80
13	Kanchan Puti	*Puntius conchonius*	4012.00	1.67
14	Dankina	*Rasbora daniconius*	3759.94	1.56
15	Shing	*Heteropneustes fossilis*	3608.20	1.50
16	Chuna Khalisha	*Colisa laboisa*	3521.06	1.46
17	Magur	*Clarius batrachus*	3315.94	1.38
18	Rui	*Labeo rohita*	3269.66	1.36
19	Gojar	*Channa marulius*	3238.86	1.35
20	Boal	*Wallago attu*	3185.50	1.32
	Total			86.33

Hail Haor Top 20 Species caught in Impact2

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Jat Puti	*Puntius sophore*	26404.26	11.79
2	Taki	*Channa punctatus*	19788.50	8.83
3	Meni/Bheda	*Nandus nandus*	19274.69	8.61
4	Khalisha	*Colisa fasciatus*	13455.95	6.01
5	Shol	*Channa striata*	9274.41	4.14
6	Foli	*Notopterus notopoterus*	8899.75	3.97
7	Mola	*Amblypharyngodon mola*	7221.32	3.22
8	Guchi Baim	*Mastacembelus pancalus*	6996.02	3.12
9	Kaikla	*Xenentodon cancila*	6500.81	2.90
10	Shing	*Heteropneustes fossilis*	6388.15	2.85
11	Tengra	*Mystus vittatus*	6119.48	2.73
12	Magur	*Clarius batrachus*	5704.37	2.55
13	Kanchan Puti	*Puntius conchonius*	5437.88	2.43
14	Gojar	*Channa marulius*	5428.37	2.42
15	Boal	*Wallago attu*	5420.01	2.42
16	Bele	*Glossogobius giurius*	5402.42	2.41
17	Thengua Echa	*Macrobrachium birmanicus*	4947.78	2.21
18	Gura Echa	*Macrobrachium lamrrei*	4549.10	2.03
19	Koi	*Anabas testudineus*	4439.62	1.98
20	Chuna Khalisha	*Colisa laboisa*	4071.84	1.82
	Total			**78.45**

Hail Haor Top 20 Species caught in Impact3

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Jat Puti	*Puntius sophore*	39824.88	11.81
2	Meni/Bheda	*Nandus nandus*	25254.10	7.49
3	Taki	*Channa punctatus*	23930.10	7.09
4	Khalisha	*Colisa fasciatus*	23205.06	6.88
5	Tengra	*Mystus vittatus*	22102.87	6.55
6	Foli	*Notopterus notopoterus*	20500.39	6.08
7	Shol	*Channa striata*	14868.10	4.41
8	Kaikla	*Xenentodon cancila*	14659.90	4.35
9	Guchi Baim	*Mastacembelus pancalus*	10663.38	3.16
10	Magur	*Clarius batrachus*	8672.98	2.57
11	Mola	*Amblypharyngodon mola*	8507.05	2.52
12	Gojar	*Channa marulius*	8439.76	2.50
13	Rui	*Labeo rohita*	7482.63	2.22
14	Kanchan Puti	*Puntius conchonius*	7274.73	2.16
15	Shing	*Heteropneustes fossilis*	6381.67	1.89
16	Koi	*Anabas testudineus*	6329.78	1.88
17	Gol Chanda	*Chanda baculis*	6054.58	1.80
18	Dankina	*Rasbora daniconius*	5747.79	1.70
19	Goinna	*Labeo gonius*	5470.92	1.62
20	Boal	*Wallago attu*	4975.66	1.48
	Total			**80.14**

