



**LOCAL GOVERNMENT
ENGINEERING DEPARTMENT**

**Upazila Town (Non-Municipal) Master Plan Preparation and
Basic Infrastructure Development Project (UTMIDP)**

SURVEY REPORTS, WORKING PAPERS AND REPORTS ON PRA SESSIONS AND KII

RAMU UPAZILA, COX'S BAZAR

Review & Update of 03 (Three) Upazilas'
(Ramu, Bagmara and Saghata) Development Plan
(Master Plan) under UTMIDP

Package No: UTMIDP/UMPR - 1

VOLUME III

DRAFT 1

REPORT ON WORKING PAPERS

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Project Director

Upazila Town (Non-municipal) Master Plan Preparation and Basic Infrastructure Development Project (UTMIDP)

02, Monipuri Para (5th Floor) Tejgaon, Dhaka 1215.

Subject: Submission of Survey Reports (Draft-1), Survey Folder Map and Executive Summary (Bangla) of Ramu, Bagmara and Saghata Upazila.

Project: Review & Update of 03 (Three) Upazilas' (Ramu, Bagmara and Saghata) Upazila Development Plan (Master Plan)" Under UTMIDP. (Package No: UTMIDP/UMPR-01).

Dear Sir,

As per the contract agreement, we are here submitting the Draft 1 of Survey Reports, Survey Folder Map and Executive Summary (Bangla) of Ramu (Cox's Bazar), Bagmara (Rajshahi) and Saghata (Gaibandha) Upazila. This submission comprises the following:

- Survey Reports (Each Upazila-08 copies)
 - **Volume 1:** Report on Engineering and Land/Space Use Survey, Geotechnical and Seismological Survey, and Hydrographic Survey
 - **Volume 2:** Socio-Economic Survey, Economic Activity Survey, and Traffic & Transportation Survey
 - **Volume 3:** Working Papers
 - **Volume 4:** Community Engagement Report (PRA sessions and KII)
- Folder Map (Each Upazila-08 copies)
 - Existing Landuse Map
 - Existing Transport, Drainage Map
 - Existing Utility, ICT and service Map
- Bangla Executive Summary (Each Upazila-01 copies)

We hope that the submission will fulfill the requirements as per the project.

Yours Sincerely,

For Sheltech (Pvt) Ltd. and Sheltech Consultants (Pvt) Ltd. (JV)
in Association with Planning, Design and Research Consultant (PDRC)

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Executive Summary



Executive Summary

An Introductory

The preparation of the comprehensive development plans (i.e., master plans) of Upazilas of Bangladesh is the urgent need of the time. To this effect, the Government of Bangladesh has undertaken a project to review and update the comprehensive development plan for Ramu Upazila that had been prepared by Urban Development Directorate (UDD) earlier. This is needed in view of expiry of validation of plan period (prepared during 2011 - 2015), incorporation of new changes and addressing relevant issues of national policies, plans, strategies, goals of *Amar Gram Amar Shohor*, Smart Bangladesh, ICT, adoption of approach - bottom up and participatory planning and use of latest technology. As far as the review of relevant national plans, acts, policies, agendas and strategies are concerned, there are certain guidelines/directives which are vitally needed to be noted in reviewing and updating the subject master (development) plan of Ramu Upazila.

However, the present Volume III report on working papers namely population, heritage, recreation and open space, health facility, education facility, agriculture including fisheries, livestock and forestry, bio-diversity including flora and fauna, hazard and disaster, public health, diseases and wellbeing, environment, and legal and institutional framework for implementation of project output has been prepared in compliance to reporting requirements of the Terms of Reference vide Appendix 2 Table 7.1.

Specifically, it is to be noted here that there are five issues/aspects of the concerned surveys embodied in the Volume III having separate objectives, methodologies, study/survey results and findings, planning implications and concluding observations. The following paragraphs depict the all the above mentioned points.

Population

The working paper on population of Ramu Upazila covers the following aspects – introduction, objectives of the Working Paper on Population, methodology adopted, Existing Scenario of the Current Population, Upazila in National and Regional Context, Population Size, Density, Growth Rate, Existing Demographic Characteristics of the Upazila - Population and Spatial Distribution, Age and sex of the household heads, Age structure by gender, Household size, Types of households, Migration status of the family members (in-migration and out-migration), Place of birth of the family members, Level of education of all family members, Death and birth status of the family members during the five years, Status of working labour force (15 years above) by sex, Children not attending schools (primary and high schools) by gender, Status of people working abroad, Age Sex Structure/Composition, Ethnic Structure, Slum Population, Population with Disabilities/Special Needs, Population Density, Growth Rate, Migration Scenario, Population Projection -Method, Assumptions, Population Projection for the Next 20 Years, Projected Population Density; SWOT Analysis, Strategies and Policies for Population Management, Spatial Implications, and, Recommendations and Concluding Observations.

Heritage

The working paper on heritage of Ramu Upazila covers objectives, operational definitions, methodology adopted, main findings - location, types of attractions, existing conditions, visitors perceptions, arising problems, SWOT analysis, needed planning interventions, and conclusion.

Recreation and Open Space

This working paper discusses operational definitions and thereof classifications, study methodology, existing sites/locations, existing conditions and problems, details of uses, critical issues, SWOT analysis, spatial implication, needed planning interventions, and conclusion.

Health Facility

The working paper on health facility of Ramu Upazila include Objectives (general and specific) of the study, Methodology Adopted - Data sources, Data collection method, Data Interpretation and analysis; Major Findings - An overview of health facilities in the Upazila, Existence of facilities by type of hospitals (child health, delivery, family planning, non-communicable diseases, diagnostic, maternal, etc. etc.), Types of patients by sex and age Types of diseases suffered by types, Institutional capacity – education and experiences, Problem faced by the patients, Problem of hospitals by types, Locations by types of hospitals/clinics and ownership, Status of licenses of the private hospitals, SWOT analysis, Spatial Implications, needed planning interventions, Recommendations and Concluding Observations.

Education Facility

The report of working paper on education facility of Ramu describes Objectives (general and specific), Methodology adopted, Analysis and Major Findings - An overview of education facilities in Upazila, Types of education facilities available in the education institutions by types, Number of students both boys and girls by types of institutions, Number of teachers both males and females by types of institutions, Problems faced by types of institutions, Structural conditions by types of institutions, Spatial Implications and needed planning interventions, SWOT Analysis, Recommendations and Concluding Observations

Public Health, Disease Control and Wellbeing

The following are the data and information has been collected from Ramu Upazila pertinent to public health, disease control and wellbeing: Public Health (status of knowledge of public health, status of knowledge of communicable diseases, types of communicable diseases suffered, source of learning the knowledge of public health, status of knowledge of public health possessed by the women, status of visit of health supervisor in your house, if so how frequent, source of use of water for drinking purposes, sources of use of water for washing utensils, status of washing hand after defecation, status of use of fuel in cooking, status of taking vaccination for prevention of diseases, institutional capacity- Government, NGO and private, money spent, people role in maintaining public health in the community and so on). Disease Control (status of immunization of children, status of feeding of vitamin by children, any indigenous medicine taken for disease control, types of diseases suffered, Types of treatment taken, status outbreak of epidemic, action when epidemic out broken, role of NGOs, role of the community in controlling diseases and so on). Well-being (status of taking drug,

status digging tube well, status of health campaign, status people's participation in crisis, Status of planting trees, problem faced)

Related data and information on public health issues have been collected both from primary and secondary sources. All these data have been analyzed and necessary projections/forecasting would be made in context of need for estimating future space requirements as well as identifying locations of those projected health facilities.

The report of working paper on public health, disease control and wellbeing covers discussion on Operational definitions used, Aim and objectives, Methodology Adopted, Analysis and Major Findings, SWOT Analysis, Spatial Implications and needed planning interventions, Recommendations and Concluding Observations.

Agriculture including Fisheries, Livestock and Forestry

The issues covered in the working paper on agriculture are: agriculture land holding size, cropping pattern of land, cropping intensity of land, production level of crops, agriculture land use intensity, types of crops produced, fertility of land – location, area, fellow land/khas land - location, area, types of crop diseases, status of pest control, status of use of mechanical tools. status of agricultural loan- sources, amount, repayment, etc , types of use of chemical fertilizers, type of agriculture extension services provided, marketing facilities of agri-products, processing facilities, research facilities, land occupied for agricultural land, number of farmers, total number of labour involved in agriculture, involvement of women, level of income, types of impact of climate change, availability of credit facilities and its status of repayment, warehouse/storage facilities. The issues included in the working paper on fisheries area: ownership of hatchery/ghers, locations, area occupied, types, production level, income level, existing extension facilities, marketing outlets, problem faced. research facilities, number of farmers, total number of labour involved in fisheries, involvement of women, level of income, Number of ponds, Number of ponds used for fisheries, Ownership pattern of the ponds, research facilities, types of impact of climate change, availability of credit facilities and its status of repayment. The issues contained in the working paper on livestock are: number of poultry farms, locations, ownership, area occupied, types, number by types, production level, problem faced/constraints, number of farmers, total number of labour involved in livestock, involvement of women, level of income, number of households having poultry, research facilities, types of impact of climate change, availability of credit facilities and its status of repayment. Dairy farms - number of farms, Location, ownership, area occupied, production level, problem faced/constraints, marketing facilities, possessing facilities, research facilities, number of farmers, total number of labour involved in dairy farms, involvement of women, level of income, types of impact of climate change, availability of credit facilities and its status of repayment. The issues on forestry sub-sector encompassed the following: types of forest tree grown, land occupied, extension facilities, forest tree plantation plan, status of illegal tree cutting, forest tree processing facilities, number of farmers, total number of labour involved in forestry, involvement of women, level of income, awareness planting trees, status of social forestry, people's attitude towards planting trees, existence of extension work, role of the NGOs

Related data and information on agriculture including fisheries, livestock and forestry have been collected both from primary and secondary sources. All these data will be analyzed and necessary projections/forecasting would be made in context of need for estimating future

space requirements as well as identifying locations of those projected agriculture including fisheries, livestock and forestry facilities.

The working paper on agriculture including fisheries, livestock and forestry describes aim and objectives, Methodology Adopted - Sources of data/information, Data collection, Data analysis/interpretation, Data presentation techniques;

Analysis and Major Findings; SWOT Analysis; Spatial Implication and needed areas of intervention; Recommendations and Concluding Observations.

Bio-diversity including Flora and Fauna

An extensive survey has been conducted in Ramu Upazila to collected relevant information bio-diversity. The report on the working paper on bio-diversity including flora and fauna covers aim and objectives, methodology, results and findings – existing ecology, terrestrial flora , aquatic flora, terrestrial fauna, aquatic fauna, SWOT analysis, spatial implication, needed planning intervention, recommendation and conclusion.

Hazard and Disaster

The working paper on hazard and disaster of Ramu Upazila covers the discussion on areas of objectives, methodology, typologies of hazard and disaster faced in the Upazila, characteristics, assessment, losses/damages, impact, SWOT Analysis, spatial implications, needed planning interventions, recommendations and conclusion.

Environment

The working paper on environment covers objectives, methodology adopted, review on existing environmental conditions in terms of climate, soil condition, flood, draught, pollution, agro-ecological zones/areas, and so on; implementation of environmental policies and plans; SWOT Analysis, spatial implication, needed planning intervention, recommendation and conclusion.

Legal and Institutional Framework for Implementation of the Project Output

Here the legal framework covers the discussion on status of knowledge/awareness of Upazila Parishad Act and Union Parishad Act , Zila Parishad Act, status of knowledge/awareness of any other Acts related to implementing development project at the Upazila level; status of knowledge/awareness of Acts related to implementing the following plans – SP, UAP, RAP, AP, Utility Plans, etc, status of need of amendments of the existing Acts, problems faced in implementing the existing Acts, results of not implementing the existing Acts. The institutional framework includes status of knowledge of existing organograms of Upazila Parishad and Union Council, status of amendment of existing organograms of Upazila Parishad and Union Council, status of knowledge of involvement/responsible organizations regarding implementing of the following plans: - SP, UAP, RAP, AP, Utility Plans, etc; status of need for the post planner at the Upazila level for effective monitoring the plans to be prepared under this project; possibility of engagement of Public- Private Partnership (PPP), Organogram of Line Organization working at the Upazila level with charter of duties/role perform, Vacancy status of line organization.

The structure of the report on Legal and Institutional Framework for Implementation of the Project Output covers aim and objectives, methodology adopted, analysis and major findings, SWOT Analysis, spatial implication, recommendations and concluding observations

Conclusion

All the findings of the above mentioned working papers namely population, heritage, recreation and open space, health facility, education facility, agriculture including fisheries, livestock and forestry, bio-diversity including flora and fauna, hazard and disaster, public health, environment, and legal and institutional framework for implementation of project has significantly portray the present conditions/situation in respect of Ramu Upazila. All these information and data will be instrumental to review and update the master plan of Ramu Upazila prepared by UDD.

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Chapter One: Population



CHAPTER ONE: POPULATION

1.1 Introduction

Population structure is pivotal in the perspective of development plans because it generates crucial insights into the demographics of an area that implies different aspects of planning. Estimating the demand for housing both now and in the future, as well as the needs for infrastructure like utilities, schools, hospitals, and transportation networks, is made easier with an understanding of the population structure. For example, regions with a large senior population may need more healthcare services and easily accessible housing, while high proportions of young families may demand more schools and childcare facilities. Economic issues like labor supply, consumer behavior, and market demand are influenced by population structure. It is easy to detect economic possibilities and customize development plans to assist localized enterprises and sectors by examining population data. For instance, an area with a high concentration of young professionals can profit from business facilities and technological investments.

1.2 Objectives of the Working Paper on Population

A population survey of high-ranking officials, such as Assistant Commissioners of Land (AC Land) and Upazila Nirbahi Officers (UNOs), is intended to achieve several administrative, developmental, and policy-making objectives. Acceptance of the demographic composition of the areas under their authority facilitates the efficient evaluation and distribution of resources by these officials. It guarantees that public services, including infrastructure, healthcare, and education, are appropriately supplied following population needs.

1.3 Methodology adopted to collect population data

Accuracy, dependability, and comprehensiveness are ensured through the systematic and planned approach to demographic data collection. This is a summary of the standard procedures used to gather population data:

- i. The precise data variables are collected (e.g., age, gender, occupation, education, income, etc.) from the community series BBS (Bangladesh Bureau Statistics), identifying the demographic segments to be surveyed, and the geographic area to be covered.
- ii. An extensive questionnaire plan that outlines the data-gathering methods, survey tools, and sample strategies is created. Such stratified sampling technique is used to collect population data related to line organization of upazila.
- iii. Population projection is addressed to know future population growth and trend analysis to allocate services and facilities for upcoming generations depending on various methods such as arithmetic mean, geometric mean, etc.
- iv. SWOT analysis and some policies are proposed to detect strengths, weaknesses, opportunities, and threats.
- v. Several policies and strategies are recommended for efficient management of the population.

1.4 Existing Scenario of the Current Population

Demography studies population number, composition, age structure, and geographic distribution. This study also examines the growth, evolution, and reproduction of a population over a given length of time. There are three main things to note: the fertility rate (birth rate), the mortality rate (death rate), and the migration rate (emigration and immigration).

1.4.1 Basic Concerned Statistics of Upazila

Table 1 shows some fundamental aspects of the population that are significantly related to the study such as population size, density, and annual growth rate of Ramu Upazila by comparing 10-year intervals in a regional context.

Table 1-1: Profile of Ramu Upazila

Key Indicators	Zilla		Upazila	
	2011	2001	2011	2001
Population (Enumerated)				
Both Sex	22,89,990	17,73,709	2,66,640	2,02,683
Male	11,69,604	9,27,196	1,35,000	1,04,172
Female	11,20,386	8,46,513	1,31,640	98,511
Urban	2,92,523	1,20,480	-	-
Other Urban	2,06,488	1,51,915	42,072	33,334
Rural	17,90,979	15,01,314	2,24,568	1,69,349
Annual growth rate (%)	2.55	2.25	2.74	1.93
Sex Ratio				
Total	104	110	103	106
Urban	119	123	-	-
Other urban	103	111	103	110
Rural	102	108	102	105
Household				
Total	4,15,954	2,96,109	47,904	34,536
Urban	54,407	20,675	-	-
Other Urban	37,698	25,574	7,673	5,580
Rural	3,23,849	2,49,860	40,231	28,956
Household Size (General)				
Total	5.45	5.99	5.54	5.88
Urban	5.09	5.78	-	-
Other Urban	5.46	5.98	5.46	5.99
Rural	5.41	6.00	5.55	5.86
Area sq.km.	2491.85	2491.86	391.71	391.71
Area sq. mile	962.10	962.11	151.24	151.24
Density per sq. km.	919	712	681	517
Density per sq. mile.	2380	1844	1763	1340
Urbanization (%)	21.79	15.36	15.78	16.45
Literacy Rate (7 years and above) (%)				
Both Sex	39.3	30.2	36.6	26.0
Male	40.3	34.0	37.8	29.3
Female	38.2	26.0	35.3	22.3

Key Indicators	Zilla		Upazila	
	2011	2001	2011	2001
School Attendance (5 to 24 Years) (%)				
Both Sex	46.5	35.0	46.1	29.3
Male	45.6	36.4	45.1	30.8
Female	47.5	33.4	47.1	27.8
Population (Adjusted)				
Both Sex	23,81,816	18,54,534	2,76,885	2,11,615
Male	12,16,641	9,69,487	1,40,187	1,08,760
Female	11,65,175	8,85,047	1,36,698	1,02,855
Administrative / Geographic Unit				
Upazila /Thana	8	7	1	1
Union	71	67	11	11
Mauza	182	189	39	39
Village	989	984	102	101
Paurashava	4	3	-	-
Ward	39	27	-	-
Mahalla	164	59	-	-

(Source: Population and Housing Census, Ramu Upazila, BBS, 2011 & 2022)

1.4.2 Upazila in National and Regional Context

The population of Bangladesh is 144043697 (Both sex) according to the Population & Housing Census 2011. In order to assess the Upazila population in national and regional context, we would compare this data with the population data of Rajshahi District and Bagmara Upazila. All data are taken from the Population & Housing Census 2011 done by BSS.

1.4.2.1 Population Size

According to the Population & Housing Census 2011, the Population (Enumerated) of Bangladesh is 144043697 (Both sex). Male Population is 72109796 and Female Population is 71933901. The Population of Cox's Bazar is 2381814 (Both sex). Male Population is 1216640 and Female Population is 1165174. The Population of Ramu Upazila is 2,66,640 (Both sex). Male Population is 1,35,000 and Female Population is 1,31,640. The Urban Population of Bangladesh is 33563183 (Both sex). Male Urban Population is 17529792 and Female Urban Population is 16033391. The Urban Population of Cox's Bazar District is 307898. Male Urban Population is 167328 and Female Urban Population is 140570. The Other Urban Population of Cox's Bazar district is 214898 (Both sex). The Other Urban Population of Ramu Upazila is 42,072 (Both sex). The Rural Population of Bangladesh is 110480514 (Both sex). Male Rural Population is 54580004 and Female Rural Population is 55900510. The Rural Population of Cox's Bazar District is 18589018 (Both sex). Male Rural Population is 940317 and Female Rural Population is 918701. The Rural Population of Ramu Upazila is 2,24,568 (Both sex).

1.4.2.2 Density

Population Density is defined as number of persons living per square kilometer area. The area used for calculating the Density is the total area including river and forest area and the Enumerated Population in the Population and Housing Census 2011.

The Population Density of Bangladesh is 976 per.sq.km. The Population Density of Cox's Bazar District is 919 per.sq.km. The Population Density of Ramu Upazila is 681 per.sq.km.

1.4.3 Existing Demographic Characteristics of the Upazila

1.4.3.1 Overall population Structure

Table 1-2 displays the Ramu Upazila population growth, population density, and male-female ratio. It has been observed that the proportion of female in the population is marginally lower than that of male population.

Table 1-2: Overall population Structure of Ramu Upazila

Year	Population	Growth Rate	Population Density (sq. km)	Male Population (%)	Female Population (%)
2001	202683	21	517	51.40%	48.60%
2011	266640	31.6	681	50.63%	49.37%
2022	344541	29.21	880	52.03%	47.97%

(Source: BBS, 2001, 2011 & 2022)

1.4.3.2 Growth rate

The difference between the birth and death rates is termed the growth rate of the population. It is usually expressed as a ratio of the annual increase in population size to the total population for that year, multiplied by 100.

The Annual Growth Rate of Bangladesh in 2011 is 1.37. The Growth Rate of Cox's Bazar District in 2011 is 2.55. The Growth Rate of Ramu Upazila in 2011 is 2.74.

1.4.3.3 Population Density

The Population Density of Ramu Upazila was 517 per.sq.km. in 2001 where as it was 681 per.sq.km. in 2011. So there was a Density increase of 164 per.sq.km. in ten years.

Table 1-3: Union Wise Population Distribution

Union	Area_sq.km	Population (2011)	Density per.sq.km
Chakmarkul	8.49	16438	1936
Fatekharkul	11.51	30569	2656
Garjania	74.60	22651	304
Idgar	60.67	18315	302
Joarianala	33.04	27323	827
Kachhapia	50.84	28336	557
Khuniapalong	89.01	36315	408
Kauarkhop	29.00	24004	828
Rashid Nagar	17.77	16538	931
Rajarkul	23.68	20153	851
Dakshin Mithachhari	47.54	25998	547

(Source: BBS, 2011, Community Report)

1.4.3.4 Population and spatial distribution

As the population and housing census, of 2022 is not published yet, the spatial distribution of the population is prepared based on the population and housing census, of 2011. In Ramu Upazila, there were 47904 households overall, with an average size of 5.5, according to BBS (2011). Approximately 135000 men and 131640 women made up the 266640 total population. Out of all the Unions, Khuniapalong Union had the highest population density, while Chakmarkul Union had the lowest. Furthermore, the average family size in Chakmarkul and Dakshin Mithachhari Union is the greatest, but the number of families in other unions varies from 5.7 to 5.2 which is the lowest due to the tiny average household size. With 6466 households, Khuniapalong Union has the most of any Union, while Chakmarkul has the fewest households. Khuniapalong Union is the largest in terms of area. Therefore, there are more homes in locations with more populations.

Table 1-4: Union Wise Population Distribution

Union	Household	Population (2011)			Average Household Size
		Male	Female	Total	
Chakmarkul	2611	8686	7752	16438	6.3
Fatekharkul	5759	15608	14961	30569	5.3
Garjania	4179	11232	11419	22651	5.4
Idgar	3437	9105	9210	18315	5.3
Joarianala	4787	13621	13702	27323	5.7
Kachhapia	5049	14310	14026	28336	5.6
Khuniapalong	6466	18497	17818	36315	5.5
Kauarkhop	4373	12024	11980	24004	5.5
Rashid Nagar	3027	8369	8169	16538	5.4
Rajarkul	3750	10382	9771	20153	5.2
Dakshin Mithachhari	4466	13166	12832	25998	5.8
Total	47904	135000	131640	266640	5.5

(Source: BBS, 2011, Community Report)

1.4.3.5 Age Structure/Composition

The percentage distribution of the population by age group, place of residence, and community is shown in Table 4. It indicates that the bulk of persons are in the 30 to 49-year-old age range, while the minority are in the 60 64-year-old age range..

Table 1-5: Distribution of the Population by Age Group

Union	Age Groups (In years)									
	0-4	5-9	10-14	15-19	20-24	24-29	30-49	50-59	60-64	65 +
Chakmarkul	12	13.5	14.2	11.9	9.7	8.6	19.4	4.8	2.3	3.6
Fatekharkul	10.6	12	12.6	11.7	10.7	9.1	21.5	5.7	2.2	4
Garjania	16	17	13.6	8.8	8.2	8.7	17.5	4.9	2.1	3.2
Idgar	13.9	16.6	14.5	9.5	8.7	8.1	18.8	4.7	2.1	3.1
Joarianala	13.6	15.3	14.2	11.1	9.3	8.3	17.5	5.1	2.2	3.4
Kachhapia	15.7	16.9	13.5	9.5	8.3	8	18.2	4.7	2.1	3.1
Khuniapalong	15.4	16.7	14.1	9.5	9.7	8.7	17.8	3.9	1.8	2.5

Union	Age Groups (In years)									
	0-4	5-9	10-14	15-19	20-24	24-29	30-49	50-59	60-64	65 +
Kauarkhop	14	17	14.2	9.8	8.5	7.9	19.1	4.6	2.2	2.7
Rashid Nagar	14.4	15.7	14.7	10.4	9.6	8.2	18.2	4.6	1.7	2.5
Rajarkul	12.4	14.7	14.2	9.5	9.3	8.8	20.3	5.3	2.1	3.4
Dakshin Mithachhari	13.3	16.2	14.8	11.6	8.2	7.9	17.7	4.9	1.9	3.5

(Source: BBS, 2011, Community Report)

1.4.3.6 Population distribution by Marital Status

The graph shows the population's marital status for the year 2011 in Ramu Upazila, Bangladesh's Cox's Bazar district. Gender-specific data shows how people are distributed among various marital situations, including never married, married, widowed/widower, divorced/separated, and never married. Developing tailored social and economic policies that meet the needs of various demographic groups requires an understanding of this distribution.

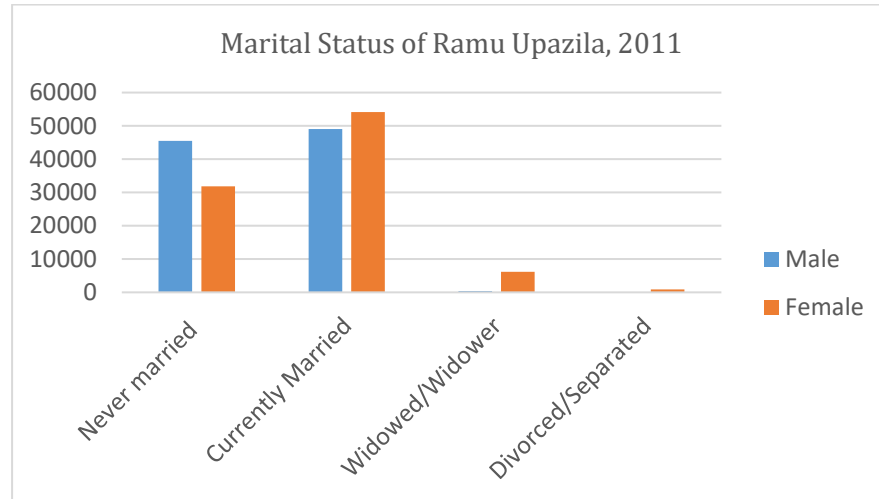


Figure 1-1: Marital Status of Ramu Upazila in 2011

(Source: BBS, 2011)

- Males are more likely than females to have never married, which may be related to socioeconomic or cultural variables that affect when people marry.
- The proportion of married women somewhat outnumbers that of married men, suggesting that marriage is a prevalent social norm in this area, maybe with women marrying younger.
- There is a notable discrepancy, with a far greater proportion of widowed women than men. This may be because women live longer on average and may marry at a younger age, which means there are more widowed women.
- There are strong societal rules against divorce and separation in this culture, which suggests that these events are uncommon.

There are notable gender differences in the married status statistics from Ramu Upazila (2011), especially when it comes to the widowed population. Improving the well-being of people in different marital statuses can be achieved by addressing these discrepancies through

focused social, economic, and educational measures. The community can endeavour to create a more harmonious and encouraging social structure by supporting gender equality, offering assistance, and improving educational chances.

1.4.3.7 Population with Disabilities/Special Needs

The "Population with Disabilities/Special Needs of Ramu Upazila, Cox's Bazar" chart shows how common it is for people in Ramu Upazila to have different kinds of impairments or special needs. The horizontal axis classifies several forms of disabilities, including physical, mental, autistic, vision, hearing, and speech impairments. The vertical axis shows the frequency of incidence.

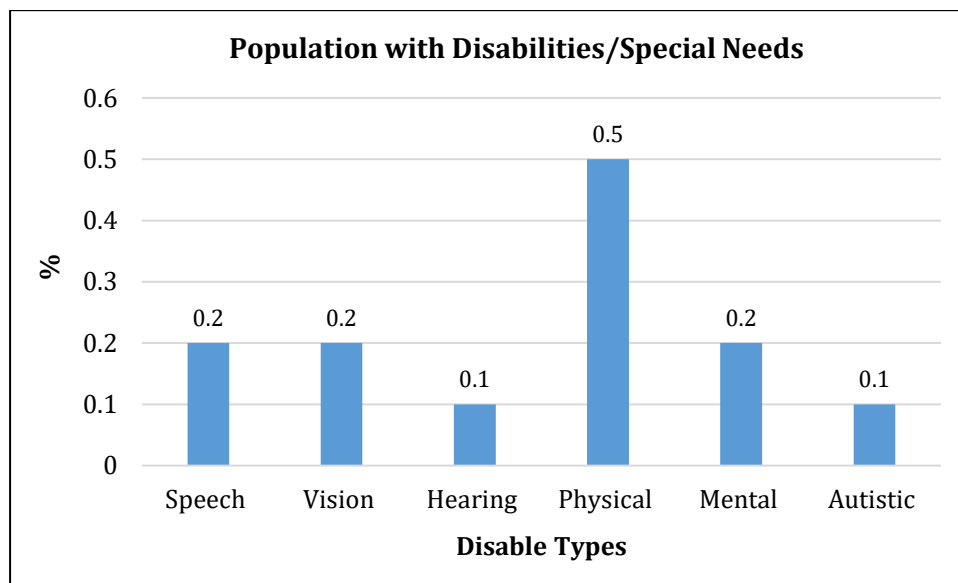


Figure 1-2: Percentages Population with Disabilities/Special Needs

(Source: BBS, 2011, Community Report)

The following information about Ramu Upazila's disability distribution is provided by the chart:

Speech impairments: 20% of people (0.2%) are affected by speech impairments.

Vision impairments: 20% of people (0.2%) are affected by vision impairments.

Hearing impairments: 10% of people (0.1%) are affected by hearing impairments.

Physical Disabilities: Among all categories, the largest percentage of the population (0.5%) has physical disabilities.

Mental impairments: Twenty percent of people, or 0.2 percent, suffer from mental impairments. 10% (0.1%) of the population suffers from autism disorders.

According to the data, half of the population with disabilities has physical disabilities, which are the most common type of disability. Autism and hearing impairments afflict 10% of people, whereas mental, visual, and speech impairments affect 20% of people.

1.4.3.8 Ethnic Structure of Ramu Upazila

The distribution of populations among four distinct ethnic groups of Ramu upazila is shown in the chart "Ethnic Population in Main Groups". Tanchaynga, Chakma, Rakhain, and Others are the groups that are included. The population is represented by the vertical axis, and the various ethnic groups are categorized by the horizontal axis. Significant variations in the population sizes of various groupings are shown by the data.

Rakhain: With 876 members, this group most certainly has the largest population.

Tanchaynga: The lack of a population record for this group suggests that it may not exist in the studied area or that there may have been a problem with the data collection process.

Chakma: There are about forty-five members of the Chakma group.

Others: With 42 members, this group comprises any remaining ethnic groups that aren't on the list.

Table 1-6: Distribution of population by Ethnic Group

Ethnic		Ethnic Population in Main Groups			
Household	Population	Rakhain	Tanchaynga	Chakma	Others
220	963	876	0	45	42

(Source: BBS, 2011, Community Report)

There may be a significant Rakhain population in the area under study based on the striking differences between the Rakhain group and the other groups.

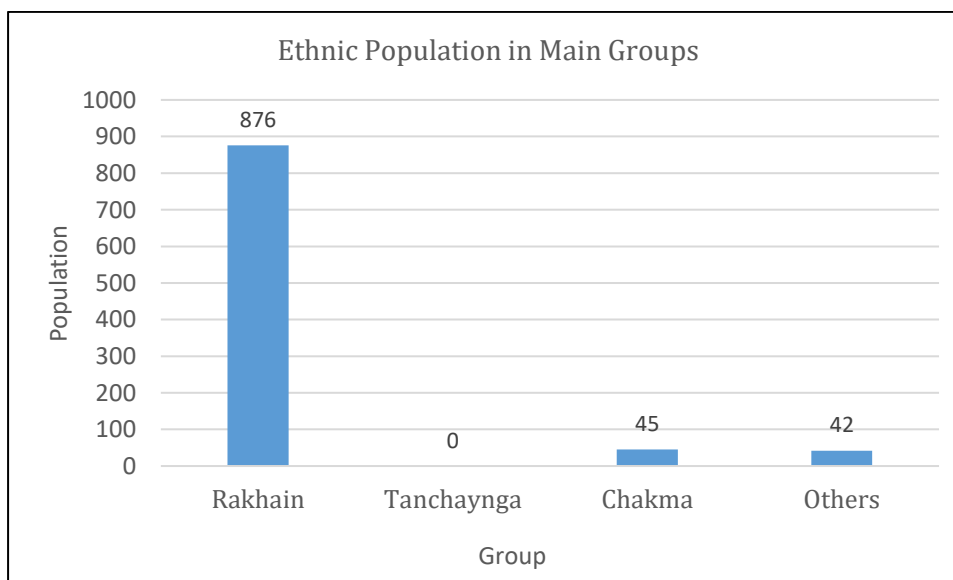


Figure 1-3: Ethnic Population Structure in Main Groups

(Source: BBS, 2011, Community Report)

Addressing the reason for the Tanchaynga group's population of zero is essential. This can be the result of a real absence in the area, a migration pattern, or a problem with data collecting that has to be fixed. Policies and initiatives to protect and conserve the Rakhain group's cultural legacy should be created in light of their substantial population. To guarantee the

inclusion and representation of the smaller Chakma and Others groups, efforts should also be taken to comprehend and address their needs.

In order to create a balanced and inclusive growth environment, development programs should take demographic discrepancies into account and work to provide all ethnic groups equal access to resources and opportunities.

Stakeholders may guarantee that all ethnic groups' needs and presence are acknowledged and provided with sufficient assistance by addressing these issues.

1.4.3.9 Migration

In Bangladesh, almost all Upazila level towns have rural-based urban environments. The lack of sufficient economic activity in these towns prevents the impoverished job searchers from finding enough work. Consequently, the majority of rural job seekers go to larger cities. The main causes of migration are unemployment and poverty. There is no migration data in the BBS population census. It takes into account solely the natural growth rate. However, real population projections need to account for both migration and natural growth rates. Due to the lack of available migration data, population prediction also became extremely challenging. In essence, the women commute to larger cities and work as "domestic house workers" to support themselves.

The migratory situation in Ramu Upazila, Bangladesh's Cox's Bazar district, is distinct and shaped by a range of environmental and socioeconomic factors. In addition to being notable for possessing the world's longest natural sea beach, Cox's Bazar is noteworthy for its socioeconomic dynamics. The Ramu Upazila migration scenario is explained as follows:

1. Economic Factors

Employment Opportunities: As a popular tourist destination, Cox's Bazar offers job opportunities in the retail, transportation, and hotel industries. In search of better employment opportunities, Ramu inhabitants may relocate to larger cities within the district or to other regions of the nation.

Ramu's economy is mostly based on agriculture, with a large number of people working in both farming and fishing. Seasonal agricultural cycles and the availability of jobs in these industries can have an impact on migration patterns.

Remittances: A lot of households depend on the money that family members who work overseas or in cities send home. Families that migrate inside a country in search of better living conditions and educational opportunities may be influenced by this financial help.

2. Environmental Factors:

Natural Disasters: Cyclones, floods, and erosion are among the natural disasters that could affect Cox's Bazar, especially Ramu. People may be forced to migrate temporarily or permanently as a result of these disasters in search of safer living conditions.

Climate Change: Increasing sea levels and shifting weather patterns impair living standards and agricultural output, which leads to migration to less impacted places.

3. Socio-Political Factors:

Rohingya Influx: A sizable population of Rohingya refugees from Myanmar reside in Cox's Bazar. As a result of the increased demand on the infrastructure and resources in the area, residents have been migrating within the country in search of less congested locations with greater access to services.

Government Policies: Government efforts and development projects, such upgraded schools and infrastructure, have the potential to draw people to or from Ramu.

4. Demographic Factors:

Urbanisation: In search of better career prospects and higher education, younger generations may relocate to urban areas. The population dynamics of Ramu are impacted by this trend of urbanisation.

Population Pressure: Rapid population expansion in rural regions can cause land fragmentation and lower agricultural output, which in turn can drive people to migrate to cities.

5. Social and Cultural Aspects:

Social Media: Decisions about migration are frequently impacted by current social networks. In destination locations, links to family and community might help ease the relocation process.

Quality of Life: Migration may be significantly influenced by the availability of improved social services, healthcare, and education in urban or more developed areas.

In brief, a multitude of factors, including economic opportunities, environmental obstacles, socio-political dynamics, demographic trends, and cultural considerations influence the migratory scenario in Ramu Upazila, Cox's Bazar. These factors interact to shape migration patterns and incentives, leading to both transient and long-term migration within and outside the region.

The following table shows the percentage of migrated population in both rural and urban areas of Ramu Upazila.

Table 1-7: Reasons of Migration in Ramu Upazila

Migration Reasons	Urban		Rural		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
Employment	5	83.33%	8	53.33%	13	61.90%
Education	1	16.67%	7	46.67%	8	38.10%
Developing life	0	0.00%	0	0.00%	0	0.00%
Others (Specify)	0	0.00%	0	0.00%	0	0.00%
Total	6	100%	15	100%	21	100%

Source: Field Survey, 2024

1.4.3.10 Slum Population

According to the 'Census of Slum Areas and Floating Population 2014', covering all city corporations, municipalities, Upazila headquarters and other urban areas, there are 22,27,754 people living in the slums in Bangladesh. Chittagong Division contains 6,33,007 slum dwellers

which is 28% of the total Slum Population of the country. The Slum Population of Cox's Bazar District is 45,684. Ramu Upazila has no significant Slum Population due to the lack of urbanization.

1.4.3.11 Housing structure by type

The housing situation in Ramu Upazila, Bangladesh's Cox's Bazar district, is varied and reflects the socioeconomic circumstances of the area. There are a variety of housing types in this area, ranging from jhupri (makeshift) shelters to pucca (permanent) structures, which indicate different degrees of living standards and economic stability among the inhabitants. Policymakers and development organisations seeking to enhance living conditions and infrastructure in the area must comprehend the distribution of various dwelling types.

Pucca Houses (4%): These are long-term constructions composed of hardy materials like stone, brick, or concrete. The fact that pucca houses make up only 4% of Ramu households suggests that only a small portion of the populace can afford to build something as durable and long-lasting.

Semi-Pucca Houses (11.1%): These buildings may contain temporary components in addition to durable ones. Semi-pucca houses are inhabited by 11.1% of households, suggesting a modest degree of economic stability and the capacity to make investments in somewhat permanent housing options.

Kutcha Houses (74.5%): These are ephemeral buildings composed of thatch, mud, and bamboo, or other non-durable materials. The vast majority of households, or 74.5%, reside in kutcha homes, which may indicate a weaker economic capacity and a higher susceptibility to environmental dangers.

Jhupri Houses (10.4%): Jhupri houses are improvised shelters that provide only rudimentary weather protection. They are frequently constructed from the simplest materials. 10.4% of jhupri house households indicate that there is a portion of the population that lives in extreme poverty and unstable circumstances.

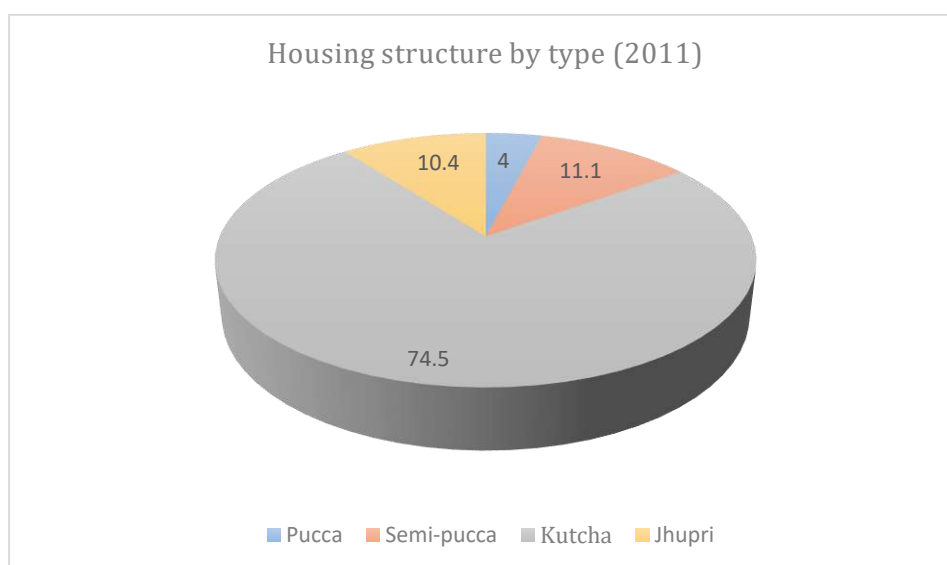


Figure 1-4: Housing Structure by Construcyion Type

(Source: BBS, 2011, Community Report)

Recommendation:

- **Subsidised Housing:** Put in place government- or non-profit-led initiatives to give low-income families access to subsidised building supplies and financial assistance so they can move up from kutchra or jhupri to semi-pucca or pucca homes.
- **Micro lending Programmes:** Make it easier for homeowners to obtain microfinance for house renovations so they can progressively make better-quality housing investments over time.
- **Development of Infrastructure:** Enforce building norms and standards, particularly in places vulnerable to natural catastrophes, to guarantee safe and resilient construction methods.
- **Improvement of utility facilities:** Building community infrastructure, such as roads, drainage systems, and clean water access, can enhance general living standards and stimulate the construction of nicer homes.
- **Improvement of construction methods:** Encourage the use of construction methods and materials that are resistant to natural disasters, especially in regions that are susceptible to flooding, cyclones, and erosion.
- **Increasing emergency shelters:** More emergency shelters should be built so that, in the event of a natural disaster, persons residing in jhupri and kutchra houses will have a temporary but secure place to stay.
- **Income-Generating Activities:** To increase residents' earning potential and provide them with the means to purchase better accommodation, support income-generating initiatives and programmes for vocational training.
- **Support for Agriculture:** As farming is the main industry in the area, give people who farm assistance and resources to increase their output and revenue.
- **Awareness Campaigns:** Educate the public about the advantages of improved housing and the resources for assistance.
- **Cooperation among different organization:** Encourage cooperation amongst local communities, NGOs, and the government to identify housing needs and create customised solutions.

In summary, Significant economic gaps are reflected in Ramu Upazila's housing distribution, which emphasises the need for focused efforts to enhance living circumstances. Communities can be made safer and more resilient by executing comprehensive housing renovation programmes, improving infrastructure, and promoting economic development. These actions will also raise inhabitants' quality of living.

1.4.3.12 Sources of drinking water

The health and welfare of humans depend on having access to clean drinking water. To address this basic need, different sources are used in numerous parts of the world. This data illustrates the spread of various drinking water sources, emphasising how common taps, tube wells, and other sources are.

- **Tube Wells (97.6%):** With a large portion of the supply, tube wells are the main source of drinking water. Deep wells with pipes that pull groundwater to the surface are known as tube wells. They are widespread in regions with accessible groundwater and are frequently dependent on it for a steady source of water.

- **Taps (1.7%):** Of all the sources of drinking water, taps make up a modest portion. Water from centralised systems, such as municipal water supplies, is usually obtained through taps. They are typically found in cities and places where there is a well-established water delivery infrastructure.
- **Other Sources (0.7%):** This group includes a range of additional sources of potable water, including rivers, springs, rainwater collection systems, and water vendors. Even though they account for a small fraction of the total, taken as a whole, they help some communities or areas meet their drinking water needs.

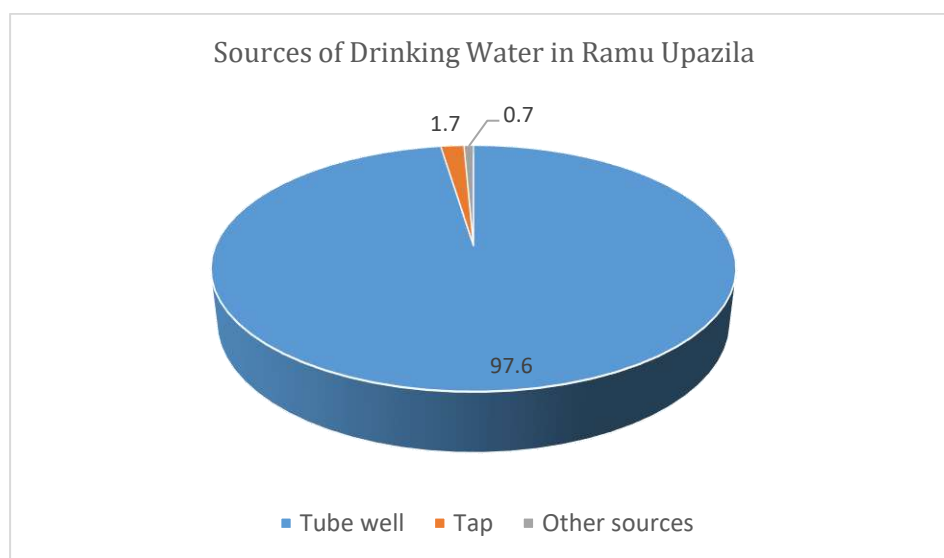


Figure 1-5: Sources of Drinking Water in RamuUpazila

(Source: BBS, 2011)

The data highlights the extensive use of tube wells as a key source of drinking water, highlighting the importance of groundwater. Even yet, the percentage of taps is lower, perhaps because access to them is restricted in rural or impoverished areas. There are more, less common sources that show the variety of approaches taken to obtain safe drinking water. In general, obtaining sustainable and clean drinking water continues to be a major global concern, with varied degrees of reliance on various sources based on infrastructural, economic, and geographic considerations.

1.4.3.13 Sanitation

The sustainability of the ecosystem and public health depend on having access to adequate sanitary facilities. The information supplied sheds light on how sanitary services are distributed in Ramu Upazila, which is located in Bangladesh's Cox's Bazar area. It distinguishes between hygienic and non-sanitary latrines as well as between the three types of latrine usage. The many kinds of latrine facilities that Ramu Upazila residents have access to are depicted in the pie chart.

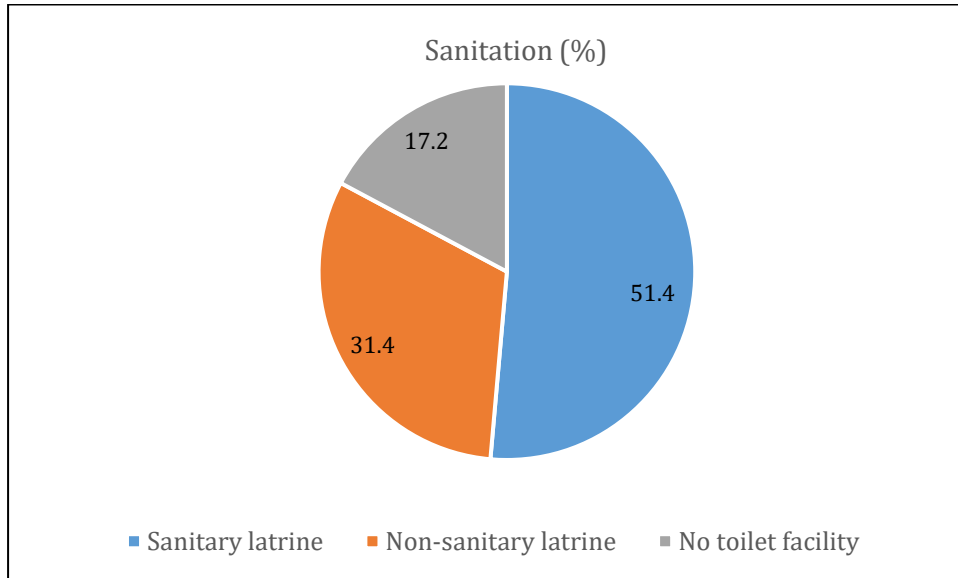


Figure 1-6: Sanitation Facilities in Ramu Upazila

(Source: BBS, 2011)

- ✓ **Sanitary Latrine (51.4%):** Sanitary latrines are accessible to slightly more than half of Ramu Upazila's population. Systems in place in sanitary latrines safely dispose of human waste, reducing the possibility of contamination and the spread of illness. Their frequency suggests that a sizable section of the populace has access to decent sanitary facilities, which is essential for good hygiene and public health.
- ✓ **Non-sanitary Latrine:** Thirty-one percent of the population (31.4%) uses non-sanitary latrines. This is a significant fraction of the population. There are health and environmental problems associated with using unsanitary latrines because they may not have adequate waste disposal systems or may not adhere to hygienic standards. The upazila's general sanitation conditions may be improved by initiatives to convert these facilities to more hygienic alternatives.
- ✓ **No Toilet Facility (17.2%):** Disturbingly, 17.2% of residents do not have access to any type of toilet facility. This suggests a serious lack of cleanliness, as a sizable section of the populace relies on subpar alternatives or practices open defecation. Inadequate sanitary facilities endanger people's health as well as their privacy and sense of dignity, especially for the most vulnerable groups.

In summary, the data highlights advancements as well as obstacles in Ramu Upazila's sanitary infrastructure. Although most people have access to hygienic latrines, a sizeable portion still uses unhygienic facilities or doesn't have access at all. Improving public health outcomes, promoting environmental sustainability, and protecting human dignity all depend on closing the sanitation gap by encouraging the use of sanitary latrines and increasing access to underprivileged communities. In Ramu Upazila and elsewhere, local authorities should give priority to investments and activities that aim to guarantee universal access to clean and hygienic sanitation facilities, in collaboration with community stakeholders and governmental agencies.

1.4.3.14 Electricity

Having access to electricity affects a number of areas, including healthcare, education, and employment prospects. It is a critical measure of progress and standard of living. The information shown shows the rate of power access in Ramu Upazila, Bangladesh's Cox's Bazar district, during a ten-year period.

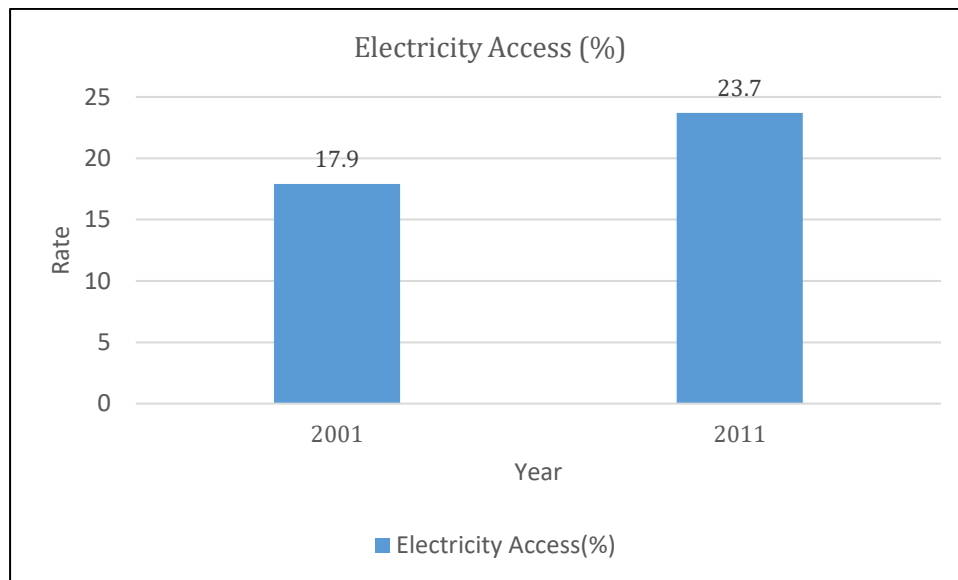


Figure 1-7: Percentages of Electricity Access in Ramu Upazila

(Source: BBS, 2011)

- **2001 (17.9%):** In Ramu Upazila, barely 17.9% of people were connected to the grid at the start of the studied period. This means that only a small portion of the population had access to electricity. The inhabitants' everyday life were probably significantly impacted by this low access rate, since they were probably less able to utilise contemporary conveniences and were more dependent on other energy and illumination sources.
- **2011 (23.7%):** The rate of electrical availability increased slightly over a ten-year period, reaching 23.7% by 2011. Even while this is a step in the right direction, the rate of improvement seems sluggish, indicating difficulties in developing the upazila's electrical grid infrastructure or reaching out to isolated and neglected areas.

In summary, the data indicates that during the course of a decade, Ramu Upazila's access to electricity has improved gradually but somewhat. Even with the rise from 17.9% to 23.7%, a sizeable section of the population still does not have access to electricity, highlighting the need for ongoing funding and initiatives to broaden coverage and build infrastructure. There are several advantages to increasing access to electricity, such as higher living standards, economic expansion, and more chances for healthcare and education. Therefore, in order to promote sustained growth and an improved standard of living for the people of Ramu Upazila, closing the remaining gaps in power access should continue to be a top priority for both local and national authorities.

1.4.3.15 Literacy Rate

In each given location, the rate of literacy serves as a crucial gauge for the advancement of both education and socioeconomic conditions. Over the past few decades, there have been noticeable improvements in the literacy rates in Ramu Upazila, which is a part of the Cox's Bazar district in Bangladesh. The gender-specific statistics on literacy rates for both sexes from 1991 to 2022 offers important insights into the progress made in education as well as the obstacles still facing society. Comprehending these patterns is crucial in order to formulate focused educational strategies and initiatives

Table 1-8: Percentages of Literate Rate

Sex	1991	2001	2011	2022
Both Sex	21.5	26	36.6	72.06
Male	28.3	29.6	37.8	74.21
Female	14.3	22.3	35.3	69.72

(Source: BBS, 1991, 2001, 2011 & 2022)

Overall Rise in Literacy:

Between 1991 and 2022, Ramu Upazila's rates of literacy for both sexes rose from 21.5% to 72.06%. This significant increase is a result of the accomplishment of educational programmes and wider access to education over time.

The literacy rates of men (28.3%) and women (14.3%) differed significantly in 1991. Males consistently have a greater literacy rate than females, even though both rates have increased over the years.

In 2022, the percentage of males who were literate was 74.21%, while the percentage for females was 69.72%. In terms of literacy rates, women still fall behind men despite the gap closing.

There was just a slight rise in literacy rates for both genders between 1991 and 2001. Between 2011 and 2022, the rate of increase increased significantly, suggesting more efforts and possibly more successful educational policies and programmes. The rate of increase also increased between 2001 and 2011.

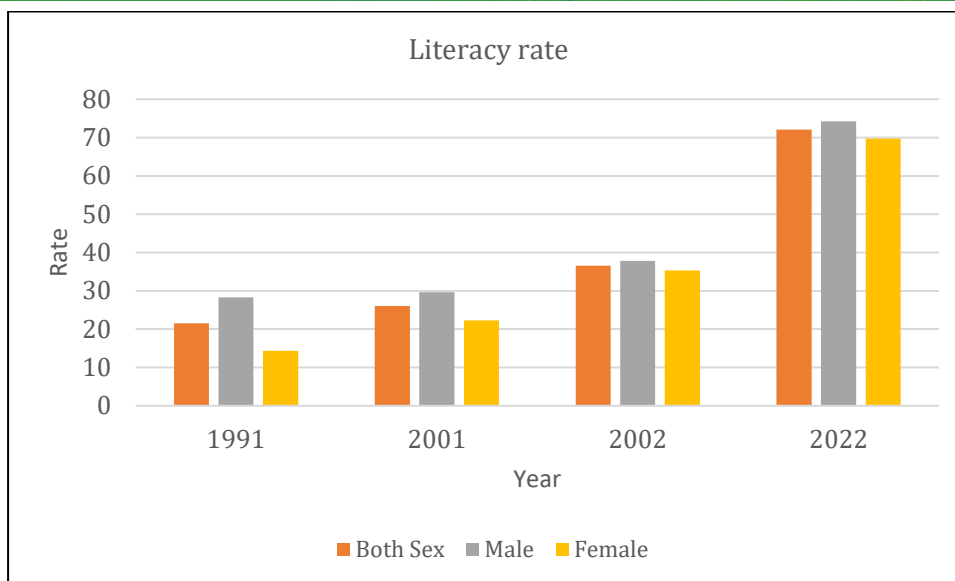


Figure 1-8: Percentages of Literate Rate from 1991-2022

(Source: BBS, 1991, 2001, 2011 & 2022)

Recommendation:

- **Scholarships and Incentives:** To promote greater enrollment and retention rates among female students, offer scholarships and financial incentives.
- **Campaigns for Community Awareness:** Run awareness efforts to remove socio-cultural barriers and highlight the value of education for women.
- **Teacher Training:** To guarantee that both boys and girls receive top-notch instruction, funds should be allocated to teacher training programmes.
- **Curriculum Development:** Create a curriculum that promotes gender equality and critical thinking abilities while being inclusive and meeting the needs of all pupils.
- **School Facilities:** Upgrade the facilities at schools, especially the restrooms, as this can have a big impact on the number of girls who attend.
- **Technology Access:** Provide digital literacy initiatives and improve learning possibilities by incorporating technology into the educational system.
- **Adult Education:** To raise the literacy rates among the elderly population, put in place adult literacy programmes that specifically target women who did not receive a formal education.
- **Establish Community study Centres:** Provide adults with flexible study schedules through community learning centres.
- **Modifications to Policy:** Utilise data-driven insights to ensure that programmes and policies are appropriately addressing the population's literacy demands.

Over the past few decades, Ramu Upazila's literacy rate has significantly improved, which is indicative of effective educational activities. Still, there are persistent gaps in gender and there is a need to keep working to improve access to and the quality of education. Ramu Upazila can move closer to its goal of universal literacy by putting in place targeted programs, enhancing infrastructure, and emphasising adult and child education.

1.4.3.16 School Attendance Rate

One important measure of student involvement and access to education is attendance at school. Understanding the dynamics of school participation in Ramu Upazila, a district of Cox's Bazar in Bangladesh, can be gained by analysing these statistics according to age and gender. The 2011 data that follows breaks out the rates of school attendance by gender for various age groups. To enhance school attendance and educational achievements in the area, it is imperative to comprehend these trends in order to identify gaps and implement targeted solutions.

❖ Education for Young Children (3-5 Years):

The low attendance rates of 7.7% apply to both men and women. This suggests a low level of early childhood education involvement, which is important for the social and cognitive development of children.

❖ Elementary Schooling (6-10 Years):

Male and female attendance rates are high (71.37% and 74.14%), indicating high levels of interest in basic education. There is a minor increase in female attendance compared to male attendance, suggesting that gender parity is on the rise at this level.

❖ Lower Secondary Schooling (Ages 11-14):

When compared to female attendance (74.07%), there is a discernible decline in male attendance (62.38%). Higher attendance rates among female students point to the need for retention measures that work for girls in this age range.

❖ Education in Upper Secondary (15-19 Years):

Male attendance drops to 25.48% and female attendance to 30.42%, respectively. Males have a steeper decrease, which suggests that socioeconomic or cultural constraints may be preventing them from pursuing higher education.

❖ Young adults (ages 20 to 24):

With male attendance at 6.44% and female attendance at 3.07%, both genders have extremely low attendance rates. This implies that most young adults are not going to college or becoming trained for a career.

❖ Individuals (Ages 25-29):

The low attendance rates for both genders (0.47%) and men (1.2%) suggest that the majority of people in this age range are not enrolled in formal education, most likely because of work or family obligations.

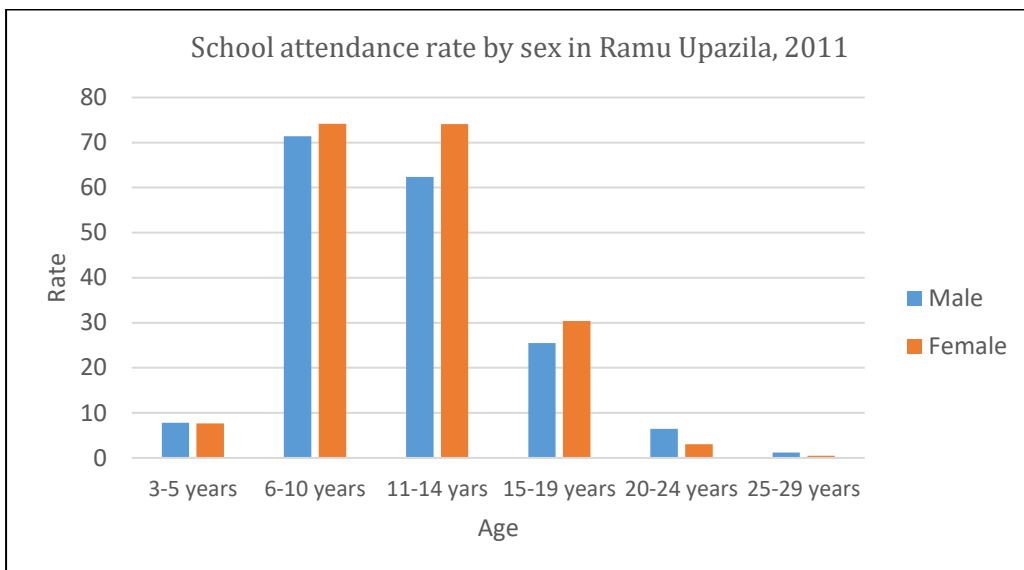


Figure 1-9: School Attendance Rate by Sex in Ramu Upazila

(Source: BBS, 2011)

Suggestions for Improving Early Childhood Education:

- **Awareness Campaigns:** To inform parents about the value of early childhood education, organise awareness campaigns.
- **Infrastructure Development:** To improve accessibility, spend money constructing and renovating pre-primary educational facilities.
- **Retention Programs:** Put in place initiatives aimed at keeping kids in school by providing rewards such as free meals, transportation, and scholarships.
- **Interventions Tailored to Gender:** Provide gender-specific interventions to address the particular difficulties that boys and girls encounter in pursuing higher education.
- **Counselling Services:** To motivate students to continue their education, offer mentorship programs and career counselling.
- **Flexible Learning choices:** To accommodate students who may need to work during the day, offer flexible learning choices including evening sessions or vocational training.
- **Scholarship Programs:** To lower financial obstacles, establish scholarship programs for vocational training and higher education.
- **Partnerships with Industries:** Establish collaborations with nearby industries to offer chances for both job placement and hands-on training.
- **Chances for Lifelong Learning:** To promote ongoing professional and personal growth, provide adult education courses and chances for lifelong learning.
- **Community Learning Centers:** Establish community learning centres where adults can obtain education and career training.

The 2011 Ramu Upazila school attendance data shows notable advancements in primary schooling but also indicates difficulties in keeping up attendance in older age groups. Targeted interventions with an emphasis on early childhood education, retention in primary and secondary education, access to higher education, and vocational training are crucial to

addressing these problems. It is possible to enhance overall educational achievements and guarantee that men and women have equal opportunities to thrive academically and professionally by putting these ideas into practice.

1.5 Population Projection

Demographic Concept:

Every research has a few fundamental ideas that need to be thoroughly and accurately comprehended. Inaccurate conclusions will result from the population prediction if they are not properly understood. The concept of population projection is theoretical. Projections are in between forecasts and predictions; they are neither estimates nor forecasts nor predictions. To believe that projection is nothing more than assumption is likewise incorrect. Scientific quantities are more precise than projections. A population prediction is a projection that takes into account several assumptions to provide a realistic image of how a population is likely to grow in the future.

The basis of Population Projection Method Used: The number and makeup of a region's population as well as how it will develop over time are among the most crucial factors for planning. One of the trickiest planning problems is estimating an area's future population for a certain time frame. Population projection is a systematic technique that uses relevant historical data that is currently accessible at a given point in time, along with a few assumptions, to estimate future population growth. The population of the future has been predicted using a number of techniques. However, the disparities in data from many secondary sources further compound the difficulties of the task. The population estimates gathered from secondary sources, particularly for the Paurashava region, were incredibly vague. Thus, multiple expert conversations were held in order to arrive at the ultimate projection. Several different approaches can be used to project the population of Ramu Upazila's ten unions over a 50-year period. The methods:

- Arithmetical Increase Method,
- Geometrical Increase Method,
- Incremental Increase Method,
- Exponential Growth Method,
- Compound Rate of Growth Method, and
- Cohort Component Method.

The "Compound Rate of Growth Method," which was chosen among the other projection techniques, is thought to be more appropriate for the project area because of the significant rural-urban and urban-urban migration that occurs there. With the use of the compound rate of growth approach, a prediction up to the year 2074 with ten-year intervals has been made using the yearly growth rate for the study region, which is available from the 2011 Population Census. The population of 2011 has been used as the base year because of union wise updated population available for 2011 (BBS only published Upazila wise total population for 2022) to operate the Compound Rate of Growth technique. The BBS was used to get the demographic data in 2011.

Compound Rate of Growth Method of Population Projection: The population prediction for Ramu Upazila has been derived using the Compound Rate of Growth approach. By utilizing the

following formula, which is also referred to as the Compound Rate of Growth approach, the population in any required year can be predicted.

$$P_n = P_o (1 + r)^n$$

Where,

P_o = Population in the base year,

P_n = Population in the projected year,

n = Number of intermediate years,

r = Annual rate of growth.

Projections, which are predicated on historical trends, aid in understanding potential outcomes should the current trend persist. The following procedures and methods have been used in population projections:

- Based on current census statistics, the base year for the aforementioned estimate is 2011.
- Lastly, the population forecast is carried out using the Compound Rate of Growth approach.

The rationale for Selecting Compound Rate of Growth Method: Following an assessment of the projection techniques, it was concluded that the Compound Rate of Growth approach is fairly appropriate for Ramu Upazila's population forecast. The primary goal of the study is to calculate the Upazila's population for 2011, which would be the base year. Based on a few assumptions, the study area population is projected starting with the base year population and increasing every ten years until 2074. Generally, the estimate is based on historical patterns of population growth and future development prospects.

The following are crucial factors to take into account:

- Natural population growth
- Population makeup, especially age distributions
- Net migration.

The following assumptions have been made in light of Ramu Upazila's demographic background, rate of urbanization, and population density relative to other parts of the nation:

It is anticipated that the current trend of development changes will continue in the future. Ramu Upazila will develop soon based on the current population, growth rate, density, literacy rate, and urbanisation rate. The viable growth rate for the population projection for the next 50 years must be calculated in order to determine the development trend that is increasing. Ramu Upazila's decadal growth rate seems to be declining and increasing over the past four decades. With the use of historical demographic trends, the expected population has been approximated. The population growth rate is determined using the population census data from 2001 and 2011.

Table 1-9: Decadal Growth Rate of Population, 1981-2022

Decade	Growth Rate (%)
1981 – 1991	20
1991 – 2001	13.3
2001 – 2011	10.8
2011 - 2022	10.3

Source: BBS, 1991, 2001, 2011, 2022

The population estimates for Ramu Upazila's urban area are calculated over a 50-year period and each Ramu Upazila union. According to BBS 2022, Ramu Upazila is expected to expand at an annual rate of 2.28.

Table 1-10: Population Growth Rate at Ramu Upazila

Area	Population (2022)	Population Growth Rate (%)			
		2022	2011	2001	1991
Ramu Upazila	3445411	2.28	2.74	1.93	3.58
Urban/Paurashava Area	NA	NA	2.36	1.58	3.08
Rural/Union Area	NA	NA	2.86	1.77	3.34
Cox bazar Zila Annual Growth Rate	1.86	NA	2.55	2.25	2.98

Source: BBS, 1991, 2001, 2011, 2022

According to Ramu Upazila's population forecast, Khuniapalong Union (737212) would have the largest population in 2074, followed by Fatekharkul Union (620566), while Chakmarkul Union (333700) will have the lowest. Assuming a 2.28 annual rate of rural growth, Ramu Upazila's population prediction for 2074 is 5412922.

Forecasting the population is crucial for macro and microeconomic planning. Its non-economic worth cannot be disregarded either. The population of Ramu Upazila is predicted in this chapter for the years 2022–2074. The population of Ramu Upazila was 3445411 in 2022 and it is projected to increase to 5412922 in 2074. The future growth of Ramu Upazila will benefit from these demographic projections in a number of ways. Planning for the construction of new schools or the extension of current ones, the provision of transit options, the provision of health services, and other development plans will all benefit from their utilization.

Table 1-11: Population Projection at Ramu Upazila

SL	Union	BBS Population		Population Projection of Ramu Upazila					
		2011	2022	2032	2042	2052	2062	2072	2074
1	Idgar	18315	236659	296504	327652	380615	363746	503467	371804
2	Gargonia	22651	292687	366700	405222	470725	449861	622661	459827
3	Kachhapia	28336	366145	458734	506924	588866	562767	778935	575234
4	Kauarkhop	24004	310170	388604	429427	498842	476732	659854	487293
5	Fatekharkul	30569	395000	494885	546874	635273	607117	840321	620566
6	Jowarinala	27323	353056	442334	488802	567815	542648	751088	554669
7	Rajarkul	20153	260409	326260	360533	418812	400249	553992	409116

SL	Union	BBS Population		Population Projection of Ramu Upazila					
		2011	2022	2032	2042	2052	2062	2072	2074
8	Dakshin Mithachhari	25998	335935	420884	465098	540279	516333	714665	527771
9	Khuniapalong	36315	469247	587907	649667	754683	721234	998272	737212
10	Chakmarkul	16438	212405	266117	294073	341608	326468	451869	333700
11	Rashid Nagar	16538	213697	267736	295862	343686	328454	454618	335730
		266640	3445411	4316664	4770135	5541205	5295608	7329743	5412922

1.6 SWOT Analysis

Table 1-12: SWOT Analysis for Ramu Upazila

Strength • Agricultural Productivity • Cultural Heritage • Educational Institutions • Biodiversity • Natural Resources	Weakness • Infrastructure Deficiency • Economic Dependency • Limited Access to Technology • Poverty and Unemployment • Education Quality • Environmental Issues
Opportunities • Tourism Development • Agricultural Innovation • Infrastructure Improvement • Local Industry Development • Renewable Energy	Threats • Climate Change • Political Instability • Market Fluctuations • Population Pressure • Migration • Health Challenges

1.7 Strategies and Policies for Population Management

A mix of family planning, healthcare, education, economic development, and social welfare techniques and policies are required to control the population of Ramu Upazila under the Cox's Bazar district. The following are some possible tactics and guidelines:

Programs for Reproductive Health and Family Planning:

Provide all-inclusive family planning services, such as counselling, access to contraception, and information on reproductive health.

Encourage awareness-raising initiatives to support fewer children and a longer time between pregnancies.

Make sure family planning services are affordable and easily accessible in underserved and rural communities.

Knowledge and Self-determination:

Increased access to education will enable more women and girls, in particular, to make knowledgeable decisions about family planning and reproductive health.

Include comprehensive sexuality education in school curricula to teach students about family planning, ethical parenting, and reproductive health.

Offer women access to programs for skill development and vocational training to improve their economic prospects and lessen their reliance on having large families.

Infrastructure and Services for Healthcare:

To provide high-quality reproductive healthcare services, prenatal care, and secure delivery facilities, strengthen the healthcare infrastructure, especially mother and child health centers.

Emphasize the value of informed decision-making and confidentiality when educating healthcare professionals about family planning counselling and services.

To increase access to healthcare services, regularly organize outreach initiatives for isolated and marginalized groups.

Poverty reduction and economic development:

Encourage the variety of sources of income and economic possibilities to mitigate poverty and lessen the need for families to have more children in order to provide labor.

Promote microfinance and entrepreneurship to provide economic empowerment for individuals and families.

Encourage the modernization and value-adding of agriculture to raise rural communities' productivity and income levels.

Community Development and Social Welfare:

Implement social welfare initiatives aimed at disadvantaged groups, such as assistance for elderly people, single moms, and orphaned children.

Encourage community involvement in population control programs by holding community gatherings, awareness campaigns, and local collaborations.

Expand social safety nets to help people in need and encourage smaller families, such as food assistance programs and cash transfer programs.

Advocacy and Policy:

Create and implement laws that support women's rights, reproductive freedom, and gender equality.

Encourage more money and resources to be allocated to national and local population control initiatives.

To guarantee efficacy and handle new issues, population management measures should be routinely observed and assessed for their effects.

Ramu Upazila can endeavor to achieve sustainable population management, enhance the well-being of its citizens, and promote socio-economic development and resilience by putting these strategies and policies into practice in a coordinated way.

1.8 Physical Planning Implication

Demography is the study of demographics, the social characteristics and statistics of a human population. This study of the size, age structures, and economics of different populations can be used for a variety of purposes. Demographic data and information helps provide a basis for understanding communities as they are now, where they've been and where they're headed. It is a powerful tool for tracking change over time and for uncovering the needs or strengths of a community to guide planning, policy development or decision making processes. Demographic analysis is also important because it gives valuable information to make good decisions in business, government, and social services. It helps to understand the characteristics of a population and how it might change in the future which is important for making decisions for the residents' diverse needs. Planning is the making of decisions in light of expected future circumstances as well as current circumstances and as such it has close relationship with demand of the people for which area plan is being prepared.

Population analysis related physical planning provides a tool for making informed decisions about resource allocation, public health, education, public utilities that are being affected by population dynamics. Environmentally, it helps to understand human effects on natural resources, the environment, and human health. Understanding these effects can lead to programs and policies that help mitigate the negative impacts people have on the environment.

However, the following are the spatial planning implications of Ramu's population in review and updating the master plan of Ramu Upazila:

- Projected population is to be spatially distributed in conjunction with present demographic growth trend of the concerned area/place
- Projected population is to be aligned with the future need for various services and facilities of the area concerned

1.9 Conclusion

An innovative approach that incorporates disaster risk reduction, agricultural innovation, economic diversification, infrastructure development, health and education improvements, environmental sustainability, and strong community engagement is needed to address the particular challenges of an agriculture-based, river-dominated, flood-affected, rural, underdeveloped upazila. Ramu can improve the resilience of its people, encourage sustainable development, and raise their standard of living by putting these initiatives and policies into practice.

Chapter Two: Heritage



CHAPTER TWO: HERITAGE

2.1 Introduction

2.1.1 Background of the Study

In Bangladesh, there are numerous archaeological and historical monuments that serve as a testament to the country's unique history. Bangladesh is a nation with a diverse history and culture. Due to the interaction of numerous civilizations, kingdoms, and colonial powers in the past, Bangladesh has been a treasure repository for historians and archaeologists. The environment has been left with a distinct imprint. Archaeology in Bangladesh explores the nation's historical past, uncovering artefacts from both the primordial and mediaeval periods. A vibrant and intricate web of historical and cultural advancement is the legacy that Bangladesh has left behind. Mosques, sanctuaries, and colonial monuments are all reflective of the stories of several centuries' worth of history, making the architectural legacy the most conspicuous aspect. Bangladesh is situated in the Eastern region of the Subcontinent, in the ancient and historic region of Bengal. Bangladesh is situated in this region, despite the fact that it only achieved independence in 1971, following a violent struggle for liberation. The nation's civilization underwent a significant transformation during the Copper Age, which occurred over four thousand years ago. Bangladeshis are influenced by their religious beliefs, ethnic heritage, values, objectives, and creativity, as well as their appreciation for the natural environment and life. The inhabitants of Bangladesh are affected by each of these variables. The nation has been a magnet for foreign entrepreneurs, vacationers, and religious missionaries throughout its history as a result of its magnificent natural grandeur, enormous resources, and unique geographical location. This has been the case for the duration of the nation's history.

The preservation of heritage sites typically necessitates an understanding of archaeology. This is because archaeological discoveries may be integrated into cultural assets. The two disciplines of study work together to foster a more profound comprehension and appreciation of the diversity of human cultures and the richness of human history. An environmentally significant geographical region is one that is designated for the purpose of preserving history, heritage, culture, tourism, and the significance of the environment, as defined by Rule No. 3 of "The Bangladesh Environment Act, 1995" (ECA, 1995). This is essential to safeguard or conserve the environment from activities that are detrimental. In Bangladesh, it is imperative to mitigate the rapid degradation and eradication of the legacy. This is an extremely substantial obligation.

The final objective of the working paper is to evaluate the current status of historical, heritage, and tourist facilities and offer suggestions for their future development and preservation.

2.2 Study Area Profile

2.2.1 Origin of the Upazila

In the Chittagong Division of the Cox's Bazar District in the southeast of Bangladesh is where the administrative area known as Ramu. Ramu is renowned for its natural beauty, which includes hills, rivers, and landscapes that are covered in lush greenery. Furthermore, it is famous for its cultural and historical value, which includes the presence of old Buddhist monasteries and temples at the location.

The city of Ramu is home to a collection of different ethnic populations, one of which being a sizeable community of Rakhine Buddhists, which contributes to the city's cultural variety. The upazila has been the location of a few significant archaeological discoveries, and it is also a place where traditional crafts and practices are kept alive. has a long and illustrious history that dates back centuries, with key advances occurring every century beginning in the 1800s. At the beginning of the 19th century, Ramu was a part of the Arakan, which is today known as Rakhine State in Myanmar. At that time, it was under the sovereignty of the Burmese. This time period was characterized by a diverse range of cultural influences as a result of its closeness to the Arakan kingdom and, subsequently, the rise of the British Empire. Following the conclusion of the First Anglo-Burmese War in 1826, the British enlarged their territory by annexing Arakan and then incorporating Ramu into their dominion. The region was incorporated into the Bengal Presidency of the British Empire. Ramu was renowned for its agricultural output, notably its production of rice, during the time when it was under British authority. It was an important administrative region that made a contribution to the economy of the colonial government.

In 1908, while Ramu was still under British authority, it was formally acknowledged as a thana, which is Greek for "police precinct." The formation of this official organization was helpful in the streamlining of local government and law enforcement, both of which were essential during the time of British colonial rule. Immediately following the partition of India in 1947 and the establishment of Pakistan, the region of Ramu was incorporated into East Pakistan. The region continued to be important for agriculture and trade with the surrounding community. Ramu was a place of action during the Bangladesh Liberation War in 1971. Local freedom fighters engaged in clashes against Pakistani forces when they were fighting for Bangladesh's independence. One local freedom fighter was killed, and sixteen Pakistani troops were killed in a noteworthy encounter that took place in Idgarh on November 25, 1971. The incident resulted in the death of one local freedom fighter. As part of the administrative reforms that took place in Bangladesh in 1983, Ramu was promoted from the position of thana to that of upazila, which are sub-districts. Improvements in local government and development activities were brought about because of this improvement.

The city of Ramu is continuing to expand by making changes to its infrastructure and making attempts to increase tourism. On the other hand, it has also been confronted with difficulties, such as the community violence that occurred in 2012 and attacked Buddhist temples and residences. Ongoing efforts have been made to bring about justice and aid in the reconstruction of the community. Because of its extensive history, diverse cultural practices, and economic activity, Ramu is a distinctive and significant component of Bangladesh's past as well as the country's modern terrain. Over the course of the last several decades, Ramu has

garnered international recognition for its cultural heritage sites, which include Buddhist temples and relics. These sites are popular with visitors as well as scholars.

2.2.2 Project Area

There is a diversified population that is dispersed over the several unions that make up Ramu Upazila, which is situated in the Cox's Bazar area of Bangladesh. Specifically, it may be found in the coordinates 21.4583°N 92.1000°E. In all, there are eleven unions that make up the upazila, which has an area of 391.71 square kilometers¹. The names of these unions are as follows: Fotekharkul, Rajarkul, Rashidnagar, Khuniapalong, Eidghar, Chakmarkul, Kachhapia,

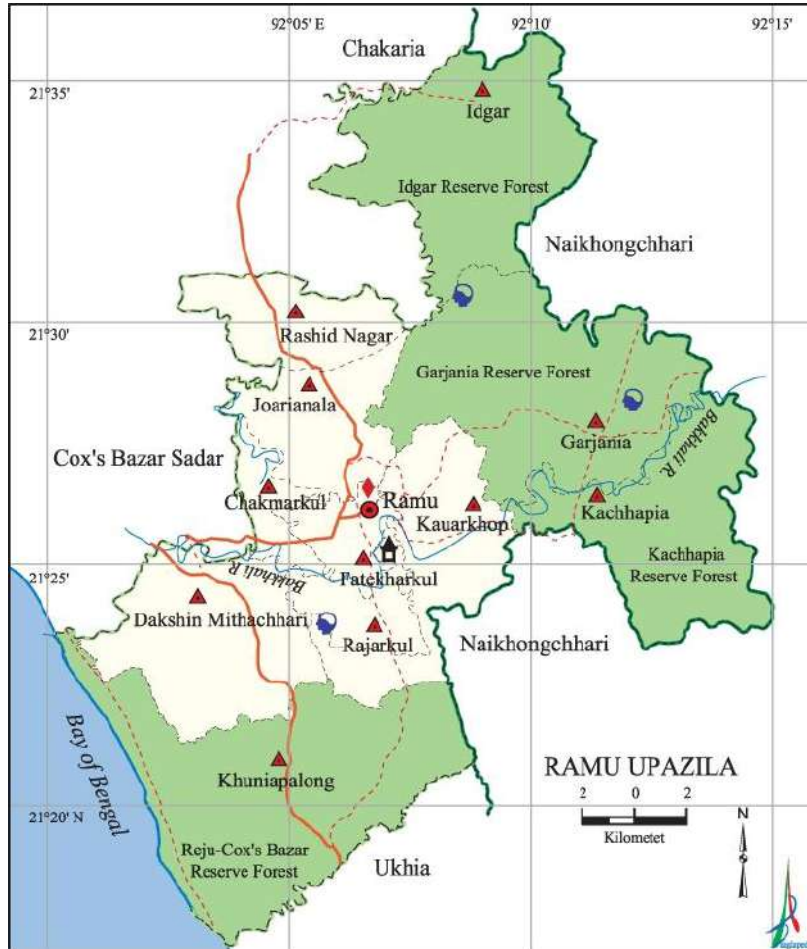


Figure 2-1: Administrative Boundary of Ramu Upazila

Kauwarkhop, Dakkhin Mithachari, Jouarianala, and Garjoniya. The population distribution of Ramu is renowned for its mix of many religious and ethnic populations, including Buddhists, Hindus, and Muslims, as indicated by the Bangladesh Population Census that was conducted in 2011. About 36.6% of the population in Ramu is literate, with men having a literacy rate of 37.8% and females having a literacy rate of 35.3%.

According to the census completed in Bangladesh in 2011, the Ramu upazila has a total population of 266,6401. When compared to the average literacy rate in the country, which is 51.8%¹, the literacy rate was 36.58%. There are 93.30 percent of people who follow the religion of Islam, followed by 3.34 percent who follow Buddhism, and 3.28 percent who follow Hinduism.

Over the past few years, Ramu has been subjected to a large amount of communal strife. Particularly noteworthy is the fact that in 2012, there were violent attacks on the Buddhist community, which led to the demolition of a number of pagodas and dwellings. Even though there have been several investigations and legal actions, justice for these attacks has not yet been achieved. There have been delays in court hearings, and many people who have been accused are currently free on bail. Ramu is continuing to flourish as a cultural heritage site as well as a hub for agricultural and commercial operations. This allows the city to strike a balance between its rich historical history and the present economic requirements and problems that it faces.

The area of Ramu is characterized by its rich legacy and cultural diversity. Islam is the religion that is practiced by the majority of the population, followed by Buddhism and Hinduism¹. The Ramu Jami Mosque, the Eidgah Bazar Mosque, the Ramkot Hindu Temple, the Shree Shree Ramdevi Purna Mandir, the Ramkot Buddhist Keyang, and the Lamarpara Buddhist Keyang are some of the religious institutions that can be found in Ramu. The Jetban Buddha Bihar temple, which is located in Ukhia Ghona and is under the jurisdiction of the Kawarkhop Union of Ramu Upazila, has been functioning as a focal point for the religious, cultural, and social activities of the community.

2.3 Existing Criteria for Selecting a Heritage Site

The authority presently selects new heritage buildings or sites to be saved without using a scientific methodology. The incremental approach is the current tactic employed by the relevant authorities. A local government or a member of parliament (MP) has made an application to the Department of Archaeology (DOA) asking for the addition of a specific site or building to their protected list. Upon receiving a request from the field level, an officer from the Department of Agriculture (DOA) was dispatched to the concerned area or facility. After getting a positive report from the official, the Department of the Interior's (DOA) Director General (DG) is the one who initially declares the building or site as a protected monument. Notwithstanding this, the Ministry of Culture retains the last say and decision-making authority. However, neither an advisory council nor a technical committee are engaged in any capacity throughout the selection process

Table 2-1: Criteria for considering a Heritage Site

Criterion	Sub-criterion
Associate Historical Significance	Associated with an event
	Associated with a notable person
	Age of the building or site
	Importance of building or site in the historical
	Development of Bangladesh
Architectural, Artistic & Aesthetic Significance	Style
	Designer/Builder
	Construction materials
	Aesthetic
	Potential for conservation
Setting and landmark status	Group or setting significance
	Community context
	Landmark status
	Zoning compatibility
	Collective memory of the community

Criterion	Sub-criterion
Authenticity, Integrity, and Rarity	Survival status
	State of preservation
	Site and foundation
	Compatibility to current use
	Adaptive re-use potential
	Rarity of age, construction materials
Significance from archaeological, technological, scientific, and spiritual perspective	Archaeological potential
	Technological and scientific potential
	Spiritual significance
	Social significance

2.4 Methodology

The Ministry of Culture is the foremost authority with the authority to make decisions regarding the subject matter, despite this. The selection process does not, in any way, involve any form of technical committee or advisory council. This is the case irrespective of the specifics of the situation. Stakeholder mapping is implemented to expedite the research process. The purpose of this is to visually represent the critical stakeholders, thereby ensuring that no perspectives are overlooked. Additionally, stakeholder mapping serves to foster a relationship between the authority and end-users, thereby fostering a bottom-up approach to planning. In order to gather secondary data from a diverse array of agencies within the Ramu Upazila Parishad, a questionnaire, meeting minutes, and a Key Informant Interview (KII) are devised prior to the field visit.

The final phase of the process entails the development of policy recommendations, which are subsequently presented in a written report and PowerPoint presentation. A party of individuals has been enlisted by the consultants to conduct an expedition in the project region. The objective of this visit is to gain a preliminary understanding of the region's history, heritage, tradition, and culture by utilizing secondary data collection, the physical characteristics of the surrounding environment, and the current state of the transportation system, infrastructure, and the various types of challenges.

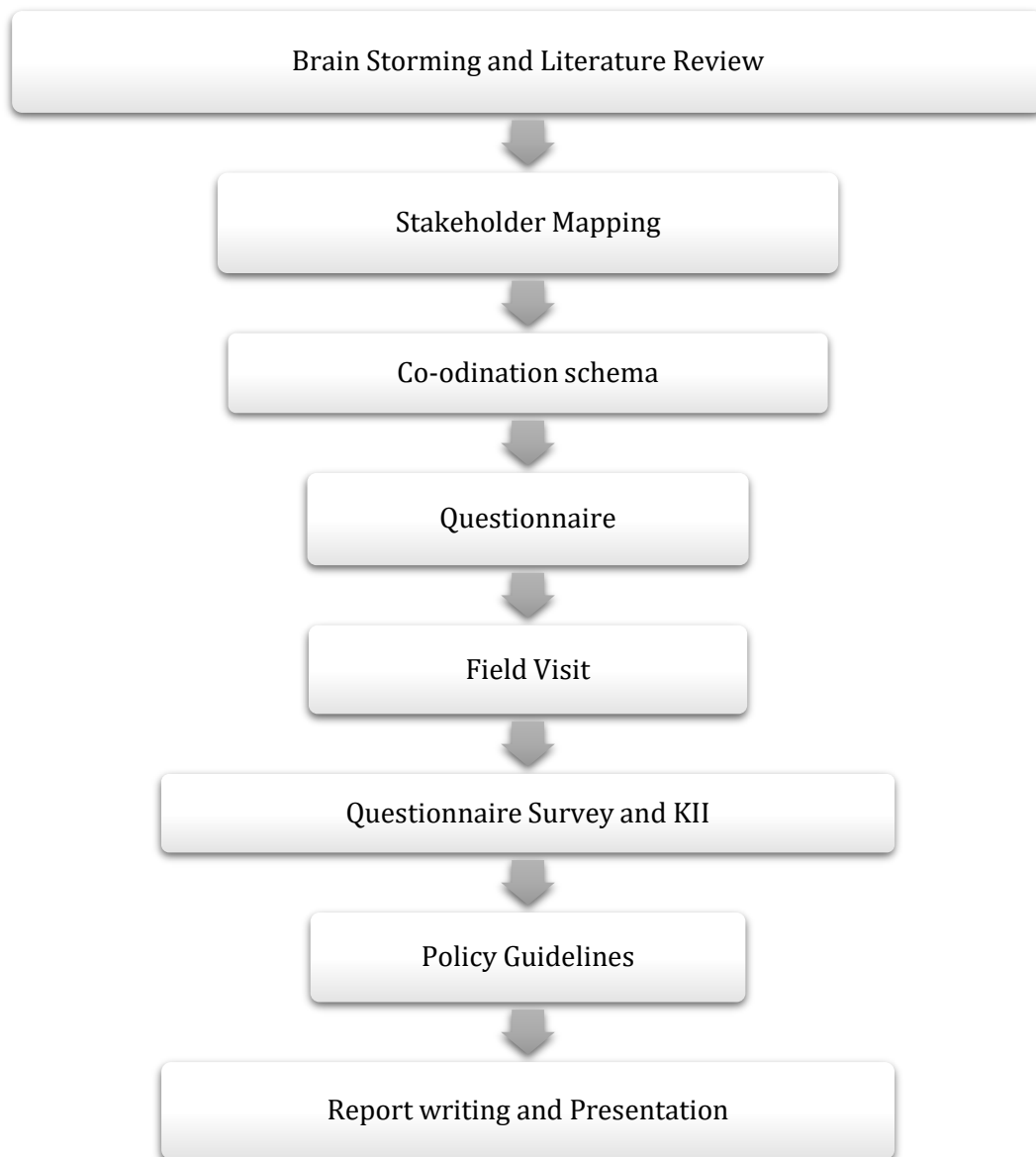


Figure 2-2: Methodological Framework for Heritage Study

2.4.1 Stakeholder Mapping

Stakeholders are individuals or organizations that are interested in the expansion of a specific industry. Organizations or individuals may constitute stakeholders. In other words, stakeholders are individuals and organizations (including the general public, local communities, and interested groups) that are either affected by the execution of a plan or have the ability to influence its implementation. I believe it would be beneficial to concentrate on individuals who are associated with the endeavor. The current state of affairs should be satisfactory to the national authorities, all things considered. The endeavor is more likely to pique the interest of residents and students; however, they possess the least authority to execute it. Consequently, it is imperative to maintain an open channel of communication with both the students and the residents. The project will be monitored by members of the project's constituents who have equivalent levels of authority and interest. In conclusion, the individuals who will be directly involved in the project have a similar but greater weight in

terms of power and interest than those who will not be directly involved. The stakeholders of this project are,

1. Urban Planners and policymakers
2. Upazila Parishad
3. Union Parishad
4. Paurashava / Municipality
5. Local Leaders
6. Local Residents
7. NGO
8. Union Chairman
9. Ward Member

2.5 Analysis and Major Findings

2.5.1 Existing Condition of Heritage of Ramu

That Ramu Upazila has such a long and diversified history is one of its defining characteristics. In order to maintain their glorious history, the ancient landlord's mansions, temple, and old palaces that have fallen into disrepair continue to maintain their existence. In order to finish the inventory of heritage sites, a questionnaire survey was administered to the people living in the project area as well as visitors who had come to visit those heritages and archaeological places at the time of the survey. The survey included the components that are necessary for a location to be considered a heritage site.