Appendix-5.2

Turag-Bangshi Top 20 Species caught in Baseline

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Gura Echa	*Macrobrachium lamrrei*	3007.58	13.60
2	Tengra	*Mystus vittatus*	1928.78	8.72
3	Jat Puti	*Puntius sophore*	1892.23	8.55
4	Taki	*Channa punctatus*	1650.65	7.46
5	Boro Baim	*Mastacembelus armatus*	1515.35	6.85
6	Chapila	*Gudusia chapra*	1421.24	6.43
7	Guchi Baim	*Mastacembelus pancalus*	1000.13	4.52
8	Bele	*Glossogobius giurius*	846.24	3.83
9	Tara Baim	*Macrognathus aculeatus*	767.39	3.47
10	Lamba Chanda	*Chanda nama*	712.41	3.22
11	Tit Puti	*Puntius ticto*	537.89	2.43
12	Aair	*Mystus aor*	501.89	2.27
13	Chola Puti	*Puntius chola*	482.19	2.18
14	Catla	*Catla catla*	481.52	2.18
15	Mrigel	*Cirrhinus mrigala*	467.92	2.12
16	Shing	*Heteropneustes fossilis*	408.50	1.85
17	Satka Chingri	*Macrobrachium Sp.*	344.13	1.56
18	Shol	*Channa striata*	342.36	1.55
19	Boal	*Wallago attu*	323.62	1.46
20	Chela	*Oxygaster pholo*	310.98	1.41
	Total			**85.64**

Turag-Bangshi Top 20 Species caught in Impact1

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Jat Puti	*Puntius sophore*	5949.44	12.46
2	Gura Echa	*Macrobrachium lamrrei*	4156.36	8.71
3	Chapila	*Gudusia chapra*	3501.96	7.34
4	Taki	*Channa punctatus*	3402.66	7.13
5	Tengra	*Mystus vittatus*	2866.06	6.00
6	Tit Puti	*Puntius ticto*	2865.13	6.00
7	Bele	*Glossogobius giurius*	2506.22	5.25
8	Guchi Baim	*Mastacembelus pancalus*	1931.25	4.05
9	Rui	*Labeo rohita*	1442.27	3.02
10	Boro Baim	*Mastacembelus armatus*	1349.37	2.83
11	Bagha Puti	*Puntius stigma*	1322.84	2.77
12	Mrigel	*Cirrhinus mrigala*	1157.62	2.43
13	Kaikla	*Xenentodon cancila*	1082.41	2.27
14	Chola Puti	*Puntius chola*	1065.12	2.23
15	Satka Chingri	*Macrobrachium Sp.*	1013.08	2.12
16	Aair	*Mystus aor*	978.86	2.05
17	Shol	*Channa striata*	904.87	1.90
18	Gol Chanda	*Chanda baculis*	859.14	1.80

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
19	Gutum	*Lepiodocephalus guntea*	688.99	1.44
20	Lamba Chanda	*Chanda nama*	671.80	1.41
	Total			**83.18**

Turag-Bangshi Top 20 Species caught in Impact2

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Gura Echa	*Macrobrachium lamrrei*	4491.04	11.20
2	Jat Puti	*Puntius sophore*	4261.03	10.63
3	Chapila	*Gudusia chapra*	3246.43	8.10
4	Tit Puti	*Puntius ticto*	3015.94	7.52
5	Taki	*Channa punctatus*	2725.46	6.80
6	Bele	*Glossogobius giurius*	2273.36	5.67
7	Boro Baim	*Mastacembelus armatus*	2111.81	5.27
8	Guchi Baim	*Mastacembelus pancalus*	1944.24	4.85
9	Tengra	*Mystus vittatus*	1474.75	3.68
10	Guzi air/Guzkata	*Mystus seenghala*	1004.88	2.51
11	Gol Chanda	*Chanda baculis*	985.48	2.46
12	Ranga Chanda	*Chanda ranga*	861.92	2.15
13	Lamba Chanda	*Chanda nama*	784.39	1.96
14	Chela	*Oxygaster pholo*	775.70	1.93
15	Shol	*Channa striata*	710.73	1.77
16	Mrigel	*Cirrhinus mrigala*	622.25	1.55
17	Tara Baim	*Macrognathus aculeatus*	477.75	1.19
18	Satka Chingri	*Macrobrachium*	437.57	1.09
19	Mola	*Amblypharyngodon mola*	402.80	1.00
20	Kaikla	*Xenentodon cancila*	397.84	0.99
	Total			**82.31**

Turag-Bangshi Top 20 Species caught in Impact3

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Jat Puti	*Puntius sophore*	5441.40	10.15
2	Gura Echa	*Macrobrachium lamrrei*	5110.27	9.53
3	Chapila	*Gudusia chapra*	4472.55	8.34
4	Taki	*Channa punctatus*	3283.16	6.12
5	Tit Puti	*Puntius ticto*	3227.58	6.02
6	Bele	*Glossogobius giurius*	2785.19	5.20
7	Rui	*Labeo rohita*	2282.38	4.26
8	Guchi Baim	*Mastacembelus pancalus*	2038.96	3.80
9	Tengra	*Mystus vittatus*	1914.31	3.57
10	Mrigel	*Cirrhinus mrigala*	1542.66	2.88
11	Chola Puti	*Puntius chola*	1538.41	2.87
12	Gol Chanda	*Chanda baculis*	1389.49	2.59
13	Guzi air/Guzkata	*Mystus seenghala*	1296.16	2.42

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
14	Lamba Chanda	*Chanda nama*	1207.98	2.25
15	Bagha Puti	*Puntius stigma*	1137.30	2.12
16	Shol	*Channa striata*	1085.35	2.02
17	Kaikla	*Xenentodon cancila*	953.31	1.78
18	Ranga Chanda	*Chanda ranga*	804.95	1.50
19	Satka Chingri	*Macrobrachium*	786.97	1.47
20	Chela	*Oxygaster pholo*	774.41	1.44
	Total			80.34

Appendix-5.3

Kongshow-Malijhee Top 20 Species caught in Baseline

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Gura Echa	*Macrobrachium lamrrei*	7716.65	19.20
2	Jat Puti	*Puntius sophore*	6460.73	16.07
3	Boal	*Wallago attu*	4652.29	11.57
4	Tengra	*Mystus vittatus*	4427.49	11.01
5	Taki	*Channa punctatus*	2371.99	5.90
6	Guchi Baim	*Mastacembelus pancalus*	2159.66	5.37
7	Bele	*Glossogobius giurius*	1937.50	4.82
8	Tit Puti	*Puntius ticto*	1389.74	3.46
9	Gutum	*Lepiodocephalus guntea*	1269.40	3.16
10	Tara Baim	*Macrognathus aculeatus*	1229.07	3.06
11	Comon Carp/Karfu	*Cyprinus carpio*	1021.09	2.54
12	Boro Baim	*Mastacembelus armatus*	685.84	1.71
13	Gol Chanda	*Chanda baculis*	671.31	1.67
14	Rui	*Labeo rohita*	555.34	1.38
15	Chuna Khalisha	*Colisa laboisa*	489.21	1.22
16	Chela	*Oxygaster pholo*	415.07	1.03
17	Kaikla	*Xenentodon cancila*	314.92	0.78
18	Shing	*Heteropneustes fossilis*	282.87	0.70
19	Lamba Chanda	*Chanda nama*	253.66	0.63
20	Kalibaush	*Labeo calbasu*	191.28	0.48
	Total			**95.75**

Kongshow-Malijhee Top 20 Species caught in Impact1

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Gura Echa	*Macrobrachium lamrrei*	5636.87	14.12
2	Jat Puti	*Puntius sophore*	5451.86	13.65
3	Bele	*Glossogobius giurius*	3370.91	8.44
4	Boal	*Wallago attu*	3163.48	7.92
5	Taki	*Channa punctatus*	2948.85	7.39
6	Tengra	*Mystus vittatus*	2459.67	6.16
7	Comon Carp/Karfu	*Cyprinus carpio*	1974.23	4.94
8	Tara Baim	*Macrognathus aculeatus*	1876.16	4.70
9	Tit Puti	*Puntius ticto*	1835.04	4.60
10	Gutum	*Lepiodocephalus guntea*	1319.37	3.30
11	Guchi Baim	*Mastacembelus pancalus*	1314.44	3.29
12	Mrigel	*Cirrhinus mrigala*	1203.00	3.01
13	Thai Shor Puti	*Puntius gonionotus*	1010.86	2.53
14	Gol Chanda	*Chanda baculis*	689.55	1.73
15	Silver Carp	*Hypophthalmichthys*	674.10	1.69