Table 2-3: Heritage Site of Ramu Upazila

Location/ Union	Name of the Heritage Site
Rajarkul	Ramkut Bihar
Fatehkharkul	Sima Buddho Bihar
Khunia palong	Himchori Fountain
	Himchori Sea beach
Joarianala	Buddhist statue with 100 feet bed
	Ramu Rubber Garden

Source: Field survey, 2024

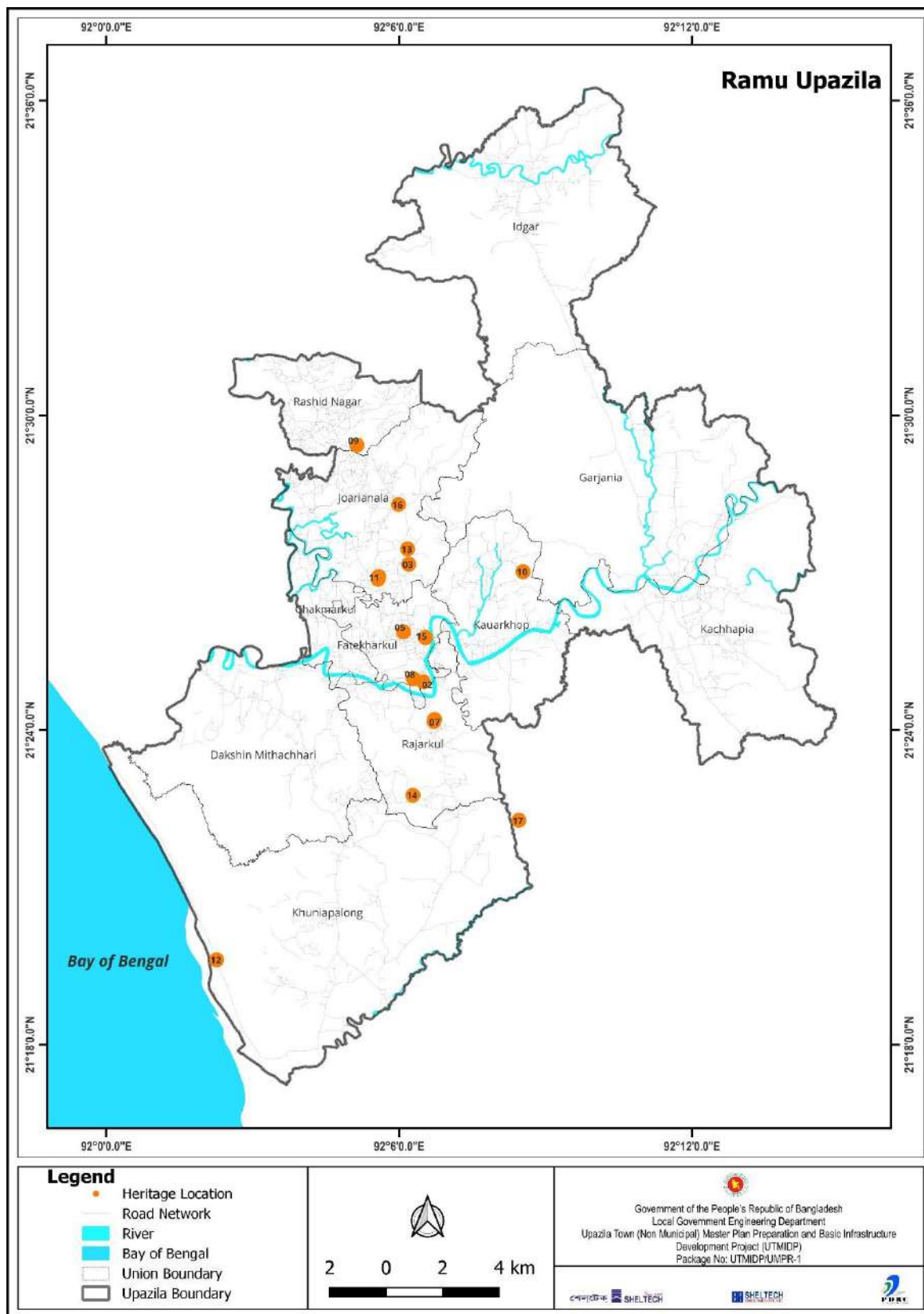


Figure 2-3: Location of Heritage sites in Ramu Upazila

2.5.1.1 Ramkut Bihar

Within the Cox's Bazar area of Bangladesh is where visitors will find the well-known Buddhist Vihara known as Rangkut Banashram Buddhist Vihara. Once upon a time, the region that was concentrated around this vihara was a thriving center for Buddhist teaching and culture. A great number of people also refer to it as the Ramkot Buddhist Vihara. Ramu is home to thirty other Buddhist Viharas, but the one that is most significant to Buddhists is Ramu. The Rangkoot Banashram Buddhist Vihar may be found in the Rajarkul Union of Ramu Upazila in the Cox's Bazar district. It is located in a steep region that is surrounded by abundant vegetation. The current Vihar might be found perched on top of a little mound.





Figure 2-4: Ramkut Bihar

In 261 AD, Gautama Buddha was horrified by the atrocities of the Kalinga war and embraced Buddhism in order to dedicate himself to the service of humanity. Gautama Buddha and his disciples visited this location in 580-528 BC at the invitation of Mahachandra Surya, the monarch of Dhanyavati (Dhaiyawadi) city in ancient Arakan. They were en route to Dhanyavati city, which is situated above Chaitgram (present-day Chittagong) in Samatat. Afterward, his primary servant, Anand, foretold the future to Sthabira and exclaimed, "O Anand! My chest will be erected on the mountaintop of the city of Ramyavati (Rammawadi) on the eastern shore of the Western Sea. It will be referred to as 'Rang-U', a Rakhine term that translates to 'chest'. 'Rang' denotes the thorax, while 'U' denotes the sternum. Additionally, "koot" is a term that denotes "location." During the 45 years of Buddha's life, Emperor Ashoka erected 84 thousand chaityas with Buddha's bones affixed to them at various times as a symbol of Buddha's knowledge to 84 thousand monks. Ramkoot Buddhist Vihara is one of them.

The Arakan King Chandrajyoti (Silver King) affixed the Buddha image in 308 BC by affixing the Buddha's bust to the crown of the six-foot-tall white stone Buddha image. Rangkut vanished as time progressed. The travelogue of the Chinese traveler Hiuen Tsang mentions this monastery. The Mughals ravaged Bihar in 1666. Jagatchandra Mahathir, a Sri Lankan cleric and Brahmo scholar, discovered an inscription during his visit to Sri Lanka in 1930. Jagatchandra Mahasthavir discovered and re-established the Ramkot Buddhist monastery in 1929 as a result of research and excavations conducted using the information derived from the inscriptions. Numerous festivals, such as the Buhyachakra Mela and the Dharmaskandha Puja, have been observed in this location since that time. Pragya Jyoti Mahareth, a religious

reformer, resided at the temple for the subsequent two decades while it was being renovated in 1966. After being robbed by a thief in 1988, Mahareth departed Rangkoot.

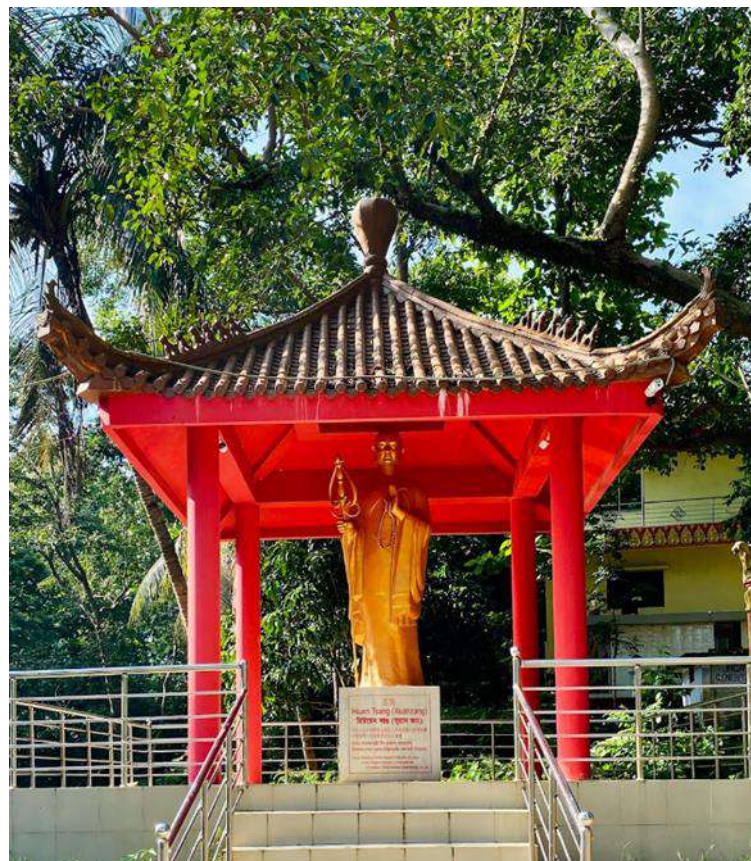
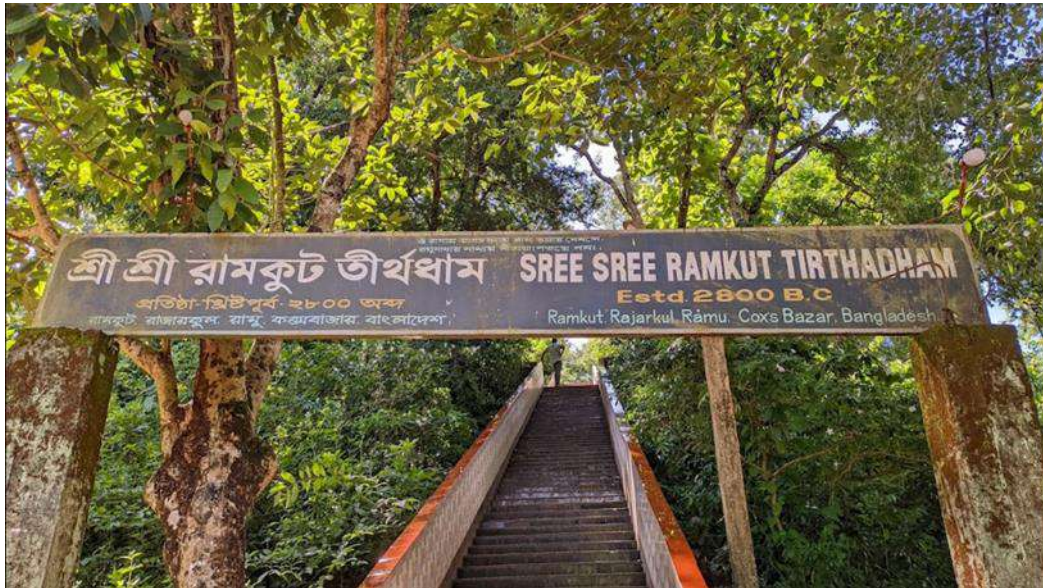


Figure 2-5: Ramkut Bihar

The masonry utilized in the vihara was 9 inches (230 mm) × 7 inches (180 mm) × 2 inches (51 mm) in size. The vihara is rectangular in shape, measuring 34 feet (10 meters) by 19 feet (5.8 meters). The highest point in Bihar is 40 feet (12 meters) in elevation. A substantial Abhayamudra-carved Buddha image is located in Bihar. Surrounded by remnants of sandstone

sculptures, the eastern slope contains the ruins of a substantial structure. Among these, Buddha's imprints and palms are particularly noteworthy.

2.5.1.2 Sima Buddho Bihar

Sheema Ramu Central Ramu Central Sima Vihara, also known as Bihar, is a prominent Buddhist temple situated in Ramu Upazila, Cox's Bazar, Bangladesh. This historic and religious location is in the village of Fatekharkul and is a significant destination for both pilgrims and visitors.

Ramu Central Sheema Bihar's origins can be traced back to primordial times when it was associated with the early Buddhist traditions of the region. Emperor Ashoka established numerous Buddhist sites throughout the Indian subcontinent during the Maurya Dynasty, as evidenced by the temple's place in a rich cultural heritage. The site is reputed to have served as a hub of Buddhist education and culture for centuries.

Jagat Jyoti Mahasthavi, a Buddhist cleric from Sri Lanka, renovated the current structure of the Sheema Bihar in 1919, during the early 20th century. This renovation was a substantial endeavor to preserve the site's religious significance and primordial heritage.



Figure 2-6: Sima Buddho Bihar



Figure 2-7: Sima Buddho Bihar

Sheema Ramu Central Bihar is renowned for its tranquil environment and stunning architecture. Several statues and relics that are significant to Buddhist history are present in the temple complex. The 100-foot-long reclining statue of Buddha is a significant attraction for visitors. The temple's architecture is reminiscent of traditional Buddhist styles, offering a tranquil environment for spiritual pursuits and meditation.

The temple serves as a focal point for a variety of religious and cultural events. It is the site of numerous pilgrimages from all over the country and beyond, as well as annual festivals and ceremonies. These events are essential for the preservation of the cultural heritage and the dissemination of Buddhist teachings.

Sheema Ramu Central Bihar can be readily accessed from the primary road that connects Chittagong to Cox's Bazar.



Figure 2-8: Sima Buddhho Bihar

The site is not only a spiritual retreat but also a visually appealing destination for nature enthusiasts and photographers, as it is surrounded by picturesque landscapes and lush vegetation.

In conclusion, Ramu Central Sheema Bihar is a critical component of Bangladesh's Buddhist heritage, providing a view into the ancient traditions and cultural practices that have influenced the region's history. For those who are interested in delving into the spiritual and historical underpinnings of Bangladesh, this location is an absolute must-see due to its unique blend of natural beauty and religious significance.

2.5.1.3 Himchori Fountain

Located around 12 kilometers south of Cox's Bazar in Bangladesh, the Himchori Fountain, which is often referred to as the Himchori Waterfall, is a popular tourist attraction. The location is well-known for its breathtaking scenery, which includes a waterfall that cascades down its slopes eventually reaches at the ocean.

The Himchori Waterfall is the only waterfall in Bangladesh that is of its sort and is a natural waterfall that flows with chilly water. The most stunning time to see the waterfall is during the rainy season, when the water flow is at its highest point. In 1980, Himchari National Park was formed with the purpose of preserving the natural beauty and biodiversity of the region. This particular location is a component of the park. There are over 286 kinds of birds, 55 species of animals, and a large number of reptiles and amphibians that call this park their home. The park encompasses a large area and serves as a haven for a unique collection of wildlife. The waterfall is situated against a backdrop of verdant hills and the beach that is located nearby, resulting in a setting that is both gorgeous and picturesque. As a result of the hilltop's ability to provide visitors with breathtaking vistas of the Bay of Bengal, this location is a favorite among those who are interested in nature and photography. The hills, the waterfall, and the sea all come together to create a backdrop that is both one of a kind and filled with peace. For those interested in bird viewing and trekking, Himchori is a fantastic location. There

is a wide range of difficulty levels available on the park's paths, making them suited for hikers of all skill levels, from novices to seasoned veterans. Picnicking, filming, and bird safaris are among common activities that take place in this region. Within the park, there are a number of smaller waterfalls and streams that Visitors may explore, which contributes to the overall allure of the place.



Figure 2-9: Himchori Fountain



Figure 2-10: Himchori Fountain

Most of the travelers begin their journey to Himchori by initially arriving at Cox's Bazar. When you get there, the waterfall is only a short distance away by car. The admission charge is not very high, and there are guides available for hiring to make the experience more enjoyable for visitors. There is a wide selection of accommodation available in Cox's Bazar, ranging from inexpensive motels to more deluxe resorts. These accommodations provide convenient access to Himchori and other local attractions.

Those who are interested in touring Cox's Bazar should make it a point to stop at the Himchori Fountain. Its natural beauty, together with the tranquil atmosphere and the opportunities for outdoor activities, makes it an ideal vacation spot for anyone who is interested in nature and who is looking for an exciting experience.

2.5.1.4 Himchori Sea beach

Himchori Sea Beach can be found in Bangladesh, approximately 12 kilometers south of the town of Cox's Bazar, and it is situated along the Bay of Bengal. Himchari National Park is recognized for its natural beauty, which includes lush green hills, a diversity of species, and the renowned Himchori Waterfall. This beach is a component of the larger Himchari National Park, which is widely known for its natural beauty.

Himchori Sea Beach is renowned for its breathtaking scenery, which includes extensive expanses of sandy shorelines that are surrounded by undulating hills and the presence of dense woods. It offers a serene atmosphere that is ideal for unwinding and taking pleasure in the natural surroundings. The beach provides tourists with breathtaking panoramas of the ocean, particularly from the hilltop viewpoints scattered around the national park. From these vantage points, travelers may take in breathtaking views of the Bay of Bengal.

In addition, the region is a well-known destination for wildlife viewing and hiking. A wide variety of flora and wildlife, including more than 286 species of birds, 55 species of animals, and a large number of reptiles and amphibians, are protected inside the Himchari National Park, which was created in 1980. Visitors will find themselves in a picture-perfect location thanks to the park's waterfall, which is a big attraction. The water flows down the cliff face into a tranquil pool to the bottom of the waterfall.

Other activities, such as picnics, exploring numerous hiking paths, and photography, are frequently enjoyed by tourists that visit Himchori Sea Beach. This is because the region is characterized by its unmatched natural beauty and distinctive terrain. Taxis and the native "Chander Gari" (a form of motorized rickshaw) are two of the local transportation choices that may be utilized to reach the park and the beach from Cox's Bazar.

In general, Himchori Sea Beach is an essential location for people who have a deep appreciation for the natural world and are interested in seeing the tranquil and picturesque side of Bangladesh's coastline.





Figure 2-11: Himchori Sea Beach

2.5.1.5 Buddhist statue with 100 feet bed



Figure 2-12: Buddhist Statue With 100 Feet Bed

The 100-foot reclining Buddha statue in Ramu, situated in the Cox's Bazar district of Bangladesh, is a noteworthy Buddhist landmark. One of the greatest statues of its kind in the world is the Bhubon Shanti or Bimukti Bidorshon Vabna Bihar.



Figure 2-13: Buddhist Statue With 100 Feet Bed

The statue was completed in the early 2000s, and the Vimukti Bibeshan Bhabna Kendra Temple, the temple that houses it, is relatively modern. The temple area has been a site of Buddhist devotion and cultural heritage for centuries, despite its contemporary construction. The area is surrounded by other earlier temples and monasteries that date back centuries.



Figure 2-14: Buddhist Statue With 100 Feet Bed

The final moments of Buddha's existence are symbolized by the reclining Buddha statue, which signifies his entrance into Nirvana. The statue is 100 feet in length and painted in a golden tint, which, despite not being made of gold, lends it a placid and majestic appearance. It is situated on a small incline, necessitating that visitors ascend a series of stairs, which contributes to the sense of reverence and pilgrimage that visitors experience.

The location is enveloped by a verdant landscape, providing a serene setting for contemplation and introspection. The temple complex is a spiritual and tourist destination that is further enhanced by the presence of numerous lesser monuments and relics. It is a favored destination for travelers who are en route to the neighboring Cox's Bazar seashore due to the religious significance and scenic beauty.

The main highway is a short drive from Cox's Bazar, and the reclining Buddha statue is readily accessible by vehicle. Providing a peaceful respite and an opportunity to experience the region's rich cultural tapestry, it is a preferred halt for those traveling to the shore.



Figure 2-15: Buddhist Statue With 100 Feet Bed

In summation, the 100-foot reclining Buddha statue in Ramu is a unique combination of natural beauty, historical interest, and spiritual significance, rendering it an essential destination for anyone traveling to the Cox's Bazar region.

2.5.1.6 Ramu Rubber Garden

The Ramu Rubber Garden is one of the oldest and largest rubber plantations in Bangladesh. It was developed during the time that Bangladesh was under British colonial rule. It exemplifies the economic significance of rubber production in the region as well as the agricultural methods that were prevalent throughout the colonial era. The garden is not only an important historical relic, but it also makes a contribution to the economy of the surrounding neighborhoods

Throughout Rubber trees are the sole vegetation on the vast, hilly terrain. The rows upon rows of rubber trees resemble an ocean of foliage. In the midst of the natural beauty of Ramu, the garden is another marvel of beauty, brimming with a variety of distinct art forms and forms of beauty. This Ramu Rubber Bagan is among the most alluring in the nation. It appears that the natural grandeur and pleasant environment in this location will provide you with a sense of peace and generosity of nature, in addition to the rubber garden.



Figure 2-16: Ramu Rubber Garden

A distance of 18 kilometers prior to the settlement of Cox's Bazar The Bangladesh Forest Industries Development Corporation constructed this sanctuary in 1960-61 in RAMU upazila. Presently, the garden occupies 2,682 acres.

Currently, the garden encompasses the region from the tea garden area, which is adjacent to the Chittagong Cox's Bazar highway, to Zoyariinalar Malapara in the north, Jumachari and Garjaniya in the east, and the lot Ukhiya Ghona in the south.

The extensive vegetation of rubber trees that stretch along both sides of the highway, The garden is readily noticeable to visitors due to the chattering of a thousand distinct birds. The oldest rest house in Cox's Bazar district is located at the end of a brick road that ascends to the summit of the hill in the midst of the rubber garden, adjacent to the tea garden junction. It is referred to as the Rubber Garden Rest House. The attractiveness of the location has been further enhanced by the stunning environs of the rest house. At present, it is the most captivating location in Ramu for a night out, picnic, or any other event. For those who appreciate the natural world, this location offers additional attractions.



Figure 2-17: Ramu Rubber Garden

In addition to the Rubber Garden Rest House of Ramu, there are numerous other points of interest; however, it is the most exceptional location in terms of its natural beauty and diverse amenities. Most of the diverse events, such as picnics, are coordinated here by various organizations. The environment and environs are so aesthetically pleasing and serene that they transcend animosity.

2.6 Existing Interaction of Local People with Heritage

In Ramu Upazila, Muslims and Hindus celebrate their own religious and cultural festivals together with a great lot of enthusiasm and mutual regard for one another. This is because they are both celebrating their respective holidays together. A clear illustration of the peaceful cohabitation that occurs between the two groups is provided by this passage. Not only do these festivals serve as a manifestation of the region's rich cultural heritage, but they also play a significant role in the process of strengthening the bonds that are already there within the community.

As a result of the complicated network of festivals that have been celebrated together by Hindus and Muslims, the region is able to display both its cultural variety and its unity. This is because of the fact that the festivals have been celebrated jointly. By participating in the activities that are being hosted, both groups will have the opportunity to come together and enjoy the happy occasions and traditions that are associated with the other community.

There is a lively and multidimensional interaction between local people and visitors in Ramu with heritage sites such as Buddho Bihar, the rubber garden, Himchori Fountain, and Himchori Sea Beach. This engagement reflects both the regard that locals have for their culture and the joy that tourists have for their visit. The local Buddhist communities of Buddho Bihar have a strong connection to the location, as seen by the fact that they regularly participate in religious

events, meditation sessions, and cultural celebrations, all of which they passionately showcase to tourists. Tourists are frequently drawn to the temple because of its historical significance and tranquil atmosphere. As a result, they frequently take part in these events, which allows them to get a more profound comprehension of the local religious rituals and heritage.

One of the most interesting intersections of agriculture and tourism is provided by the rubber garden. The ancient rubber tapping activities of the local farmers are still being carried out, providing tourists with an opportunity to witness the process firsthand. Visitors get the opportunity to learn about the history of rubber farming in the region as well as the economic significance of the industry through educational tours and demonstrations. Through the promotion of agrotourism, this interaction not only helps to increase tourism but also contributes to the health of the local economy.

At Himchori Fountain, the natural beauty and ecological value of the location contribute to the interaction that takes place between the residents and the international visitors. Locals frequently take on the role of guides, imparting their expertise on the flora, wildlife, and geological characteristics of the region. Tourists, in turn, make a contribution to the economy of the area by paying admission fees, participating in guided tours, and purchasing handicrafts made in the area. According to research, the waterfall and the trails that surround it are popular destinations for hiking and bird viewing. These are activities that are enjoyed by both residents and visitors alike, which helps to promote a mutual love for environment.

Heritage landmarks in Ramu, such as Buddho Bihar, the rubber garden, Himchori Fountain, and Himchori Sea Beach, play an important part in the religious and cultural life of the local people. These people in Ramu adhere to a variety of religions, including Buddhism, Hinduism, and Islam. Not only are these locations popular destinations for tourists, but they also serve as important gathering places for members of the community and for religious ceremonies. Buddho Bihar is frequently utilized by Buddhists in Ramu for the purpose of hosting religious events, meditation, and celebrations such as Buddha Purnima. Whenever these events take place, the temple transforms into a bustling center of activity, with villagers and monks both conducting rituals and praying. Additionally, the grounds of the temple fulfill the function of a community area, where individuals congregate to celebrate and share meals. Local temples and heritage sites are utilized by the Hindu community in Ramu for the purpose of celebrating a variety of religious holidays, including Durga Puja, Diwali, and other significant traditions. Families invest a great amount of money on making offerings, decorating their homes, and preparing community feasts since these festivals attract big groups. For the purpose of community prayer during Eid festivities, Muslim inhabitants make use of public places and heritage sites such as the beach that is located on the coast. Extensive gatherings for Eid prayers and accompanying celebrations can take place in the open areas that are located close to these heritage monuments, which provide an excellent environment. Families in Ramu normally spend between 30,000 and 50,000 taka on significant religious celebrations, with some families spending as much as 100,000 taka on certain occasions. These expenditures include the following: The acquisition of religious offerings, which may include flowers, fruits, incense, and other unique goods that are necessary for particular rites.

Costs associated with decorations, such as lighting, banners, and idols, particularly during Hindu and other religious celebrations. The tradition of organizing communal feasts and

offering food to participants is a typical practice that is observed at all major religious gatherings.

For the purpose of preparing home-cooked meals that are shared with extended family members and neighbors, hiring caterers or purchasing huge quantities of culinary components. During these times of celebration, it is common practice to purchase new clothing for members of the family. Traditional garb plays a big role in the celebrations, and families spend a large amount of money on new clothing to represent their cultural heritage.

The tradition of exchanging presents is another frequent ritual. This practice involves the purchase of sweets, toys, and stuff for the home. The majority of households set aside a portion of their income for charitable contributions, which may include contributions to mosques, temples, and community welfare programs.

Zakat, which is a form of special almsgiving that takes place on Eid, is also an essential component of the religious activities of Muslims. One of the things that makes these cultural sites so lively is the fact that religious traditions and tourism often intersect with one another. When tourists go at these seasons, they have the opportunity to observe and occasionally even take part in local traditions, which enriches their overall cultural experience. Increased business for local merchants, artists, and service providers is a result of this synergy, which is beneficial to the economy of the local community. The fact that religious rites are incorporated into historical sites in Ramu is a clear indication of the profound cultural value that these places hold for the community. Not only does the enormous investment that residents make during religious festivals serve as a reflection of their dedication, but it also makes a significant contribution to the economy of the local community, which helps to establish a sustainable link between environmental preservation and communal life. The cultural wealth and economic vigor of Ramu are both enhanced as a result of this interaction, which makes Ramu a destination that is both distinctive and vibrant.

2.7 SWOT Analysis

In order to conduct a comprehensive analysis of past assets, the Strengths, Weaknesses, Opportunities, and Threats (SWOT) study is a valuable tool. It ensures the effective protection of the sites and the valuable contributions they make to society by providing assistance in making well-informed decisions and taking the necessary action. Ramu's strategic plans are able to leverage its strong community engagement and rich cultural heritage by acknowledging these assets. The community may derive substantial advantages from these initiatives. Subsequently, these strategies could be implemented to reinforce the conservation initiatives that are currently underway. The ability to identify vulnerabilities, such as inadequate currency and inadequate infrastructure, enables the execution of targeted initiatives with the objective of enhancing facilities and acquiring financial resources.

The identification of opportunities, such as the development of tourism and educational activities, serves as a starting point for the development of programs that not only safeguard cultural sites but also improve them. These opportunities can be used as a starting point.

The capacity to recognize deficiencies, such as inadequate infrastructure and insufficient funds, enables the implementation of targeted activities to improve facilities and secure financial resources.

The identification of opportunities, such as the development of educational programs and tourism, can serve as a starting point for the development of initiatives that not only protect but also improve cultural monuments.

The development of catastrophe management plans and the implementation of more stringent zoning rules are two examples of proactive measures that may be taken to protect heritage sites. These measures can be implemented because of awareness of potential hazards, including urbanization and environmental degradation. To ensure that existing resources are utilized effectively, the strengths, vulnerabilities, opportunities, and threats analysis may be employed to prioritize funds and resources toward areas with the greatest need or potential for positive impact. The more local communities are aware of their capabilities and potential, the more they are able to engage in preservation initiatives, which in turn fosters a sense of ownership and pride in their legacy. By employing the insights obtained from the SWOT analysis, it is feasible for policymakers to be apprised of the most suitable legislation and policies for protecting heritage sites. This will guarantee the sites' sustainability in the long term. By employing the strengths, vulnerabilities, opportunities, and threats (SWOT) analysis, promotional strategies can be devised to attract funders, scholars, and visitors. This will ultimately generate additional revenue and increase global interest in Ramu's legacy.

To gain a more comprehensive understanding of Ramu's cultural sites, it is beneficial to conduct a SWOT analysis, which provides a comprehensive framework for examining the internal and external factors that influence these sites. This research contributes to the development of strategic plans that improve the preservation and enjoyment of the region's rich cultural heritage by bolstering its strengths, capitalizing on opportunities, limiting risks, and addressing the region's deficiencies. The cultural sites situated in Ramu Upazila are associated with several benefits. These advantages encompass the abundance of resources, historical remnants, and heritage sites, as well as the fact that these sites are reasonably priced as a potential tourism destination. Furthermore, the inhabitants are ardent and willing to contribute to the marketing of these cultural assets, which is yet another positive aspect. Inadequate laws, rules, and regulations regarding property transfer, inadequate road accessibility, insufficient media coverage, and an absence of appropriate signage are among the factors that contribute to the limitations of these locations. These issues are significantly exacerbated by the absence of sufficient marketing, branding, and image resources in cultural areas.

Opportunities to brand heritages, favorable access to a destination, the development of career prospects for museum specialists and cultural administrators with the objective of promoting and conserving heritage, and the implementation of TDR policies are all accessible. All of these opportunities are accessible. You have access to each of these alternatives. These cultural areas are susceptible to a variety of potential hazards, such as a conflict of interest between land brokers and the organization responsible for the plan's implementation, an insufficient budget to address heritage issues, and a host of other potential hazards.

Table 2-2: SWOT Analysis of the Heritages' of Ramu Upazila

Strengths	Weaknesses	Opportunities	Threats
Rich Cultural heritage that attracts pilgrims and tourists	Insufficient use of digital and social media platforms	Opportunities to brand heritages, favorable access to a destination	Natural disasters like cyclones, floods, and erosion
Showcase religious diversity.	Poor road conditions and limited public transport	Growing demand for green eco-tourism	Climate change and environmental degradation
The temples and relics serve as physical records of the region's past, providing insights into historical religious practices and architectural styles.	Poor coordination in manifesting Cultural heritage	Creating employment and promotion of cultural heritage	Historical sites in Ramu have been targets of communal violence and Ongoing political instability
	Limited funding and resources for the conservation and restoration		Potential exploitation of cultural assets for commercial gain at the expense of preservation and respect for local traditions
Enhance the appeal of heritage spots by providing stunning natural backdrops	Poor accessibility, no media coverage and proper signage	Application of TDR strategies	Unregulated tourism development could lead to over-commercialization, detracting from the authenticity

2.8 Spatial Planning Implication

The modern Cox's Bazar derives its name from Captain Cox (died 1798) an army officer who served in British India. For historical background we found that according to the district gazetteers, the name of Ramu has been originated from the name of the kingdom of Rame, the country of Magus. When this area was ruled by the Arakanese there was a fort here, commanded by one of the brothers of Raja (king) of Arkan and was stormed by Mughal forces after the capture of Chittagong in 1660AD.

According to Historical events Tradition Ramu, Cox's Bazar got its name from the Royal Ramu dynasty of Arakan. At the time of the conquest of Chittagong by the Mughals (1666) a thirteen feet high bronze image of Buddha was found at Ramu. This is the biggest of the Buddha images hitherto discovered in Bangladesh. It is said that Ramachandra met Sita at Ramkot which is another sightseeing attraction since the stone grinder used by Sita while she was in Lanka is preserved here and Rama also met after her abduction by Ravana and that had once been preserved at Ramkot.

Various Buddhist relics and Burmese handicrafts are available and cheap of comparison. Here the weavers all times busy in their trades in open workshops and craftsmen are engaged in making handmade cigars from their houses which look like pagodas, all these their own creation traditionally. It has an excellent charm of its own which is spread here in the form of monasteries, khyangs and pagodas containing temples and various Buddhist statues and images of Buddha in gold, bronze and various other metals and studded with precious stones which are natural beauties for tourists. The monastery is also famous because of its intricate wood carvings in the monastery. One of the most interesting of these temples enjoying the biggest Buddhist Temple which is the oldest one in Bangladesh is on the bank of the another natural scenario Bakkhali River. Also some other canals have laid down to the river Bakkhali and the Bay of Bengal from India and Myanmar.

This is not only interesting relics and Burmese handicrafts but also a large bronze statue of Buddha measuring thirteen feet high and rests on a six feet high pedestal. The best attraction is however it is the biggest among the Buddha statues that are found in whole of Bangladesh. Main attractions are:

- Ramkot Buddhist Keyang/ Ramu Buddhist Temple
- Lamarpara Buddhist Keyang/Pagoda (chatopa chytta or jodi)
- Jhogatjhoti child care

However, Ramu Upazila has been endowed with a good number of heritage and historical sites having religious as well as other values. And these resources are a bridge to our past by understanding the past and the way others lived makes us know where we come from and where we're going as a nation. This creates an understanding of what citizenship means and how it can bring about tolerance and respect for diversity. Heritage study is defined as the field that considers heritage as a 'living entity' and emphasizes the continuous process of interpretation to sustain cultural significance. The management of heritage involves making choices about the preservation and utilization of cultural resources for development purposes, considering economic dimensions and development strategies. It plays a crucial role in guiding decisions related to heritage conservation and economic development initiatives. However,

the old buildings, monuments, or landscape areas identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest

The most notable heritage sites of Ramu Upazila are: Ramkot Pilgrim Dam, Rangkot Buddhist Bihar, Ramu Shima Bihar and Ramu Jadi Bihar. However, in context of spatial planning implication of Ramu's heritage in review and updating the master plan of Ramu Upazila, it is to be mentioned that there should be adequate provision of supportive facilities in terms of linking roads, rest houses, gift shops, security arrangements etc. for conserving and effective use of the concerned heritage sites.

2.9 Recommendations

The core guidelines support the standardization of conservation efforts across various contexts and geographical areas, which is essential for providing best practices-based guidance for preserving the authenticity and integrity of cultural assets. Many historical sites are susceptible to environmental degradation caused by human activities and/or external factors. The recommendations include steps that may be done to mitigate these hazards and stop them from growing worse. These things are often quite important from a cultural, historical, and social standpoint. These recommendations guarantee that the historical context and cultural relevance of these sites be respected and preserved during the conservation efforts. Owing to their importance, it typically highlights how important it is to include local residents in conservation efforts. Because they feel more responsible and a part of the community, conservation initiatives become more environmentally and culturally sensitive. The procedures for monitoring and assessing the success of conservation efforts are outlined in the guidelines. This allows approaches to be improved and changed continuously in response to feedback and changing conditions. Suggestions are essential for the preservation of both natural and cultural heritage since they offer a systematic and informed method of doing so. This helps to guarantee that these unique treasures will be preserved for future generations.

It is essential to carry out thorough surveys and compile an inventory of each and every historically significant place. It is important to take note of the historical context of each location, as well as the architectural traits and cultural value of each location. Education should be used to bring the importance of cultural preservation to the attention of the local population. In order to instill a sense of ownership in the members of the community, it is essential to include them in the conservation effort.

Make it a priority to advocate for the formal recognition and protection of heritage sites by both local and national institutions. Ensure that stringent laws are enforced in order to avoid vandalism, encroachment, and building that is not authorized. For the sake of historical preservation, submit applications for funds at the national and international levels. The local companies and benefactors should be encouraged to become sponsors of conservation programs. It is important to develop tourist plans that are responsible and that promote heritage places without creating any harm. Tourism packages should be developed that contain heritage sites and promote the culture of the local area.

To maintain the sites in excellent shape, a routine maintenance program should be implemented. To conducting routine inspections of cultural monuments, new technologies

such as drones and geographic information systems (GIS) should be utilized. Conserve the originality of the structure by restoring it using materials and techniques that are traditional.

The original locations of artefacts and architectural elements must be maintained wherever it is feasible to do so. For the benefit of local craftspeople and conservationists, it is important to educate them on building methods that have been utilized for centuries. Something that ought to be done is to provide local authorities with the opportunity to participate in workshops on heritage management and conservation. It is important to work together with non-governmental organizations (NGOs), institutions, and international organizations to acquire resources and offer technical assistance. It is essential to collaborate with local historians and cultural experts to ensure that preservation activities are carried out in the most effective manner.

Create a fund that is exclusively dedicated to the preservation and upkeep of Buddhist temples. Government grants, international aid, and donations from religious organizations and vacationers can all contribute to this. Maintain the architectural integrity and historical significance of the temples through consistent maintenance and restoration efforts.

Create educational programs and excursions that will inform visitors about the historical significance and cultural significance of the Buddhist temples in Ramu.

Incorporate field excursions and research projects related to the monuments by collaborating with local schools and universities. Involve local communities in conservation initiatives. Fostering a sense of ownership and pride can be achieved by training local interpreters and involving them in the administration of the sites.

Organize cultural festivals and events that are community-driven in order to celebrate local heritage and attract visitors. Utilize digital platforms and social media to advertise the temples as significant visitor destinations.

Create informative brochures and pamphlets that emphasize the sanctuaries' historical and cultural importance. Encourage eco-friendly tourism activities in the rubber garden, including guided excursions that emphasize the economic significance and history of rubber cultivation.

Establish educational signage and walking trails to provide visitors with information regarding the garden's history and the rubber production process. To guarantee the rubber garden's long-term sustainability, implement sustainable agricultural practices.

Conduct research and development activities to enhance rubber production techniques and protect the health of the trees. Foster the creation of secondary products and crafts that are made from rubber and can be sold to travelers.

Train local artisans to produce rubber-based handicrafts, thereby stimulating the local economy. Enhance the accessibility of Himchori Fountain by upgrading roads and offering more convenient transportation options for visitors.

Construct visitor amenities, including lavatories, seating areas, and designated picnic areas, to improve the visitor experience. Create interpretive programs that inform visitors about the fountain's ecological and geological importance.

Encourage the development of recreational activities, including guided nature walks and bird viewing visits, in the vicinity of Himchari National Park. Incorporate beach clean-up initiatives

that involve both local communities and vacationers to preserve the beach's charm and cleanliness.

Enforce regulations to safeguard marine life and prevent littoral erosion, such as prohibiting the accumulation of corals and shells. Develop marketing campaigns that emphasize the natural grandeur and tranquility of Himchori Sea Beach, with an emphasis on both domestic and international tourism.

Enhance the accessibility of the shore by implementing improved transportation connections and providing visitors with plain signage and information.

As a result, the region may develop a unique personality and set itself apart from all other travel destinations. The term "destination brand" describes the timeless quality of the location, sometimes referred to as the essential features of the city. These qualities, which also set the location apart from all of its rivals, eventually make up its own identity. Individuals are responsible for determining whether or not there is a destination brand. The destination and the manner that prospective guests and consumers perceive it are dynamically related. This is something that might be said regarding the relationship. The cornerstone that ought to be the starting point for all marketing initiatives, including behavior and communications, is a destination brand. It is the main structural component.

For the destination brand to be genuinely effective, there must be congruence between the impressions held by residents and tourists. This is due to the fact that residents and visitors view the destination brand differently. In particular, this alignment should concern the location's most valuable features and how it is portrayed in promotional materials.

The creation of awards for the locations and buildings connected to cultural heritage that are best conserved. The government may be able to purchase historically significant structures and locations in order to save and preserve them. One possible way to promote the sites is by using documentaries, films, festivals, or events.

Create a comprehensive management plan that includes all heritage sites in Ramu, ensuring that conservation and tourism efforts are coordinated.

Establish a heritage council that includes local authorities, community leaders, historians, and conservationists to supervise and direct the preservation efforts. Leverage digital technologies, including mobile applications and virtual excursions, to improve visitor engagement and offer educational content regarding the heritage sites.

Utilize state-of-the-art conservation technologies to oversee the sites' condition and coordinate maintenance activities in accordance. In order to secure funding and technical expertise for conservation initiatives, pursue partnerships with international heritage organizations, NGOs, and private sector stakeholders.

Foster public-private partnerships to create tourism infrastructure and services that are advantageous to both the local economy and heritage sites. Ramu can guarantee that its cultural and natural treasures are relished by future generations by preserving its rich heritage and promoting sustainable tourism through the implementation of these recommendations.

Chapter Three: Recreation and Open Space



CHAPTER THREE: RECREATION AND OPEN SPACE

3.1 Introduction

Cox's Bazaar is home to the longest beach in the world is situated at the southernmost point of Bangladesh. It's a beautiful district, surrounded by scenic views of mountains and the sea. The district is comprised of 8 upazilas; Ramu is one of these upazilas. This upazila of Cox's Bazar is oldest human habitation and once it was a centre place for king of the Arakan and Mog. Ramu lies 15 kilometers to the northeast of Cox's Bazar District Sadar. Endless natural beauty, ancient Buddha antique, Ashoka temple/shrine, tunnel of king Kana, high bank and other natural resources as well as the multifarious/variety/diversity livelihood of indigenous people are remarkable/prominent of this upazila. Ramu is comprised of 11 unions. The mountain, river, canal, and channel enriched this upazila.

Ramu Upazila with an area of 391.71 sq km, located in between 21°17' and 21°36' north latitudes and in between 92°00' and 92°15' east longitudes. It is bounded by Chakaria and Cox's Bazar Sadar upazilas on the north, Naikhongchhari and Ukhia Upazilas on the south, Naikhongchhari Upazila on the east, Cox's Bazar Sadar and the Bay of Bengal on the west. It is situated in very close proximity to Cox's Bazar with an enriched prospect of linking open spaces for recreation. It needs immediate attention by regularizing and ordering of land, services, and infrastructural development to make both cities functional and compatible with local and regional settings.

Chapter 9 of the 8th Five Year Plan addresses the greatest challenge of rapid urbanization on a massive scale in the form of degradation of the urban environment. As a result, in order to accommodate rapid urbanization and increasing population, recreation and open space are filling up. One objective and strategy of 8th FYP for the Municipality and City Corporation's is "Ensuring land use Planning and Development Control of towns". The section-5 of "The Bangladesh Environment Conservation Act, 1995" (ECA, 1995) and Rule - 3 declared ecologically critical area for conservation. A nation's cultural history is supported by its heritage. The current era calls for the preservation of historic structures and locations. The need to halt the rapid deterioration and eradication of the heritages is quite an urge in Bangladesh. The working paper aims to assess the existing scenario regarding recreation and open space and finally to provide policy guidelines for future requirements regarding recreation and open space.

3.2 Definition and Classification

The phrase "open space" is used extremely broadly to describe all areas that is not exploited for construction and is left in its natural state. Open space is not vacant space. The purposes of open space are connected to this usage of land, water, and air. Numerous active and passive recreational activities take place in open places. For outdoor physical recreation, there are playgrounds, sports fields, stadiums, etc. For mental and intellectual relaxation, there are parks, attractive gardens, and serene places of beauty with grass, trees, and water features. Open space can be used to create a beautiful image of visual elements. Open space can be defined as un-built lands within the city which provides environmental, social, and economic benefits for the communities. These areas typically include water and land areas used for

recreation, scenic beauty, and conservation. Open areas serve as leisure spaces for urban residents, both actively and passively, in addition to their ecological and aesthetic significance. Outside of urban heritage, open space is a crucial component of both domestic and international tourists' leisure time. They are crucial livability indicators for towns and communities to guarantee the health and wellness of people living there.

The lungs of cities are thought to "be open spaces. The two are connected because of them. They provide a break from the routine of city life. Without an open space system, no municipal layout is complete. It is currently understood that their provision is a civic duty that should be carried out through town and rural planning. In order to provide adequate recreational opportunities, 10% of urban land should be set aside as open space (Murray, 1997) and apportioned in accordance with the town's population density. Any prudent human activity that produces a pleasurable reaction, at any time, location, or circumstance, and has accompanying enriching physical, intellectual, or emotional benefits is referred to as recreation. These areas are used for mental or physical refreshment following a day of labor through amusing or simulating play activities. Through its surroundings, environments, and locations, it offers mental relaxation.

Open Space: Open spaces are defined as all publicly accessible and privately owned lands that have an open feel and are used for outdoor leisure. This includes not just undeveloped land but also, water and the upper atmosphere. They could range from modest playgrounds to sizable hunting grounds, lakes, and beaches.

Recreation: Recreation refers to activities or experiences that people engage in for enjoyment, relaxation, and fun. It is a way to take a break from work, school, or other daily responsibilities and to recharge and rejuvenate oneself. Recreation can take many different forms, such as sports, games, and outdoor activities, creative pursuits like art and music, or simply spending time with friends and family. It refers to the provision of recreational spaces, facilities, and services for the residents of a city or town. This includes parks, playgrounds, sports fields, swimming pools, community centers, and other public spaces where people can engage in recreational activities.

3.3 Typology of Recreation and Open Space Facilities

Recreational facilities may include active or passive recreational activity or sometimes include both. Typology for recreation and open space facilities describes the concept of classification or categorization that is used for understanding and arranging various kinds of open space and recreational places. This typology facilitates the conception, design, and administration of areas that meet the many recreational demands of a community by urban planners, architects, and legislators. It offers a framework for classifying and recognizing different facilities, making sure they satisfy user preferences and particular goals. Since recreation space provided by the City differs according to purpose, function, and activity, a Recreation Space Classification System was developed and used to profile the existing recreation system. This study also adopted best suitable classification method which suits best for Ramu Upazila and also serves the purpose of the study.

Typically, typology takes into account elements like the size, purpose, user demographics, and activities available in these places. The following are some typical categories included in a typology of open-space and recreational facilities.

Table 3-1: Recreation Typology

Type	Description
Active recreation	Activities that require physical exertion and can range from team sports like soccer or basketball, to individual activities such as jogging, cycling, or hiking. These types of activities are typically well-suited for larger open spaces such as parks or trails.
Passive recreation	Activities that are more relaxed and can be enjoyed in a more tranquil setting. Examples of passive recreation include reading a book, having a picnic, or enjoying the scenery. These types of activities are typically well-suited for smaller open spaces such as plazas or gardens.
Water recreation	Activities that are centered around bodies of water such as lakes, rivers, or oceans. Examples of water recreation include swimming, fishing, boating, or paddle boarding. These types of activities are typically well-suited for open spaces with water features such as waterfront parks or beaches.
Cultural and Educational recreation	Activities that focus on learning about and appreciating the cultural or natural history of a place. Examples of cultural and educational recreation include nature walks, historical tours, or art exhibits. These types of activities are typically well suited for open spaces with historical or cultural significance such as museums, monuments, or heritage sites.
Social and Community recreation	Activities that are designed to bring people together and foster social connections. Examples of social and community recreation include community events, festivals, or concerts. These types of activities are typically well-suited for open spaces that are centrally located and easily accessible to the community.

The typology may change depending on goals, setting, and features of a developed area or community. By using a thorough typology, planners and designers can make sure that the community's varied requirements and preferences are met by building a well-rounded network of open spaces and recreational areas.

Table 3-2: Typology for Open Space

Type		Description
Neighborhood Open Space	Play lot	Small area intended for children of pre-school age having playing equipment such as low swings, slides, see-saw, sand boxes etc.
	Playground	Areas intended for children of ages 6-14 having courts like tennis, basketball, badminton, volleyball etc. for informal play.
	Play field	Area combining play lot and playground for young people and adults having provision of football, baseball, cricket etc.
	Parks	Areas like small parks, school parks and banks of small watercourses are designed mainly to serve a local area to get rid of noise and traffic rush being indiscriminately accessible in terms of age, gender, race, ethnicity, and religion.
	Incidental Open space	It means not the land just left over but properly designed open space such as the space between two buildings, footpath spaces etc.
City Open Space	City parks	Areas for passive recreation provided in or around the heart of the city.
	Parkways/ Boulevards	Areas with tree-lined avenues having separate provisions for cyclists, pedestrian, additional carriageways for vehicular traffic.

Type		Description
	Green belts	Areas not usually devoted to public recreation entirely but serves to restrict the further outward growth of city/town.
	Stadium	Areas for sports center, athletic fields, golf courses, racecourses etc. comparatively larger than play fields.
	Water bodies	Areas having opportunities for bathing, swimming, fishing, boating etc.
Regional/ National Open Space	National Park	Areas to picturesque mountainous regions, marshy lowlands, foreshore, flora, fauna, geology, entomology, forest ecology, meteorology, seismology etc.
	Botanical garden	Areas for scientific purposes having opportunity for passive recreation covering flora.
	Zoological garden	Areas for scientific purposes having opportunity for passive recreation covering fauna.
Public parks and gardens		Areas of land normally enclosed, designed, constructed, managed, and maintained as a public park or garden. These may be owned or managed by community groups.
Private gardens or grounds		Areas of land normally enclosed and associated with a house or institution and reserved for private use.
Amenity greenspace		Landscaped areas providing visual amenity or separating different buildings or land uses for environmental, visual or safety reasons and used for a variety of informal or social activities such as sunbathing, picnics or kickabouts.
Play space for children and teenagers		Areas providing safe and accessible opportunities for children's play, usually linked to housing areas.
Sports areas		Large and generally flat areas of grassland or specially designed surfaces, used primarily for designated sports (including playing fields, golf courses, tennis courts and bowling greens) and which are generally bookable.
Green corridors		Routes including canals, river corridors and old railway lines, linking different areas within a town or city as part of a designated and managed network and used for walking, cycling, or linking towns and cities to their surrounding rural areas. These may link green spaces together.
Natural/semi-natural greenspaces		Areas of undeveloped or previously developed land with residual natural habitats or which have been planted or colonized by vegetation and wildlife, including woodland and wetland areas.
Allotments and community growing spaces		Areas of land for growing fruit, vegetables, and other plants, either in individual allotments or as a community activity.
Civic space		Squares, streets, and waterfront promenades, predominantly of hard landscaping that provide a focus for pedestrian activity and can make connections for people and for wildlife.
Burial grounds		Includes churchyards and cemeteries.
Other functional greenspace		May be one or more types as required by local circumstances or priorities.

3.4 Importance of Recreational and Open Space Facilities

Many of us like the great outdoors – fresh air, sunshine, a place to walk or a quiet place to relax. But people who live in cities may not always be able to get outdoors as often as they would

like. As urbanization rate of Ramu Upazila is growing day by day, so need for recreational and open space facilities planning is a compulsory for the well-being of the citizen and also for the preservation of the natural resources and habitats. However, there are outdoor spaces in cities that can give us the same feelings of being out in nature such as parks, playing fields, small public spaces, even green roofs. That's a good thing for many reasons, as we take a look below.

Environmental Benefits

It's been proven that trees improve air quality by adding oxygen and removing pollutants. In addition, green spaces with less pavement have a cooling effect, reducing city temperatures in the summer. Not only does this cool down humid summers, but saves energy costs to cool buildings. Studies found that rooftops with grass and plants beats asphalt and gravel roofs as they help cool the building while providing a more aesthetically pleasing place for tenants to visit.

Another environmental benefit to open space, particularly green space, is help with stormwater runoff. Unpaved ground absorbs water, aiding in water collection during storms and helping to prevent flooding.

Exercise

Open space such as parks, walking trails, playgrounds and fields are great areas for recreation. These spaces encourage people to walk and exercise by providing places for physical activities – whether organized or spontaneous. This is especially important for city residents who cannot afford gym memberships or exercise classes.

Mental Health

Exercise has great mental and physical health benefits. Open spaces also boost a sense of well-being by providing calm places to stop and think without the city noise and hustle, bustle. This helps reduce stress by providing a respite from the city.

Community Benefits

Open spaces are areas for recreation, but they can also be social spaces for people to gather, meet, play, and talk. Open space can be used for cultural purposes, for social events or to engage in recreational activities with one another. These places cause people to interact with others in the community, whether via an organized event or activity or just because they are places where people gather. This benefits adults and children by providing a sense of community as people get to know others in their neighborhood.

Urban green spaces are good for the environment, facilitate physical exercise and better mental health for city residents, and help create a sense of community in a city. City has a network of parks, natural open spaces, and waterfront offering residents many opportunities for recreational and nature experiences.

Economic Benefits

Open spaces such as parks and recreation areas can increase residential property values and property tax revenues for local governments; it is less expensive to provide roads, water and sewer services to homes in compact, walkable developments than it is to homes in large, suburban developments; and the parks and the open spaces and greenbelts offered by compact walkable neighborhoods create higher housing prices and marketing opportunities.

The increase in property values due to proximity to open space occurs in urban, suburban and rural areas; the impact is greatest in urban areas. In rural and suburban areas, it is the houses near preserved open spaces and farmland that are associated with increases in property value. Open space tends to require fewer municipal services than residential, so land preservation can decrease a community's tax burden. The design elements used in these neighborhoods can also create a tax savings on infrastructure.

Some studies show that the parks, open spaces and greenbelts offered by compact, walkable neighborhoods, (also known as traditional neighborhood development), create higher housing prices, create marketing opportunities, and tend to cause the neighborhood's houses to sell more quickly than conventionally designed neighborhoods.

Recreational and Open Space facilities may act as basic industry which bring money from other region to Ramu Upazila. It has the potential to create job and business opportunity.

3.5 Study Methodology

The study was conducted by review approach, brainstorming and literature review on historical, heritage and tourism. The Dhaka City Structure Plan, Detail Area Plan (DAP), previous Upazila master plan and working papers, existing rules and regulations, higher level plans are reviewed. For the convenience of the study, stakeholder mapping is done to picturesque the related stakeholders so that none of the opinions are missed and to develop a bridge between end-users and authority encouraging bottom-up approach of planning. Before moving onto the field visit for secondary data collection from different offices in the Ramu upazila, KII, meeting and to picturesque the heritages co-ordination schema along with a questionnaire is developed. At last policy guidelines are prepared to present it in the form of report writing and power point presentation.

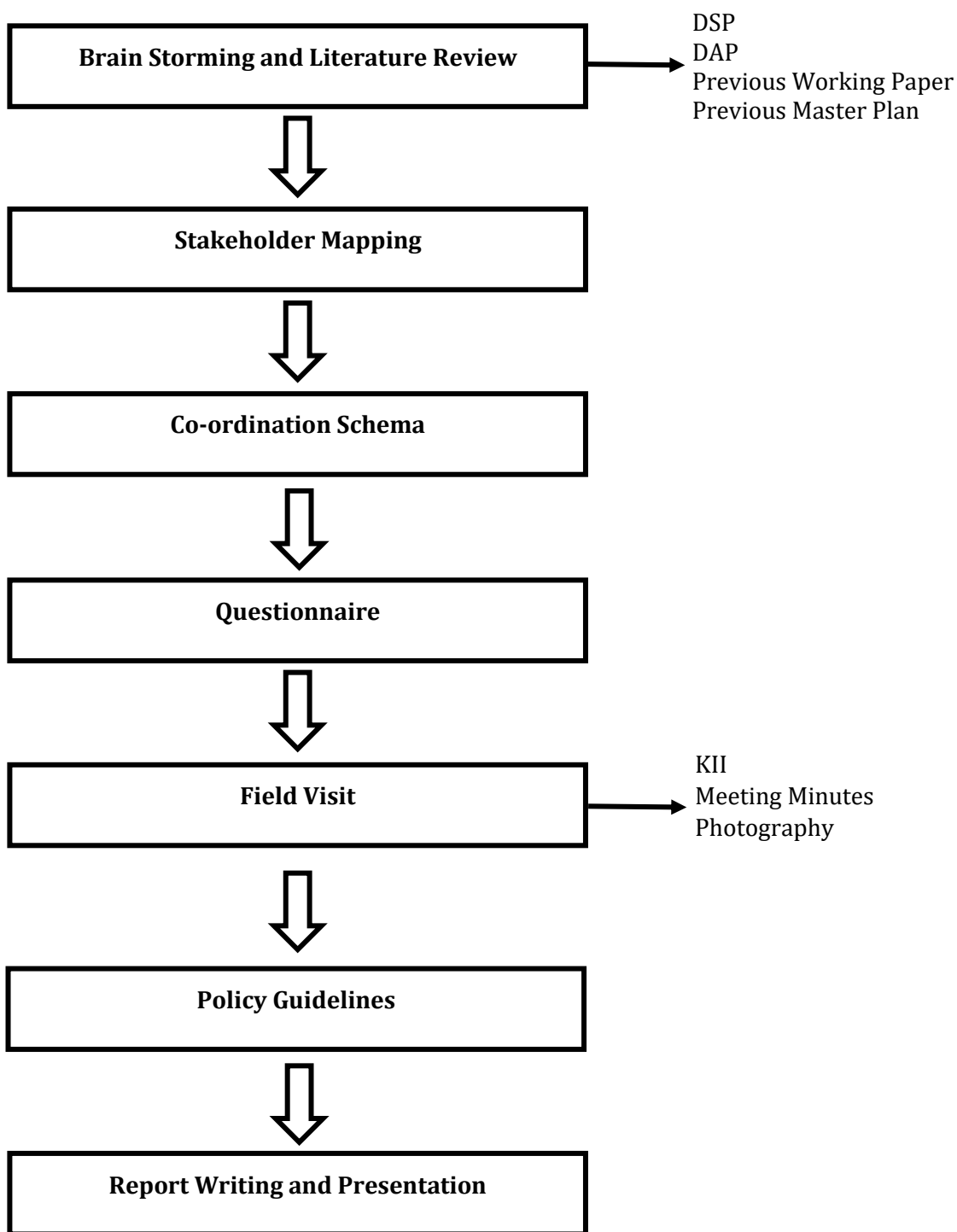


Figure 3-1: Core Methodological Framework

Stakeholder Mapping



Figure 3-2: Stakeholder Mapping

Table 3-3: Co-ordination Schema

Objective 01: To assess the existing scenario regarding recreation and open space		
Complex Variable	Simple Variable	Data Collection Method / Work Approach
Open spaces	- Classification and listing - Natural and man-made elements - Plant categories - Soil quality - Standards - Hierarchy	Physical Survey, Secondary Data Collection
Recreation	- Linkage between open space and recreation - Natural recreational facilities - Man-made recreational facilities - Important landmarks	Physical Survey, Secondary Data Collection
Recreation facility types	- Outdoor recreation facilities - Indoor recreation facilities	Physical Survey, Secondary Data Collection
Environment	- Pollution - Surrounding features - Heat island - Weather - Temperature	Physical Survey, Secondary Data Collection

Objective 02: To assess future requirements regarding recreation and open space		
Wildlife Habitat	• Flora • Fauna • Sanctuary	Physical Survey, Secondary Data Collection
Mobility	• Pedestrian Walkway • Bi-Cycle Lane • Vehicle Choice	Physical Survey / Design Process
Accessibility	• Parking Facilities • Roadway	Physical Survey / Design Process
Services and Facilities	• Restaurants • Recreational Points • Price Range • Viewpoint • Relaxing Spot	Physical Survey / Design Process
Safety and Security	• Area Boundary • Unsocial Activity • Emergency Equipment • Street Lighting	Physical Survey / Design Process

3.6 Existing Scenario and Critical Issues

3.6.1 Recreation and Open Space Sites

Open spaces are vital for modern cities. Some of the most modern and liveable metropolises in the world are just as famous for their open spaces as they are for their architectural landmarks and culture. Whether it is Central Park in New York City, Hyde Park in London, or Kruger National Park in South Africa, open spaces in cities not only boost tourism but also create a high quality of life by stimulating commercial growth and supporting outdoor recreation.

With the concept of sustainable cities continuing to gain prominence, open spaces have become a key consideration in urban planning. From stormwater management and preservation of nature to the provision of green spaces and rising property values, these undeveloped areas can revitalise a cosmopolis. They are also extremely important for the physical and mental health of the local community.

However, maintaining open spaces can also become a challenge. For instance, growth in population combined with unplanned urban expansion and the increased demand for affordable housing can lead to a substantial decrease in green spaces and agricultural land. Nonetheless, these spaces are vital for the well-being of people who live in large and crowded cities filled with concrete buildings.

Recreational and Open Space Planning lacks a consistent definition, the phrase is typically used to describe an undeveloped or lightly developed parcel of land that is not meant for agricultural practices.

Whether they are owned publicly or privately, open spaces cannot be utilised for residential, commercial, institutional, or industrial developments. Some of the most common types of open

spaces include urban parks and playgrounds, green belts, forest land, undeveloped beaches, national parks and preserves, areas surrounding lakes, and more.

However, that being said, it is important to note that urban open spaces are usually defined based on their surroundings. For instance, a neighbourhood park or a walkway will be considered an urban open space in big cities even if it is surrounded by developed areas. Similarly, some historical sites may also be counted as open spaces.

Urban parks, such as public gardens, landscaped boulevards, and waterfront promenades, are considered powerful tools for sustainable cities.

A city that is home to a sufficient number of parks is generally considered to be a healthy one. These open spaces provide residents with an opportunity to enjoy the fresh breeze and indulge in recreational activities. In addition, they enhance the aesthetic appeal of the neighbourhoods, increase community engagement, offer educational opportunities to children, expand the green infrastructure, hike property prices and define the civic culture.

Furthermore, urban parks can help promote and preserve biodiversity at varying levels. They can also become the top tourist attractions, thus sustaining the local economy as well. Many of these open spaces are situated in proximity to residential areas as they essentially cater to the dwellers by offering them a place to breathe in the fresh air, go on evening walks, or simply relax on a bench. They may also have a small play area for children featuring slides, swings, and other attractions.

However, For the study purpose of existing recreational and open space in Ramu Upazila, The consultants appointed a team to conduct a secondary data collection expedition and to picturesque heritage landmarks in the project area. The purpose of this visit is to achieve an idea about the physical characteristics of the heritages, history, tourism, its surrounding environment, including various kinds of problem, infrastructure and utility facilities, the state of the transportation system, institutional adequacy etc. The team has also performed a preliminary consultation with a number of important project stakeholders, which are covered in the following sections: A courtesy meeting with Assistant Engineer, Ramu Upazila was conducted at his office. The team was able to explain all the specifics required of the project's completion of Ramu upazila master plan. He showed the crew with some necessary material and expressed a strong interest in the upazila master plan. Additionally, he briefly discussed some of upazilas most pressing issues on heritages. He quoted:

Table 3-4: Impact of various Heritage Sites on Ramu Upazila

Name of the site	Type	Location	Having any impact on Ramu upazila or not?
Himchari National Park	Tourism	Khuniapalong	No
Sea Beach	Tourism, Swimming	Khuniapalong	No
Marine Drive Road	Tourism	Khuniapalong	No
BKSP Sports Ground	Sports & Trainning	Joarianala	Yes
Khijari Playground	Sports	Fatehkharkul	Yes
Sonartari Park	Tourism	Joarianala	Yes
Rajarkul Forest Range	Tourism	Rajarkul	Yes
Ramu Botanical Garden	Tourism	Rajarkul	Yes
Rangkut Buddha Monastery	Tourism	Rajarkul	Yes

Name of the site	Type	Location	Having any impact on Ramu upazila or not?
Ramu Historical Buddha Monastery	Tourism	Fatehkharkul	No
Niribili Park	Tourism	Idgar	Yes
Tat Mela	Fair	Fatehkharkul	Yes
Buddha Mela	Fair	Fatehkharkul	Yes
Upajati Mela	Fair	Fatehkharkul	Yes
Sonartari Super Market	Shopping & Visiting	Fatehkharkul	Yes

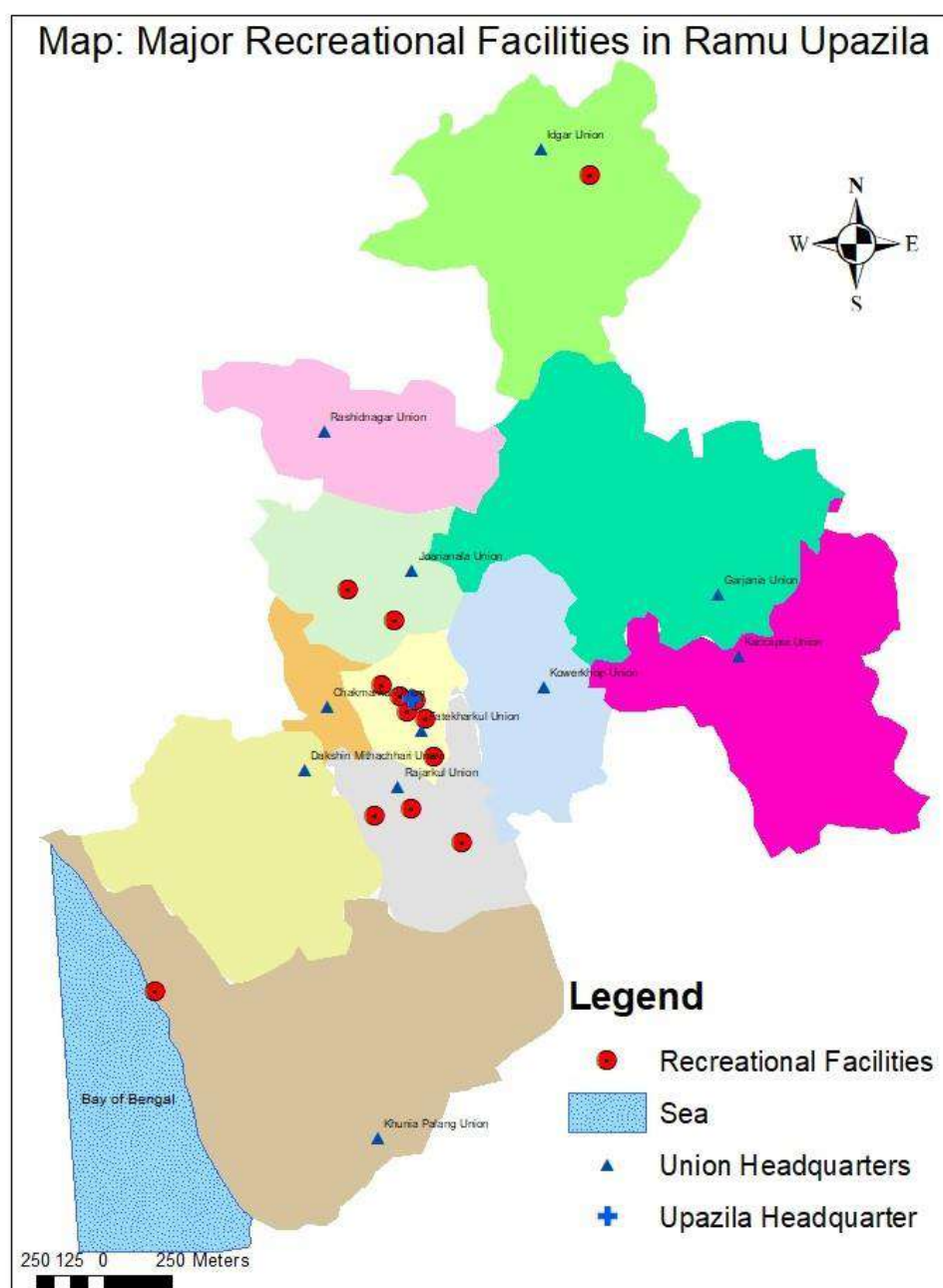


Figure 3-3: Major Recreational Facilities in Ramu Upazila

(Source: Field survey)

3.6.2 Findings of Physical Feature Survey

Open spaces and playgrounds provide a breadth of enriching experiences for kids and families. There are so many benefits of open spaces and playgrounds. The major difference between Playground and Open space can be describe as that playgrounds typically are defined by a specific area of play featuring play equipment, while parks or complexes often feature a playground and sports fields, walking trails, and more amenities.

An open space is defined as a public, green recreation area. Open space often include playgrounds but can also be encompassed by forests and walking trails, athletic fields, bathrooms, gazebos and shelters, public gardens, and more. Open spaces are often used for the protection of wildlife and natural habitats in addition to being set aside for human enjoyment.

A playground is defined as an outdoor area provided for children to play in. It can feature several different kinds of play equipment, like swings, a ramped structure, sensory panels, musical instruments, even modern options like technology-infused play arches and activity zones. Some playgrounds have amenities like benches and trash receptacles.

Open spaces and playgrounds feature different amenities and equipment. Open spaces often have several amenities that playgrounds do not have, but designs vary and sometimes playgrounds do feature additional amenities like benches, tables, receptacles, and outdoor athletic equipment in addition to traditional playground equipment. The aforementioned elements are common in most open spaces today. Larger open spaces and revolutionary inclusive complexes include several other amenities, like accessible bathrooms, sight-seeing walking trails, athletic fields, shade structures and trellises, snack shacks, and more.

Playgrounds and open spaces have different safety concerns. Playgrounds often provide a more contained environment; some larger complexes even provide a private experience through membership programs. Playgrounds also feature safety surfacing that meets certain head impact and fall height criteria, whereas open spaces are usually largely natural grass. Open spaces are usually public and are larger environments, which may be a safety concern. Open spaces are great for older kids, while most playgrounds are best suited for kids 12 and under.

Open spaces are larger, often including playgrounds within them as a feature. Playgrounds, being smaller, are often enclosed. Location and design choices are a huge factor in the size of a playground, while open spaces can span for miles due to the incorporation of the natural environment and very often forests. Open spaces are usually located in the heart of a city or town and are easily accessible. Playgrounds are frequently found scattered throughout a town and may be spread out into rural areas.

This study describe the differences in size and varying amenities of open spaces and playgrounds. Open spaces, being larger and having many more features, are often more expensive to complete than playgrounds. That being said, playground designs vary widely and have a large range of prices.

For the study, a detailed physical feature survey has been taken places in Ramu Upazila for its eleven union. Both open spaces and playgrounds have been identified with their geographical location through the physical feature survey.

Union-wise Open spaces and Vacant land are identified through physical feature survey.

Union-wise Playgrounds are also identified through physical feature survey.

Table 3-5: Union wise Open Spaces

Serial No	Union Name	Number of Open Space
1	Idgor	12
2	Kauarkhop	09
3	Khuniapalong	18
4	Joarianala	07
5	Kocchopia	14
6	Dakkshin Mithachori	09
7	Gorzonia	15
8	Razarkul	08
9	Chakmarkul	07
10	Rashidnogor	10
11	Fatekharkul	05
	Grand Total	114

(Source: Physical Feature Survey, 2024)

Table 3-6: Union wise Playgrounds

Serial No	Union Name	Number of Playgrounds
1	Idgor	27
2	Kauarkhop	16
3	Khuniapalong	33
4	Joarianala	15
5	Kocchopia	32
6	Dakkshin Mithachori	23
7	Gorzonia	28
8	Razarkul	18
9	Chakmarkul	16
10	Rashidnogor	23
11	Fatekharkul	14
	Grand Total	245

(Source: Physical Feature Survey, 2024)

Map: Open Spaces and Playgrounds of Ramu Upazila

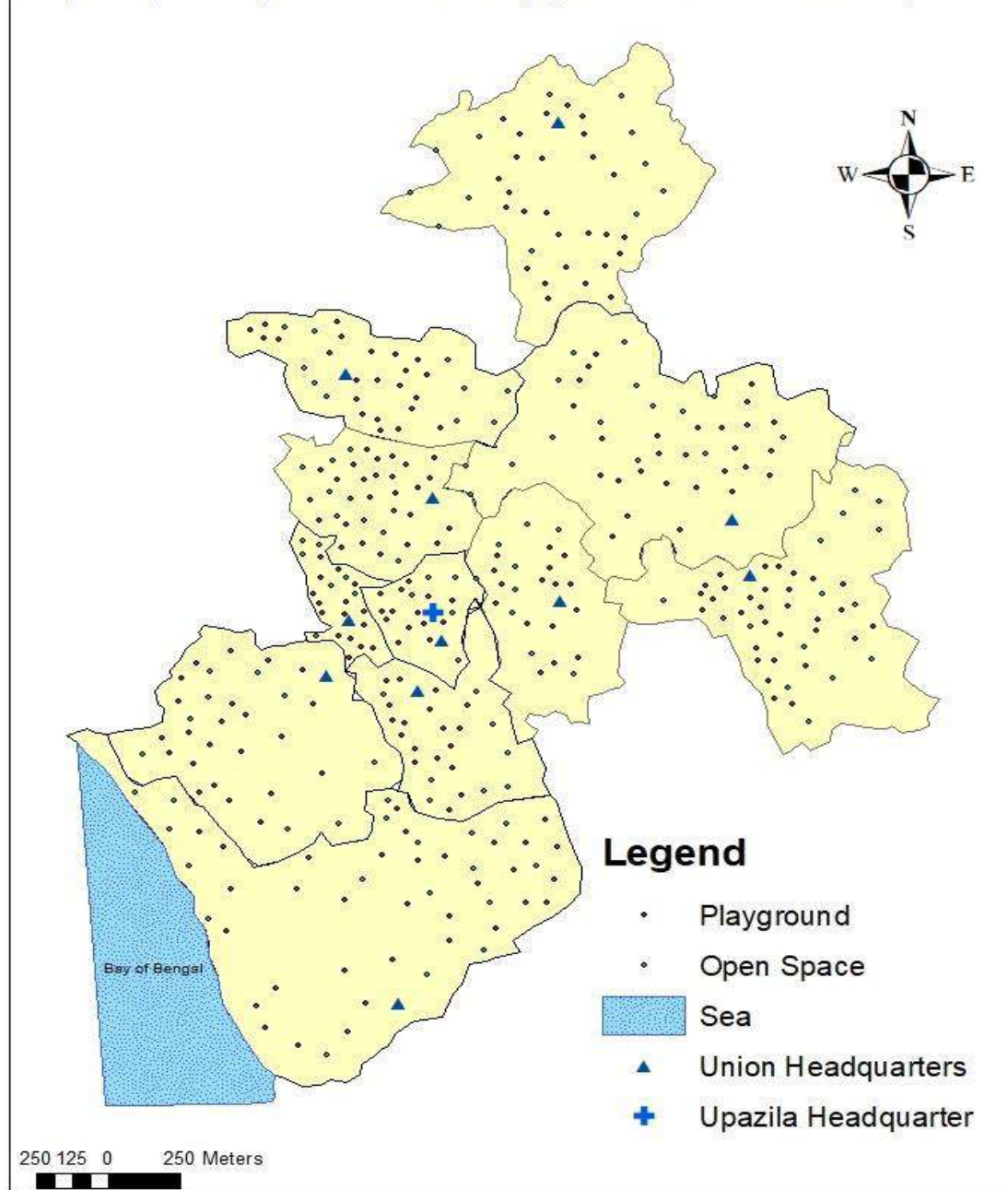


Figure 3-4: Open Spaces and Playgrounds of Ramu Upazila

(Source: Field survey)



Figure 3-5: Open space and Recreation facilities in Ramu Upazila



Figure 3-6: Playgrounds in Ramu Upazila

3.6.3 SWOT Analysis

SWOT analysis as a management tool that helps enhances the functions of a system and ensures the achievement of the predetermined goals. SWOT analysis, which includes the four components of strengths, weaknesses, opportunities and threats, is frequently employed systematically evaluate a decision, plan or instruction. SWOT analysis is widely used for strategic planning of the long-term and short-term development of an organization. The main purpose of strategic planning is to maintain the balance of the organization to any changes in the environment and to maintain the stability of the organization to be able to survive all over time. This method is based on a two-stage analysis performed separately: strengths (S) and weaknesses (W) are internal (controllable) factors that help organizations accomplish, or prevent them from accomplishing, their missions. Nevertheless, opportunities (O) and threats (T) are external (undeniable) factors that allow organizations to achieve, or prevent them from achieving, their missions. By identifying the factors of these four components, one can perform evaluations for decision-making, planning and, formulating regulations.

Strategic planning is essential for realizing development plan's potential. Essential to that plan is an awareness of your company's strengths and weaknesses, as well as understanding opportunities and threats facing your business.

A SWOT analysis takes a global view of study topic but also evaluates smaller-scale elements of the development plan. It points out where you are strong, or not so strong, and can help you explore the opportunities and threats existing in target area. It's this type of knowledge that makes your strategic planning that much more robust.

SWOT is an acronym for strengths, weaknesses, opportunities and threats. Since your strengths and weaknesses are internal to your organization, and opportunities and threats external factors, SWOT analysis is sometimes called internal-external analysis.

SWOT analysis is a framework for identifying and analyzing your organization's strengths and weaknesses, as well as the opportunities and threats you are facing.

Strengths are the things that your company does particularly well, or resources and assets that it owns that distinguish it from your competitors. You need to know your company's strengths; they're what make it thrive.

Weaknesses are internal attributes and resources that study area lacks. You need to know your weaknesses because they make your plan vulnerable. To identify the underlying cause of study area's weaknesses it is to use root cause analysis.

Opportunities are a set of external circumstances that, with the right decisions, development plan can be directed towards a favorable strategic position.

Threats are external forces that constitute a risk to the development plan. Development plan should be on the lookout for external obstacles; it will have to overcome them if it is to flourish.

SWOT analysis was also done by discussing with key informants. The planning team also visited the Upazila and noted the key points of SWOT analysis.

Table 3-7: SWOT Analysis

Strength	Weakness
Playlot, play field are observed within school, high-school, and college	Defective land transfer laws, rules, and regulations
Natural Greenery	The UNO does not have the proper authority to enforce open conservation
There are many old and manor houses and Buddha monastery which bear witness to history	Poor management of formal open space
Youth sectors are becoming more aware of the necessity and conservation of open spaces and recreation	Failure of development agencies and urban local governments to implement plan designated open space provisions
Opportunity	Threat
With proper maintenance, old Buddha monastery can become tourist attractions.	Conflict of Interest between land brokers and implementing authority
Opportunity to raise public awareness of local community	Insufficient finances to address urban linkage between open space and recreation
Scope to develop recreational open space in suburban areas due to presence of unused and natural landscape	Degradation of the recreation and open space due to pollution and lack of conservation. Encroachment of public open space

3.7 Review of Relevant Existing Plans, Rules, Regulation and Policies

3.7.1 Reviewed Relevant Plans

Environment related existing rules and regulations are reviewed to assess the existing recreational facilities. Local level to higher level planning policy both are considered i.e., Sustainable Development Goals (SDGs) Dhaka Strategic Plan (2016-2035) Patuakhali Municipal Master Plan (2010-2030) The Environment Conservation Act (ECA), 1995 The Environment Conservation (Amendment) Act, 2010 National Urban Sector Policy, 2011 (Draft) Land Use Policy, 2001. The relevant matters are discussed below-

Table 3-8: Review of Existing Planning Policy

Existing Rule and Regulations/Higher Level Plans	Relevant Matters
Sustainable Development Goals (SDGs)	Aim-11 – Creating green spaces Aim-15 – Restoration of damaged land
Dhaka Strategic Plan (2016-2035)	Conservation of river channels, canal banks and wetlands
Patuakhali Municipal Master Plan (2010-2030)	Population, considering distance and suitable land, most urban social services are offered to citizens within 1-2 km range
The Environment Conservation Act (ECA), 1995	The declaration of ecologically critical area is addressed under section-5 of ECA, 1995 and Rule – 3 by considering the factors as mentioned in Chapter 2.2
The Environment Conservation (Amendment) Act, 2010	–Environmentally sensitive areas (Ecologically Critical Area) determination.

Existing Rule and Regulations/Higher Level Plans	Relevant Matters
	–Regarding conducting activities in environmentally sensitive areas
National Urban Sector Policy, 2011 (Draft)	Conservation of land resources in ecologically sensitive areas
Land Use Policy, 2001	Reservation of special land

3.8 Physical Planning Implication

Ramu Upazila's existing recreation and open spaces are featured as not planned and scattered all over the places. Physical planning for recreation and open space involves: inventory assets, establishing policies, setting priorities and recommendations, integrating with other land uses, balancing preservation and development, environmental benefits, health benefits etc. Recreation and open space resource planning is a rational systematic decision-making process about the future management of recreation resources and recreation opportunities. Recreation planning applies analytical tools to deter our human tendencies to make decisions based on predisposition, bias, inadequate analysis, group-think, insular perspective, resistance to change, and excessive self-confidence. It results in decisions that are more effective, efficient, fair, reasoned, and defensible. Planning and evaluation are essential in community recreation. They help bring people together around shared goals that ultimately make the community a better place for everyone.

In context of reviewing and updating the master plan of Ramu Upazila, the following are the spatial planning implication of recreation and open space sector study:

- Existing spatial distribution pattern of recreation and open space are to be duly studied/examined in view of the future need
- Existing recreational and open spaces are to be made accessible to the users
- New sites are to be suggested and selected for open space and recreational facilities in view of future need vis-à-vis thereof maintaining spatial hierarchical order
- Determining planning standard for recreation and open space in connection with local conditions i.e., the availability of land, accessibility, affordability to implement, etc.

3.9 Conclusion and Recommendations

This paper shows not only the condition of recreational or open spaces but also heritage sights and historical background of Ramu Upazila. It has potential to develop as an environmentally friendly Upazila. This study will help to decide the development policy of recreational spaces and conservation policy for historical places. Some recommendations are –

- Conservation of Buddha Monastery.
- Conservation of Bakkhali River.
- Renewal of existing play fields.
- Open spaces should be utilized by providing recreational activity.
- Parks for children should be established.
- Recreational activity might be created around pond side.

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Chapter Four: Health Facility



CHAPTER FOUR: HEALTH FACILITY

4.1 Introduction

An examination of the state of health facilities and services is given in this working paper on Ramu Upazila's health facilities. We have gathered information for this working paper from both primary and secondary sources. After analyzing the data, several policy recommendations are made to enhance the current state of affairs. The goal of the study is to help master plans create better health-related ideas

In an Upazila or any other community, health facilities are vital. The following are some of the factors that make Ramu Upazila's health facilities so important:

1. Healthcare accessibility: Ramu Upazila people would have easy access to healthcare facilities. Primary care services including immunizations, frequent checkups, and mild disease treatment fall under this category.
2. Emergency care: Medical institutions are outfitted with the tools necessary to manage crises and offer life-saving treatment. Having rapid access to medical care can be crucial for preserving lives in the event of an accident or severe sickness.
3. Disease prevention and control: By administering immunizations, carrying out health screenings, and keeping an eye out for disease outbreaks, medical facilities can aid in the prevention and management of the spread of communicable illnesses.
4. Maternal and child health: By offering prenatal care, delivery services, and postpartum care, health facilities play a crucial role in supporting the health of mothers and their children. This may lower the incidence of infant and mother mortality.

Mental health: Support and services for mental health are available in health facilities, and these are essential for enhancing people's general wellbeing.

4.2 Methodology Adopted

- The data are collected mostly from secondary sources. Secondary sources include BBS, Upazila public health website, Upazila website, Historical data, Hospital records, local clinic authorities, and census data, Google Map etc.
- Primary survey include working paper survey.
- Analytical statistical analysis involves statistical inference, trend analysis, and descriptive statistics.
- Statistical tools for analyzing demographic trends, academic performance measures, and quantitative survey data (e.g. Excel) would be addressed for interpretation.
- SWOT evaluation: Determine the advantages, disadvantages, opportunities, and dangers associated with the health facility's present and future conditions. Examine both external and internal variables affecting the expansion and advancement of the health institutions.
- Reporting and Graphics: To portray data in an understandable and efficient manner, use maps, graphs, charts, and info graphics.
- Final products: thorough reports, executive summaries, and presentations that inform stakeholders of findings.

The master plan for the health institution can be based on precise, thorough, and implementable insights by using a strong methodology for data gathering and interpretation. This will guarantee that the final plan takes into account the genuine objectives and goals of the health care community.

4.3 Existing Condition of Health Facilities

4.3.1 Public Health

The Bangladeshi district of Cox's Bazar includes the Ramu Upazila, which is well-served by a variety of medical services. Planning changes and evaluating healthcare accessibility require an understanding of the location and accessibility of these institutions. The information given describes the quantity and kinds of medical facilities in Ramu Upazila.

Table 4-1: Types of Medicle facilities

Facility Type	Total No.of Faciliti(es)	No. of Beds
Upazila Health Complex	1	31
OPD at Sadar Upazila Health facility	0	0
Union Sub Centers	2	0
Union Health & Family Welfare Centers (belong to DGHS)	0	0
Union Health & Family Welfare Centers (belong to DGFP)	7	0
Rural/Urban/Thana Health Centers	0	0
Community Clinics	23	0
Trauma Centers	0	0
NGO Clinics/Facilities	2	30
Private Clinic	2	40
Diagnostic center	10	0

(Source: Primary Survey)

The following categories of health facilities and their corresponding counts are included in the data:

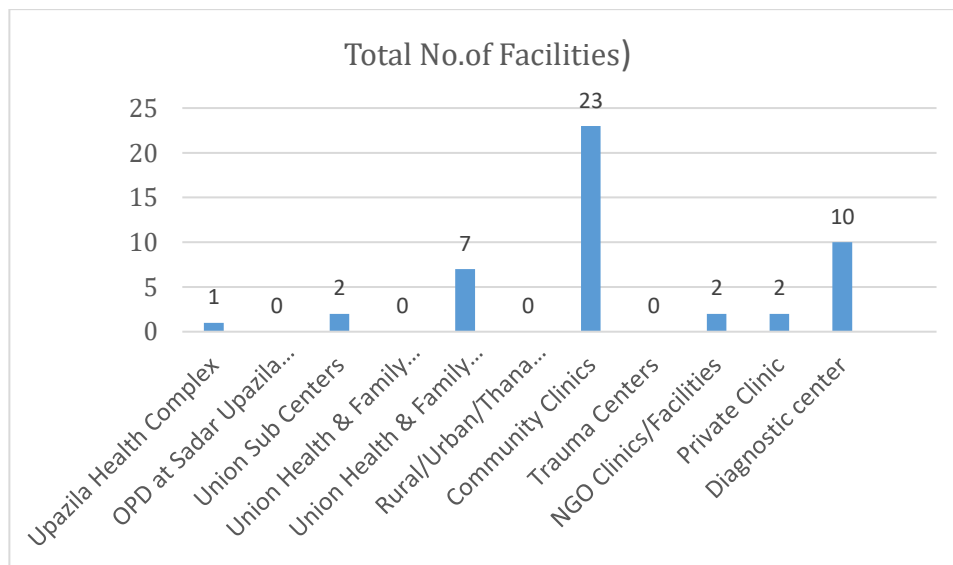


Figure 4-1: Total Number of Medicle Facilities

(Source: Primary Survey)

4.3.1.1 Institutional Capacity

Upazila Medical Center: This is a main healthcare institution that offers both inpatient and outpatient care, among other comprehensive services.

Sadar Upazila Health Facility's OPD: Dedicated outpatient departments (OPDs) are absent from the main Upazila medical institution.

Union Sub Centers: Smaller health facilities offering primary healthcare services to union-level people.

DGHS's Union Health & Family Welfare Centers: Under the Directorate General of Health Services (DGHS), there are no such centers.

DGFP-affiliated Union Health & Family Welfare Centers: The Directorate General of Family Planning (DGFP) oversees several centers, which provide services related to reproductive health and family welfare.

Health Centers in Rural/Urban/Thana: There are no dedicated health facilities for the people living in thanas (sub-districts), cities, or rural areas.

Community Clinics: These are community-based clinics that offer primary healthcare services, dispersed extensively to effectively serve the local populace.

Trauma Centers: There are no trauma centers with specific training.

Private Facilities/Clinics: There are twice facilities for private healthcare accessible.

NGO Facilities/Clinics: A few clinics run by non-governmental organizations (NGOs) offer extra medical services.

Diagnostic center: There are remarkable number of diagnostic center.

Ramu Upazila's healthcare system exhibits a mixed picture of availability and gaps:

Basic Healthcare: The foundation of basic healthcare in the area is comprised of 23 community clinics and one Upazila Health Complex. These establishments are vital in providing the community with necessary healthcare services.

Family Welfare: Under the DGFP, there are a lot of Union Health & Family Welfare Centers (seven altogether), which suggests that family planning and reproductive health services are given priority.

Secondary and Specialized Care: There are significant gaps in the availability of secondary and specialized healthcare services. Private healthcare institutions, trauma centers, and maternity and child welfare centers are all absent. Patients may need to go outside of the Upazila in order to receive advanced care due to the lack of specialized services.

NGO Participation: Non-governmental organizations (NGOs) augment the public health infrastructure by adding two facilities and may offer specialized or community-focused services.

A small number of NGO clinics and government-run primary health institutions provide the majority of Ramu Upazila's healthcare infrastructure. Although the area makes significant efforts in providing family welfare and primary healthcare, it lacks private and specialized healthcare facilities. Filling up these gaps could lead to better healthcare outcomes and more complete medical care for the Ramu Upazila community.

4.4 Number of Bed Facilities and Health Personnel in Government Health Complex

An Upazila Health Complex serves Ramu Upazila, which is a component of Bangladesh's Cox's Bazar area, and offers the locals access to vital medical treatment. A facility's ability to provide healthcare is mostly determined by the number of beds available and the presence of medical staff. The Ramu Upazila Health Complex's bed capacity and staffing are described in the data that is provided.

Accommodations for Beds

Bed count: With 31 beds overall, the health facility has a moderate inpatient capacity. This ability is necessary to admit patients who need medical supervision to the hospital and provide them with overnight care.

Medical Personnel Physicians: The health complex has a modest number of medical experts to diagnose and treat patients, with 6 doctors on duty. These physicians probably provide both inpatient and outpatient care.

Nurses: Having 23 nurses indicates a good nurse-to-patient ratio, which is essential for providing high-quality treatment, patient supervision, and help during medical operations.

Technicians: With seven technicians, the facility has the technical support to run medical equipment and provide diagnostic services (such as imaging and laboratory testing).

Doctors: The facility offers a wide range of medical services, and its 15 physicians may include both general practitioners and specialists.

Assistant Health Inspectors (AHI), Health Assistants (HA), and Health Inspectors (HI): The lack of these positions suggests a deficiency in public health and preventive services, which are essential for illness prevention, health education, and community health monitoring.

Additional Staff: There are twenty-five employees in the "Others" category. These employees are probably support staff, administrative workers, and potentially additional healthcare practitioners. This team is crucial to the health complex's seamless operation since they oversee maintenance, patient records, administrative duties, and other non-clinical responsibilities.

Table 4-2: Number of Bed facilities in Upazila Helth Complex

Upazila Health Complex	
Bed facilities/health personnel	Number
Number of Beds	31
Number of doctor	6
Number of nurse	23
Number of technician	7
Physician	15
HI	0
AHI	0
HA	0
Others	25

(Source: Primary Survey)

With 31 beds, the Upazila Health Complex in Ramu Upazila can accommodate moderate numbers of inpatients. With 23 nurses and 7 technicians working with a team of 6 doctors and 15 physicians, the hospital boasts a well-rounded medical staff that can provide a wide range of healthcare services.

The lack of Health Inspectors, Assistant Health Inspectors, and Health Assistants, however, highlights significant inadequacies in public health and preventative services. Since these positions are essential for illness prevention, health education, and public health surveillance, the gap may have an effect on the community's overall health results.

With 25 'Other' employees, the facility is staffed to guarantee smooth operations, providing a range of administrative and support services required for the day-to-day running of the health complex.

With its current bed capacity and medical staff, the Ramu Upazila Health Complex is moderately equipped to manage both inpatient and outpatient care. The proficient group of physicians, nurses, and technicians guarantees the provision of crucial medical care. However, addressing the shortage of Health Inspectors and Assistants is essential to improving public health outcomes and preventive treatment. Improving illness prevention, health monitoring, and general community health in Ramu Upazila would result from strengthening these areas.

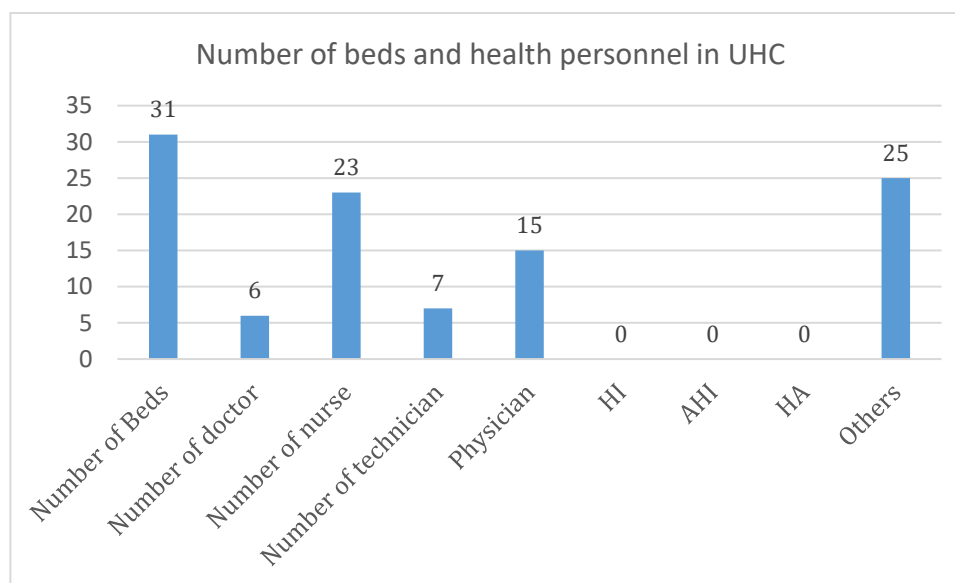


Figure 4-2: Number of beds and health personnel in UHC

4.5 Number of Physician Type

There are many different types of doctors in Ramu Upazila, Bangladesh's Cox's Bazar region, each with their own specializations and certifications. Understanding the distribution and makeup of physicians is essential to comprehending the healthcare environment in this area since they have a direct influence on the kind and caliber of medical services that the general public can access.

4.5.1 Physicians with Allopathy

FCPS/Over, MBBS (10): These doctors possess a wealth of education and credentials. While FCPS (Fellowship of the College of Physicians and Surgeons) or other advanced certifications denote extra focus and expertise, MBBS (Bachelor of Medicine, Bachelor of Surgery) is the primary medical degree. These doctors probably offer a variety of medical services, including specialist treatment.

L.M.F. (8): LMF professionals offer basic medical care and possess a diploma. They may not have received the same comprehensive training as MBBS physicians, but they are nonetheless extremely important in providing primary healthcare, especially in underprivileged or rural areas.

4.5.2 Practitioners of Alternative Medicine

Ayurvedic/Unani Practitioners (2): These medical professionals adhere to age-old medical systems that have their roots in Ayurvedic and Unani traditions. With an emphasis on holistic health and wellness, they provide alternative treatment alternatives based on herbal and natural therapies.

Practitioners of Homeopathy (14): Homeopathy is an additional alternative medicine that follows the "like with like" theory of treatment. Homeopathic healers enhance the body's self-healing mechanisms with much concentrated medicines. Of all the alternative medicine modalities, homeopathy has the most number of practitioners; it seems to play a major role in healthcare in Ramu Upazila.

Table 4-3: Number of Physician Type

Number of physician Type	
Type	Number
MBBS, FCPS/over	10
L.M.F	8
Unani / ayurvedic	2
Homeopathy	14

(Source: Primary Survey)

Ramu Upazila has a wide range of medical professionals, both in terms of their training and the kinds of medicine they practice:

4.5.3 Allopathic Medical Practice:

MBBS, FCPS/Over: Ten exceptionally skilled doctors who are able to offer both general and specialty medical care.

L.M.F.: Eight professionals providing crucial primary care services; especially helpful in areas with little access to medical professionals with the necessary training.

Alternative Health Care: Two practitioners who contribute to traditional and holistic healthcare practices are unani and ayurvedic.

Homeopathy: 14 practitioners show that the community heavily relies on homeopathic treatment.

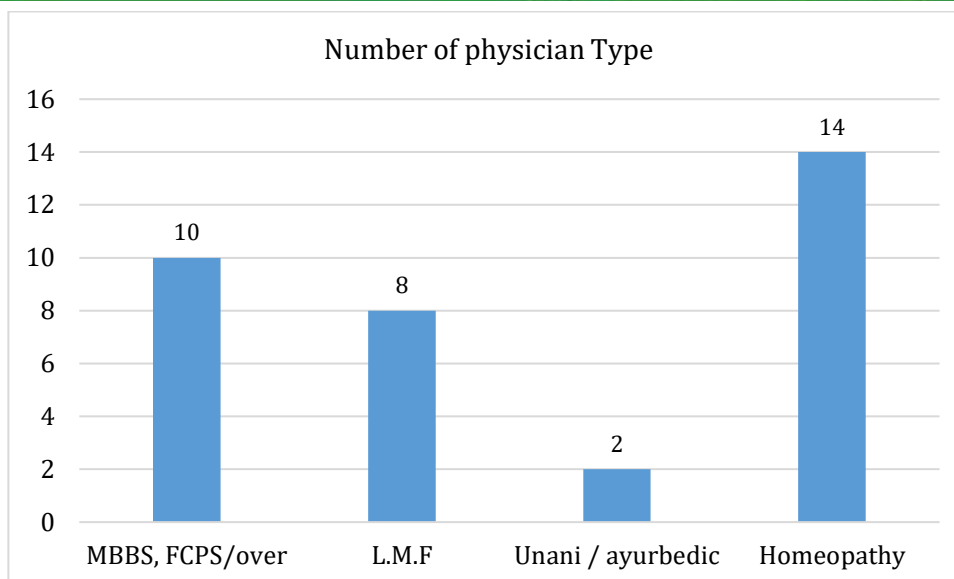


Figure 4-3: Number Of Physician Type

(Source: Primary Survey)

Ramu Upazila's medical system combines complementary and alternative therapy with traditional allopathic medicine. Ten highly qualified MBBS, FCPS/Over physicians guarantee that patients will have access to comprehensive and specialized medical care. The eight L.M.F. practitioners improve the area's healthcare coverage by offering essential primary care services. The community's preference for complementary and alternative medicine is shown in the high number of homeopathic practitioners (14) and the presence of Unani/Ayurvedic practitioners (2). Because different medical practices cater to different patient requirements and preferences, the healthcare environment is more holistic. However, ongoing support for allopathic education and the incorporation of alternative medicine practices could further improve healthcare delivery and results in Ramu Upazila for a robust and balanced healthcare system.

4.5.4 Recommendation:

Boost Contemporary Healthcare Services: By providing access to current medical materials and technology, as well as continuing education, physicians with advanced certifications such as MBBS and FCPS can further develop their skills.

Support Practitioners at the Diploma Level: Give L.M.F. doctors opportunity for ongoing professional development and training so they may stay up to date on the latest medical procedures and deliver the finest care possible.

Complementary Medicine Integration: To guarantee a comprehensive approach to patient care, acknowledge the importance of homeopathic practitioners and think about combining their services with the larger healthcare system.

Examine Your Options for Traditional Medicine: Determine the level of interest in Unani and Ayurvedic medicine in the community and investigate the possibility of introducing these techniques through licensed practitioners, guaranteeing a wide choice of medical services.

4.6 Health Center and Family Planning Service

Through its infrastructure for healthcare, Ramu Upazila in the Cox's Bazar district provides a range of health and family planning services. The information supplied on the volume of services rendered and the locations of immunization facilities facilitates comprehension of the efficiency and reach of the local healthcare system. Understanding the community's health requirements, the priorities in healthcare, and possible areas for development can all be gained by analyzing this data. Through its infrastructure for healthcare, Ramu Upazila in the Cox's Bazar district provides a range of health and family planning services. The information supplied on the volume of services rendered and the locations of immunization facilities facilitates comprehension of the efficiency and reach of the local healthcare system. Understanding the community's health requirements, the priorities in healthcare, and possible areas for development can all be gained by analyzing this data.

Table 4-4: Types of Family planning Services

Type of services	Number
Health service	12140
Sterilization	1
M.R	7
Injection/ copper-T	45412
Number of immunization center	88

(Source: Primary Survey)

4.6.1 Institutional Capacity

Healthcare Services (12,140): General Health Services which probably includes outpatient visits, doctor consultations, treatments, and preventative care. The volume shows that the community is actively involved in providing primary healthcare.

Steps for Sterilization (1): There is virtually little need for or availability of long-term contraceptive options, as seen by the single sterilization process. This could be because of challenges with awareness, lack of access, or cultural preferences.

Menstrual Regulation (M.R.) (7): Services for managing early pregnancies are offered under menstrual regulation. The low figure suggests little usage, which may be brought on by societal norms, awareness levels, or service accessibility.

Procedures for Injection/Copper-T (45,412): The extremely high number of these treatments indicates how commonly injectables and intrauterine devices (IUDs), long-term, reversible forms of contraception, are used. This implies that family planning is highly valued and that various forms of contraception are preferred by the population.

The total number of vaccination centers (88): A strong infrastructure for vaccine delivery is indicated by the existence of 88 vaccination centers. In order to guarantee high immunization program coverage and prevent diseases that can be prevented by vaccination, this vast network is essential.

The following salient features of Ramu Upazila's family planning and health services are reflected in the data:

Services for General Health: 12,140 health services are provided, demonstrating a proactive approach to addressing the population's healthcare requirements with an emphasis on primary and preventative care.

Family Planning and Health in Reproduction: The remarkably low number of menstrual regulation services (7) and sterilization operations (1) indicates that there is little use or access to these services. Effective family planning services are indicated by the large number of injection/Copper-T treatments (45,412), which emphasizes the preference and success of long-term, reversible contraceptive techniques.

Vaccination: The fact that there are 88 immunization clinics demonstrates a strong dedication to public health by guaranteeing broad vaccination coverage and preventative healthcare.

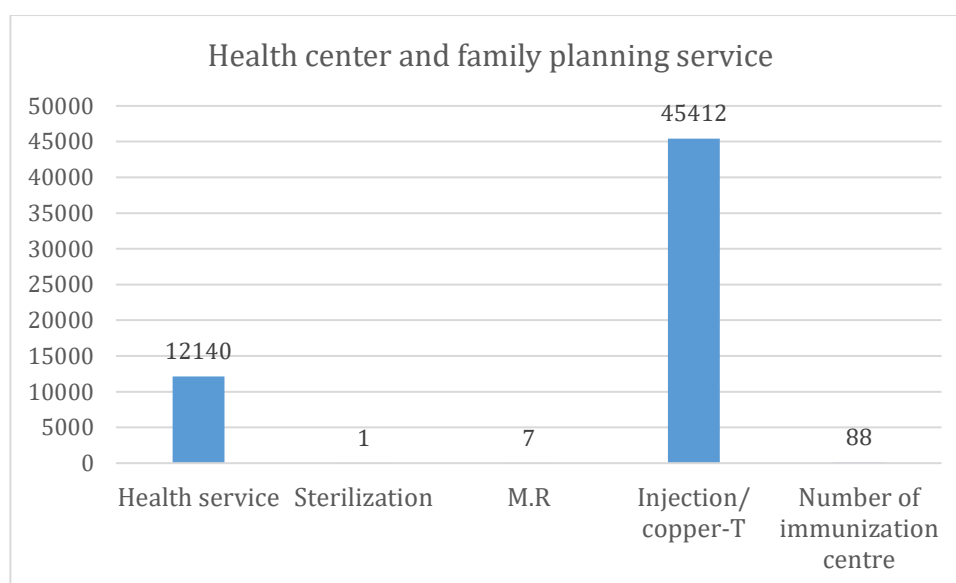


Figure 4-4: Health center and Family Planning Services

(Source: Primary Survey)

The healthcare services offered by Ramu Upazila exhibit a strong framework for both family planning and general health, with notable advantages being the substantial immunization program and the widespread use of long-term contraceptive methods. A good family planning program is shown by the high number of Injection/Copper-T operations, and widespread vaccine coverage is guaranteed by the large number of immunization centers. The extremely low figures for menstruation control and sterilization services, however, point to possible gaps in the accessibility or acceptance of these choices. Reproductive health care should be further enhanced by addressing these gaps through greater accessibility, awareness, and education. All things considered, the Ramu Upazila healthcare system seems to be well-organized and actively used, making major contributions to immunization and family planning that improve the general health and wellbeing of the local population.

4.7 Number of Existing Family Planning Personnel

Staff members who specialize in family planning are essential in providing the community with reproductive health services, information, and encouragement. The information given reflects the quantity and variety of family planning professionals in the district of Cox's Bazar, Ramu Upazila. Understanding the workforce's makeup and ability to provide family planning services successfully is made possible by the analysis of these data. Direction and Medical Supervision: A centralized leadership and medical monitoring for family planning activities is suggested by the presence of one Thana Family Planning Officer and one Medical Officer. For the purpose of organizing, coordinating, and carrying out family planning services, these positions are essential.

4.7.1 Support and Supervision Positions

FPI (5): Field-level staff are supervised and assisted by Family Planning Inspectors. There is sufficient supervision capability to guarantee quality and adherence to family planning guidelines with five FPIs.

TFPA (3): The Thana Family Planning Assistants assist the TFPO with operational and administrative duties. A small level of assistance is recommended to efficiently manage family planning efforts, according to three assistants.

Field-Level Service Providers FWV (7): Family Welfare Visitors offer advice and distribution of contraceptives, maternal health care, and education related to reproductive health. A reasonable presence in the field, directly contributing to service delivery, is indicated by seven FWVs.

FWA (28): Frontline workers known as Family Welfare Assistants visit homes to offer contraceptives, family planning information, and referrals. There is significant field-level involvement with 28 FWAs, guaranteeing broad reach and community contact.

Services for Maternal Health: SBA or midwife (13): The availability of thirteen midwives or skilled birth attendants guarantees assistance with safe childbirth and prenatal and postoperative medical care. For the purpose of improving maternal and newborn mortality rates, in particular, this workforce is essential to maternal health care. The family planning staff of Ramu Upazila is divided into a number of positions, each of which adds to the program's overall efficacy:

Support and Supervision Roles: Five Family Planning Inspectors and three Thana Family Planning Assistants provide sufficient supervisory capacity to assist and manage field operations.

4.7.2 Field-Based Service Companies:

FWV and FWA: To ensure wide community reach and participation, seven Family Welfare Visitors and twenty-eight Family Welfare Assistants offer complete field-level services.

Maternal Health Services:

Midwife or SBA: Thirteen midwives, also known as skilled birth attendants, provide vital services for women's health and safety during childbirth.

Table 4-5: Number of Personnel Type

personnel Type	Number

TFPO	1
M.O	1
FPI	5
TFPA	3
FWV	7
FWA	28
Midwife or SBA	13

(Source: Primary Survey)

The family planning team at Ramu Upazila is well-organized, with positions ranging from field-level service delivery and maternal health assistance to leadership and medical supervision. Maternal health and family planning services are widely covered and accessible due to the large number of Family Welfare Assistants and midwives/skilled birth attendants. Adequate supervisory responsibilities facilitate the provision of high-quality services, and family planning programs are implemented in a coordinated and efficient manner thanks to medical monitoring and centralized leadership. Ramu Upazila's workforce makeup demonstrates the upazila's ability to address issues related to reproductive health and enhance community well-being.

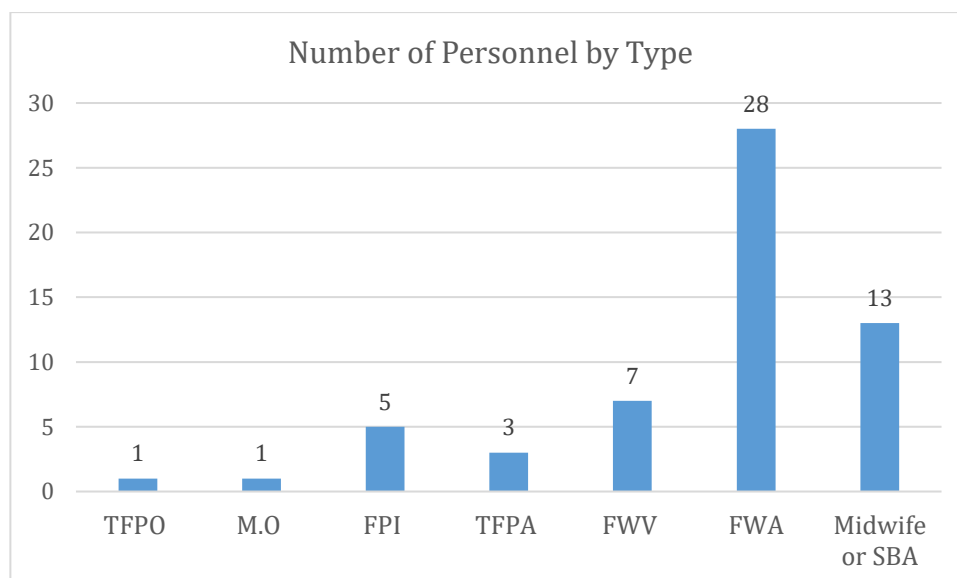


Figure 4-5: Number of Personnel By Type

(Source: Primary Survey)

4.8 Number of person engaged in Community Clinic

Community clinics play a critical role in the delivery of primary healthcare, particularly in underprivileged and rural communities. They play a vital role in carrying out public health initiatives and act as the initial point of contact for those in need of medical assistance. The information supplied describes the staff working in the Community Clinics in the Ramu Upazila, Cox's Bazar district, and aids in evaluating the distribution and capability of human resources for the provision of healthcare in these establishments.

Health Assistants (21): Frontline workers known as health assistants are in charge of delivering basic medical care, educating the public about health issues, and putting

community-based public health initiatives into action. The Community Clinics employ a sizable workforce committed to providing primary healthcare, as seen by the presence of 21 Health Assistants.

Personnel in Family Planning:

FWV (0) and FPI (0): A deficiency in specialist family planning services at the Community Clinics may be indicated by the lack of Family Planning Inspectors and Family Welfare Visitors. These positions usually involve dispensing contraceptives, giving family planning advice, and providing reproductive health services.

FWA (16): Family Welfare Assistants have a critical role in providing services and information on family planning. There are a lot of people working to promote family planning and reproductive health in the community, including 16 FWAs.

Other Staff Other Staff (0): The lack of other staff members in the Community Clinics suggests that there aren't enough jobs providing administrative, maintenance, or auxiliary support. This might have an effect on the clinics' general effectiveness and seamless operation.

Table 4-6: Number of Personnel Community Clinic

Type of personnel	Number
health assistant	21
FPI	0
FWV	0
FWA	16
other staff	0

(Source: Primary Survey)

The following crucial factors are highlighted by the staffing distribution in the Ramu Upazila Community Clinics:

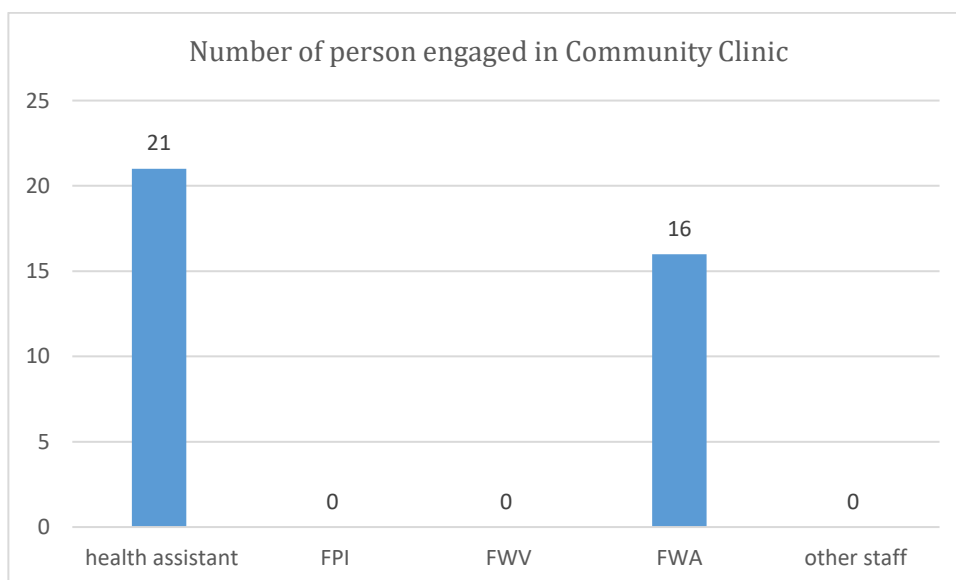


Figure 4-6: Number of Person Engaged in Community Clinic

(Source: Primary Survey)

Primary Medical Services: The active delivery of public health initiatives, health education, and primary healthcare services at the community level is ensured by the presence of 21 Health Assistants.

Family Planning and Health in Reproduction: A deficiency in specialist family planning services is shown by the absence of Family Planning Inspectors and Family Welfare Visitors. On the other hand, the 16 Family Welfare Assistants are essential in supporting family planning and offering community-based services.

Support for Operations: The absence of additional staff members raises the possibility that Community Clinics will experience difficulties with operational and administrative efficiency as a result of a shortage of support positions.

Family welfare assistants and health assistants ensure that primary healthcare services are provided to the community and that family planning is encouraged in the Ramu Upazila Community Clinics. The lack of Family Welfare Visitors and Family Planning Inspectors, however, suggests a need for more specialized family planning services, which may have an effect on how complete the offered reproductive health care. The clinics' general effectiveness and seamless functioning may be impacted by the absence of more employees. In order to close these gaps, the Community Clinics in Ramu Upazila may be able to provide healthcare more effectively and efficiently by hiring support workers and professional family planning personnel. In general, the current workforce contributes to the community's health and well-being by offering a solid foundation for primary healthcare and family planning services.

4.9 NO. OF OPD & EMERGENCY VISITS

Emergency room (ER) and outpatient department (OPD) visits are crucial markers of healthcare accessibility and use. The information presented shows the number of OPD and emergency visits by gender at different Ramu Upazila, Cox's Bazar district health facilities. Understanding the gender disparity in healthcare utilization and the ability of various healthcare facilities to provide for the community's healthcare needs are made easier by analyzing this data.

Males (24,655) and females (41,015) at Upazila Health Complex: Approximately 62.5% of all trips to the Upazila Health Complex are made by females, making them the more frequent visitors than males. This suggests that women use healthcare services quite frequently, most likely as a result of needs related to general healthcare as well as maternity and reproductive health.

4.9.1 Sub-Centers of Union

There are 19,525 males and 19,173 females in the sub-centers. Like the Upazila Health Complex, Union Sub-Centers see a higher proportion of female patients—59.7% of all visits are made by women. This pattern implies that women are actively making use of these facilities' healthcare offerings as well.

DGFP-affiliated Union Health & Family Welfare Centers

There are 13,849 males and 35,478 females. The Directorate General of Family Planning (DGFP)'s Union Health & Family Welfare Centers saw a much larger proportion of female

visitors—roughly 71.9% of all visits—than male visits. This is probably because family planning and reproductive health services are prioritized, mostly serving women.

Table 4-7: No.of OPD and Emergency Visits

Health Facility	Male	Female
Upazila Health Complex	24655	41015
Union Sub-Centers	13173	19525
Union Health & Family Welfare Centers (belong to DGFP)	13849	35478
Community Clinics	43533	103064

(Source: Primary Survey)

4.9.2 Neighborhood Clinics

Men (43,533) and Women (103,064): Community clinics have the most visitors overall, however there is a significant gender gap, with women making up about 70.3% of the visits. This high figure indicates how frequently women utilize these clinics for a range of medical services, including care for mothers and children.

Several important findings may be drawn from the data on OPD and emergency visits at various Ramu Upazila health facilities:

High Usage among Women: Women routinely make up a larger percentage of visitors than men do in all kinds of health institutions. The Union Health & Family Welfare Centers and Community Clinics exhibit this pattern the greatest.

Trends Specific to Facilities: More women attend the Union Sub-Center and Upazila Health Complex as well, however the change is not as noticeable as it is at the family planning centers. With the most visitors overall, community clinics play a critical role in delivering accessible healthcare at the community level.

Emphasis on Health of Reproduction: The Union Health & Family Welfare Centers' high female attendance rate is indicative of the importance placed on family planning and reproductive health, both of which are essential to women's health.

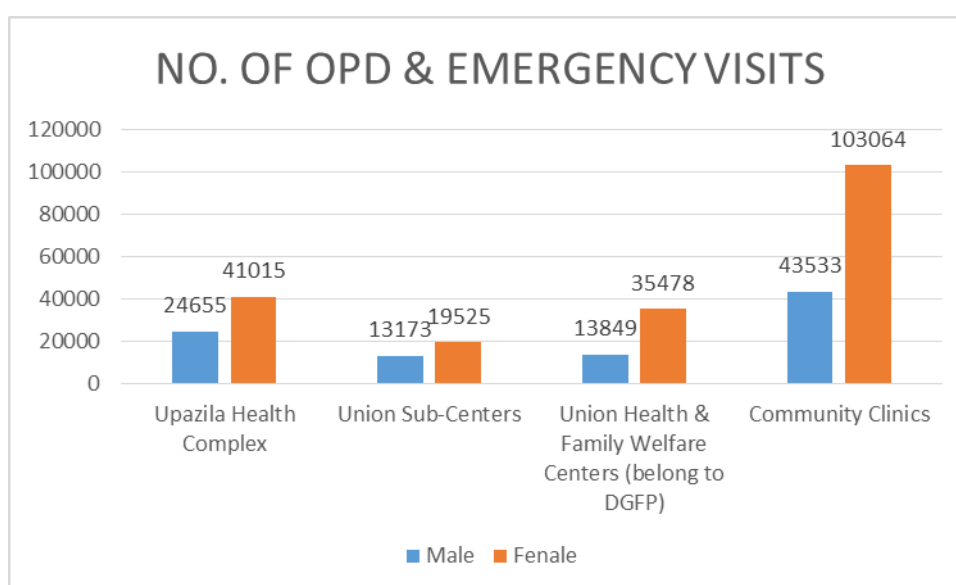


Figure 4-7: Number of OPD and emergency Visits

(Source: Primary Survey)

The Ramu Upazila healthcare utilization statistics shows that women heavily depend on health services provided by a variety of facilities, especially those that deal with family planning and community health. Community clinics, which have the most visitors overall, are essential to the healthcare system because they offer the community easily accessible primary healthcare.

It might be advantageous to keep bolstering programs that address women's health requirements while simultaneously making sure that men have appropriate access to healthcare services in order to further enhance healthcare delivery. Comprehending these patterns aids in the distribution of resources, formulation, and execution of focused health initiatives to efficiently address the requirements of the populace.

4.10 Top Most Occurred Diseases in Ramu

Comprehending the disease profile of a populace offers significant perspectives on the prevailing health concerns and facilitates the development of suitable healthcare therapies. The top five ailments affecting Ramu Upazila, Cox's Bazar district, residents 30 years of age and over, are included in the data that was provided. By analyzing this data, healthcare initiatives to effectively address the key health risks in this age group will be guided.

Unknown and Other Types of Gastroenteritis and Infectious Colitis Cases (945): The biggest number of instances of this condition suggests that gastrointestinal infections are very common in those over the age of thirty. Symptoms of these illnesses include diarrhea, abdominal pain, and dehydration, and they can be brought on by a variety of pathogens, including bacteria, viruses, and parasites. The high frequency points to problems with food safety, sanitation, and water quality.

Unspecified Cases of Bronchopneumonia (206): Bronchopneumonia is a kind of lung infection that affects the surrounding lung tissues and the bronchi. The lack of specificity suggests that although the diagnosis is obvious, the precise causal organism could not yet be known. This illness can be rather serious in older persons, particularly those with compromised immune systems or underlying medical issues. It is frequently brought on by bacterial or viral infections.

Cases of attack by Blunt Objects (202): The large number of cases resulting from blunt object attack indicates a significant prevalence of trauma and physical violence in the community. This highlights social and safety concerns that require attention through law enforcement, community safety initiatives, and potentially preventative measures to lessen violence and enhance dispute resolution.

Peptic Ulcer, Site Unspecified Cases (131): Sores on the lining of the stomach, upper small intestine, or esophagus are known as peptic ulcers. The fact that the site is unidentified indicates that the ulcers' precise position was not established. Long-term NSAID use, *Helicobacter pylori* infection, and lifestyle choices including alcohol and smoking are risk factors. The frequency of peptic ulcers emphasizes the necessity of raising awareness about gastrointestinal health and improving the management of these risk factors.

Cases (78) of Plasmodium Falciparum Malaria: Without quick medical attention, *Plasmodium falciparum* malaria is a dangerous illness that can be fatal. The fact that there are still 78 cases indicates that Ramu Upazila is having difficulty preventing and controlling malaria. This emphasizes the necessity of implementing efficient malaria prevention

strategies, such as the use of bed nets treated with insecticide, indoor residual spraying, and quick access to diagnostic and treatment facilities.

Significant health issues are revealed by the disease profile of Ramu Upazila's population aged 30 and above:

Infections of the Gastro intestines: 945 cases of colitis and gastroenteritis point to serious problems with food safety, water quality, and sanitation. It is essential to address issues through public health programs and infrastructure upgrades.

Respiratory Infections: A total of 206 cases of bronchopneumonia demonstrate the necessity of improving the management of respiratory infections, particularly in susceptible older persons.

Violence and Trauma: 202 occurrences of assault by blunt objects point to serious problems with social safety, necessitating action to lower the rate of violence and enhance community safety.

Malaria: 78 cases of Plasmodium falciparum malaria highlight the continued difficulties in malaria control, requiring consistent preventive measures and treatment access. **Gastrointestinal Ulcers:** 131 cases of peptic ulcers highlight the significance of managing risk factors such as Helicobacter pylori infection, NSAID use, and lifestyle choices.

Table 4-8: Top 5 (30+) Diseases and No. of Cases

Disease name	No. of Cases
Other and unspecified gastroenteritis and colitis of infectious origin	945
Bronchopneumonia, unspecified	206
Assault by blunt object	202
Peptic ulcer, site unspecified	131
Plasmodium falciparum malaria	78

(Source: Primary Survey)

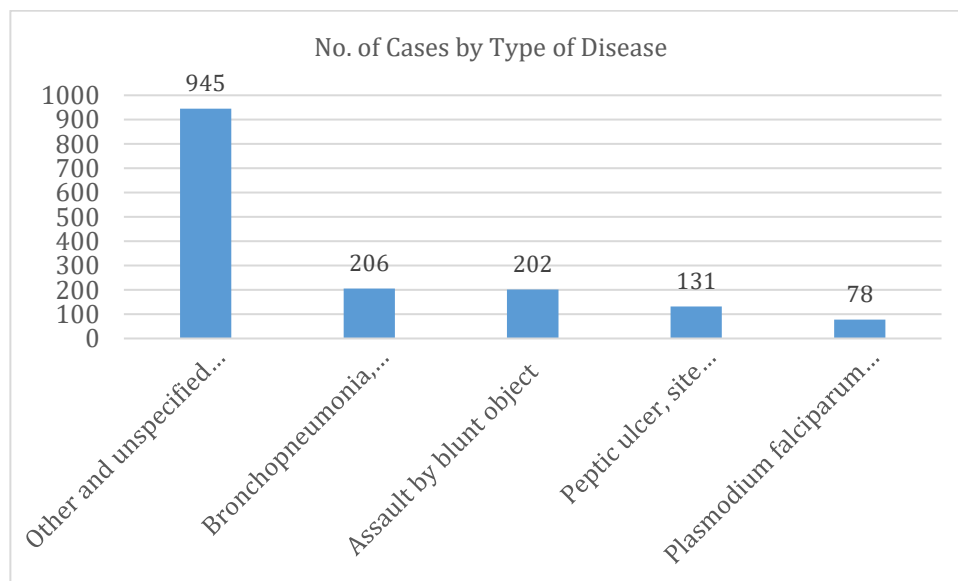


Figure 4-8: No. of cases and type of Diseases

(Source: Primary Survey)

In summary:

The top five illnesses among Ramu Upazila residents aged 30 and beyond point to important areas that require attention in healthcare:

- **Sanitation and Hygiene:** Reducing gastrointestinal infections through improvements in food safety, sanitation, and water quality. Improved methods to avoid and cure respiratory infections, especially in the elderly, are part of respiratory health. Community safety refers to initiatives aimed at addressing and minimizing trauma and violence in the local area.
- **Gastrointestinal Health:** Medical and lifestyle therapies for the management and prevention of peptic ulcers.
- **Malaria Control:** Persistent attempts to avoid malaria, identify it early, and provide an efficient treatment.

The health and well-being of the Ramu Upazila population aged thirty and over can be considerably enhanced by addressing these health conditions through focused public health efforts and healthcare services.

4.11 Sanitation:

The sustainability of the ecosystem and public health depend on having access to adequate sanitary facilities. The information supplied sheds light on how sanitary services are distributed in Ramu Upazila, which is located in Bangladesh's Cox's Bazar area. It distinguishes between hygienic and non-sanitary latrines as well as between the three types of latrine usage.

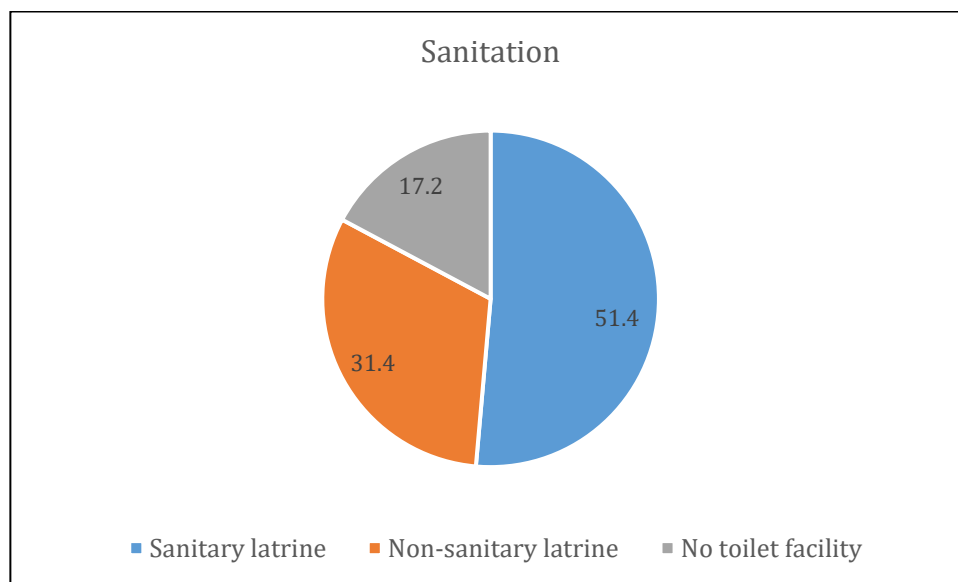


Figure 4-9: Sanitation facilities in Ramu

(Source: Primary Survey)

Sanitary Latrine (51.4%): Sanitary latrines are accessible to slightly more than half of Ramu Upazila's population. Systems in place in sanitary latrines safely dispose of human waste, reducing the possibility of contamination and the spread of illness. Their frequency suggests that a sizable section of the populace has access to decent sanitary facilities, which is essential for good hygiene and public health.

Thirty-one percent of the population (31.4%) uses non-sanitary latrines: This is a significant fraction of the population. There are health and environmental problems associated with using unsanitary latrines because they may not have adequate waste disposal systems or may not adhere to hygienic standards. The upazila's general sanitation conditions may be improved by initiatives to convert these facilities to more hygienic alternatives.

No Toilet Facility (17.2%): Disturbingly, 17.2% of residents do not have access to any type of toilet facility. This suggests a serious lack of cleanliness, as a sizable section of the populace relies on subpar alternatives or practices open defecation. Inadequate sanitary facilities endanger people's health as well as their privacy and sense of dignity, especially for the most vulnerable groups.

In summary, the data highlights advancements as well as obstacles in Ramu Upazila's sanitary infrastructure. Although most people have access to hygienic latrines, a sizeable portion still uses unhygienic facilities or doesn't have access at all. Improving public health outcomes, promoting environmental sustainability, and protecting human dignity all depend on closing the sanitation gap by encouraging the use of sanitary latrines and increasing access to underprivileged communities. In Ramu Upazila and elsewhere, local authorities should give priority to investments and activities that aim to guarantee universal access to clean and hygienic sanitation facilities, in collaboration with community stakeholders and governmental agencies.

4.12 Sources of drinking water:

The health and welfare of humans depend on having access to clean drinking water. To address this basic need, different sources are used in numerous parts of the world. This data illustrates the spread of various drinking water sources, emphasising how common taps, tube wells, and other sources are.

Tube Wells (97.6%): With a large portion of the supply, tube wells are the main source of drinking water. Deep wells with pipes that pull groundwater to the surface are known as tube wells. They are widespread in regions with accessible groundwater and are frequently dependent on it for a steady source of water.

Taps (1.7%): Of all the sources of drinking water, taps make up a modest portion. Water from centralised systems, such municipal water supplies, is usually obtained through taps. They are typically found in cities and places where there is a well-established water delivery infrastructure.

Other Sources (0.7%): This group includes a range of additional sources of potable water, including rivers, springs, rainwater collection systems, and water vendors. Even though they account for a small fraction of the total, taken as a whole, they help some communities or areas meet their drinking water needs.

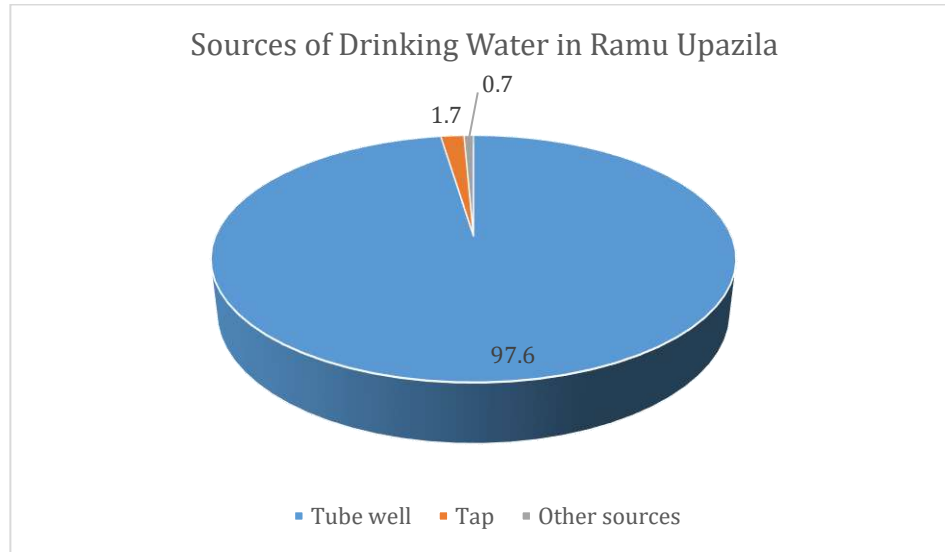


Figure 4-10: Sources of Drinking Water in Ramu Upazila

(Source: Primary Survey)

The data highlights the extensive use of tube wells as a key source of drinking water, highlighting the importance of groundwater. Even yet, the percentage of taps is lower, perhaps because access to them is restricted in rural or impoverished areas. There are more, less common sources that show the variety of approaches taken to obtain safe drinking water. In general, obtaining sustainable and clean drinking water continues to be a major global concern, with varied degrees of reliance on various sources based on infrastructural, economic, and geographic considerations.

4.12.1 Existing Condition of Medical Waste Management

Effective implementation of Medical waste management in the public and private hospitals is a key determinant of improvement of hospital environment and providing quality service. Capacity development and awareness of the service providers will be the most important aspect of MWM. Supply of logistics and technical support to the hospitals together with smooth coordination with local government agencies and department of environment will ensure the proper implementation of the program. Enforcement of Medical Waste Management rules may be of great help for achieving the goals.

Different health facilities in Ramu Upazila generate significant amount of medical waste. This waste needs to be managed properly.

The table shows that 75% health facilities use six colour separated bins while the remaining 25% facilities don't use six colour separated bins.

Table 4-9: Use of six color separated bins

Response	Frequency	Percentage
Yes	6	75.00
No	2	25.00
Total	8	100.00

(Source: Primary Survey)

The table shows that 100% health facilities use closed bins.

Table 4-10: Use of closed bins

Response	Frequency	Percentage
Yes	8	100.00
No	0	0.00
Total	8	100.00

(Source: Primary Survey)

The table shows that 50% health facilities have garbage transportation route while the remaining 50% health facilities don't have garbage transportation route.

Table 4-11: Garbage Transportation Route

Response	Frequency	Percentage
Yes	4	50.00
No	4	50.00
Total	8	100.00

(Source: Primary Survey)

The table shows that 62.50% health facilities have garbage disposal sites while 37.50% health facilities don't have garbage disposal sites.

Table 4-12: Garbage Disposal Site

Response	Frequency	Percentage
Yes	5	62.50
No	3	37.50
Total	8	100.00

(Source: Primary Survey)

The table shows that 66.67% health facilities use open air burning process in garbage disposal while 33.33% facilities use incinerators.

Table 4-13: Garbage Disposal Process

Disposal Process	Frequency	Percentage
Open air burn	4	66.67
Incinerator	2	33.33
Total	6	100.00

(Source: Primary Survey)

4.12.2 Existing Condition of Air & Noise Environment

4.12.2.1 Air Quality

Increased concentrations of particulate matter and gaseous pollutants can have harmful effects on ecology and human health. The assessment of air quality is based on the different Environmental Impact Assessment (EIA) report, particularly the Comprehensive Environmental & Social Impact Assessment (ESIA) for Ramu upazila.

With multiple development projects currently underway in Ramu upazila, it is imperative to closely observe and assess the air quality in this region. This study considers the major air pollutants are- PM10, PM2.5, SO2, NO2, CO, O3, Suspended Particulate Matter (SPM), and

Volatile Organic Component (VOC). Based on the air quality monitoring findings presented in the tables above, it is clear that all the parameters fall within the permissible limits set by ECR, 2023, during both dry and wet seasons. However, when compared to the guidelines of WHO, 2021, it has been noted that concentrations of particulate matters (PM_{2.5} and PM₁₀) and NO₂ (µg/m³) exceeded the recommended levels in both dry and wet seasons. In general, the air quality is comparatively poorer during the winter season than in the monsoon period. Various factors, such as the transport of air pollutants by wind beyond the designated airshed, ongoing local construction activities, wind erosion, emissions from nearby power plants, emissions from both paved and unpaved roads, vehicular and residential areas, as well as rainfall washout, could play significant roles in contributing to heightened air pollution within the project air shed.

In addition, for the better assessment, air quality measurement was conducted in Ramu Gov't Primary school on 28th May 2024 to assess the recent baseline condition of the project area. The details test result has been given in below table.

Table 4-14: Air Quality Monitoring - Wet and Dry Season in Ramu

Criteria Pollutants	Unit	Wet Season	Dry Season	ECR,2023	WHO, 2021
PM ₁₀	(µg/m ³)	70.20	76.63	150	45
PM _{2.5}	(µg/m ³)	40.47	39.47	65	15
SPM	(µg/m ³)	110.80	103.10	-	-
SO ₂	(µg/m ³)	7.60	7.50	80	40
NO ₂	(µg/m ³)	27.20	26.90	80	10
CO	(µg/m ³)	142	135	5	-
O ₃	-	19	<19	180	-
VOCs	mg/m ³	<4.2	<4.2	-	-

From the above test result it has been noted that, Particulate matter (PM), particularly PM_{2.5}, is significantly higher than recommended limits. PM_{2.5}, being smaller and more easily inhaled, can penetrate deep into the lungs and cause severe respiratory and cardiovascular problems. Elevated levels of sulfur dioxide (SO₂) and nitrogen oxides (NO_x) indicate significant emissions from industrial sources and vehicular traffic. These pollutants can contribute to acid rain, smog formation, and respiratory irritation. While carbon monoxide (CO) levels are within the acceptable range, ozone (O₃) concentrations are approaching the standard, suggesting potential air quality issues during peak sunlight hours.

Exposure to high levels of these pollutants can have severe health consequences, including respiratory diseases, cardiovascular diseases, increased risk of premature death, and irritation of the eyes, nose, and throat. Air pollution can also have detrimental effects on the environment, such as acid rain, climate change, damage to vegetation, and reduced visibility.

Table 4-15: Ambient Air Quality Analysis Result

SL No.	Parameters	Method	Test Duration (Min)	Unit	AQ1	AQ2	AQ3	DoE Std.	IFC/WB Std.
1	PM _{2.5}	Gravimetric	480	µg/m ³	23.42	57.13	64.06	65 ^a	65 ^a
2	PM ₁₀	Gravimetric	480	µg/m ³	31.44	81.16	84.72	150 ^a	150 ^a
3	SO ₂	West Geake	480	µg/m ³	6.29	15.26	16.43	80 ^a	125 ^a

SL No.	Parameters	Method	Test Duration (Min)	Unit	AQ1	AQ2	AQ3	DoE Std.	IFC/WB Std.
4	NO _x	Jacob and Hochheiser	480	µg/m ³	9.39	23.75	20.36	80 ^a	200 ^a
5	CO	CO Sensor	480	µg/m ³	0.4	1.0	0.7	20 ^d	NF
6	O ₃	O ₃ Sensor	480	µg/m ³	29	41	43	180 ^a	180 ^c

(NF-Not found DoE- Department of Environment), a= standard for 24 hours exposure, b= standard for year, c= standard for 8 hours exposure, d= standard for 1 hour exposure.

4.12.2.2 Noise Pollution

Noise pollution, or sound pollution, is the propagation of noise or sound with ranging impacts on the activity of human or animal life, most of which are harmful to a degree. The source of outdoor noise worldwide is mainly caused by machines, transport and propagation systems.

Poor urban planning may give rise to noise disintegration or pollution, side-by-side industrial and residential buildings can result in noise pollution in the residential areas. Some of the main sources of noise in residential areas include loud music, transportation (traffic, rail, airplanes, etc.), lawn care maintenance, construction, electrical generators, wind turbines, explosions and people.

In case of Ramu there is no heavy industry or construction site but only traffic noise create a few noise pollution.

Noise level measurement were conducted in Ramu at four potential locations on 28th May 2024 to assess the recent baseline condition of the project area. The details test result has been given in below table.

Table 4-16: Noise level test Result

SN.	Station ID	Location	Site Condition	Receptor Type	Concentration present (L _{eq}) dBA		
					Day Time		
					Min.	Max.	L _{eq}
1	NQ1	Chowmohoni Chourasta	Preconstruction Phase	Commercial	50.2	59.6	55.6
2	NQ2	Chairman paradise		Commercial	50.3	58.3	55.0
3	NQ3	Ramu Bypass Road		Mixed	51.2	59.4	55.2
4	NQ4	Moddhom meronglua		Mixed	61.2	54.8	56.58
DoE (Bangladesh) Standard for Residential Area					50		
DoE (Bangladesh) Standard for Commercial Area					70		
DoE (Bangladesh) Standard for Mixed Area					60		
IFC/ International standard for residential Area					55		
IFC/ International standard for Commercial / Industrial Zone					70		

Max***= Maximum Value, Min= Minimum Value, Avg=Average L_{eq} Value, DoE= Department of Environment, IFC= International Finance Corporation, WB= World Bank, dBA= Noise Level Unit

4.13 Role of NGOs

In Cox's Bazar district, Ramu Upazila, non-governmental organizations (NGOs) are essential to the provision of healthcare facilities. Similar to numerous other regions in Bangladesh, this area also confronts difficulties with resources, quality, and accessibility to healthcare. Through a variety of projects and activities, NGOs' engagement aids in addressing these issues. The functions of current NGOs in this field are examined in depth below:

Primary Medical Services: NGOs offer the local populace vital primary healthcare services, such as:

Medical Camps: Periodic health camps for specific ailments such as diabetes, hypertension, and maternal health, as well as routine medical checkups.

Mobile Clinics: Where there are few healthcare facilities, mobile health units provide healthcare to underprivileged and remote locations.

Health education refers to initiatives aimed at increasing public knowledge of family planning, nutrition, cleanliness, and preventative healthcare practices.

Health of Mothers and Children: For NGOs, improving the health of mothers and children is a major priority

Prenatal and Postnatal Care: To guarantee safe pregnancies and healthy newborns, NGOs provide prenatal and postnatal care.

Programs for Immunization: Endorsing government efforts to immunize kids against common and avoidable diseases.

Nutritional Support: To prevent malnutrition, pregnant women and young children can get nutritional supplements and counseling.

WASH, or water, sanitation, and hygiene

NGOs play a crucial role in improving WASH guidelines to avert illnesses.

Safe Water Access: Creating and preserving sources of clean water.

Building and encouraging the use of latrines and appropriate waste disposal systems are examples of sanitation facilities.

Promoting good hygiene in communities by teaching them about handwashing and other hygiene habits.

Illness Prevention and Management

Among the initiatives taken to manage and stop communicable diseases are:

HIV/AIDS and tuberculosis (TB) programs: screening, treatment, and public awareness campaigns. Controlling malaria involves spreading mosquito nets sprayed with insecticide and teaching people about preventive measures.

Humanitarian and Emergency Assistance

Because Cox's Bazar is prone to natural calamities and has a sizable refugee population, NGOs offer.

Disaster Response: Provides logistical and medical assistance both during and following natural disasters.

Refugee Health Services: Full medical care, including mental health support, is provided to Rohingya refugees.

Capacity Building and Training Nonprofits improve the capacity of local healthcare systems by:

Training Healthcare professionals: To enhance service delivery, local health professionals should receive training.

Educating members of the public to serve as health volunteers who can direct patients with serious conditions to appropriate medical facilities and provide general health advice.

NGOs that are currently active in Ramu Upazila

BRAC: Well-known for its all-inclusive health initiatives, which cover nutrition, TB prevention, and maternity health. The Rohingya community can receive emergency medical attention and services from Médecins Sans Frontières (MSF).

ASHA: It is a government-funded initiative in the United States that helps foreign medical facilities, libraries, and schools spread American concepts and practices. It is essential to healthcare in a number of ways.

Building and Remodeling: The funding for the building, remodeling, and furnishing of healthcare facilities comes from ASHA. Hospitals, clinics, and medical education facilities fall under this category.

Medical Equipment: Availability of cutting-edge medical equipment to enhance the capacity for diagnosis and treatment.

Medical Education: To improve the education and training of healthcare workers, ASHA supports medical schools and nursing institutions.

Professional development: Courses designed to teach medical staff members the newest techniques and equipment.

Support for Medical Research: Allocating funds for studies meant to solve important health problems and create novel therapies.

Collaborative Projects: Forming alliances with nearby establishments to promote information sharing and cooperative research.

CARE: CARE is a multinational humanitarian organization whose mission is to combat poverty worldwide and offer aid in times of need. It plays a broad and varied role in healthcare:

Health of Mothers and Children: Reproductive health services include family planning, prenatal, and postnatal care, with the goal of enhancing the health of mothers and their unborn children.

Nutrition Programs: Putting in place initiatives to prevent child and pregnant woman malnutrition by providing food supplements and nutritional education. WASH stands for water, sanitation, and hygiene.

Creating and managing water supply infrastructure is necessary to guarantee that communities have access to clean drinking water.

Sanitation Infrastructure: To stop waterborne illnesses, latrines should be built and proper sanitation habits should be encouraged. Hand washing and other preventive actions are encouraged by running campaigns to promote cleanliness.

Prevention and Control of Diseases: Programs for the prevention and control of infectious diseases, such as HIV/AIDS, malaria, and tuberculosis, through testing, treatment, and education.

Campaigns for Vaccination: encouraging immunization campaigns to shield adults and children from diseases that can be avoided.

Emergency Medical Services: Disaster response is the provision of emergency medical attention as well as relief during humanitarian emergencies and natural catastrophes.

Health Services for Displaced Populations: Providing medical treatment, including mental health support, to refugees and internally displaced people (IDPs).

Initiatives for Community Health: Health education is the process of teaching people about diseases, healthy living, and related topics.

Local Health professionals: Educating community health professionals to serve as a liaison between the general public and institutional healthcare settings while providing basic healthcare services.

4.13.1 Effects and Accomplishments

ASHA: ASHA raises the standard of medical education and healthcare services around the world by constructing better educational facilities and healthcare infrastructure. Better patient care and more highly qualified healthcare personnel are the results of this.

CARE: CARE's extensive health initiatives tackle long-term health determinants as well as urgent medical needs. The vulnerable communities' health outcomes have significantly improved as a result of their focus on disease prevention, maternity and child health, and emergency response.

4.13.2 Effects and Difficulties

In Ramu Upazila, NGOs' initiatives have greatly increased both the availability and caliber of healthcare. Nonetheless, there are still issues, like:

Resource Constraints: The viability of healthcare initiatives may be hampered by a lack of funds and resources.

Government Coordination: Ensuring cooperation and alignment with government health services to provide all-encompassing coverage.

Cultural Barriers: Getting over regional cultural customs and beliefs that could be resistant to contemporary medical treatments.

In conclusion, by offering primary care, maternity and child health services, WASH programs, disease prevention, emergency help, and capacity building, NGOs significantly contribute to closing the healthcare gaps in Ramu Upazila. Their efforts are crucial to enhancing health outcomes and creating robust health systems in this area.

4.14 Role of Local Elites

Local elites in Bangladesh's Cox's Bazar district, Ramu Upazila, are heavily involved in the construction and upkeep of medical facilities. These elites, who frequently consist of prominent members of the community, politicians, business, and religious groups, can use their networks, resources, and power to improve healthcare services in a number of ways:

Finance and Resource Gathering

Philanthropy: The establishment and upkeep of medical institutions, including clinics, hospitals, and health centers, is frequently funded in part by the local elite. Their contributions might be very helpful in purchasing medications, medical supplies, and other necessities.

Initiatives for Fundraising: They are capable of planning and directing campaigns to raise money for medical projects. They are able to raise substantial sums of money from businesses and other community members thanks to their networks and social standing.

The Impact of Advocacy and Policy

Advocating for Better Healthcare Policies: Local elites, as powerful members of society, can push for improved healthcare policies and more government funding for the medical field. They can influence legislators and government representatives to give healthcare top priority in regional development plans.

Public Health Campaigns: Local elites can spearhead public health campaigns to increase public knowledge of critical health concerns including immunization, maternity health, and cleanliness habits by using their power.

Infrastructure Development: By contributing land or financing construction projects, the wealthy can help to provide the infrastructure needed for healthcare. This entails opening new clinics, renovating current ones, and making sure they have the necessary equipment.

Public-Private Partnerships: By using their contacts to attract private capital and expertise, they can lead collaborations between the public and private sectors to enhance healthcare services.

Endorsing Health Initiatives

Medical Camps and Outreach Initiatives: Local aristocracy have the ability to fund and endorse medical camps and outreach initiatives that offer underprivileged communities free or heavily discounted healthcare treatments. General health examinations, consultations with specialists, and medication distribution are frequently included in these programs.

Initiatives for Health Education: They can support and provide funding for programs that educate the public on nutrition, hygiene, preventative healthcare, and other health-related issues.

Improving Scholarships and Training for Human Resources: Elites have the ability to provide funding for healthcare professionals and medical students to pursue higher education and training. A higher qualified healthcare personnel in the area may result from this.

Attracting Skilled Professionals: Elites can stop the brain drain of skilled healthcare workers to larger cities or overseas by enhancing the amenities and working conditions in nearby healthcare facilities.

Trust and Community Involvement Construction

Establishing Trust: Local elites have a significant influence in fostering trust between the community and healthcare practitioners because of their well-respected standing. Their support of health-related projects may inspire more acceptance and involvement from the community.

Conflict Resolution: Local elites can mediate and resolve disputes in places where there may be opposition or cultural hurdles to particular health methods, creating a supportive atmosphere for healthcare initiatives.

Examples of the Contributions Made by Local Elites in Ramu Upazila

Company Leaders: Local company owners may create foundations devoted to health and wellbeing, promote health-related activities, or provide money or goods to medical facilities.

Political leaders: They have the power to guarantee that government money are allocated to health projects, prioritize healthcare in local government agendas, and streamline bureaucratic procedures for the construction of infrastructure linked to health.

Religious Leaders: Through their religious organizations, religious leaders can promote healthcare initiatives and play a significant role in promoting health education and health practices among their followers.

4.15 SWOT Analysis

A SWOT analysis is a strategic planning framework that helps healthcare industries analyze their strengths, weaknesses, opportunities, and threats. The SWOT analysis of the healthcare facilities of Ramu Upazila is given below:

Table 4-17: SWOT Analysis

Strength	Weakness
Good no. of health facilities	Small no. of beds at Upazila level
Good support by private clinics	Union level Govt. facilities don't have inpatient services
Good support by NGO clinics	Private and NGO facilities have more inpatient facilities than Govt.
Good no. of diagnostic centers	No OPD at Upazila facility
Opportunity	Threat
Due to lack of outpatient facilities at Upazila level, private facilities may boom	No chest disease facility
Scope for installing facilities with specialized health care	No trauma center
Scope for public-private partnerships in both business and non-profit sectors	Lack of specialized facilities
Unani, Ayurvedic etc. traditional medicine practice may develop	Severe shortage in maternity and childcare facilities

4.16 Review of Higher-Level Documents Regarding Public Health Policy

4.16.1 National Health Policy, 2011

There are 29 main goals of National Health Policy, 2011. Many are relevant in our case. They are summarized below.

- The first and second goals state that fundamental and easily accessible health services are to be ensured.
- According to the third goal, one community clinic is to be established for every six thousand people.
- The fourth goal is to prioritize emergency medical care.
- Fifth goal is to reduce child and maternal mortality.
- Seventh goal is to improve child and maternal health.
- Eleventh goal is to improve manpower and equipments in public health care facilities.
- Twelfth goal is about providing health services through private sectors.
- Fifteenth goal is to strengthen disease prevention system.
- Nineteenth goal is to improve alternative healthcare methods such as Unani, Ayurveda and Homeopathy.

4.16.2 Health Care Financing Strategy, (2012-2032)

Strategic interventions and supportive actions according to Health Care Financing Strategy, (2012-2032) are:

1. Design & implement Social Health Protection Scheme

- Determine institutional arrangements for Social Health Protection Scheme
- Design and implement Health Equity Fund/National Health Security Office
- Implement SSK for BPL
- Design social health protection scheme for above BPL (formal and informal)

2. Strengthen financing and provision of public health care services

- Implement needs and performance based allocation
- Scale up/reinforce Result Based Financing (MHVS)
- Retain user fees at point of collection

3. Strengthen national capacity

- Support information exchange platform/knowledge hub/resources pool
- Develop the capacity to design and manage the social health protection scheme
- Strengthen Financial Management and Accountability
- Improve monitoring and evaluation
- Introduce mechanisms to support the production of additional key staff (nurses, paramedics and medical technicians)

4.16.3 Sustainable Development Goals (SDG-3)

The SDG Goal 3 is stated and described below.

Goal 3: Ensure healthy lives and promote well-being for all at all ages

- by 2030 reduce the global maternal mortality ratio to less than 70 per 100,000 live births
- by 2030 end preventable deaths of newborns and under-five children
- by 2030 end the epidemics of AIDS, tuberculosis, malaria, and neglected tropical diseases and combat hepatitis, water-borne diseases, and other communicable diseases
- by 2030 reduce by one-third pre-mature mortality from non-communicable diseases (NCDs) through prevention and treatment, and promote mental health and wellbeing
- strengthen prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol
- by 2020 halve global deaths and injuries from road traffic accidents
- by 2030 ensure universal access to sexual and reproductive health care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes
- achieve universal health coverage (UHC), including financial risk protection, access to quality essential health care services, and access to safe, effective, quality, and affordable essential medicines and vaccines for all
- by 2030 substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination
- 3.a strengthen implementation of the Framework Convention on Tobacco Control in all countries as appropriate
- 3.b support research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to
- affordable essential medicines and vaccines, in accordance with the Doha Declaration which affirms the right of developing countries to use to the full the provisions in the TRIPS agreement regarding flexibilities to protect public health and, in particular, provide access to medicines for all
- 3.c increase substantially health financing and the recruitment, development and training and retention of the health workforce in developing countries, especially in LDCs and SIDS
- 3.d strengthen the capacity of all countries, particularly developing countries, for early warning, risk reduction, and management of national and global health risks

4.16.4 8th Five Year Plan

The 8th Five Year Plan strategies and policies to make growth pro-poor and inclusive:

- Projected Growth Path for the 8FYP
- Strategy for COVID-19 GDP Growth Recovery
- The Challenge of Job Creation for Inclusive Growth
- Projected Job Creation Target for the 8FYP
- Strategies for Accelerating Pro-poor and Inclusive Growth
- Policies for Pro-Poor and Inclusive Growth

4.17 Spatial Planning Implication

Health facilities aim to make the communities healthier by providing safe, effective and sustainable health services. It is essential that health services are well planned and organized

based on a community's and its healthcare provider's strength. Services must evolve in line with cultural expectations, changing practice and technological advancement. The planning process aims to ensure that health services align and adapt to changing patterns of health needs while making the most effective use of available resources. Basically, health service plans address the following questions: Who is the health service for and where is it located? Where is the health service going – what are its objectives? How is the health service currently being delivered and how should it be delivered in the future? What resources does the health service currently use and require in the future? When will the health service be delivered?

The purpose of the health service planning exercise of Ramu Upazila would be to propose a position to desired future services using a systematic and ordered approach. Planning engenders coordination between various organizations' within a system (both public and private) or between subunits of an organization. Service planning requires that issues of resource scarcity and investment choice be considered in recognition that demand always outweighs the resources available. An effective service plan considers the availability of resources to achieve the improved structure, function and outcomes of the proposed services.

Health facility planning is a key health engagement capability that assesses the health needs of a population and identifies the combination of services, equipment, facilities, and infrastructure necessary to support them. The following are the spatial planning implication of Ramu's health facility in reviewing and updating the master plan of Ramu Upazila:

- Finding out the existing locational distribution patterns of health facilities and services; and their accessibility to the people
- Existing health facilities are to be made accessible to the users
- New sites are to be suggested and selected for health facilities in view of future needs vis-à-vis thereof spatial hierarchical order of health facilities are to be maintained
- Fixation /revisiting the planning standard of the health facilities in view of hierarchy of services

4.18 Recommendation and Concluding Observation

Boosting the Infrastructure of Healthcare: Investment in Facilities: Invest more money in the construction and modernization of healthcare facilities to make sure they are equipped to treat a wide range of medical ailments.

Mobile Clinics: Increase the number of mobile health units to serve Ramu Upazila's rural and underprivileged areas.

Instructional Plans: Provide healthcare workers with ongoing training to stay current on emerging medical procedures and technology.

Rewards for Healthcare Professionals: To draw and keep qualified healthcare workers, offer incentives including competitive pay, housing, and chances for professional growth.

Campaigns for Health Education: Run recurring health education programs with an emphasis on diet, hygiene, preventative healthcare, and the health of mothers and children.

Volunteers in Community Health: To serve as a bridge between medical facilities and the population, community health volunteers are recruited, trained, and assigned to provide basic health services and education.

Prenatal and Postnatal Care: To protect women's and their children's health and safety, improve prenatal and postnatal care services.

Immunization Schedules: Boost vaccination campaigns to protect all children from diseases that can be prevented by vaccination.

Access to Clean Water: Make certain that every community has access to safe and clean drinking water.

Sanitation Facilities: To lower the prevalence of waterborne illnesses, upgrade sanitation facilities and encourage proper hygiene habits.

Relationships with NGOs: To better utilize their programs, resources, and experience in enhancing healthcare services, fortify your relationships with NGOs.

Participation of Local Elites: Involve local elites in healthcare activities to support community health projects, push for improved policies, and mobilize resources.

Telemedicine Services: Provide remote consultations and follow-ups via telemedicine, particularly for patients who live in rural places.

Health Information Systems: Put in place reliable systems for tracking patient data, effectively allocating resources, and enhancing the quality of healthcare provided overall.

Disaster Response strategies: Create thorough strategies for responding to natural disasters and emergencies in order to provide prompt and efficient medical care.

Keeping Supplies in Stock: Keep a supply of necessary medical equipment and supplies on hand for use in an emergency.

Finally, some observations

The Ramu Upazila healthcare facilities in the Cox's Bazar area deal with a number of issues, such as inadequate funding, a lack of competent healthcare staff, and limited infrastructure. Nonetheless, there are plenty of chances to raise the quality of healthcare delivery by making wise investments, improving training, including the community, and working well with NGOs and local leaders.

The general state of health in Ramu Upazila can be greatly improved by fortifying the healthcare system, improving human resources, and emphasizing preventive treatment. Comprehensive healthcare solutions for the community can also be provided by addressing the unique needs of maternity and child health, raising WASH standards, and utilizing technology for telemedicine.

Involving NGOs and local elites in these initiatives is essential for raising funds and guaranteeing the long-term viability of healthcare advancements. Their involvement can result in more effectively funded, community-widely recognized health projects that are supported by the community and sensitive to cultural differences.

In conclusion, improving healthcare services in Ramu Upazila will require a multifaceted strategy that includes collaborations, community participation, infrastructure development, and human resource upgrading. Better health outcomes, expanded accessibility to high-quality healthcare, and a stronger, healthier community are all expected benefits of these initiatives.

Chapter Five: Education Facility



CHAPTER FIVE: EDUCATION FACILITY

5.1 Introduction

Education is essential for societal and personal growth because it gives people the information, skills, and abilities they need to succeed in life. It lessens poverty, fosters social and economic mobility, and opens doors for individual development and fulfillment. In addition, education is essential for fostering social cohesiveness and producing informed, involved citizens. Education is crucial for community development because it equips people with the knowledge and abilities they need to raise their standard of living, engage in civic life, contribute to the economy, and become human resources.

The data included in this working paper was gathered from primary and secondary sources. It offers data on topics like the current state of education, the categories of institutions that currently exist, the number of students and teachers in each institution, and the classification of facilities in upazila. It then analyzes the data and makes recommendations for improvements and policies based on approved measures. It will assist in creating the Upazila master plan as efficiently as possible while taking the educational sector into account. The main scope of this study include: Analyze the present and anticipated student enrolment in great detail, determine the institution's needs in terms of academics, administration, and extracurricular, engage the community, parents, teachers, staff, and students as stakeholders to get their opinions, examine the location, infrastructure, and environmental compatibility of the site. Some limitations involves getting the required permissions and approvals from different agencies might take a while and may result in delays. During the planning and construction stages, modifications to rules or policies may have an effect on the project. The facility's location and size may be limited by the scarcity of suitable land. Additional design and construction issues may arise due to geographical and environmental considerations.

5.2 Methodology Adopted

- The data are collected mostly from secondary sources. Secondary sources include BBS, Upazila educational website, Upazila website, Historical data, School records, local education authorities, and census data, Google Map etc.
- Primary survey include working paper survey.
- Analytical statistical analysis involves statistical inference, trend analysis, and descriptive statistics.
- Statistical tools for analyzing demographic trends, academic performance measures, and quantitative survey data (e.g. Excel) would be addressed for interpretation.
- SWOT evaluation: Determine the advantages, disadvantages, opportunities, and dangers associated with the educational facility's present and future conditions. Examine both external and internal variables affecting the expansion and advancement of the institutions.
- Reporting and Graphics: To portray data in an understandable and efficient manner, use maps, graphs, charts, and info graphics.
- Final products: thorough reports, executive summaries, and presentations that inform stakeholders of findings.

The master plan for the educational institution can be based on precise, thorough, and implementable insights by using a strong methodology for data gathering and interpretation. This will guarantee that the final plan takes into account the genuine objectives and goals of the educational community.

5.3 Upazila Education Profile

The population of Bangladesh in 2022 was 171.2 million. The literacy rate of Bangladesh is 74.66%. Male literacy rate is 76.56% and female literacy rate is 72.82%. Now we can compare this data with the information in regional context.

According to the 2022 Census of Bangladesh, Cox's Bazar District had 587,127 households and a population of 2,823,265, 43.6% of whom lived in urban areas. The population density was 1,133 people per km². The literacy rate (age 7 and over) was 71.5%, compared to the national average of 74.7%.

The current population of Ramu Upazila is 344541. The population density of this Upazila is 880 sq-km. The literacy rate of this Upazila is 72.06%. The upazila has 1 primary school for every 3333 population (2011), while nationally there is one school for every 1380 population. The literacy rates of Ramu Upazila, Cox's Bazar district, are shown in the graph by sex (both sexes, male and female) and over the course of several years (1991, 2001, 2011, and 2022). One important measure of a region's social and economic growth is its level of literacy. This study examines the rates of literacy for both sexes (male and female) in Ramu Upazila, a subdistrict of the Cox's Bazar district, over a range of years. The information covers the years 1991 to 2022 and shows changes and differences in literacy over that period. To pinpoint areas for improvement and areas for progress, policymakers and educators must have a thorough understanding of these trends.

Total Growth: Between 1991 and 2022, both sexes' literacy rates showed a definite rising tendency. The time frame from 2011 to 2022 shows the biggest increase.

Gender Disparity: Men have continuously demonstrated a higher literacy rate than women over time. There appears to be a gradual improvement in female literacy as evidenced by the shrinking difference between male and female literacy rates

Table 5-1: Upazilla Education profile in Ramu

Literacy Rate				population
Year	Both Sex	Male	Female	Both Sex
1991	21.5	28.3	14.3	160120
2001	26	29.6	22.3	202683
2011	36.6	37.8	35.3	266640
2022	72.06	74.21	69.72	344541

(Source: BBS,2011)

Notable Observations:

Male literacy was substantially higher than female literacy in 1991. By 2022, the gender gap has significantly closed, despite the fact that men still had a higher literacy rate than women. The biggest increase in literacy rates for both genders happened between 2011 and 2022.

Between 1991 and 2001, there was a 4.5% total increase in both sexes' literacy rates, with males improving by 1.3% and females by 8%. This suggests a preliminary attempt to increase female literacy.

Between 2001 and 2011, the general literacy rate increased by 10.6%, which was a more significant increase. While female literacy climbed dramatically by 13%, male literacy increased by 8.2%.

From 2011 to 2022: This period saw the most gain, rising by 35.46% overall. The impact of significant educational programs was seen in the 36.41% improvement in male literacy and the 34.42% improvement in female literacy.

From 1991 to 2022, Ramu Upazila's literacy rate had a marked rising trend. In 1991, the general rate of literacy for both genders was roughly 10%, with 15% for females and 30% for males. Modest gains were observed over the ensuing ten years, with both sexes reaching about 20% by 2001. This pattern was maintained in the 2011 data, which showed a small improvement in literacy rates with a persistent gender gap.

But the biggest gains were made between 2011 and 2022, when both genders' literacy rates increased to over 75%. The gender gap narrowed dramatically by 2022, with males reaching an 80% literacy rate and females reaching almost 70%. This suggests that educational outreach and efficacy have significantly improved, especially when it comes to tackling female literacy.

The literacy rate for Ramu Upazila, which is part of the Cox's Bazar district, has been improving over time, as seen by the graph. Additionally, there has been a discernible improvement in closing the gender literacy gap, which is notably noticeable by 2022. This significant development may have been facilitated by specific programs to boost female literacy and an increasing emphasis on education.

There may have been some success with earlier educational endeavors based on the notable increase in literacy rates between 2002 and 2022. These programs can be examined by policymakers to find effective tactics that can be modified or repeated in different contexts.

Males continue to be more literate than females notwithstanding advancements. Policymakers can better target gender-specific educational programs to close this inequality by acknowledging it.

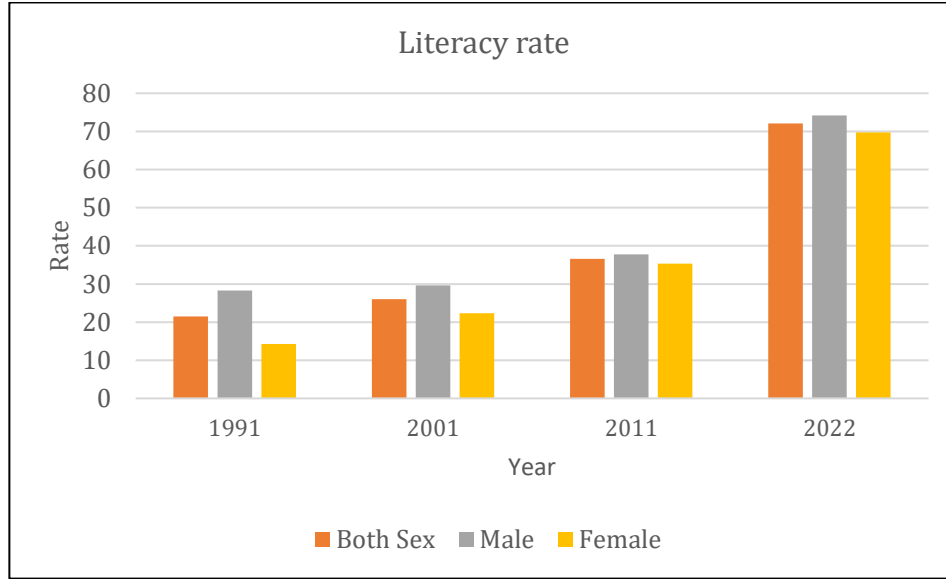


Figure 5-1: Literacy rate of ramu Upazilla

(Source: BANBEIS, 2024)

5.4 Age Group Wise School Attendance Comparison

The following Table and graph compares school attendance by age group in the Ramu Upazila, Cox's Bazar district. It divides the population into age groups (3-5, 6-10, 11-14, 15-19, 20-24, and 25-29) and compares the proportion of people who attend school to that of those who do not. This analysis offers insights for educational planning and policy creation by illuminating patterns of school attendance across various age groups.

Table 5-2: School Attendance According to Age groups

Age group (in years)	Attending School	Not Attending School
3-5	24723	16954
6-10	26725	10532
11-14	7645	19764
15-19	1120	23217
20-24	181	22220
25-29	36	15744

(Source: BANBEIS, 2024)

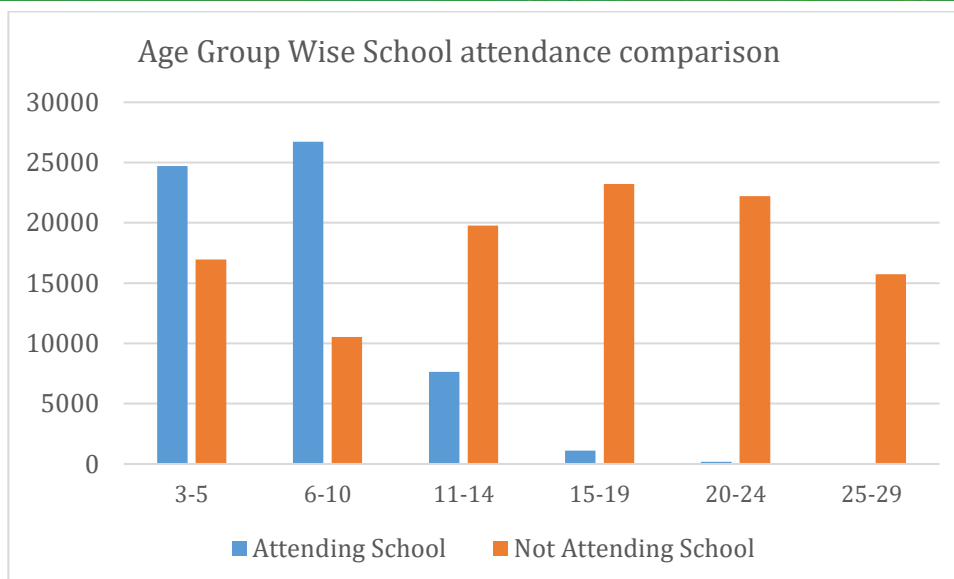


Figure 5-2: Age Group Wise School Attendance Comparison

(Source: BANBEIS, 2024)

Early Life (ages 3-5): Even if a sizable portion of young children are not attending school, a sizable portion do attend.

Age group (6-10) in primary school: This age group has the highest rate of attendance in school, indicating high primary enrollment.

Early Adolescence (ages 11-14): There is a discernible decline in the number of people attending school; more people are not going than are.

Late Adolescence and Young Adults (15-19, 20-24, 25-29): Almost everyone in these age groups does not attend school, with a sharp decline in attendance.

Important Aspects:

Highest Attendance: Based on successful enrollment in primary education, the age range of 6 to 10 has the highest attendance in school.

Significant Drop: There is a noticeable decline in attendance starting in the age range of 11 to 14, which raises the possibility of problems keeping pupils in secondary school.

Lower Attendance in Upper Age Groups: The lower attendance in the 15-19, 20-24, and 25-29 age groups suggests that the majority of people in these age groups have either finished their schooling or are not seeking higher education.

Implications:

Emphasis on Retention: Policies and initiatives aimed at keeping pupils in school past the primary school level are necessary, particularly for those between the ages of 11 and 14.

Support for Higher Education: Low attendance in older age groups points to a possible gap in the availability of or persistence in higher education, hence calling for the establishment of support networks to encourage teenagers and young people to continue their study.

Early Childhood Education: Efforts can be made to guarantee that the remaining children are also enrolled in the educational system, even if attendance in the 3-5 age range is generally high. Ramu Upazila's age-group-specific school attendance data identifies important areas that require educational intervention. Although there is a high enrolment in basic education, keeping pupils in secondary education and beyond presents considerable hurdles. These findings can be used by policymakers to create focused plans to raise school attendance rates; they should pay special attention to secondary education retention and chances for postsecondary education.

5.5 Facilities Available in the Education Institutions by Types

Any region's development depends on its ability to provide the infrastructure required for learning and personal development—educational facilities. The information provided here lists the many kinds of schools that are accessible in the district of Cox's Bazar, Ramu Upazila. Determining the locations and accessibility of these resources can be useful in evaluating the state of education and pinpointing areas in need of development.

Primary Schools: The core of the education system is early childhood education, which is heavily emphasised at the country's 80 primary schools.

Kindergarten Schools: With seventeen of them, there are quite a few establishments that concentrate on teaching children before they enter primary school.

NGO Schools: There are just two schools managed by non-governmental organisations, which may indicate that they are not very involved in education or that they are concentrating on serving particular populations or needs.

High Schools: The population is served by 16 high schools, which offer secondary education. This figure suggests a lower percentage when compared to elementary schools, which may be a reflection of the decline in student attendance seen in older age groups.

Colleges: The upazila's possibilities for higher education are severely limited with only one institution, which may require students to go beyond the area for additional coursework or to drop out completely.

Madrasas: There are 48 madrasas, indicating a sizable number of religious educational establishments that may serve individuals in need of both basic and religious education.

Technical/Vocational Schools: The lack of technical or vocational schools indicates a weakness in the educational system, which may restrict young people's access to possibilities for skill development and vocational training.

Table 5-3: Educational facilities in Ramu

Educational Facilities	No. of Facilities
Primary School	80
Kindergarten school	17
NGO School	2
High School	16
College	1
Madrasa	48
Technical/Vocational	0

(Source: BANBEIS, 2024)

Important Aspects:

Good Primary Education Infrastructure: There are 80 primary schools, which indicates that the primary education system has a strong infrastructure.

Restricted Pre-Primary and Secondary Education: The number of high schools (16) is comparatively smaller than that of kindergarten schools (17), which may account for the observed decline in school attendance in older age groups.

Lack of Facilities for Higher Education: With just one college, there is a clear shortage of higher education options in the upazila.

Religious instruction: There is a noticeable preference for or availability of religious instruction, as evidenced by the 48 madrasas.

Absence of Vocational Training: The lack of technical or vocational schools points to a crucial area in need of improvement in order to offer education focused on skills and increase employability.

Implications:

Facilities for Secondary and Higher Education: In order to offer additional options for secondary and higher education, it is imperative that the number of high schools and colleges rise.

Improving Vocational Training: In order to give students real-world experience and increase their chances of finding work, technical and vocational institutions must be established.

Support for NGO Schools: Promoting increased NGO participation in the educational system could aid in filling up gaps and offer creative approaches to teaching. While basic education in Ramu Upazila is well-established, there are notable deficiencies in secondary, higher, and vocational education, according to the data on educational facilities in the area. More funding for colleges, high schools, and career training facilities is required to guarantee complete educational growth. Closing these disparities will be necessary to raise the standard of education overall and provide young people more chances to advance both personally and professionally.

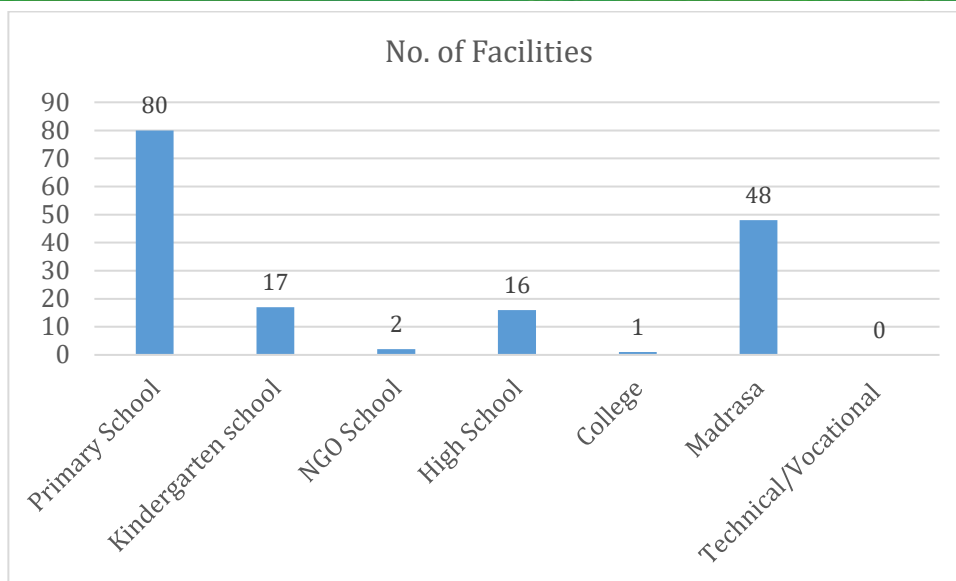


Figure 5-3: No. of Educational Facilities in ramu Upazilla

5.6 Number of students both boys and girls by types of institutions

The distribution of students in different kinds of educational institutions depicts the educational landscape of Ramu Upazila, the district of Cox's Bazar. The number of male and female pupils at each type of school—government primary schools, registered primary schools, kindergartens, non-governmental schools, non-government secondary schools, non-government colleges, and madrasas—is categorised in the statistics. Gaining knowledge about gender parity, enrollment trends, and possible areas for development in the education sector can be achieved by analysing the distribution of students by gender and kind of institution.

Government elementary School: There are more girls enrolled (14,225) than boys (13,130), suggesting that there is a significant female presence in government schools at the elementary level.

In Registered Primary Schools: The enrollment ratio of girls (3,609) in comparison to boys (3,199) is similar to that of government primary schools, indicating a high percentage of female students enrolled in registered primary schools.

Kindergarten School: A gender difference in kindergarten attendance is evident, with 773 boys enrolled compared to only 72 girls.

NGO School: Enrollment in NGO-run schools is slightly higher among girls (197) than among boys (167), suggesting that NGOs are more supportive of female education.

Non-Government Secondary School: The enrollment ratio of boys (5,414) to girls (4,458) suggests that there is either a higher dropout rate or a lower enrollment of girls in non-government secondary schools.

Non-Government College: Despite having a small overall enrollment, there are slightly more boys (394) than girls (362), indicating fairly balanced gender representation at the college level.

Madrasah (run by the Madrasah instruction Board): Enrollment is higher among males (1,700) than among girls (1,468), indicating a gender disparity in religious instruction.

Table 5-4: No. of Students by types of Institutions

Institution Type	Student	
	Boy	Girl
Government primary school	13130	14225
Registered primary school	3199	3609
kindergarten school	773	72
NGO school	167	197
Non-government secondary school	5414	4458
Non-government college	394	362
madrasah(under the madrasah education board)	1700	1468

(Source: BANBEIS, 2024)

Ramu Upazila's student enrollment data provides important new information about the distribution and dynamics of gender in various educational settings. Although female attendance in primary school is showing encouraging trends, there are still issues in early childhood (kindergarten) and secondary education, especially for girls. Targeted policies that promote female involvement at all educational levels, increase access to higher education, and guarantee gender parity in madrasas are necessary to close these disparities. With these findings, policymakers may create initiatives that support inclusive and equitable education in Ramu Upazila.

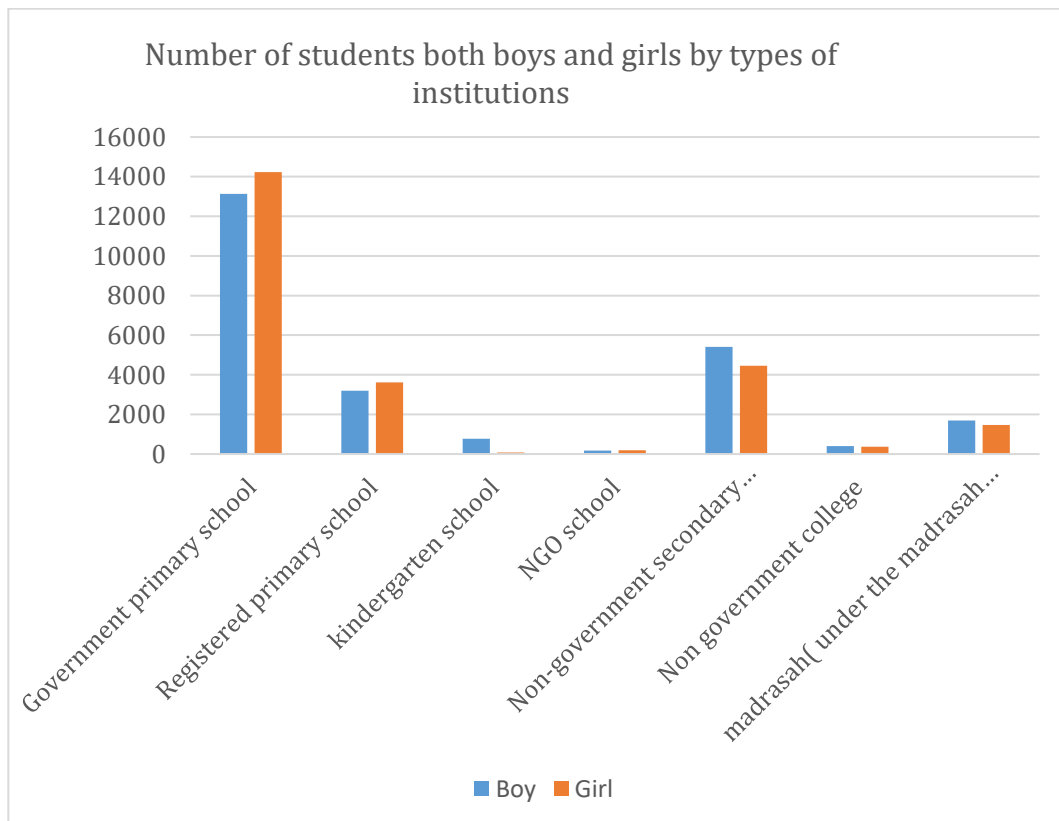


Figure 5-4: Number of both boys and girls by

(Source: BANBEIS, 2024)

5.7 Number of teachers both males and females by types of institutions

The distribution of teachers throughout educational institutions has a significant impact on the standard of instruction. The number of male and female teachers in different kinds of educational institutions in Ramu Upazila, Cox's Bazar district, is shown in detail by this dataset. By analysing this data, we can better understand how gender is represented in the teaching profession and pinpoint areas where teacher deployment and recruiting need to be improved.

Government Primary School: A greater proportion of women are employed in primary education teaching roles, as evidenced by the fact that there are 203 female teachers and only 153 male teachers.

In registered primary schools, there is a gender imbalance as there are more male teachers (41) than female teachers (24).

Kindergarten School: There are more female teachers (49) than male teachers (36), which indicates that the number of female teachers in early childhood education is on the rise.

NGO School: There are far more female teachers (6) than male teachers (2), indicating that there may be a higher percentage of female staff members at NGO schools.

Non-Government Secondary School: The ratio of male to female teachers is significantly out of balance, with 130 male teachers to 32 female teachers, suggesting that men predominate in secondary education teaching positions.

Non-Government College: There is a comparable gender disparity at the college level, with male teachers (24) vastly outnumbering female teachers (7).

Madrasah (Under the Madrasah instruction Board): There is a stark difference in the number of male teachers 132 compared to the number of female teachers (12). This indicates that males predominate in religious instruction.

Table 5-5: Number of teachers By types of Institutions

Institution Type	Teachers	
	Male	Female
Government primary school	153	203
Registered primary school	41	24
kindergarten school	36	49
NGO school	2	6
Non-government secondary school	130	32
Non-government college	24	7
madrasah(under the madrasah education board)	132	12

(Source: BANBEIS, 2024)

Overall Patterns:

Primary Education: There are more female teachers in government elementary schools, which is good for gender parity. Nonetheless, there are more male teachers in recognised primary schools.