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
		molitrix		
16	Boro Baim	*Mastacembelus armatus*	531.63	1.33
17	Chuna Khalisha	*Colisa laboisa*	434.50	1.09
18	Grass Carp	*Ctenopharyngodon idellus*	416.57	1.04
19	Chela	*Oxygaster pholo*	385.57	0.97
20	Kaikla	*Xenentodon cancila*	378.46	0.95
	Total			**92.85**

Kongshow-Malijhee Top 20 Species caught in Impact2

Serial No.	Bengali Name	Scientific Name	Total Catch(kg)	%
1	Gura Echa	*Macrobrachium lamrrei*	13325.19	18.21
2	Jat Puti	*Puntius sophore*	8641.28	11.81
3	Taki	*Channa punctatus*	5761.29	7.87
4	Tengra	*Mystus vittatus*	5425.99	7.41
5	Comon Carp/Karfu	*Cyprinus carpio*	5106.87	6.98
6	Mrigel	*Cirrhinus mrigala*	4425.81	6.05
7	Guchi Baim	*Mastacembelus pancalus*	4387.88	6.00
8	Boal	*Wallago attu*	4032.97	5.51
9	Bele	*Glossogobius giurius*	3813.12	5.21
10	Tara Baim	*Macrognathus aculeatus*	2467.45	3.37
11	Thai Shor Puti	*Puntius gonionotus*	2249.73	3.07
12	Boro Baim	*Mastacembelus armatus*	1493.92	2.04
13	Gutum	*Lepiodocephalus guntea*	1350.50	1.85
14	Tit Puti	*Puntius ticto*	959.30	1.31
15	Grass Carp	*Ctenopharyngodon idellus*	923.75	1.26
16	Gol Chanda	*Chanda baculis*	856.14	1.17
17	Rui	*Labeo rohita*	775.31	1.06
18	Bagha Puti	*Puntius stigma*	658.68	0.90
19	Chuna Khalisha	*Colisa laboisa*	629.58	0.86
20	Kalibaush	*Labeo calbasu*	567.08	0.78
	Total			**92.71**

Appendix-6

Per Capita non fish Protein Consumption (g) in Sreemongal (Hail Haor Site)

Pulses

Land Class	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Landless	11.04	9.77	9.86	10.34
Marginal	12.06	11.40	10.45	10.35
Small	13.28	13.07	11.01	11.09
Medium	11.66	10.62	8.70	9.76
Large	11.53	14.62	9.28	10.17
All Class	**11.57**	**10.78**	**9.99**	**10.37**

Meat

Land Class	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Landless	4.53	5.33	5.13	7.30
Marginal	4.91	6.71	8.59	10.10
Small	5.09	8.75	9.40	9.34
Medium	7.07	11.84	10.86	13.22
Large	4.76	8.42	6.99	10.65
All Class	**4.92**	**6.72**	**6.89**	**8.66**

Egg (No.)

Land Class	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Landless	0.04	0.05	0.06	0.06
Marginal	0.04	0.05	0.06	0.07
Small	0.06	0.06	0.07	0.10
Medium	0.03	0.05	0.05	0.05
Large	0.03	0.04	0.04	0.04
All Class	**0.04**	**0.05**	**0.06**	**0.06**

Milk

Land Class	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Landless	3.43	3.18	2.26	2.59
Marginal	7.82	5.68	6.17	11.01
Small	13.29	3.16	4.94	7.87
Medium	8.35	4.31	6.83	8.47
Large	6.32	1.72	1.01	6.92
All Class	**5.96**	**3.75**	**3.71**	**5.51**

Per Capita non fish Protein Consumption (g) in Kaliakoir (Turag Bangshi Site)

Pulses

Land Class	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Landless	13.88	9.22	9.85	11.63
Marginal	15.33	9.29	10.68	13.20
Small	16.47	11.04	13.07	15.57
Medium	16.98	11.53	14.07	16.99
Large	14.38	9.71	13.35	15.67
All Class	**14.83**	**9.69**	**11.01**	**13.19**

Meat

Land Class	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Landless	6.68	9.74	13.81	11.88
Marginal	10.47	11.38	16.38	15.26
Small	8.37	12.51	14.50	14.92
Medium	13.30	16.40	19.43	23.18
Large	10.42	10.02	14.65	14.85
All Class	**8.65**	**11.08**	**15.08**	**14.27**

Egg (No.)