Early Childhood Education: The proportion of female teachers in kindergartens is greater, suggesting that women are more available or preferable for early childhood education roles.

NGO Schools: There are also more female teachers at NGO schools, which may indicate that these establishments are more accepting of or supportive of female teachers.

Secondary Education: There is a noticeable male predominance in non-government secondary schools and colleges, which draws attention to the gender gap in higher education teaching positions.

Religious Education: There is a gender imbalance in religious education institutes, as seen by the substantial male domination among teachers in madrasas.

Important Aspects:

Parity of Gender in Public Primary Schools: The greater proportion of female instructors in government elementary schools points to initiatives aimed at achieving gender parity in the field.

Unbalance in Secondary and Higher Education: The significant gender gap in secondary schools and colleges suggests that specific initiatives to encourage and attract female instructors at the higher education levels are required.

Male Dominance in Madrasas: There is a notable gender disparity in religious educational institutions, as seen by the preponderance of male instructors in madrasas.

Important information about gender representation in a range of educational settings is provided by the teacher distribution data in Ramu Upazila. While the number of female students in government kindergartens and primary schools is encouraging, there is a noticeable gender gap in madrasas, colleges, secondary schools, and registered primary schools. Policies that support gender equality in education at all levels, as well as specific recruiting and support for female educators, are necessary to address these gaps. These steps would improve the general efficacy and quality of education in Ramu Upazila by assisting in ensuring a fair and inclusive learning environment.

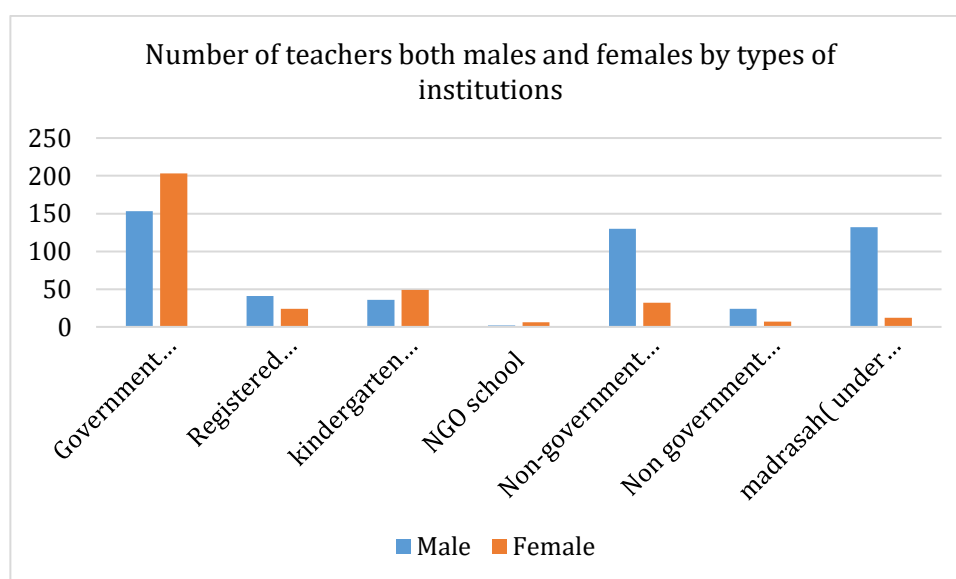


Figure 5-5: Number of teachers both males and Females by types of Institutions

(Source: BANBEIS, 2024)

5.8 Student Teacher Ratio by the Type of Institution

An important indicator of the quality of education is the student-teacher ratio, which shows how many students are typically given to each teacher. Higher student achievements, more individualised attention, and higher-quality instruction are typically linked to lower student-teacher ratios. The student-teacher ratios for the several kinds of educational institutions in the Ramu Upazila, Cox's Bazar district, are provided by this dataset. Understanding the allocation of educational resources and identifying places that could need more support are made easier by analysing these ratios.

Table 5-6: Student Teacher ratio by the Type of institutions

Institution type	Number of Students per teacher
Government primary school	77
Registered primary school	105
Kindergarten school	19
NGO school	46
Non-government secondary school	61
Non-government college	24
Madrasah (under the madrasah education board)	22

(Source: BANBEIS, 2024)

Government Primary School: With a student-teacher ratio of 77:1, this school has a high student-teacher ratio that could potentially compromise the quality of instruction and the individualised attention each student receives.

Registered Primary School: Among all institution categories, registered primary schools have the greatest student-teacher ratio—105:1—which raises concerns about serious overcrowding and possible difficulties in providing an effective education.

Kindergarten School: With a student-teacher ratio of 19:1, the lowest of all institution kinds, this school type offers more individualised attention and superior early childhood education.

NGO School: With a student-teacher ratio of 46:1, this is a reasonable ratio that may strike a balance between providing each student with individual attention and allocating resources.

Non-Government Secondary School: The comparatively high student-teacher ratio of non-government secondary schools—61:1—may have an effect on the secondary education quality.

Colleges that are not government-run: The ratio of 24:1 indicates a rather excellent balance that permits more individualised instruction at the collegiate level.

Madrasah (Under the Madrasah Education Board): The student-teacher ratio is 22:1, which is a good ratio that encourages improved communication between teachers and students as well as maybe higher-quality instruction in places of worship.

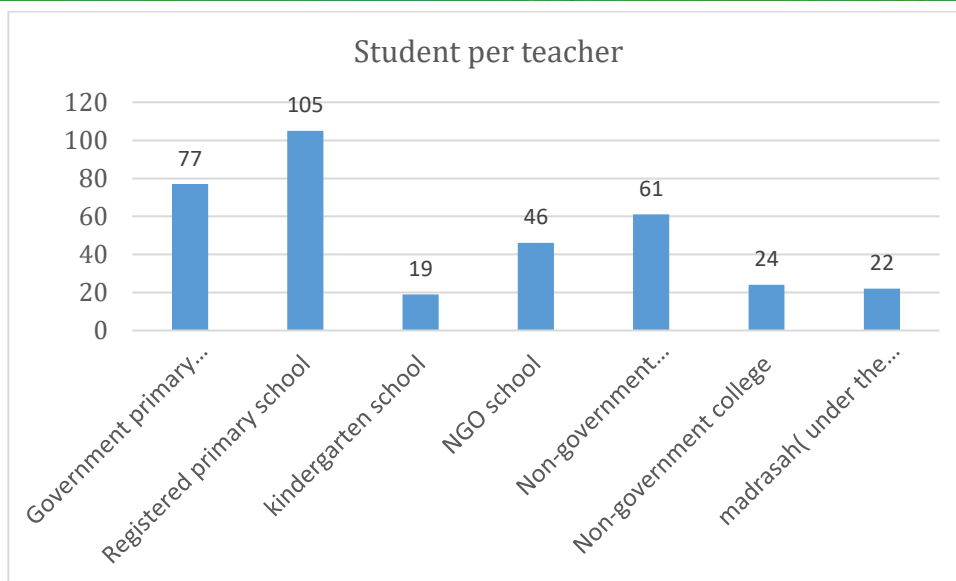


Figure 5-6: Student per teacher by the types of institutions

(Source: BANBEIS, 2024)

Overall Patterns:

High student-teacher ratios in primary schools are a sign of overcrowding and possible strain on educational resources. The ratios are high in both government and registered primary schools (77:1 and 105:1, respectively).

Positive Student-teacher Ratios in Kindergartens and Madrasas: The low student-teacher ratios in kindergartens (19:1) and madrasas (22:1) allow for more individualised attention and maybe higher educational performance.

Average Ratios in Secondary and Non-Profit Institutions: The moderate ratios of non-government secondary schools (61:1) and non-governmental organisations (46:1) indicate the need for improvement in order to improve the quality of education.

Balanced Student-Teacher Ratio in Colleges: The student-teacher ratio at non-government colleges is more favourable at 24:1, suggesting a higher quality of learning environment.

Important Aspects:

Primary School Overcrowding: To reduce overcrowding and raise educational standards, primary schools' high student-teacher ratios point to the need for more instructors or new facilities.

Good Early Childhood Education: The favourable low ratio found in kindergarten schools suggests that early childhood education is effective when teachers are given enough support.

Secondary schools and NGOs: Based on the moderate ratios, it appears that these institutions may use more support to lower the student-teacher ratio and improve instructional efficacy.

Higher Education Quality: Because non-government colleges have more manageable class sizes, the favourable ratio suggests that the quality of education there may be superior.

The statistics on Ramu Upazila's student-teacher ratio shows notable differences between various kinds of educational establishments. High student-teacher ratios cause problems for

primary schools, especially registered ones, while low ratios are advantageous for kindergartens and madrasas. By building more schools, hiring more teachers, and distributing funds wisely, we can correct these inequities and raise the standard of instruction at all levels. These insights can be used by policymakers to focus measures that guarantee all Ramu Upazila students receive a more effective and equitable education.

5.9 Problem Faced by the type of institutions

Located in Bangladesh's Cox's Bazar district, Ramu Upazila is home to a wide variety of educational institutions that serve the needs of the local populace. The region's educational scene is greatly influenced by these establishments, which include madrasahs, technical and vocational schools, secondary schools, colleges, and primary schools. But in spite of their importance, these organisations face a number of obstacles that reduce their influence and efficacy. The purpose of this paper is to draw attention to the issues that every kind of educational institution in Ramu Upazila faces.

5.9.1 Primary Schools

Inadequate Infrastructure: A large number of Ramu Upazila's primary schools are deficient in infrastructure. They frequently work in small, ill-ventilated classrooms. Teachers and children alike are at risk for health problems due to inadequate or nonexistent sanitation facilities, such as toilets. The teaching-learning process is hampered when there are no educational aids, textbooks, or notes available.

Teacher Shortage: There is usually a teacher shortage in primary schools. Due to the high student-teacher ratios caused by this scarcity, it is difficult for teachers to give each pupil individualized attention. In certain instances, the quality of education provided may be impacted by the lack of training that current teachers may have had.

Low Attendance: Due to financial constraints, a large number of children in Ramu Upazila are forced to work or help out around the house rather than consistently attending school. Low attendance rates are the outcome, which impedes pupils' ability to learn and grow as individuals.

Education Quality: The use of memorization and antiquated teaching strategies frequently result in subpar instruction in basic schools. The practical application of knowledge, creativity, and critical thinking abilities—all crucial for holistic development—are not given enough attention.

5.9.2 Secondary Education Institutions

Restricted Resources: Ramu Upazila's secondary schools frequently struggle with a lack of resources. The breadth of practical instruction is restricted by inadequate classrooms, out-of-date textbooks, and a lack of laboratory supplies, especially in science and technology courses.

Teacher's ability: Although some secondary schools have excellent instructors, others face a staffing deficit. Different teachers may have different levels of training or motivation to provide high-quality instruction.

Dropout Rates: A large percentage of secondary school pupils drop out due to socioeconomic factors such as early marriages and poverty. Human potential and talent are lost as a result of this problem, which is made worse by a lack of parental encouragement and support.

Curriculum Relevance: Secondary school curricula might not always be in line with what employers or postsecondary educational institutions require. The development of vocational skills is frequently underemphasized, which limits students' post-graduation career options.

5.9.3 College

Infrastructure Issues: Just like elementary and secondary schools, several colleges in Ramu Upazila deal with infrastructure issues. Inadequate labs, libraries, and classrooms make it more difficult to provide high-quality higher education.

Lack of Experienced Faculty: Colleges may have a faculty shortage, especially in specialised disciplines. Some educational institutions use underqualified or part-time teachers, which lowers the standard of instruction.

Restricted Course Offerings: Students' academic options and career paths may be constrained by the courses that Ramu Upazila's colleges offer. Students might not be able to access specialized fields of study or pursue their interests as a result of this restriction.

Access to Higher Education: Students from underprivileged families are frequently unable to pursue higher education due to economic hurdles. High tuition costs and a dearth of funding possibilities create educational achievement disparities.

5.9.4 Madrasah

Funding Restrictions: Because madrasahs in Ramu Upazila mostly rely on donations and endowments to support their operations, they frequently experience financial difficulties. Insufficient funding has an impact on teacher wages, the growth of facilities, and the general standard of education delivered.

Modernization: Many madrasahs find it difficult to strike a balance between traditional religious instruction and contemporary academic topics. It's possible that not enough resources or knowledge are available to properly incorporate courses like science, math, and language studies into the curriculum.

Teacher's ability: There is a large range in the caliber of madrasah teachers. While some teachers might be highly skilled and certified, others might not have the required training or qualifications. This variance affects the standard of instruction as well as the students' overall educational experience.

Integration with Mainstream Education: Students from madrasahs may find it more difficult to pursue higher education and get jobs if there is little integration with mainstream educational systems. In some industries, madrasah graduates may face discrimination or stigma, which would hinder their ability to advance in their careers.

5.9.5 Vocational and Technical Institutes

Lack of Knowledge: The low enrollment rates in technical and vocational schools are partly caused by a lack of knowledge regarding the significance of these programs. Vocational

training may not be prioritized over traditional academic courses by many parents and students.

Inadequate funding: Technical and vocational schools frequently experience financial difficulties that limit their ability to create new facilities and provide access to contemporary technology.

This restriction makes it more difficult to provide the hands-on, practical instruction that is necessary to get students ready for the workforce.

Industry Relevance: Technical and vocational education programmers' curricula might not always meet the demands of nearby companies or industries. The skills that are required in the labor market and those that are taught in schools may not match, which could cause graduates to be underemployed or unemployed.

Perception: Because technical and vocational education are frequently seen as having low value by society, students who choose to pursue these paths may face stigma and discrimination. Because of this perception, students may be deterred from attending technical and vocational schools, which would limit their access to useful skills and employment prospects.

There are several issues that Ramu Upazila's educational institutions must deal with at all levels, such as poor infrastructure, a lack of teachers, inadequate curricula, and socioeconomic hurdles. To guarantee that all students have equitable access to high-quality education, addressing these concerns would require concerted efforts from governmental organizations, educational authorities, community leaders, and other stakeholders.

5.10 Structural Condition by type of institutions

5.10.1 Primary Institutions:

Classroom Setup:

In Ramu Upazila, elementary schools usually feature simple classroom buildings made of wood or concrete. However, because of the high student-to-classroom ratio, many schools struggle with issues like overcrowding. The learning environment at certain schools may be negatively impacted by inadequate lighting and ventilation.

Facilities for Sanitation:

Primary schools differ in their access to hygienic and well-maintained restrooms and hand washing stations. While some schools could have sufficient infrastructure for sanitization, others might not, putting students' and employees' health at danger.

Play areas and leisure areas:

Playgrounds and other leisure areas are not always available in elementary schools. While some schools could have spaces set aside for outdoor activities, others might not have enough room for kids to play and engage in physical activity.

5.10.2 Secondary Education Institutions:

Classroom and Lab Equipment:

Compared to primary schools, secondary schools in Ramu Upazila usually feature bigger, more organized classroom buildings. A lot of secondary schools provide labs for science projects and hands-on instruction in topics like biology, chemistry, and physics.

Study spaces and the library:

For students to have access to textbooks, reference materials, and other educational resources, secondary schools may offer dedicated library rooms. Nonetheless, there may be differences in the calibre and amount of books found in school libraries.

Sports Facilities:

Sports facilities, like football fields, basketball courts, and playgrounds, are available at some secondary schools so that students can engage in extracurricular activities and sports.

5.10.3 Colleges

Lecture halls and classrooms:

Compared to elementary and secondary schools, colleges in Ramu Upazila usually have bigger, more contemporary classroom structures. Academic presentations and lectures may be held in lecture halls with audiovisual equipment.

Facilities for Workshops and Labs:

For practical study and experimentation, science, engineering, and technical colleges could contain well-equipped labs and workshop areas.

Research centers and libraries:

In order to support students' learning and research endeavors, colleges frequently include sizable libraries with a broad selection of scholarly books, periodicals, and research materials.

5.10.4 Madrasahs

Conventional Classroom Organizations

In Ramu Upazila, madrasahs could have conventional classroom layouts akin to those of elementary and secondary schools. On the other hand, some madrasahs could contain distinctive architectural elements such prayer halls and places for religious study.

Facilities for Islamic Studies

Prayer rooms, halls for reciting the Quran, and Islamic libraries are common features of madrasahs that are devoted to Islamic study.

5.10.5 Vocational and Technical Institutes

Workshops and Instructional Resources

For the development of practical skills, workshop spaces and training facilities are provided by Ramu Upazila's technical and vocational schools. These facilities could have equipment, tools, and machinery related to the provided vocational training.

Infrastructure Particular to an Industry

Technical and vocational schools may have specialized facilities, such computer labs, culinary restaurants, or automobile workshops, designed to meet the demands of particular industries or vocational disciplines.

5.10.6 Placement and Internship Centers

Certain technical and vocational institutions could have alliances with nearby companies and industries to offer internships and help students find employment following graduation.

In conclusion, depending on the kind and level of institution, different structural conditions apply to educational institutions in Ramu Upazila. Secondary schools and colleges typically feature more advanced infrastructure, including classrooms, labs, and libraries, whereas primary schools may struggle with issues like overcrowding and inadequate sanitary facilities. Madrasahs often have conventional classroom layouts with areas set aside for Islamic study, whereas technical and vocational institutions priorities offering hands-on instruction that is customized to the demands of business. Encouraging learning environments and advancing high-quality education in the area require efforts to preserve and enhance these institutions' structural circumstances

5.11 Effects of Socioeconomic and Environmental Factors on Educational Institutions in the Cox's Bazar District of Ramu Upazila

Areas Affected by Floods:

Educational institutions in Ramu Upazila's flood-affected areas experience particular difficulties because of infrastructural damage and disruptions to academic programming during the monsoon season. Low-lying primary and secondary schools may be susceptible to floods, which could force temporary closures and force teachers and students to relocate. Flood damage can exacerbate pre-existing infrastructure flaws by causing structural problems like unstable buildings, soggy classrooms, and ruined sanitary facilities.

Elevated Terrain:

Educational establishments located in the hilly regions of Ramu Upazila face challenges related to accessibility and conveyance. The provision of sufficient infrastructure and resources in schools situated in isolated alpine areas may be hindered by the harsh terrain and restricted connectivity. Mountains may require students to travel great distances on foot or across challenging terrain in order to get to school, which can increase absenteeism and dropout rates.

Inadequate Financial Framework:

Ramu Upazila's inadequate economic infrastructure impacts the region's educational standards and socioeconomic inequalities. Due to poor pay and a lack of incentives, schools in economically deprived locations may find it difficult to recruit and retain talented teachers. In disadvantaged regions, limited access to clean water, electricity, and sanitary facilities impedes the provision of high-quality education and compromises students' learning objectives.

Absence of Growth Centre Facilities:

There might not be enough resources and facilities for education in Ramu Upazila's growth centers, which act as focal points for social and economic development. Growth centers may put educational institutions in rivalry with other development goals for financing and resources, which could result in the neglect of academic demands and infrastructure. The lack of educational facilities in growth centers makes it more difficult for locals to receive a high-quality education and maintains disparities in educational achievement.

Overcoming Obstacles:

Resilient infrastructure can lessen the effects of floods on educational institutions by putting in place plans for disaster preparedness, raised classrooms, and structures resistant to flooding. Enhancing access to education and lowering dropout rates can be achieved through investing in transport infrastructure improvements and offering dependable, safe travel options to students residing in hilly areas. The development of economic infrastructure, such as access to clean water, power, and sanitary facilities, can foster the growth and development of education.

In Ramu Upazila, inclusive and sustainable development can be encouraged by giving priority to the construction of educational facilities in growth centers and making sure that resources are distributed fairly. Educational institutions in Ramu Upazila face numerous obstacles due to natural and socioeconomic causes such floods, steep terrain, inadequate economic infrastructure, and a lack of facilities in development centers. To guarantee that all students have access to high-quality education and opportunities for growth and prosperity, addressing these issues requires comprehensive plans that place a priority on resilience, accessibility, and equitable development.

5.12 SWOT Analysis

Strength:

Cultural Diversity: The population of Ramu Upazila is diverse, comprising indigenous communities, which adds richness to the educational experience by offering a range of viewpoints and customs.

Natural Resources and Scenic Beauty: The Cox's Bazar district's beaches and hills, among other natural resources, provide opportunity for hands-on learning and environmental education.

Government Initiatives: Investments in teacher training programs, literacy campaigns, and infrastructure development are just a few examples of government initiatives that improve education and help to improve conditions for students generally.

Existence of Development and Non-governmental Organizations (NGOs): The presence of development and non-governmental organizations (NGOs) in the region offers extra resources and support for educational activities, such as community outreach, skill development programs, and scholarships.

Weakness:

Infrastructure shortcomings: The provision of high-quality education is hampered by the overcrowding in classrooms, the absence of sanitary facilities, and the use of antiquated teaching materials in many of Ramu Upazila's educational institutions.

Teacher Shortages: High student-teacher ratios and subpar education are caused by a lack of skilled teachers, especially in rural areas and in fields requiring specialised knowledge.

Socioeconomic Challenges: Poverty and economic inequality restrict access to education and exacerbate problems including high dropout rates, child labor, and early marriages, especially for marginalized groups.

Natural Disasters: The area is vulnerable to cyclones, landslides, and floods, which can disrupt school operations, destroy infrastructure, and endanger the safety of faculty and staff.

Opportunities:

Technological Advancements: Accessibility obstacles can be removed and educational achievements can be enhanced, especially in rural locations, by utilising technology for digital classrooms, online resources, and distance learning.

Community Engagement: Increasing community support for schools and cultivating a feeling of accountability and ownership can be achieved by bolstering community involvement in education through parent-teacher associations, volunteer programmes, and community-led projects.

Tourism and Cultural Exchange: As a popular tourist destination, Cox's Bazar offers chances for educational travel, cultural exchange initiatives, and collaborations with travel-related businesses to enhance educational opportunities and foster cross-cultural understanding.

Vocational Training and Skill Development: Funding technical education, skill development programs, and vocational training can help meet the growing need for skilled workers across a range of industries while also preparing students for the workforce.

Threats:

Political instability: Political upheaval and instability in the area can interfere with funding, policymaking, and educational endeavors, creating uncertainty and impediments to educational advancement.

Environmental Degradation: Natural resources, educational infrastructure, and the general wellbeing of students and communities are all under risk due to environmental issues like pollution, deforestation, and climate change.

Societal and Cultural Barriers: Girls, minority groups, and marginalized populations may find it difficult to obtain education due to ingrained societal norms, cultural traditions, and gender inequality. This will limit their prospects for advancing their education.

Economic Constraints: Especially in impoverished areas, budgetary restrictions, funding volatility, and conflicting priorities in resource distribution may make it more difficult to solve issues like teacher shortages, inadequate infrastructure, and other educational needs.

5.13 National Education Policy

The aims, objectives, goals and principles of the National Education Policy 2010 are as follows.

1. to reflect the Constitutional guarantee at all levels of education and make learners aware of the freedom, sovereignty and integrity of Bangladesh;
2. to stimulate the intellectual and practical qualities of the learners so that moral, human, cultural, scientific and social values are established at personal and national levels;
3. to inspire the students with the spirit of our war of liberation and develop patriotism, nationalism and qualities of good citizens (i.e, sense of justice, non-communalism, dutifulness, awareness of human rights, cultivation of free thinking and discipline, love for honest living, the tolerance of corporate life, friendliness and perseverance);
4. to promote the continuity of national history, tradition and culture through an intergenerational process;
5. to foster creative and thinking faculties among the learners through a system of education that contains indigenous spirit and elements and which will lead to a life oriented development of knowledge of the learners;
6. to evolve an education process that is oriented to creativity, practicability and productivity to achieve advancement in the economic and social fields of the country; to create a scientific mindset of the students and to develop in them the qualities of leadership;
7. to remove socio-economic discrimination irrespective of race, religion and creed and to eradicate gender disparity; to develop non-communalism, friendliness, global fraternity, fellow-feeling and respect for human rights; to create unhindered and equal opportunities of education for all as per learners' talents and aptitudes, irrespective of geographical, social and economical situations to establish a society that is free from discrimination; to resist use of education as a commodity to reap profits;

8. to create unhindered and equal opportunities of education for all as per learners' talents and aptitudes, irrespective of geographical, social and economical situations to establish a society that is free from discrimination; to resist use of education as a commodity to reap profits;
9. to show tolerance for different ideologies for the development of a democratic culture and to help develop a life-oriented, realistic and positive outlook;
10. to ensure the marginal competencies of learners at each level so that they are discouraged from rote learning, rather use their own thoughtfulness, imagination and urge for curiosity;
11. to ensure skills of high standard at different areas and levels of education so that learners can successfully compete at the global context;
12. to attach substantial importance to information and communication technology (ICT) along with maths. science and English in order to build up a digital Bangladesh based on knowledge-orientation and cultivation of ICT;
13. to put special emphasis on the extension of education; to give priority to primary and secondary education; to motivate the students to show dignity of labour; to enable students to acquire skills in vocational education to facilitate self-employment, irrespective of levels of education;
14. to develop some uniform and basic ideas amongst all learners; to establish a sense of equal status amongst all citizens of the country to implement a uniform curriculum of certain basic subjects at the primary level schools of diverse delivery systems; to prescribe and ascertain the learning of some uniform textbooks to attain that; to initiate some method of teaching in some basic subjects at the secondary level to achieve similar objectives;
15. to ensure a creative, favorable and joyful environment for the students at the primary and secondary levels for their proper protection and congenial development;
16. to help students grow up with sound moral character through lessons from their respective religious teachings and moral sciences;
17. to ensure proper quality of education at each level and to correlate the competencies learnt at the earlier level (as per the aims and objectives of education) with the next one to consolidate the formations of knowledge and skills; to promote extension of such knowledge and skills; to enable the learners to acquire these skills; to motivate the people to participate in the educational process, at the primary, secondary and vocational levels, in particular to realize the objectives of education;
18. to build students as skilled human resources to fight the challenges of the world threatened by climate change and other natural disasters and to create in them a social awareness about environment;
19. to ensure quality of the higher education in all disciplines and motivate students in research and to create a congenial and necessary environment of research within the country through the cultivation of knowledge and sciences;
20. to ensure the proper context and situations in the education system at the higher level that facilitates ideal cultivation of learning;

21. to extend the use of information and communication technology (ICT) instrumental in educational process at every level
22. to take special measures for the development of education of the backward classes of the country including the street-children;
23. to promote and develop the languages and cultures of the indigenous and small ethnic groups;
24. to ensure the education of the physically and mentally challenged learners;
25. to create a society free from the curse of illiteracy ;
26. to initiate special measures to promote education in the areas identified as backward in education;
27. to ensure efficient and correct teaching of Bangla language;
28. to take necessary steps to create facilities of playground, sports, games and physical exercises in all educational institutions for the healthy growth of the physical and mental qualities of the learners;
29. to take various steps to foster hygienic awareness of the students;
30. to caution the students and make them aware of the dangers of taking drugs or similar items.

5.14 Recommendations and Concluding Observations

1. Infrastructure Development: Provide funding and resources to upgrade Ramu Upazila's educational institutions' physical spaces, such as by building additional classrooms, restrooms, libraries, and labs.
2. Teacher Training and Recruitment: To improve the abilities and proficiencies of educators in the area, funds should be allocated to teacher training programs. To solve the teacher shortage, you should also provide incentives for competent educators to work in isolated and rural locations.
3. Community Engagement: Encourage more community participation in education by forming volunteer programs, parent-teacher groups, and community-led projects that assist schools and advance accountability.
4. Technology Integration: Provide computers, internet access, and digital learning materials to schools in order to enable online learning, remote learning, and interactive teaching techniques. This is one way to incorporate technology into education.
5. Specialized Programs: To prepare students for employment prospects and satisfy the expectations of the local job market, implement specialized programs like skill development, entrepreneurship education, and vocational training.
6. Awareness Campaigns: To overcome social and cultural barriers and raise enrollment and retention rates, run awareness campaigns about the value of education, paying special attention to marginalized communities.
7. Disaster Preparedness: To lessen the effects of natural disasters like floods, landslides, and cyclones on educational institutions and to guarantee the safety of students and staff, develop plans for disaster preparedness and infrastructure resilience measures.

8. Collaboration and Partnerships: Encourage cooperation and partnerships between government agencies, non-governmental organizations, development organizations, and stakeholders in the private sector to improve educational outcomes in Ramu Upazila by utilizing resources, best practices, and expertise.

5.15 Planning Implication

The physical aspects of education facilities in context of reviewing and updating the master plan of Ramu Upazila have been noted below:

- Preparing a stock list of existing locational distribution of educational institutions' vis-à-vis their accessibilities to the students, structural conditions, and availability of needed facilities and services etc.
- Determination of future requirement of future educational institutions considering the population projection of the area concerned
- Determination/adaption of planning standards by hierarchy of educational institutions and availability of land at the concerned sites
- Ensuring accessibility to the proposed educational institutions

5.16 Concluding Observations

Despite the difficulties that Ramu Upazila's educational institutions face, there are chances for development and progress through focused interventions, well-timed investments, and community empowerment. In order to empower people, combat poverty, and advance socioeconomic development in the area, education is essential. As a result, investing in and prioritizing education as a fundamental human right is essential. An all-encompassing strategy is needed for sustainable development, one that tackles socioeconomic inequality, environmental sustainability, and cultural inclusivity in addition to educational infrastructure and resources. Through collaboration with many stakeholders such as government agencies, community leaders, educators, parents, and students, we can establish a learning environment that is favorable to the development of talent, innovation, and equal opportunity for all Ramu Upazila citizens. It is important to consistently observe, assess, and modify educational policies and programs in order to monitor advancements, pinpoint opportunities for enhancement, and guarantee the efficacy and durability of educational endeavors in Ramu Upazila.

Chapter Six: Agriculture Including Fisheries, Livestock and Forestry



CHAPTER SIX: AGRICULTURE INCLUDING FISHERIES, LIVESTOCK AND FORESTRY

6.1 Introduction

6.1.1 Background of the Study

The land of Ramu Upazila is intensively used for agriculture, housing and settlements, forest, fisheries and other infra-structural development. These diversified uses of land giving financial benefits in one hand but on the other creating many problems in respect of criteria based uses and conflicts among the users. This Upazila is comprised of 11 unions and these unions are devastated year in and year out by one or more natural disasters – flash flood, river erosion, tornadoes, tidal surges, salinity malaria, deforestation, attacking wild elephant etc. In spite of having enormous opportunities Ramu Upazila is also vulnerable to natural disasters like drainage congestion and land erosion, draught, erratic rain fall, water logging which are the main causes of loss of crops and bio-diversity, human lives and properties. This Upazila is surrounded by many hills and mountain and the river Bakhali and other small rivers, therefore, flood and mountain sliding happen during rainy season (Please see Map 1.1). Besides, due to some areas of this Upazila being very adjacent to the sea, it is vulnerable to the risk of tidal surge and salinity intrusion in almost every year. These vulnerabilities as well as opportunities call for distinctive sustainable land management for proper use of land and other natural resources of the area.

In view of the above mentioned context, a comprehensive study was conducted in all the unions of Upazila of Ramu to assess present situation of land uses, related problems and potentialities of land for different other uses, and to find out possible ways for future development. Therefore, a sustainable land management was considered to develop better crop production considering all available parameter and characteristics of the area.

6.1.2 Objectives of the Study

The main objective of the study is to assess the present cropping pattern and cropping intensities (single, double and triple crop area), land utilization and flood level. The main study questions are to determine the growth or decline of agricultural land during last ten years (from 2005 to 2015), and their causes for growth or decline covering a possible quality of existing and future agricultural land for the project area. The study is to determine the present scenario in agriculture practices and assessment the potential sustainable future development of the sector.

6.1.3 Approach and Methodology

A multi-disciplinary, participatory and interactive method has been followed in carrying out the study. Both primary and secondary data were reviewed. The primary data were collected through KII (Key Informant Interview) and field visit (Questionnaire). KII data was collected by used of questionnaire Annex-1. The secondary data collected and reviewed on land use from Department of Agriculture Extension (DAE) Union and Upazila Office documents. KII information was collected from 15 Sub-Assistant Agriculture Officers under 11 Unions

through interviewed. Structured and semi-structured questionnaire was used for data collection (Annex- 2). Data collection and consolidation occurred simultaneously. Data consolidation activities, such as editing, coding, classifying and data entry into the computer software for analysis were carried out simultaneously. Frequency tables (one, two or multiple ways) were prepared for interpretations and analyses using SPSS and d-Base) for data analysis.

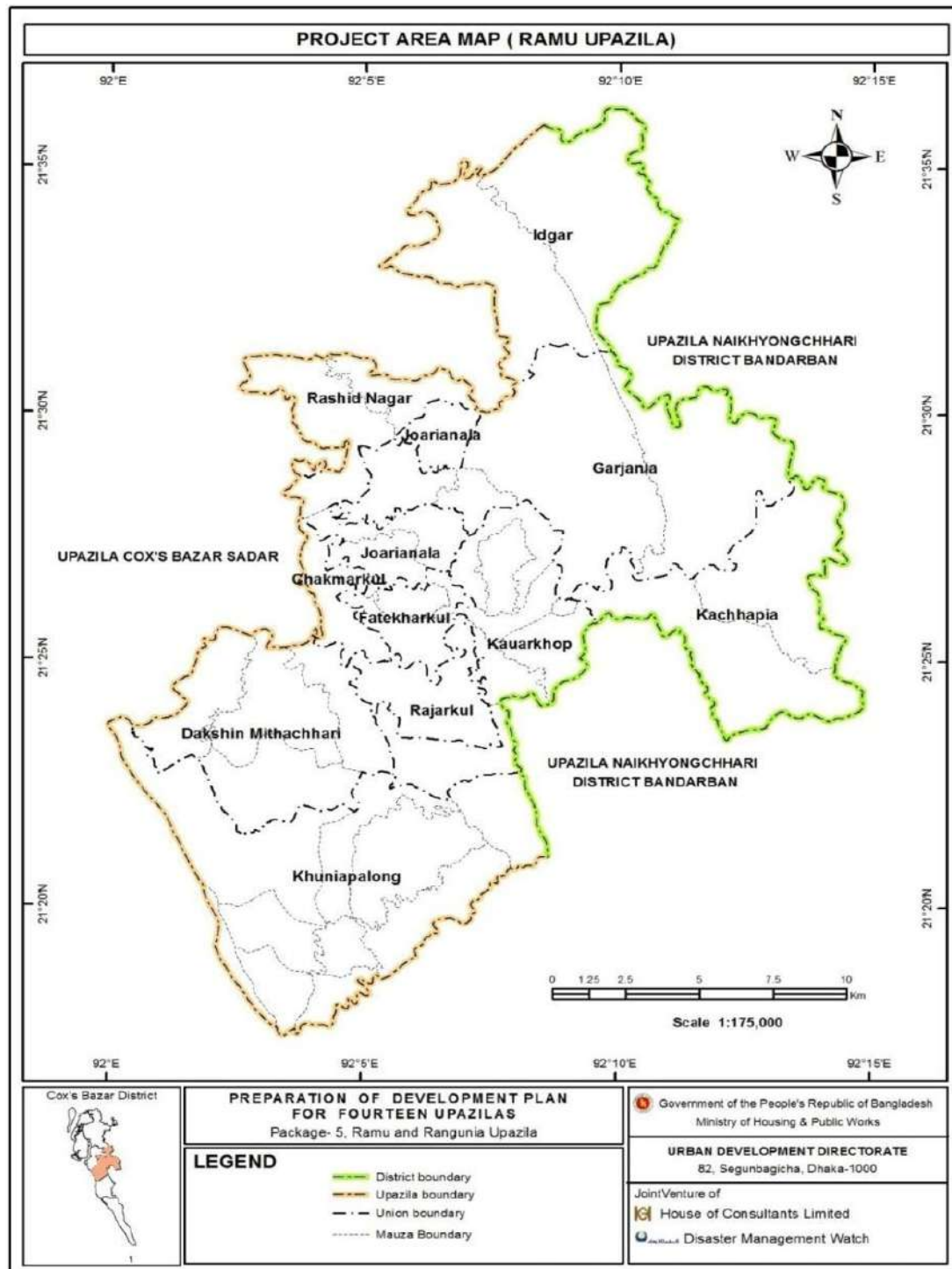


Figure 6-1: Project Area Map of Ramu Upazila

(Source: Field Survey, 2024)

6.2 Existing Land Use of Ramu Upazila

6.2.1 Description of the Existing Situation

The Upazila Agro-ecological zone: Ganges Tidal Floodplain (AEZ-23 and part 29). The soils are formed from alluvial sediments and are seasonally flooded, poorly drained soil developed in medium textured to fine textured alluvial deposits. This Upazila is surrounding by 40% plain, 10% low and 50% mountain and high land. Type/nature of soil is 25 % mixed soil, 25% clay 30 % sediment, and 20 % sand. The soil pH ranges from 6.5-7.5 (SRDI 1997,& UAO 2016). Soil salinity level ranges from very slightly to moderately saline 2-4 dS/m and partly becomes strongly saline in dry season. Main river is Bakhali river of Ramu Upazila and others stream and small rivers. Due to different river flash flood nearest villages flooded and damaged the houses and crops. Lands are fertile for Sedimentation after rivers yielding water every year.

6.2.2 Ramu Upazila and Union Wise Farm Families

Ramu Upazila has 11 unions. Union and category wise farm family is shown in following Table. On an average about land less 6336, marginal 10740, small 5613, medium large 2691 farm families and remaining 1343 are larger farmers under Ramu Upazila. Farmer's family is categorized on the basis of their own land. Those farmer have 0.51-1.50 acre of land that farmer is categorized under marginal farm family. The highest percentage of farm families are marginal farmers (40%) followed by landless (23%), Small (21.00%), medium farmers (10%) and remaining are larger farmers (Fig. 1).

Table 6-1: Union and Category wise Farm Family under Ramu Upazila

Name of Union	Category of Farm Family (%)				
	Landless (0.05-0.50 acre)	Marginal (0.51-1.50 acre)	Small (1.51-2.50 acre)	Medium (2.51-7.50 acre)	Larger (above 7.50 acre)
Garjania	131(14)	350(36)	355(36)	80(8)	60(6)
Rashidnagar	180(10)	400(24)	600(36)	300(18)	200(12)
Eidgar	540(18)	1350(46)	540(18)	270(9)	270(9)
Rajarkhul	1370(38)	1362(38)	588(17)	221(6)	45(1)
Chakmarkul	700(28)	800(32)	700(28)	200(8)	100(4)
Fatakharkul	1094(31.98)	1315(38.44)	545(15.93)	354(10.35)	113(3.30)
Khuniapalong	300(7)	2400(55)	990(23)	600(14)	60(1)
Joarianala	231(21)	418(38)	275(25)	121(11)	55(5)
Dakkin Mitachari	600(39)	425(28)	330(21)	100(6)	85(6)
Kascapia	355(14)	1350(52)	345(14)	270(10)	270(10)
Khawarkhup	835(42)	570(28)	345(17)	175(9)	85(4)
Total	6336 (23.71)	10740(40.19)	5613(21.00)	2691(10.07)	1343(5.03)

(Source: Field Survey, 2024)

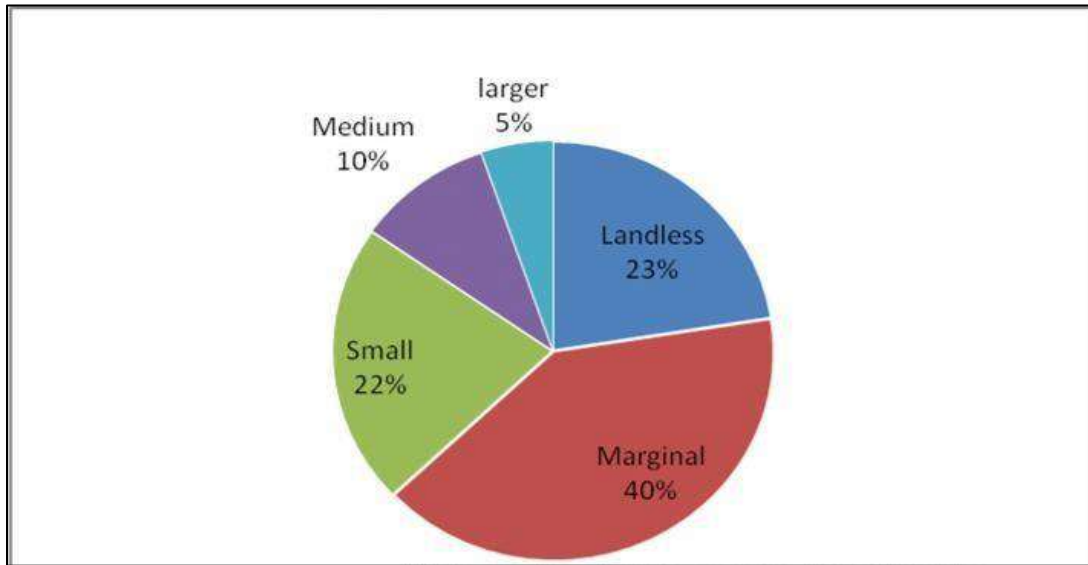


Figure 6-2: Upazila wise Farm Family under Ramu Upazila

(Source: Field Survey, 2024)

6.3 Agriculture

6.3.1 Upazila Existing Agricultural land Use

The scenario of present Ramu Upazila land utilized is shown in Table-2. Upazila covers a net cropped area 19400 ha of which about cultivated area 9700 ha. The highest percentage are double cropped area 80% and followed by single 10% and remaining triple cropped area under Upazila (Fig. 2). Other land are use Shrimp culture (110ha), forest land (21938ha), Fish cultivation pond (1180 ha and hill area (3503ha). A large cultivable fallow land is 2800ha. There is one rubber garden; one coconut garden and one BADC seed multiplication farm are established under Ramu Upazila. The cropping intensity of Upazila Ramu is 200% which is higher than national average cropping intensity 190% (Krishi Diary 2016). Union-wise Present Agriculture Land Use Information and Identified land Zoning (Ramu Upazila are shown in following Table.

Table 6-2: Ramu Upazila Present Agriculture Land Use

Sl. No.	Upazila Land use	Total Area (ha)
1.	Cultivable land	9700
2.	Single cropped area	900
3.	Double cropped area	7800
4.	Triple cropped area	1000
5.	Total crops land	19400
6.	Cropping Intensity	200%
7.	Irrigated land	6235
8.	Shrimp culture cultivated area	110
9.	Water land	1180
10.	Forest land	21938
11.	Hill land	3503
12.	High land	2698

Sl. No.	Upazila Land use	Total Area (ha)
13.	Medium land	3550
14.	Medium low land	2827
15.	Low land	625
16.	Cultivable Fallow land	2800
17.	Salinity land	50
18.	Rubber garden	1(one)
19.	Isolated coconut garden	1(one)
20.	BADC Seed Production Farm	1(one)

(Source: Field Survey, 2024)

Table 6-3: Union-wise Present Agriculture Land Use Information and Identified land of adjoining Ramu Upazila

Name of Union	Total Area(HA)	Land Type (%) NCA	Soil P ^H	Soil Texture	Salinity soil dS/m	Present land Use (%)	Identified Land Zoning
Fatekharkul	985.83	HL-25 MHL-65 MLL-20	4.1-5.5	Sandy clay to clay	0-4	Agriculture=70 Urban=13 Settlement=22 Water=05	Agro-Urban & Commercial Zone *Suitable for agriculture
Garjania	6448.988	HL-15 MHL-65 MLL-20	4.1-5.0	Loam (Brown hill soil)	0-2	Agriculture=22 Settlement=10 Hill forest=60 Rubber garden =06 Others=02	Agro-Hill Forest Zone *Dominant by hill forest
Eidgar	5208.502	HL-30 MHL-60 MLL-10	5.0	Sandy Loam(Brown hill soil)	0-2	Agriculture=17 Settlement=07 Hill forest=73 Others=03	Agro-Hill Forest Zone *Dominant by hill forest
Joarianala	5228.34	HL-40 MHL-50 MLL-10	4.1-5.5	Silt loam	0-2	Agriculture=24 Settlement=24 Hill forest=27 Water =11 Rubber garden =14	Agro-Hill Forest Zone *Dominant by hill forest
Kacchapia	4360.324	HL-30 MHL-60 MLL-10	4.5-5.5	Sandy Loam (Brown hill soil)	0-2	Agriculture=34 Settlement=12 Hill forest=50 Others=04	Agro-Hill Forest Zone *Dominant by hill forest
Khuniapalong	7699.595	HL-40 MHL-50 MLL-10	5.0-5.7	Sandy Loam(Brown hill soil)	0-2	Agriculture=21 Settlement=16 Hill forest=64 Others=05	Agro-Hill Forest Zone *Dominant by hill forest

Name of Union	Total Area(HA)	Land Type (%) NCA	Soil P ^H	Soil Texture	Salinity soil dS/m	Present land Use (%)	Identified Land Zoning
Khauarkhup	2487.447	HL-20 MHL-60 MLL-20	4.5-5.5	Clay loam	0-2	Agriculture=42 Settlement=13 Hill forest=45	Agro-Hill Forest Zone *Dominant by agriculture
Rajarkhul	2059.514	HL-20 MHL-60 MLL-20	4.5-5.5	Silt Loam to Silty Clay loam	0-2	Agriculture=60 Settlement=20 Hill forest=15 Others=05	Agriculture Zone *Dominant by agriculture
Dakkin Mitachari	4084.211	HL-40 MHL-50 MLL-10	4.5-5.7	Silt loam	0-4	Agriculture=25 Settlement=12 Hill forest=55 Water=08	Agro-Hill Forest Zone *Dominant by hill forest
Rashidnagar	1718.623	HL-30 MHL-60 MLL-10	4.5-5.6	Sandy loam	2-4	Agriculture=32 Settlement=15 Hill forest=50 Others=03	Agro-Hill Forest Zone *Dominant by hill forest
Chakmarkul	729.555	HL-20 MHL-70 MLL-10	4.5-5.3	Silt loam	2-4	Agriculture=72 Settlement=25 Hill forest=00 Water=03	Agriculture Zone *Dominant by agriculture

(Source: Field Survey, 2024)

Table 6-4: Unions Identified Land Zoning under Ramu Upazila

Name of Land Zoning	Name of Union under Land Zoning	Remarks
Agriculture Zone	Rajarkhul and Chakmarkul union	Peoples' opinions are in favor of this zoning
Agro-Hill Forest Zone	Garjania, Eidgar, Joarianala, Kacchapia, Khuniapalong, Khauarkhup, Dakkin Mitachari and Rashidnagar	People's opinions are in favor of Both agriculture and hill forest zoning
Agro-urban and Commercial Zone	Fatekharkul	Comprehensive Urban development program is a common demand without degrading fertile agricultural land

(Source: Field Survey, 2024)

6.3.2 Union-Wise Present Agriculture Land Use

Ramu Upazila has 11 Unions and lands used of all the 11 unions are given below.

6.3.2.1 Fatekharkul Union Land Use

General Description: Fatekharkul Union is comprised of 4 mouzas having an area of 985.83ha of land of which cultivable area is 690ha (70%). The land types of this union are medium highland (65%), medium low land (10%) and high land (25%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation(SAAO,2016). This union is

covered by Chittagong Coastal Plain (AEZ23) and Northern and Eastern Hills (AEZ29). The soil P^H is 4.1-5.5 and soil salinity level ranges from 0-4dS/m. The agricultural potentiality of these soils is moderate for field crops, but low to high forest crops and Agro-forestry species (Field Survey, 2024).

Present Agriculture Land Use: Fatekharkul Union dominant land use is agriculture followed by homestead garden and pond. From the agriculture point of view, this union is suitable for agriculture. Boro (HYV) is the main irrigated crops cultivated using water hilly charas (canals) and confined water of khals and ponds. There are three cropping pattern are practiced in Fatekharkul Union which is shown in Table 5. The cropping intensity of this union is 195%. Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, and potato etc.

Table 6-5: Present Cropping Patterns of Fatekharkul Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area (ha)
Fatekhakul	690	Boro(HYV) Fallow T.Aman(HYV)	195	65.0	450.0
		RC Fallow T.Aman(HYV)		15.0	105.0
		Boro(HYV) vegetables T.Aman(HYV)		15.0	100
		Sugarcane and orchard (Perennial) crops)		5.0	35.0
		Total		100	690

(Source: Field Survey, 2024)

Major Agricultural Problems under Fatekharkul Union

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives & properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be

stopped through motivational and awareness building program.

- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area as well as crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.
- ⇒ BRRI, BARI, BSRI and BINA has recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan -47,-53,-55,-61,-67 and BRRI Dhan -73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI Poato-22, Sugarcane Ishardi-40 to be widely introduced and encouraged to cultivate.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation
- ⇒ of “preparation of Development Plan for Fourteen Upazilas” Package 05(Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.2 Garjania Union Land Use

General Description: Garjania Union is comprised of 3 mouzas having an area of 6448.988ha of land of which cultivable area is 1225ha (19%). Except hilly areas, the land types of this union are medium highland (66%), medium low land (20%) and high land (15%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation. This union is covered by Chittagong Coastal Plain (AEZ23) and Northern and Eastern Hills (AEZ29).The soil P^H is 4.1-5.0 and soil salinity level ranges from 0-2 dS/m. General fertility of the soil is medium (Field Survey, 2024).

Present Agriculture Land Use: Garjania Union dominant land use is reserved forest (4240 ha) followed by agriculture and rubber garden (255 ha). From the agriculture point of view, this Union is not suitable for agriculture. Boro(HYV) is the main irrigated crops cultivated using water hilly charas (canals) .There are four cropping pattern are practiced in this Union which is shown **Table 6**. Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, and potato etc.

Table 6-6: Present Cropping Patterns of Garjania Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area(ha)
Garjania	1225	Boro(HYV)☐Fallow☐T.Aman (HYV)	220	55.0	673.75
		Tobacco☐Fallow☐T.Aman(HYV)		10.0	122.50
		Rabi crops☐vegetables☐T.Aman (HYV)		10.0	122.50
		Fallow☐Fallow☐T.Aman		25.0	306.25
		Total		100	1225

(Source: Field Survey, 2024)

Major Agricultural Problems under Garjanja Union

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives & properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area as well as crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.
- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan- 47,-53,-55,-61,-67 and BRRI Dhan-73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “Preparation of Development Plan for Fourteen Upazilas” Package 05 (Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.3 Eidgar Union Land Use

General Description: Eidgar Union is comprised of 2 mouzas having an area of 5208.502ha of land of which cultivable area is 900ha (17%). The land types of this union are medium highland (60%), medium low land (10%) and high land (30%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season. This union is covered by Chittagong Coastal Plain (AEZ23) and Northern and Eastern Hills (AEZ29). The soil PH is 4.7-5.5 and soil salinity level ranges from 0-2dS/m. The agricultural potentiality of these soils is moderate for field crops, but low to high forest crops and Agro-forestry species (Field Survey, 2024).

Present Land Use: Eidgar union dominant land use is reserved forest followed by agriculture (900ha). From the agriculture point of view, this union is suitable for agriculture. Boro(HYV) is the main irrigated crops cultivated using water hilly charas (canals) . The area of khas land is 300 ha which is used for different development purposes. Present cropping patterns of Eidgar union is shown **Table7**. There are three cropping pattern are practiced under this union. The cropping intensity of this union is 239%. Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, and potato etc.

Table 6-7: Present Cropping Patterns under Eidgar Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area(ha)
Eidgar	900	Boro (HYV) Fallow T.Aman (HYV)	239	51.0	459.0
		RC Fallow T.Aman(HYV)		44.0	396.0
		Fallow Fallow T.Aman(HYV)		15.0	100
				5.0	45.0
		Total		100	900

(Source: Field Survey, 2024)

Major Agricultural Problems under Eidgar Union

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives and properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area as well as crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.
- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan- 47,-53,-55,-61,-67 and BRRI Dhan 73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05(Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.4 Joarianala Union Land Use

General Description: Joarianala Union is comprised of 8 mouzas having an area of 5228.34ha of land of which cultivable area is 1267ha (24%). The land types of this union are medium highland (50%), medium low land (10%) and high land (40%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season. This Union is covered by Chittagong Coastal Plain (AEZ23) and Northern and Eastern Hills (AEZ29).The soil P^H is 4.1-5.5 and soil salinity level ranges from 0-2dS/m and soil is being affected different degree of salinity especially in Ultakhal and Nandakhali mouza Soil salinity is 4-8 dS/m (**Field Survey, 2024**).

Present Agriculture Land Use: From the agriculture point of view, this union is not suitable for agriculture. Boro(HYV) is the main irrigated crops cultivated using water hilly charas (canals). Present cropping patterns of Joarianala union is shown Table 8. There are five cropping pattern are practiced under this union. Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, and potato etc.

Table 6-8: Present Cropping Patterns under Joarianala Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area(ha)
Joarianala	1267	Boro(HYV) Fallow T.Aman (HYV)	206	65.0	823.55
		RC Fallow T.Aman(HYV)		10.0	126.7
		Vegetables Fallow T.Aman(HYV)		11.0	126.7
		Watermelon Fallow T.Aman (HYV)		10.0	45.0
		Fallow Fallow T. Aman (LV)		4	50.68
		Total		100	1267

(Source: Field Survey, 2024)

Major Agricultural Problems under Joarianala Union

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives & properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area and crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.

- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan 47,53,55,61,67 and BRRI Dhan 73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05 (Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.5 Kachhapia Union Land Use

General Description: Kachhapia Union is comprised of 2 mouzas having an area of 4360.320 ha of land of which net cultivable area is 1483ha (34%). The land types of this union are medium highland (60%), medium low land (10%) and high land (30%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season. This union is covered by Chittagong Coastal Plain (AEZ 23) and Northern and Eastern Hills (AEZ 29).The soil P^H is 4.5-5.5 and soil salinity level ranges from 0-2 dS/m. The agricultural potentiality of these soils is moderate for field crops, but low to high forest crops and Agro-forestry species (Field Survey, 2024).

Present Agriculture Land Use: From the agriculture point of view, this union is not suitable for agriculture. Boro (HYV) is the main irrigated crops cultivated using water hilly charas (canals). Present cropping patterns of Joarianala union is shown **Table 9**.There are four cropping pattern are practiced under this union. Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, and potato etc.

Table 6-9: Present Cropping Patterns under Kachhapia Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area(ha)
Kachhapia	1483	Boro(HYV)☐Fallow☐T.Aman (HYV)	204	50.0	742.0
		Tobacco☐Fallow☐T.Aman(HYV)		20.0	296.0
		Rabi crops☐Fallow☐T.Aman(HYV)		17.0	252.0
		Fallow☐Fallow☐T. Aman (HYV)		13.0	193.0
		Total		100	1483.0

(Source: Field Survey, 2024)

Major Agricultural Problems under Kachhapia Union:

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives &

properties.

- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations:

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the Unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system needs to be converted into pucca drain which will increase the command area as well as crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.
- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan-47,-53,-55,-61,-67 and BRRI Dhan 73, BINA Dhan -8, BARI Wheat-25, BARI Muatard-11, BARI Poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05(Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.6 Khuniapalong Union Land Use

General Description: Khuniapalong Union is comprised of 10 mouzas having an area of 7699.595ha of land of which net cultivable area is 1650ha (21%). The land types of this union are medium highland (50%), medium low land (10%) and high land (40%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season when both water and soils become salinity free. This union is covered by Chittagong Coastal Plain (AEZ 23) and Northern and Eastern Hills (AEZ 29). The soil P^H is 5.0-5.7 and soil salinity

level ranges from 0-4dS/ m. The agricultural potentiality of these soils is moderate for field crops, but low to high forest crops and Agro-forestry species (Field Survey, 2024).

Present Agriculture Land Use: The most dominant land use of this Union is reserved forest. From the agriculture point of view, this union is not suitable for agriculture. Boro (HYV) is the main irrigated crops cultivated using water hilly charas (canals) . Major cropping patterns of Khuniapalong Union is hown Table10. There are five cropping pattern are practiced under this Union. Rabi crops cultivated in this Union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, and potato etc.

Table 6-10: Present Cropping Patterns under Khuniapalong Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area(ha)
Khuniapalong	1650	Boro (HYV) Fallow T. Aman (HYV)	183	59.0	973.5
		Rabi crops Fallow T. Aman (HYV)		5.0	82.5
		Vegetables Fallow T. Aman (HYV)		7.0	115.5
		Fallow Fallow T. Aman (HYV)		22.0	363.0
		Watermelon Fallow T. Aman (HYV)		7.0	115.5
		Total		100	1650.0

(Source: Field Survey, 2024)

Major Agricultural Problems under Khuniapalong Union:

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives & properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other

regulatory measures by the concerned authority.

- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area as well as crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in Union.
- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan -47,-53,-55,-61,-67 and BRRI Dhan -73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI Poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05(Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.7 Rajarkul Union Land Use

General Description: Rajarkul Union is comprised of one mouza having an area of 2059.514ha of land of which net cultivable area is 1235ha (60%). The land types of this union are medium highland (60%), medium low land (20%) and high land (20%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season when both water and soils become salinity free. This union is covered by Chittagong Coastal Plain (AEZ 23) and Northern and Eastern Hills (AEZ 29).The soil P^H is 4.7-5.6 and soil salinity level ranges from 0-2dS/m. The agricultural potentiality of these soils is moderate for field crops, but low to high forest crops and Agro-forestry species (Field Survey, 2024).

Present Agriculture Land Use: The most dominant land use of this Union is agriculture followed by reserved forest. From the agriculture point of view, this union is suitable for agriculture. Boro(HYV) is the main irrigated crops cultivated using water hilly charas (canals). Major cropping patterns of Rajarkul union are shown **Table-11**. There are five cropping pattern are practiced under this union. Rabi crops cultivated in this Union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, and potato etc.

Table 6-11: Present Cropping Patterns under Rajarkul Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area(ha)
Rajarkul	1235	Boro (HYV)☐Fallow☐T. Aman (HYV)	224	62.0	765.0
		Tobacco☐Fallow☐T. Aman(HYV)		8.0	98.0
		Rabi crops☐Fallow☐T. Aman(HYV)		12.0	148.0
		Vegetables☐Vegetables☐T. Aman (HYV)		15.0	186.0
		Sugarcane (Annual)		3.0	38.0
		Total		100	1235.0

(Source: Field Survey, 2024)

Major Agricultural Problems under Rajarkul Union

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives & properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area as well as crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.
- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan-47,-53,-55,-61,-67 and BRRI Dhan-73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI Poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05 (Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector

6.3.2.8 Kauarkhop Union Land Use

General Description: Kauarkhop union is comprised of 6 mouzas having an area of 2487.499ha of land of which net cultivable area is 1038ha (42%). The land types of this union are medium highland (60%), medium low land (10%) and high land (30%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season when both water and soils become salinity free. This union is covered by Chittagong Coastal Plain (AEZ 23) and Northern and Eastern Hills (AEZ 29). The soil P^H is 4.7-5.6 and soil salinity level ranges from 0-2dS/m. The agricultural potentiality of these soils is moderate for field crops, but low to high forest crops and Agro-forestry species (Field Survey, 2024).

Present Agriculture Land Use: The most dominant land use of this union is reserved forest. From the agriculture point of view, this union is not suitable for agriculture due to irregular land shape. Boro (HYV) is the main irrigated crops cultivated using water hilly charas (canals). The area of khas land is 10ha which could be used for different development purposes. Major cropping patterns of Kauarkhop union is shown **Table 12**. There are five cropping pattern are practiced under this union. Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, and potato etc.

Table 6-12: Present Cropping Patterns under Kauarkhop Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area (ha)
Kauarkhop	1038	Boro (HYV) Fallow T. Aman (HYV)	199	63.0	653.94
		Tobacco Fallow T. Aman (HYV)		20.0	207.6
		Rabi crops Fallow T. Aman (HYV)		8.0	83.0
		Fallow fallow T. Aman		6.0	62.28
		Sugarcane Sugarcane Sugarcane		3.0	31.14
		Total		100	1038.0

(Source: Field Survey, 2024)

Major Agricultural Problems under Kauarkhop Union

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives and properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the Unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area as well as crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.
- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan -47,-53,-55,-61,-67 and BRRI Dhan -73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05 (Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.9 Dakshin Mithachari Union Land Use

General Description: Dakshin Mithachari Union is comprised of 3 mouzas having an area of 4084.211ha of land of which net cultivable area is 1016 ha (25%). Except hilly areas, The land types of this union are medium highland (50%), medium low land (10%) and high land (40%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season when both water and soils become salinity free. This union is covered by Chittagong Coastal Plain (AEZ 23) and Northern and Eastern Hills (AEZ 29). The soil P^H is 4.6-5.7 and soil salinity level ranges from 0-2dS/m. The agricultural potentiality of these soils is moderate for field crops, but low to high forest crops and Agro-forestry species (Field Survey, 2024).

Present Agriculture Land Use: The most dominant land use of this Union is agriculture (1016 ha) followed by reserved forest (956ha). From the agriculture point of view, this Union is not much suitable for agriculture due to irregular land shape. Boro (HYV) is the main irrigated crops cultivated using water hilly charas (canals). There are five cropping pattern are practiced under this union .Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, cabbage and potato etc.

Table 6-13: Present Cropping Patterns under Dakshin Mithachari Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area (ha)
Dakshin Mithachari	1016	Boro(HYV) Fallow T.Aman (HYV)	175	55.0	558.8
		Rabi crops Vegetables T. Aman (HYV)		4.0	40.64
		Vegetables Fallow T. Aman (HYV)		6.0	60.96
		Watermelon fallow T. Aman (HYV)		6.0	60.96
		Fallow Fallow T. Aman (HYV)		29.0	294.64
		Total		100	1016.0

(Source: Field Survey, 2024)

Major Agricultural Problems under Dakshin Mithachari Union:

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives & properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area as well as crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present

agricultural situation in Union.

- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan - 47,-53,-55,-61,-67 and BRRI Dhan-73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI Poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “Preparation of Development Plan for Fourteen Upazilas” Package 05 (Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.10 Rashid Nagar Union Land Use

General Description: Rashid Nagar union is comprised of mouzas having an area of 1718.6231ha of land of which net cultivable area is 550 ha (32%). Except hilly areas, the land types of this union are medium highland (70%), medium low land (10%) and high land (20%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season when both water and soils become salinity free. This union is covered by Chittagong Coastal Plain (AEZ 23) and Northern and Eastern Hills (AEZ 29).The soil P^H is 4.5-5.6 and soil salinity level ranges from 0-2dS/m. About 170 ha of land is affected by various degrees of salinity restricting crop cultivation and other uses of natural resources. The area of khas land 10 ha which could be used different purposes (Field Survey, 2024).

Present Agriculture Land Use: The most dominant land use of this union is reserved forest (755ha) followed by agriculture (550 ha). At present, reserved forest is being encroached for agriculture, housing and other non-agriculture purposes. From the agriculture point of view, this Union is suitable for agriculture due to irregular land shape. Boro (HYV) is the main irrigated crops cultivated using water hilly charas (canals). Major cropping patterns of Rashid Nagar Union are shown Table 14. There are three cropping patterns practiced under this Union. Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, cabbage and potato etc.

Table 6-14: Present Cropping Patterns under Rashid Nagar Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area(ha)
Rashid Nagar	550	Boro (HYV) Fallow T. Aman (HYV)	205	75.0	412.5
		Rabi crops Vegetables T. Aman (HYV)		12.0	66.0
		Fallow Fallow T. Aman (HYV)		19.0	104.5
		Total		100	550.0

(Source: Field Survey, 2024)

Major Agricultural Problems under Rashid Nagar Union

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.

- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives & properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations

- ⇒ Re-excavating all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and katcha drainage system need to be converted into pucca drain which will increase the command area and crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.
- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan 47,53,55,61,67 and BRRI Dhan 73, BINA Dhan -8, BARI Wheat-25,BARI Muatard-11, BARI poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05(Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

6.3.2.11 Chakmarkul Union Land Use

General Description: Chakmarkul union is comprised of an area of 729.5541ha of land of which net cultivable area is 527 ha (72%). The land types of this union are medium highland (60%), medium low land (10%) and high land (30%) which indicates lands are free from monsoon flood and suitable for T. Aman Cultivation in Kharif-11 season when both water and soils become salinity free . This union is covered by Chittagong Coastal Plain (AEZ 23) and Northern and Eastern Hills (AEZ 29).The soil P^H is 4.5-5.3 and soil is not affected by salinity. About 120 ha of land is affected by various degrees of salinity restricting crop cultivation and other uses of natural resources. The area of khas land 70 ha which could be used different purposes (Land Zoning Report, January 2011).

Present Agriculture Land Use: From the agriculture point of view, this union is suitable for agriculture The most dominant land use of this union is agriculture (527ha) followed by forest which has been cleared no for salt and shrimp cultivation. Boro(HYV) is the main irrigated crops cultivated using water hilly charas (canals) . Major cropping patterns of Chakmarkul union is shown Table 15. There are four cropping pattern are practiced under this union. Rabi crops cultivated in this union are: chili, onion, vegetables, ladies finger, long yard bean, tomato, cabbage and potato etc.

Table 6-15: Present Cropping Patterns under Chakmarkul Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	% of NCA	Area (ha)
Chakmarkul	527	Boro (HYV) Fallow T. Aman (HYV)	218	70.0	368.9
		Rabicrops Vegetables T. Aman (HYV)		17.0	89.59
		Fallow Fallow T. Aman (HYV)		6.0	31.62
		Vegetables Vegetables T. Aman		7	36.89
		Total		100	527.0

(Source: Field Survey, 2024)

Major Agricultural Problems under Chakmarkul Union

- ⇒ Water stagnation, drainage congestion in medium low land, salinity some areas and low organic matter contents in soil.
- ⇒ Barriers of natural water flow and causing drainage congestion due to unplanned construction of housing, markets and infrastructures.
- ⇒ Flash flood from hilly areas which causes loss of agricultural crops.
- ⇒ Vulnerable to Storm surges and cyclone which is damages crops, human lives & properties.
- ⇒ Hill forest and hilly areas cutting by local peoples and different agencies.
- ⇒ Agricultural land reducing due to unplanned construction of houses & settlements, markets, industries and other infrastructure development.
- ⇒ Cultivable land is kept fallow in Kharif-1 season due to risk of flash flood and scarcity of irrigation water.
- ⇒ Scarcity of both ground and surface irrigation water due to salinity problems in dry season.

Recommendations:

- ⇒ Re-excavating river and all the old canals by making connection to adjacent rivers and khals of the unions which will reduce the drainage congestion and also improve the flash flood problems.
- ⇒ Unplanned and unwanted interventions responsible for land degradation need to be stopped through motivational and awareness building program.
- ⇒ Hill cutting need to be stopped by imposing forest law, land zoning law and other regulatory measures by the concerned authority.
- ⇒ Development of irrigation facilities, proper planned use of land as per its criteria and kutchra drainage system need to be converted into pucca drain which will increase the command area and crop production.
- ⇒ Introduce more drought and saline tolerant different crops, improvement of drainage and prevention of intrusion of saline water from the sea will improve the present agricultural situation in union.
- ⇒ BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan 47,53,55,61,67 and BRRI Dhan 73, BINA Dhan -8, BARI Wheat-25, BARI Muatard-11, BARI poato-22, Sugarcane Ishardi-40 widely introduce and encouraged to cultivate.
- ⇒ To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops.
- ⇒ Zoning of land as per its existing uses and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05 (Ramu and Rangunia Upazilas) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.

The Chakmarkul, Joarianala Eidgar and Rajarkhul Unions present land use under Ramu Upazila obtained from the field survey is shown in Table 16. The Chakmarkul Union covers a net cropped area 1120ha of which about cultivated area 580 ha. The highest percentage is double cropped area (76%) and followed by single (15%) and triple cropped area (9%) under Chakmarkul Union. Similarly, the Joarianala Union covers a net cropped area 790 ha of which about cultivated area 385 ha. The highest percentage is double cropped area (85%) and followed by triple cropped area (10%) and single crop area (15%) under Joarianala Union. Further, the Eidgar Union covers a net cropped area 2750 ha of which about cultivated area 1250 ha. The highest percentage is double cropped area (56%) and followed by triple cropped area (32%) and single crop area (12%) under Eidgar Union. Rajarkhul Union covers a net cropped area 1691 ha of which about cultivated area 835 ha. The highest percentage is double cropped area (85%) and followed by triple cropped area (9%) and single crop area (6%) under Rajarkhul Union.

The Rashidnagar, Dakkin Mitachari, Gajnia and Kascapia unions present land use obtained from the field survey is shown in Table 17. Rashidnagar Union covers a net cropped area 1114 ha of which about cultivated area 572 ha. The highest percentage is double cropped area (91%) and followed by single crop area (7%) and triple cropped area (2%) under Rashidnagar

Union. Similarly, Dakshin Mitachari Union covers a net cropped area 790 ha of which about cultivated area 596 ha. The highest percentage is double cropped area (84%) and followed by single crop area (9%) and triple cropped area (7%) under Dakshin Mitachari Union. Further, Gajnia Union covers a net cropped area 1190 ha of which about cultivated area 570 ha. The highest percentage is double cropped area (56%) and followed by triple cropped area (26%) and single crop area (18%) under Gajnia Union. Finally, Kascapia Union covers a net cropped area 1300 ha of which about cultivated area 600 ha. The highest percentage is double cropped area (50%) and followed by triple cropped area (33%) and single crop area (17%) under Kascapia Union.

The Fatakharkul, Khuniapalong and Khawarkhup unions present land use obtained from the field survey is shown in Table 17. Fatakharkul Union covers a net cropped area 1610 ha of which about cultivated area 730 ha. The highest percentage is double cropped area (75%) and followed by triple cropped area (23%) and single crop area (2%) under Fatakharkul Union. Khuniapalong Union covers a net cropped area 2755 ha of which about cultivated area 1560 ha. The highest percentage is double cropped area (66%) and followed by single crop area (29%) and triple cropped area (5%) under Khuniapalong Union. Khawarkhup Union covers a net cropped area 957 ha of which about cultivated area 487 ha. The highest percentage is double cropped area (80%) and followed by triple cropped area (12%) and single crop area (8%) under Khawarkhup Union.

Table 6-16: Existing Land Use under 4 Unions

Sl. No.	Types of Land use	Union wise present land used in ha (%)			
		Chakmarkul	Joarianala	Eidgar	Rajarkhul
1	Cultivated area	580	385	1250	835
2	Single cropped area	90 (15.52)	20(5.20)	150(12.00)	51(6.11)
3	Double cropped area	440(75.86)	325(84.41)	700 (56.00)	712 (85.27)
4	Triple Cropped area	50 (8.62)	40(10.39)	400 (32.00)	72 (8.62)
5	Net cropped area	1120	790	2750	1691
	Cropping Intensity (%)	193	205	220	202

(Source:Field Survey, 2024)

Table 6-16: Existing Land Use under 4 Unions

Sl. No.	Types of Land use	Union wise present land used in ha (%)			
		Rashidnagar	Dakkin Mitachari	Gajnia	Kascapia
1	Cultivated area	572	596	570	600
2	Single cropped area	40(6.99)	56 (9.40)	100(17.54)	100(16.67)
3	Double cropped area	522(91.26)	500(83.89)	320(56.14)	300(50.00)
4	Triple Cropped area	10(1.75))	40(6.71)	150(26.32)	200(33.33)
5	Net cropped area	1114	1176	1190	1300
	Cropping Intensity (%)	194	197	208	216

(Source: Field Survey, 2024)

Table 6-17: Existing land Use under 3 Unions

Sl. No.	Types of Land use	Union wise present land used in ha (%)		
		Fatakharkul	Khuniapalong	Khawarkhup
1	Cultivated area	730	1560	487
2	Single cropped area	15(2.05)	450 (28.85)	57(11.71)
3	Double cropped area	550(75.34)	1025 (65.70)	390(80.08)
4	Triple Cropped area	165 (22.60)	85 (5.45)	40 (8.21)
5	Net cropped area	1610	2755	957
	Cropping Intensity (%)	220	176	196

(Source: Field Survey, 2024)

6.3.3 Cropping Pattern and Cropping Intensities and Production

6.3.3.1 Cropping Pattern

The term 'Cropping pattern' as it applies to the area of reclamation can be defined as the acreage distribution of different crops in any one year in a given farm area such as a water agency, or farm. Thus, a change in a cropping pattern from one year to the next can occur by changing the relative acreage of existing crops, and/or by introducing new crops, and/or by cropping existing crops'. Information that defines a cropping system consists of the number of crops on a given field per year including the accompanying cropping periods from sowing to maturity for each crop cycle and whether each crop is grown under rain fed or irrigated conditions.

The scenario of existing cropping pattern under Ramu Upazila predominantly Rice, Vegetables, Tobacco, Betel Leaf and Orchard based. Detailed Upazila cropping patterns by season are presented in Table 6. The present cropping pattern under Ramu Upazila is Boro (HYV/Hybrid) Fallow Transplanted Aman (HYV) which is practiced 46.63% of the Net Cultivable Area (NCA). Winter vegetables Fallow T. Aman (HYV) are the cropping pattern covering 17.41% of the net crop area. Boro – Fallow T. Aman (LV) is covering 14.51% of the NCA. Boro (HYV/Hybrid) S. vegetables T. Aman (local) is the cropping pattern covering about 4.63% of the NCA. Winter vegetable summer vegetables vegetables are practiced about 4.46% of the Net Cultivable Area (Table 19). A detailed GIS based map of cropping pattern will be produced for the whole Upazila comprising single, double and triple cropped agricultural land after physical feature data processing.

6.3.3.2 Cropping Intensity

Cropping intensity is an important index of utilization of land. Crop intensity index assesses farmers actual land use in area and time relationship for each crop or group of crops compared to the total available land area and time, including land that is temporarily available for cultivation. It is calculated by summing the product of area and duration of each crop divided by the product of farmers total available cultivated land area and time periods plus the sum of the temporarily available land area. For a specific crop, the cropping intensity is the number of times that crop is grown in one year on the same field. It is distinguish single, double and triple cropping systems respectively.

Different cropping pattern are practiced in Ramu Upazila. Union wise (11 Unions) present cropping intensity is shown in Figure-2. The average cropping intensity under Ramu

Upazila is 200% which is less than cropping intensity of Unions of Eidgar & Fateharkul (220%), Cocchopia (216%), Gorgonia (208%), Zoarianala (205%) and Razarkul (202%) respectively. Further, Ramu Upazila cropping intensity which is higher than the Unions of South Mithachori (197%), Kaurkhop (196%), Rashidnagar (194%), Chakmarkul (193%) and Khuniapalong (176%) respectively (Fig.2). There is an ample scope of increasing double and triple cropped areas under each Union after development irrigation facilities, ensure availability of quality crop production inputs and market infrastructure through intervention of Urban Development project. The average cropping intensity under Ramu Upazila is 200% which is higher than Cox's Bazar district (180%) and national average cropping intensity (190%).

Table 6-18: Present Cropping Pattern under Ramu Upazila

Major Cropping Pattern			Area(ha)	Contribution %
Rabi	Kharif-1	Khari-2		
Boro (HYV/Hybrid)	Fallow	T. Aman (HYV)	9000	46.63
Boro (HYV/HYBrid)	S. Vegetables	T. Aman (LIV)	893	4.63
Boro (HYV/Hybrid)	Fallow	T. Aman (LV)	2800	14.51
W. Vegetables	Fallow	T. Aman (HYV)	3360	17.41
Boro (HYV/HYBrid)	S.vegetables	Fallow	422	2.19
Pulses (Phelon)	Fallow	T. Aman (LIV)	105	0.54
Tobacco	Fallow	T. Aman (HYV)	700	3.63
Potato	Fallow	T.Aman (HYV)	40	0.21
Species/Oil seeds	S.Vegetables	T. Aman (LIV)	255	1.32
W. Vegetables	S. Vegetables	S. Vegetables	860	4.46
Sugarcane	Sugarcane	Sugarcane	55	0.28
Betel Leaf	Betel Leaf	Betel Leaf	150	0.78
Betel Nut	Betel Nut	Betel Nut	120	0.62
Orchard	Orchard	Orchard	540	2.80
Total			19300	100.00

(Source: Field Survey, 2024)

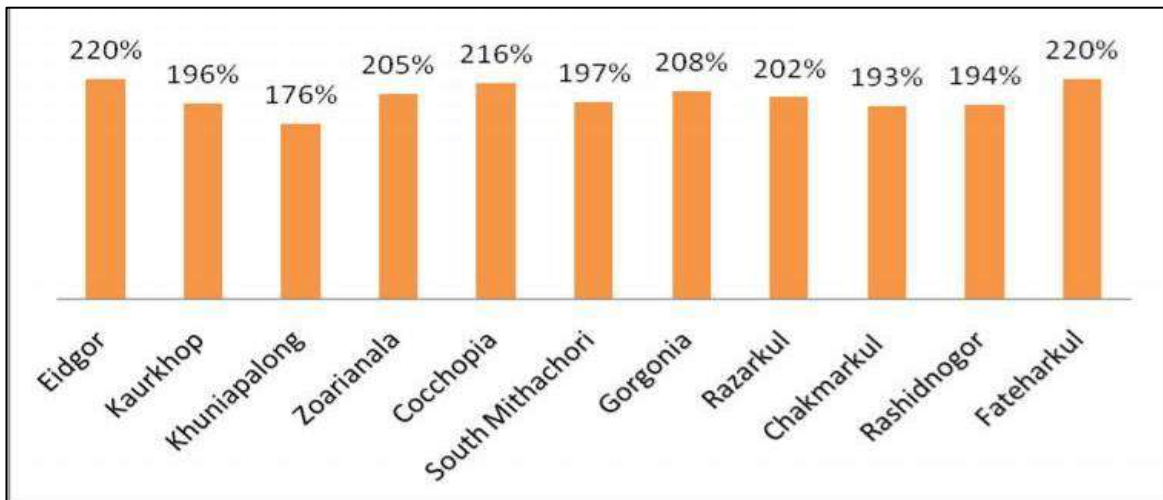


Figure 6-3: Union wise cropping intensity

(Source: Field Survey, 2024)

6.3.3.3 Present Cropped Area

Rice, vegetables, pulses and fruits are cultivated in different unions under Ramu Upazila. Different cropped area, yield rate and production levels present scenario under Ramu Upazila are shown in Table 20. The present total cropped area is 37483 ha of which rice cropped area is 29568ha and the rest 7915 ha is covered by non-rice crops (Vegetables, Pulses, Orchard and Betel leaf etc.). The rice and non-rice cropped area are about 78.88% and 21.12% of the total cropped area respectively.

6.3.3.4 Present Crop Production

Total crop production is 305674.75 metric tons of which rice production is 143446.4 metric tons and non-rice production is 162228.35 metric tons (Table 7). Among the rice crops the contributions of T. Aman (LV), T. Aman (HYV) and Boro (HYV & Hybrid) are about 11%, 40%, 49% respectively. The highest contribution among the non-rice crops are winter vegetables (57%) & summer vegetables (28%) followed by orchard (8%) and Sugarcane (2%) and Betel leaf (3%) respectively (Table below).

Table 6-19: Present cultivated area, yield and production under Ramu Upazila

Crop Grown	Crop area (ha)	Yield/ha (mt)	Production (mt)	Contribution (%)
T. Aman(LV)	4053	3.8	15401.4	10.74
T.Aman(HYV)	12400	4.6	57040	39.76
Boro (HYV)	13000	5.4	70200	48.94
Boro (Hybrid)	115	7	805	0.56
Sub Total Rice	29568		143446.4	100.00
S. Vegetables	2430	18.5	44955	27.71
W. vegetables	4220	22	92840.00	57.23
Felon	105	2.8	294	0.18
Potato	40	21.5	860	0.53
Spices	255	3.25	828.75	0.51
Sugarcane	55	50	2750	1.70
Tobacco	700	2	1400	0.86
Betel Leaf	150	22	3300	2.54
Betel nut	120	12.505	1500.6	0.92
Orchard	540	25	13500	8.32
Sub-otal	7915		162228.35	100.00
Total	37483		305674.75	

(Source: Field Survey, 2024)

6.3.3.5 Irrigation Facilities under different unions

Irrigation is the lifeline of agriculture, because without irrigation facility multiple crops or HYV cultivation would be impossible. Irrigation facilities assured production of crops in the dry season as well as stabilized production through supplemental irrigation of the rain fed crops and ensured greater productivity. For irrigation purposes, Deep Tube Wells (DTW), Shallow Tube Well (STW) and Low Lift Pump (LLP) are used. Rubber Dams has provided irrigation water for crop production. Union wise DTW, STW and LLP under Ramu Upazila is shown in Table 21. Different Unions a total of 352 DTW, 740 STW and 120 LLP used for

irrigation under Ruma Upazila. Farmers reported that above 85% of the irrigation drainage system is not pucca which is causes wastage of irrigation water.

Union	Deep Tube Well	Shallow Tube Well	Shallow Machine
Eidgor	17	275	15
Kaurkhop	20	50	13
Khuniapalong	150	50	5
Zoarianala	8	12	1 (Rubber Dam)
Cocchopia	10	20	16
South Mithachori	15	12	13
Gorgonia	10	20	16
Razarkul	13	10	20
Chakmarkul	29	265	10
Rashidnogor	71	13	11
Fateharkul	9	13	-
Total	352	740	120

(Source: Field Survey, 2024)

6.3.3.6 Rubber Dam

Rubber Dams being deflectable to open the full passage way of the river channel during monsoon floods are ideally feasible water conservation structures for many small and medium rivers and will thus play a vital role in enhancement of irrigation capacity. Rubber Dams can be used to conserve water in channel storages of small and medium rivers and streams in flat areas and in small reservoirs in hilly areas for the principal purpose of irrigation. Bangladesh has adopted Rubber Dams for conservation of water in the channels of its small and medium rivers to support winter-summer irrigation. Since introduction of the technology in 1995, Rubber Dams have been recognized as a successful method of water conservation under the conditions in Bangladesh.

There are in total, 41dams in Ramu upazila which stretches over nearly 158.5 km. These dams protect the farming lands, roads, houses and very institutions from natural disasters, such as river bank erosion, floods, inland flooding during tide, tidal surges, etc. All rubber dam water is used for Rabi crops and Boro rice cultivation under Ramu Upazila. Farmers and DAE personnel reported that Rubber Dam irrigation water is less cost in compared to DTW and STW irrigation water.

6.3.3.7 Cultivation Practices

All the Unions is dominated by agriculture crops are: Boro rice (Plate-2) and Transplanted Aman (T. Aman) rice, potato, pulses, Felon (Plate-1) and different kinds of winter and summer vegetables& Chili (Plate-4), spices which are cultivated under both rain fed and irrigation condition. Betel Leave (Plate -3) and Orchard (Mango, Banana and Betel nut) are also grown. All the SAAOs and UAO reported that about 95-100% farmers used power tiller and tractor during land preparation. Boro and T. Aman rice seedlings grown in seedbed are uprooted when they are about 30-45 days old and transplanted in the main fields. They transplanted Boro and T. Aman rice haphazardly instead of line sowing. Generally in rice field weeding is done once, about a month after transplanting and this exercise is closely followed by top dressing with urea. Majority of the farmers did not use balance dose of chemical fertilizers due to lack of knowledge. Due to lack of knowledge and awareness'

farmers did not cultivate T. Aus rice. Farmers reported pests are acute problems for crop production. Farmers used pesticides over and under dose as preventive and curative measures for controlling different pests because of lack of knowledge.



Plate-1: Felon Crop at Ramu



Plate-2: Boro Rice at Ramu

6.3.3.8 Major Types of Crops Cultivated

Main crops: Paddy (Boro Rice (HYV/Hybrid), T. Aman (HYV/LIV), Vegetables, Betel leaf, Betel nut, Sugarcane, Tobacco, Spices etc.

Vegetables: Tomato, Potato, Brinjal, Radish, Cauliflower, Cabbage, Bean, Chili, Lalshakh, Loncho, Kolmi, Peas, Kochu, Bitter gourd, Felon, Pumpkins, Gourd, Rai Shakh, Ladies finger, Palong, Spinach, Cucumber etc.

Spices: Chili, Turmeric, Ginger, Onion & Garlic etc.

Fruits: Mango, Damson Plum, Jackfruit, Pomelo, Orange, Olive, Star fruit, Banana, Wood Apple, Coconut, Areca Nut, Country Goose Berry, Bel, Golap Jum. Guava, Kul, Pineapple Papaya etc.



Plate-3: Betel Leaf



Plate-4: Vegetables and Chili field

6.3.4 Production Cost of Rice and Vegetables

6.3.4.1 Cost of Rice Production

The cost of production of paddy varies depending on crop season, variety (HYV/Hybrid/LV), land preparation (Power tiller/Tractor/Bullock), seeds and seedlings, manure and fertilizer,

irrigation (complete irrigated (Boro Rice) and rain fed or provided supplementary irrigation), pesticide and labor. To assess farmers cost of rice production, Agriculture Economic Division of BRRI (2014-15) were conducted survey all over the country in three rice seasons (Boro, Aus and Aman paddy). BRRI study findings shows that Boro and Aus farmers per kg rice production cost is Tk.18.65 and Tk.18.64 and Aman rice production cost is Tk.17.61 which is less than Boro and Aus (Table 22). Ramu upazila farmers T. Aus rice were not cultivated. Ramu upazila farmers and DAE SAAOs reported that Boro rice per kg or per ha production cost is higher than T. Aman rice because T. Aman rice is cultivated by natural water or rain water. There is no need for supplementary irrigation for T. Aman rice production. Fertilizers and pesticides are needed more in Boro rice production in compared to Aman rice.

Table 6-20: Cost of Rice Production (2014-15)

Name of Rice	Average per kg rice production cost (TK)	Crop season
Boro	18.65	Rabi
Aus	18.64	Kharif-1
Aman	17.61	Kharif-11

(Source: Field Survey, 2024)

6.3.4.2 Cost of Vegetable Production

The cost of production of vegetables varies depending on crop, variety, time, place, and season. During the survey, farmers were asked to identify the major types of production costs on which they usually spend. According to the respondents, the production cost of vegetables can be categorized into eight major categories: land preparation, seeds and seedlings, manure and fertilizer, irrigation, pesticide, labor, lease/rent of land, and other expenses like fencing, shedding, mulching etc. Zaman et.al (2010) assess the cost of production of four winter vegetables namely cauliflower, cabbage, tomato and brinjal in five villages under Dhaka district. The study finding shows that 39.2% of the total cost was devoted to labor, 30.3% to fertilizer, 3.4% to seed, 4.8% to pesticides, 7.9% land rent, 6.3% to land preparation, 4.2% to irrigation and 3.6% to interest on capital, whereas, the result estimated by AVRDC (2001) shows that 48.4% of the total cost was devoted to labor, 24.2% to fertilizer, 6.1% to irrigation, pesticides and 3.7% to seeds (Fig 3). Cost of per kg and per 40kg was found approximately the highest for tomato and the lowest for cabbage and cauliflower.

Farmers of Ramu reported that major cultivation occurred in land preparation (Power tiller/tractor cost), irrigation, pesticides, fertilizers and labor. Farmers reported that per ha cultivation cost is Tk. 6000-7000/-. Generally, supplementary irrigation provided potatoes, water melon, Chili and winter vegetables. Supplementary irrigation cost is 1000-15000 taka or more depends on crops and number of application. The highest supplementary irrigation provided in water melon and summer vegetables crop field. Farmers did not practice supplementary irrigation T. Aman crops. The highest pesticides used in T. Aman and Boro rice fields (Tk.2500-3000/-) and followed Groundnut & Water melon (Taka 1000-1500), W & S. vegetables fields (Taka 500-700/ha). Labor cost day by day increased and per day labor cost more or less Tk. 350-500 depends on crop season.

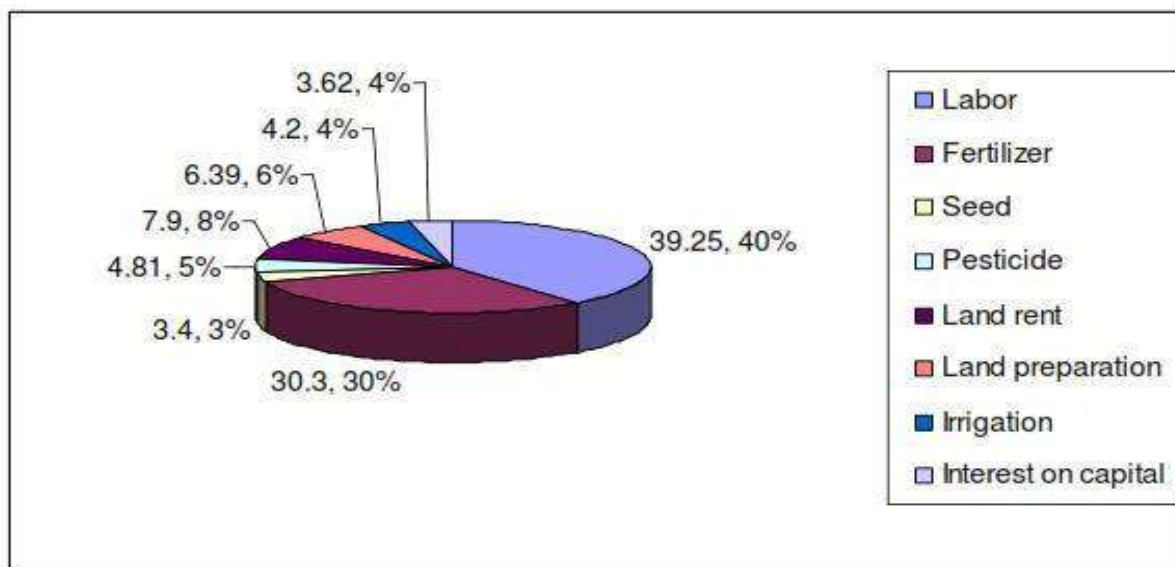


Figure 6-4: Percentage of Major Types of Production Costs for Vegetables

Brinjal is one of the most popular and important vegetable in Ramu Upazila. Farmers are cultivated this vegetables throughout year. Some farmer's brinjal vegetable is cultivated commercial basis in Ram Upazila. Compare the financial profitability of brinjal vegetable production in different region in Bangladesh. Several studies were done to estimate the financial profitability of brinjal vegetable production (Table 23). It is evident from the table that productions of brinjal vegetable were increased chronologically. This is due to adoption of farmers for different HYV varieties of brinjal. Price of brinjal vegetable was also increased through time change. Farmers were adjusted their vegetables price due to change the production cost. Now farmers used different insecticide, pesticide and fertilizer to increase production and protect vegetables from disease and pest. For this reason profitability of different vegetables also increased. It is true that total production cost of different vegetables increased but net margin also increased. Farmers were produce different vegetables because vegetables productions were profitable in the present study area which is reflected by high BCR for brinjal vegetable. The previous studies were done several years ago and we can interpret the different return by yield, price and place difference. The prices and demand of brinjal vegetable are very high in all over the country. Finally it is clear that productions of vegetables are more profitable in the study area like other vegetables growing areas.