Land Class	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Landless	0.04	0.04	0.05	0.05
Marginal	0.04	0.05	0.07	0.06
Small	0.04	0.03	0.05	0.06
Medium	0.04	0.05	0.05	0.05
Large	0.03	0.04	0.03	0.07
All Class	**0.04**	**0.04**	**0.06**	**0.06**

Milk

Land Class	Baseline	Impact Y-1	Impact Y-2	Impact Y-3
Landless	12.71	13.90	17.87	21.77
Marginal	17.35	19.85	24.71	29.58
Small	15.37	34.33	39.83	50.20
Medium	32.19	35.78	44.91	51.11
Large	28.05	34.79	36.87	42.29
All Class	**17.07**	**20.81**	**25.59**	**30.76**

Per Capita non fish Protein Consumption (g) in Sherpur (Kongshow-Malijhee)

Pulses

Land Class	Baseline	Impact Y-1
Landless	5.20	4.58
Marginal	6.59	6.05
Small	6.21	4.74
Medium	6.93	6.51
Large	9.77	8.53
All Class	**5.99**	**5.29**

Meat

Land Class	Baseline	Impact Y-1
Landless	6.33	5.45
Marginal	9.53	8.63
Small	8.82	10.06
Medium	13.21	14.41
Large	17.22	20.40
All Class	**8.42**	**8.21**

Egg (No.)

Land Class	Baseline	Impact Y-1
Landless	0.05	0.07
Marginal	0.05	0.07
Small	0.05	0.07
Medium	0.06	0.09
Large	0.07	0.09
All Class	**0.05**	**0.07**

Milk

Land Class	Baseline	Impact Y-1
Landless	10.033	9.07
Marginal	16.33	16.56
Small	12.02	13.59
Medium	23.50	23.63
Large	37.44	37.91
All Class	**14.42**	**13.82**

Appendix-7.1

Ranked top 20 fish species consumed at Sreemongol (Hail Haor)

Baseline (Sept'99 - April'00)			
Species	**Scientific Name**	**Weight(kg)**	**%**
Jat Puti	*Puntius sophore*	1069.43	13.82
Khalisha	*Colisa fasciatus*	719.39	9.3
Taki	*Channa punctatus*	583.29	7.54
Koi	*Anabas testudineus*	516.12	6.67
Gura mach		482.49	6.24
Shing	*Heteropneustes fossilis*	429.25	5.55
Mola	*Amblypharyngodon mola*	399.23	5.16
Dry fish		342.73	4.43
Gura Echa	*Macrobrachium lamrrei*	274.91	3.55
Shol	*Channa striata*	248.39	3.21
Meni/Bheda	*Nandus nandus*	241.67	3.12
Okol/Cheng		241.67	3.12
Chuna Khalisha	*Colisa laboisa*	229.92	2.97
Lal Khalisha	*Colisa lalius*	170.33	2.2
Magur	*Clarius batrachus*	142.32	1.84
Hilsha	*Tenualosa ilisha*	131.17	1.7
Tengra	*Mystus vittatus*	118.64	1.53
Rui	*Labeo rohita*	109.55	1.42
Kanchan Puti	*Puntius conchonius*	108.85	1.41
Boal	*Wallago attu*	97.69	1.26