Table 6-21: Compare the Financial Profitability of Brinjal Vegetable Production in Different Region

Cultivation year	Study Area	Yield (kg/ha)	Price (Tk/kg)	Gross Return (Tk/ha)	Total Cost (Tk/ha)	Net Return (Tk/ha)	BCR	Sour
1997	Bangladesh	11730	6.0	70372	17,343	53,029	4.06	EPC, 1997
1998	Comilla	24,699	2.51	61,994	31,339	30,655	1.98	Miah et al., 1998
2002	Jessore	43,899	7.09	3,10,293	1,77,457	1,32,836	1.75	Rashid et al. 2002
2014	Dhaka	55,691	18.00	10,02,438	269,627	732,811	3.72	Hasan et.al 2014

Cultivation year	Study Area	Yield (kg/ha)	Price (Tk/kg)	Gross Return (Tk/ha)	Total Cost (Tk/ha)	Net Return (Tk/ha)	BCR	Source
2024	Ramu	39520	20.00	790400	218372	572028	3.67	UAO,2016

6.3.4.3 Growth or Decline of Agricultural Land during Last Ten Years

Quantification of various parameters in relation to land use and farming is really a very difficult task, specially, in Bangladesh where record keeping is poor either by an organization or by individual. Beside this difficulty in mind a sincere attempt has been made to collect land use last ten year data (2014 to 2024) from Upazila Agriculture Office and discussion with 11 Unions Sub- Assistant Agriculture Officers of Ramu Upazila and review the other documents. A census on land resources reported that every day 220 ha of land had been converting for others like constructions of houses, roads, commercial industries and for other non-agricultural activities, which is very alarming for the sustainable land resources of our country. The growth or decline of agricultural land use during last ten years under Ramu Upazila is shown in **Table 24**. The findings show about 40% local variety rice and 17% sugarcane area were decreased during last ten years. The main reason for decreased local variety rice area due to yield is less in compared to HYV rice and farmers dictated to switchover cultivated HYV rice. The HYV paddy cultivation area were 22% increased. The reason for decreased Sugarcane cultivated area because of lands is not suitable and profitable for sugarcane commercial cultivation. Remarkable significant changed (68%) was occurred in winter and summer vegetables land use. The main reason for increased of vegetables cultivation area which is more profitable than others non crops. The highest increased trend (250%) was found in tobacco cultivation and housing (200 %) under Ramu Upazila. Farmers were getting large amount of cash money and production loan from Tobacco Company. Fruits crops and oilseeds areas 150% and pulses 178% increased last ten years. About 67% Brick field and 47%.Poultry sector land used increased due to local market demand, increase the number of brick fields and poultry farms.

Table 6-22: Percentage of Changes of Agricultural land use from 2005 to 2015

Types of Agricultural land	Area of Land Use (in ha)		Change %
	Land use 2014	Land Use 2024	
Paddy (local varieties)	830	500	-39.76
Paddy (HYV)	12740	15500	+21.66
Vegetables (Summer)	190	320	+68.42
Vegetables (Winter)	650	1091	+67.85
Tuber crops	250	420	+24.58
Pulses	100	278	+178
Oilseed crops	20	50	+150
Maize	20	25	+25
Spices crops	295	395	+33.90
Fruits crops	800	2000	+150
Sugarcane	30	25	-16.67
Brick field	18	30	+66.67
Poultry	15	22	+46.67

Types of Agricultural land	Area of Land Use (in ha)		Change %
	Land use 2014	Land Use 2024	
Fish/shrimp culture	162	183	+12.96
Gardening/forestry	43	47	+9.30
Tobacco	200	700	+250
Housing	20	60	+200

(Source: SAAOs, Ramu Upazila, DAE, 2024, NB: + Increase, - Decrease)

6.3.4.4 Major Crop Production Problems

Major Crop Production Problems in 11 Unions under Ramu Upazila Agriculture survey findings and Participatory Rural Appraisal March 2024 study report findings show farmers some problems are common in different unions under Ramu Upazila such as natural disaster, bad communication and wholesale market and infrastructure. Major problems are:

- Natural disaster such as heavy rain, water came from hill, Flash flood, drought, river erosion;
- Bad communications due to many roads are damaged by floods.
- There is no wholesale market and infrastructure for agriculture product under 11 Unions.
- No cold storage and large vegetable selling center in Unions
- Produce crops market price is less & market control by local forhia
- Farmers were not interested to invest recommended doses of inputs in crop production
- Crop production inputs (seeds, fertilizers, pesticides, power tiller) are partly available and price is high in compared to other Upazila
- T. Aus rice crops are not cultivated due to flash flood, hilly water and financial constraints
- Insects, diseases, rodents and weeds are chronic problem causes 25-30% damage every year. Farmers over and under dose haphazardly applied pesticides for controlling pests due to lack of technological knowledge.
- There is no control over the grazing cattle which caused damage to farmers field crops
- Farmers lack of knowledge on modern crop production technology
- There is no Government seed selling center and good quality seeds are not availability in local market and seed price is high.
- Cultivation of tobacco is expanding rapidly in the area due to comparatively more return from other crop. But ultimately cultivatable land is losing fertility gradually and the water of the canal and 'chara' are polluting and as a result environment for breeding of the fishes is under threat.

Identified problems of Preparation of Disaster Management Plan of Ramu Upazila 2014

The proposed Preparation of Development Plan for Fourteen Upazilas Package 05 is expected to contribute to achieving the objectives of the agriculture, Preparation of Disaster

Management Plan of Ramu Upazila 2014 identified problems of agriculture and suggestion will be helpful for future plan (Table 25). For sustainable development of the agriculture activities need to implement the disaster risk reduction strategy and agriculture areas under the development planning are shown below:

Table 6-25: Detailed Description of the Agriculture Sector

Area	Identified Problems	Consistency with Disaster Reduction Plans
Agriculture	• Every year crops are produce less in the rainy season .There is possibility of spoiling about 30% farmlands of 1700 acre lands in river bank erosion and about 40% farmlands of 8000 acre lands in mountain slides every year • There is possibility of spoiling 30% farmlands of 1100 acre fields in water logging in rainy season in Kauarkhop, Rashidnagar, Cocchopia, Fatekharkul, Zoarianala, Chakmerkul, Razarkul and south Mithachori union • There is possibility of spoiling 40% farmlands of 3400 acre by elephant attack in Eidgor Gorjonia Kocchopia Kawerkhope Razarkul Joarianala Rashisnagar, South Mithachori and Khuniapalong • There is possibility for becoming 800 acre fields unfertile because of tobacco cultivation illegally in Gorzonia, Cocchopia, Kauarkhop union • There is possibility for becoming 30% fields and 20% vegetable land spoiled in salt water flowing by various canals of Rashidnagar, Chakmerkul, Fatekharkul, Zoarianala union • There is possibility of spoiling about 70 acres fields as 9 nos. bontok of ward no.3 of khuniapalong union is situated by the side of Bay of Bengal , at the tidal serge • About 60% farmlands can be destroyed if cyclone is occurred in 200-220 km velocity.	• Make dam strong Farmlands can get protection from mountain fall by construction of mountain chora • Initiative has to be taken for removing water logging by making dam/ barrages stronger • Initiative can be taken for alternate farming in water logging areas by Government agriculture division • Arrange water falling in river or canal • Create depth in canal • Take initiative for canal digging by local government and concerned office • Farmlands can get protection from attack of forest elephant

(Source: Disaster Management Plan of Ramu Upazila 2014)

6.3.5 Policy Framework and Conclusion

6.3.5.1 Policy Framework

As per Sub-Assistant Agriculture Officers, Farmers and District, Upazila level different organizational Officers opinions and field visit following recommendations are made which will help for proper planning and adoption of appropriate crop production measure to the Ramu Upazila different Unions beneficiaries in future.

- 1. Developing Infrastructural Facilities:** Road network, agro-processing and marketing infrastructure, canals and irrigation facilities need to be improved for mitigating impacts of

crop production related vulnerabilities and climate change. Each Union one wholesale market infrastructure need to be constructed.

2. **To Reduce the Irrigation Water Wastage:** Proper utilization and increase the irrigated command crop area the DTW, STW and, LLP kutchra drain need to be converted into pucca drainage system or introduce underground pipe irrigation system.
3. **Management of Coastal Saline Soils:** There is need for improving the management of coastal line saline soils through protective embankment, proper sluice gates, land leveling and improved drainage systems. Introduce salt tolerant varieties crops through demonstration. BRRI, BARI, BSRI and BINA have recommended drought and salt tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan 47,53,55,61,67 and BRRI Dhan 73, BINA Dhan-8, BARI Wheat-25,BARI Muatard-11, BARI Poato-22, Sugarcane Ishardi-40 need to be widely introduce and encouraged to cultivate the farmers.
4. **Farming and Adaptation Practices:** There is need for conducting, strengthening and expanding crop demonstrations and block farming based on adaptation practices. Introduction of risk resistant crop varieties in agriculture with emphasis on crop diversification should be an integral part of the TOT, farmers training and demonstrations.
5. **Vegetables Production:** Different types of winter and summer vegetables are grown under 11 unions. All the Unions are excellent suitable for vegetables cultivation round the year. There is no cold storage and large vegetable selling center (market) under 11 Unions. As results farmers could not get good price for their produced products. There is a need for establishment of cold storage each Union and development of market infrastructure.
6. **Crop Production Inputs Availability:** Ensure availability of quality HYV and Hybrid crop seeds, fertilizer, pesticides and cultivation equipments.
7. **Availability of Crop Seeds:** Drought, Salt and Submergence tolerant variety of different quality HYV/Hybrid crop seeds need to be available in local market
8. **Fertilizer Management and Soil Health:** (a) Chemical fertilizers application in HYV varieties crops trend increasing but decreasing inorganic fertilizer (Green manure, cow dung). As a result, soil nutritional health will be alarming situation which is in future serious affected on yield. There is a need for soil health improving program for Union farmers. DAE may arrange joint collaborative soil testing and recommendation and training program for beneficiaries. Financial support need to be provided to DAE from project. (b) To increase the organic matter contents in soil, leguminous crop cultivation need to be present in the cropping pattern. Farmers need to be encouraged more use of cow dung and compost and cultivate green manure crops
9. **Pesticides Management:** Insects, rats, weeds and diseases are a chronic problems which causes considerable damage of crops every season and increase the farmers cultivation cost. For the control of this pest, farmers applied pesticides under or over dose. Judicious use of pesticides needs to be developed and implement pest surveillance, monitoring and forecasting system. Farmers also need to increase knowledge on Integrated Pest Management (IPM) technology through practical oriented program and DAE joint collaborative crop production training. Farmers training budget need to be provided to DAE from project.

- 10.Impact of Rubber Dam:** Rubber Dam is an excellent source of surface water irrigation in Ramu Upazila but its agricultural impact not yet assessed. Agricultural and others impact of Rubber Dam assessment are need to be under take which will be helpful for preparation of future action plan.
- 11.Agro-based Industries:** Establishment of Agro-based processing center & industries in 11 Unions. There is a need for construction of infrastructure for some agro-base processing center.
- 12.Land Zoning:** Zoning of land as per its present used and potentialities and the proper implementation of “preparation of Development Plan for Fourteen Upazilas” Package 05 (Ramu and Rangunia Upazila) as to ensure sustainable management of land resources in the area as well as improvement of agriculture sector.
- 13.Disaster Management Plan 2014:** Preparation of Disaster Management Plan of Ramu Upazila 2014 identified problems of agriculture and suggestions need to be considered and implemented which will be helpful for improvement of agricultural sector.

6.3.6 Conclusion

Soil and weather conditions are suitable for different vegetables and other high value crops cultivation round the year in Ramu Upazila. There is a need to develop vegetables wholesale market and improvement of communication system different Unions to Upazila. Farmers need modern crop production technological training which will be helpful for crop diversification and proper utilization land and increase crop production.

6.4 Fisheries

6.4.1 Background

Ramu Upazila is situated in a region with ponds, lakes, and other water bodies, providing ample habitat for various fish species. The surrounding areas contribute to the region's diverse aquatic ecosystems. In the rainy season, a lot of young and old men and women in rural areas catch fish in the floodplain, public canal, river etc. Moreover, freshwater fish, both caught in public water and cultured, is also an important source of cash income. Farmers rear various fish species in ponds and water bodies for commercial purposes, contributing to both local consumption and export markets. Traditional fishing methods are prevalent in Ramu, with local fishermen employing techniques such as net fishing, angling, and fish trapping to catch fish from rivers, ponds, and lakes. These traditional practices have been passed down through generations and remain important for livelihoods in the area. In recent years, there has been an increasing emphasis on modern fisheries management practices in Ramu and across Bangladesh. This includes measures such as the establishment of fish sanctuaries, implementation of sustainable fishing practices, and promotion of fish conservation efforts to ensure the long-term viability of fish stocks. The government of Bangladesh, through its fisheries department and related agencies, implements various programs and initiatives to support the fisheries sector in Ramu and other regions. These initiatives may include providing training and technical assistance to fish farmers, distributing fish fingerlings, and improving infrastructure for fish processing and marketing. Fisheries play a crucial role in the livelihoods of many people in Ramu, providing employment opportunities for fishermen, fish farmers, fish traders, and others involved in the fishery value chain. The sector contributes to poverty alleviation and food security by providing a source of income and nutrition for local communities.

Table 6-23: Types of Inland fish available

Serial No.	Local Name	Common English Name	Serial No.	Local Name	Common English Name
1	Rui	Salmon	7	Pabda	Catfish
2	Katla	Indian Carp	8	Tengra	Mystus
3	Silvercrap	Silverfin	9	Puti	Puntius fish
4	Boal	Wallago	10	Shing	Stinging Catfish
5	Gulia	Mystus Cavasius	11	Vetki	Barramundi
6	Moi	Pacific threadfin	12	Coral fish	Sea Fish

Source: Ramu Upazila field survey

The table shows the diversified species of fishes found in Ramu Upazila. Those are the most common fishes of that region.

Table 6-24: Types of Fish which are at Danger

Serial No.	Local Name	Common English Name
1	Puti	Puntius fish
2	Shing	Stinging Catfish
3	Tengra	Mystus
4	Boal	Wallago
5	Gulia	Mystus Cavasius

The table shows the diversified species of fishes which are at danger in Ramu Upazila. Those are also the most common fishes of that region.

6.4.2 Government Policy for Fishery Development

The government's water policy serves as a guiding framework for various agencies and institutions involved in the water sector, with a specific focus on achieving targeted goals. This policy is designed to foster the development of crucial sectors, including fisheries, with a simultaneous emphasis on improving the livelihoods of the local population. Ramu Upazila, situated in Bangladesh, emerges as a prospective region for fisheries, given its abundant land resources. This discourse delves into the key components of the government's water policy and its implications for the development of fisheries in Ramu Upazila.

- **Preservation of Natural Aquatic and Water Channels**

A pivotal aspect of the government's water policy is the commitment to minimizing disruptions to natural aquatic and water channels. Recognizing the interconnectedness of ecosystems, the policy underscores the importance of preserving these channels to maintain ecological balance. This measure is particularly relevant to the fisheries sector, as disruptions to natural water flows can adversely affect fish habitats and migration patterns. By minimizing such disruptions, the policy aims to sustain the health of aquatic ecosystems, ensuring the continued prosperity of fisheries in the region.

- **Key objectives of Upazila Fisheries department**

The fisheries sector in Ramu is doing well, meeting the needs of both local and global markets with safe and good-quality fish. To make this happen, the office has some important goals. They want to produce more fish by using better farming methods, so they can meet the growing demand. They also want to teach modern and safe ways of fish farming to many different farmers, so they can work better and sustainably. The office also wants everyone involved in the fish business, like sellers and hatcheries, to work together smoothly. Lastly, they believe that when the government, non-government groups, and private companies work together, the fisheries sector can grow well and help the area develop. With all these efforts combined, the Ramu Fisheries Office hopes to see a strong and lasting fisheries industry that helps the area and beyond. Ramu Upazila emerges as a highly prospective region for fisheries, given its abundance of land resources. The policy's commitment to preserving natural water channels and facilitating fish migration aligns with the region's potential for increased fish production. The ample land available in Ramu Upazila provides opportunities for sustainable aquaculture practices, allowing for the expansion of fisheries activities. This, in turn, contributes to economic development, improved nutrition, and increased employment opportunities for the local population.

6.4.3 Critical Issues

According to the National Water Resources Management Program, there is no specific regional water resources program except a national level program for the Study Area. Here are some critical issues which obtained from field survey.

- Inadequate Technological facilities
- Insects increase due to Temperature
- Poor fish marketing infrastructure compared to Production amount
- Poor fish marketing infrastructure
- River Breakdown

- Lack of proper fish processing system
- Economical insolvency
- Poor transportation network
- Fish diseases and parasites
- Natural disasters (floods, cyclones, etc.)
- Higher cost of Production

6.5 Livestock

6.5.1 Existing Scenario

The livestock and poultry segment within agriculture has demonstrated significant promise and dynamism, showcasing substantial potential for poverty alleviation. It stands as a highly feasible avenue for generating employment and income opportunities, particularly benefiting landless individuals, unemployed youth, and impoverished women. The table below provides an overview of the total livestock inventory in Ramu Upazila, as per the Ramu Upazila at a glance.

The challenging climatic and topographic conditions in Bangladesh, marked by high temperatures, humidity, and frequent flooding, pose significant hurdles for domestic animal rearing. Moreover, pasture lands for cattle and goats are scarce. Recent water shortages and the rise of agricultural machinery further complicate conditions for water buffalos. Coupled with low feed efficiency, these factors have hindered the advancement of livestock farming in a country striving for food self-sufficiency.

Despite these challenges, there's a growing recognition of the importance of livestock farming for future economic development. While it hasn't been a priority in the past, the potential for livestock as a crucial income stream for farmers is becoming increasingly evident. With a rising national economy, there's a corresponding increase in demand for livestock products. Therefore, investing in the development of livestock farming holds promise as a demand-driven enterprise, essential for both economic growth and agricultural sustainability in Bangladesh.

6.5.2 Critical Issues

The critical issues encompass the lack of cow grazing land, low feed efficiency, topographic conditions, inadequate animal health services, scarcity of feed and fodder, and hydrological problems.

- **Due to the absence of necessary veterinary surgeons, rural practitioners (quacks) provide inadequate treatment:**

The absence of essential veterinary surgeons in Ramu upazila limits the quality of healthcare available to livestock. Rural practitioners, lacking proper qualifications and training, often resort to providing inadequate treatment. This situation not only compromises the health and well-being of the animals but also hampers efforts to effectively manage diseases and ensure proper care.

- **Artificial breeding programs are conducted in an unregulated manner by various NGOs:**

In Ramu upazila, artificial breeding programs for livestock are conducted without proper regulation by multiple non-governmental organizations (NGOs). This lack of oversight can lead to inconsistent practices, suboptimal breeding outcomes, and potential genetic issues

within the livestock population. Without standardized protocols and monitoring, the effectiveness and sustainability of these breeding programs may be compromised, affecting the overall productivity and genetic diversity of the livestock sector in the area.

- **High cost of dairy/poultry feed and chicks:**

The region's topographic conditions pose additional complexities for agricultural activities. The geographical landscape may present obstacles to efficient land use and cultivation, impacting the overall agricultural output.

- **Decrease in selling price compared to production cost:**

The In Ramu upazila's livestock sector, there is a concerning trend of the selling price of livestock products decreasing in comparison to the production cost. This imbalance directly affects the profitability of livestock farming enterprises, making it challenging for farmers to cover their expenses and generate adequate income. Factors such as market fluctuations, increased competition, and rising input costs contribute to this disparity, creating economic hardships for livestock producers and limiting their ability to reinvest in their operations or improve their livelihoods.

- **Unable to fetch fair prices for the produced goods:**

Despite their efforts, farmers in Ramu upazila often find themselves unable to secure fair prices for the goods they produce within the livestock sector. This limitation stems from various factors, including lack of market access, uneven bargaining power with buyers, and insufficient market information. As a result, farmers may be forced to accept lower prices for their products, undermining their economic viability and discouraging further investment in livestock production. Addressing this challenge requires initiatives to strengthen market linkages, enhance farmer bargaining power, and promote transparent pricing mechanisms to ensure that producers receive equitable compensation for their efforts.

- **Climate Vulnerability**

Ramu's proximity to the coast makes it more vulnerable to climate change, which exacerbates issues like flooding, cyclones, and rising sea levels. These environmental threats disrupt livestock rearing and the availability of necessary resources like grazing land.

6.6 SWOT Analysis

SWOT analysis serves as a strategic planning instrument utilized to assess the strengths, weaknesses, opportunities, and threats pertinent to a specific entity. In this context, a SWOT analysis is undertaken to evaluate the agricultural status, encompassing fisheries and livestock, of Ramu Upazila.

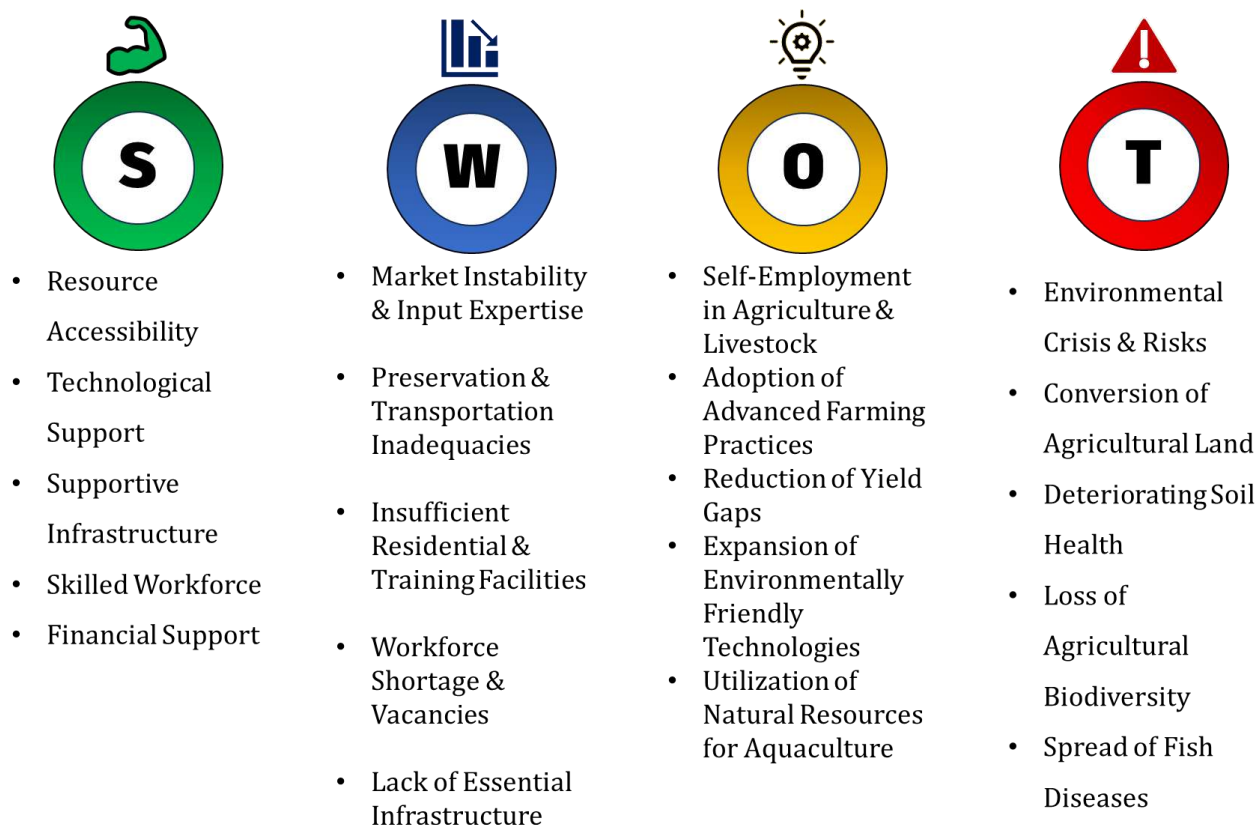


Figure 6-5: SWOT Analysis of Ramu Upazila Agriculture, Fisheries and Livestock Department

Strengths:

- Access to essential resources: Adequate supply of agricultural equipment, irrigation water, and tested fish food ensures smooth agricultural and aquaculture practices.
- Technological advancement: Availability of essential technologies, active laptops, and motorcycles facilitate modern farming methods and research.
- Supportive infrastructure: Divisional disease research centers and access to vaccines and improved breeds strengthen disease management and breeding programs.
- Well-equipped and knowledgeable workforce: Experienced field staff, skilled farmers, and trained fish farmers contribute to efficient operations.
- Financial assistance and incentives: Farmer bank accounts, agricultural equipment assistance cards, and available financial aid encourage sustainable farming practices and investment in agricultural development.

Weaknesses:

- Market instability and limited expertise in input utilization hinder optimal production and profitability.
- Inadequacies in preservation, processing, and transportation affect product quality and market access.
- Lack of residential facilities for laborers and insufficient modern training equipment impede skill development and knowledge dissemination.
- Shortage of workforce and vacancies in key positions like fisheries officers and field assistants hamper operational efficiency and service delivery.
- Absence of essential infrastructure, including veterinary services, adequate budgets, and modern diagnostic facilities, leads to ineffective disease management and healthcare provision.

Opportunities:

- Self-employment potential in agriculture and livestock farming offers avenues for economic empowerment and livelihood diversification, contributing to rural development.
- Adoption and dissemination of hybrid technologies and advanced farming practices present opportunities to enhance agricultural productivity, profitability, and resilience to climate change.
- Opportunities to reduce yield gaps through improved agricultural techniques and management strategies enhance overall crop yields, food security, and farm incomes.
- Expansion of environmentally friendly technologies such as biogas plants and organic fertilizer production promotes sustainable agricultural practices, reduces environmental impact, and enhances soil health.
- Utilization of abundant natural resources including ponds, low-lying lands, and canals for aquaculture provides opportunities for increasing fish production, income generation, and foreign currency earnings, thereby contributing to economic growth and development.

Threats:

- Environmental crisis, including climate change, waterlogging, diseases, and pests, poses significant risks to agricultural productivity, sustainability, and food security.
- Increasing conversion of agricultural land for non-agricultural purposes exacerbates land scarcity, reducing the availability of cultivable land and threatening agricultural production.
- Deteriorating soil health due to various factors threatens crop yields, soil fertility, and long-term agricultural sustainability.
- Loss of agricultural biodiversity poses risks to ecosystem resilience, genetic resources, and the ability to adapt to changing environmental conditions.
- Spread of fish diseases and lack of proper disease management measures jeopardize aquaculture production and livelihoods of fish farmers, impacting food security and economic stability in the region.

6.7 Recommendations

6.7.1 General recommendation

- **Encouraging sustainable agricultural practices:** Supporting farmers in adopting sustainable farming methods can enhance soil quality, decrease reliance on pesticides and fertilizers, and boost crop productivity. This goal can be realized through government incentives, educational initiatives, and public awareness drives.
- **Developing infrastructure:** Allocating resources to rural infrastructure like roads, irrigation networks, and cold storage facilities can enhance farmers' market reach and minimize post-harvest wastage.
- **Enhancing extension services:** Furnishing farmers with timely and precise insights into farming techniques, weather patterns, and market dynamics empowers them to make informed choices and enhance their agricultural outputs.
- **Investing in research and development:** Allocating resources to agricultural research and development endeavors can foster the creation of innovative technologies, crop breeds, and livestock varieties better suited to withstand evolving climatic conditions.
- **Supplying financial aid:** Furnishing farmers with avenues to obtain credit, insurance, and other financial services aids them in investing in their farms and navigating the risks inherent in agricultural production.

6.8 Physical Planning Implication

The agriculture, forestry, fishing and livestock sectors comprises establishments primarily engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals from a farm, ranch, or their natural habitats. Physical planning plays a critical role in shaping agricultural practices. Factors like climate, topography, soil type, and water availability directly influence the choice of crops and farming techniques. Physical features i.e., access to water, climate, soil types, landforms influence how people farm in a region. Irrigation, terrace farming, deforestation, desertification, and the drainage of wetlands have occurred as farmers try to increase production to feed an ever-growing human population.

In view of consideration of physical planning aspects of agriculture including fisheries, livestock and forestry in relation to reviewing and updating the master plan of Ramu Upazila are:

- Enlisting/demarcating and conservation of fertile lands suitable agriculture and forestry
- Provision of support services for agricultural, livestock and fisheries in terms of linking roads, market outlets, availability seed, fertilizers, and irrigation facilities, extension services, etc.
- Protection of forest land for forestry and rubber cultivation

6.9 Conclusion

Preserving the agricultural integrity of Ramu Upazila, Cox's Bazar, is paramount for ensuring food security, sustaining rural livelihoods, and safeguarding the environment. Enforcing a policy mandating solely agricultural land use is pivotal in conserving agricultural land for farming activities and averting its conversion to non-agricultural purposes. This policy can be actualized through a multifaceted approach encompassing land use zoning, stringent regulations, monitoring mechanisms, financial incentives, and public awareness initiatives. The promotion of sustainable livestock farming practices in Ramu Upazila aligns with several Sustainable Development Goals, including SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land). By implementing these practices, we can anticipate improved livestock health, reduced environmental impact, enhanced farmer livelihoods, and strengthened food security in the region, contributing to the overall sustainable development agenda. The fisheries sector in Ramu Upazila is crucial for both economic development and food security. Strengthening fisheries management practices is imperative to ensure sustainable use of fishery resources and safeguard livelihoods. By implementing the proposed methods and aligning with SDGs, Ramu Upazila can achieve sustainable fisheries management, benefiting both the environment and the local community. Collaboration among stakeholders, robust monitoring mechanisms, and continued support for fishers are essential for the successful implementation of these initiatives. In summation, preserving agricultural land, promoting sustainable livestock farming practices, and fortifying fisheries management within Ramu Upazila constitute a holistic approach to sustainable development. These initiatives not only address immediate challenges related to food security and economic prosperity but also contribute to long-term environmental resilience and social well-being. By embracing these strategies, Ramu Upazila can pave the way for a more sustainable and equitable future for its residents and the generations to come.

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Chapter Seven: Biodiversity Including Flora and Fauna



CHAPTER SEVEN: BIO-DIVERSITY INCLUDING FLORA AND FAUNA

7.1 Background

Biodiversity is crucial for the processes that sustain all life on Earth, including humans. A wide range of animals, plants, and microorganisms is necessary for healthy ecosystems, which provide us with the air we breathe and the food we eat. Additionally, people value nature for its own sake (K. Colwell, 1998). Biodiversity, or biological diversity, encompasses the variety of life on Earth at all levels of organization, including the diversity of species, ecosystems, and genetic diversity within species. It includes the variety of living organisms, genetic differences within these organisms, and the ecosystems they form. Biodiversity is fundamental for the health and functioning of ecosystems and offers numerous benefits to human well-being (M. Wood, 1997).

There are three main components of biodiversity: Species Diversity, Genetic Diversity, Ecosystem Diversity. Species Diversity refers to the variety of different species present in a particular region or ecosystem. It includes the number of species and their relative abundance. High species diversity is often associated with a healthier and more resilient ecosystem. Genetic Diversity involves the variety of genetic information within a species. It includes the diversity of genes, alleles, and genetic traits within populations. Genetic diversity is crucial for the adaptation and survival of species in changing environments. Ecosystems are dynamic communities of living organisms interacting with each other and their physical environment. Ecosystem diversity refers to the variety of ecosystems within a region. Different ecosystems, such as forests, grasslands, wetlands, and coral reefs, provide unique habitats and contribute to overall biodiversity.

Biodiversity is important for various reasons. It helps to increase ecological stability, enhance ecological value, support economically as well as cultural and recreational values. Diverse ecosystems are better able to resist and recover from disturbances, such as diseases, climate change, or natural disasters. Many human activities, such as agriculture, forestry, and fisheries, rely on diverse ecosystems. Biodiversity provides resources like food, medicine, and raw materials that are essential for human well-being and economic development.

Biodiversity is threatened by various human-induced and natural disturbances. These disturbances can negatively impact ecosystems, leading to the loss of species, disruption of habitats, and changes in overall biodiversity. The major reasons of disruption of biodiversity are climate change, environmental pollution, deforestation, habitat destruction, Overexploitation, invasive species, and species extinction which are the critical aspect of the on-going biodiversity crisis.

7.2 Methodology

To assess the present state of ecology and biodiversity in Ramu Upazila, this study has extensively reviewed various documents and reports, utilizing them as secondary sources of information. The analysis has included important documents and reports, such as those from the International Union for Conservation of Nature (IUCN), the National Biodiversity Strategy and Action Plan of Bangladesh 2016-2021. In accordance with the project's terms of reference, the study also incorporates a field survey, information gathering from residents, and interviews with key personnel, including officials from the Ministry of Fisheries and Livestock, the Division of Forest in Ramu Upazila.

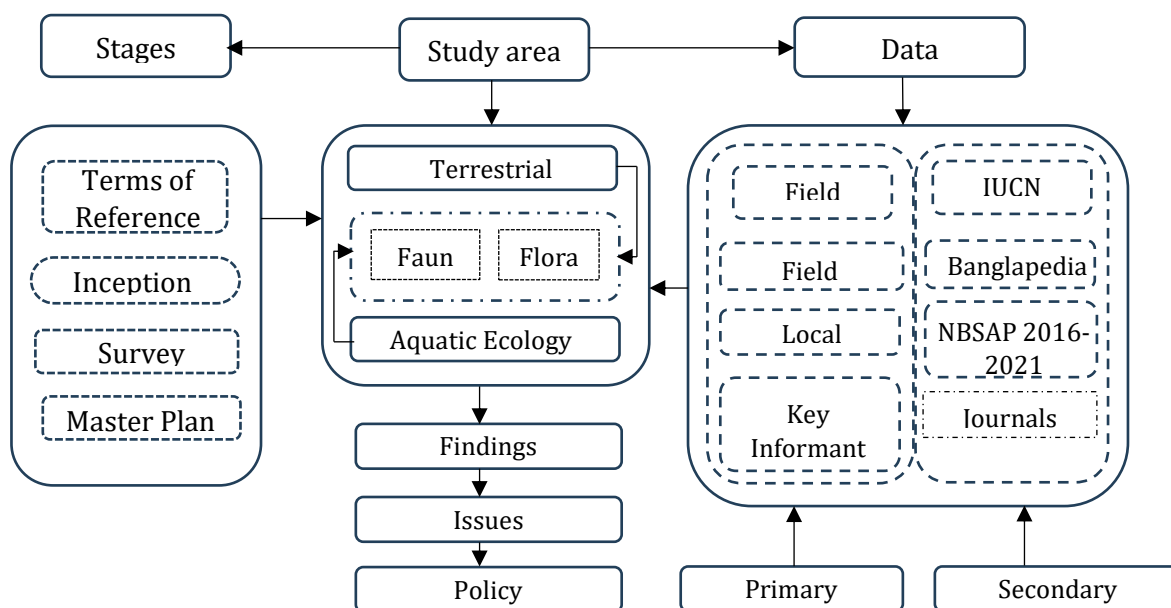


Figure 7-1: Methodological Diagram

7.3 Existing Ecology

Ramu Upazila, located in Cox's Bazar District, is a region rich in biodiversity, influenced by its proximity to the Bay of Bengal and the hilly terrains of the Chittagong Hill Tracts. The area's diverse ecosystems, ranging from coastal mangroves to inland forests, support a wide variety of plant and animal species, some of which are endangered. Most part of the upazila consist of hilly region thus it is rich in various types of biodiversity components. The harmonious coexistence of both plant and animal life is crucial for safeguarding the area's biodiversity. Predominantly rural, this region serves as a habitat for a diverse range of birds, animals, and insects.

The Sub-Project Influence Area (SPIA) is a vibrant tapestry of diverse vegetation. The surrounding area teems with the cultivation of rice, wheat, rabi crops, and an array of homegrown vegetables. Notably, the SPIA boasts a bountiful assortment of economically valuable fruit trees, such as jackfruit, mangoes, litchi, banana, coconut, and blackberry, alongside majestic timber trees like mahogany, neem, and koro. Moreover, this rich habitat supports an abundance of avian and animal life, thanks to the lush canopy of trees and shrubs. Within this lively ecosystem, low-growing grasses, trees, herbs, and shrubs blend

harmoniously to create a captivating natural landscape. Field data confirms that the SPIA is dominated by a myriad of cultivated vegetables and trees, highlighting the richness and productivity of this remarkable environment.

7.3.1 Terrestrial Fauna

As part of this study, vegetative cover and terrestrial fauna are assessed. Terrestrial faunas include all species of animals except for fish, which are referred to as aquatic fauna. Surveys of terrestrial flora and fauna are conducted to assess the extent of potential impacts of a development on the environment and monitor effects of disturbances or rehabilitation success. Standard field survey methodologies such as transect walks, habitat searching, trapping, etc., are employed to determine richness, relative abundance, diversity, endemism, rare or endangered status, and other ecological parameters. Literature and databases are also reviewed to assess the environmental values of the terrestrial floral and faunal community.

Fauna habitat is defined as the natural environment of an animal or assemblage of animals, including biotic and abiotic elements, that provides a suitable place for them to live (e.g. breed, forage, roost or seek refuge). The scale at which fauna habitat is defined will depend on the ecological requirements of the species considered.

The EPA recognizes that there are inherent links between the factor Terrestrial Fauna and other environmental factors, and that individual factors should not be considered in isolation. For example, impacts or changes to the factors Flora and Vegetation, Landforms and Inland Waters Environmental Quality can impact the factor Terrestrial Fauna. Some species of terrestrial fauna may also use marine habitats and may be considered under the factor Marine Fauna.

Terrestrial plants and animals are typically subjected to much greater fluctuations in temperature—in average values, the temperature extremes encountered, and in their frequency of change. Body temperatures cannot be allowed to “track” environmental temperatures uncontrolled, and the organisms living in terrestrial environments have evolved enumerable structural and functional mechanisms to cope with their temperature environment. These mechanisms affect the adaptability of organisms to the range of temperatures tolerable to life; temperature extremes, as for aquatic organisms, are often dictated by the universal solvent and medium for life processes—water. Shelford's Law of Tolerance (Shelford, 1931) advocated that an organism's success is based on a complex set of conditions and that each organism has a certain minimum, maximum, and optimum environmental factor.

7.3.1.1 Mammals

- **Common Species:** The forests and rural areas of Ramu are home to several mammal species, including the Bengal Fox (*Vulpes bengalensis*), Indian Hare (*Lepus nigricollis*), and various species of bats.
- **Endangered Species:** While not as common, the region may also support populations of the endangered Bengal Tiger (*Panthera tigris tigris*) and Asian Elephant (*Elephas maximus*), particularly in the more remote and forested areas. However, these species are highly threatened by habitat loss and human-wildlife conflict.

- **Conservation Efforts:** Protection of these species requires habitat conservation, anti-poaching measures, and community engagement to reduce conflict.

7.3.1.2 Birds

- **Resident and Migratory Birds:** Ramu Upazila is a haven for birdlife, with both resident and migratory species. Common resident birds include the Red Junglefowl (*Gallus gallus*), Spotted Dove (*Spilopelia chinensis*), and various species of kingfishers and woodpeckers. Migratory birds, such as the Lesser Whistling Duck (*Dendrocygna javanica*) and different species of waders, visit the wetlands during the winter months.
- **Bird Watching Sites:** The wetlands and mangrove areas are particularly rich in birdlife, making them important sites for bird watching and biodiversity conservation.

7.3.1.3 Reptiles and Amphibians

- **Reptiles:** The diverse habitats in Ramu support various reptile species, including the Indian Cobra (*Naja naja*), Monitor Lizard (*Varanus bengalensis*), and the Olive Ridley Turtle (*Lepidochelys olivacea*), which is known to nest along the coastline.
- **Amphibians:** Amphibian species such as the Common Toad (*Duttaphrynus melanostictus*) and the Indian Bullfrog (*Hoplobatrachus tigerinus*) are commonly found in the wetlands and agricultural areas.
- **Threats and Conservation:** Reptiles and amphibians face threats from habitat destruction, pollution, and poaching. Conservation efforts focus on habitat protection and legal measures to prevent the illegal trade of endangered species.

From the desk study, field visit and stakeholder consultation the identified Terrestrial Fauna Species of Ramu Upazila is given figure and table.

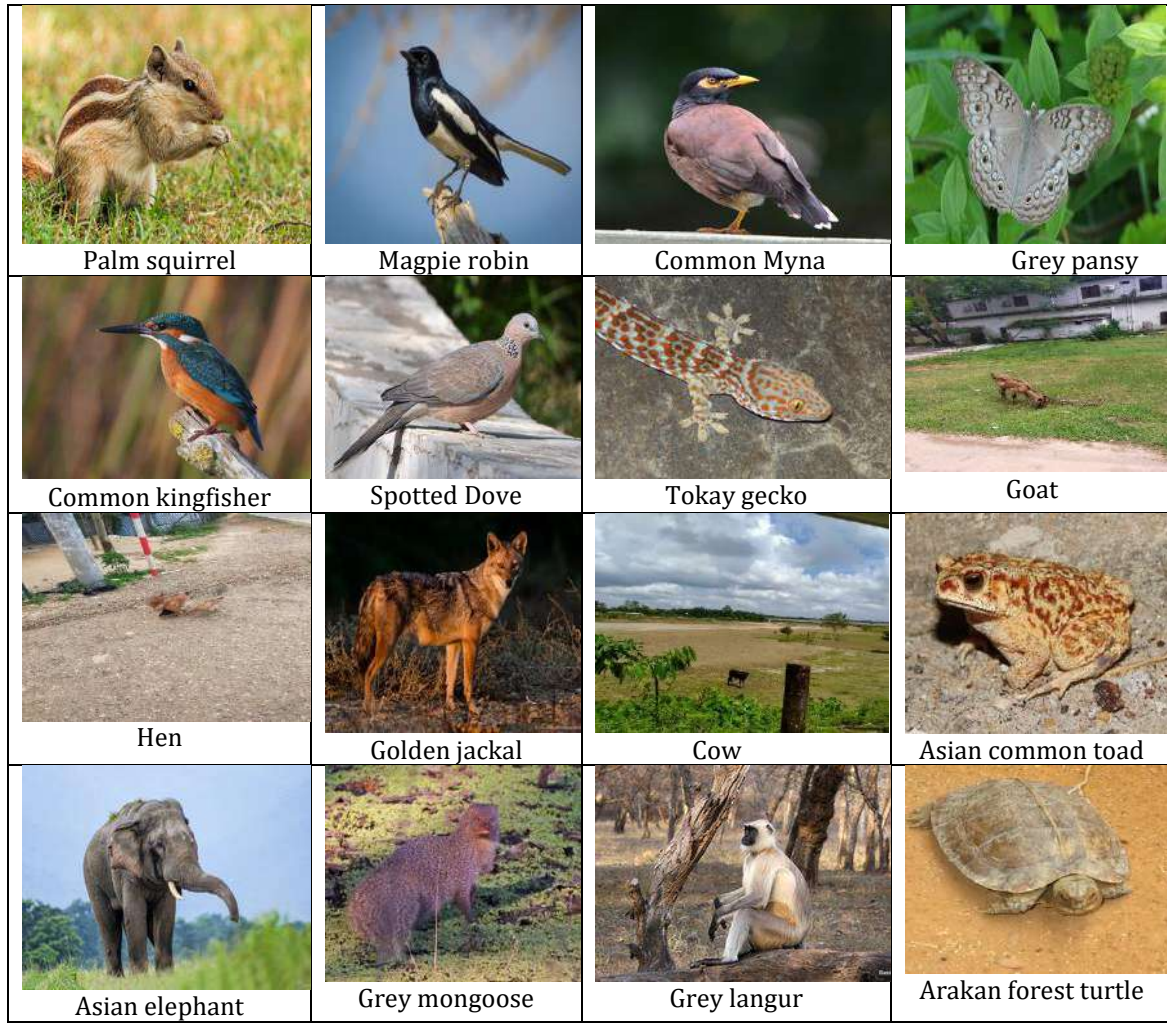


Figure 7-2: Scenario of terrestrial fauna (Photo courtesy: Banglapedia and Field Survey)

Table 7-1: List of Terrestrial Fauna of Ramu Upazila

English Name	Scientific name	Family name	IUCN Status	Local Status
Elephant	<i>Elephas maximus indicus</i>	<u>Elephantidae</u>	NT	Common
Honey Bee	<i>Apis indica</i>	Apidae	NO	Common
Bat	<i>Chiroptera</i>	Chiroptera	NO	Common
Myna	<i>Acridotheres tristis</i>	Sturnidae	NT	Common
Red-Vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae	NT	Common
Magpie-Robin	<i>Copsychus saularis</i>	Muscicapidae	NT	Common
Rose-Ringed Parakeet	<i>Psittacula kramera</i>	<u>Psittacidae</u>	NT	Common
katipo spider	<i>Latrodectus katipo</i>	Theridiidae	NO	Common
Golden jackal	<i>Canis aureus</i>	<u>Canidae</u>	NT	Common

English Name	Scientific name	Family name	IUCN Status	Local Status
Monitor lizards	<i>Varanidae</i> <i>Varanus</i>	<u>Varanidae</u>	NT	Common
stump-tailed macaque	<i>Macaca arctoides</i>	Cercopithecidae	NT	Common
Arakan forest turtle	<i>Heosemys depressa</i>	Geoemydidae	NT	Rare
Grey mongoose	<i>Herpestes edwardsii</i>	Herpestidae	NT	Common
Blue Rock Pigeon	<i>Columba livia</i>	Columbidae	NO	Common
Brahminy Kite	<i>Haliastur indus</i>	<u>Accipitridae</u>	NT	Rare

(Source: Field Survey and Stakeholder consultation, 2024)

Note: NO= Not Threatened; NT= Nearest Vulnerable, LC=Least Concern, EN= Endangered

Among them, the following species are commonly found in Ramu Upazila – Elephant (*Elephas maximus indicus*) The Bangladeshi species is Asian Elephant, the flagship species of most of the tropical forests of Bangladesh. The IUCN Red List of Bangladesh (Khan, 2015) categorized this species as 'Critically Endangered' in Bangladesh, although globally this is categorized as 'Endangered' by IUCN Red List (IUCN, 2008). Apis indica (Indian honeybee), Chiroptera (Bats), Acridotheres tristis (Common Myna), Pycnonotus cafer (Red-Vented Bulbul), Copsychus saularis (Magpie-Robin), Psittacula krameria (Rose-Ringed Parakeet), Latrodectus katipo (katipo spider), Canis aureus (golden jackal), Monitor lizards, and Macaca arctoides (stump-tailed macaque). These diverse species contribute to the ecological richness of the area. Terrestrial birds in the study area are divided into two groups: those in floodplains and wetlands, and those in dry land habitats. Birds of prey, including the Brahminy Kite, herons, and Common Kingfisher, thrive in the region. Other common species like the Bronzed Drongo, Common Mynah, Barn Owl, Arakan Forest turtle (*Heosemys depressa*), Grey mongoose (*Herpestes edwardsii*), Grey langur (*Semnopithecus entellus*) and Blue Rock Pigeon are also present. Notably, the Brahminy Kite is classified as a threatened species by the IUCN-Bangladesh (2015).

7.3.2 Aquatic Fauna

Aquatic animals are those that live in or around water. Freshwater animals are aquatic organisms that populate ponds, rivers, and lakes. Marine or saltwater animals are aquatic species that inhabit oceans. Aquatic animals include both vertebrates and invertebrates.

Organisms that live in water and fully depend on water for nutrition are known as aquatic animals. Water contains dissolved oxygen that is used by these animals in the respiration process. Aquatic animals depend on water and cannot survive on land. The salinity of water affects the types of animals that live there. Water has special features, such as:

- Temperature variations lower the chance of dryness out instead of getting too hot or cold.
- Nutrients are easily dissolved and accessible.
- Aquatic organisms' hazardous metabolic wastes are neutralised and diffused. Aquaculture is the practice of producing freshwater and marine fish in ponds and underwater cages.

Aquatic animals live in water and adapt to their surroundings in order to survive. Adaptation increases the chances of an organism's survival. In various fish, the swim bladder is an air-filled pouch beneath the vertebral column that aids in floating. Ectothermic organisms are those that modify their body temperature in response to variations in water temperature. Blubber aids in the thermal regulation of aquatic species.

The study area encompasses various wetland types, including rivers, khals/canals, beels, ditches, and ponds. Two distinct categories of wetlands have been identified:

- (i) Perennial wetlands, such as beels, khals, and homestead ponds, which retain water throughout the entire year. The water from these sources is commonly utilized for domestic needs and fish cultivation, making them favorable for aquatic fauna.
- (ii) Seasonal wetlands, characterized by water presence only during the rainy season, drying up in the dry season. The existence of these diverse wetland types provides a varied habitat for aquatic fauna. Below are listed the aquatic flora species found in the study area.

7.3.2.1 Fish Species

The rivers, canals, and ponds in Ramu Upazila are rich in fish species, which are crucial for local livelihoods. Common species include Rohu (*Labeo rohita*), Catla (*Catla catla*), and different types of carp. The coastal waters also support species like Hilsa (*Tenualosa ilisha*), which is economically important.

7.3.2.2 Freshwater and Marine Ecosystems:

The aquatic ecosystems are vital for maintaining the region's biodiversity. However, these ecosystems are under threat from overfishing, pollution, and changes in water flow due to infrastructure development.

From the desk study, field visit and stakeholder consultation the identified aquatic Flora Species of Ramu Upazila is given in Table 1.2

Table 7-2: List of Aquatic Fauna Species of Ramu Upazila

English Name	Scientific name	Family name	IUCN Status	Local Status
Birds				
White breasted Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae	NO	Common
Common Kingfisher	<i>Alcedo atthis</i>	Alcedinidae	NO	Common
Brahminy Kite	<i>Haliastur indus</i>	Accipitridae	LC	Common
Little egret	<i>Egretta garzetta</i>	Ardeidae	LC	Common
Great egret	<i>Casmerodious albus</i>	Ardeidae	LC	Common
pond heron	<i>Ardeola grayii</i>	Ardeidae	LC	Common
Grey heron	<i>Ardea cinerea</i>	Ardeidae	LC	Common
Little cormorant	<i>Phalacrocorax niger</i>	Phalacrocoracidae	LC	Common
Black Kite	<i>Milvus migrans</i>	Accipitridae	NO	Common
Reptiles				
Bengal Monitor	<i>Varanus bengalensis</i>	Varanidar	NT	Common
Stripes Keelback	<i>Amphiesma stolata</i>	Natricidae	NO	Common

English Name	Scientific name	Family name	IUCN Status	Local Status
Olive Keelback	<i>Atretium schistosum</i>	Natricidae	NO	Common
Rat Snake	<i>Ptyas mucosus</i>	Coiubridae	LC	Common
Garden Lizard	<i>Calotes versicolor</i>	Agamidae	LC	Common
Checkered Keel back	<i>Xenocrophis piscator</i>	Colubridae	NO	Common
Smooth water snake	<i>Enhydryis enhydryis</i>	Homalopsidae	NO	Common
Amphibians				
Common Toad	<i>Bufo melanostictus</i>	Ranidae	NO	Common
Skipper Frog	<i>Euphlyctis cyanophlyctis</i>	Ranidae	NO	Common
Cricket frog	<i>Rana limnocharis</i>	Ranidae	NO	Common
Bull frog	<i>Hoplobatrachus tigerinus</i>	Ranidae	NO	Common
Mammals				
Irrawaddy Dolphin	<i>Orcaella brevirostris</i>	Delphinidae	LC	Common

Source: Field Survey and Stakeholder consultation, 2024

Note: NO= Not Threatened; NT= Nearest Vulnerable, LC=Least Concern, EN= Endangered

		
White breasted kingfisher	Common kingfisher	Little egret
		
Pond heron	little cormorant	Black kite
		
Bengal Monitor	Stripes Keelback	Rat snake

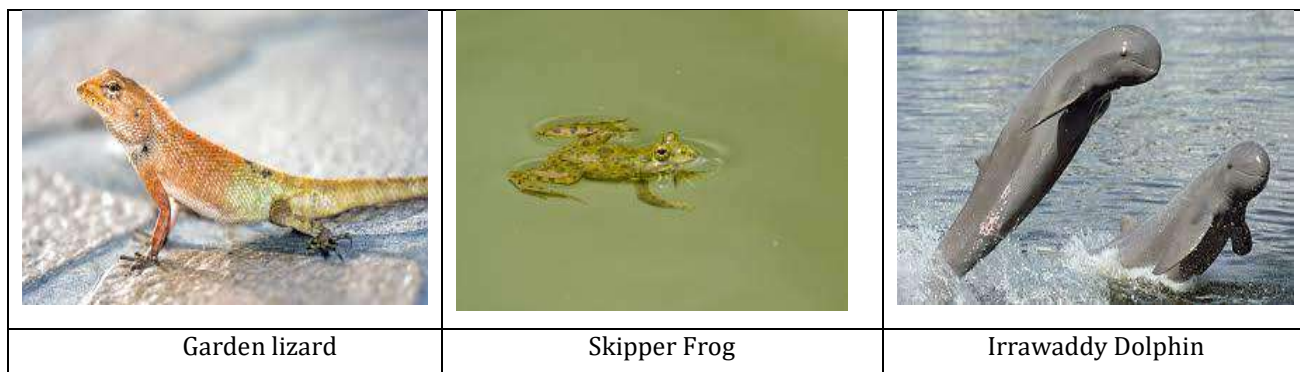


Figure 7-3: Scenario of aquatic fauna (Photo courtesy: Field Survey and Banglapedia)

7.3.3 Terrestrial Flora

7.3.3.1 Mangrove Forests

- **Species Composition:** The coastal areas of Ramu, particularly those near rivers and estuaries, are home to mangrove forests. Common species include *Rhizophora mucronata* (Red Mangrove), *Avicennia alba* (White Mangrove), and *Bruguiera gymnorrhiza*. These species are well-adapted to saline conditions and play a crucial role in protecting the coastline from erosion.
- **Ecological Importance:** Mangroves provide habitat for a variety of marine and terrestrial species. They act as nurseries for fish, crabs, and shrimp, supporting local fisheries. The dense root systems also trap sediments, improving water quality and protecting against storm surges.
- **Threats:** The mangrove ecosystems in Ramu are under threat from deforestation, pollution, and conversion of land for agriculture or aquaculture. Rising sea levels due to climate change also pose a long-term threat to these vital ecosystems.

7.3.3.2 Deciduous and Evergreen Forests

- **Forest Composition:** Inland from the coast, Ramu Upazila features patches of deciduous and evergreen forests, especially in the hilly areas. These forests are dominated by species such as *Dipterocarpus turbinatus* (Garjan), *Tectona grandis* (Teak), and *Shorea robusta* (Sal).
- **Biodiversity:** These forests are rich in biodiversity, supporting a variety of plant species, including medicinal plants and hardwoods. The undergrowth includes a mix of shrubs, herbs, and climbers, contributing to the overall ecological diversity.
- **Conservation Status:** The forest cover in Ramu has been reduced due to logging, agriculture, and human settlement. Conservation efforts are needed to preserve these forests, which are crucial for maintaining the region's biodiversity and ecological balance.

7.3.3.3 Agricultural Lands

- **Cultivated Species:** The agricultural lands in Ramu are primarily used for paddy cultivation, but they also support a variety of other crops such as vegetables (eggplants, tomatoes, chilies), betel leaf, and fruits (bananas, papayas). The region's fertile alluvial soil and favorable climate allow for multiple cropping seasons. In the

study area, maximum agricultural land was found as medium high land which are inundated during monsoon. Major crops found in this field are Auas, B. Aman and Boro paddy. Besides these, some vegetables and economically valued crops are also cultivated in the dry season. During the month November to February, Onion, Garlic, Coriander, Black Cumin are commonly found in this region.

- **Agroforestry:** In some areas, agroforestry practices are employed, integrating tree species like *Acacia* and *Albizia* with crops. This not only improves soil health but also provides additional sources of income from timber and non-timber forest products.

In the homestead vegetation of the region, commonly planted tree species include mango (*magnifera indica*), Jackfruit (*Artocarpus heterophyllus*), American mahogany (*Swietenia mahagoni*), Banana (*Musa sp*), Gogon Shirish tree (*Albizia lebbek*), Indian nut palm (*Areca catechu*), Pomelo (*Citrus maxima*), Mallotus (*Trewia nudiflora*), Black Berry (*Rubus argutus*), Silk tree (*Albizia richardiana*), Jujube (*Ziziphus mauritiana*), and others. This vegetation serves as essential shelter for local wildlife. The area is also utilized for cultivating various vegetables and economically valuable crops. In addition to the cultivated varieties, different plant species, primarily weeds, thrive in the area, including *Echinochloa colonum*, *Centipeda orbicularis*, *Cheratopteris sp*, *Panicum repens*, *Amaranthus spinosus*, *Cyperus sp.*, *Ethulia conyzoides*, *Chenopodium ambrosoides*, and more. This type of vegetation creates a feeding habitat for numerous wildlife.

The vegetation alongside roads is primarily deliberate plantings, creating a well-established ecosystem. Commonly found in this region are introduced species such as Eucalyptus (*Eucalyptus obliqua*), West Indian mahogany (*Swietenia mahagoni*), Silk tree (*Albizia richardiana*), and Date palm (*Phoenix sylvestris*). Additionally, there is a presence of small-sized herbs and shrubs, including black nightshade (*Solanum nigrum*), Ivy gourd (*Coccinia grandis*), Taro (*Colocasia esculenta*), Makra (*Dactyloctenium aegyptium*), Fig tree (*Ficus hispida*), and Pink Morning Glory (*Ipomoea fistulosa*), frequently observed in the study area.

Besides some medicinal plants can also be found in this region mainly Ulot Kombol (*Abroma agusta*), Babla (*Acacia nilotica*), Muktajhuri (*Acalypha indica*), Basak (*Adhatoda vasica*), Bel (*Agele mamilos*), Aloe (*Aloe vera*), Shimul (*Bombax ceiba*), Telakucha (*Coccinia grandis*), Holud (*Curcuma longa*), Dhutra (*Datura metal*), Dumur(*Ficus racemose*).

The vegetation along the sides of rivers, canals, and khals is characterized by the presence of local plant species such as Beachwood (*Gmelina arborea*), Bamboo (*Bamboosa sp*), Banana (*Musa sp*), and others. Some herbs and shrubs, including Wild Senna (*Senna hebecarpa*), Croton plant (*Codiaeum variegatum*), Mexican poppy (*Argemone Mexicana*), Chinese Spinach (*Amaranthus dubius*), are also observed in the vegetation along rivers, canals, and khals. These plant communities serve as crucial habitats for a diverse range of insects, reptiles, birds, and small mammals. From the desk study, field visit and stakeholder consultation the identified Terrestrial Flora Species of Ramu Upazila is given in following table.

Table 7-3: List of Terrestrial Flora Species of Ramu Upazila

English Name	Scientific name	Family name	IUCN Status	Local Status
Mango	<i>Mangifera indica</i>	<u>Anacardiaceae</u>	NO	Common
Jack fruit	<i>Artocarpus heterophyllus</i>	<u>Moraceae</u>	NO	Common
American mahogany	<i>(Swietenia mahagoni)</i>	<u>Meliaceae</u>	NO	Common
Banana	<i>Musa sp</i>	<u>Musaceae</u>	NO	Common
Gogon Shirish	<i>Albizia lebbek</i>	<u>Fabaceae</u>	NO	Common
Indian nut palm	<i>Areca catechu</i>	<u>Arecaceae</u>	NO	Common
Rubber	<i>Hevea brasiliensis</i>	<u>Euphorbiaceae</u>	NO	Common
Black Berry	<i>Rubus argutus</i>	<u>Rosaceae</u>	NO	Common
Silk tree	<i>Albizia richardiana</i>	<u>Fabaceae</u>	NO	Common
Date palm	<i>Phoenix sylvestris</i>	<u>Arecaceae</u>	NO	Common
Black nightshade	<i>Solanum nigrum</i>	<u>Solanaceae</u>	NO	Common
Pink Morning Glory	<i>Ipomoea fistulosa</i>	<u>Convolvulaceae</u>	NO	Common
Babla	<i>Acacia nilotica</i>	<u>Fabaceae</u>	NO	Common
Muktajhuri	<i>Acalypha indica</i>	<u>Euphorbiaceae</u>	NO	Common
Basak	<i>Adhatoda vasica</i>	<u>Acanthaceae</u>	NO	Common
Aloe	<i>Aloe vera</i>	<u>Asphodelaceae</u>	NO	Common
Dhutra	<i>Datura metal</i>	<u>Solanaceae</u>	NO	Common

Note: NO= Not Threatened; NT= Nearest Vulnerable, LC=Least Concern, EN= Endangered

	
Rubber tree	Dhutra

	
Aloe	Basak
	
Muktajhuri	Gogon Shirish
Major Scenario of Ramu	
	
	

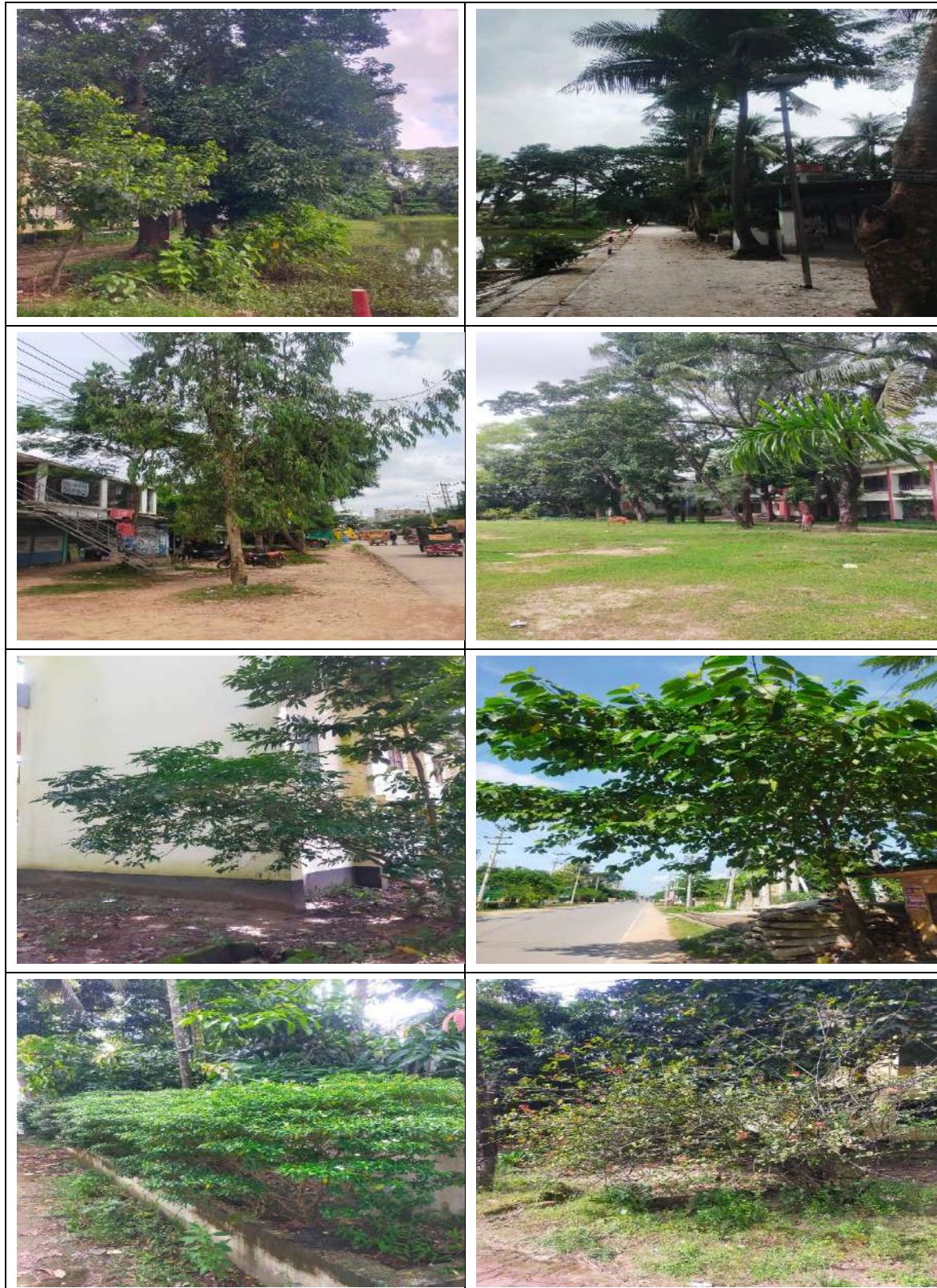


Figure 7-4: Scenario of terrestrial flora (Photo courtesy: Internet and Field Survey)

7.3.4 Aquatic Flora

Any type of plant or vegetation which lives and grows in water is called an aquatic plant. They are found in all types of water whether seawater or freshwater. For instance, you can see them in oceans, rivers, lakes, ponds and more. Just like aquatic animals that have unique characteristics, aquatic plants also have features which the terrestrial plants do not possess. Usually, we refer to these aquatic plants as 'submerged macrophytes'. It is essential to learn their importance. Though they may not be seen in our daily lives, nonetheless, they carry great importance. They are quite an essential part of the aquatic ecosystem.

Furthermore, they provide oxygen to the animal species living underwater. It is very important for their metabolic processes. Moreover, they also supply food to some of the species of animals living underwater. For instance, the turtles eat the algae present in freshwater pond surfaces. While some remain underwater, some of the aquatic plants float above the surface of freshwater. Their stems and roots allow them to remain firmly affixed despite strong currents. For instance, moss clings on to rocks.

It does not matter if they are terrestrial plants or aquatic, all of them need sunlight, soil, water and gases for surviving. Photosynthesis helps the plants in preparing food. They need the sunlight for that. Moreover, the soil helps in holding their roots.

The terrestrial plants need Carbon Dioxide to power the process of photosynthesis. However, the aquatic plants have evolved beyond that. They make do with dissolved Carbon Dioxide that is present in the water. Finally, water is very essential to complete this process of photosynthesis.

Floating plants are not fixed to the bottom of the water. However, they do have roots that absorb the water. You can find them in fresh or saltwater. Their leaves are firm and remain flat to absorb more sunlight. For instance, lilies and water hyacinth are aquatic plants.

Submerged plants are rooted in the water's floor. Most of the vegetation of this plant is found underwater. They have thin and narrow leaves. For instance, hydrilla's and bog moss are submerged plants.

Emergent plants are rooted to the ground of the water, however, most of its vegetation is above water instead of the soil. They require constant sunlight. For instance, knotweed and redroot are emergent plants.

The wetlands within the project area play a crucial role in supporting the aquatic ecosystem by supplying essential nutrients. Both seasonal and perennial wetlands contribute to the flourishing of aquatic plant communities. Various types of aquatic flora were observed throughout the project area, including common submerged species like Tape grass (*Vallisneria spiralis*), Isotes, and *Nitella*. In this area, free-floating plants such as Water hyacinth (*Eichhornia crassipes*), Water cabbage (*Pistia stratiotes*), and Azola (*Azolla pinnata*) were identified. Rooted floating plant communities dominate both perennial and seasonal wetlands within the project area, with Water lily (*Nymphae nouchali*) being the most prevalent species. Sedges and meadow plants are abundant in seasonal wetlands, and notable plants in the project area include Knotweed (*Polygonum Sp*), Pink morning glory (*Ipomoea fistulosa*), *Salvinia auriculata*, and *Azolla pinnata*. From the desk study, field visit and stakeholder consultation the identified Aquatic Flora Species of Ramu Upazila is given in Table 1.4

Table 7-4: List of Aquatic Flora Species of Ramu Upazila

English Name	Scientific name	Family name	IUCN Status	Local Status
Water lily	<i>Nymphae nouchali</i>	<u>Nymphaeaceae</u>	NO	Common
Tape grass	<i>Vallisneria spiralis</i>	<u>Hydrocharitaceae</u>	NO	Common
Water hyacinth	<i>Eichhornia crassipes</i>	<u>pontederiaceae</u>	NO	Common
Azola	<i>Azolla pinnata</i>	<u>Salviniaceae</u>	NO	Common
Knotweed	<i>Polygonum Sp</i>	<u>Polygonaceae</u>	NO	Common
Watermoss	<i>Salvinia auriculata</i>	<u>Salviniaceae</u>	NO	Common

Note: NO= Not Threatened; NT= Nearest Vulnerable, LC=Least Concern, EN= Endangered

	
Lily	Tape grass
	
Water hyacinth	Azola

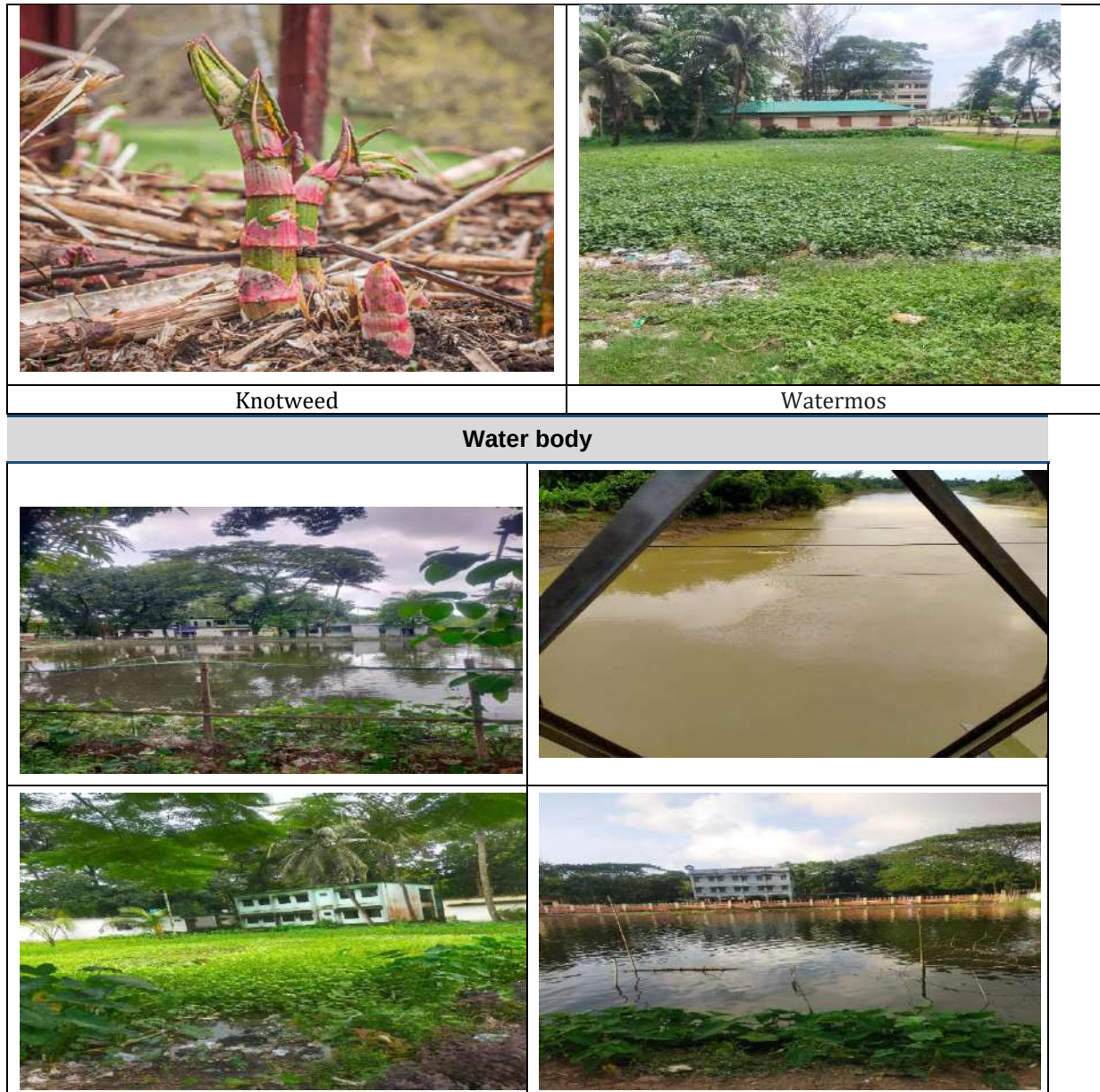


Figure 7-5: Scenario of terrestrial flora (Photo courtesy: Internet and Field Survey)

7.4 Protected Areas and Conservation Efforts in Ramu Upazila

7.4.1 Protected Areas

- **Existing Protected Areas:** While Ramu Upazila itself does not have large-scale protected areas like national parks, it is influenced by nearby conservation areas such as the Cox's Bazar Marine Protected Area, which helps protect the coastal and marine biodiversity.
- **Community Conservation Areas:** In some villages, community-led conservation initiatives are in place to protect local forests, wetlands, and wildlife. These areas, while not officially protected, play a significant role in conserving biodiversity at the local level.

7.4.2 Ongoing Conservation Projects

- **Mangrove Restoration Projects:** Several NGOs and government agencies are involved in mangrove restoration projects along the coastal areas of Ramu. These projects aim to rehabilitate degraded mangrove forests, protect against coastal erosion, and support local fisheries.
- **Wildlife Conservation Initiatives:** There are ongoing efforts to monitor and protect endangered species such as the Asian Elephant and Bengal Tiger. These initiatives often involve habitat restoration, anti-poaching measures, and community education programs to reduce human-wildlife conflict.
- **Community-Based Natural Resource Management:** Local communities are increasingly involved in managing natural resources, particularly in the sustainable use of forest products, fishery management, and the protection of water resources.

7.4.3 Challenges and Future Directions

- **Challenges:** The primary challenges to conservation in Ramu include habitat loss due to deforestation and land conversion, climate change impacts such as rising sea levels and increased salinity, and the pressure from a growing population.
- **Future Directions:** Strengthening community participation in conservation, expanding protected areas, and integrating climate change adaptation into conservation planning are crucial steps for the future. Additionally, greater enforcement of environmental regulations and increased funding for conservation initiatives will be necessary to protect Ramu's rich biodiversity.

7.5 Physical Planning Implication

The issues to be considered in physical planning aspects related to biodiversity key elements include identifying and protecting critical habitats for both flora and fauna, ensuring connectivity between these area through green infrastructure, incorporating diverse native plant species in urban design, managing land use to minimize fragmentation and implementing strategies to mitigate potential impacts on wildlife movement patterns, needs of local systems and species present. The key elements of physical planning for diversity area are habitat identification and protection, connectivity and green infrastructure, species-specific considerations, urban design and vegetation selection, land use planning and mitigation strategies, community engagement and education, ecological corridor analysis and so on.

However, all the above mentioned issues and aspects related to bio-diversity including flora and fauna are to be taken into account in view of reviewing and updating the master plan of Ramu Upazila.

7.6 Consequence

Ramu Upazila is a region of significant ecological importance, with diverse flora and fauna that require targeted conservation efforts. The area's biodiversity, particularly its mangrove forests, wildlife, and aquatic ecosystems, faces threats from human activities and climate change. However, with ongoing conservation projects and community involvement, there is

potential to preserve and even restore these valuable natural resources. Long-term sustainable development and environmental protection will be key to ensuring that Ramu Upazila's natural heritage is safeguarded for future generations. Consequently, we get Elephant which is very unique compared to any other terrestrial fauna found in any other region of Bangladesh. Besides Rubber tree is also a unique characteristic found in Ramu. Ramu is actually a full biodiversity hub in a meaning of terrestrial flora and fauna, besides it has a long cost line in which we can see various aquatic flora and fauna as well, Irrawaddy Dolphin is also an identical fauna in Ramu.

Infrastructure development, including roads, housing, and commercial areas, can lead to the destruction of critical habitats such as mangrove forests, wetlands, and deciduous forests. This loss could result in the decline of species populations, including endangered species like the Bengal Tiger and Olive Ridley Turtle. The construction of roads and urban areas may fragment existing ecosystems, disrupting wildlife corridors and leading to isolated populations of flora and fauna. Development near wetlands could disturb the habitats of migratory birds that rely on these areas during their seasonal movements. This disturbance could lead to a decline in bird populations and a loss of biodiversity in the region.

7.6.1 Recommendations for the Master Plan and Infrastructure Development

- **Biodiversity Protection Zones:** Designate specific areas within the Upazila as biodiversity protection zones where no development activities are permitted. These zones should include critical habitats such as mangroves, wetlands, and forested areas to ensure the preservation of local flora and fauna.
- **Environmental Impact Assessments (EIA):** Conduct comprehensive EIAs for all major infrastructure projects to assess potential impacts on biodiversity and natural resources. These assessments should guide the planning process to minimize environmental damage.
- **Green Corridors and Wildlife Crossings:** Integrate green corridors into the Master Plan to maintain connectivity between habitats. Wildlife crossings should be constructed over or under major roads to allow safe passage for animals specifically wild elephant and reduce habitat fragmentation.
- **Sustainable Agriculture Practices:** Promote sustainable agriculture practices that protect soil health and biodiversity. This could include the use of organic farming techniques, crop rotation, and the cultivation of salt-tolerant crop varieties in areas affected by salinity.
- **Agroforestry:** Encourage agroforestry practices that integrate trees with agricultural crops, providing additional income for farmers while enhancing biodiversity and soil stability.
- **Flood-Resilient Infrastructure:** Design infrastructure that is resilient to flooding, with adequate drainage systems to prevent waterlogging. This should include raised buildings in flood-prone areas and the construction of retention ponds to manage excess water.

- **Wetland Conservation:** Protect and restore wetlands as part of the water management strategy. Wetlands act as natural buffers against flooding, support biodiversity, and improve water quality.
- **Climate-Resilient Infrastructure:** Ensure that all infrastructure development is designed to withstand the impacts of climate change, including rising sea levels, increased salinity, and more frequent extreme weather events. This could involve the use of climate-resilient construction materials and techniques.
- **Mangrove Restoration:** Support mangrove restoration projects to protect coastal areas from storm surges and erosion. Mangroves not only provide critical habitat for wildlife but also serve as a natural defense against climate-related hazards.

7.6.2 Long Term Planning and Monitoring

- **Flexible Planning:** Incorporate adaptive management into the Master Plan, allowing for flexibility in response to new information or changes in environmental conditions. If monitoring reveals significant biodiversity loss or habitat degradation, the plan should be adjusted to mitigate these impacts.
- **Integrated Land Use Planning:** Develop an integrated land use plan that balances development needs with environmental protection. This plan should prioritize the preservation of natural resources and consider the long-term sustainability of the region.
- **Offsetting Development Impacts:** Where development leads to unavoidable habitat loss, implement biodiversity offsetting programs that create or restore habitats elsewhere in Ramu Upazila. These offset areas should be equivalent or greater in ecological value than the areas affected by development.
- **Reforestation with Native Species:** Promote reforestation efforts using native species that are adapted to the local environment. This not only enhances biodiversity but also improves ecosystem resilience to climate change.

For the Upazila Town Master Plan and Basic Infrastructure Development Project in Ramu Upazila, it is crucial to implement a development strategy that prioritizes environmental sustainability and biodiversity conservation. By incorporating these recommendations into the planning process, Ramu Upazila can achieve sustainable growth while preserving its unique natural heritage for future generations. This balanced approach will ensure that infrastructure development meets the needs of the community without compromising the ecological integrity of the region.

Incorporating biodiversity into the long-term planning and monitoring framework for this project in Ramu Upazila is essential for ensuring sustainable development. By prioritizing the protection of critical habitats, engaging communities in conservation efforts, and implementing adaptive management strategies, the Master Plan can support both human development and the preservation of Ramu's rich natural heritage. This approach will help maintain the ecological balance, support local livelihoods, and ensure that Ramu Upazila remains a thriving environment for both people and wildlife.

Chapter Eight: Hazard and Disaster



CHAPTER EIGHT: HAZARD AND DISASTER

8.1 Introduction

Hazards and disasters pose threats to humans, the environment, and infrastructure. Hazards, whether natural or human-induced, may escalate into disasters without effective management. Disasters are catastrophic events resulting from significant damage, loss of life, or property destruction caused by hazards. Their impact extends to communities, nations, and the global economy, disrupting infrastructure, food and water supplies, and communication networks, often leading to social disorder. Climate change is a major hazard threatening humans, causing various risks like rising sea levels and extreme weather events. Hazards and disasters, with both immediate and long-term impacts, affect societies and the environment, leading to economic losses, infrastructure damage, and loss of life. Bangladesh, with high vulnerability due to natural hazards, faces yearly challenges in Ramu Upazila, including floods, cyclone, earthquake, extreme weather effect, arsenic, and riverbank erosion. This working paper addresses the hazard and disaster issues in Ramu Upazila, considering the socio-economic conditions and the significant impacts on lives and livelihoods.

8.2 Methodology

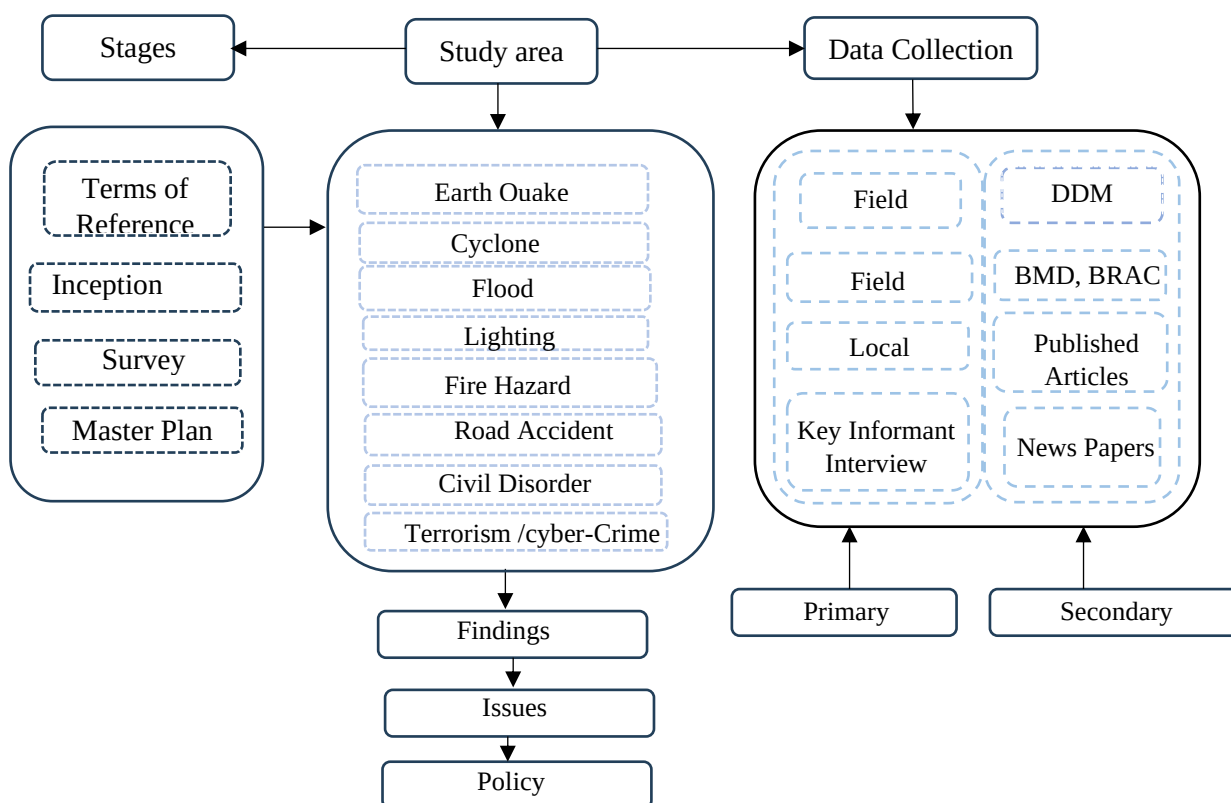


Figure 8-1: Methodological Flow Chart

This research thoroughly reviewed several papers and reports, utilizing them as secondary sources of information, in order to assess the present state of hazard and disaster in Ramu

Upazila. Important papers and records from the Bangladesh National Portal, local government agencies, and national disaster-related policies were all included in this study. The study included a field survey in accordance with the project's guideline.

8.3 Hazard

8.3.1 Hazard and its classification

Hazard is any substance, phenomenon or situation which has the potential to cause disruption or damage to people their property, their services, and their environment. Hazard is which has potential to occurrence of an event. A hazard is a potential source of harm. Substances, events, or circumstances can constitute hazards when their nature would allow them, even just theoretically, to cause damage to health, life, property, or any other interest of value.

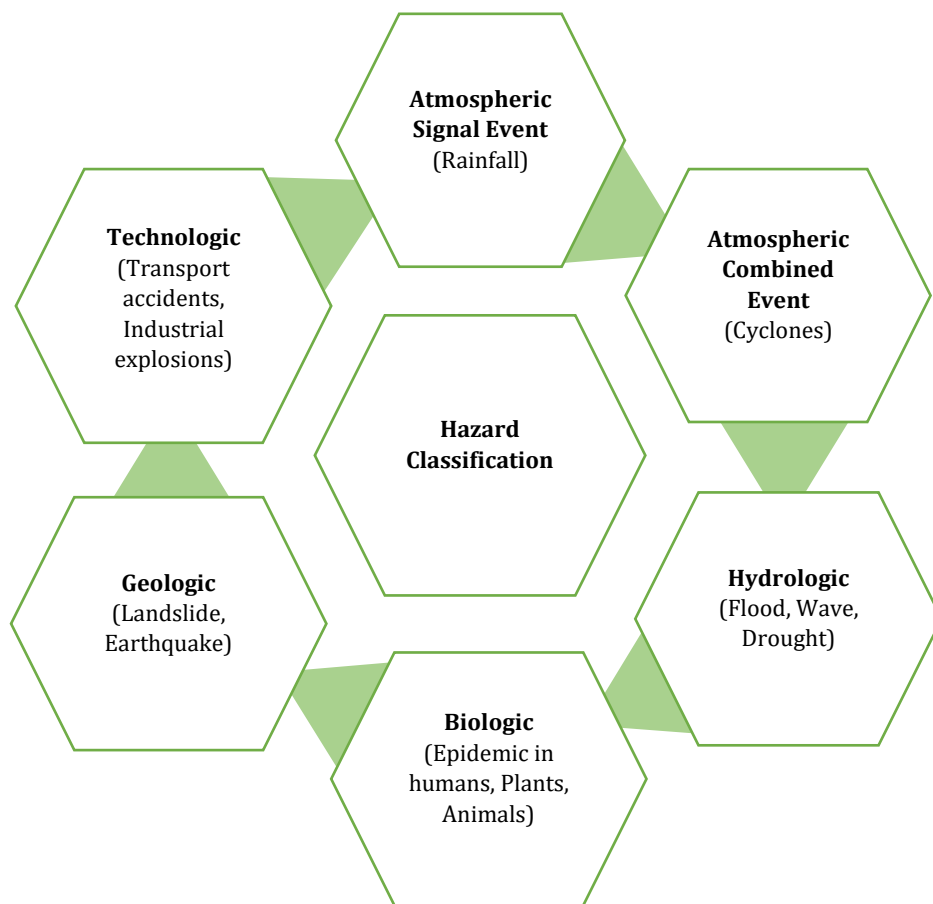


Figure 8-2: Classification of Hazard

The probability of that harm being realized in a specific incident, combined with the magnitude of potential harm, make up its risk, a term often used synonymously in colloquial speech. Hazards can be classified in several ways; they can be classified as natural, anthropogenic, technological, societal, secondary hazard or any combination. Secondary hazard refers to a result of other hazard events. For example, secondary hazards to an earthquake may be landslide, Tsunami, building collapse, interruption of power, water supply, transportation, communication.

Natural Hazard: Natural hazard encompasses atmospheric, hydrologic, geologic, and wildfire phenomena that can negatively impact humans, structures, or activities. These events are influenced by human influence and can be classified as hazardous events or natural disasters if they result in high fatalities or extensive property damage. This definition challenges the perception of natural hazards as inevitable chaos caused by unrestrained natural forces. These arise from natural processes and phenomena. Examples include:

- Earthquakes
- Hurricanes
- Tornadoes
- Floods

Anthropogenic Hazard: Human-caused hazards, resulting from intentional actions, errors, or system failures, can cause moderate to severe damage to individuals, communities, economies, supply chains, and the environment.

Biological Hazard: Biological hazards encompass substances or agents of organic origin, as well as those transmitted through biological vectors. This includes pathogenic microorganisms, toxins, and bioactive substances, such as bacteria, viruses, parasites, venomous wildlife, insects, poisonous plants, and mosquitoes carrying disease-causing agents.

- Epidemics and pandemics
- Invasive species
- Bioterrorism

Environmental Hazard: Environmental hazards cover chemical, natural, and biological elements, often arising from environmental degradation, as well as physical or chemical pollution in the air, water, and soil. However, certain processes and phenomena within this category are better described as drivers of hazard and risk rather than hazards themselves, such as soil degradation, deforestation, loss of biodiversity, salinization, and sea-level rise.

Geological Hazard: Geological hazards arise from internal earth processes like earthquakes, volcanic activity, and emissions, with hydrometeorological factors playing a crucial role. Categorizing tsunamis is challenging due to their oceanic context.

Hydrologic Hazard: Hydrometeorological hazards, including tropical cyclones, floods, droughts, heatwaves, and coastal storm surges, are influenced by atmospheric, hydrological, and oceanographic conditions.

Technological Hazard: Technological hazards, such as industrial pollution, nuclear radiation, and toxic waste, can result from various risky procedures, infrastructure failures, and human activities. These result from human activities and technological processes. Examples include:

- Industrial accidents
- Chemical spills
- Nuclear accidents
- Transportation accidents
- Terrorist attacks
- Infrastructure failures

8.4 Disaster

A disaster is an event, natural or man-made, sudden, or progressive, that seriously disrupts the functioning of a society, causing human, material, or environmental losses of such severity that the affected community has to respond by taking exceptional measures.

- ✓ **Qualitative Definition:** A disaster is an overwhelming situation where the regular routines of life are abruptly interrupted, leading to a need for essential provisions such as protection, food, water, shelter, clothing, medical care, and social assistance to ensure the well-being of affected individuals (according to UNDRO- United Nations Disaster Relief Organization and the League of Red Cross and Red Crescent Societies).
- ✓ **Quantitative Definition:** Mr. Bindi V. Shah of London School of Economics made a global survey of disasters between 1947 and 1980 and suggested that the damage cost by a natural hazard may be termed as disaster if it satisfies one of the following conditions:
 - a) At least US\$ 3.6 million worth of damage
 - b) At least one hundred people dead
 - c) At least one hundred people injured

The damage caused by a disaster can be described as tangible loss and intangible loss. Tangible loss refers to measurable losses in monetary terms such as physical damage and economic loss, while intangible loss refers to losses that cannot be measured in monetary terms (impacts on health, cultural heritage, or the environment).

8.5 Review of Existing Rules and Regulations

Table 8-1: Existing Rules and Regulation, Higher Level Plans

Existing Rules and Regulation, Higher Level Plans	Relevant Issues
	Goal-13
Sustainable Development Goals(SDGs)	Strengthening resilience and adaptive capacity to climate-related disasters the climate. Incorporating change measures into policies and plans for the climate. Building knowledge and capacity to cope with change the climate. Develop procedures for capacity building in planning and management. Above the changes UN framework implementation of the convention.