Impact 1 (Sept'00 - April'01)			
Species	**Scientific Name**	**Weight(kg)**	**%**
Jat Puti	*Puntius sophore*	1194.84	13.93
Mola	*Amblypharyngodon mola*	979.22	11.42
Taki	*Channa punctatus*	934.83	10.9
Gura Echa	*Macrobrachium lamrrei*	541.01	6.31
Shing	*Heteropneustes fossilis*	451.76	5.27
Shol	*Channa striata*	377.88	4.41
Dry fish		371.21	4.33
Khalisha	*Colisa fasciatus*	357.61	4.17
Hilsha	*Tenualosa ilisha*	334.84	3.9
Gura mach		326.18	3.8
Meni/Bheda	*Nandus nandus*	285.98	3.33
Tengra	*Mystus vittatus*	242.21	2.82
Koi	*Anabas testudineus*	187.70	2.19
Rui	*Labeo rohita*	152.60	1.78
Foli	*Notopterus notopoterus*	141.28	1.65
Magur	*Clarius batrachus*	135.34	1.58
Kaikla	*Xenentodon cancila*	132.53	1.55
Silver Carp	*Hypophthalmichthys molitrix*	119.38	1.39
Goinna	*Labeo gonius*	113.45	1.32
Mrigel	*Cirrhinus mrigala*	111.14	1.3

Impact 2 (Sept'01 - April'02)			
Species	**Scientific Name**	**Weight (kg)**	**%**
Taki	*Channa punctatus*	1334.79	14.63
Jat Puti	*Puntius sophore*	1016.85	11.14
Gura Echa	*Macrobrachium lamrrei*	557.79	6.11
Shol	*Channa striata*	525.76	5.76
Mola	*Amblypharyngodon mola*	502.12	5.5
Hilsha	*Tenualosa ilisha*	461.81	5.06
Shing	*Heteropneustes fossilis*	406.91	4.46
Meni/Bheda	*Nandus nandus*	406.06	4.45
Gura mach		393.53	4.31
Dry fish		325.56	3.57
Khalisha	*Colisa fasciatus*	323.60	3.55
Pangas	*Pangasius pangasius*	227.15	2.49
Rui	*Labeo rohita*	207.52	2.27
Silver Carp	*Hypophthalmichthys molitrix*	191.71	2.1
Koi	*Anabas testudineus*	187.19	2.05
Goinna	*Labeo gonius*	170.49	1.87
Magur	*Clarius batrachus*	157.33	1.72
Comon Carp/Karfu	*Cyprinus carpio*	147.33	1.61
Mrigel	*Cirrhinus mrigala*	146.66	1.61
Chuna Khalisha	*Colisa laboisa*	133.20	1.46

Impact 3 (Sept'02 - April'03)			
Species	**Scientific Name**	**Weight(kg)**	**%**
Taki	*Channa punctatus*	1339.58	13.84
Jat Puti	*Puntius sophore*	1168.25	12.07
Shol	*Channa striata*	659.89	6.82
Khalisha	*Colisa fasciatus*	483.72	5.00
Meni/Bheda	*Nandus nandus*	481.35	4.97
Mola	*Amblypharyngodon mola*	479.31	4.95
Gura Echa	*Macrobrachium lamrrei*	460.43	4.76
Shing	*Heteropneustes fossilis*	390.66	4.04
Gura mach		334.91	3.46
Koi	*Anabas testudineus*	324.39	3.35
Dry fish		284.93	2.94
Foli	*Notopterus notopoterus*	276.03	2.85
Hilsha	*Tenualosa ilisha*	233.81	2.42
Silver Carp	*Hypophthalmichthys molitrix*	232.47	2.4
Pangas	*Pangasius sutchi*	221.63	2.29
Comon Carp/Karfu	*Cyprinus carpio*	209.92	2.17
Magur	*Clarius batrachus*	205.62	2.12
Goinna	*Labeo gonius*	196.99	2.04
Rui	*Labeo rohita*	194.64	2.01
Tengra	*Mystus vittatus*	167.65	1.73

Appendix-7.2

Ranked top 20 fish species consumed at Kaliakoir (Turag Bongshi)