Existing Rules and Regulation, Higher Level Plans	Relevant Issues
Bangladesh Delta Plan-2100	The flood and ensuring security from climate change-related disasters of water increase safety and cost-effective water use. Durable and ensuring integrated river management and estuarine management. Swamp and conservation of ecosystems and promotion of their beneficial use of the country and building effective and equitable institutions in indigenous water resources management. Land and achieving maximum and integrated use of water resources.
The Eighth Five Year Plan (2020-2025)	Adopting a sustainable approach that is resilient to disasters and climate change that will ensure sustainable use of natural resources and successfully manage inevitable urbanization the city Three steps in management restructuring: (1) strengthening public-private partnerships to improve service quality; (2) capacity building of public institutions involved in urban service delivery; (3) Development of accountable urban government system with economic decentralization - Urgent Investment in civic amenities such as water supply, drainage, sewage, and waste management - The poor Government subsidies on affordable housing for communities. - Institutional restructuring to develop strong local government institutions.
National Disaster Management Plan, 2021-2025	Roles and Responsibilities of Related Organizations in Emergency Operations and Risk Reduction - Disaster Management Regulatory Framework. Provides a long-term strategic goal in disaster management one for disaster management planning by various organizations also provides directions. Management planning at various ministry and administrative levels, such as publication of District Disaster Management Plan, Upazila Disaster Management Plan, Union Disaster Management Plan and Municipality/City Corporation Disaster Management Plan. Recommends inclusion of disaster component in various plans and development projects of various ministries NGO lays down civil society and the private sector their responsibilities and means for disaster management strategic goals and government implementation. Pre-disaster policy and post-disaster mitigation design.

Existing Rules and Regulation, Higher Level Plans	Relevant Issues
Bangladesh Water Act, 2013	No structure shall be constructed which interferes with the natural course of any creek or river without prior permission. Prioritization of water use in areas where water resources are in crisis is a significant step (water use only for consumption and domestic purposes will be considered a fundamental right). From the point of view of protection and conservation of water resources, surface Timely decisions for irrigation and water needs of urban areas should be made according to the law based on the availability of water, groundwater and rainwater. Prior permission shall be pending for river dredging to maintain navigability, land reclamation projects by filling wetlands, flood control and structures to prevent river erosion. Public hearings are a very good provision for proposed national water management plans.
The environment Conservation (Amendment) Act, 2010	Environmentally sensitive areas (Ecologically Critical Area) determination. Regarding conducting activities in environmentally sensitive areas.
National Urban Sector Policy, 2011 (Draft)	Integrating green infrastructure into communities. Conservation of land resources in ecologically sensitive areas Conservation of open space in water drainage, future use, green belt and recreational facilities. Wetland and floodplain management through land use control. Circular waterways within the city as an alternative to the existing road system. Cost of waste management Recycling medium in reduction Community Providing basic citizen benefits in the community Promotion of cooperatives and business, regional exchange system, informal credit system, community based environmental management.
Coastal Zone Policy, 2005	A combination of all sectoral policies (land use, industry, fisheries etc.). Coastal Development and Jurisdiction of Coastal Zones Identify key stakeholders in coastal development and determine their role in the development process. Supporting Development in Coastal Zones Amidst the adverse Impacts of Climate Change.
The climate Change Strategies and Action Plans, 2009	Low-income people and ensuring all basic amenities (food security, safe shelter, jobs, health) while protecting the most vulnerable in society, including women and children, from the effects of climate change Already Successful disaster management strategies must be used for increasingly frequent and deadly natural disasters. Existing structures (ie, seawalls and river

Existing Rules and Regulation, Higher Level Plans	Relevant Issues
	embankments) must be preserved and ensured to be functional. Determining the proper location of critical infrastructure (cyclone shelters and drainage systems) to address climate change impacts. Determining future scenarios and timing of climate change impacts on economic and socio-economic sectors, guiding future investment strategies. Bangladesh's engagement with global ongoing scientific thinking and ensuring best practice climate change management.
National Waste Management Strategy, 2010	Open pile, to completely eliminate waste discharge into rivers and floodplains. Promote recycling through source segregation and create markets for recycled products. To encourage recycling of waste. Emphasis on waste avoidance/reduction through waste recycling and environmentally sound disposal of all types Using environment friendly raw materials. Using hazardous waste materials to the minimum possible level.
My Village is my town	Modern Provision of all amenities of the city (improved roads, communication, clean water, modern health care and treatment, quality education, improved sewage and waste management, increased electricity and fuel supply, computer and high-speed internet facilities, expansion of the market for quality consumer goods including electrical appliances), in the village. Encouraging and supporting the installation of biogas plants and solar panels on group basis to increase and increase reliability of power and energy supply the village. Expanding rural mechanization services including machinery repair by setting up agricultural machinery service centers, workshops and training rural youth and agricultural entrepreneurs to provide productive employment. Non-agricultural in addition to these services of the sector, providing necessary assistance including credit facilities to marginal and small entrepreneurs of the private sector to manufacture and market light machinery.
Land Use Policy, 2001	Land zoning for coastal areas of Bangladesh. Optimum use of land and water resources based on effectiveness of land use planning. Reservation of special land.
Building Construction Rules, 1996	Construction of building height, parking management, light and air circulation system, roof, sunshade, emergency exit etc. and other emergency management.

Existing Rules and Regulation, Higher Level Plans	Relevant Issues
	Land use policy for construction of buildings.
National Adaptation Plan of Bangladesh 2023-2050	Development of climate resilient agriculture for food nutrition and livelihood security Promoting nature based solutions for conservation of forestry, biodiversity and wellbeing of communities.

8.6 Existing Scenario of Disaster and Hazard in Ramu Upazila

Ramu Upazila, located in Cox's Bazar District of southeastern Bangladesh, is a region prone to multiple natural hazards due to its geographical location, topography, and climatic conditions. Due to coastal and mountain area Ramu upazila is usually affecting by flood, river erosion, landslide and cause of flash flood and tidal surge. Besides, this area has devastated by cyclones. The livelihood in Ramu is partly sustained by agricultural production, with every union having designated agricultural land, most of which is used for farming. Additionally, some unions have the potential to develop into tourist destinations. However, these areas are highly vulnerable to various natural hazards throughout the year, which poses a constant risk to both agriculture and tourism potential. These hazards have significant implications for the local population, infrastructure, and environment.

Strom, Cyclone, Falsh flood, river erosion, flood and torrential rain are common hazards of Ramu Upazilla. Nevtrhelss this upazilla threaten due to landslide, salinity. Due to deforestation and mountain cutting from previous these hazards are happening and turns in disaster. This upazila is also in risk from attacking of wild elephant, malaria and tobacco farming etc. A disaster profile of the project area was tabulated from the Disaster and Climate Risk Information Platform (DRIP) web tool (source: <http://drip.plancomm.gov.bd/Report/Report>). In DRIP database, all data related to natural disaster vulnerability are represented at the upazila level aggregation. The DRIP web tool represents hazard, exposure and risk level on a scale of 1 to 5 where the levels are very low, low, medium, high, and very high. The risk level of the prominent disasters of the study area are as follows:

Below is a detailed overview of the hazard and disaster situation in Ramu Upazila.

Table 8-2: Disaster profile of Ramu Upazila

Disaster	Hazard Level	Exposure Level	Vulnerability Level	Risk Level
Erosion	Very Low	Medium	High	Very Low
Flood	Low	Low	High	Low
Sea Level Rise	Medium	Low	High	Medium
Salinity	High	Low	High	High
Cyclone	Very High	Low	High	High
Storm Surge	High	Low	High	High
Earthquake	Medium	Medium	High	Medium

8.6.1 Cyclones and Storm Surges

8.6.1.1 Cyclone Frequency and Historical Data

Cyclone Occurrence

Cyclone Prone Area: The Bay of Bengal is one of the most cyclone-prone regions in the world. Ramu Upazila, situated along the southeastern coast of Bangladesh, frequently experiences the effects of cyclones that develop in this region.

Historical Cyclones: Several major cyclones have impacted Ramu Upazila over the past few decades. Ramu is a cyclone-prone area, and it is expected that each union would have a cyclone center. However, the study revealed that only Garjania Union (Union No. 2) and Chakmarkul Union (Union No. 10) have cyclone centers, with four centers each. The rest of the unions lack such facilities.

The study also found a significant number of religious establishments, reflecting the religious diversity in Ramu, where Muslims, Hindus, and Buddhists coexist. On average, each union has 25–50 mosques, with Fatekharkul Union (Union No. 5) having the highest number at 57. Most unions also have 3–5 pagodas, while temples are slightly fewer in number, with 5–10 per union. These established sometimes used as the shelter during the cyclone. Notable events include:

- **Cyclone Sidr (2007):** A Category 4 tropical cyclone that made landfall on November 15, 2007. Sidr caused extensive damage across southern Bangladesh, including Ramu, with wind speeds exceeding 240 km/h (150 mph). The cyclone resulted in significant loss of life, property damage, and agricultural losses.
- **Cyclone Aila (2009):** A Category 1 cyclone that struck on May 25, 2009. Although not as powerful as Sidr, Aila caused widespread flooding and storm surges that inundated coastal areas, including parts of Ramu. The cyclone affected over 3.9 million people across Bangladesh.
- **Cyclone Amphan (2020):** A Category 5 super cyclone that affected Bangladesh on May 20, 2020. While the most severe impacts were felt in the southwestern parts of the country, the storm's peripheral effects, including heavy rainfall and storm surges.

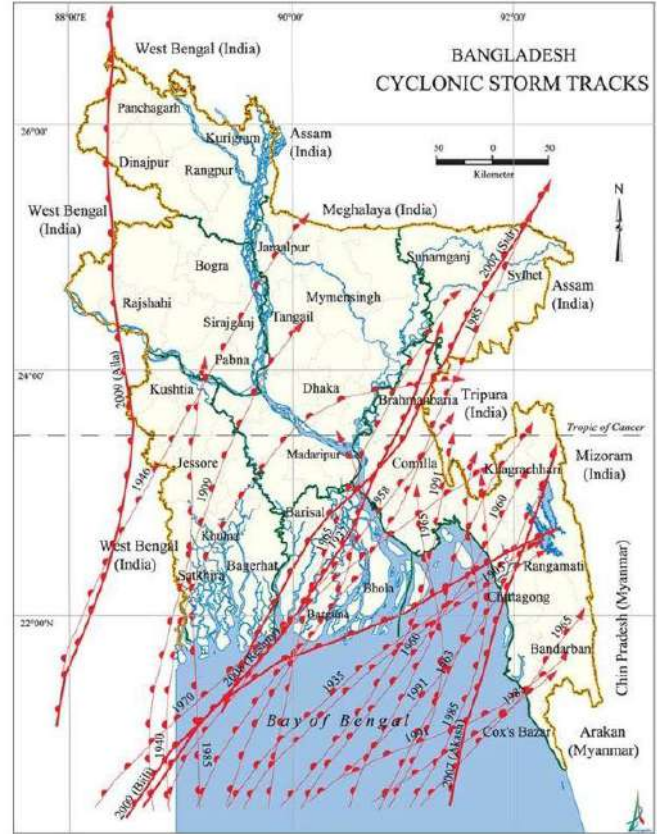


Figure 8-3: Cyclone map of Bangladesh

Cyclone Intensity

Categories of Cyclones: Cyclones affecting Ramu Upazila can vary in intensity, typically categorized as follows:

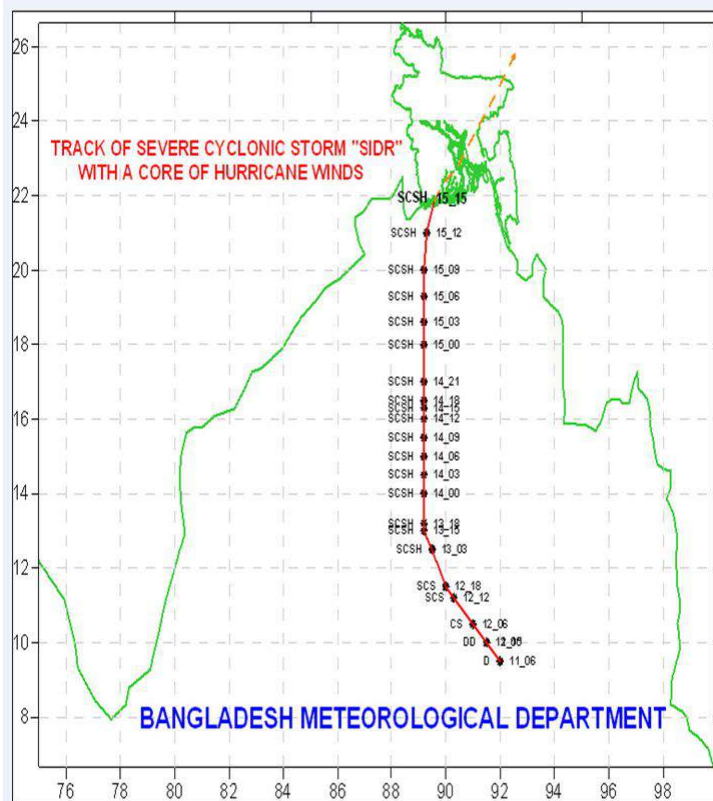


Figure 8-4: Cyclone storm 'Sidr'

- **Category 1-2 (Tropical Storm to Weak Cyclone):** Wind speeds between 74-110 mph. These cyclones cause moderate damage to infrastructure and crops, with minor storm surges.
- **Category 3-4 (Severe Cyclone):** Wind speeds between 111-155 mph. These cyclones cause extensive damage to buildings, infrastructure, and agriculture, with significant storm surges and coastal flooding.
- **Category 5 (Super Cyclone):** Wind speeds exceeding 156 mph. These cyclones cause catastrophic damage, with widespread destruction, high storm surges, and severe inland flooding.

8.6.1.2 Storm Surges

Mechanism and Impact

Storm Surge Definition: A storm surge is an abnormal rise in sea level above the normal tide, caused primarily by the strong

winds and low pressure associated with cyclones. In coastal regions like Ramu Upazila, storm surges can lead to severe flooding and coastal erosion.

Impact on Coastal Areas:

- **Inundation:** Low-lying coastal areas in Ramu are particularly vulnerable to storm surges, which can inundate large swathes of land, displacing communities, destroying homes, and contaminating freshwater resources with seawater.
- **Agricultural Damage:** The intrusion of saltwater due to storm surges can have long-lasting impacts on agricultural land, making it unsuitable for crop production and leading to reduced food security.
- **Infrastructure Damage:** Storm surges can severely damage coastal infrastructure, including roads, bridges, embankments, and buildings. The force of the water can wash away structures and leave behind extensive debris.

Historical Storm Surge Data

1. **Cyclone Sidr (2007):** The storm surge associated with Cyclone Sidr reached heights of up to 5-6 meters (16-20 feet) in some coastal areas, leading to widespread inundation and destruction in Ramu and nearby regions.
2. **Cyclone Aila (2009):** Aila generated a storm surge of approximately 3 meters (10 feet), causing severe flooding in coastal areas, breaching embankments, and leading to significant displacement of populations.
3. **Cyclone Amphan (2020):** Although the direct impact of Amphan's storm surge was more pronounced in southwestern Bangladesh, peripheral areas, including Ramu, experienced storm surge effects that caused localized flooding and erosion.

8.6.1.3 Vulnerability and Risk Factors

Geographic Vulnerability

Low Elevation: Ramu Upazila is characterized by low-lying terrain, with much of the land at or just above sea level. This makes the region particularly susceptible to storm surges and tidal inundation.

Coastal Proximity: The proximity to the Bay of Bengal further increases the risk, as the area is exposed to the full force of cyclones and their associated storm surges.

Socioeconomic Vulnerability

High Population Density: Coastal and riverine areas in Ramu are densely populated, with many communities relying on agriculture, fishing, and aquaculture for their livelihoods. These communities are particularly vulnerable to the impacts of cyclones and storm surges.

Inadequate Infrastructure: The region's infrastructure, including housing, roads, and embankments, is often not built to withstand the severe impacts of high-intensity cyclones. Many homes are constructed from materials that are easily damaged by strong winds and floodwater.

8.6.1.4 Summary of Key Data Points

- **Cyclone Sidr (2007):** Category 4, storm surge 5-6 meters, extensive damage in Ramu.
- **Cyclone Aila (2009):** Category 1, storm surge 3 meters, significant flooding and erosion.
- **Cyclone Amphan (2020):** Category 5, peripheral impact in Ramu, localized storm surge effects.
- **Vulnerability Factors:** Low elevation, coastal proximity, high population density, inadequate infrastructure.

8.6.1.5 Cyclone Center

Ramu Upazila has a total of 42 Cyclone Centers which are also located in Maximum Government Primary School. During disasters, especially floods or cyclones, many times they bring their cattle, goats and poultry with all their assets to the shelter. Relief is provided through the council.

	
Coordinate: 21.426124, 92.100805 Established: 2009-2010 (IGED)	Coordinate: 21.4374136, 92.0948760 Established: 1992-1993 (Saudi Arabia)

8.6.2 Floods

8.6.2.1 Flooding Patterns

The level of land is 50% high of this upazila therefore long-term flood does not affect here. But due to flash floods short-term water-log happens in some areas.

- **Monsoon Flooding:** The monsoon season, from June to September, brings heavy rainfall that often leads to flooding in Ramu Upazila. The region's where the flat topography, combined with its extensive river network, makes it highly susceptible to flooding. The Bakkhali River, which flows through Ramu, frequently overflows its banks during heavy rains, inundating surrounding areas. **Flash Floods:** Ramu is also at risk of flash floods, particularly in hilly areas where rapid runoff from intense rainfall can lead to sudden and severe flooding. Flash flood occurred in Eidghar union, Khuniapalong union, Rashidnagar union and Kacchapia union while excess rainfall in the hillocks. These flash floods can cause significant damage in a short period, affecting both rural and urban areas.

8.6.2.2 Historical Flood Events

Ramu Upazila, located in Cox's Bazar District, is highly susceptible to flooding due to its low-lying terrain, proximity to rivers such as the Bakkhali River, and its location in a region prone to heavy monsoon rainfall. Floods in Ramu are a recurring event, Rajarkul, Chakmarkul, Rashidnagar significantly impacting the lives of the local population, agriculture, infrastructure, and overall development. Below is a detailed overview of the flood history in Ramu Upazila. The major flooding event in Ramu are described below:

- **Flood of 1991:** The 1991 flood in Ramu was a result of the devastating cyclone that struck the southeastern coast of Bangladesh. The cyclone's storm surge caused the Bakkhali River to overflow, leading to extensive flooding in Ramu. Thousands of homes were destroyed, and the floodwaters inundated large areas of agricultural land.
- **Flood of 2004:** The monsoon floods of 2004 were among the most severe in recent history, affecting large parts of Bangladesh, including Ramu. Continuous heavy rainfall caused the Bakkhali River to swell, resulting in widespread flooding. The floodwaters submerged homes, roads, and farmlands, displacing many families and leading to significant agricultural losses.
- **Flood of 2012:** In June 2012, Ramu experienced another major flood event. Heavy monsoon rains, combined with waterlogging and inadequate drainage, led to extensive

flooding in both rural and urban areas of the upazila. The floods caused severe damage to infrastructure, including roads and bridges, and disrupted local businesses and markets.

- **Flood of 2017:** The 2017 monsoon season brought prolonged and intense rainfall, leading to severe flooding in Ramu. The floodwaters inundated low-lying areas, causing significant displacement of people, especially in the southern and eastern parts of the upazila. Many households faced food shortages due to the destruction of crops and disruption of local markets.
- Idgor UP, Garjania, Kocchopia, KhawarKhop, Fatekharkul, Rajarkul, Daskhin Mithachar faced river bank erosion.

8.6.2.3 Erosion

River erosion and Flash flood are one of the most vulnerable hazards of the area. Kowerkhop, Fatekharkul, Razarkul, Kachapia and Grazania unions are surrounded by the river Backhali. And the rivers Eidgrah-Eidgaon, Goliapalong, Ramiatya, Dochari are adjacent to the Eidghar, Khuniapalong, Rashid nagar, Kachapia Unions respectively. Heavy rain falls on different mountains cause large volume of water to come down the mountain sides, which then flows into the rivers and create flash flood and river bank erosion. The two hazards are correspondingly connected with each other and occur between the months of Ashar to Ashshin which hampers the everyday life of the inhabitants and cause damages to the crop production of the areas.

8.6.2.4 Waterlogging

- **Persistent Waterlogging:** Waterlogging is a common problem in Ramu, especially Jowarianala union and in low-lying agricultural fields. Poor drainage systems, combined with heavy monsoon rains, often result in waterlogged conditions that can last for weeks, damaging crops and reducing agricultural productivity.
- **Impact on Agriculture:** The prolonged inundation of farmlands due to waterlogging severely impacts crop yields, particularly for rice, which is the staple crop in the region. Farmers often suffer significant economic losses as a result of these conditions.

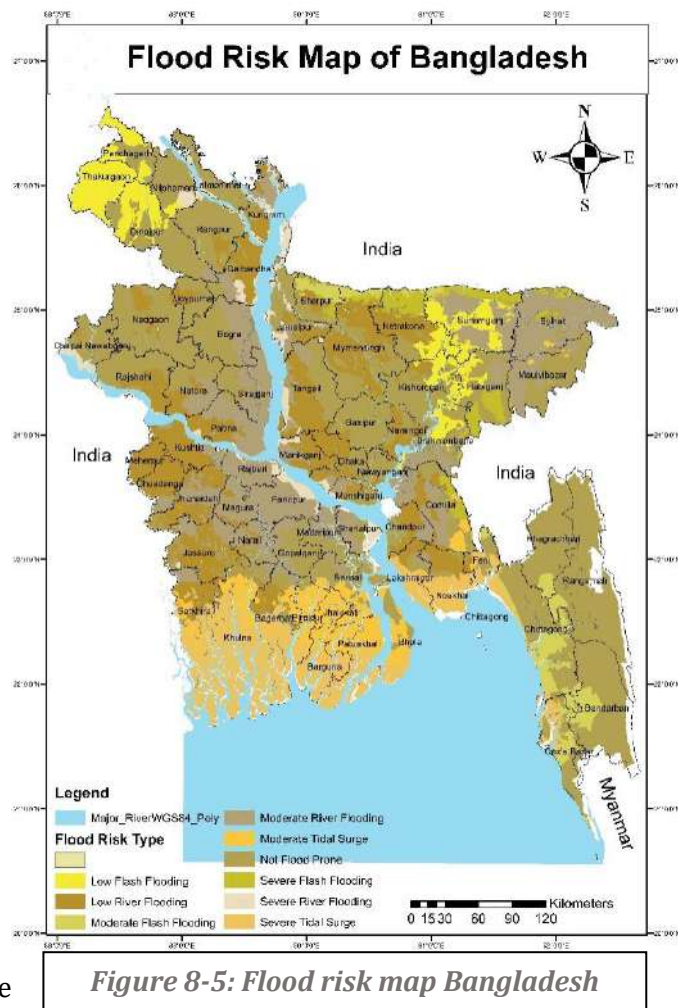


Figure 8-5: Flood risk map Bangladesh

8.6.2.5 Attack of Wild Elephant

Due to unplanned deforestation wild elephant faces problems of dwelling and food. As a result, in search of food they come to the villages and causes loss to households and crops.

8.6.2.6 salinity

Particularly in three Unions of the upazila. Rashidnagar, Chakmarkul, Zoarinala union are affected with salinity. High concentration of salinity has been observed in Ashar, srabon and ashshin months during rainy season and reducing the productivity of the farming lands.

8.6.3 Landslides

8.6.3.1 Landslide Risk

- **Hilly Terrain:** The eastern part of Ramu Upazila, which borders the Chittagong Hill Tracts, is characterized by hilly terrain. Hill cutting has been identified as an issue in Daskhin Mithachari and Khuniar Palong, making these areas prone to landslides. These areas are prone to landslides, particularly during the monsoon season when heavy rains saturate the soil, making it unstable.
- **Deforestation and Human Activity:** Deforestation and the expansion of human settlements into hilly areas have increased the risk of landslides. The removal of vegetation reduces the soil's ability to hold together, making slopes more susceptible to collapse during heavy rains.

8.6.3.2 Consequences of Landslides

- **Loss of Life and Property:** Landslides can result in the loss of life, destruction of homes, and damage to infrastructure such as roads and bridges. The sudden nature of landslides means that they often occur without warning, leaving little time for evacuation or preparation.
- **Displacement of Communities:** In severe cases, landslides can force the evacuation and displacement of entire communities, leading to long-term socio-economic challenges for the affected populations.

8.6.4 Earthquake

Bangladesh is situated in one of the most tectonically active regions in the world. Here is where three major plates meet (the Indian plate, the Tibet sub-plate, and the Burmese sub-plate). The project area is located over the Indian plate, which is moving north. On the basis of the distribution of earthquake epicenters and the morphotectonic behavior of different tectonic blocks, the Bangladesh National Building Code (BNBC) has divided our country into four (04) seismic zones. As per the seismic zone map Chattogram & Cox's bazar falls under zone III. It means the project area is prone to all types of seismic intensity.

Each zone has a seismic zone coefficient (Z) which represents the maximum considered peak ground acceleration (PG) on very stiff soil/rock (site class SA) in units of g (acceleration due to gravity). The seismic coefficient is a measure of how strong an earthquake has the potential to be based on a combination of the mass of the plate & the seismic forces acting on it, as well as how frequently these quakes are likely to occur. While Ramu Upazila is not as seismically active as other parts of Bangladesh, it is still vulnerable to earthquakes due to its proximity to the active seismic zones in the Chittagong Hill Tracts. Chakmarkul union, Fatekharkul Union, Dakshin Mithaichari, Kauarkhop, Rajarkul and a little portion of Eidghar union are moderately vulnerable (2nd degree sensitivity) to Peak Ground Acceleration (PGA). Earthquakes in this region can cause ground shaking, leading to damage to buildings and infrastructure.

The latest earthquake data was obtained from the BMD website. Bangladesh underwent numerous moderate to low-intensity earthquakes between 2014 and 2023, with most originating within the country. On average, these earthquakes measured about 4.3 on the Richter scale. In 2023, the strongest earthquake on record occurred, measuring 5.50 in magnitude. Analysis of Bangladesh's seismic zone map, shown in Figure 8- and Figure 8- , indicates that the majority of earthquakes have taken place in seismic zones I and II. Over the past 10 years, Bangladesh experienced 27 earthquakes, with 6 occurring in 2023 and 5 in 2020.

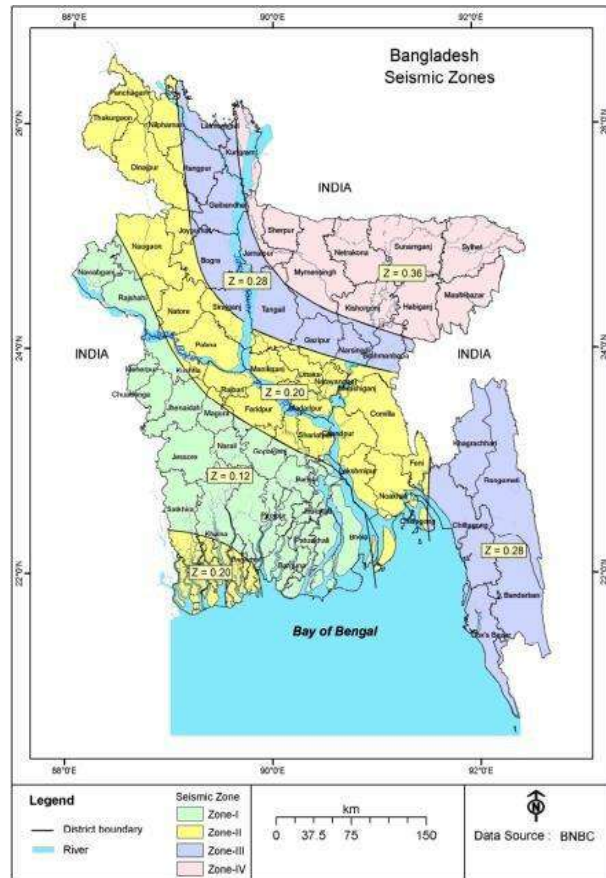


Figure 8-6: Seismic map of Bangladesh

8.6.5 Lighting (Thunderstorm)

Thunderstorms in Bangladesh are a significant natural hazard, leading to a considerable number of fatalities and injuries each year. The country experiences an increase in thunderstorm activity during the pre-monsoon and monsoon seasons, with May seeing the highest frequency of these events. Thunderstorms are common in Ramu Upazila, particularly during the pre-monsoon and monsoon seasons (April to September). These storms can bring heavy rainfall, strong winds, and lightning strikes. Lightning is a significant hazard during these storms. The flat terrain of Ramu, combined with the presence of tall trees and structures, makes the area particularly susceptible to lightning strikes.

Lightning strikes can result in fatalities and injuries, particularly in rural areas where people work outdoors in agriculture or fishing. These incidents are more common during the peak of the monsoon season when thunderstorms are frequent. Thunderstorms can cause damage to homes, particularly those with tin roofs, as well as to electrical infrastructure, leading to power outages. Lightning strikes can also ignite fires, compounding the risk of damage.

8.6.6 Fire Hazard

Fire safety in Bangladesh has been a significant concern, with numerous incidents highlighting the inadequacy of safety measures in place. One of the common causes of fire accidents in Ramu Upazila, particularly in densely populated areas, is electrical short circuits. Poor wiring, overloaded circuits, and the use of substandard electrical materials often lead to fires, especially in residential areas and markets. In rural and semi-urban areas, kitchen fires are another common cause of accidental fires. These are often caused by the improper handling of cooking stoves or the use of open flames, particularly in homes with thatched roofs or other flammable materials. Fire accidents in Ramu often result in the destruction of homes, shops, and other structures, leading to significant financial losses for those affected. The close proximity of buildings in certain areas can lead to rapid fire spread, exacerbating the damage.

Ramu Upazila has limited firefighting resources, which hampers the ability to quickly respond to fire accidents. Fire stations are often under-equipped, and in some cases, firefighters have to rely on community members to help control fires until professional help arrives.

Ramu Upazila currently has one fire service station located in Ramu Sadar, which serves as the primary emergency response unit for fire incidents across the upazila. This station is equipped with basic firefighting vehicles and resources but is limited in capacity.

The nearest fire station beyond Ramu is in Cox's Bazar, approximately 10-15 kilometers away, which often provides additional support during larger fire incidents or emergencies.

As for the manpower, the Ramu Fire Service operates with around 10-15 firefighters. The available equipment includes firefighting vehicles, hoses, water pumps, and rescue tools. However, the station is known to face challenges during peak disaster times due to limited resources and the vast area it covers.

For more significant emergencies, such as during cyclones or major fires, reinforcements are typically requested from Cox's Bazar Fire Service. Upgrading the firefighting infrastructure, including more stations and equipment, is crucial for enhancing disaster preparedness in Ramu.

8.6.7 Road Accident

As Ramu Upazila develops, road accidents have become a growing concern, particularly along the major roads that connect Ramu to Cox's Bazar and other parts of the district. Poor road conditions, lack of traffic management, and the increase in vehicular traffic contribute to these accidents. Most of the roads within Ramu Upazila are paved; the communication system has improved significantly over the last 5-10 years. But the road system within the unions of the upazila is not better. All most villages connected to main road with herring bone road and earthen road.

The roads in Ramu Upazila, particularly the major ones connecting to Cox's Bazar, are paved roads. These roads serve as key transportation routes for both local and inter-district traffic. However, there are also secondary rural roads, some of which may be less developed or in poorer condition. The road conditions typically worsen during the monsoon season (June to September) due to heavy rainfall. The rainwater can cause damage to the road surfaces, leading to potholes, waterlogging, and slippery conditions that contribute to an increased number of accidents.

In most cases, travels are troublesome for loss of bricks on these roads. Types of transport used in this sub-district minibus, jeep, taxi, tomtom, auto-rickshaw and engine boat. People are travelling usually by foot, rickshaw on earthen road, ricksaw, autorickshaw and taxi in metaled road and boat in river among different unions and different wards of unions of this upazilla.

Road accidents can result in injuries and fatalities, as well as economic losses due to damage to vehicles and goods. Pedestrians, particularly children and the elderly, are often the most vulnerable. Road accidents can result in injuries and fatalities, as well as economic losses due to damage to vehicles and goods. Pedestrians, particularly children and the elderly, are often the most vulnerable.

8.7 History of Disaster at a Glance:

Due to coastal and mountain area Ramu upazila is usually affecting by flood, river erosion and water logging cause of flash flood and tidal surge. Besides, this area has faced by at least 70 cyclones since 1970. Hundreds crore of Taka Wealth has been damaged and lost life by different hazards including cyclone. Information of cyclone, flood, and river erosion of this upazila are given following table:

Year	Name of the Disaster	Total amount of damages (taka)	Which fields or productions are affected
1991	Cyclone and Tidal Surges	Approximately 20 crore	Infrastructure, domestic animals, farmlands, trees, human resource, educational institutions, shops of market and huge resource damaged
1994, 1997	Cyclone	Approximately 10 crore	Infrastructure, farmlands, trees, architecture
1998	Flood	Approximately 6	Infrastructure, domestic animals, farmlands, trees, architecture

Year	Name of the Disaster	Total amount of damages (taka)	Which fields or productions are affected
		crore	
2011,2012,2013	Heavy rainfall and flood	Approximately 20 crore	Infrastructure, trees, latrine, farmlands, seed root
Every year	River erosion	Approximately 8 crore in every year	Infrastructure, educational institution, trees, farmlands, roads
Every year	Landslide	Approximately 6 crore in every year	Infrastructure, educational institution, trees, farmlands
Every year	Storm	Approximately 12 lac in every year	Infrastructure, trees, farmlands
Every year	Attack of Wild elephant	Approximately 1 crore in every year	Infrastructure, trees, farmlands, life

(Source: RIC/CDMP-II, MODMR 2014)

8.8 Disaster Management

Disaster management refers to the systematic process of using administrative decisions, organization, operational skills, and capacities to implement policies, strategies, and coping capacities to lessen the impacts of natural and human-made hazards and related environmental, technological, and biological disasters. It encompasses all aspects of planning, preparedness, response, and recovery.

8.8.1 Key Principles of Disaster Management

- **Risk Assessment and Analysis:** Identifying potential hazards and assessing vulnerabilities to determine the risk levels and prioritize mitigation efforts.
- **Community Involvement:** Engaging local communities in the planning and implementation of disaster management activities to ensure they are aware, prepared, and resilient.
- **Coordination and Collaboration:** Ensuring effective communication and cooperation among various stakeholders, including government agencies, non-governmental organizations (NGOs), private sector, and international bodies.
- **Sustainability:** Integrating disaster risk reduction into development planning and ensuring that recovery efforts contribute to long-term sustainability and resilience.

8.8.2 Key Components of Disaster Management

1. **Mitigation:** This involves efforts to reduce or eliminate the risk of disasters. Mitigation activities can include:
 - Building codes and zoning regulations

- Public education and awareness campaigns
 - Infrastructure improvements like flood defenses and earthquake-resistant buildings
 - Environmental management and sustainable land-use practices
- 2. Preparedness:** This stage focuses on planning and preparing to effectively respond to disasters. Preparedness measures include:
- Developing emergency plans and conducting drills
 - Establishing early warning systems
 - Training first responders and emergency personnel
 - Stockpiling necessary supplies and equipment
- 3. Response:** This phase involves immediate actions taken during and immediately after a disaster to ensure safety and provide basic needs. Response activities include:
- Search and rescue operations
 - Emergency medical assistance
 - Provision of food, water, and shelter
 - Maintaining law and order and ensuring public safety
- 4. Recovery:** Recovery efforts aim to restore the affected area to its previous state and improve resilience against future disasters. Recovery activities encompass:
- Rebuilding infrastructure and homes
 - Restoring public services and utilities
 - Providing financial assistance and support to affected individuals and businesses
 - Conducting post-disaster assessments and learning to improve future response efforts

8.9 Recommendations for Disaster Risk Reduction and Management

8.9.1 Strengthening Early Warning Systems

- **Enhanced Communication:** Improve the dissemination of early warning information for cyclones, floods, and other hazards. This can be achieved through better use of technology, such as mobile phone alerts, radio broadcasts, and community networks.
- **Community Awareness Programs:** Conduct regular community awareness programs to educate the local population about the risks of natural disasters and the importance of early preparedness.

8.9.2 Infrastructure Development

- **Cyclone Shelters and Safe Houses:** Expand the number of cyclone shelters and safe houses in Ramu Upazila, particularly in coastal and flood-prone areas. These shelters

should be designed to accommodate large numbers of people and be equipped with essential supplies.

- **Flood-Resilient Infrastructure:** Construct and upgrade infrastructure, such as roads, bridges, and drainage systems, to be more resilient to floods and waterlogging. This includes elevating roads and building proper drainage channels to reduce the impact of heavy rainfall. Establishing infrastructures considering characteristics of flood on that area, strengthening the existing polder or embankment and increase the height of the polder or embankment and providing assistance in re-establishing infrastructures (houses, roads etc.)
- **Improved Drainage Systems:** Upgrade and maintain drainage systems to prevent waterlogging. This includes constructing larger and more efficient drainage channels, ensuring regular maintenance to prevent blockages, and integrating green infrastructure such as wetlands and rain gardens to manage stormwater.
- **Strengthening Coastal Defenses:** Build and reinforce coastal embankments and sea walls to protect against storm surges. Mangrove reforestation should also be prioritized as a natural defense against cyclones, as mangroves help dissipate wave energy and reduce coastal erosion.
- **Cyclone-Resilient Building Standards:** Implement and enforce building codes that require cyclone-resilient construction, particularly in coastal and flood-prone areas. Structures should be designed to withstand high winds and equipped with features such as storm shutters and secure roofing.
- **Community Health, Food Security and Sanitation:** Low cost desalinization techniques, provision of pond sand filter for ensuring availability of food and drinking water. Rainwater harvesting. Assessment of disease like increased high blood pressure, premature child birth or death during maternity triggered by salinity and provide proper medication facilities.

8.9.3 Environmental and Land Use Planning

- **Reforestation and Afforestation:** Promote reforestation and afforestation efforts in hilly areas to reduce the risk of landslides. Planting trees and restoring vegetation can help stabilize slopes and reduce soil erosion.
- **Sustainable Land Use Practices:** Implement sustainable land use practices that consider the region's vulnerability to natural hazards. This includes restricting development in high-risk areas, such as floodplains and unstable slopes, and promoting agricultural practices that reduce environmental degradation.

8.9.4 Climate Change Adaptation

- **Adaptation Strategies for Agriculture:** Encourage the use of climate-resilient crop varieties and farming techniques that can withstand changes in temperature and precipitation patterns. This could include the adoption of salt-tolerant crops in coastal areas and improved irrigation systems to manage water scarcity.
- **Coastal Protection Measures:** Invest in coastal protection measures, such as mangrove restoration and the construction of embankments, to reduce the impact of rising sea levels and storm surges.

8.9.5 Disaster Preparedness and Response

- **Emergency Response Plans:** Develop and regularly update comprehensive emergency response plans for different types of disasters. These plans should include evacuation routes, emergency contact lists, and protocols for coordination between local authorities and national agencies.
- **Capacity Building:** Strengthen the capacity of local disaster management committees and volunteers through training and the provision of necessary resources. This will improve the effectiveness of disaster response and recovery efforts in Ramu Upazila.

8.10 Physical Planning Implication

Physical planning aspects of hazard and disaster include land use planning, zoning regulations and building codes, environmental conservation, structural mitigation, non-structural mitigation, preparedness. These planning aspects are part of disaster mitigation which is a set of actions that reduce the impacts of disasters on communities.

However, all the above mentioned issues and aspects related to hazard and disaster are to be considered in view of reviewing and updating the master plan of Ramu Upazila.

8.11 Conclusion

Ramu Upazila, located in Cox's Bazar District, is highly vulnerable to a range of natural hazards due to its geographic location, including cyclones, floods, riverbank erosion, landslides, and the impacts of climate change such as rising sea levels and irregular rainfall patterns. These hazards pose significant risks to the local population, infrastructure, and agriculture, leading to loss of life, displacement, and economic challenges.

In conclusion, Ramu Upazila's vulnerability to various natural and anthropogenic hazards, including floods, cyclones, riverbank erosion, fire accidents, and technological disasters, necessitates a carefully crafted Upazila Town Master Plan. The plan must prioritize sustainable development while minimizing risks through flood-resilient infrastructure, enhanced drainage systems, cyclone-resistant construction, and fire safety measures. It should also address riverbank stabilization, technological disaster preparedness, and community-based disaster management. Incorporating climate change adaptation, ongoing hazard assessments, and flexible planning will ensure that Ramu can build resilient infrastructure that safeguards lives, livelihoods, and the environment.

Chapter Nine: Public Health, Disease Control and Wellbeing



CHAPTER NINE: PUBLIC HEALTH, DISEASE CONTROL AND WELLBEING

9.1 Introduction

The preservation and improvement of the health of individuals and their communities are the primary objectives of public health science and practice. It is focused on the prevention of diseases and the encouragement of healthy behaviors through the informed decisions and collective efforts of society, organizations, public and private communities, and individuals. Examining the distribution and determinants of health-related conditions or events in specific populations, and subsequently applying this research to the management of health issues. The utilization of statistical techniques in the disciplines of biology, health, and medicine. Disease control is a set of strategies that are intended to prevent and regulate the transmission of diseases, with a particular focus on infectious diseases. The planning, implementation, and evaluation of public health practices are facilitated by the systematic collection, analysis, and interpretation of health data. Well-being is the term used to describe the comprehensive health and contentment of both individuals and communities. The body's condition, which includes the absence of chronic diseases, nutrition, and physical fitness. Emotional and psychological wellness, which includes the ability to confront life's obstacles, maintain relationships, and manage tension. Ramu is a prime example of the intricate relationship between public health, disease control, and overall well-being. Ramu, a predominantly rural region, is confronted with unique health challenges and opportunities that are indicative of broader national and global trends in health and development. This report examines the public health landscape of Ramu, assessing the efficacy of disease control measures and the overall well-being of its residents. Its purpose is to provide a thorough evaluation of health status and to pinpoint potential areas for improvement. Public health is influenced by the demographic, economic, and environmental characteristics of Ramu. The economic dependence on agriculture, which is characterized by a high prevalence of occupational hazards, pesticide exposure, and nutritional deficiencies, has a substantial impact on the public health dynamics of the region. A substantial number of families are engaged in agricultural and related activities. Public health initiatives in Ramu are focused on the prevention of disease, the promotion of healthy behaviors, and the provision of essential health services.

Local health authorities are endeavoring to enhance maternal and infant health, decrease the prevalence of communicable and non-communicable diseases, and enhance healthcare infrastructure with the support of national programs. Essential components of these initiatives include the implementation of community clinics, health education campaigns, and vaccination programs. However, challenges such as a scarcity of trained health professionals, inadequate healthcare facilities, and inadequate awareness of health issues persist.

9.1.1 Operational Definition of Public Health

The organized effort of society, particularly through its public institutions, to improve, protect, advance, and restore the health of the populace is referred to as public health. It entails the systematic implementation of policies, programs, and services that are designed to enhance physical, mental, and social well-being, prevent disease, and extend life. This field requires a comprehensive approach that includes the prevention and control of diseases through health

education, surveillance, and vaccination programs; health promotion initiatives that encourage healthy lifestyles and environments; and environmental health measures that ensure the safety of air, water, and food through environmental health measures. It is also a component of public health to plan, organize, and manage healthcare resources to ensure the effective delivery of health services and equitable access. This is known as health services administration. Furthermore, epidemiological research is integrated to facilitate the understanding of health patterns and to inform policy decisions. This is why policy and advocacy are so crucial: public health professionals are committed to the development, promotion, and implementation of policies that promote healthier communities. Community engagement is another critical component that entails the empowerment of individuals to actively participate in their health and the collaboration with local organizations. The ultimate objectives of public health are to reduce the incidence and prevalence of both communicable and non-communicable diseases, promote sustainable, healthy environments, enhance overall health outcomes and life expectancy, and resolve health disparities in order to achieve health equity. In order to evaluate the efficacy of interventions and the effective allocation of resources in public health initiatives, measures such as the prevalence of risk factors, vaccination coverage, and morbidity and mortality rates are implemented. Public health aims to address current health challenges and prepare for future ones by implementing these multifaceted strategies, thereby establishing a strong foundation for a healthier society. The medical specialty that pertains to public health, which encompasses epidemiology, sanitation, and disease prevention. Public health is a multidisciplinary discipline that integrates and applies methodologies from both the social sciences and the natural sciences. It encompasses the evaluation of the health status of a population, the prevention of illnesses, and the promotion of health. The term "health" refers to a state of complete physical, mental, and social well-being. Health incorporates all aspects of well-being, not just the absence of illness or infirmity. Every individual is entitled to the utmost possible level of health care, which is considered one of the fundamental rights of every human being, irrespective of their socioeconomic status or religious beliefs. What are the three Ps in the context of public health? Prevention, protection, and the promotion of health awareness and education comprise the three P's of public health. These are the primary obligations of public health, to state it simply. Diabetes, cardiovascular disease, hypertension, stroke, chronic respiratory disorder, and prostate cancer are all examples of noncommunicable diseases.

Tuberculosis, HIV, tetanus, leprosy, malaria, measles, and rubella are all examples of maladies that can be transmitted from person to person.

9.1.2 Operational Definition of Disease Control

In local contexts, the process of disease control is defined by public health professionals as the reduction of the number of new infections, the number of individuals who are currently afflicted, and the number of individuals who become ill or die from a disease. Disease control is the term used to describe the strategic combination of activities and measures that are implemented to decrease the incidence, prevalence, and impact of diseases, particularly infectious diseases, within a population. This necessitates a multifaceted approach that encompasses education, diagnosis, treatment, surveillance, and prevention. Ultimately, the goal of disease control is to prevent the transmission of diseases, mitigate their impact on affected individuals and communities, and eliminate or eradicate the diseases from a population. Vaccination programs that protect individuals and communities from vaccine-

preventable diseases are an essential element of prevention. Public health campaigns that promote behaviors and practices that reduce the risk of infection, such as proper sanitation, secure sexual practices, and hand hygiene, frequently reinforce these programs. Another fundamental component of disease control is surveillance, which involves the systematic collection, analysis, and interpretation of health data to promptly identify and address outbreaks. This real-time surveillance allows health authorities to monitor disease patterns, identify emergent hazards, and evaluate the effectiveness of control measures.

An early and precise diagnosis is essential for effective disease control. Public health systems strive to ensure that diagnostic services are both accessible and reliable, thereby facilitating the diagnosis and treatment of diseases in a timely manner. This includes laboratory testing, field diagnostics, and point-of-care testing. Additionally, treatment protocols are indispensable, as they encompass the administration of suitable medications, the management of complications, and the provision of supportive care. In order to effectively manage the situation in low-resource settings, it is essential to ensure that treatment is both affordable and accessible. Education is a critical component of disease control, as it informs the public about the importance of preventive measures, the proliferation of diseases, and the availability of treatment options. The goal of health education campaigns is to foster a community-wide culture of health and safety by modifying behaviors and attitudes.

The management of diseases that are transmitted by insects, such as mosquitoes, is significantly influenced by vector control. This includes strategies such as insecticide-treated netting, indoor residual sprinkling, and environmental management to reduce the number of reproductive sites. During epidemics of highly contagious diseases, quarantine and isolation measures are crucial for preventing the spread of the disease by separating the healthy population from those who are infected or exposed. Furthermore, the improvement of health systems' capacity to confront health threats is essential for disease control. This includes the provision of healthcare personnel with training, the enhancement of infrastructure, and the preservation of a consistent supply of essential resources and medications. It is imperative to collaborate and coordinate at the local, national, and international levels, as diseases are not territorially restricted. A critical organization that facilitates global cooperation and provides guidance and support for disease control efforts is the World Health Organization (WHO). Ultimately, the operational definition of disease control encompasses a comprehensive, coordinated, and sustained effort to prevent, detect, and manage diseases, thereby promoting and protecting public health on a global scale. Disease control is the term used to describe the strategic combination of activities and measures that are implemented to decrease the incidence, prevalence, and impact of diseases, particularly infectious diseases, within a population. This necessitates a multifaceted approach that encompasses education, diagnosis, treatment, surveillance, and prevention. Ultimately, the goal of disease control is to prevent the transmission of diseases, mitigate their impact on affected individuals and communities, and eliminate or eradicate the diseases from a population. Vaccination programs that protect individuals and communities from vaccine-preventable diseases are an essential element of prevention. Public health campaigns that promote behaviors and practices that reduce the risk of infection, such as proper sanitation, secure sexual practices, and hand hygiene, frequently reinforce these programs. Another fundamental component of disease control is surveillance, which involves the systematic collection, analysis, and interpretation of health data to promptly identify and address outbreaks. This real-time surveillance allows health authorities

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9.1.3 Operational Definition of Well-Being

Well-being is the quality of existence and the ability of individuals and societies to make a meaningful and purposeful contribution to the world. Concentrating on well-being facilitates the monitoring of the equitable distribution of resources, overall thriving, and sustainability. A state of complete physical, mental, and social well-being is not solely the absence of disease or infirmity; it is a state of health (World Health Organization [WHO], 1948: 100. Well-being is a positive state that is felt by both individuals and societies. It is a resource that is essential for daily life, akin to health, and is influenced by social, economic, and environmental factors. Health, according to the World Health Organization's Constitution, is not merely the absence of disease or infirmity, but rather a state of complete physical, mental, and social well-being. Well-being is a conceptual framework that encompasses the comprehensive quality of life that individuals and communities experience, encompassing a diverse array of dimensions of physical, mental, and social health. The operational definition of well-being is a state in which individuals perceive their lives as progressing effortlessly, experience health and pleasure, and are capable of effectively overcoming the challenges they encounter. The well-being of the body is encapsulated by physical health, which incorporates the absence of disease, regular

physical activity, appropriate nutrition, ample sleep, and access to healthcare services. Mental well-being encompasses cognitive functioning, emotional health, and the presence of positive emotions, including life satisfaction and contentment. Furthermore, it incorporates the ability to maintain psychological resilience, adapt to change, and manage stress. The character of social networks and relationships, as well as the support and sense of belonging that individuals receive from their family, friends, and community, are all part of social well-being. It encompasses the ability to form and maintain satisfying relationships, as well as positive interactions and social engagement.

A critical dimension of economic well-being is the ability to meet basic needs, including housing, food, and education, as well as financial stability and access to resources. It is inextricably linked to economic security, income levels, and employment opportunities, all of which collectively influence the capacity of individuals to lead productive and fulfilling lives. The existence of a sustainable and healthy environment that promotes both mental and physical health is further influenced by environmental well-being, which is an additional critical component. This includes access to natural and recreational areas, secure neighborhoods, and clean air and water. Although spiritual well-being is more subjective, it is often linked to a sense of purpose and meaning in life, which is often associated with personal beliefs, values, and connections to something greater than oneself.

Acknowledging that well-being is multifaceted and dynamic, the operational definition of well-being also encompasses the integration and equilibrium of these diverse dimensions. A comprehensive approach that considers both individual experiences and broader societal factors is essential for the effective measurement and promotion of well-being. Objective measures such as economic indicators, health statistics, and environmental quality, as well as self-reported assessments of health status, contentment, and life satisfaction, are frequently employed as indicators of well-being. The primary goals of public health initiatives that are intended to enhance well-being are to create supportive environments, promote healthy behaviors, and address the social determinants of health. In order to improve well-being, it is essential to establish policies and programs that improve education, reduce poverty, encourage community engagement, and ensure access to healthcare. Ultimately, well-being is a state of prospering and positive health in which individuals and communities have the resources, opportunities, and capabilities to achieve their full potential and live fulfilling lives.

9.2 Aim and Objectives

The objective of this report is to provide a comprehensive assessment of the current state of health facilities, public health initiatives, disease control measures, and the general welfare of the population in the designated area. with the objective of identifying the deficiencies and challenges that exist within the current public health systems and health infrastructure. In order to ascertain the current effectiveness of the prevalent disease control tactics and public health programs. The objective of this evaluation is to evaluate the community's overall well-being by examining the physical, mental, social, economic, and environmental aspects. To bolster public health initiatives, enhance health facilities, strengthen disease control methods, and promote holistic well-being within the population, suggestions that are substantiated by evidence are provided. The objectives are,

- To evaluate the quality, accessibility, and availability of health facilities in the designated region.
- To evaluate public health programs and initiatives that are designed to enhance the health of the general population.
- To examine the efficacy and strategies of disease control measures.
- To assess the general welfare of the general population.
- To identify the primary determinants of health and well-being.
- To develop evidence-based recommendations for community leaders, healthcare providers, and policymakers.

9.3 Methodology

The term "methodology" denotes the methodical and theoretical analysis of the procedures employed in a specific field of research. It encompasses the concepts, instruments, and procedures that are employed during the data acquisition, analysis, and interpretation processes. The term "methodology" in the context of a research report denotes the procedures and approaches that were employed to gather information. In order to guarantee the validity, accuracy, and objectivity of the study, the methodology section of a research report presents an overview of the strategies and methodologies employed to gather data.

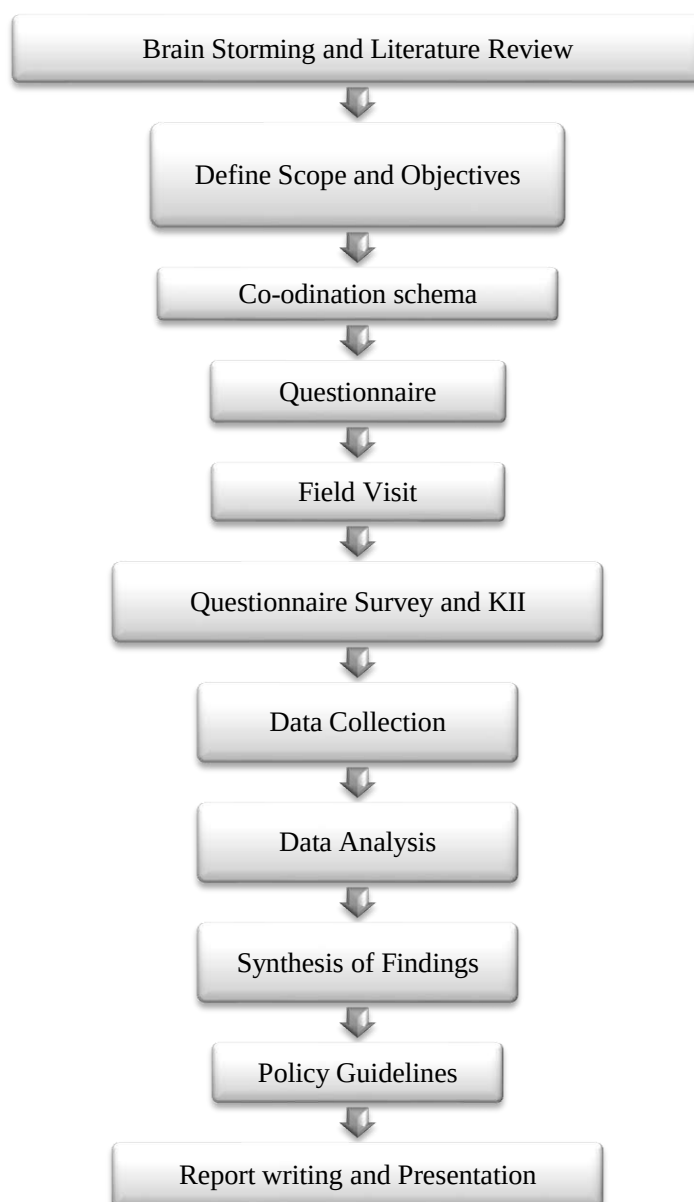


Figure 9-1: Methodological Diagram

9.3.1 Sources of Data and Data Collection

In addition to conducting in-depth interviews with important stakeholders, such as healthcare experts, public health authorities, and community leaders, an investigation was conducted into the difficulties, achievements, and perspectives associated with health services and well-being. The process of locating the sources of data and doing the gathering of data involved several processes and methods that were followed. These included the development and dissemination of questionnaires to physicians, patients, and members of the community who are involved in healthcare. The questionnaires included inquiries concerning the availability, accessibility, and quality of health facilities, as well as public health programs, disease control measures, and general well-being. Demographic information, statistical reports, and existing health records were also gathered and analyzed.

9.3.2 Data Analysis/Interpretation

We devised a comprehensive strategy and established a timeline for the data collection process. It is imperative that ethical concerns, including confidentiality and informed consent, are adequately addressed, and data collectors should receive training.

9.3.3 Data Presentation Techniques

The analytic methodologies employed in this study were solely based on the information obtained from survey data, which was collected through the use of a questionnaire, interviews, and focus group discussions using Microsoft Excel.

Afterward, the results were analyzed using both qualitative and quantitative methodologies to summarize, present, and analyze the findings. A quantitative analysis was conducted on the questionnaires collected from the respondents, and the results were presented in a table formatted as percentages. The details were arranged and collated to generate a report after all the data analysis was completed. Visual representations of the data are included in the report, in addition to the explanations. The report is suitable for any individual to study due to the simplicity of these representations.

9.4 Analysis and Major Findings

9.4.1 Literacy rate of Local People (%)

The bar chart presents the literacy rate of local people and public health statistics. The literacy rate of the local population stands at 72.4%, indicating a significant portion of the population possesses basic reading and writing skills. On the other hand, the public health aspect shows that 27.6% of the population suffers from infectious diseases. This suggests a lower prevalence of

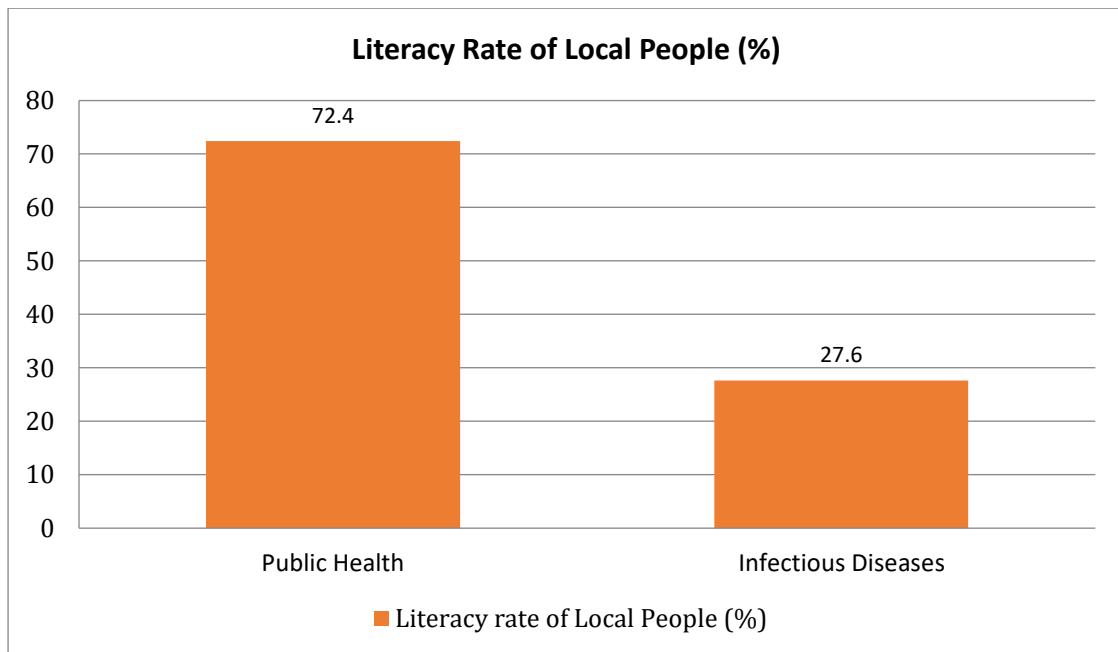


Figure 9-2: Literacy rate of local people

9.4.2 The Rate of Affected People with Infectious Disease

The pie chart shows that 70.6% of the population is affected by infectious diseases, while 29.4% is not affected. This indicates a high prevalence of infectious diseases in the community,

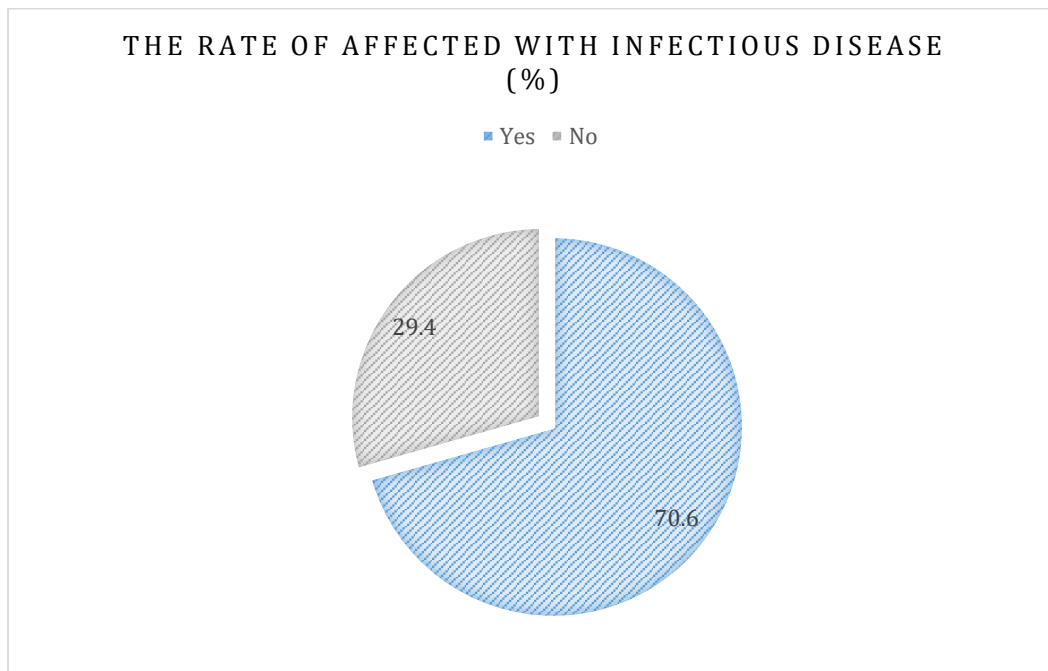


Figure 9-3: The Rate of Affected with Infactious Disease(%)

highlighting potential health challenges and the need for interventions. It suggests a significant burden on the healthcare system and the overall well-being of the population. Efforts should be focused on preventive measures, such as vaccinations and hygiene practices, to reduce the spread of infectious diseases and improve public health outcomes. Adequate access to healthcare services and resources should also be ensured to effectively diagnose and treat these conditions. Furthermore, health education and awareness campaigns can play a vital role in promoting healthy practices and reducing the occurrence of infectious diseases. Overall, the data underscores the importance of prioritizing public health initiatives to address the high prevalence of infectious diseases in the community.

9.4.3 Source of Knowledge of public health

The bar chart presents the percentage distribution of the sources of public health knowledge. It indicates that the majority (75.8%) of the population acquires knowledge about public health from educational institutions. This suggests that educational institutions play a crucial role in disseminating information related to public health. Additionally, NGOs account for 4% of the

population's source of knowledge, indicating their significant contribution to spreading awareness and education on public health issues. Government institutions contribute to 9% of the public's knowledge, highlighting the importance of government initiatives and programs in promoting public health. The data also reveals that private enterprises contribute 11.1% to the

public's knowledge of public health, suggesting that the private sector also has a role in disseminating information and driving public health initiatives. Understanding the sources of public health knowledge is crucial for designing targeted interventions and formulating effective public health campaigns. By focusing on educational institutions, NGOs, government institutions, and private enterprises, policymakers and organizations can strengthen existing channels of public health education and develop new strategies to increase knowledge dissemination and improve public health outcomes.

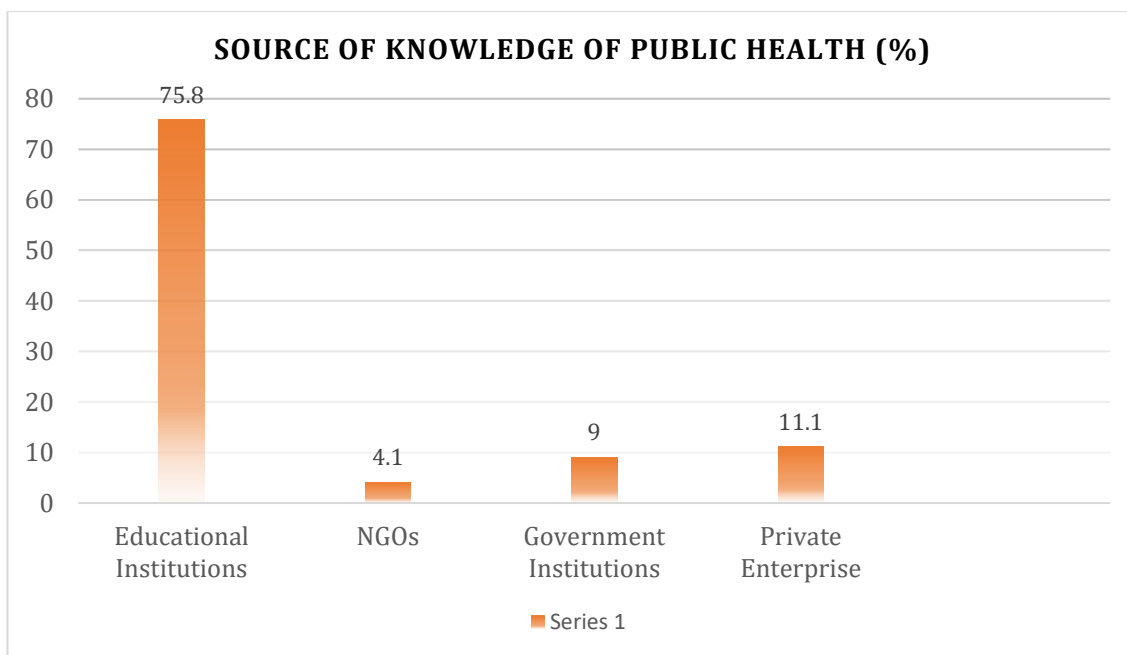


Figure 9-4: Souce Of Knoledge of Public Health (%)

9.4.4 Source of water for Drinking and Daily Use

The bar chart presents the percentage distribution of different sources of water for drinking and daily use. The majority of the population obtains water from deep tube-wells, accounting for 48.3% of the total. This suggests that deep tube wells are the most common and preferred source of water for the population.

Tube-wells are the second most commonly used source, accounting for 31.5% of the tube well. Natural reservoirs contribute to 3% of the population's water source, indicating that a small portion of individuals rely on natural water bodies for their daily needs. Supply water accounts for 17.2% of the population's water source, indicating that a portion of the population is dependent on water supplied through pipelines and other centralized distribution systems.

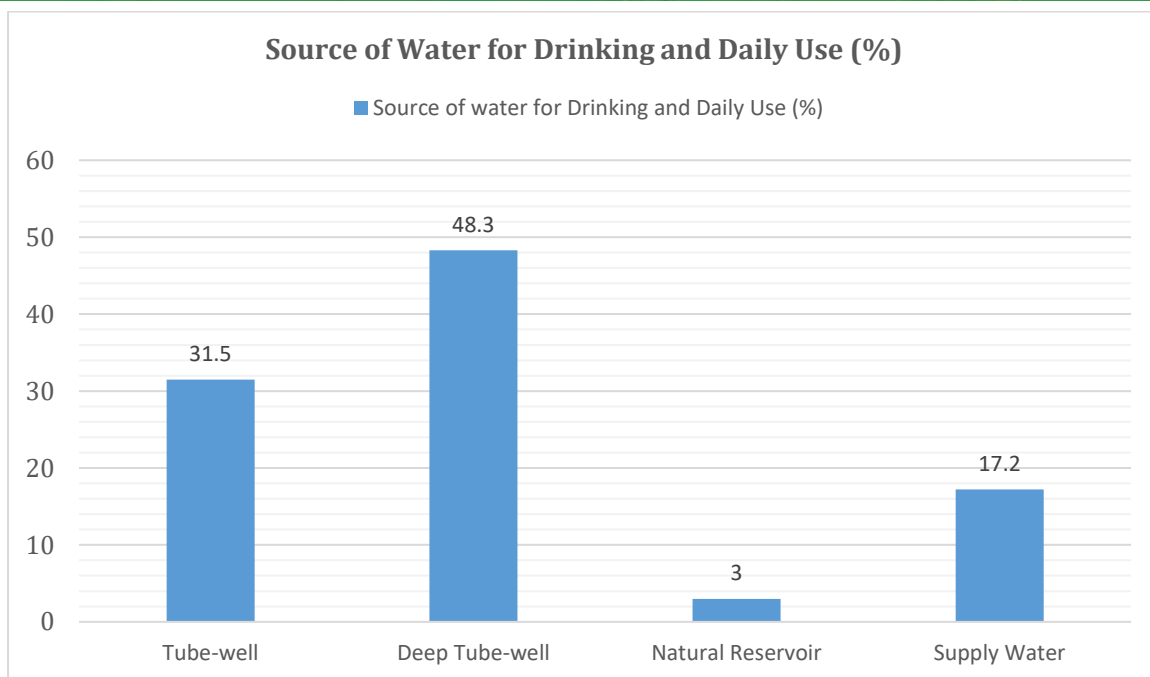


Figure 9-5: Source of Water for Drinking and Daily Use (%)

Understanding the sources of water for drinking and daily use is crucial for ensuring access to clean and reliable water sources. It allows policymakers and organizations to prioritize infrastructure development and maintenance to meet the population's water needs effectively. Additionally, this data can inform water conservation efforts and the implementation of water treatment and purification measures to ensure the safety and quality of water sources.

9.4.5 Type Of Fuel Used at Cooking

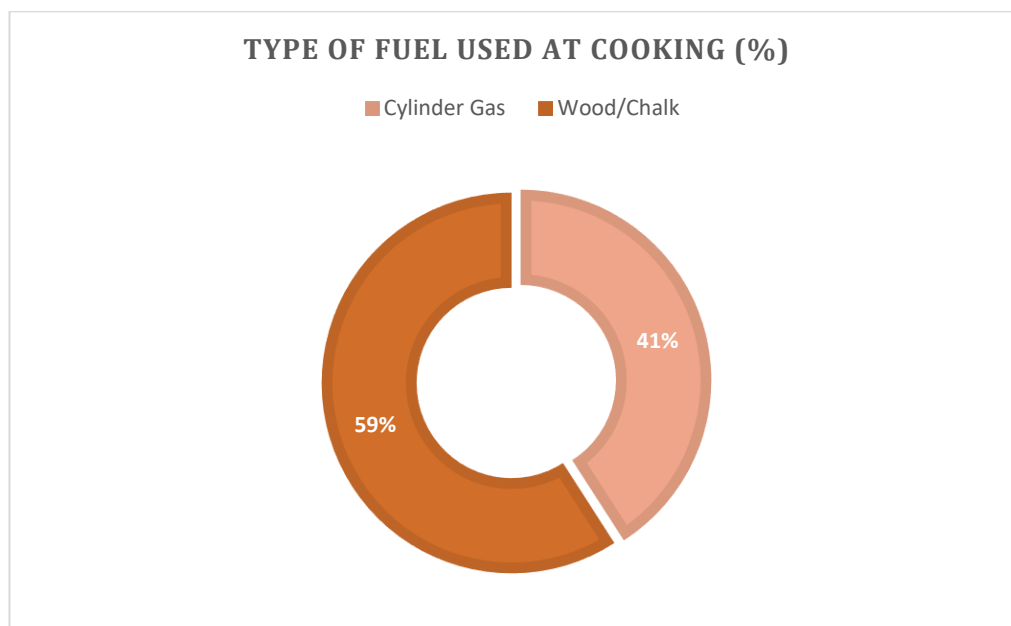


Figure 9-6: Type of Fuel Used At Copoking (%)

The pie chart illustrates the percentage distribution of the type of fuel used for cooking. It reveals that 41% of the population chooses cylinder gas as their preferred fuel, while 59% rely on wood/chalk for cooking. The dominant use of wood/chalk suggests a high reliance on traditional cooking methods, which can have negative implications for health and the environment. This may include indoor air pollution and associated respiratory issues. In contrast, the preference for cylinder gas indicates a level of adoption of cleaner and more efficient cooking practices. This can contribute to reducing indoor air pollution and improving public health outcomes. Efforts should be made to promote the use of cleaner fuels, like cylinder gas, and to address barriers to adoption, including affordability and accessibility, particularly for marginalized communities. Regular monitoring and evaluation of fuel usage patterns can provide valuable insights for designing effective interventions to promote the adoption of cleaner cooking technologies and improve public health. Implementing targeted awareness campaigns and providing incentives for transitioning to cleaner fuels can also be beneficial.

9.4.6 Rate of People that Received Vaccinations

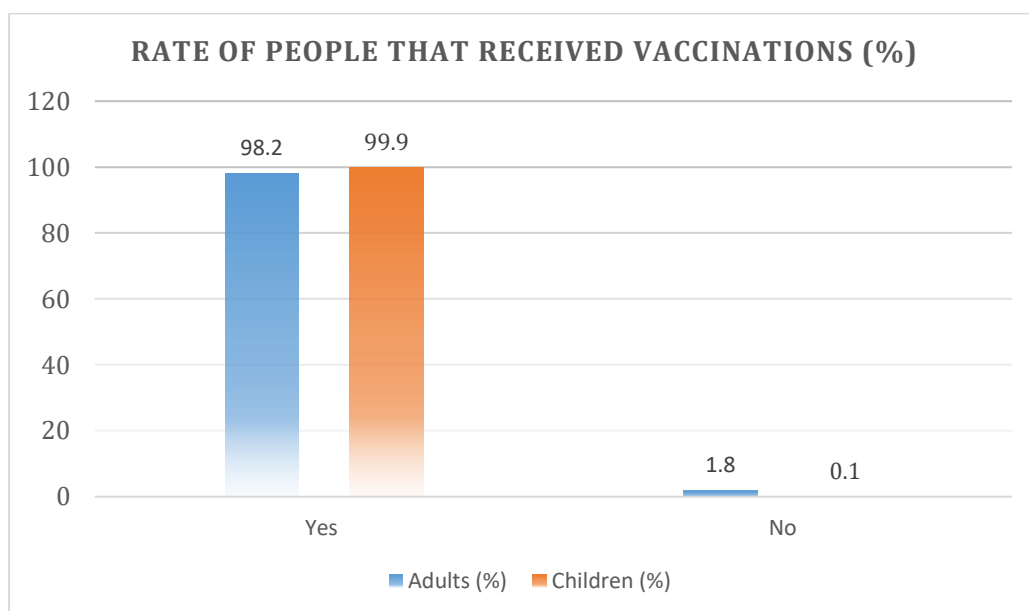


Figure 9-7: Rate Of That Received vaccinations(%)

The bar chart shows the rate of people who have received vaccinations, with 98.2% of adults and 99.9% of children reporting that they have been vaccinated. This indicates that the majority of both adults and children in the population have received vaccinations, highlighting a high level of immunization coverage. On the other hand, 1.8% of adults and 0.1% of children have not received any vaccinations, suggesting a small portion of the population remains unvaccinated. This can pose a potential risk for outbreaks of vaccine-preventable diseases and emphasizes the importance of promoting vaccination programs and addressing barriers to vaccination. The high vaccination rates among both adults and children are positive findings, reflecting the effectiveness of vaccination campaigns and public health efforts in promoting immunization. These rates are also important indicators of the population's overall health and protection against infectious diseases.

However, it is crucial to address the reasons behind the low vaccination rates in certain individuals and communities, as well as to counter any vaccine hesitancy through education and awareness campaigns. Ensuring high vaccination coverage across all segments of the population remains critical to safeguarding public health and preventing the occurrence of vaccine-preventable diseases.

9.4.7 Rate of Enough Facilities of Pharmacy or Medicine

The pie chart shows that 70% of people reported having enough facilities for pharmacy or medicine, while 30% did not have access to adequate facilities. This indicates that the majority of the population surveyed have sufficient resources for obtaining pharmacy services or medicine. The high percentage of individuals reporting access to adequate facilities is a positive finding, as it suggests that the healthcare system is meeting the needs of a significant portion of the population in terms of pharmacy and medicine availability. However, the presence of 17.1% of individuals lacking access to sufficient facilities raises concerns about healthcare inequality and potential barriers to obtaining necessary medications. This could be due to various factors, such as geographic location, socioeconomic status, or limited healthcare infrastructure in certain areas.

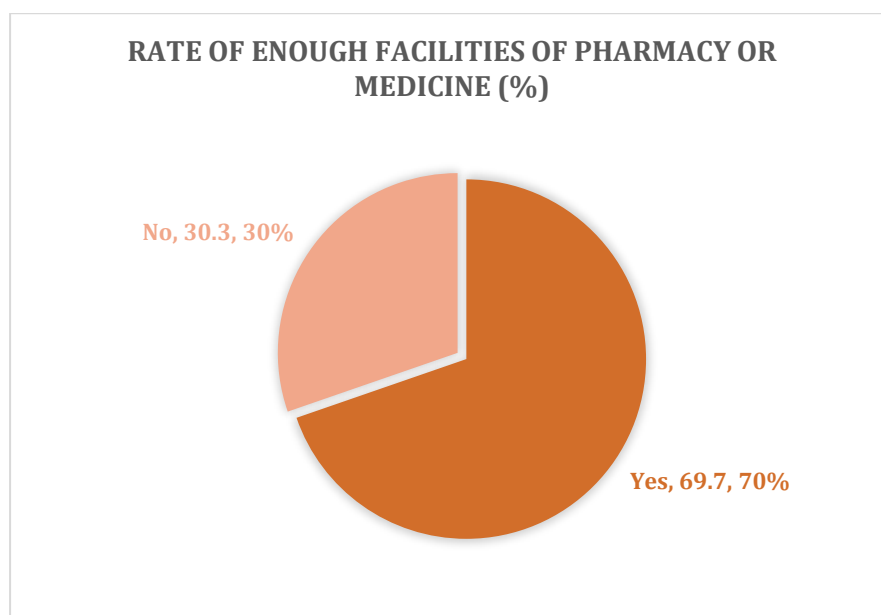


Figure 9-8: Rate Of Enough Facilities Of Pharmacy or Medicine(%)

Efforts should be made to address these disparities, such as improving healthcare infrastructure in underserved regions, increasing the number of pharmacies or medicine distribution centers, and implementing measures to ensure equitable access to essential medications for all segments of the population. Additionally, it is important to investigate the reasons behind the reported lack of facilities and work towards resolving any underlying issues that may be contributing to this disparity. By addressing these gaps in access to pharmacy or medicine facilities, the overall health outcomes of the population can be improved, ensuring that everyone has equal opportunities to receive the healthcare they need.

9.4.8 Rate of Consultation with Doctor

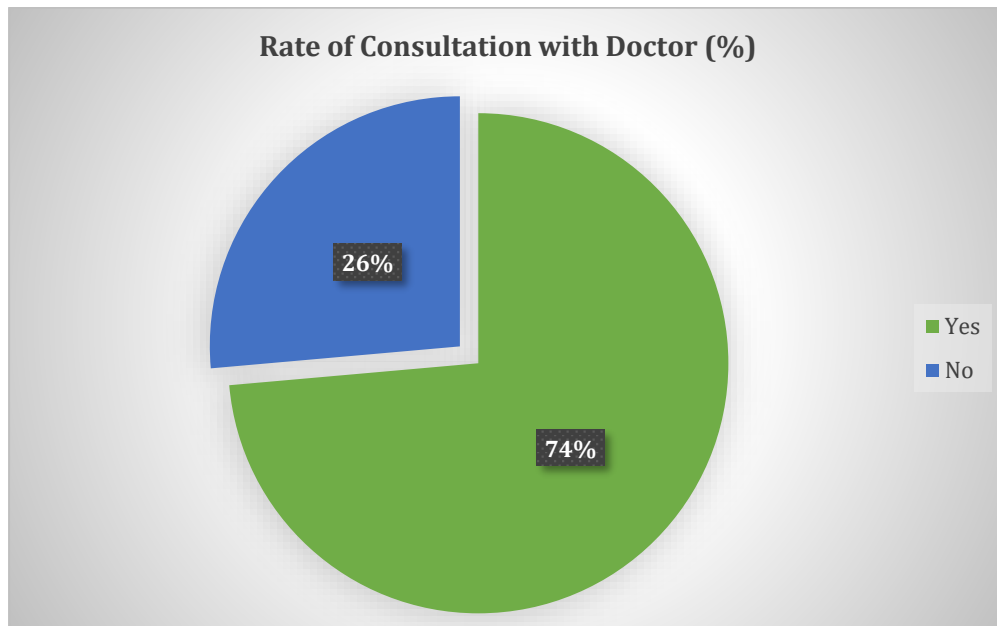


Figure 9-9: Rate of Consultation With Doctor (%)

According to the pie chart, 74% of the population reported having consulted with a doctor, while 26% did not. This indicates that the majority of individuals surveyed have sought medical advice from a healthcare professional. The high rate of consultation with a doctor is a positive finding, as it suggests that a significant portion of the population is actively seeking medical guidance and potentially receiving appropriate treatment. However, the presence of 15% of individuals who have not consulted with a doctor raises concerns about potential barriers to accessing healthcare, such as lack of healthcare facilities, financial constraints, or limited awareness about the importance of regular medical check-ups.

9.4.9 Rate of Arranging Health Campaign

According to the pie chart, only 6.4% of respondents reported arranging a health campaign, while the majority (93.6%) did not. This finding suggests that a small percentage of individuals surveyed have taken the initiative to organize health campaigns in their communities. This low rate of organizing health campaigns may have several implications. It could reflect a lack of awareness about the benefits of organizing such events, limited resources to fund and coordinate

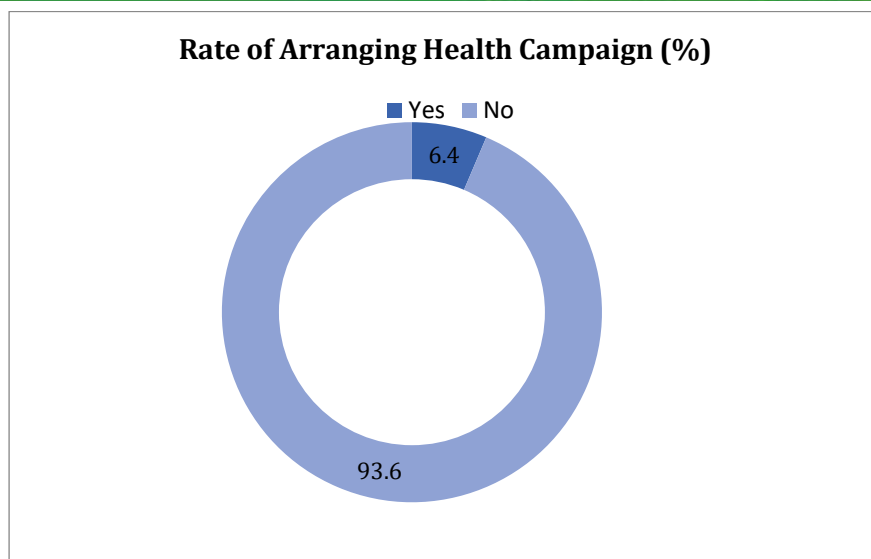


Figure 9-10: Rate of Arrabging Health Campaign

campaigns, or a general disinterest or apathy among the population. Efforts should be made to promote the importance of health campaigns and encourage individuals to take an active role in organizing them. This could include initiatives such as providing education about the benefits of health campaigns, offering support and resources to those interested in organizing events, or implementing policies that incentivize community involvement in health promotion activities. Increasing the rate of arranging health campaigns has the potential to improve public health outcomes by raising awareness, promoting preventive behaviors, and improving access to information and services.

9.4.10 Rate of Arsenic test of Tubewells

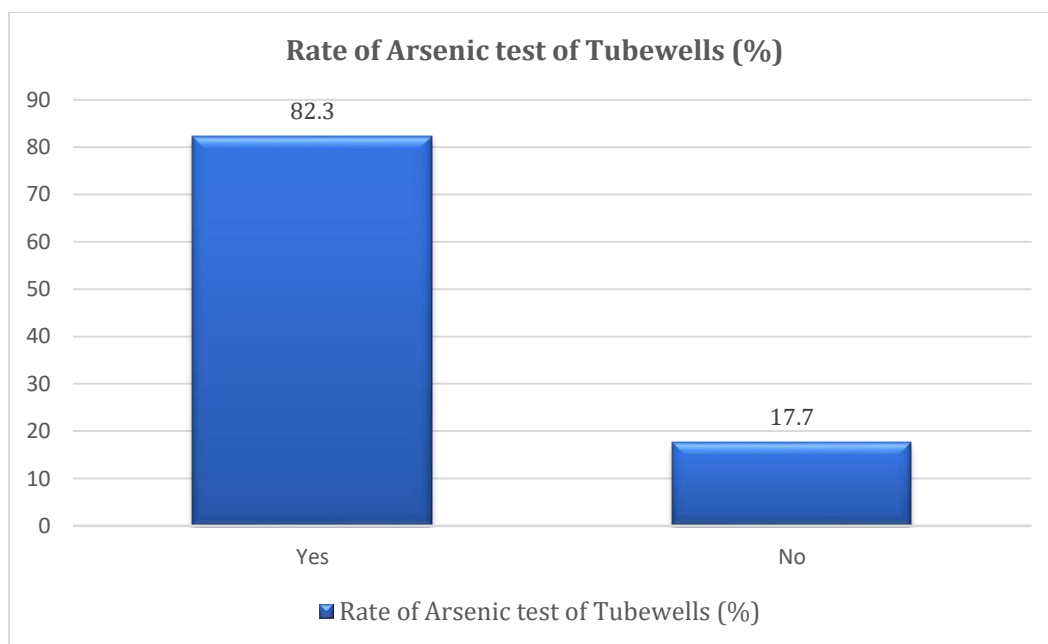


Figure 9-11: Rate of Arsenic Tet of Tubewells (%)

The bar chart shows the rate of arsenic test results for tubewells, indicating that 82.3% of tubewells have tested positive for arsenic while 17.7% have tested negative. This suggests that a significant majority of tubewells may be contaminated with arsenic. Further investigation is needed to determine the overall impact of this contamination on public health and to inform necessary interventions. The high percentage of positive test results highlights the urgency in addressing this issue to ensure the provision of safe and clean drinking water for affected communities.

9.4.11 Rate of Tree Plantation

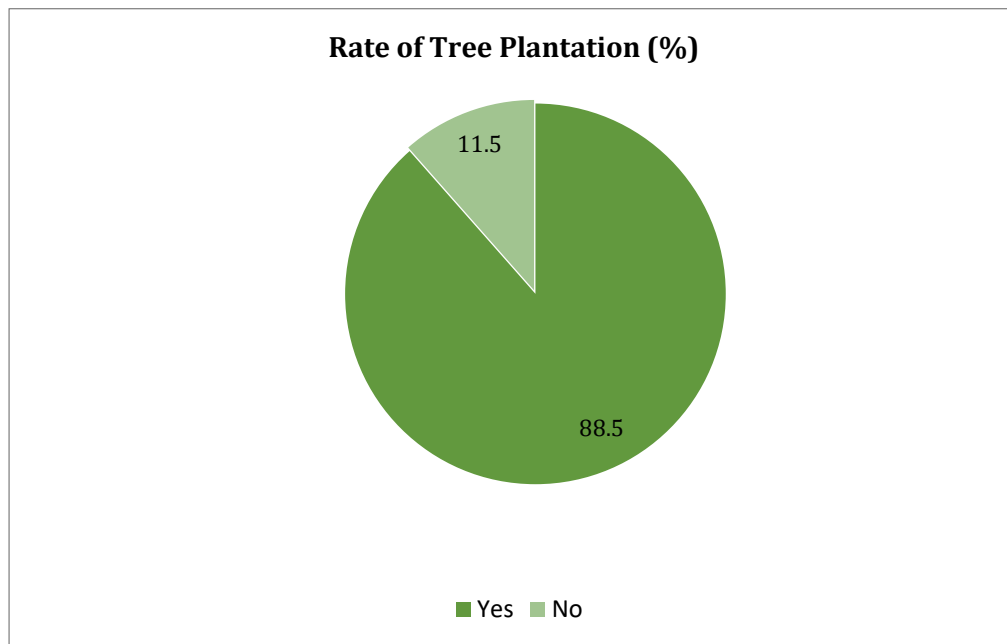


Figure 9-12: Rate of Tree Plantation (%)

The pie chart represents the rate of tree plantation, with a percentage breakdown of Yes and No responses. The analysis reveals that a significant majority, 88.5%, responded positively to tree plantation, indicating a high level of support for the practice. Conversely, only 11.5% responded negatively, suggesting a relatively small group opposed to tree plantation. This data underscores the widespread recognition and acceptance of the importance of planting trees for various environmental and ecological benefits. It also showcases a potential opportunity for further education and awareness initiatives to increase the rate of tree plantation among those who responded negatively.

9.5 Role Of DPHE

The Department of Public Health Engineering (DPHE) in Ramu is instrumental in the improvement of public health and the community's well-being by implementing a diverse array of initiatives that concentrate on the promotion of public health, disease control, and health facilities. The following is a comprehensive examination of the specific functions and contributions of DPHE in these areas: DPHE plays a critical role in the development and maintenance of water supply infrastructure, which includes the construction of pipeline water systems, water treatment facilities, and deep tube wells. These initiatives guarantee that health facilities have access to pure and secure water, which is essential for the prevention of

infections and the provision of patient care. DPHE is responsible for the construction and maintenance of sanitation facilities in health centers, ensuring that patients and personnel have access to hygienic latrines and refuse disposal systems. It is imperative to maintain proper sanitation in health facilities in order to prevent healthcare-associated infections and foster a healthy environment. DPHE implements extensive health education campaigns to increase awareness of water, sanitation, and hygiene (WASH) practices. The purpose of these campaigns is to inform the community about the significance of secure waste disposal, the use of clean water, and the appropriate application of handwashing techniques to prevent waterborne diseases. DPHE implements WASH programs in schools to guarantee that students have access to clean potable water and appropriate sanitation facilities. Educational components are also incorporated into these programs to instruct children on hygiene practices, which they can subsequently implement at home. In order to identify and resolve contamination, the Department of Public Health and Environment (DPHE) conducts routine monitoring of water sources. This entails the examination of pathogens, chemical contaminants, and other hazardous substances. It is imperative to guarantee the availability of safe potable water in order to prevent waterborne diseases, including dysentery, cholera, and diarrhea. In an effort to mitigate the incidence of diseases transmitted by insects, such as malaria and dengue fever, the Department of Public Health and Environment (DPHE) implements vector control measures. These measures encompass the promotion of insecticide-treated nets, the implementation of domestic residual spraying, and the management of reproductive sites. DPHE contributes to the improvement of overall sanitation and the reduction of open defecation by promoting the use of sanitary facilities and constructing and maintaining latrines. This has a direct effect on the reduction of the prevalence of diseases associated with inadequate hygiene and sanitation. DPHE's initiative to promote hygiene extends beyond education to encompass the distribution of hygiene supplies, the implementation of handwashing stations, and community-led total sanitation (CLTS) programs. These initiatives cultivate a culture of health consciousness and hygiene within the community. DPHE provides emergency water and sanitation services in the event of natural calamities, such as flooding. The rapid deployment of mobile water treatment units, the distribution of safe drinking water, and the construction of temporary latrines in displaced persons' communities are all included in this program. In order to guarantee a prompt and efficient response to calamities, the Department of Public Health and Environment (DPHE) creates and executes disaster preparedness plans. These strategies entail the prepositioning of supplies, the training of response teams, and the execution of community exercises. DPHE collaborates with international agencies, non-governmental organizations (NGOs), and other government departments to improve the delivery of WASH services. These partnerships enable the sharing of resources, the acquisition of technical expertise, and the coordination of efforts to enhance public health outcomes. Engaging the local community in the planning and maintenance of water and sanitation initiatives is a critical strategy. DPHE collaborates with community leaders and volunteers to guarantee that initiatives are sustainable and address the unique requirements of the population.