Baseline (Oct'99 - April'00)			
Species	**Scientific Name**	**Weight(kg)**	**%**
Gura mach		388.04	18.62
Jat Puti	Puntius sophore	290.59	13.94
Rui	Labeo rohita	214.88	10.31
Gura Echa	Macrobrachium lamrrei	165.43	7.94
Thai Shor Puti	Puntius gonionotus	92.41	4.43
Mrigel	Cirrhinus mrigala	83.44	4
Silver Carp	Hypophthalmichthys molitrix	81.46	3.91
Comon Carp/Karfu	Cyprinus carpio	75.18	3.61
Taki	Channa punctatus	72.68	3.49
Hilsha	Tenualosa ilisha	65.31	3.13
Boro Baim	Mastacembelus armatus	61.54	2.95
Tengra	Mystus vittatus	57.56	2.76
Chapila	Gudusia chapra	41.83	2.01
Catla	Catla catla	38.17	1.83
Pangas	Pangasius sutchi	27.83	1.33
Lamba Chanda	Chanda nama	26.77	1.28
Air	Mystus aor	21.58	1.04
Telapia	Oreochromis (Telapia) mossambicus	20.64	0.99
Chola Puti	Puntius chola	20.59	0.99
Shing	Heteropneustes fossilis	20.02	0.96

Impact 1 (Oct'00 - April'01)			
Species	**Scientific Name**	**Weight(kg)**	**%**
Jat Puti	Puntius sophore	370.78	16.2
Gura mach		292.01	12.76
Rui	Labeo rohita	242.48	10.59
Gura Echa	Macrobrachium lamrrei	210.26	9.19
Mrigel	Cirrhinus mrigala	134.75	5.89
Taki	Channa punctatus	90.54	3.96
Comon Carp/Karfu	Cyprinus carpio	87.91	3.84
Hilsha	Tenualosa ilisha	82.45	3.6
Thai Shor Puti	Puntius gonionotus	82.33	3.6
Pangas	Pangasius sutchi	75.66	3.31
Chapila	Gudusia chapra	74.53	3.26
Silver Carp	Hypophthalmichthys molitrix	63.92	2.79
Catla	Catla catla	61.43	2.68
Tengra	Mystus vittatus	34.76	1.52
Lamba Chanda	Chanda nama	34.03	1.49
Boro Baim	Mastacembelus armatus	33.55	1.47
Shol	Channa striata	26.32	1.15
Shar Puti	Puntius sarana	26.32	1.15
Telapia	Oreochromis (Telapia) mossambicus	21.04	0.92
Lakka	Polynemus indicus	19.80	0.87

Impact 2 (Oct'01 - April'02)			
Species	Scientific Name	Weight(kg)	%
Gura mach		303.32	12.59
Pangas	*Pangasius sutchi*	271.91	11.28
Rui	*Labeo rohita*	263.89	10.95
Jat Puti	*Puntius sophore*	212.42	8.82
Gura Echa	*Macrobrachium lamrrei*	206.25	8.56
Mrigel	*Cirrhinus mrigala*	163.53	6.79
Silver Carp	*Hypophthalmichthys molitrix*	142.26	5.9
Thai Shor Puti	*Puntius gonionotus*	124.69	5.17
Comon Carp/Karfu	*Cyprinus carpio*	111.53	4.63
Hilsha	*Tenualosa ilisha*	78.05	3.24
Taki	*Channa punctatus*	74.92	3.11
Catla	*Catla catla*	73.19	3.04
Chapila	*Gudusia chapra*	41.31	1.71
Telapia	*Oreochromis (Telapia) mossambicus*	40.27	1.67
Boro Baim	*Mastacembelus armatus*	36.75	1.53
Tengra	*Mystus vittatus*	31.44	1.3
Magur	*Clarius batrachus*	31.23	1.3
Shol	*Channa striata*	19.37	0.8
Air	*Mystus aor*	17.47	0.73
Dry fish		16.76	0.7

Impact 3 (Oct'02 - April'03)			
Species	Scientific Name	Weight(kg)	%
Rui	*Labeo rohita*	465.04	16.1
Pangas	*Pangasius sutchi*	325.19	11.26
Gura mach		302.11	10.46
Mrigel	*Cirrhinus mrigala*	257.62	8.92
Jat Puti	*Puntius sophore*	242.82	8.4
Silver Carp	*Hypophthalmichthys molitrix*	226.52	7.84
Gura Echa	*Macrobrachium lamrrei*	135.75	4.7
Comon Carp/Karfu	*Cyprinus carpio*	130.57	4.52
Thai Shor Puti	*Puntius gonionotus*	128.74	4.46
Taki	*Channa punctatus*	93.10	3.22
Chapila	*Gudusia chapra*	69.75	2.41
Telapia	*Oreochromis (Telapia) mossambicus*	68.74	2.38
Catla	*Catla catla*	44.79	1.55
Shol	*Channa striata*	39.22	1.36
Air	*Mystus aor*	30.79	1.07
Tengra	*Mystus vittatus*	28.38	0.98
Boro Baim	*Mastacembelus armatus*	27.82	0.96
Dry fish		27.82	0.96
Hilsha	*Tenualosa ilisha*	27.63	0.96
Bighead Carp	*Aristechthys nobilis*	17.75	0.61

Appendix-7.3

Ranked top 20 fish species consumed at Sherpur (Kongshow Malijhee)

Baseline(Jan'01 - Dec'01)			
Species	**Scientific Name**	**Weight (kg)**	**%**
Gura mach		532.02	23.49
Jat Puti	*Puntius sophore*	296.88	13.11
Taki	*Channa punctatus*	248.30	10.96
Gura Echa	*Macrobrachium lamrrei*	207.89	9.18
Dry fish		139.10	6.14
Hilsha	*Tenualosa ilisha*	129.68	5.72
Silver Carp	*Hypophthalmichthys molitrix*	124.58	5.5
Mrigel	*Cirrhinus mrigala*	60.58	2.67
Rui	*Labeo rohita*	53.85	2.38
Tengra	*Mystus vittatus*	45.37	2
Tara Baim	*Macrognathus aculeatus*	44.24	1.95
Gutum	*Lepiodocephalus guntea*	34.05	1.5
Dankina	*Rasbora daniconius*	33.24	1.47
Pangas	*Pangasius sutchi*	32.36	1.43
Boal	*Wallago attu*	24.72	1.09
Comon Carp/Karfu	*Cyprinus carpio*	24.39	1.08
Koi	*Anabas testudineus*	23.60	1.04
Thai Shor Puti	*Puntius gonionotus*	19.52	0.86
Shar Puti	*Puntius sarana*	19.52	0.86
Catla	*Catla catla*	18.67	0.82

Impact 1(Jan'02 - Dec'02)			
Species	**Scientific Name**	**Weight(kg)**	**%**
Gura mach		557.09	19.14
Jat Puti	*Puntius sophore*	517.35	17.77
Taki	*Channa punctatus*	288.26	9.9
Gura Echa	*Macrobrachium lamrrei*	240.39	8.26
Silver Carp	*Hypophthalmichthys molitrix*	218.10	7.49
Mrigel	*Cirrhinus mrigala*	156.16	5.37
Dry fish		113.64	3.9
Comon Carp/Karfu	*Cyprinus carpio*	79.60	2.73
Hilsha	*Tenualosa ilisha*	78.62	2.7
Tengra	*Mystus vittatus*	59.47	2.04
Rui	*Labeo rohita*	59.34	2.04
Shar Puti	*Puntius sarana*	48.33	1.66
Dankina	*Rasbora daniconius*	42.24	1.45
Gutum	*Lepiodocephalus guntea*	41.33	1.42
Thai Shor Puti	*Puntius gonionotus*	40.27	1.38
Tara Baim	*Macrognathus aculeatus*	40.13	1.38
Chuna Khalisha	*Colisa laboisa*	33.38	1.15
Koi	*Anabas testudineus*	31.62	1.09
Boal	*Wallago attu*	28.92	0.99
Catla	*Catla catla*	28.62	0.98

A project of the Government of Bangladesh

Supported by USAID

Project Partners:

Winrock International
Bangladesh Centre for Advanced Studies (BCAS)
Center for Natural Resource Studies (CNRS)
CARITAS Bangladesh

MACH Headquarters:
House No: 2, Road 23A
Gulshan 1, Dhaka 1212
Bangladesh