The DPHE in Ramu is instrumental in the improvement of the health infrastructure, the promotion of public health, the control of maladies, and the enhancement of the community's overall well-being as a result of these comprehensive efforts. Their efforts guarantee the

availability and accessibility of critical health services, thereby fostering a more resilient and healthier populace.

9.6 Role of NGOS

In Ramu, non-governmental organizations (NGOs) are instrumental in the improvement of public health, disease control, health facilities, and overall well-being. Their involvement encompasses a wide variety of activities and interventions that frequently complement government initiatives and address service deficits. The following is a comprehensive examination of the functions and contributions of nongovernmental organizations (NGOs) in these regions:

The construction, renovation, and provisioning of health facilities are frequently supported by nongovernmental organizations (NGOs). The provision of essential medical instruments and supplies, as well as the construction of clinics, health posts, and maternity facilities, are all included in this. They provide healthcare providers with training programs to enhance their skills and knowledge, thereby guaranteeing that medical personnel can provide high-quality care. This encompasses specialized training in the administration of chronic diseases, emergency care, and maternal and neonatal health. In order to provide essential medical services, including immunizations, antenatal care, and treatment for common afflictions, to underserved and remote populations, a multitude of nongovernmental organizations (NGOs) operate mobile clinics. They establish community health programs that prioritize the promotion of healthy practices and the prevention of diseases. This encompasses programs such as nutrition programs, reproductive health services, and secure water and sanitation projects. Nongovernmental organizations (NGOs) implement school-based health programs to offer children sustenance support, rudimentary medical services, and health education. The objective of these programs is to enhance the academic performance and overall health of students. Government agencies and nongovernmental organizations (NGOs) collaborate to execute mass vaccination campaigns against diseases such as hepatitis, polio, and measles. These campaigns are essential for the prevention of outbreaks and the achievement of a high level of immunization coverage. Additionally, they frequently deploy rapid response teams to contain and manage these epidemics, and they facilitate the tracking and monitoring of disease outbreaks to assist in disease surveillance. This encompasses the establishment of isolation facilities, the provision of medical supplies, and the implementation of public awareness campaigns during epidemics. Numerous nongovernmental organizations (NGOs) implement initiatives that enhance the economic status of vulnerable populations. Including vocational training, microfinance initiatives, and support for small enterprises, all of which contribute to the enhancement of overall health and quality of life. NGOs frequently establish partnerships with international organizations, as well as local and national administrations, in order to execute health initiatives. These partnerships contribute to the program's overall efficacy, technical expertise, and resource mobilization.

Nongovernmental organizations (NGOs) prioritize the establishment of community organizations and local health systems to ensure that they can independently sustain health enhancements. This encompasses the provision of technical support, training, and resources to local entities.

The health facilities, public health, disease control, and overall well-being of the people in Ramu have been significantly enhanced by the diverse and comprehensive efforts of NGOs. Their initiatives guarantee equitable access to health services, address critical disparities, and contribute to the community's sustainable health enhancements.

9.7 National Health Policy

There are a few national policies in Bangladesh that are dealing with the development of health facilities. Just a handful of them are as follows:

- Health, Population, and Nutrition Sector Development Program (HPNSDP 2011-2016): This is a program that is led by the government and has the objective of enhancing the general health status of the population, particularly women and children, by means of the development of health facilities and services.
- National Health Policy: A strategic framework for the growth of the health sector in Bangladesh is provided by the National Health Policy, which is a fundamental component of the Bangladeshi government. The commitment of the government to providing healthcare services that are both equal and affordable to all citizens is outlined in this document.
- Health Care financing Strategy: The Health Care Financing Strategy is an effort launched by the government with the purpose of enhancing the funding of the health sector in Bangladesh. The objective of the plan is to bring about an increase in the total budget for the health sector and to guarantee that the money is utilized in an efficient and effective manner.
- Health Facilities Improvement Project (HFIP): The Health Facilities Improvement Project is an initiative that is backed by the World Bank and aims to improve the quality of health care in Bangladesh as well as the accessibility of such services. The primary goals of the project are to better manage health services, improve the administration of health facilities, and improve the skills of those who work in the health care industry.
- Essential Service Package (ESP): The Essential Service Package (ESP) is a comprehensive compilation of vital health services that are made available to the general community at no cost.
- In addition to emergency care, the package addresses preventative, curative, and promotional services as well as curative treatments.

In 1996, the Ministry of Health and Family Welfare established a committee with members chosen from various professional groups, technocrats, and bureaucrats in order to prepare a Health Policy. The committee's members were drawn from civil society and professional organizations.

9.8 Physical Planning Implication

Physical planning aspects of public health, disease control and wellbeing of Ramu Upazila primarily focus on designing and managing the built environment – including land use, transportation, housing and green spaces so as to promote health behaviours, prevent disease spread and enhance overall community wellbeing by considering factors such as access to health care, safe walking and cycling routes and minimizing environmental hazards; essentially creating communities that support healthy lifestyles through thoughtful designs.

The factors in the physical environment that are important to health include harmful substances, such as air pollution or proximity to toxic sites (the focus of classic environmental epidemiology); access to various health-related resources (e.g., healthy or unhealthy foods, recreational resources, medical care) and so on. Physical wellbeing is the ability to maintain a healthy quality of life that allows us to get the most out of our daily activities without undue fatigue or physical stress. It relates to a variety of different aspects ranging from sleep and exercise and to nutrition.

The physical aspects of public health, disease control and wellbeing in context of reviewing and updating the master plan of Ramu Upazila are:

- Preparing a stock list of existing locational distribution of related infrastructure and establishments vis-à-vis their accessibilities to the users
- Determination of future requirement considering the population projection of the area concerned
- Determination/adaption of planning standards by hierarchy of facilities and series and availability of land at the concerned sites
- Ensuring accessibility to the proposed educational institutions

9.9 Recommendations and Concluding Observations

A multifaceted and coordinated strategy is necessary to effectively resolve the issues that Ramu faces in terms of health facilities, public health, disease management, and overall well-being. Due to the current circumstances, the subsequent observations and recommendations are proposed as conclusions:

1. Enhancing the Health Infrastructure's Capabilities: At this juncture, it is imperative that Ramu's medical facilities endure both enhancements and additions. The infrastructure of the Upazila Health Complex and other local health centers should be upgraded in its entirety as part of this program. These enhancements should encompass an increase in the quantity of healthcare providers, an enhancement in the quantity of medical supplies, and an enhancement in the overall infrastructure. It is crucial to guarantee that these institutions are adequately staffed and well-stocked with the necessary resources to facilitate the provision of expeditious and effective medical services to the general public.

2. Improving Public Health Initiatives: It is imperative to revive and broaden public health initiatives. This can be achieved by implementing targeted health education initiatives that promote preventative measures, immunization efforts, and maternal and child health services. The community's involvement is of the uttermost significance; therefore, emphasis must be placed on the involvement of local communities in health promotion activities. Furthermore, there is a need to enhance the efficacy and reach of public health programs, particularly in underserved and remote communities.

In order to improve public health initiatives in Ramu, it is imperative to implement a multifaceted strategy that addresses both acute health needs and long-term health determinants. Implementing extensive health education campaigns that prioritize sanitation, hygiene, nutrition, and preventive health measures. Local media, social networks, and community events can be employed to facilitate extensive outreach and engagement. Integrating comprehensive health education into school curricula to instill healthful habits in children at a young age. Disease prevention, nutrition, physical activity, and personal hygiene are among the subjects that should be addressed. Enhancing the quality and accessibility of antenatal and postnatal care services. This includes routine health examinations, nutritional assistance, and childbirth education. Ensure that access to purified, potable water is guaranteed by establishing and maintaining reliable water supply systems. Community-led initiatives may be implemented to ensure the sustainable maintenance of these systems. Enhance and construct sanitation facilities, with a particular focus on rural and underserved areas. Community initiatives, such as Community-Led Total Sanitation (CLTS), are designed to promote the construction of latrines and the implementation of secure waste disposal practices. Creating programs that provide nutritional supplements to at-risk populations, such as the elderly, pregnant women, and infants. These programs should be complemented by nutrition education to encourage the adoption of healthy dietary habits. Organizing community-based fitness programs, such as sports events, exercise courses, and walking societies, to promote physical activity. Increasing the accessibility of preventive health services, which encompasses screenings for prevalent conditions such as hypertension, diabetes, and cancer. Early detection and management can significantly reduce the disease burden. Enhance sanitation, vaccination, and public education initiatives to combat infectious

diseases. It is essential to establish effective disease surveillance systems in order to promptly detect and respond to epidemics.

3. Improving the Effectiveness of Disease Control Measures: In order to enhance the efficacy of disease control, it is necessary to fortify the mechanisms that are employed for disease surveillance and response. To achieve this strategy, it is necessary to invest in a robust epidemiological infrastructure that can promptly detect and respond to disease outbreaks. In order to mitigate the transmission of infectious diseases, it is imperative to enhance sanitation, water supply infrastructure, and vector control programs. In addition, the success of disease control programs should be guaranteed by continuous surveillance and evaluation, which will also enable the implementation of modifications at the appropriate time.

In order to address the community's frequent outbreaks and health challenges, it is essential to improve disease control measures in Ramu. Incorporate disease surveillance systems that are capable of monitoring, compiling, and analyzing health data in real time. This involves providing healthcare professionals with guidance on the utilization of standardized reporting tools to submit cases in a timely and accurate manner. The application of GIS technology to map disease patterns and identify hotspots. This can aid in the more accurate targeting of interventions. Ensuring that existing laboratories are adequately staffed with trained technicians and providing modern apparatus. This will enhance diagnostic capabilities and expedite the identification of pathogens. Improve immunization programs to include all age groups, with a focus on both routine immunizations and outbreak response. Guarantee that vaccines are accessible and available in all regions of Ramu. Organize community awareness campaigns to educate the public on the importance of vaccinations and to dispel any misconceptions or fallacies. Develop health communication strategies that are specifically intended to promote healthy lifestyle choices and raise awareness of preventive measures. Disseminate information through local media, social networks, and community meetings. In order to guarantee that health facilities are capable of accommodating the increased patient volume during epidemics, they should be expanded and upgraded. Improve the accessibility of essential medical supplies and medications.

4. Fostering the Promotion of Mental Health and Well-Being: It is of the utmost need to build mental health services that are both easily accessible and reasonably priced in Ramu, given the high levels of stress and mental health difficulties that are prevalent in the area. The training of healthcare practitioners in mental health care, the expansion of the provision of psychological support services, and the incorporation of mental health into primary healthcare are all included in this. There is a significant potential for programs that aim to improve education, reduce poverty, and promote economic development to make a significant contribution to overall well-being.

To guarantee that primary healthcare practitioners are able to recognize, manage, and refer patients who are experiencing mental health concerns in an appropriate manner, it is vital to equip them with training in mental health care. As part of this, training will be provided on the utilization of standardized screening methods for common mental health illnesses such as anxiety, depression, and stress-related diseases. It is important to incorporate screening for mental health into routine checkups for overall health. The early detection of mental health concerns and the provision of timely treatments can both be facilitated by these means. It is important to establish community-based mental health centers that offer mental health

treatment that is easily accessible and reasonably priced. These centers should offer counselling, psychotherapy, and psychiatric services. Mobile mental health units should be implemented in order to reach places that are underserved and isolated. These units are able to provide mental health services, crisis intervention, and follow-up care to persons who are unable to easily reach static facilities. In order to facilitate the sharing, support, and motivation of persons who have experienced similar things, it is important to establish peer support groups. Support from peers may be an important component in the process of rehabilitation and in the maintenance of mental health. The promotion of mental health awareness and assistance within the community should involve the participation of community leaders and influential members. Religious leaders, officials from the local government, and respected members of the community are all examples of this sort of person.

5. Taking into consideration sociopolitical factors such as: The persistent political instability in Ramu has a significant influence on the health of the general population. Both the development of political stability and the establishment of an atmosphere that is favorable to the activities of health promotion need to be prioritized. It is possible that this will require measures for dispute resolution as well as coordination with local leaders and stakeholders in order to guarantee that health programs will continue to function without interruption.

6. To facilitate improvements in health: it is essential to establish governance and policy frameworks that are very effective. It is imperative that the formulation of policies be aimed towards ensuring that all individuals have equitable access to medical care, protecting the public's health, and promoting well-being. This includes policies that address the socioeconomic determinants of health, such as education, housing, and employment, as well as processes that are transparent and accountable in the management of health care, and policies that provide sufficient funding for health programs.

As a conclusion, it is of the utmost importance to put into action a comprehensive strategy that includes infrastructure, community engagement, disease monitoring, mental health, socio-political stability, and governance. This is necessary in order to improve the health facilities, public health, disease control, and overall well-being of the Ramu population. If these ideas are put into action, Ramu has the potential to make substantial progress towards being a community that is both more resilient and healthier. It is very necessary for the government agencies, healthcare providers, community organizations, and international partners to work together in order to achieve the goal of enhancing the overall quality of life of the people living in Ramu and achieving health results that are sustainable.

Chapter Ten: Environment



CHAPTER TEN: ENVIRONMENT

10.1 Background

The environmental baseline is the existing status of environment around the proposed project site. It has been analyzed through assessment of environmental components like air, water, land, noise, soil, etc. and environmental characteristics like physical, biological and socio-economic status of the study area, within the 10 km radial zone of the project site. Physical environment includes topography, land, soil, meteorology, air, water, noise, etc. and the biological environment includes flora and fauna. Socio-economic environment of the study area includes demography, ethnicity, religion, education and employment opportunity, occupation, income, poverty, social relations, etc. Baseline environmental conditions are based on the data collected from the current studies and the secondary documents from published sources and websites. The baseline provides the basis for assessment of impact (potential changes in the baseline conditions) due to the development of the upazilla.

A physical feature study and a questionnaire survey were conducted to determine the current state of environmental issues in Ramu Upazila. In addition, data on Natural and build environment including air, water, soil has been gathered and presented. Other relevant information about environmental management has also been gathered and presented in the form of maps, tables, images, and other visual aids. The main objectives of conducting environmental management survey are:

- To find out the existing and potential environmental related problems that might affect the urban and rural area.
- To establish a database for preparing environmental management plan for Ramu Upazila.

10.2 Methodology

This study has extensively examined a variety of documents and reports to assess the current environmental conditions and their components in Ramu Upazila.

These documents, including significant ones such as those from the Bangladesh Meteorological Department, Department of Public Health, and Engineering (DPHE), Department of Environment (DoE), and various journals were utilized as secondary sources of information. Following the project's terms of reference, the study also integrates a field survey, collects information from local residents, and conducts interviews with key personnel, including officials in Ramu Upazila.

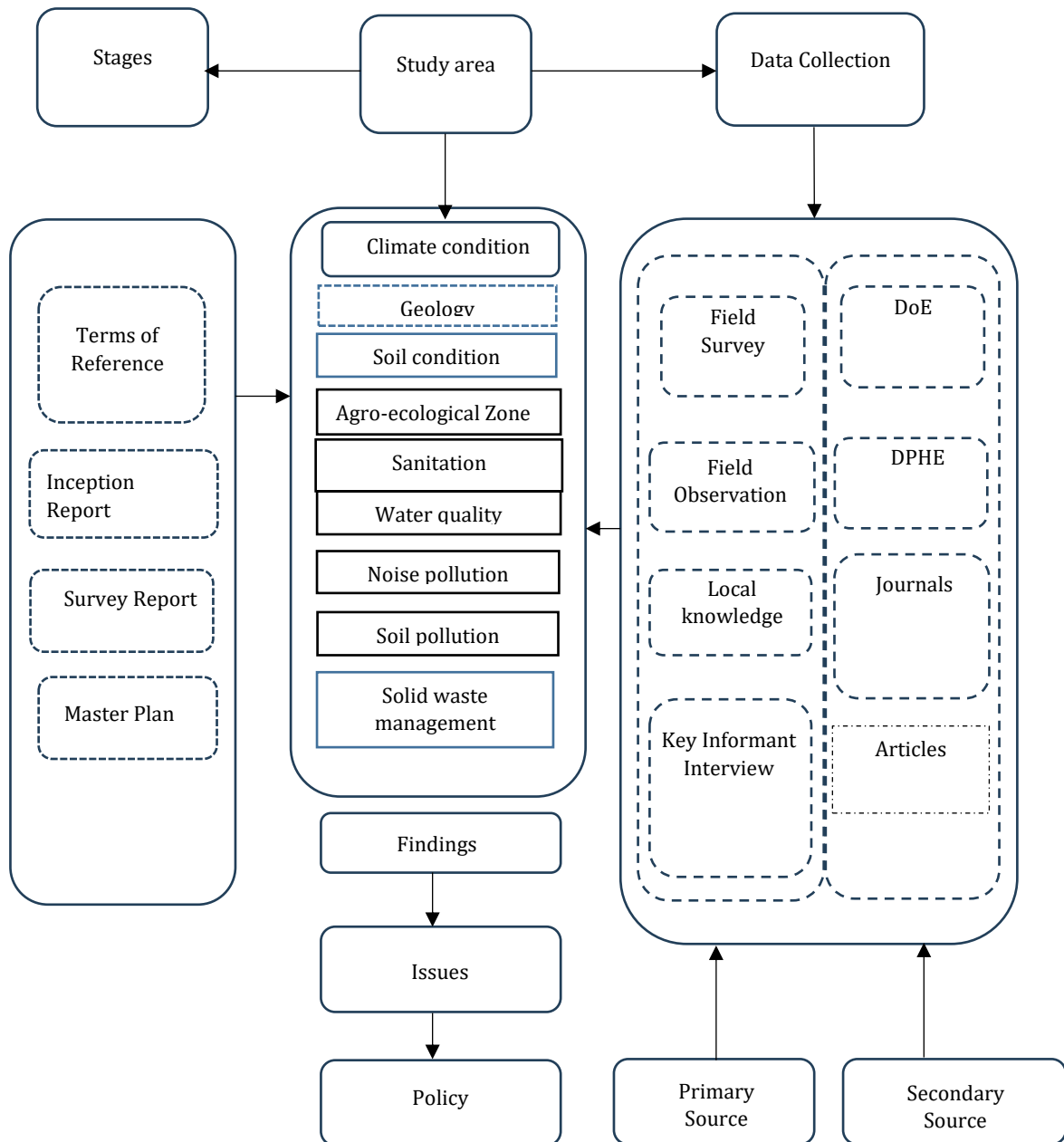


Figure 10-1: Methodological Diagram

10.3 Policy, Rules and Legislation

For the Upazila Town Master Plan and Basic Infrastructure Development Project in Ramu Upazila, several policies, rules, and regulations of Bangladesh need to be considered to ensure that the project aligns with national guidelines and legal frameworks. Below are some key policies, rules, and regulations relevant to urban planning, disaster management, environmental protection, and infrastructure development:

15	Policy/Acts/Rules	Key Provisions
1.	National Environment Policy, 2018	Major elements of the policy are Natural equilibrium provision and overall development of the country through environmental protection and sustainable management

15	Policy/Acts/Rules	Key Provisions
		• Encourage collection and promotion of low carbon emission technology in the country. • Identifying and controlling all types of environmental pollution and degradation activities • Ensure environmental development in all fields • Ensure sustainable, long term, and environmentally friendly use of all-natural resources. • Maintain and streamline the environmental policies and strategies among other policy strategies in the interest of sustainable development. • Ensure the Environmental Impact Assessment and Strategic Environmental Assessment in all necessary sectors. • Actively involved as possible with all international environmental initiatives and take necessary actions at local and national levels.
2.	National Environmental Management Action Plan (NEMAP), 1995	The NEMAP was developed with the following objectives: • to identify key environmental issues affecting Bangladesh. • to identify actions to halt or reduce the rate of environmental degradation. • to improve management of the natural environment. • to conserve and protect habitats and biodiversity. • to promote sustainable development; and • to improve the quality of life.
3.	Environment Conservation Act (ECA), 1995 (with all amendments)	The main objectives of ECA are: • Conservation and improvement of the environment; and • Control and mitigation of pollution of the environment. The main focuses of the Act can be summarized as: • Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried out/ initiated in the ecologically critical areas (ECA); • Regulations in respect of vehicles emitting smoke are harmful to the environment. • Environmental clearance. • Regulation of industries and other development activities' discharge permits. • Promulgation of standards for quality of air, water, noise, and soil for different areas for different purposes. • Promulgation of a standard limit for discharging and emitting waste; and • Formulation and declaration of environmental guidelines.
4.	The Water Act, 2013	The Act recognizes the significance of managing all water resources in the natural flow of surface water and recharge of groundwater. The private landowners will use the surface water inside their property for all purposes per the Act. No individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor will they build any structure that impedes rivers and creeks' natural flow.

15	Policy/Acts/Rules	Key Provisions
		Electrification projects that involve laying cables underground or installing new water pumps could fall under WARPO's purview for ensuring minimal impact on groundwater resources.
5.	Environment Conservation Rules, 1997 (with all amendments)	The Environment Conservation Rules, 1997, were issued by the GOB to exercise power conferred under the Environment Conservation Act (Section 20), 1995. Under these Rules, the following aspects, among others, are covered: • Declaration of ecologically critical areas. • Classification of industries and projects into four categories. • Procedures for issuing the Environmental Clearance Certificate (ECC); and • Determination of environmental standards.
6.	Environment Conservation Rules, 2023	These rules categorize all the industries and projects as well as the types of environmental assessments that should be conducted in relation to each category of industries or projects. The ECR 1997 has been replaced by the ECR 2023 which plays the key role to set the environmental regulatory requirements of any project with the following basic features; • NEQS for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise, and vehicular exhaust; • Categorization of industries, development projects and other activities based on actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load; • Procedure for obtaining ECC; • Requirements for undertaking IEE and EIA's as well as formulating EMP according to categories of industries/ development projects/activities; and • Procedure for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.
7.	Environmental Courts Act, 2000	This Act sets out a policy for effective pursuance and completion of legal proceedings related to environmental crimes. Under this Act, the Director General of the DoE has the power to impose heavy penalties on industrial polluters who are dumping untreated wastewater into the environment or not operating their legally mandated ETPs.
8.	Wetland Protection Act, 2000	The latest Wetland Act -- The Playground, Open Spaces, Gardens, and Wetland Conservation Act 2000 -- suffers from loopholes and inadequacies regarding the protection of water bodies. Section 1 of this Act suggests that it applies to the water bodies of the cities, divisional and district towns, and municipalities. The water bodies in the rural areas are outside the jurisdiction of this Act

15	Policy/Acts/Rules	Key Provisions
9.	The Forest Act (1927) and the Forest (Amendment) Act (2000)	It is the main legislative context for forestry protection and management in Bangladesh. It was enacted to control trespass illegal resources extraction from forests and to provide a framework for the forestry revenue collection system
10.	National Forest Policy (amendment), 1994	The policy is designed to conserve the existing forest areas, bring about 20 % of the country's land area under the Forestation Programme, and increase reserve forests by 10 percent per year to 2015.
11.	The Private Forests Ordinance, 1959	An Ordinance to provide for the conservation of private forests and the afforestation in some wetlands in Bangladesh.
12.	Bangladesh Wildlife (Conservation & Security) Act, 2012 (previously known as Bangladesh Wildlife (Preservation) Order, 1973; amended as Bangladesh Wildlife (Preservation) Act, 1974	This Act protects 1,307 species of plants and animals under four schedules that mandate imprisonment and fines for wildlife poaching, capturing, trapping, and trading.
13.	National Water Policy, 1999	The policy emphasizes efficient and equitable management of water resources, proper harnessing and development of surface and groundwater, availability of water to all concerned, and institutional capacity building for water resource management
14.	National Fisheries Policy, 1999	The National Fisheries Policy focuses on aquaculture and marine fisheries development. The policy suggests, among others, that biodiversity will be maintained in all-natural water bodies and marine environment, and control measures will be taken against activities that harm fisheries, resources, and vice-versa
15.	Protection and Conservation of Fish Act 1950 (Amended 1982)	This is framework legislation with rulemaking powers. Among others, some of these rules may prohibit the destruction of, or any attempt to destroy, fish by the poisoning of water or the depletion of fisheries by pollution, by industrial effluent, or otherwise.
16.	National Agriculture Policy, 1999	This policy aims to make the nation self-sufficient in food through increasing production of all crops, including cereals, and ensure a dependable and secure food system for all
17.	National Land Use Policy, 2001	The main contents of this policy are: • Stopping the high conversion rate of agricultural land to nonagricultural purposes. • Utilizing agro-ecological zones to determine maximum land-use efficiency. • Adopting measures to discourage the conversion of agricultural land for urban or development purposes. • Improving the environmental sustainability of land-use practices.
18.	Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009	This is a comprehensive strategy to address climate change challenges in Bangladesh. Bangladesh Climate Change Strategy and Action Plan built on and expanded the NAPA.
19.	The Acquisition and Requisition of Immovable Property Act 2017 (ARIPA)	It is the principal legislation governing eminent domain land acquisition in Bangladesh. The Act requires that compensation be paid for: (i) land and assets

15	Policy/Acts/Rules	Key Provisions
		permanently acquired (including standing crops, trees, houses); and (ii) any other damage caused by such acquisition. The Act also provides the acquisition of properties belonging to religious organizations like mosques, temples, pagodas, and graveyards if acquired for the public interest. The Ministry of Land (MoL) is the authorized government agency to undertake the process of land acquisition. The MoL partly delegates its authority about the land acquisition to the Commissioner at the Divisional level and the Deputy Commissioner at the District level. The Deputy Commissioners (DC) are empowered by the MoL to process land acquisition under the act and pay compensation to the legal owners of the acquired property. Khas (government-owned land) should be acquired first when a project requires both Khas and private land. If a project requires only khas land, the land will be transferred through an inter-ministerial meeting following the acquisition proposal submitted to DC or MoL. The Government of Bangladesh does not have a national policy on involuntary resettlement. The new Act of 2017 has incorporated specific provisions to address social and economic impacts that were not previously included in the 1982 land acquisition ordinance. Therefore, these provisions under the new law would reduce the gaps between the national legislative framework of the government and AIIB policies.
20.	Public Procurement Rule, 2008	This is the public procurement rules of Bangladesh, and this rule shall apply to the Procurement of Goods, Works or Services by any government, semi-government or any statutory body established under any law. Conditions of service and employment including wages and payment, the establishment of Wages Boards, employment of young people, maternity benefits, working hours, and leave. (i) Safeguard the health and safety of all workers working on the Site and other persons entitled to be on it, and to keep the Site in an orderly state and (ii) Protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of the Contractors methods of operation.
21.	National 3R Strategy for Waste Management, 2010	The National 3R Strategy for waste management has been established by Department of Environment in December 2010. Sector specific strategies for promotion of 3R are depicted in this national 3R strategy. The national 3R goal for waste management is achieve complete elimination of waste disposal on open dumps, rivers, flood plains by 2015 and promote recycling of waste through mandatory segregation of waste at source as well as create a market for recycled products and provide incentives for recycling of waste.
22.	Cultural Heritage	The Antiques Law of 1968 consolidates all laws relating to the preservation and protection of antiquities under the auspices of the Department of Archaeology. The law

15	Policy/Acts/Rules	Key Provisions
		empowers the Director of the Department of Archaeology to take steps necessary for antiquity's custody, preservation, and protection. The Environment Conservation rules (1997) state that GoB will consider the presence of human habitat, ancient monuments, or archeological sites, among other factors, in declaring an area as ecologically critical.
23.	Bangladesh Labor Act (Amendment), 2013	The Bangladesh Labor Act (Amendment) Bill was enacted by parliament in 2013, to make the present legislation more time-appropriate for workers' wellbeing. The bill was approved with the conditions of legalizing trade unions in factories, assuring worker safety at work, establishing mandatory group insurance, and prohibiting children from working in dangerous environments.
24.	The Building Construction Act 1952 (with subsequent amendments)	An Act to provide for the prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh
25.	Electricity Rules 2020 (Amendment on 2022)	Electricity Rules have been amendment on 10 February 2022 and published by the ministry on November 2020 based on Clause 59 of Electricity Act 2018 (SRO 297 of Act/2020). The main observation is to provide compensation for the installation of transmission line towers to the landowners as per the applicable laws and policy. As per this policy BREB shall ensure to provide compensation to project affected persons (PAPs) according to the rules.
26.	GoB 8 th Five Year Plan, 2021-25	The preparatory process of the 8 th Five Year Plan is marked by the infestation of major global catastrophe 'COVID-19', which has caused consequential economic conundrum across the world. The Eighth Five Year Plan is unique compared to its preceding two plans as it blends the COVID-19 recovery strategies in the macroeconomic framework as well as developing sectoral strategies in the plan
27.	Water Resource Planning Act, 1992	An Act was made to ensure the development and balanced use of water resources. The Institution shall have the following functions, namely. • To conduct the general planning of environmentally balanced water resources for the purpose of developing water resources. • To determine the national means and methods for the scientific utilization and preservation of water resources. • To give advice to other institutions involved in the development, utilization and preservation of water resources.
28.	Power System Master Plan, 2016	To show the targets and approach in the Energy and Power Sectors in order to achieve Bangladesh's national goal: to achieve VISION2041 and become a high-income country by 2041.

15	Policy/Acts/Rules	Key Provisions
29.	National Water Management Plan, 2001 (Approved in 2004)	The plan provides a framework within which all concerned with the development, management, and use of water resources water services in Bangladesh can plan and implement their own activities in a coordinated and integrated manner. The planned activity programs have been presented in the eight sub-sectoral clusters: i) Institutional Development, ii) Enabling Environment, iii) Main River, iv) Towns and Rural Areas, v) Major Cities; vi) Disaster Management; vii) Agriculture and Water Management, and viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programs.
30.	E-waste management Rules 2021	On June 10, 2021, Bangladesh's Department of Environment (DOE) published the Hazardous Waste (e-waste) Management Rules, 2021 under the Bangladesh Environmental Protection Act, 1995. The main provisions of this regulation are as follows. - Registered manufacturers, recyclers, etc. shall obtain environmental clearance in accordance with the Bangladesh Environmental Protection Rules, 1997. - Manufacturers have to establish individual or joint collection centers and set aside funds for the management of WEEE.
31.	Solid Waste Management Regulations 2021	The Solid Waste Management Regulations 2021 were published in Bangladesh on December 23, 2021, under the Bangladesh Environmental Protection Act, 1995. The Regulations define the responsibilities of businesses involved in solid waste management and impose collection, recycling, and disposal obligations according to Extended Producer Responsibility (EPR) on manufacturers of non-biodegradable products such as glass, plastic, and bottles. The Regulations also include provisions for the treatment of solid waste such as composting and energy recover
32.	Air Pollution (Control) Rules 2022	The Rule has been formulated with the objective of preventing, controlling and reducing air pollution in order to protect the environment and public health. This is applicable to air pollution control for any development activities in the project area.
33.	Ecological Critical Area Rules, 2016	The Government framed the Ecologically Critical Areas (ECA) Rules, 2016 for the proper management and development of the ECAs in Bangladesh. The development of upazila must comply with the requirements.
34.	Deltaic Plan 2100	The Bangladesh Delta Plan (BDP) 2100 is a broad-based long-term vision about the likely changes and necessary intervention to make the Bangladesh Delta a safe by the end of the 21st Century. Implementation of the UDD masterplan will respon to the sector specific requirements of the Deltaic Plan.
35.	Bangladesh Fire Service and Civil Defense Act, 2013:	This is the comprehensive law that established the legal framework for fire prevention, firefighting, and civil defense in Bangladesh.

15	Policy/Acts/Rules	Key Provisions
36.	The National Plan for Disaster Management (NPDM) 2021-2025	The NPDM outlines the strategies and actions needed to reduce disaster risks and enhance resilience across the country. It emphasizes the importance of integrating DRR into urban planning, particularly in hazard-prone areas like Ramu Upazila, and promotes community-based disaster management approaches.
37.	The Agricultural Land Protection and Land Use Act, 2017	This act aims to protect agricultural land from unplanned urbanization and industrialization, ensuring that agricultural productivity is not compromised by development. It restricts the conversion of agricultural land to non-agricultural uses without proper assessment and approval, prioritizing the protection of fertile land.

10.4 Review of Existing Environmental Condition

In identifying, predicting and evaluating impacts, it is necessary to establish a baseline of environmental quality in the area of the project's site. For many components of the environment, the baseline environmental quality is assessed by conducting field investigations within an impact zone. The environmental and social assessment was based on findings field survey, environmental quality testing and public consultations and several focus group discussions (FGDs), secondary data from sources such as Population and Housing Census 2022 and Population and Housing Census 2011. Public consultation was held to discuss issues and concerns related to the environment and socio-economy. Social-survey and disclosure was conducted to collect information on environmental and social risks and impacts of Projects.

10.4.1 Physical Environment

10.4.1.1 Topography

The terrain of Ramu Upazila is a mix of flatlands and undulating landscapes, with low-lying areas that are susceptible to flooding, especially during the monsoon season. The hilly areas towards the east are part of the Chittagong Hill Tracts, which gradually rise as one moves closer to the Myanmar border.

General Landscape

- **Terrain:** Ramu Upazila exhibits a mix of low-lying flatlands and gently undulating terrain. The region is predominantly flat, with slight elevations towards the east where it borders the Chittagong Hill Tracts.
- **Elevation:** The average elevation of the area ranges between 3 to 15 meters above sea level. The lower elevation areas, particularly near the Bakkhali River and other water bodies, are more prone to flooding, especially during the monsoon season.
- **Water Bodies:** The landscape is interspersed with several rivers, canals, and ponds. The Bakkhali River is the most prominent watercourse, flowing through the heart of Ramu Upazila and influencing the local hydrology.

Hilly Areas

- **Eastern Hilly Region:** The eastern part of Ramu, bordering the Chittagong Hill Tracts, features low hills that gradually rise as one moves closer to the hilly terrains of the region. These hills are not particularly high but are significant in terms of their impact on local microclimates and biodiversity.

- **Soil Erosion:** The hilly areas are prone to soil erosion, especially during the rainy season. Deforestation and unsustainable agricultural practices can exacerbate this issue, leading to loss of topsoil and degradation of the land.

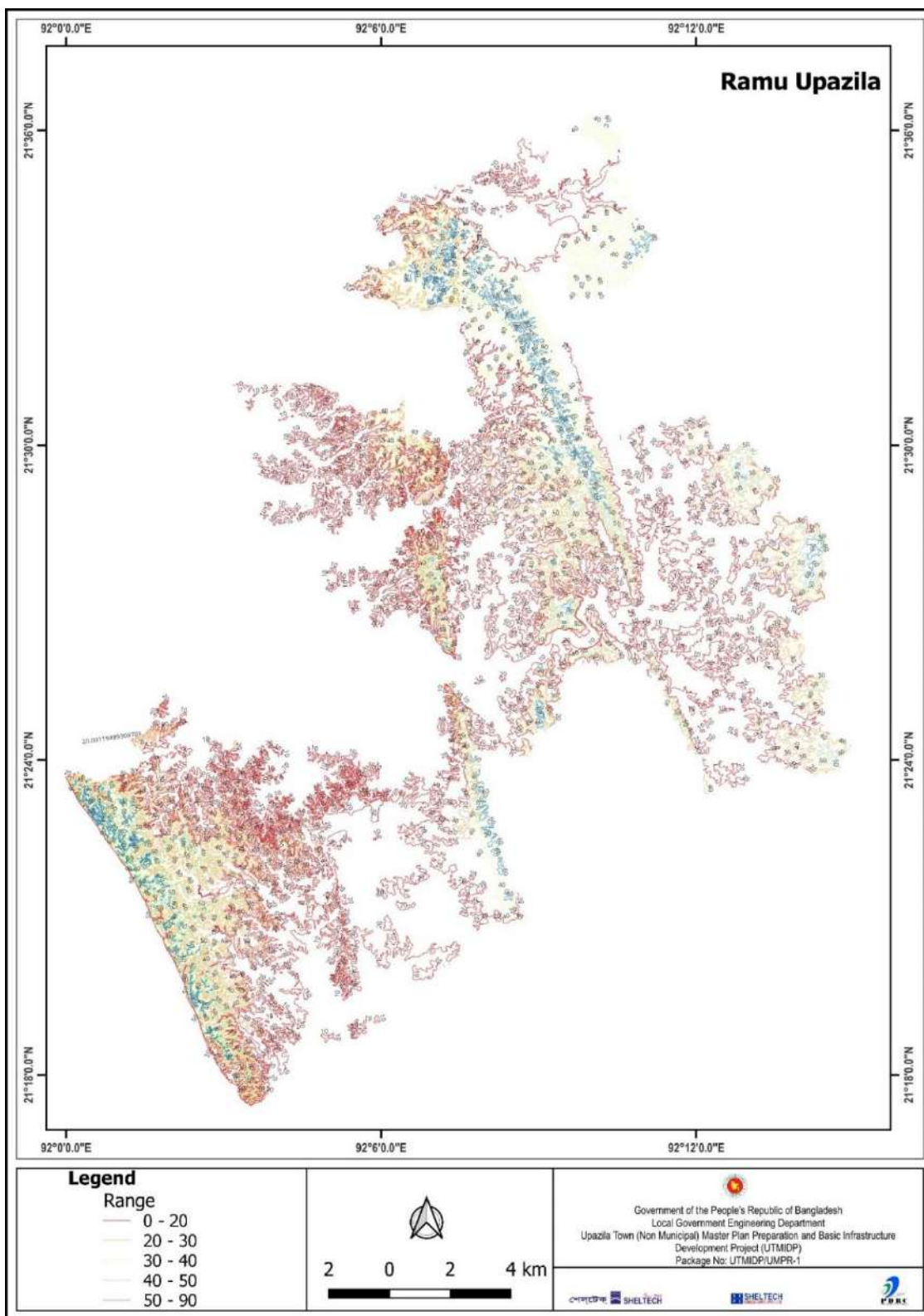


Figure 10-2: Topography map of Project Area, Ramu Upazila

10.4.1.2 Geology

Geology is the field of study concerned with the solid Earth. Included are sciences such as mineralogy, geodesy, and stratigraphy

The greater part of Bangladesh is covered by alluvium deposited by three mighty rivers, the Ganges, the Meghna and the Brahmaputra and their large number of tributaries. The Bangladesh part of the Bengal basin is divided into three main structural units. These are-

- Pre-Cambrian Platform or the Buried Indian Shield.
- The Deeper Basin (Bangia Foredeep)
- The Folded Flank of the Chittagong Trough.

The Pre-Cambrian Platform is separated from the Deeper Basin by the Eocene Hinge Based on geological, geophysical and drill well data of Petro Bangla, the Deeper Basin is subdivided into three big depressions.

Ramu Upazila, located in the Cox's Bazar District of southeastern Bangladesh, is part of the Chittagong Division. The geological setting of Ramu can be understood in the context of the broader geological framework of the region, which includes several key feature:

Bengal basin

Ramu lies within the Bengal Basin, one of the largest and most active sedimentary basins in the world. This basin is characterized by thick sequences of sedimentary rocks deposited primarily by the Ganges-Brahmaputra-Meghna river system.

Geological formation

The area predominantly features Quaternary alluvial deposits, which are relatively young geological formations (less than 2.6 million years old) consisting mainly of sands, silts, clays, and gravels. The older Tertiary formations, which include sedimentary rocks like sandstones, shales, and siltstones, are found in the nearby hilly regions. These formations are a result of the deposition from ancient river systems and marine environments.

Tectonics

The region is part of the eastern extension of the Indian Plate. It is influenced by the tectonic activity associated with the collision between the Indian Plate and the Eurasian Plate, which has given rise to the Himalayan orogeny and affects the overall geological stability of the region.

This tectonic setting contributes to the seismic activity in the region, making it prone to earthquakes.

Geomorphology

The landscape of Ramu is a mix of flat alluvial plains and rolling hills. The plains are primarily used for agriculture, supported by the fertile alluvial soils.

The hilly areas, which are part of the Chittagong Hill Tracts, have a more complex geology with older rock formations and are subject to erosion and landslides.

Hydrology

The area is traversed by the Bakkhali River and other smaller streams, which play a significant role in shaping the local geomorphology and supporting the region's agriculture.

10.4.1.3 Land Use

Agricultural Land

- **Paddy Fields:** The vast majority of land in Ramu is dedicated to agriculture, with paddy fields being the most common land use. The fertile alluvial soils of the floodplains support the cultivation of multiple rice crops per year.
- **Betel Leaf Cultivation:** Ramu is renowned for its betel leaf production. This crop is grown in well-shaded areas, often intercropped with other plants or under specially constructed shades.
- **Vegetables and Fruits:** In addition to rice and betel leaves, a variety of vegetables and fruits are grown, including eggplant, tomatoes, chilies, bananas, and papayas. These crops are usually cultivated in small plots by individual farmers.

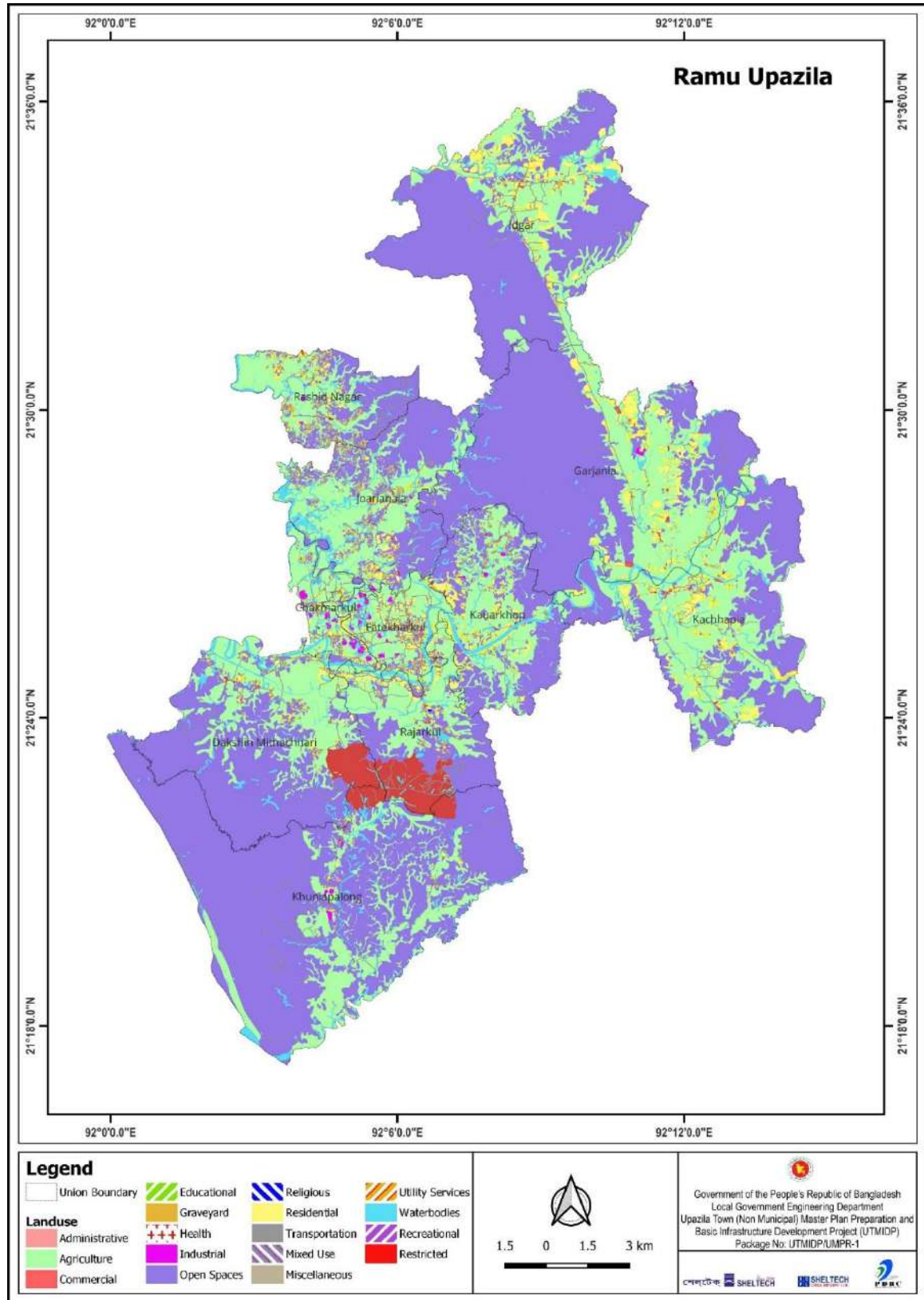


Figure 10-3: Land Use map of Project Area, Ramu Upazila

Water Bodies

- **Rivers and Canals:** The Bakkhali River and its tributaries, along with numerous canals, are vital for irrigation, fishing, and transportation. These water bodies also contribute to the region's natural beauty and are central to the local ecosystem.
- **Ponds and Fish Farms:** Many farmers in Ramu utilize small ponds for fish farming, which is a significant supplementary income source. These ponds are often integrated into the agricultural landscape, providing water for irrigation and contributing to the local food supply.

Forested Areas

- **Mangrove Forests:** Along the coastal and riverine areas, remnants of mangrove forests can still be found. These forests are crucial for protecting against coastal erosion and providing habitat for various species of fish and birds.
- **Deciduous Forests:** In the hilly areas, patches of deciduous forests remain, though much of the original forest cover has been reduced due to agricultural expansion and human settlement.

Residential and Urban Areas

- **Villages:** The majority of Ramu's population lives in rural villages scattered throughout the Upazila. These villages are typically located on slightly elevated ground to avoid floodwaters and are surrounded by agricultural land.
- **Urbanization:** While Ramu is primarily rural, there are small urban centers where markets, administrative offices, and other facilities are located. Urbanization is limited but gradually increasing, particularly along major roads and near the Upazila headquarters.

Infrastructure Development

- **Road Networks:** The road network in Ramu is relatively well-developed, with both paved (pucca) and unpaved (katcha) roads connecting villages to market centers and the Cox's Bazar district town. However, many roads are vulnerable to flooding during the rainy season.
- **Bridges and Culverts:** Numerous small bridges and culverts span the rivers and canals, ensuring connectivity even during the monsoon. The maintenance of these structures is critical to prevent disruptions in transport and communication.

10.4.1.4 Climate:

The climate of Ramu is tropical, characterized by high temperatures and significant rainfall. The monsoon season, from June to September, brings heavy rains, often leading to flooding in low-lying areas. The winter season is mild and dry, with temperatures ranging from 12°C to 20°C.

Temperature Trends

Historical Temperature Data: Over the past few decades, Ramu Upazila has experienced a gradual increase in average annual temperatures. Data from the Bangladesh Meteorological Department (BMD) indicates that the average temperature in the region has risen by approximately 0.5°C to 1.0°C over the last 30 years.

Seasonal Temperature Variations:

- **Summer (March to June):** Summers are typically hot and humid, with average temperatures ranging from 28°C to 34°C. The hottest months are April and May, with peak temperatures occasionally reaching 38°C to 40°C.
- **Monsoon (June to September):** The monsoon season sees slightly lower temperatures due to cloud cover and frequent rainfall, with averages between 26°C and 30°C.
- **Winter (December to February):** Winters are mild and dry, with average temperatures ranging from 12°C to 20°C. However, minimum temperatures can occasionally drop to 10°C during cold spells.
- **Heat Waves:** The frequency and intensity of heatwaves in Ramu have increased, particularly in the pre-monsoon period. These heatwaves have significant impacts on agriculture, water resources, and human health.

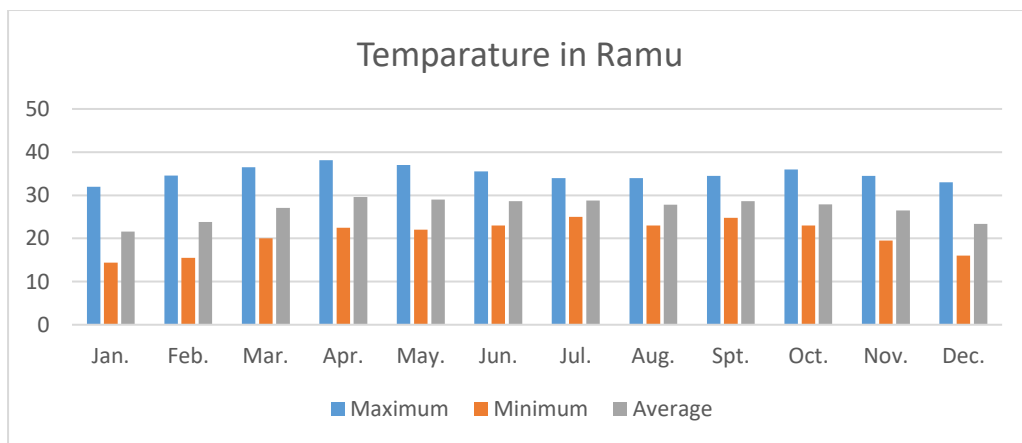


Figure 10-4: Temperature trend in Cox's bazar

The average, maximum and minimum temperature data of 2023 collected at Cox's bazar weather station of Bangladesh Meteorological Department. The temperature trend in Ramu throughout 2023 reveals a distinct seasonal pattern. The hottest months are April, May, and June, with maximum temperatures reaching around 40 degrees Celsius. In contrast, December and January are the coldest months, with minimum temperatures dropping to approximately 10 degrees Celsius. The transitional months of March, August, September, and October exhibit more moderate temperatures. The significant difference between maximum and minimum temperatures indicates a wide temperature variation throughout the year. The average temperature line shows that Ramu experiences a warm climate overall, with average temperatures ranging from 20 to 30 degrees Celsius. These seasonal variations can impact agriculture, tourism, and energy consumption.

Precipitation Patterns

- **Annual Rainfall:** Ramu receives an average annual rainfall of around 3,000 to 3,500 millimeters, with significant year-to-year variability. The majority of the rainfall occurs during the monsoon season, which accounts for nearly 80% of the total annual precipitation.
- **Monsoon Onset and Duration:** The monsoon typically begins in late May or early June and continues until September. However, the onset and duration of the monsoon

have become more erratic in recent years, with delayed starts and extended periods of heavy rainfall.

- **Intense Rainfall Events:** The frequency of intense rainfall events, where over 100 millimeters of rain falls within a 24-hour period, has increased. Such events lead to flash floods, landslides in hilly areas, and waterlogging in low-lying regions.
- **Dry Season:** The dry season, from November to February, is characterized by minimal rainfall, leading to water scarcity and challenges in maintaining agricultural productivity. This season has shown a slight decrease in rainfall over the past decades.
- The recorded table remains uniform across all locations in Cox's Bazar District. The figures indicate that the annual rainfall of Cox's Bazar District.

Table 10-1: Monthly & Yearly Total Rainfall in mm of Cox's Bazar District

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Spt	Oct	Nov	Dec	Annual
2014	0	29	1	4	139	677	717	611	264	41	0	0	2483
2015	10	0	16	72	96	1573	1400	657	618	207	40	27	4716
2016	0	0	25	22	359	538	1113	472	309	418	41	0	3297
2017	0	0	216	361	143	541	1437	531	524	149	13	36	3951
2018	26	0	0	56	172	984	1246	398	341	395	8	8	3634
2019	0	12	82	16	98	225	951	412	628	256	80	0	2760
2020	27	1	0	56	189	936	934	1068	426	430	34	0	4101
2021	0	0	0	46	160	731	1097	995	206	208	0	39	3482
2022	8	30	4	52	237	726	167	328	412	85	0	15	2064
2023	0	0	30	53	154	335	251	872	278	317	95	5	2390

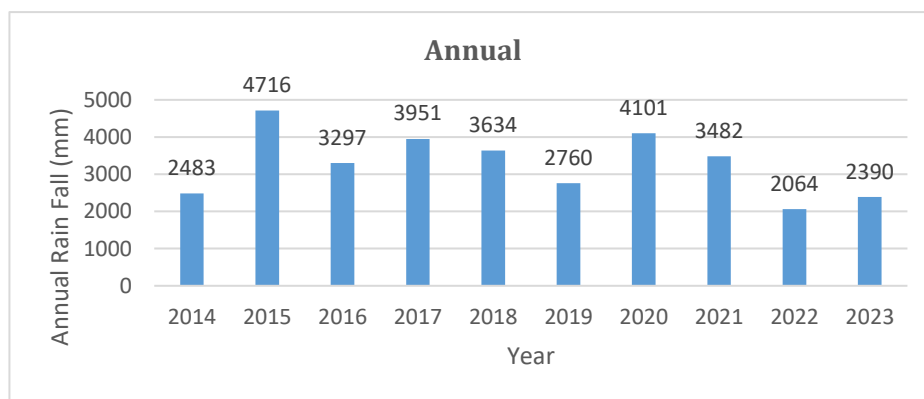


Figure 10-5: Average Annual Rainfall in Cox's Bazar District

The average annual precipitation in the study area reveals a decreasing trend during the 2000 to 2022 period, as illustrated in Figure. In 2000, the average precipitation measured 235.5 mm, and by 2022, it had dropped to 160 mm. Over this two-decade timeframe, the average precipitation witnessed a decline of 65.5 mm, indicating an annual reduction of 3.09 mm in the study region.

Humidity

Humidity is a quantity representing the concentration of water vapour in the atmosphere or in a gas. When there's lots of water vapour present in the air, humidity is high, and the higher the humidity, the wetter it'll feel outside.

Humidity is influenced by the temperature and the pressure of the environment being measured. A fixed quantity of water vapour will result in higher humidity in cool air than it will in warm air. Plus, as the temperature increases, so does the amount of water vapor required to reach saturation. There are three main measurements of humidity: absolute, relative and specific. The table indicate the annual humidity of Cox Bazar district.

Table 10-2: Monthly and Yearly Humidity in Cox.s Bazar

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
2014	73	71	73	76	79	86	85	88	84	79	77	76	78
2015	76	71	69	80	78	88	91	87	86	84	79	77	80
2016	74	76	75	77	79	82	89	86	84	82	78	77	79
2017	68	67	76	81	78	85	89	87	87	83	76	76	79
2018	72	71	75	74	79	87	90	87	85	85	75	72	79
2019	69	68	72	75	76	82	89	85	85	81	76	71	77
2020	73	67	66	75	77	86	88	88	85	82	77	72	78
2021	67	69	71	75	75	88	88	88	83	83	70	72	77
2022	73	65	70	76	80	86	82	83	85	79	72	70	76
2023	67	68	66	71	77	83	83	89	85	81	75	75	76

(Source: Bangladesh Meteorological Department, 2023)

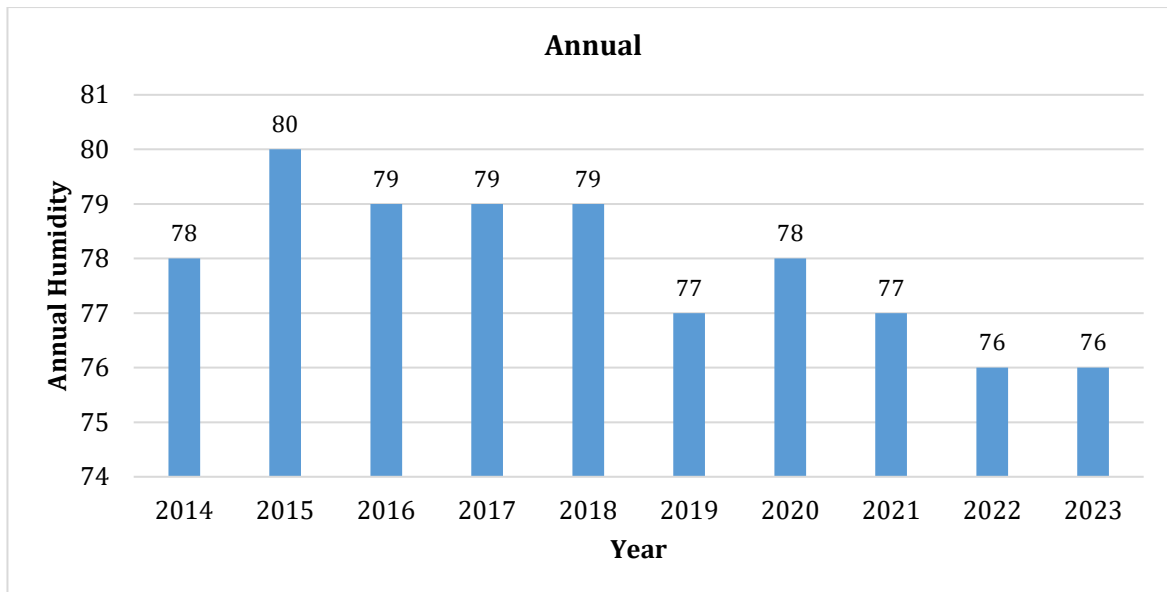


Figure 10-6: Average annual Humidity trend at the study area from 2000 to 2022

A general trend observed in the graph is a relatively consistent level of humidity throughout the decade. The annual humidity values fluctuate within a narrow range, primarily between 76% and 80%. There is no significant upward or downward trend, suggesting a relatively stable humidity environment in Dhaka during this period.

However, slight variations can be noted year-to-year. For instance, in 2015, the humidity reached its highest point at 80%. Conversely, 2022 and 2023 experienced the lowest humidity levels at 76%. These minor fluctuations are likely influenced by various meteorological factors, such as rainfall patterns, wind direction, and temperature variations.

Wind Speed

The recorded data remains uniform across all areas in Ramu Upazila. Upon analyzing the wind speed in Ramu Upazila over a span of 20 years, it was observed that the minimum wind speed recorded was 1 m/s in 2000, while the maximum wind speed reached 3.45 m/s in 2019. The average wind speed in that locality is approximately 1.5 m/s. The usual wind speed in the study area is being disturbed due to several cyclones such as Sidr, Fani, Bulbul, Amphan, Yaas, and Sitrang.

10.4.1.5 Soil Types

The soil in Ramu is predominantly alluvial, making it fertile for agriculture. The area is known for its paddy fields, betel leaf plantations, and various vegetables. However, the fertility can be challenged by salinity intrusion from the Bay of Bengal and soil erosion in hilly areas.

Alluvial Soils

- **Description:** The predominant soil type in Ramu is alluvial, deposited by the rivers that flow through the region, such as the Bakkhali River. These soils are generally fertile, with a good mix of sand, silt, and clay, making them ideal for agriculture.
- **Fertility:** Alluvial soils in Ramu are highly fertile, supporting the cultivation of a wide variety of crops. The high nutrient content and good water-holding capacity of these soils are particularly favorable for paddy cultivation, which is the main agricultural activity in the area.
- **Challenges:** Despite their fertility, alluvial soils in Ramu can be prone to challenges such as waterlogging during the monsoon season, which can affect crop yields. Additionally, these soils are vulnerable to erosion, particularly in areas near riverbanks and in regions with hilly terrain.

Coastal Soils

- **Description:** In the coastal areas of Ramu, the soil tends to be more saline due to the influence of seawater from the Bay of Bengal. These soils are typically sandy or loamy, with varying levels of salinity depending on their proximity to the coast.
- **Salinity Issues:** The salinity in these coastal soils poses a significant challenge for agriculture. High salt concentrations can inhibit plant growth, reduce crop yields, and limit the types of crops that can be grown.
- **Management Practices:** Farmers in coastal areas often employ various soil management practices to mitigate salinity, such as flushing soils with fresh water, using salt-tolerant crop varieties, and applying organic matter to improve soil structure and reduce salinity levels.

Hilly and Eroded Soils

- **Description:** The eastern part of Ramu Upazila, which borders the Chittagong Hill Tracts, has hilly terrain with soils that are more prone to erosion. These soils are generally shallow and less fertile, with a higher content of gravel and stones.

- **Erosion Issues:** Soil erosion is a significant problem in the hilly areas, particularly during the monsoon season when heavy rains can wash away topsoil. This erosion reduces soil fertility and affects agricultural productivity.
- **Conservation Efforts:** Efforts to conserve soil in these areas include terracing, afforestation, and the use of contour plowing to reduce runoff and prevent erosion.

Specific Characteristics of Ramu's Soils

- **Texture:** The texture of soils in Ramu ranges from sandy loam to silty clay loam, depending on the specific location within the upazila and the proximity to riverbanks.
- **pH Levels:** The soils typically exhibit a neutral to slightly acidic pH, which is conducive to a variety of crops, including rice, vegetables, and fruits.
- **Organic Matter:** The soils in agricultural areas tend to have high organic matter content due to the decomposition of plant residues and organic amendments added by farmers.

Engineering Soil Characteristics (Geotechnical)

The engineering soil characteristics (geotechnical properties) of Ramu Upazila in Bangladesh are important for construction, infrastructure development, and land use planning. The region's soils are influenced by its geographical location in the Bengal Basin and its alluvial nature. Here are the key geotechnical properties of the soils in Ramu:

1. Soil Composition and Texture

- **Alluvial Soils:** Predominantly sandy loam, silty loam, and clay loam.
- **Texture:** Varies from sandy to silty to clayey, reflecting the depositional environment of the floodplains.

2. Grain Size Distribution

- **Sand:** Typically 30-50%
- **Silt:** Around 20-40%
- **Clay:** Approximately 10-30%

3. Soil Strength and Bearing Capacity

- **Shear Strength:** Moderate to high depending on compaction and moisture content.
- **Bearing Capacity:** Generally suitable for low to medium load-bearing structures. Values can vary but often range from 100 to 200 kPa for shallow foundations.

4. Compaction Characteristics

- **Optimum Moisture Content (OMC):** Typically ranges from 12% to 20%.
- **Maximum Dry Density (MDD):** Usually around 1.6 to 1.9 g/cm³.

5. Permeability

- Permeability: Varies widely; sandy soils exhibit high permeability, while clayey soils have low permeability. Typical values range from 1×10^{-5} to 1×10^{-7} cm/s.

6. Compressibility and Settlement

- Consolidation Characteristics: Moderate compressibility; settlement issues can be significant in clay-rich areas.
- Settlement: Primary consolidation occurs relatively quickly, but secondary consolidation might take longer in clayey soils.

7. Plasticity

- Plasticity Index (PI): Varies with soil type, typically low to moderate (10-30).
- Liquid Limit (LL): generally between 25% to 45%.

8. Soil Reaction and Stability

- pH: Ranges from slightly acidic to neutral (pH 6.0 to 7.5).
- Stability: Generally stable under normal conditions but prone to erosion and landslides in hilly areas.

9. Moisture Content and Swelling

- Moisture Content: Naturally high due to the tropical monsoon climate; ranges from 15% to 30%.
- Swelling Potential: Low to moderate; clayey soils can exhibit higher swelling.

10. Erosion and Seismic Activity

- Erosion: High in areas with loose, sandy soils and during heavy rainfall.
- Seismic Activity: The region is seismically active, requiring geotechnical designs to account for earthquake resistance.

10.4.1.6 Agricultural Patterns

Paddy Cultivation

- **Primary Crop:** Paddy (rice) is the dominant crop in Ramu Upazila, with extensive paddy fields spread across the fertile alluvial plains. The region supports multiple cropping seasons, including Aus, Aman, and Boro, depending on the availability of water and the timing of the monsoon.
- **Cropping Seasons:**
 - **Aus (April-July):** Grown during the early monsoon, Aus rice is typically planted in April and harvested in July. This crop relies on the initial monsoon rains for irrigation.

- **Aman (July-November):** The main monsoon crop, Aman rice, is sown in July and harvested in November. This season benefits from the full monsoon rains, making it the most productive rice-growing period in Ramu.
- **Boro (December-May):** Boro rice is grown during the dry season using irrigation. It is sown in December and harvested in May. Boro rice is crucial for maintaining food security during the dry months when natural rainfall is insufficient.

Betel Leaf Plantations

- **Specialty Crop:** Betel leaf (Paan) is another important crop in Ramu, particularly in areas with slightly higher elevations that are less prone to flooding. Betel leaf cultivation is a traditional practice in the region, providing a significant source of income for many farmers.
- **Growing Conditions:** Betel leaf requires well-drained, fertile soil with good organic content. The alluvial soils of Ramu are well-suited for this crop, provided they are not too waterlogged. Farmers often grow betel leaf in shaded areas or under trellises to protect the plants from direct sunlight.

Vegetable Farming

- **Diverse Crop Production:** In addition to paddy and betel leaf, Ramu Upazila supports a variety of vegetable crops, including tomatoes, eggplants, pumpkins, cucumbers, and various leafy greens. These crops are often grown in the winter and spring seasons when the risk of flooding is lower.
- **Small-Scale Farming:** Vegetable farming in Ramu is typically small-scale, with farmers cultivating vegetables on homestead plots or in small fields. The use of organic fertilizers and traditional farming methods is common, although some farmers are adopting modern techniques to increase yields.

Fruit Orchards

- **Mango and Jackfruit:** Ramu is also known for its fruit orchards, particularly mango and jackfruit, which are grown in both homestead gardens and larger orchards. These fruits are important for both local consumption and sale in regional markets.
- **Seasonal Production:** Mangoes are harvested during the summer months, while jackfruits are harvested from late spring to early summer. The cultivation of these fruits is often integrated with other crops, providing additional income streams for farmers.

10.4.1.7 Hydrology

Ramu Upazila, located in Cox's Bazar District, is characterized by a complex hydrological network that plays a crucial role in the region's agriculture, fisheries, and overall livelihood. The hydrology of Ramu is dominated by several rivers, canals, and floodplains, which contribute to both its natural resource wealth and its vulnerability to hydrological hazards such as flooding. Below is a detailed analysis of the hydrological characteristics of Ramu Upazila, including its major water bodies, flood patterns, and water management challenges.

The Bakkhali River

- **Overview:** The Bakkhali River is the most prominent river flowing through Ramu Upazila. It originates from the hills in the Chittagong Hill Tracts and flows southward,

eventually emptying into the Bay of Bengal. The river is a vital source of water for irrigation, fisheries, and daily household use.

- **River Course:** The Bakkhali River meanders through Ramu, creating a series of bends and oxbow lakes. This meandering nature contributes to the dynamic hydrology of the region, influencing both water availability and flood risks.
- **Ecological Significance:** The river supports a diverse range of aquatic life, including fish species that are important for local fisheries. The riverbanks are also lined with vegetation that helps prevent erosion and provides habitat for wildlife.

Canals and Tributaries

- **Secondary Waterways:** In addition to the Bakkhali River, Ramu is crisscrossed by numerous smaller canals and tributaries. These water bodies serve as important channels for water distribution, especially for agricultural irrigation.
- **Irrigation Canals:** Many of these canals are man-made or have been modified to enhance irrigation capabilities. They play a crucial role in the local agricultural system, particularly during the dry season when water from the main river is diverted to irrigate fields.

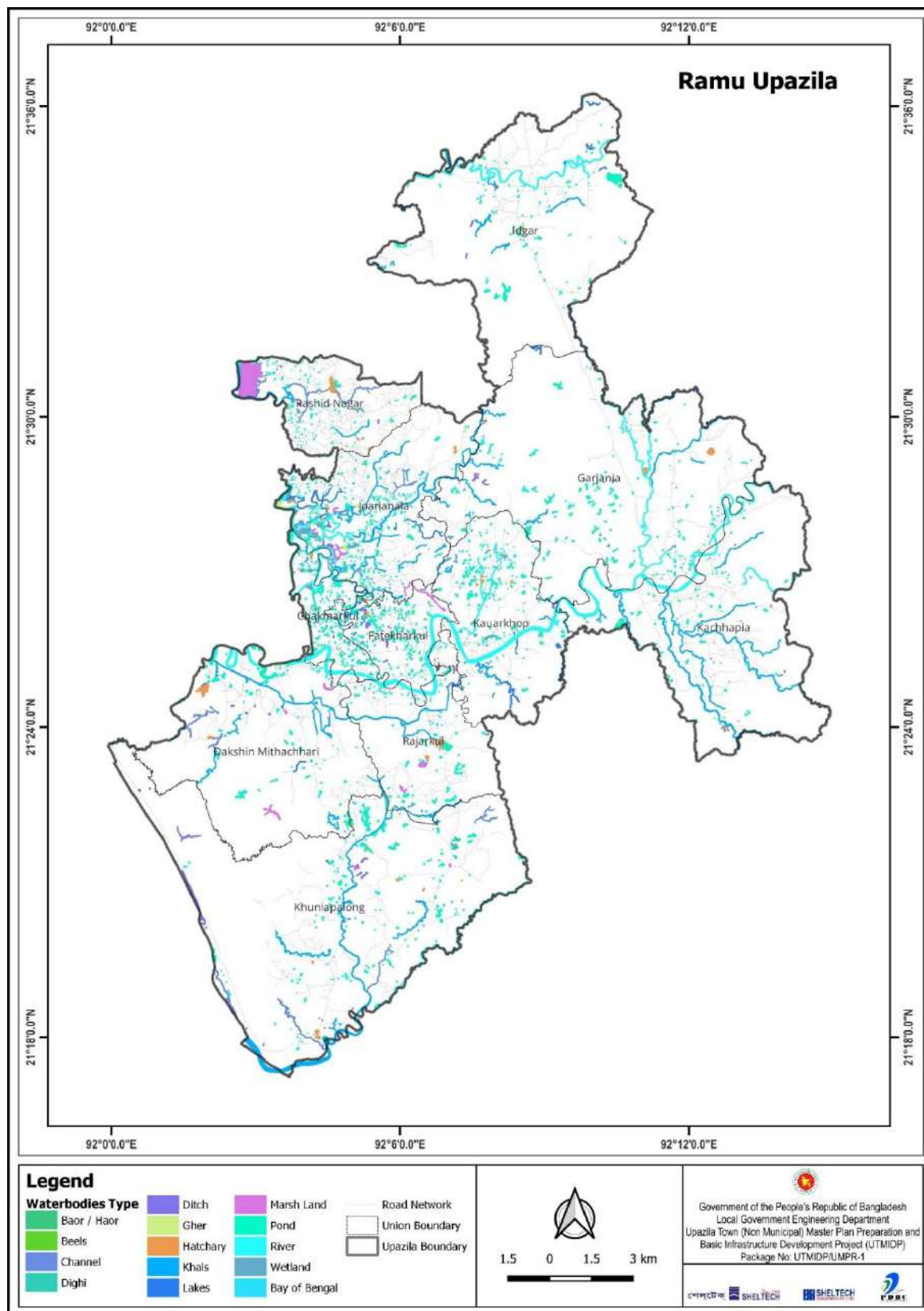


Figure 10-7: Land Use map of Project Area, Ramu Upazila

Floodplains and Wetlands

- **Floodplains:** The low-lying areas adjacent to the Bakkhali River and its tributaries form extensive floodplains. These floodplains are seasonally inundated during the monsoon, creating fertile grounds for agriculture, particularly for rice cultivation.
- **Wetlands:** Several natural wetlands are scattered across Ramu, which are critical for maintaining the region's biodiversity. These wetlands provide habitat for a variety of aquatic species and act as natural buffers against floods by absorbing excess rainfall.

10.4.1.8 Vegetation:

The region's vegetation includes mangrove forests along the coastal areas, tropical deciduous forests in the hilly regions, and a mix of agricultural lands. The forests are home to diverse flora and fauna, some of which are under threat due to deforestation and human activities.

10.4.1.9 Biodiversity:

Ramu, Bangladesh, is home to several mangrove forests, including the larger network of mangroves that fringe the coastline of southeastern Bangladesh. These forests play a crucial ecological role in coastal protection, stabilizing the shoreline, reducing erosion, and providing a natural barrier against storm surges and tidal waves. Mangrove forests support a diverse range of flora and fauna, including fish, crabs, mollusks, birds, insects, and small mammals. However, they are under threat from deforestation and land conversion for agriculture, aquaculture, and settlement expansion. Conservation efforts include community-based reforestation programs, legal protections against illegal logging, and sustainable land use practices.

Tropical deciduous forests, located in the eastern parts of the upazila, cover hilly terrains and are characterized by seasonal leaf shedding, which helps conserve water. Common tree species include Sal, Teak, Mahogany, and Bamboo species. Deforestation due to illegal logging, agricultural expansion, and firewood collection is a significant threat to these forests. Conservation efforts include afforestation, reforestation programs, agroforestry, and protected areas.

10.4.1.10 Agro-Ecological Region

Ramu Upazila, situated in the Cox's Bazar District of Bangladesh, is part of the Chittagong Coastal Plain, recognized as Agroecological Zone 23 (AEZ 23). This zone is characterized by its distinctive coastal landscape, which heavily influences the region's agricultural and environmental conditions. The topography of Ramu is predominantly flat and low-lying, with the presence of tidal rivers, canals, and coastal plains shaping the area's hydrology. This landscape is particularly vulnerable to tidal flooding and waterlogging, especially during the monsoon season from June to October, when heavy rainfall is common. The soils in Ramu range from loamy to clayey, primarily formed from alluvial and tidal deposits. These soils are fertile but are often affected by varying degrees of salinity, particularly during the dry season when the flow of freshwater from rivers decreases, allowing saline water intrusion from the sea. This salinity poses a significant challenge to agriculture, necessitating the cultivation of salt-tolerant crops and innovative farming techniques to mitigate its effects.

The climate of Ramu, like much of coastal Bangladesh, is tropical monsoon, characterized by high humidity, significant rainfall, and temperature fluctuations between mild winters and hot summers. The average annual temperature in Ramu ranges from 20°C to 30°C, providing a suitable environment for a variety of crops. However, the agricultural calendar is closely tied to the region's hydrological cycles and the challenges posed by salinity. Rice is the predominant crop in Ramu, with varieties such as Aman and Boro being widely cultivated. These rice varieties are well-suited to the flood-prone and saline conditions of the region,

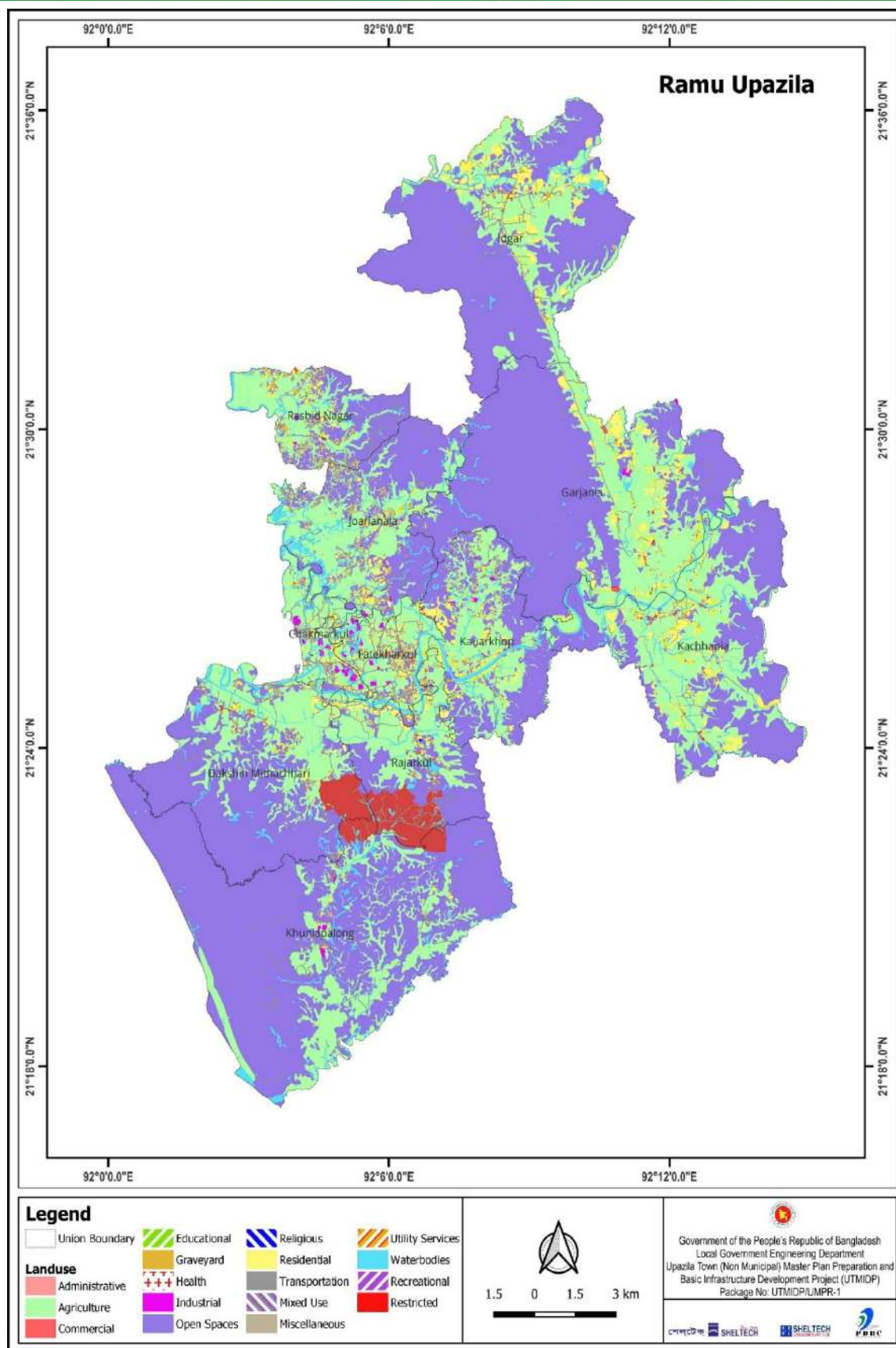


Figure 10-8: Map showing the agricultural area of Ramu Upazila

particularly during the monsoon and post-monsoon seasons. Additionally, Ramu's higher, less saline areas support the cultivation of vegetables, pulses, and oilseeds, contributing to the diversity of agricultural production in the area.

Aquaculture also plays a significant role in Ramu's economy, driven by the region's proximity to the coast and the natural brackish water environment. Shrimp farming is particularly prominent, capitalizing on the saline conditions that would otherwise limit traditional crop farming. However, this practice also brings environmental concerns, including the potential for increased salinity in agricultural lands and the degradation of local ecosystems. Ramu's environmental and agricultural landscape is further shaped by the presence of mangrove forests along its coastal areas. These mangroves provide critical protection against tidal surges and cyclones, which are frequent in this region. They also contribute to the overall biodiversity and ecological balance, supporting both terrestrial and marine life.

The challenges faced by Ramu in its agricultural practices are multifaceted, involving the management of salinity, the risk of flooding, and the impacts of extreme weather events like cyclones. These challenges require adaptive and sustainable agricultural practices that can accommodate the region's environmental constraints while optimizing its agricultural potential. The integration of traditional knowledge with modern agricultural techniques is essential to ensure food security, protect livelihoods, and sustain the environment in Ramu. As the population grows and economic pressures increase, careful management of land use and natural resources will be critical to maintaining the balance between agricultural productivity and environmental conservation in this unique agroecological zone.

10.4.2 Socio-economic Environment

10.4.2.1 Population and Demographics

- **Population Size:** Ramu Upazila has an estimated population of approximately 344541(as per Housing Census of 2022). Among the total populations, total male population is 179276 and female population is 165265. The population density is around 879 people per square kilometer.
- **Population Growth:** The population growth rate has been moderate, driven by natural growth and limited migration, with a slight increase due to rural-urban migration within Cox's Bazar District.
- **Age Distribution:** The population is relatively young, with a significant portion under the age of 30. This demographic structure influences the workforce, education needs, and economic activities.
- **Household Structure:** The average household size is 4.5 persons per household, with a mix of nuclear and extended family structures common in rural areas.

10.4.2.2 Economy and Key Economic Activities:

- **Agriculture:** The primary economic activity in Ramu is agriculture, employing a significant portion of the population. The region is known for:
 - **Paddy Cultivation:** Rice is the staple crop, with multiple harvests per year due to the favorable climate.

- **Betel Leaf Production:** Ramu is one of the major producers of betel leaves in the region, which are widely consumed and traded both locally and internationally.
- **Vegetable Farming:** Various vegetables, such as eggplants, tomatoes, and green chili, are cultivated, contributing to both local food security and income generation.
- **Fisheries:** The abundant rivers, canals, and ponds in Ramu support a vibrant fishing industry. Both freshwater and brackish water fish are cultivated, with species like tilapia, carp, and shrimp being common.
- **Small-Scale Industries:** Ramu has a few small-scale industries, including rice mills, betel nut processing units, and cottage industries producing traditional handicrafts.
- **Livestock:** Livestock farming, particularly cattle, poultry, and goats, is a supplementary economic activity, providing dairy products, meat, and additional income to households.
- **Tourism:** Although Ramu itself is not a major tourist destination, its proximity to Cox's Bazar allows it to benefit indirectly from the tourism industry. Local crafts and agricultural products are often sold to tourists.

10.4.2.3 Infrastructure and Development Indicators:

- **Education:** The literacy rate in Ramu Upazila is around 62%, with a growing number of educational institutions ranging from primary schools to high schools. However, higher education facilities are limited, leading to outmigration for tertiary education.
- **Health Services:** Health services in Ramu are provided by a mix of government-run clinics, community health centers, and private practitioners. However, access to advanced healthcare facilities is limited, with residents often traveling to Cox's Bazar town for specialized medical care.
- **Transportation:** Ramu is well-connected by road, with the Ramu-Cox's Bazar Highway being the main artery. Local transportation includes buses, rickshaws, and boats for riverine transport. However, the road infrastructure can be vulnerable to seasonal flooding.
- **Utilities:** Access to electricity is widespread, although there may be occasional shortages or disruptions. Water supply is primarily sourced from groundwater, with some areas relying on river water. Sanitation facilities are improving, with ongoing efforts to expand sewerage systems and reduce open defecation.
- **Telecommunications:** Mobile network coverage is extensive, and internet services are available, although rural areas may experience slower connectivity.
- **Development Programs:** Several government and NGO-led development programs are active in Ramu, focusing on areas like disaster risk reduction, agricultural improvement, education, and women's empowerment. These programs are essential in addressing the socioeconomic challenges of the region.

10.4.2.4 Challenges and Opportunities:

- **Environmental Vulnerabilities:** Ramu's economy, particularly agriculture, is vulnerable to environmental risks such as flooding, cyclones, and salinity intrusion. These challenges are compounded by climate change, which is expected to increase the frequency and severity of such events.
- **Economic Diversification:** While agriculture remains dominant, there is a need to diversify the economy to include more industrial and service-oriented sectors, which could provide more stable employment and income.
- **Infrastructure Development:** Ongoing and planned infrastructure projects, such as road improvements and flood control measures, offer opportunities for growth but require careful planning to avoid environmental degradation.

10.4.2.5 Social Indicators:

- **Gender and Social Inclusion:** Women in Ramu are increasingly participating in economic activities, particularly in agriculture and small businesses. However, gender disparities remain, particularly in education and formal employment. Social inclusion programs are necessary to address the needs of marginalized communities.
- **Community Dynamics:** Ramu's social fabric is characterized by strong community ties, with local leadership playing a significant role in governance and development initiatives. Religious and cultural institutions also contribute to the social cohesion of the area.

10.4.2.6 Sanitation

Sanitation encompasses the conditions and practices aimed at preserving health and preventing the transmission of diseases. It primarily involves ensuring the availability of clean drinking water and the secure disposal of human and animal waste. According to the World Health Organization, sanitation is defined as the provision of facilities and services for the safe handling of human excreta. This includes processes from toilet usage to containment, storage, on-site treatment, and conveyance, to eventual safe end-use or disposal.

Sanitation Coverage: The sanitation coverage of Ramu Upazila is approximately 87.95% on average. This means that almost 90% of the households in the Upazila have access to and use sanitary latrines or toilet facilities. The statement implies that sanitation coverage is determined by the percentage of households with access to sanitary latrines. Sanitary latrines contribute to maintaining a clean and hygienic environment, reducing the risk of diseases related to poor sanitation. The data was collected from the Department of Public Health and Engineering (DPHE).

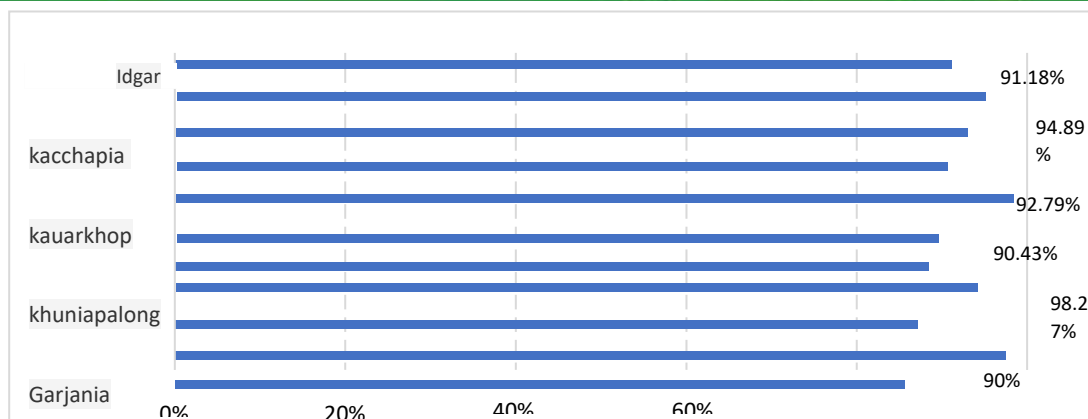


Figure 10-9: Union-wise Sanitation Coverage Status of ramu Upazilla

(Source: Department of Public Health and Engineering)

Sanitation Latrine Provider: The majority of latrines, approximately 85.47%, in Ramu Upazila are established by individual households. This implies that most families take the initiative and invest in constructing their own latrine facilities, contributing to personal hygiene and sanitation. A significant portion, about 13.27%, of latrines are established by different volunteer agencies, including non-governmental organizations (NGOs) or community organizations. This indicates the involvement of external entities in promoting sanitation practices and providing resources for latrine construction.

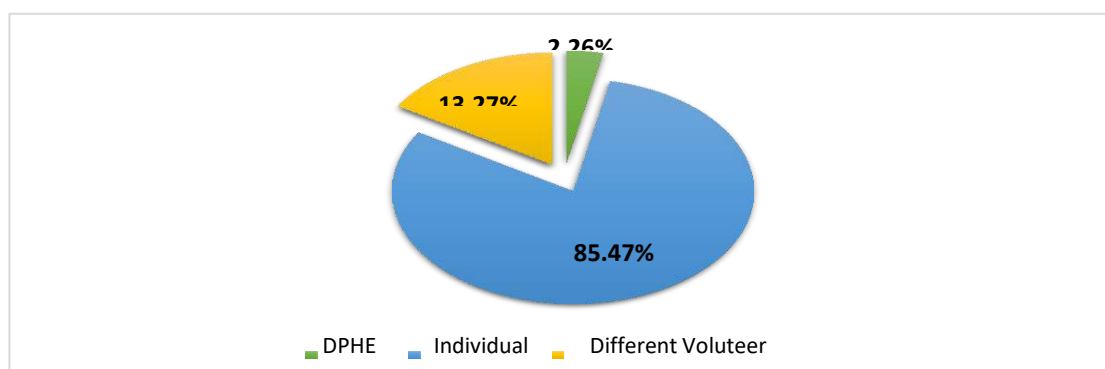


Figure 10-10: Status of Sanitary equipment provider in Ramu

(Source: DPHE)

10.5 Environmental Quality in Ramu

10.5.1 Groundwater Condition

Groundwater samples were gathered from three distinct locations in and around Ramu Upazila. The table displays the tested parameters along with their respective values and the corresponding Bangladesh standards. GW-1 and GW-3 represent the Community Tube well locations, while GW-2 represents the School Tube well. The locations of the groundwater sample collection is given below:

Table 10-3: Details location of the sample collection

Location name	Latitude	Longitude
Ramu Upazile Complex Jaame Masjid	21.42813889	92.10055556
Ramu Upazila Parishad	21.72725	92.17488889
Atika Bibi bridge (Bakkhali River)	21.42036111	92.10936111

Groundwater in the project area underwent an analysis to evaluate mineral presence and salinity conditions, with a focus on Chloride and Fluoride. Chloride concentrations in the project area remained relatively stable across the two monitoring seasons, ranging from 48 mg/l to 66 mg/l, all well below the maximum standard set by Bangladesh (250 mg/l).

Although Fluoride is naturally found in various foods and utilized for dental benefits in medical applications, excessive consumption of fluoride ions beyond 1.5 mg/l can result in dental and skeletal fluorosis, brain damage, thyroid issues, and an elevated risk of kidney diseases. The Environmental Conservation Rules of 2023 recommend an even lower fluoride concentration (1.0 mg/l) for drinking water. Importantly, at all sampled locations, fluoride values were below the detection limit (0.1 mg/l). To assess metal contamination in the groundwater surrounding the project area, four parameters were examined: Iron, Manganese, Arsenic, and Zinc. Iron, a natural component of groundwater, demonstrated minimal seasonal and spatial variations, with concentrations ranging from 0.12 mg/l to 0.25 mg/l across all samples. Notably, the Environmental Conservation Rules of 2023 recommend a drinking water iron concentration range of 0.3 – 1.0 mg/l, indicating that the project area does not face issues related to iron contamination. Manganese, which is abundantly present in the Earth's crust and often found in association with iron, was also part of the assessment.

Table 10-4: Ground Water Quality Status of Ramu Upazila

Parameters	Unit	Concentrations present at monitoring locations						Bangladesh Standard for Drinking Water
		GW-1		GW-2		GW-3		
		Monsoon	Post-Monsoon	Monsoon	Post-Monsoon	Monsoon	Post-Monsoon	
Temperature	°C	26.7	28.5	26.8	28.2	27.1	28.1	20-30
pH	-	6.56	6.58	6.78	6.79	6.96	6.79	6.5-8.5
Electrical Conductivity (EC)	µs/cm	624	598	712	689	665	633	-
Dissolved Oxygen (DO)	mg/l	4.6	5.5	2.3	6	4.2	5.1	≥5.0
Chemical Oxygen Demand (COD)	mg/l	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25
Biochemical Oxygen Demand (BOD ₅)	mg/l	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	≤3
Nitrate (NO ₃)	mg/l	2.6	3.1	2.1	10	1.6	1.8	45
Nitrite (NO ₂)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.0
Sulphate (SO ₄)	mg/l	35	41	23	29	29	35	250
Phosphate (PO ₄)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	6
Chloride (Cl)	mg/l	55	48	66	59	52	48	250
Fluoride (F)	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.0
Iron (Fe)	mg/l	0.18	0.23	0.12	0.18	0.25	0.25	0.3 – 1.0
Manganese (Mn)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.4
Arsenic (As)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05
Zinc (Zn)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	5.0
Oil and Grease	mg/l	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	0.01
E-Coli	number /100 ml	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	0

In additions a groundwater sample has been collected from a tube well in Ramu upazila, Bangladesh, reveals that the majority of the tested parameters are within the acceptable limits prescribed by the ECR '2023 - Bangladesh' drinking water quality standards. This indicates that the water source is generally safe for consumption.

However, the iron concentration in the sample was found to be slightly elevated at 4.65 mg/L, exceeding the maximum allowed limit of 1.0 mg/L. While this excess iron may not pose an immediate health risk, it can have aesthetic consequences such as discoloration and a metallic taste. Prolonged exposure to high levels of iron can also lead to various health problems.

It is important to note that the presence of iron in groundwater is a common occurrence in many regions, including Bangladesh. Several factors can contribute to elevated iron levels, such as the geological composition of the aquifer, the presence of iron-rich minerals, and the redox conditions of the water.

To ensure the safety and quality of the drinking water, it is recommended to implement treatment methods that can effectively remove excess iron from the groundwater. This may involve processes like filtration, aeration, or chemical treatment. By addressing the iron issue, the groundwater from Ramu upazila can be made suitable for consumption without any adverse health effects.

Ramu Upazila faces significant challenges due to increasing soil and water salinity, primarily driven by its proximity to the Bay of Bengal and tidal influences from nearby rivers. Salinity intrusion is exacerbated by tidal flows, particularly during the dry season when freshwater inflows are reduced. This results in saline water seeping into agricultural lands, reducing soil fertility and hampering the growth of key crops such as rice, vegetables, and fruit trees. Farmers in the area struggle with declining crop yields, forcing many to shift towards more

salt-tolerant varieties or alternative livelihoods. The salinity issue also impacts freshwater sources, affecting drinking water availability for the local population. Addressing salinity requires improved water management, the introduction of salt-resistant crop varieties, and community-based initiatives to protect vulnerable farmland.

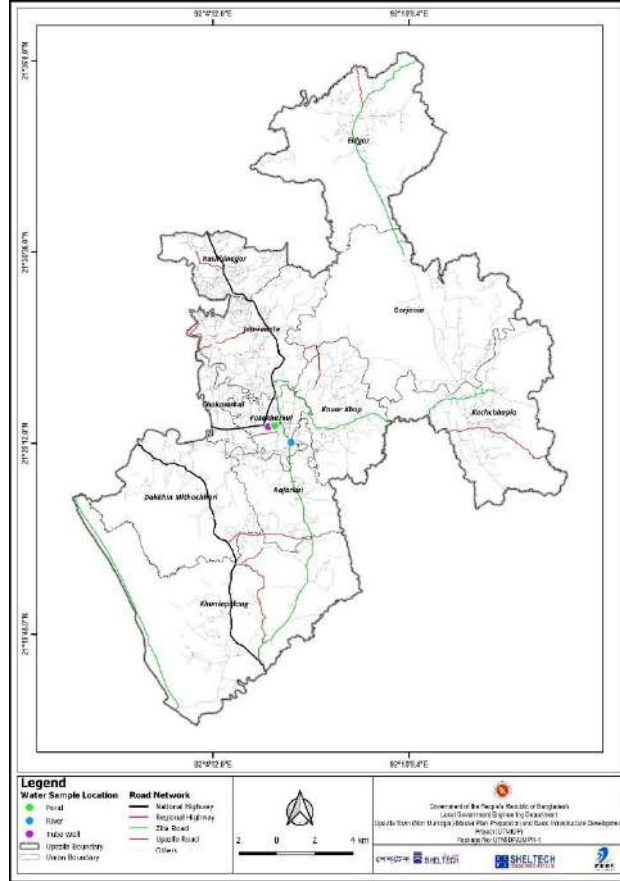


Figure 10-11: Water sample collection map

Table 10-5: Test Result of Tubewell water in Ramu

Name of Parameters	Concentration Present	Drinking Water Quality Standard (ECR '2023 – Bangladesh)	Unit
pH	7.5	6.5 - 8.5	-
Turbidity	<1	5	NTU
Hardness	70	500	mg/L
Iron	4.65	1.0	mg/L
Manganese	0.32	0.4	mg/L
Alkalinity	167	200 - 500	mg/L
Arsenic	0.008	0.05	mg/L
Chloride	<61	250*	mg/L
TC	0	0	#/100mL
FC	0	0	#/100mL
Salinity	<100	-	mg/L

Source: Field data collection; 2024

10.5.2 Surface Water Condition

Five parameters were analyzed in order to examine the physio-chemical characteristics of surface water in and around Ramu Upazila such as pH, temperature, turbidity, dissolved solids, suspended solids. pH serves as an indicator of the acidity of water, with values above 7 indicating alkalinity and values below 7 indicating acidity. The analysis revealed pH values ranging from 6.56 to 7.38 during the monsoon and from 6.76 to 7.52 in the post-monsoon period. These values fall within the standard limits for surface water (6.5 – 8.5). Nonetheless, water samples with a pH below 7 suggest that the water is slightly acidic.

Table 10-6: Surface Water Quality of Surrounding River of Ramu Upazila

Parameters	Unit	Bakkhali River		Bangladesh Standard for Surface Water for fisheries
		21.42036111 N 92.10936111 E		
		Monsoon	Post Monsoon	
pH	-	6.56	6.88	6-9
Temperature	0C	32.2	-	-
Turbidity	NTU	52	44	-
Total Dissolved Solids (TDS)	mg/l	195	189	1000
Total Suspended Solids (TSS)	mg/l	95	73	-
Dissolved Oxygen (DO)	mg/l	5.4	5.6	≥5.0
Chemical Oxygen Demand(COD)	mg/l	<4.0	<4.0	50
Biochemical Oxygen Demand(BOD5)	mg/l	<2.0	<2.0	≤6
Lead (Pb)	mg/l	<0.005	<0.005	0.1
Chromium (Cr)	mg/l	<0.01	<0.01	0.05
Mercury (Hg)	mg/l	<0.001	<0.001	0.004
Oil and Grease	mg/l	<1.4	<1.4	≤10

Water turbidity, caused by solid particles in dissolved and suspended forms, can obscure water clarity, impede sunlight penetration, and negatively impact benthic species. This reduction in sunlight also lowers phytoplankton photosynthesis, contributing to low oxygen conditions in the water column.

To assess the oxygen conditions in surface water, the study examined parameters including Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD). Dissolved Oxygen quantifies the oxygen content, while BOD and COD indicate the oxygen deficiency in surface water. Aquatic organisms rely on oxygen for respiration. Inadequate oxygen levels, known as hypoxia, or complete absence of oxygen, termed anoxia, can arise when excessive organic materials, such as large algal blooms, undergo decomposition by microorganisms. Microorganisms consume DO in water through oxidation. BOD and COD represent the oxygen needed for microorganisms to decompose and the oxygen required for the complete decomposition of all organic matter in the water, respectively

(UNEP/WHO, 1996). Reduced DO, along with elevated BOD and COD concentrations, can disrupt aquatic health and impact the composition of aquatic fauna.

The data in the preceding table indicates that during the post-monsoon period, Dissolved Oxygen (DO) values range slightly higher, varying between 5.2 mg/l and 5.8 mg/l, compared to the monsoon period where they range from 4.9 mg/l to 5.5 mg/l. The minimum acceptable DO level for surface water is 5 mg/l, below which the aquatic ecosystem can experience severe consequences. Additionally, both Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) values were found to be within acceptable limits for surface water in both monitoring seasons. BOD and COD concentrations were below 2 mg/l and 4 mg/l, respectively, while the maximum permissible levels for fisheries are 10 mg/l and 25 mg/l, respectively.

Table 10-7: Surface Water Quality of Bakkhali River

Parameters	2015	2016	Bangladesh Standard for Surface Water
pH	7.00-7.34	6.36-7.69	6-9
DO	3.3-7.5 mg/L	6.2-7.7 mg/L	≤5 mg/l
BOD	1.2-5.0 mg/L	1.2-3.2 mg/L	≤6 mg/l
TDS	57.1-250 mg/L	42-276 mg/L	1000 mg/l
SS	6.0-22.0 mg/L	8.0-38.0 mg/L	25 mg/l
Chloride	1.06-12.7 mg/L	4.0-8.99 mg/L	250 mg/l
Alkalinity	16.6-58 mg/L	18.0-56 mg/L	-
Electrical Conductivity	135.4-480 umhos/cm	84-513 umhos/cm	-

(Source: Surface and Ground Water Quality Report 2016, Department of Environment (DoE))

10.5.3 Air Quality

Increased concentrations of particulate matter and gaseous pollutants can have harmful effects on ecology and human health. The assessment of air quality is based on the different Environmental Impact Assessment (EIA) report, particularly the Comprehensive Environmental & Social Impact Assessment (ESIA) for Ramu upazila.

With multiple development projects currently underway in Ramu upazila, it is imperative to closely observe and assess the air quality in this region. This study considers the major air pollutants are- PM10, PM2.5, SO2, NO2, CO, O3, Suspended Particulate Matter (SPM), and Volatile Organic Component (VOC).

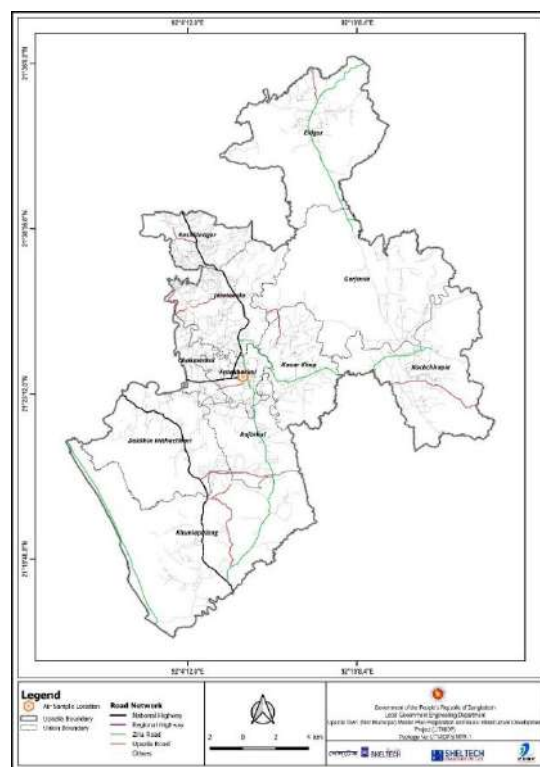


Figure 10-12: Air quality testing

Based on the air quality monitoring findings presented in the tables above, it is clear that all the parameters fall within the permissible limits set by ECR, 2023, during both dry and wet seasons. However, when compared to the guidelines of WHO, 2021, it has been noted that concentrations of particulate matters (PM_{2.5} and PM₁₀) and NO₂ (µg/m³) exceeded the recommended levels in both dry and wet seasons. In general, the air quality is comparatively poorer during the winter season than in the monsoon period. Various factors, such as the transport of air pollutants by wind beyond the designated airshed, ongoing local construction activities, wind erosion, emissions from nearby power plants, emissions from both paved and unpaved roads, vehicular and residential areas, as well as rainfall washout, could play significant roles in contributing to heightened air pollution within the project air shed.

Table 10-8: Air Quality Monitoring - Wet and Dry Season in Ramu

Criteria Pollutants	Unit	Wet Season	Dry Season	ECR,2023	WHO, 2021
PM ₁₀	(µg/m ³)	70.20	76.63	150	45
PM _{2.5}	(µg/m ³)	40.47	39.47	65	15
SPM	(µg/m ³)	110.80	103.10	-	-
SO ₂	(µg/m ³)	7.60	7.50	80	40
NO ₂	(µg/m ³)	27.20	26.90	80	10
CO	(µg/m ³)	142	135	5	-
O ₃	-	19	<19	180	-
VOCs	mg/m ³	<4.2	<4.2	-	-

In addition, for the better assessment, air quality measurement was conducted in Ramu Gov't Primary school on 28th May 2024 to assess the recent baseline condition of the project area. The details test result has been given in below table.

Table 10-9: Ambient Air Quality Analysis Result

SL No.	Parameters	Method	Test Duration (Min)	Unit	AQ1	AQ2	AQ3	DoE Std.	IFC/WB Std.
					21.42947 92.10356	21.4291 92.1165	21.4286 92.1124		
1	PM _{2.5}	Gravimetric	480	µg/m ³	23.42	57.13	64.06	65 ^a	65 ^a
2	PM ₁₀	Gravimetric	480	µg/m ³	31.44	81.16	84.72	150 ^a	150 ^a
3	SO ₂	West Geake	480	µg/m ³	6.29	15.26	16.43	80 ^a	125 ^a
4	NO _x	Jacob and Hochheiser	480	µg/m ³	9.39	23.75	20.36	80 ^a	200 ^a
5	CO	CO Sensor	480	µg/m ³	0.4	1.0	0.7	20 ^d	NF
6	O ₃	O ₃ Sensor	480	µg/m ³	29	41	43	180 ^a	180 ^c

(NF-Not found DoE- Department of Environment), a= standard for 24 hours exposure, b= standard for year, c= standard for 8 hours exposure, d= standard for 1 hour exposure.

From the above test result it has been noted that, Particulate matter (PM), particularly PM_{2.5}, is significantly higher than recommended limits. PM_{2.5}, being smaller and more easily inhaled, can penetrate deep into the lungs and cause severe respiratory and cardiovascular problems. Elevated levels of sulfur dioxide (SO₂) and nitrogen oxides (NO_x) indicate significant emissions from industrial sources and vehicular traffic. These pollutants can contribute to acid rain, smog formation, and respiratory irritation. While carbon monoxide (CO) levels are within the acceptable range, ozone (O₃) concentrations are approaching the standard, suggesting potential air quality issues during peak sunlight hours.

Exposure to high levels of these pollutants can have severe health consequences, including respiratory diseases, cardiovascular diseases, increased risk of premature death, and irritation of the eyes, nose, and throat. Air pollution can also have detrimental effects on the environment, such as acid rain, climate change, damage to vegetation, and reduced visibility.

10.5.4 Noise Pollution

Noise pollution, or sound pollution, is the propagation of noise or sound with ranging impacts on the activity of human or animal life, most of which are harmful to a degree. The source of outdoor noise worldwide is mainly caused by machines, transport and propagation systems.

Poor urban planning may give rise to noise disintegration or pollution, side-by-side industrial and residential buildings can result in noise pollution in the residential areas. Some of the main sources of noise in residential areas include loud

music, transportation (traffic, rail, airplanes, etc.), lawn care maintenance, construction, electrical generators, wind turbines, explosions and people.

In case of Ramu there is no heavy industry or construction site but only traffic noise create a few noise pollution.

Noise level measurement were conducted in Ramu at four potential locations on 28th May 2024 to assess the recent baseline condition of the project area. The details test result has been given in below table.

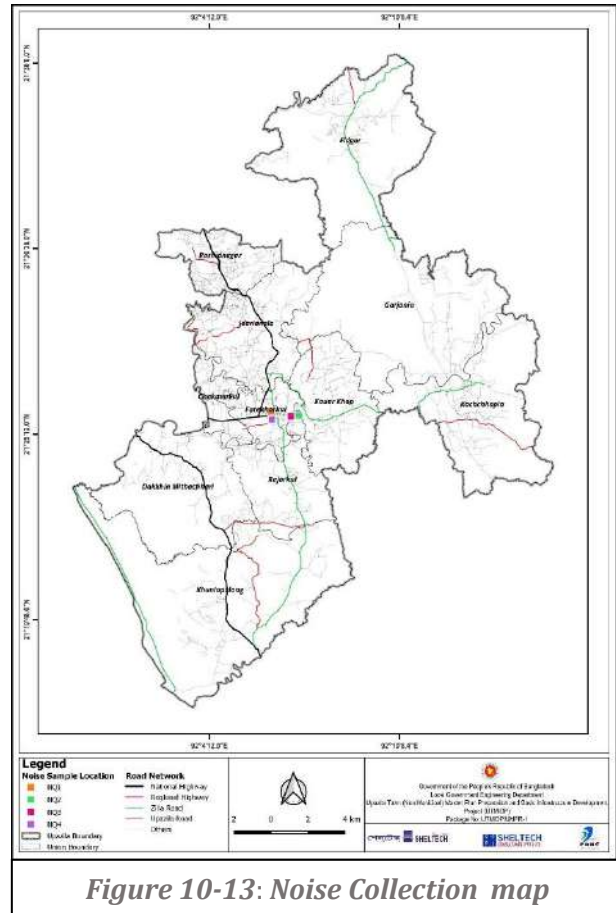


Figure 10-13: Noise Collection map

Table 10-10: Noise level test Result

SN.	Station ID	Location	GPS	Site Condition	Receptor Type	Concentration present (Leq) dBA		
						Day Time		
						Min.	Max.	Leq
1	NQ1	Chowmohoni Chourasta	21.42947 92.10356	Preconstruction Phase	Commercial	50.2	59.6	55.6
2	NQ2	Chairman paradise	21.4291 92.1165		Commercial	50.3	58.3	55.0

3	NQ3	Ramu Bypass Road	21.4286 92.1124		Mixed	51.2	59.4	55.2
4	NQ4	Moddhom meronglua	21.42925 92.10288		Mixed	61.2	54.8	56.58
DoE (Bangladesh) Standard for Residential Area						50		
DoE (Bangladesh) Standard for Commercial Area						70		
DoE (Bangladesh) Standard for Mixed Area						60		
IFC/ International standard for residential Area						55		
IFC/ International standard for Commercial / Industrial Zone						70		

Max***= Maximum Value, Min= Minimum Value, Avg=Average L_{eq} Value, DoE= Department of Environment, IFC= International Finance Corporation, WB= World Bank, dBA= Noise Level Unit

10.6 Site-specific Environmental Impact & Mitigation Measures

The Upazila Town Master Plan and Basic Infrastructure Development Project in Ramu Upazila, Cox's Bazar District, involves the construction and upgrading of infrastructure such as roads, public buildings, and drainage systems. Given Ramu's unique environmental context, particularly its coastal location, diverse ecosystems, and susceptibility to natural hazards, the project poses several site-specific environmental impacts. This section details these impacts and proposes targeted mitigation measures to ensure sustainable development in Ramu Upazila.

10.6.1 Site-Specific Environmental Impacts

10.6.1.1 Impact on Coastal Mangrove Forests

The construction of coastal roads and embankments, as well as land reclamation for new development, threatens the mangrove forests along the Bakkhali River and the Bay of Bengal coast. Mangroves are crucial for protecting the coastline from erosion and storm surges, and their destruction would significantly reduce the natural coastal defenses of Ramu.

Potential Consequences:

- **Loss of Biodiversity:** The destruction of mangrove habitats would lead to a decline in species that rely on these forests, including fish, crabs, and various bird species.
- **Increased Coastal Erosion and Flooding:** Without mangroves, coastal areas are more vulnerable to erosion and flooding, particularly during cyclones and high tides.

10.6.1.2 Impact on Riverbanks and Floodplains

The construction of infrastructure near the Bakkhali River and other water bodies could exacerbate riverbank erosion and disrupt the natural floodplain dynamics. This could lead to increased sedimentation in the river, altering its course and potentially increasing flood risks downstream.

Potential Consequences:

- **Increased Flood Risk:** Alterations to the riverbank and floodplain could increase the frequency and severity of floods in low-lying areas, threatening homes, crops, and infrastructure.
- **Loss of Agricultural Land:** Erosion and changes in river flow could lead to the loss of valuable agricultural land, impacting local food security and livelihoods.

10.6.1.3 Impact on Agricultural Lands

The expansion of infrastructure, including roads and public facilities, may lead to the conversion of agricultural lands, particularly in the fertile floodplains of Ramu. This could reduce the area available for farming and disrupt local agricultural practices.

Potential Consequences:

- **Reduced Agricultural Productivity:** The loss of agricultural land could reduce crop yields, affecting food supply and the livelihoods of farming communities.
- **Soil Degradation:** Construction activities could lead to soil compaction, loss of topsoil, and degradation of soil fertility, further reducing the productivity of remaining agricultural lands.

10.6.1.4 Impact on Wetlands and Water Bodies

Infrastructure development near wetlands and natural water bodies may lead to their degradation through land reclamation, pollution, and disruption of natural water flows. Wetlands are critical for water filtration, flood control, and supporting biodiversity.

Potential Consequences:

- **Loss of Wetland Ecosystems:** The degradation of wetlands could result in the loss of habitats for fish, amphibians, and waterfowl, reducing biodiversity and affecting local fisheries.
- **Water Pollution:** Construction runoff and waste could contaminate water bodies, harming aquatic life and reducing water quality for local communities.

10.6.1.5 Impact on Hilly Areas

Development in the hilly regions of Ramu, particularly for roads and settlements, poses a risk of deforestation and increased soil erosion. These areas are prone to landslides, especially during the monsoon season.

Potential Consequences:

- **Increased Landslide Risk:** Deforestation and soil disturbance in hilly areas could destabilize slopes, leading to landslides that threaten lives, property, and infrastructure.
- **Loss of Vegetation:** The clearing of hilly vegetation would reduce biodiversity and contribute to the degradation of the local environment.

10.6.2 Site-Specific Mitigation Measures

10.6.2.1 Coastal Mangrove Conservation

- **Mangrove Protection Zones:** Designate protected zones for mangrove forests where no construction or land reclamation activities are allowed. These zones should be clearly marked and enforced by local authorities.
- **Mangrove Reforestation:** Implement mangrove reforestation programs in degraded areas along the coast. This should include planting native mangrove species and involving local communities in conservation efforts.
- **Sustainable Infrastructure Design:** Design coastal infrastructure to avoid or minimize impacts on mangrove areas. For example, elevated roads or boardwalks can be used to avoid direct contact with mangrove roots.

10.6.2.2 Riverbank and Floodplain Management

- **Erosion Control Structures:** Construct erosion control structures, such as riprap, gabions, and vegetative buffers, along vulnerable sections of the riverbank to prevent erosion and stabilize the soil.
- **Floodplain Zoning:** Implement zoning regulations that restrict construction activities in floodplain areas to minimize disruption to natural water flows and reduce flood risks. Develop floodplain restoration projects to enhance natural flood management.
- **Sustainable Agriculture Practices:** Promote the use of sustainable agriculture practices that reduce soil erosion and improve soil health in areas adjacent to rivers and floodplains. This includes crop rotation, cover cropping, and agroforestry.

10.6.2.3 Agricultural Land Preservation

- **Land Use Planning:** Integrate land use planning into the project to prioritize the preservation of prime agricultural lands. Infrastructure development should be directed towards less fertile areas or previously disturbed lands.
- **Soil Conservation Techniques:** Implement soil conservation techniques, such as contour plowing and the use of organic mulches, to protect remaining agricultural lands from degradation during and after construction.
- **Compensation and Support for Farmers:** Provide compensation and support programs for farmers who are displaced by the project. This could include financial compensation, relocation assistance, and training in alternative livelihoods.

10.6.2.4 Wetland and Water Body Protection

- **Wetland Buffers:** Establish buffer zones around wetlands and water bodies where no construction is permitted. These buffers should be vegetated with native plants to filter runoff and protect water quality.
- **Pollution Control Measures:** Implement strict pollution control measures at construction sites near wetlands and water bodies. This includes sediment control practices, proper waste disposal, and the use of environmentally friendly construction materials.

- **Wetland Restoration:** Restore and enhance degraded wetlands by re-establishing native vegetation, improving hydrology, and removing invasive species. This will help maintain the ecological functions of wetlands and support biodiversity.

10.6.2.5 Landslide and Erosion Prevention in Hilly Areas

- **Slope Stabilization:** Use engineering techniques, such as terracing, retaining walls, and slope reinforcement, to stabilize slopes and reduce the risk of landslides in hilly areas.
- **Reforestation and Afforestation:** Reforest cleared hillsides with native tree species to prevent erosion and improve slope stability. Afforestation efforts should prioritize areas at high risk of landslides and soil degradation.
- **Monitoring and Early Warning Systems:** Establish monitoring systems to detect early signs of landslides and erosion. Implement early warning systems to alert communities and authorities in the event of a potential landslide.

10.7 Environmental Management Plan

The Environmental Management Plan (EMP) for Ramu Upazila is designed to mitigate the environmental impacts associated with the Upazila Town (Non-Municipal) Master Plan and Basic Infrastructure Development Project. This plan outlines specific actions, responsibilities, timelines, and monitoring mechanisms to ensure that development activities align with environmental sustainability and minimize harm to the local ecosystem.

10.7.1 Objectives of the EMP

- To minimize environmental degradation associated with infrastructure development and land use changes.
- To protect and enhance biodiversity and natural resources in Ramu Upazila.
- To ensure sustainable use of water and soil resources through effective management practices.
- To mitigate the impacts of climate change by promoting resilient infrastructure and land use.
- To engage local communities in environmental conservation and management efforts.

10.7.2 Key Components of the EMP

10.7.2.1 Biodiversity Conservation

Action 1: Habitat Protection and Restoration

- **Objective:** Protect existing natural habitats, including mangrove forests, tropical deciduous forests, and wetlands, and restore degraded areas.
- **Activities:**
 - Designate protected areas within the Upazila, focusing on critical habitats.
 - Implement reforestation and afforestation programs, particularly in degraded forest areas and along riverbanks.

- Establish biodiversity corridors to connect fragmented habitats.
- **Responsible Parties:** LGED, Upazila Parishad, Department of Environment (DoE)
- **Timeline:** Ongoing, with annual progress reviews.

Action 2: Prevention of Habitat Fragmentation

- **Objective:** Avoid fragmentation of ecosystems due to infrastructure development.
- **Activities:**
 - Conduct Environmental Impact Assessments (EIAs) before infrastructure projects to identify and mitigate risks of habitat fragmentation.
 - Re-route roads and other infrastructure to avoid critical habitats.
- **Responsible Parties:** Contractor, LGED
- **Timeline:** During planning and pre-construction phases of all projects.

10.7.2.2 Soil Management

Action 3: Erosion Control and Soil Stabilization

- **Objective:** Prevent soil erosion and degradation, particularly in hilly areas and along riverbanks.
- **Activities:**
 - Implement terracing, contour plowing, and the planting of deep-rooted vegetation to stabilize soil.
 - Use geotextiles and retaining walls in vulnerable areas.
 - Promote sustainable agricultural practices, such as crop rotation and agroforestry, to maintain soil health.
- **Responsible Parties:** LGED, Contractor, Department of Agriculture, Local Farmers' Associations, DoE.
- **Timeline:** Throughout the project, with monitoring after each rainy season.

Action 4: Soil Salinity Management

- **Objective:** Mitigate soil salinity in coastal and low-lying areas to maintain agricultural productivity.
- **Activities:**
 - Introduce salt-tolerant crop varieties.
 - Improve drainage systems to prevent waterlogging and salinity buildup.
 - Encourage the use of organic matter to improve soil structure and reduce salinity.
- **Responsible Parties:** Department of Agriculture, Local Farmers' Associations.

10.7.2.3 Water Management

Action 5: Sustainable Water Use and Irrigation

- **Objective:** Ensure the sustainable use of water resources for agriculture, domestic use, and industrial activities.
- **Activities:**
 - Upgrade irrigation infrastructure to reduce water loss and improve efficiency.
 - Promote rainwater harvesting and the construction of small reservoirs to store water during the dry season.
 - Implement groundwater management practices to prevent over-extraction and salinization.
- **Responsible Parties:** Water Development Board, Department of Agriculture, Local NGOs.
- **Timeline:** Continuous, with reviews during the dry season.

Action 6: Flood Risk Management

- **Objective:** Minimize the impact of flooding on communities and infrastructure.
- **Activities:**
 - Construct and maintain embankments, levees, and flood retention basins.
 - Restore and conserve wetlands to act as natural flood buffers.
 - Develop and implement early warning systems for floods.
- **Responsible Parties:** Contractor, BWDB,, Upazila Parishad, Local NGOs.
- **Timeline:** Ongoing, with monitoring before and during the monsoon season.

10.7.2.4 Waste Management and Pollution Control

Action 7: Construction Waste Management

- **Objective:** Reduce the environmental impact of construction waste.
- **Activities:**
 - Implement waste management plans for construction sites, including recycling and proper disposal of materials.
 - Monitor construction activities to prevent illegal dumping and pollution of water bodies.
- **Responsible Parties:** Construction Contractors, DoE, LGED, Municipality and Local Authorities.
- **Timeline:** During all phases of construction.

Action 8: Pollution Prevention

- **Objective:** Prevent pollution from construction and industrial activities.

- **Activities:**
 - Enforce regulations on the use of hazardous materials and chemicals in construction and agriculture.
 - Implement sediment control measures to prevent runoff into rivers and wetlands.
 - Regularly monitor air, water and soil quality in areas near construction sites.
- **Responsible Parties:** DoE, Local Environmental Monitoring Agencies, Construction Contractors.
- **Timeline:** Continuous, with regular inspections.

10.7.2.5 Climate Change Adaptation

Action 9: Climate-Resilient Infrastructure

- **Objective:** Build infrastructure that can withstand the impacts of climate change, including increased storm intensity and sea-level rise.
- **Activities:**
 - Use climate-resilient materials and construction techniques for roads, buildings, and coastal defenses.
 - Incorporate green infrastructure solutions, such as permeable pavements and green roofs, to enhance climate resilience.
- **Responsible Parties:** LGED, DoE, Others NGO
- **Timeline:** During the design and construction phases of all infrastructure projects.

Action 10: Mangrove Restoration

- **Objective:** Enhance coastal resilience through mangrove restoration.
- **Activities:**
 - Identify and restore degraded mangrove areas along the coast.
 - Engage local communities in mangrove planting and conservation efforts.
 - Monitor the health of restored mangrove forests and their effectiveness in protecting against storm surges.
- **Responsible Parties:** Department of Forestry, Local NGOs, Coastal Communities.
- **Timeline:** Ongoing, with biannual assessments.

10.7.3 Monitoring and Evaluation

Action 11: Regular Environmental Audits

- **Objective:** Ensure compliance with the EMP and assess the effectiveness of mitigation measures.

- **Activities:**
 - Conduct regular environmental audits of all project activities, including construction sites, agricultural areas, and protected zones.
 - Use remote sensing and GIS tools to monitor changes in land use, vegetation cover, and water quality.
- **Responsible Parties:** DoE, Independent Environmental Consultants.
- **Timeline:** Annually, with reports submitted to relevant authorities.

Action 12: Community-Based Monitoring

- **Objective:** Involve local communities in monitoring environmental impacts and implementing mitigation measures.
- **Activities:**
 - Establish community-based monitoring groups to report on environmental changes and compliance with EMP measures.
 - Provide training and resources to communities for effective monitoring and reporting.
- **Responsible Parties:** Local NGOs, Community Leaders, DoE.
- **Timeline:** Continuous, with regular feedback sessions.

10.7.4 Reporting and Review

Action 13: Environmental Reporting

- **Objective:** Ensure transparency and accountability in the implementation of the EMP.
- **Activities:**
 - Prepare quarterly and annual environmental reports summarizing the findings from monitoring activities, progress on mitigation measures, and any incidents of non-compliance.
 - Make reports available to the public and stakeholders through community meetings and online platforms.
- **Responsible Parties:** Contractor, LGED.
- **Timeline:** Quarterly and annually.

Action 14: EMP Review and Revision

- **Objective:** Update the EMP based on new information, monitoring results, and stakeholder feedback.
- **Activities:**
 - Conduct an annual review of the EMP to assess its effectiveness and relevance.
 - Revise the EMP as needed to address emerging environmental challenges and improve mitigation strategies.
- **Responsible Parties:** LGED, Independent Environmental Consultants.
- **Timeline:** Annually, with revisions implemented as needed.

10.8 Physical Planning Implication

The physical environment refers to the external surroundings and conditions in which we live and which influence a person's health. The physical environment comprises all the different factors of nature, including air, trees, natural vegetation, lakes, hills, forest, rivers and other water bodies.

Physical planning in context of environment refers to known as land use planning as a process that considers the environment in many ways including location, land use, environmental aspects, natural features – hills and forest, built environment, sustainable development, transport and place-making. Physical planning is all about designing urban and rural areas that are not only livable and efficient but also sustainable and resilient. Environmental planning addresses issues like transportation, housing, waste management, and green spaces to minimize environmental impacts. Eventually, physical planning is targeted to

- Minimizing environmental impacts which are instrumental in minimizing environmental impacts by fostering eco-friendly urban development.
- Promoting sustainable lifestyle which encourages sustainable lifestyles by enhancing access to public transport, green spaces, and eco-conscious housing.
- Enhancing resilience i.e., the resilience of urban and rural areas and their inhabitants in the face of environmental challenges.
- Protecting existing natural features such as hills and forest areas
- Improving quality of life which contributes to an improved quality of life by creating healthier and more sustainable urban environments.

All the above mentioned issues and aspects related to environment would be adequately addressed in view of reviewing and updating the master plan of Ramu Upazila.

10.9 Conclusion & Recommendations

With its rich biodiversity, critical ecosystems, and vulnerable coastal and agricultural landscapes, Ramu Upazila faces significant environmental challenges as it undergoes infrastructure development under the Upazila Town Master Plan and Basic Infrastructure Development Project. The area exhibits key environmental features—coastal mangroves, riverbanks, wetlands, hilly areas, corridor for wildlife movement specifically elephants and agricultural lands—those are vital to the region’s ecological balance and the livelihoods of its communities. However, these components are also at risk from the potential impacts of development, including habitat destruction, soil erosion, water pollution, and increased vulnerability to climate change.

To address these challenges, the project has integrated site-specific mitigation measures that focus on preserving and restoring critical habitats, managing soil and water resources sustainably, and protecting vulnerable areas from environmental degradation. Key mitigation strategies include establishing protected zones for mangroves, implementing erosion control and floodplain management practices, conserving agricultural lands, and ensuring pollution control in sensitive areas. These measures are supported by a comprehensive management and monitoring plan, which includes regular environmental audits, community engagement programs, and adaptive management to respond to emerging issues.

Effective implementation of these mitigation measures and the continuous monitoring of environmental impacts is crucial to achieving the project’s goals while safeguarding Ramu’s natural heritage. By prioritizing environmental sustainability and involving local communities in conservation efforts, the project can contribute to the long-term resilience and ecological health of Ramu Upazila, ensuring that development benefits both the environment and the people who depend on it.

Chapter Eleven: Legal and Institutional Framework for Implementation of the Project Output



CHAPTER ELEVEN: LEGAL AND INSTITUTIONAL FRAMEWORK FOR IMPLEMENTATION OF THE PROJECT OUTPUT

11.1 Introduction

Legal and institutional framework is a broad notion and it concerns the functions of governments, private enterprises, political jurisdictions, judicial systems, legislative bodies, and regulatory agencies. The legal and regulatory framework matrix category covers broad issues related to the laws, regulations, and policies passed by governments, including stakeholder participation and input into the decision-making process. The term “institutional framework” refers to a set of formal organizational structures, rules and informal norms for service provision. Regulatory Framework brings about ongoing confidence to the public that sustainable procedures and processes have been put in place to which they participate. It is the backbone to which the economy and the people depend on.

Bangladesh is one of the most populous and densely populated countries in the world. About 40 percent of its 169.40 million people live in the urban areas of the country. There has been increased rural to urban movement by the population over the last two decades seeking better living conditions and greener pastures. The increased migration has caused a major shift in the need for urban infrastructure to support services at where the population is congregating to. Urban population as a percentage of total population increased from around 8% (at independence in 1971) to nearly 38.95% (BSS data, 2022). Though the present urban dwellers constitute about 38.95 percent of the total populations of Bangladesh, the share and contribution of urban centers to GDP is more than 60 percent indicating that the productivity of labor in urban areas is much higher than in rural areas.

Government policies, laws and regulations influence the creation and implementation of a master plan, particularly one for an urban region both directly and indirectly. Before beginning of the master plan for Ramu Upazila, It is critical to evaluate the relevant policies, rules and regulations.

11.2 Review of Legal Policies, Strategies and Statement

11.2.1 Urban Management Policy Statement, 1999

11.2.1.1 Background

Rapid urbanization in Bangladesh necessitates increased investment and improvements in urban public service delivery, in the eleven major metropolitan centers — Dhaka, Chittagong, Khulna, Sylhet, Rajshahi, Mymensingh, Barisal, Rangpur, Cumilla, Narayanganj and Gazipur — as well as in smaller towns. The government is committed to improving the quality of life in cities and urban centers, particularly for the poor; so that service delivery is proportionate with population density so that these urban areas can become sources of opportunity, commerce, and economic growth forecasted in the 8th FYP.

11.2.1.2 Overview

Urban population of Bangladesh rose at a pace of nearly 5.4 percent per year between 1981 and 1990 (more than double the average yearly population growth rate of about 2.4 percent) and is currently rising at about 4.2 percent. As a result, there are significant to extreme shortages in urban infrastructure and services, such as water supply, sanitation, solid waste collection, drainage, and transportation. Bangladesh's urban sector consists of twelve city corporations and over 200 subsidiary towns or municipalities, known as Pourashavas, which are the country's primary urban institutions. Decentralization can improve the efficiency of government spending by allowing local governments to be more responsive to local needs and preferences.

While decentralization is a long-term aim, certain policies must be implemented immediately in order to improve the management and delivery of urban services. These are primarily focused on increasing Pourashavas' technical, financial, and management capacity to plan, create, and implement long-term programs and projects with strong civic participation. These must come before any long-term decentralization attempts, as political devolution without local capacity to absorb the increased fiscal and political power could lead to waste and infrastructure shortages. The Bangladeshi government has issued an Urban Management Policy Statement, which serves as a basic policy framework for guiding and sustaining the gradual decentralization process. The goal of this policy statement is to enhance and build upon the existing policy.

11.2.1.3 Objectives

The principal objective of an urban management policy is to ensure that investment choices and methods pertaining to urban services balance considerations of equity and efficiency to produce sustainable gains. Specific operational objectives of the Government for improving urban management are:

- To promote long term capital investment planning by Pourashavas and city corporations, wherein specific investments are linked to an overall capital investment program;
- To improve the fiscal discipline — including budgeting and accounting processes — of Pourashavas and city corporations,
- To rationalize the inter-governmental revenue sharing mechanism to induce local effort and better reflect demand for resources;
- To improve tax efforts by Pourashavas and city corporations;
- To improve municipal access to long term infrastructure financing on a demand driven basis;
- To enhance private sector participation in the management and delivery of urban services;
- To improve community participation in the prioritization of investment as well as in specific operations and maintenance (O&M) activities;
- To provide all necessary technical assistance to Pourashavas and city corporations.

11.2.1.4 Policy Principles

Based on local and international experiences, the following principles have been adopted as the basis of policy formulation:

- Physical investments by municipalities will focus on the entire range of municipal services leading to the improvement of public health, well-being of people and economic development;
- Infrastructure deficits should be addressed on a priority basis with emphasis on maintenance and extension of coverage to the slums and poorer communities;
- Steps should be taken to gradually reduce grant dependency of Pourashavas and city corporations;
- Community and civic group participation in the prioritization of municipal investments should be emphasized. Community participation should be encouraged both in the long-term capital investment planning exercises as well as for specific subprojects with a view to ascertaining demand and ensuring long-term sustainability.
- The Government will promote an enabling environment for the private sector to participate and contribute to sector development both in terms of service delivery as well as provision of technical assistance.
- It will be ensured that all municipal investments and development activities are considered within broader environmental considerations.
- Municipal capacity building and urban management shall be approached within the context of the overall goal of democratic decentralization.

11.2.1.5 Policies

Municipal Services: Pourashavas and city corporations shall provide and maintain the following services to their constituents: (i) Water supply, (ii) storm water drainage (iii) solid waste disposal,

(iv) Public sanitation. (v) roads and traffic control systems, (vi) public markets, (vii) public transport terminals. (viii) recreational parks and reserves, (ix) community centres, (x) street lighting, etc.

Public Investment Programs: Municipalities shall develop Public Investment Programs (PIP), which will reflect the priority infrastructure needs and appropriate fiscal practices needed to accomplish these. A PIP prototype to be used by all municipalities shall be developed to facilitate this process.

Transparent Capita Budgeting Process: The capital budgeting process by municipalities and project selection shall be made transparent. For capital investment projects financed with central government funds, municipalities shall be made, wherever feasible, participants in the design and implementation of such projects.

Land Use: Land use plans shall be prepared by Pourashavas and city corporations in consultations with local communities and shall be periodically updated. Such plan shall form the basis for all property and land development and the assessment of taxes. Each

Pourashava and City Corporation shall endeavor to appoint a full-time qualified Urban Planner to its staff for this purpose, and until such appointment is executed, such services shall be contracted out.

Focus on Slum and Poor Communities: Pourashavas and city corporations shall provide services in slums, including provisions of water, drainage, footpaths, sanitation, solid waste disposal and street lighting. Self-help shall be the basis of such development with Pourashavas and city corporations providing necessary facilitation including trained community and health workers. Income generation especially for women shall be a major objective of all slum improvement programs.

Uniform Municipal Financial Policy: All external financing extended directly to either Pourashavas or City Corporations by multilateral or bilateral sources or lent via the MDF for municipal investments shall be provided on comparable terms.

Double Entry Accounting System: Pourashava and city corporations will adopt as early as possible a double entry accounting system on a cash basis. Training and technical assistance shall be provided on a priority basis to facilitate computerization in the transition to double entry accounting.

Own Source Revenues: Pourashavas and city corporations shall generate sufficient revenues from their own sources to meet, at a minimum, all of their operating expenses.

Intergovernmental Revenue Transfer System: The Government shall review in consultation with municipalities the current intergovernmental revenue transfer system and make appropriate changes to make it transparent, rational, and predictable and to some extent performance based.

Private Sector Participation: Pourashavas and city corporations shall endeavor to contract out service provision in whole or in part to private providers in areas such as solid waste disposal, public sanitation, and road maintenance. Finally, the Government shall formulate and issue a comprehensive privatization policy statement clarifying and providing for a conducive legal and regulatory framework for private participation in all sectors, including the municipal sector.

Community Participation and Public Consultation: Pourashavas and City Corporation shall conduct periodic public meetings to advise their constituents regarding their activities as well as to engage the public in consultations regarding investment choices, decisions, and priorities. As part of this increased transparency, Municipalities shall follow an open public record policy. Additionally, municipalities shall ensure that communities will actively participate in planning, implementation, and operation and maintenance municipal services.

Role of Women: Maximizing the participation of women shall be accorded high priority.

11.2.2 Housing Policy, 2004

11.2.2.1 Introduction

Housing, like food and clothing, is a basic human requirement. It ensures the people's safety and social standing. It also provides living amenities for humans, laying the groundwork for them to work and earn money. In both urban and rural parts of Bangladesh, there is now a

severe housing shortage. The Bangladeshi government is well aware of the issue. To address the housing crisis, the

Government has taken a number of actions, including involving the public and private sectors in the housing sector, particularly for the lower and lower middle-income groups, providing shelter for homeless persons, and so on. Housing, in reality, is seen by the government as an attempt to promote human settlements, culture, and the economy of the country. In accordance with a United Nations decision made in 1988 to offer housing for everyone by the year 2000 AD and to achieve such a goal as a strategy, UN member states were asked to develop their own housing policies. Furthermore, all United Nations member states have been asked to put the recommendations of the 1992 Rio de Janeiro Conference on Environment and Development on human settlements development into action. The national housing policy was developed in response to the above-mentioned proposals and the government's Fifth Five Year Plan (1997-2002).

11.2.2.2 Objectives

The following are the main objectives of the housing policy:

- Ensure housing for all people of all walks living in the urban and rural areas especially for the lower and medium income group of people. In this context, preferences will be given to female headed households, socially disadvantaged people, and homeless people
- Arrange land for the lower and medium income group of people within their affordable limits
- In this context, earn profit through providing land to the richer section of people and provide subsidy to the lower income people
- Evolve strategies to reduce the development of slums and squatters here and there and transfer those settlements in suitable places ensuring healthy environment
- Resettlements for the people affected by disasters and fire
- Development of economic institutional facilities for encouraging and engaging personal savings for the housing purposes
- Evolve and making efforts for development and use of alternative and sustainable building materials based on the locally available forest resources such as wood, bamboo, straw, etc.
- Prepare appropriate institutional and legal framework which are easier for the housing development.
- Ensure to maintain and develop the local entity/character, quality, and environmental condition of the existing residential area
- amend and incorporate new strategies in the existing housing policy so as to address the newly emerging problems and issues to the housing in the country
- make efforts to keep housing cost and rent within the tolerable limit of the people

- reduce the migration of the rural people in the urban areas through creating employment opportunities
- encourage people to construct houses through keeping limit to imposing property taxes
- Evolve new strategies and techniques for the housing development to ensure better environment in the housing areas.

11.2.2.3 Policies

To achieve the above objectives, the strategy of the government is to act as a promoter and facilitator and also as a provider to a limited extent. The salient features of the housing strategy envisaged in the National Housing Policy are:

- The role of the government in housing will be to supply serviced land at reasonable price and to help create and promote housing financing institution
- Efforts will be made to increase affordability of the disadvantaged and the low-income groups through providing credit for income generation
- Improvement and rehabilitation of the existing housing stock will be given priority by the government alongside new housing
- Encroachment on public land and unauthorized constructions will be discouraged
- Facilities incremental house building and ensure wider application resources
- Conservation of the natural environment and preservation of cultural heritage in new housing projects

11.2.3 Population Policy, 2004

11.2.3.1 Introduction

Bangladesh's constitution places a strong emphasis on socioeconomic development for all inhabitants. According to Articles 15, 16, 17, and 18 of the Constitution, the state is responsible for providing basic needs such as health, education, food, and security to its population. The government had implemented a wide range of public policies in order to make these constitutional ambitions a reality. The government created a Population Policy Outline in 1976, recognizing the importance of population and development, and had designated the population problem as a national priority. The Policy stands out as one of the government's most notable accomplishments. This policy focus has been mirrored in all subsequent 5-year plans and programs since 1976. As a result, the percentage of people who utilize family planning methods has risen from 8% in the mid-1970s to 54% in 1999- 2000. The total fertility rate (TFR) has lowered from 6.3 to 3.32, allowing the population growth rate to be reduced from 3% in the mid-1970s to 1.47 percent by the year 2000. However, the environment needed to improve the general public's quality of life has yet to be created. High population growth continues to be a roadblock to national progress. In 2002, Bangladesh's population was estimated to be over 129.3 million people. In the Interim Poverty Reduction Strategy Paper (IPRSP) document: A National Strategy for Economic Growth, Poverty Reduction, and Social Development, the government just established its development strategy. Upholding human rights and focusing decisions made at the

International Conference on Education in Jomtien in 1993, the International Conference on Population and Development (ICPD) in 1994, the International Conference on Women and Children in Beijing in 1995, the Millennium Development Goals (MDGs) of the Millennium Summit in New York in 2000, and other relevant decisions taken in international forums have begun to update the existing national population policy.

11.2.3.2 Major Objectives

The objectives of the National Population Policy are to improve the status of family planning, maternal and child health including reproductive health services and to improve the living standard of the people of Bangladesh through making a desirable balance between population and development in the context of Millennium Development Goals (MDGs) and Interim Poverty Reduction Strategy Paper (IPRSP): A National Strategy for Economic Growth, Poverty Reduction and Social Development. The following major policy objectives will help address the future challenges:

- Reduce Total Fertility Rate (TFR) and increase the use of family planning methods among eligible couples through raising awareness of family planning;
- Attain NRR equal to one by the year 2010 so as to stabilize population around 2060;
- 3.3 Ensure adequate availability and access of Reproductive Health Services, specially family planning services to all including information, counseling and services for adolescents;
- Improve maternal health with emphasis on reduction of maternal mortality;
- Reduce RTIs/STIs and prevent spread of HIV/AIDS
- Reduce infant and under five mortality rates;
- Reduce maternal and child malnutrition;
- Promote and actively support programs for elimination of gender disparity in education, health and nutrition;
- Ensure Early Childhood Development (ECD) program;
- Ensure and support gender equity and empower women;
- Develop the human resource capacity of planners, managers and service providers, including improved data collection, research and dissemination;
- Actively support measures to provide food and social security and shelter for the disadvantaged including the elderly, destitute, physically and mentally retarded persons;
- Actively support measures to regulate and reduce rural to urban migration;
- Support measures for environmental sustainability with emphasis on access to safe drinking water;
- Support poverty alleviating strategies and conducive environment for improved quality of life;
- Ensure coordination among relevant Ministries in strengthening population and

development linkages and making their respective mandates and implementation strategies more population focused;

11.2.3.3 Strategies

Urban population in Bangladesh is increasing at the rate of 4.0 percent per annum, largely attributable to rural-urban migration. This high growth rate is putting tremendous pressures on urban facilities and civil services, including law and order. Hence, the following strategies will be adopted to slow down the growth of urban population:

- Slow down the rate of migration from rural areas to Dhaka and other major cities. To this end, there is a need to mitigate the push factors from rural areas by ensuring rural employment opportunities in agriculture and agro-based industries. Simultaneously satellite towns and growth centers should be established with adequate facilities to provide alternative destinations to rural migrants. Roads and communication systems should be linked with the growth centers; along with health, education, housing, and other welfare services created in those places. Headquarters of important Government and non- Government Organizations, educational institutions and industrial units may also be shifted or relocated to other cities;
- Relax rules relating to going abroad of skilled workers and make provision for dual citizenship;
- Impart education and skill training to the young men and women to become competent and skillful to handle many new and emerging fields in the cities and towns;
- Create skilled manpower for overseas employment;

Ensure coordinated and planned development of the towns and cities keeping in view the future growth of population and prevent the growth of urban slums through vigilance of administration, municipalities and law enforcing agencies, which may slow down the rate of population growth in urban areas.

11.2.4 National Agriculture Policy, 1999

11.2.4.1 Introduction

Bangladesh's economy is mostly based on agriculture. Approximately 84 percent of the population lives in rural areas and is involved in a variety of agricultural activities, either directly or indirectly. Agriculture accounts for around 32% of the country's GDP, with the crop industry accounting for about 23% of that. Agriculture employs over 63 percent of the workforce, with agricultural production accounting for about 57 percent. Upazila is also dependent on agricultural production and most of the population is engaged in agriculture directly.

The scope of modern agriculture has been greatly expanded. Although agriculture was originally defined as the cultivation of land for the sole purpose of producing crops, it is now widely accepted that any applied activity involving the production, development, preservation, processing, marketing, and extension of not only crops but also other agricultural commodities such as fish, meat, eggs, forest products, and so on, falls under the

umbrella of agriculture. Crop production, animal husbandry, fishing, forestry, and other aspects of agriculture are included in the above concept. Crops, on the other hand, are without a doubt Bangladesh's largest and most important agricultural industry.

By establishing agriculture as a profitable sector in Bangladesh, it is possible to alleviate rural poverty and enhance the living standards of ordinary people. As a result, the agricultural production system must be reorganized and developed into a more dynamic and commercially viable sector. In this context, the National Agriculture Policy's main purpose is to modernize and diversify the crop sector, or the overall agricultural system, by launching and implementing a well-organized and well-coordinated development plan.

11.2.4.2 Objectives

The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable food security system for all. The specific objectives of the National Agriculture Policy are to:

- To ensure a profitable and sustainable agricultural production system and raise the purchasing power by increasing real income of the farmers;
- To preserve and develop land productivity;
- To reduce excessive dependence on any single crop to minimize the risk;
- To increase production and supplies of more nutritious food crops and thereby ensuring food security and improving nutritional status;
- To preserve existing biodiversity of different crops;
- To take up programs for the introduction, utilization and extension of bio-technology;
- To take necessary steps to ensure environmental protection as well as 'environment-friendly sustainable agriculture' through increased use of organic manure and strengthening of the Integrated Pest Management (IPM) program;
- To take appropriate steps to develop an efficient irrigation system and encourage farmers in providing supplementary irrigation during drought with a view to increasing cropping intensity and yield;
- To establish agriculture as a diversified and sustainable income generating sector through strengthening of 'Farming System' based agricultural production and agro-forestry programs;
- To take effective steps to ensure input supplies to the farmers at fair prices in a competitive market and remove difficulties at the farmers' level which have arisen out of the privatization of input distribution system;
- To develop marketing system to ensure fair prices of agricultural commodities;
- To introduce an appropriate institutional system of providing credit to ensure the availability of agricultural credit in time;
- To produce and supply of agricultural commodities as required by the industrial sector;

- To reduce imports of agricultural commodities and find out newer opportunities for increasing exports as well;
- To create opportunities for establishing agro-processing and agro-based industries;
- To protect interests of the small, marginal and tenant farmers;
- To update the agricultural system in the light of the Agreement on Agriculture under WTO, SAFTA and other international treaties by protecting the national interests; and
- To Develop contingency management system to combat natural disasters.

In line with the above-mentioned objectives, the Government has the primary responsibility of ensuring optimum use of land. Although land is privately owned property in general, its use has to be compatible with the overall social goals and utility. Moreover, it is important to consider that the interests of small arid marginal farmers and the sharecroppers are protected, as they constitute the majority of farmers.

11.2.4.3 Steps and Strategies

The following steps will be taken to ensure planned utilization of land for crop production:

- Land zoning program will be taken up by the Soil Resources Development Institute (SRDI) on a priority basis. Integrated approach of SRDI will be further strengthened for this purpose.
- To ensure maximum utilization of land, bottom-up planning through people's participation and its implementation will be started from the mouza or village level.
- In most areas the same land is suitable for more than one crop. Therefore, farmers will be encouraged to grow more profitable crops as an alternative to only rice-rice cropping pattern.
- Fertile agricultural land is going out of cultivation due to its use for non-agricultural purposes such as private construction, house building, brickfield, etc. Appropriate measures will be taken to stop this trend in the light of the Land Policy of the government.
- Maximum utilization of land will be ensured through promotion of inter-cropping with the main crops
- Acquisition of land in excess of requirement for non-agricultural purposes will be discouraged.
- Programs will be taken up to motivate the landowners not to keep their land unused without any acceptable reason.

Appropriate measures will be taken in the light of the Land Policy so that the interests of small and marginal farmers and the sharecroppers are protected and that the agricultural land is not kept fallow for a long period.

11.2.5 Industrial Policy, 2005

11.2.5.1 Introduction

Bangladesh is a developing country, and the present government is striving relentlessly to attain rapid economic development in the country. Many programs taken so far have been carried out successfully. Despite a lack of resources faced by the Government, development programs in the key sectors have continued. At the same time, considering the importance of the private sector, an all-out support is being provided to initiatives taken in this sector. As a result, a new kind of dynamism is under way in both the public and private sectors. In this backdrop, it is essential to examine various aspects of industrialization and its impacts on overall economic activities. Given the present environment of global competition, the private sector is playing an important role in the industrialization of the country. Therefore, the Government in the Ministry of Industries has taken the role of a facilitator. Faced with the challenges of the free-market economy and globalization, the government has accepted private ownership and management of industrial enterprises as one of the major guiding forces in achieving economic growth. Besides this, the government has also brought about many constructive and timely reforms in the running of businesses, and liberalized trade so that private entrepreneurs can seize opportunities of establishing and running industrial enterprises profitably and freely.

In the meantime, quite a number of publicly managed industrial enterprises have already been sold out and transferred to private ownership. In order to establish economically prospective industries in industrial sub-sectors, there are plans to set up industrial parks and special economic zones so that huge amounts of unused and abandoned land can be utilized. All this is aimed at fostering industrialization and economic development and generating employment opportunities in the country. To reduce poverty and generate employment opportunities, more efforts are needed to establish agro-based industries as well as to raise agricultural production. This will ensure the protection and fair price of agricultural products and employment of a huge number of unemployed people. In order to create further employment opportunities beyond the agricultural sector, initiatives should be taken to set up small, medium, and large industries across the country. If these types of industries are set up in a planned way, then unemployment rates will decline, and poverty alleviation will be accelerated. With these objectives in mind, the Industrial Policy has been radically reshaped.

The industrial sector is likely to grow rapidly over the next decade raising its contribution to the country's GDP to 30 to 35 percent, and the workforce in this sector is expected to increase to 35 percent of national employment need. In order to attain this growth in this sector, special importance has been given to the Industrial Policy on agro-based and agro-processing industries and on steps to overcome possible adverse conditions in the export-oriented garment sector. Importance has also been given on considering the SMEs and cottage industries as one of the major driving forces, providing assistance to women entrepreneurs on a priority basis, setting up special economic zones in different parts of the country, improving the quality of industrial products to world standard, marketing of goods at competitive prices, and enhancing productivity in the industrial sector.

To this end, it can be hoped that the guidelines contained in the new Industrial Policy will help expand planned industrialization in the country, bring about sustainable and continuous industrial growth, and overcome the past failures of industrialization to a great extent. As a result, a sound and prospective foundation of economic development will be established. This will help bring about poverty alleviation, create further employment opportunities, reduce unemployment instances, improve living standards of people, and achieve overall economic growth in the country.

11.2.5.2 Objectives

- One of the foremost objectives of the Industrial Policy 2005 is to set up planned industries considering the real domestic demand, prospect of exporting goods abroad, and discouraging unplanned industries in the light of past experience.
- Accept private initiatives as the main driving force of economic development and uphold the government's facilitating role in creating a favorable atmosphere in order to augment private investments in the country's industrialization, given the background of a free-market economy and globalization.
- Arrange for state-owned industrial enterprises to be sold/transferred/leased or administered in any other way by the Privatization Commission or concerned ministries in order to accelerate the privatization process.
- Take necessary initiatives to set up industries with private entrepreneurships, and where that is feasible, establish industries on state initiative in those sectors that are considered very important and essential because of national interest, where private entrepreneurs are not forthcoming.
- Catering the needs for local and foreign market and also for consumer satisfaction of the local products; measures to be undertaken (a) produce world class quality products, (b) diversification of goods, (c) introduce cost-effective management in the production system, (d) more value addition in the industrial sector, and (e) provide support for enhancing productivity by using continuous, appropriate, and advanced technology.
- Provide assistance to augment the industrial sector's contributions to the GDP of the national economy, meet the general demands of local consumers and earn more foreign exchange so that local industrial entrepreneurs can attain further capacity to establish industries, and industrial goods can have access to the overseas market on a competitive basis
- Provide inspiration for the speedy expansion of cottage industries and SMEs and for further investment in these sectors so that new employment opportunities are generated, unemployment reduced, and poverty alleviation program made in the country.
- Prioritize the expansion and development of agro-based and agricultural processing industries, and assist in the expansion of poultry, dairy and goat-sheep industry as agricultural industries.

- Provide women entrepreneurs with all necessary assistance in establishing industries in various sectors.
- Increase productivity at enterprise level; produce high value-added products step by step through development and application of appropriate technology and increase export through export diversification.
- Provide all necessary assistance for producing environmentally friendly products with the objective for creating a pollution-free environment in the industrial sector.
- Expand the local market and establish more backward linkage industries in order to accelerate the export of high value-added garments produced in the export-oriented garment industries and other relevant industrial sub- sectors.
- Further, enrich the industrial sector with the proper utilization of the country's various natural and mineral resources.

11.2.6 National Health Policy, 2000

11.2.6.1 Introduction

The Ministry of Health and Family Welfare constituted a committee in 1996 for preparation of a Health Policy with members drawn from technocrats, bureaucrats, civil society, and professional bodies.

11.2.6.2 Objectives

- First: To make necessary basic medical utilities reach people of all strata as per Section 15(A) of the Bangladesh Constitution and develop the health and nutrition status of the people as per Section 18(A) of the Bangladesh Constitution.
- Second: To develop a system to ensure easy and sustained availability of health services for the people, especially communities in both rural and urban areas
- Third: To ensure optimum quality, acceptance and availability of primary health care, and governmental medical services at the Upazila and Union levels.
- Fourth: To reduce the intensity of malnutrition among people, especially children and mothers; and implement effective and integrated programs for improving nutrition status of all segments of the population.
- Fifth: To undertake programs for reducing the rates of child and maternal mortality within the next 5 years and reduce these rates to be acceptable level;
- Sixth: To adopt satisfactory measures for ensuring improved maternal and child health at the union level and install facilities for safe and clean child delivery in each village;
- Seventh: To improve overall reproductive health resources and services;
- Eighth: To ensure the presence of full-time doctors, nurses and other officers/staff, provide and maintain necessary equipment and supplies at each of the Upazila Health Complexes and Union Health and Family Welfare Centers;
- Ninth: To devise necessary ways and means for the people to make optimum usage

of the available opportunities in government hospitals and health service system, and to ensure satisfactory quality management, cleanliness of service delivery at the hospitals;

- Tenth: To formulate specific policies for medical colleges and private clinics, and to introduce appropriate laws and regulations for the control and management of such institutions including maintenance of service quality;
- Eleventh: To strengthen and expedite the family planning program with the objective of attaining the target of Replacement Level of Fertility;
- Twelfth: To explore ways to make the family planning program more acceptable, easily available and effective among the extremely poor and low-income communities;
- Thirteenth: To arrange special health services for mentally retarded, the physically disabled and for elderly populations;
- Fourteenth: To determine ways to make family planning and health management more accountable and cost-effective by equipping it with more skilled manpower;
- Fifteenth: To introduce systems for treatment of all types of complicated diseases in the country and minimize the need for foreign travel for medical treatment.

11.2.7 Draft National Urban Sector Policy 2011

11.2.7.1 Introduction

It is a matter of long-outstanding subject that realized by the concerned professional that urbanization and other related issues of the urban sector need a strong policy support so as to deal with the problems of rapid urban growth in Bangladesh. It was only in the year 2005 that the Government of Bangladesh through its Local Government Engineering Department (LGED), Ministry of Local Government, Rural Development and Cooperatives took initiative and formed a Committee for Urban Local Governance (CULG) and a Sub-Committee for preparation of the National Urban Sector Policy with Professor Nazrul Islam, Chairman of Center for Urban Studies (CUS) as its Convener. The Committee consisted of 16 members who worked for almost a year and formulated a draft policy report. On this draft policy report, a number of consultation meetings were held with different stakeholders. Additions/modifications were done in the draft report. However, it requires now formal approval by the Government which is still in draft form.

11.2.7.2 Background of the Policy

In Bangladesh, cities and towns are playing a crucial role in the national development despite the adverse socio economic and environmental consequences resulting from rapid growth of these urban centers. At present urban dwellers constitute about 26 percent of the total populations of the country, but their contribution to GDP is more than 45 percent indicating that the productivity in urban areas is much higher than that in rural areas. Such gains in productivity, however, cannot be sustained if appropriate steps are not taken to combat negative consequences of urbanization. In other words, there is need for sustainable urbanization so as to achieve sustainable development. Sustainable urbanization' is a dynamic, multi-dimensional process. Most crucially, it includes not only environmental but

also social, economic, cultural, and political-institutional sustainability. Even at 26 percent level of urbanization the total urban population of Bangladesh is already over 36 million

and this population is growing at a very rapid rate of nearly 4 percent per annum while the capital and premier city, Dhaka and the port city, Chittagong are growing even faster. Urbanization in Bangladesh is also characterized by a spatially unbalanced pattern.

11.2.7.3 Future Vision of the Policy

The National Urban Policy envisions strengthening the beneficial aspects of urbanization and at the same time effectively dealing with its negative consequences so as to achieve sustainable urbanization, keeping in view the multi-dimensional nature of the urbanization process. The policy also envisions a decentralized and participatory process of urban development in which the central governments, the local government, the private sector, the civil society, and the people all have their roles to play. The policy, therefore, should cover spatial, economic, social, cultural, aesthetic and environmental aspects of urban life directed towards achieving an urban reality that can ensure freedom from hunger and poverty; capacity to live a healthy life; access to education, shelter, and basic services, and a secure and livable environment at home and at the workplace. The policy will be gender sensitive and friendly to children, the aged and the disadvantaged.

11.2.7.4 Objectives of the Policy

The major objectives of National Urban Sector Policy for Bangladesh, therefore, will be to

- To ensure regionally balanced urbanization through decentralized development and hierarchically structured urban system;
- To facilitate economic development, generation, reduction of inequality eradication through appropriate frameworks and infrastructure provisions;
- To ensure optimum utilization of land resources and meet increased demand for housing and urban services through public-private and other partnerships;
- To protect, preserve and enhance the urban environment, particularly water bodies;
- To devolve authority at the local urban level and strengthen local governments through appropriate powers, resources and capabilities so that these can take effective responsibility for a wide range of planning, infrastructure provision, service delivery and regulatory functions;
- To involve all sectors of the community, including women and the poor, in participatory decision-making and implementation processes;
- To ensure social justice and inclusion by measures designed to increase the security of poor people through their access to varied livelihood opportunities, secure tenure and basic affordable services;
- To take into account particular needs of women, men, children, youth, the elderly and the disabled in developing policy responses and implementation;
- To assure health, safety and security of all citizens through multifaceted initiatives to reduce crime and violence;

- To protect, preserve and enhance the historical and cultural heritage of cities and enhance their aesthetic beauty;
- To develop and implement urban management strategies and governance arrangements for enhancing complementary roles of urban and rural areas in sustainable development; and,
- To ensure good governance by enhancing transparency and establishing accountability.

11.2.7.5 Major Dimensions of the Policy

Effective responses to the challenges posed by rapid urbanization and fulfilling the stated objectives will require giving priorities to the following dimensions while formulating the National Urban Sector Policy: (i) Patterns and process of urbanization; (ii) Local urban planning; (iii) Local economic development and employment; (iv) Urban local finance and resource mobilization; (v) Urban land management; (vi) Urban housing; (vii) Urban poverty and slum improvement; (viii) Urban environmental management; (ix) Infrastructure and services; (x) Urban transportation; (xi) Health and education; (xii) Social structure; (xiii) Gender concerns; (xiv) Urban children, aged, the disabled and The scavengers; (xv) Urban Recreation, Playground, Park, Open Spaces and Graveyards; (xvi) Cultural and aesthetic development; (xvii) Rural-urban linkage; (xviii) Law and order; (xix) Legislation; (xx) Urban Governance and (xxi) Urban Research, Training and Information.

11.2.7.6 Conclusion

In fact, the above-mentioned draft national urban policy has covered a number of wide-ranging issues which are needed to address the problems and issues related to urban growth and development of Bangladesh. It is of urgent need that the present Government should take all the initiatives to adopt and implement the policy so that the urban issues and concerns are duly addressed in the country.

11.2.8 National Land Use Policy, 2001

11.2.8.1 Introduction

Bangladesh is an agrarian country. The source of one-third of the GDP of Bangladesh is agriculture and two-thirds of the people of the country live on agriculture. Therefore, the importance of land and water resources is vital. The land is the natural basic resource which supplies food, industrial raw- materials, elements of ensuring health condition, etc. About 130 million people live 14.4 million hectares of land resulting average land occupation by a person is about 27 decimals and cultivable land of 17 decimals. The size of land possessing per capita is decreasing day by day. In conformity to economic development, the rate of urbanization is increasing, industrial development is taking place, infrastructure such as roads, hospitals, and educational institutions are coming up. As a result, the

land under agriculture is diminishing. The land area under agriculture was 20.2 million acres in 1983-84 has reduced to 17.5 million acres in 1997.

In fact, the best use of the land and water resources depends on the effective land use plan. Land, water resource and environment altogether play a vital in creating indigenous

resources. This is immense importance of having a definite policy through which the use of limited land resources can be ensured.

11.2.8.2 Objectives of the Policy

- To arrest the existing reduction of land used for various purposes so as to ensure the availability of agricultural land to be used for food production;
- To ensure effective control of land use through introducing land zoning in the country based on regional natural potentiality so as to deal with the problem of unplanned residential, industrial and commercial developments;
- To ensure optimum use of *haor* or land rose from the sea or char land targeting resettlements of the landless people;
- To protect government *khas* land for using those land for the future developmental purposes;
- To ensure conformity of land uses with that of the natural environment;
- To use the land optimally in reducing poverty and creating employment opportunities so that eventually the number of landless people is reduced;
- To control land pollution;
- To encourage construction of multi-storied building by the government and private organizations so that modest land is used.

11.2.8.3 Main Components of the Policy

- Use as much as required for agriculture purposes and land use cannot be changed with permission of the appropriate authority
- Ensure use of land owned by the landlord absentee
- Keep limit the process of division of agricultural land into small pieces
- Identification of zones for land uses by all city corporations and Pourashavas and other places of Upazilas
- Preparation of maps for the identified zones
- Provision of assistance by the revenue office of district administration in preparing zoning maps by the local government organizations
- No alteration of land use zoning approved by the authority without any definite valid reasons and bindings
- Existence of zoning law in the country; abide this law to implement the zoning map prepared by the local government organizations
- Encouragement to construct model house and planned residential areas in the rural areas
- Encouragement to construct multi-storied buildings instead of single storied in the rural and urban areas so as to ensure optimum use land for residential purposes

- Identification of the forest land by the Ministry of Forest and Environment
- Undertake measures for protection, maintenance, and expansion of the existing forest land
- Encouragement for development of the social forestry
- Keep open the exiting water bodies and those are not to be filled in. Entrust the responsibility of maintaining small ponds by the owners and large water bodies such as rivers, channels, *haor*, *baor* and *beel* by the community people and the Government. To this effect, these water bodies are to be re-excavated regularly
- Use of embankments for controlling flood as roads as far as possible
- Planned tree plantation on the embankments
- Use ditches and other water bodies for fish production and rearing ducks created during cutting of earth for constructing embankments. Not to dig new land as much as possible during constructing embankments rather re-excavate the existing filled in water bodies
- Ensure not to create waterlogging by constructing embankments
- No acquisition of land for the purpose of road construction other than/except national highways, regional and district to Upazila roads, Upazila to Upazila connecting roads. Avoid human settlements and fertile agricultural land to acquire land wherever land acquisition is of utmost need. Constructs inter and intra village roads in planned manner
- Construct/establish industries in the designated places keeping view on the availability of support services for industrialization
- Construct industries of special types in the areas delineated for such purposes
- Not to pollute/infect land or environment through discharging waste from the industries and follow strictly to treat industrial waste
- Construct service roads along the main roads of the country so as to ensure safe movement of traffic as well as set aside 10 feet to 20 feet of land for plantation trees on both sides of roads
- Discourage construction of small and cottage industries within 10 kilometers of radius if industries are accommodated within the BSCIC industrial area
- Identification and ensuring land use suitable for tea gardens and rubber plantations through surveys and investigations. No other use of land as designated for tea garden purposes
- Inclusion of districts under Chittagong Hill Tracts for conducting surveys for land uses
- Protection of social rights of possessing land by the indigenous people living in the different parts of the country following their traditional laws

11.2.9 Forest Policy, 1994

11.2.9.1 Introduction

The first formal forest policy for the undivided India was promulgated in 1894, which was the basic guidelines for the formulation of Acts and Rules, for the management of forests in the country and latest one in 1994. Prior to this policy" Charter of Indian Forests "was made in 1855 by the Government of British India for conserving forests in India including this tract, Bangladesh. Prior to this charter, there were only scanty regulations regarding the felling of trees for revenue.

11.2.9.2 Objectives

- To meet the basic needs of the present and future generations and also to ensure greater contribution of the forestry sector in the economic development, about 20% of the total area of the country will be afforested by taking up various afforestation programs
- By creating employment opportunities, strengthening the rural and national economy, the scope for poverty alleviation and trees and forest based rural development sectors will be extended and consolidated
- Biodiversity of the existing degraded forests will be enriched by conserving the remaining natural habitat birds and animals
- Agricultural sector will be strengthened by extending assistance to the sectors related with forest development.
- National responsibilities and commitments will be fulfilled by implementing various international efforts and government ratified agreements relating to global warming, decertification and control of trade and commerce of wild birds and animals.
- Through the participation of the local people, illegal occupation of the forest lands, illegal tree felling and hunting of the wild animals will be prevented
- Effective use and utilization of the forest goods at various stages of processing will be encouraged
- Implementation of the afforestation programs - on both public and private lands will be provided with encouragement and assistance.

11.2.9.3 Policy Statements

- Attempts will be made to bring about 20% of the country's land under the afforestation programs of the government and private sector by year 2015
- Because of limited amount of forest land, effective measures will be taken for afforestation in rural areas, in the newly accreted char and in the denuded Unclassed State Forest
- Private initiatives will be encouraged to implement programs of tree plantation and afforestation on fallow and hinter land, the banks of the ponds and homestead lands

- Tree plantation on the courtyards of rural organizations such as Union Parishad, School,
Eidgah, Mosque-Moktob, Temple, Club, Orphanage home, Madrassa
- Massive afforestation on either side of land surrounding road, rail, dam and *khas* tank through the partnership of the local people
- Protected area i.e. National Parks, Wildlife Sanctuaries and Game Reserves' area will be increased by 10 per cent of the reserved forest land by the year 2015
- Inaccessible areas such as slopes of the hills, fragile watersheds, swamps, etc. will be identified and kept as protected forests.
- Women will be encouraged to participate in homestead and farm forestry, and participatory afforestation programs.
- Forest resource based labor-intensive small and cottage scale industries will be encouraged in the rural areas.
- Ecotourism, related to forest and wildlife, is recognized as forestry related activity, which will be promoted taking into consideration the carrying capacity of nature
- Forest Department will be strengthened in order to achieve the goal and objectives of National Forestry Policy. A new department called "Department of Social Forestry" will be established.

11.2.10 Water Conservation Act, 2000

11.2.10.1 Particular Features of the Act

This act is applicable for all playgrounds, open space, play field and natural water body of Metropolitan city, Divisional town, District town and all other Pourashava area. Some Definitions, Specifications and Compensation of illegal encroachments related to these features are mentioned in this Act.

The Act has been formed considering specific features. The illegal development activities need to be controlled to keep those features as it is. This is crucial to preserve the natural environment. The Definitions of specific features are:

- i. Land of Natural Trees/Park-it means that identified Natural land of trees/ park in Master plan or any land Survey design or any place proclaimed by Government, Government gazette
- ii. Open space- it means that identified open space which is proclaimed by Government, Government gazette or which is used as Eidgah or other relevant use by public for a long time.
- iii. Playground-it means that place which is used for Sports or to display any athletic games or any place identified as playground in Master plan
- iv. Natural Water body- it means the Natural Streams (River, khal, Beel, Large Pond/ Lake, Waterfall or water bodies which is identified in Master Plan or any place as flood flow area, rainwater or other natural drainage water reservoir area proclaimed by Government, Local Government, or any organization

Changes in the category of features - it means the changes of any features from those conditions which are as identified or defined in Master Plan or Government Gazette by land deposition, pucca, semi-pucca or katcha structures and any type of building construction.

11.2.10.2 Major Features of the Act

The major specifications in the Act are:

- i. Change in the category of features is strictly prohibited. According to this law, the categories of these features cannot be changed as identified or used for any other purpose or transferred to others for the purpose of rent, lease etc.
- ii. In addition, if the natural characters of any Land are destroyed by cutting trees, then it will be also considered as changes in the category of features.
- iii. If the owners want to change the category of features, it is required to the authority showing the proper reasons that
 - a. Either the changes would hinder the purpose of Master plan or not. If it causes then what would be the amount of loss
 - b. Either the changes cause any negative impact on the environment or not
 - c. Either the changes cause any negative impact on the inhabitants or not
- iv. If any person or Company violate this law by doing any construction work or building any structure which may destroy any features then the development activities or constructed structures will be forfeited.

11.2.11 Building Construction Act 1952

The Act provided regulations regarding setbacks, building heights etc. in urban areas. The act also provided for prevention of haphazard construction of buildings and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh and enables government to make any substantial rules for carrying out the purposes of the act.

11.2.11.1 Definitions

“Building” includes a house, out-house, hut, wall, and any other structure whether of masonry, bricks, corrugated iron sheets, metal, tiles, wood, bamboos, mud, leaves, grass, thatch, or any other material whatsoever.

“Master plan” means the master plan prepared and approved under any law for the time being in force for the utilization of any land anywhere in Bangladesh.

“Owner” in relation to a building or tank means the person at whose expense such building or tank is constructed or excavated or who has the right to transfer the same, and includes his heirs, assigns and legal representatives.

“Tank” includes ditch, drain, well and channel.

11.2.11.2 Restriction on Improper Use of Land and Buildings

No owner or occupier of a building shall, without obtaining previous permission from the Authorized Officer, as the case may be, uses the building for a purpose other than that mentioned in the sanction. When the Authorized Officer is satisfied that the existing use of

any land or building does not conform the scheme of land utilization indicated in the Master Plan, the Authorized Officer may, by an order in writing, direct the owner, occupier, or the person in charge of the land or building to discontinue such use and, in the case of a building also to remove or dismantle such building. Provided, however, that the owner, occupier, or the person in charge of the land or building shall be given six months' time before effect is given to the order of discontinuance of such use and twelve months' time before effect is given to the order of removal or dismantlement of the building. Provided further that no existing or further use of any land or building for combined residential and commercial purpose shall be discontinued or prohibited unless, in any particular case, such use militates against the dominant character of the scheme of land utilization as indicated in the Master Plan and constitutes a nuisance generally to the zone and particularly to the neighborhood in which the land or building is situated.

11.2.11.3 Removal of Buildings

If any person fails to comply with any direction for removal of any building given to him under section 4 or sub-section (1) of section 5 of the Act, within the period fixed therefore, the Authorized Officer may cause the temporary building or the building under construction, as the case may be, to be removed at his own expenses in which case such person shall not be any more entitled to any compensation.

11.2.12 Bangladesh National Building Code (BNBC)

In order to ensure optimum return of substantial portion of national resource invested in building construction, in both public and private sectors and to achieve satisfactory performance of any building construction needs to be controlled and regulated. These instruments needed updating, rationalization, and unification. It was therefore felt that a comprehensive building code would serve the purpose of a uniform national standard. The work to develop the Code began in 1992 and was completed by the end of 1993.

11.2.12.1 Purpose

The purpose of the Code is to establish minimum standards for design, construction, quality of materials, use and occupancy, location, and maintenance of buildings within Bangladesh in order to safeguard, within achievable limits, life, limb, health, property, and public welfare.

11.2.12.2 Scope

The provisions of the code shall apply to the design, construction or occupancy, alteration, moving, demolition, repair of any building or structure and to any appurtenances installed there in or connected or attached there to, except such matters as are otherwise provided in other ordinances and statues controlling and regulating buildings. It is stated that the provisions of the code are applicable to all persons of Bangladesh.

11.2.12.3 Updating BNBC

BNBC needs to update due to lack of consideration of some issues. BNBC of 1993 came into effect with a gazette notification issued on November 15, 2006. It has been made mandatory to comply with any building construction under the Building Construction Act of 1952 to ensure accountability in the management of overall

building construction and safety of the buildings. As per section 2.1 of chapter 2 of part 1 of the BNBC 1993 the Government is under obligation to establish a new or designate an existing agency responsible for the enforcement of this Code with a given area of jurisdiction. However, the Government is yet to set up any Code Enforcement Authority. Thus, absence of regulatory authority to care for all safety aspects of building as per BNBC is major concern. The BNBC 1993 has dealt only with construction, structure, material, geotechnical, seismic aspects, etc. of development. The BNBC has left out the planning aspects of development as is evidence from section (f). All these planning and development factors need to be incorporated BNBC, if it is to produce a safe and livable environment at all.

11.2.13 Master Plans (RAJUK, RDA, KDA, CDA Master Plan)

The existing master plans such as RDA, KDA, and CDA etc. have also been reviewed to get an idea. The planning and development controls, however, practiced in urban areas from late fifties are structured on master plan concept. At present master plan prepared under the framework of Strategic and Structural Plan, has been set out to serve as a land-use zoning together with development of urban infrastructure and services. The plan will serve as a basis for development control and overall development of the city. However, for execution of development schemes, detailed plans are to be prepared for the Detailed Area Planning Zones, under a separate planning program in future. Table 11.1 shows the review of previous Master Plans of RAJUK, RDA, KDA and CDA.

11.2.14 Sustainable Development Goals (SDG)

Objective-11

- Support economic, urban, and environmental connectivity through strong national and regional planning in cities, peri-urban and rural areas
- Building a sustainable society and economy
- Creation of career and business opportunities
- Invest in building safe, affordable, and sustainable public transport systems for all
- Creation of green public space
- Safe and affordable housing
- To improve urban planning and management
- Participatory and inclusive planning
- Strive to preserve cultural and natural heritage.

Objective-13

- Strengthening resilience and adaptive capacity to climate related disasters
- Incorporating climate change measures into policies and plans
- Knowledge and capacity building to deal with climate change
- Implementation of the UN Framework Convention on Climate Change

- Development of methods for capacity building of planning and management.

Objective-14

- Sustainable fishing
- Protecting and restoring ecosystems

Objective-15

- Reforestation and restoration of damaged forests
- Restoration of damaged land
- Conservation and restoration of terrestrial and freshwater
- Ecosystems
- Protecting biodiversity and natural sanctuary

11.2.15 Bangladesh Delta Plan- 2100

- The delta plan 2100 represents the country's current centers will continue their growth in the coming decades under the influence of rural –urban migration and by 2045 the majority of the nation's population will live in cities. The delta plan focuses on urban planning and water needs for the population, industry, commerce, agriculture and related issues.
- Ensuring security from floods and climate change related disasters;
- Enhancing water security and cost-effective water use;
- Ensuring sustainable and integrated river management and estuarine management;
- Conserving wetlands and ecosystems and promoting their beneficial use ;
- Building effective and equitable institutions for national and sub-national water resource management;
- Achieve maximum and integrated use of land and water resources as well.

11.2.16 Bangladesh Perspective Plan (2021-2041)

- The Perspective Plan 2041 (PP2041) presents the country's urban development issues – (i) Managing the urban transition; (ii) Urban Governance; and (iii) Urban sector financing requirements and options.
- Reducing income inequality to alleviate urban poverty;
- Sustainable agricultural systems in urban future food and nutrition security;
- Urban transition (Urban Transition), good governance reforms, information technology and scientific research, environmental management for the blue economy etc.;
- Construction of efficient and sustainable transport and communication infrastructure;
- Creation of digital city through development of information technology.
- To accelerate inclusive growth through macroeconomic management in a sustainable

manner;

- Sustainable human development;
- Industrialization and trade sustain dynamic growth in competitive markets and reach 1-2% growth.

11.2.17 Eight Five Year Plan (2020-2025)

- Adopting a comprehensive inclusive strategy to enable every citizen to participate in and benefit from development activities; helping poor and vulnerable groups under social security;
- Adopt a sustainable development approach resilient to disasters and climate change that will ensure sustainable use of natural resources and successfully manage inevitable urbanization;
- Institutional development to manage the economy for transition to an upper middle-income country;
- Achieving the Sustainable Development Goals and adapting to the impact of transition from least developed country;
- Relating urbanization to growth in economic activity;
- Three steps in restructuring urban management:
 - (1) Strengthening public-private partnerships to improve service quality;
 - (2) Capacity building of public institutions involved in urban service delivery;
 - (3) Development of accountable urban government system with economic decentralization;
- Investment in essential civic amenities such as water supply, drainage, sewage and waste management;
- Government subsidy on affordable housing for poor people;
- Institutional restructuring to develop strong local government institutions.

11.2.18 Dhaka Structure Plan (2016-2035)

- Establishment of urban centers at various levels, decentralization of civic amenities and employment;
- Establishing regional connectivity with core cities through rapid transport system;
- Affordable housing;
- Development of Green and Blue Urban Corridor;
- Improving connectivity between parks, open spaces and roads;
- Ensuring clean environment including waste management;
- Acquiring disaster and fire prevention capabilities;
- Compact development;

- Construction of strong economic infrastructure and planned industrial zones;
- Conservation of river channels, canal banks and wetlands.

11.2.19 National Disaster Management Plan, 2010-2015

- Roles and Responsibilities of Related Organizations in Emergency Operations and Risk Reduction;
- Disaster Management Regulatory Framework;
- Provides a long-term strategic goal in disaster and its management;
- To provide a direction for disaster management planning by various agencies;
- Publication of management plans at various ministry and administrative levels, such as District Disaster Management Plan, Upazila Disaster Management Plan, Union Disaster Management Plan and Municipal/City Corporation Disaster Management Plan;
- To recommend inclusion of disaster component in various plans and development projects of various ministries;
- Assigning NGOs, civil society and the private sector their responsibilities and means for disaster management strategic goals and government implementation;
- Pre-disaster policy and post-disaster mitigation design formulation.

11.2.20 Local Government (Paurashava) Act 2009

- Conducting surveys on municipal history, statistics, public services and other matters;
- Development and enlargement of any area included in the municipality;
- Enactment of restrictions and regulations relating to municipal area development, building construction, reconstruction.

11.2.21 The Playgrounds, Open Parks, and Natural Reservoirs Conservation Act, 2000

Applicable for all municipal areas of the country including the municipal areas of metropolitan cities, divisional cities, and district towns

- No structure shall be built which disturbs the natural course of any creek or river without prior permission;
- Prioritization of water use in areas where water resources are in crisis is a significant step (use of water only for consumption and domestic purposes will be considered a fundamental right);
- From the point of view of protection and conservation of water resources, timely decisions should be taken according to the law for irrigation and water demand of urban areas based on the availability of surface water, ground water and rain water;
- Prior permission shall be pending for dredging of rivers to maintain navigability, land reclamation projects by filling wetlands, construction of structures to control floods and prevent river erosion;

- Public hearing is a very good provision for the proposed National Water Management Plan.

11.2.22 Environment (Conservation) Act, 2010

- Inclusion of green infrastructure in communities;
- Conservation of land resources in ecologically sensitive areas;
- Conservation of open space for water drainage, future use, green belt and recreational facilities;
- Agricultural land management and control of excess Urban Sprawl;
- Management of wetlands and floodplains through land use regulation;
- Circular waterways within the city as an alternative to the existing road system;
- Compact and mixed land use development for non-motorized transport and pedestrian coordination;
- Attention to traffic rules and management for rickshaws and bi-cycles;
- Recycling means reducing costs in waste management
- Providing community based civic amenities;
- Housing for people of all classes and incomes;
- Compulsory education system, women education and technical training of women;
- Provision of free primary medical facilities to underprivileged communities; special focus on women and children;
- Development of cooperatives and businesses in the community, regional exchange system, informal credit system, community based environmental management.

11.2.23 Climate Change Strategy and Action Plan, 2009

- Ensuring all basic amenities (food security, safe housing, jobs, health) while protecting low- income people and the most vulnerable in society, including women and children, from the effects of climate change;
- Already successful disaster management strategies should be used for increasing and deadly natural disasters;
- Existing structures (i.e., seashore and river embankments) should be preserved and ensured to be functional;
- Correct location of critical infrastructure (cyclone shelters and drainage systems) to address climate change impacts;
- Determining the future situation and timing of climate change impacts on economic and socio- economic sectors, guiding future investment strategies;
- Bangladesh's engagement with global ongoing scientific thinking and ensuring best practice climate change management;

- Capacity building and institutional strengthening.

11.2.24 National Waste Management Strategy, 2010

- Complete elimination of waste disposal in open dumps, rivers and floodplains;
- Promote recycling through source segregation and create markets for recycled products; To encourage recycling of waste;
- Emphasis on waste avoidance/reduction through waste recycling and environmentally sound disposal of all types;
- Using environment friendly raw materials;
- Using hazardous waste materials to the minimum possible level.

11.2.25 My Village My Town Project Report, 2023

- Promotion of all amenities of a modern city in rural areas (improved roads, communication, clean water, modern health care and medical care, quality education, improved sewage and waste management, increased electricity and fuel supply, computer and high-speed internet facilities, market for quality consumer goods including electrical appliances);
- Encouraging and supporting the installation of biogas plants and solar panels on group basis to increase and increase the reliability of electricity and energy supply in villages;
- Expanding rural mechanization services including machinery repair by setting up agricultural machinery service centers and workshops at the village level and providing productive employment by training rural youth and agricultural entrepreneurs through these;
- In addition to these services in the non-agricultural sector, providing necessary assistance including credit facilities to the marginal and small entrepreneurs of the private sector to manufacture and market light machinery.

11.2.26 10.1.30 Upazila Parishad Act 1998 (Amended 2011):

The Government of Bangladesh is implementing a number of initiatives to increase the capacity of local government institutions. These initiatives are being implemented in the light of the Constitution of Bangladesh, SDGs, Five Year Development Plan, Local Government Act etc. The Upazila Parishad Act was first enacted in 1998 and in 2009 it was amended extensively. In the light of this law, Upazila Parishad elections have been held in 2009, 2014 and 2019. As a result, the responsibilities and duties of the Upazila Parishad as a mid-level local government body have been steadily increasing in recent times.

11.2.26.1 Mission of Upazila Parishad

Public services delivered at the Upazila level are improved through the comprehensive coordination of all Upazila-level development activities.

The comprehensive coordination is highlighted in the mission. Planning of development projects is a crucial factor for Upazila Parishads to realize the comprehensive and integrated

development of the whole Upazila areas. Integration of all the concerned entities, including Districts, Unions and Paurashavas, and transferred line departments is also crucial.

Development projects at the Upazila level need to be well coordinated to maximize their impacts. In this context, the comprehensive coordination is considered as the core function of Upazila Parishads. In fact, the legal provisions and national policies emphasized the importance of the coordination function. As a middle-tier local government institution, and as a unique institution to which line departments are transferred, Upazila Parishad is inherently required to coordinate among stakeholders such as Union Parishads, Paurashavas, and 17 transferred line departments.

At the Upazila level, both horizontal and vertical coordination is crucial. The former is coordination with the 17 transferred government departments, and the latter is coordination with Union Parishads and Paurashavas, and Zila Parishads. To ensure better coordination at the Upazila level, information should be widely shared among these stakeholders. The Upazila Parishads need to take into considerations the shared information when planning and implementing any development activities to maximize the impacts, ensure synergies, and avoid overlapping. Such information sharing is the first step for the coordination.

The coordination will contribute to the comprehensive development of Upazilas. Consensus building on “coordination as the core function” is essential among all stakeholders including LGD and other ministries and departments, Union Parishads, Paurashavas, and Zila Parishad. Such consensus will help Upazila Parishad better perform their coordination functions, and then contribute to the welfare of local residents in the long run.

11.2.27 National Environment Policy -2018- Ministry of Environment, Forest and Climate Change.

Environmental policy has gradually evolved since the late 1960s. Whereas the earlier efforts addressed distinct issues such as pollution of air and water in the national contest and among international neighbors, more recent concerns such as the greenhouse effect, the destruction of the ozone layer and the loss of biodiversity transcend national boundaries and require a broad international response. New principles and methods of environmental protection here slowly emerged, emphasizing, *inter alia* the need for prevention of damage and the cost-effectiveness of environmental programs. On the international level, the key challenge today lies in the ongoing search for a workable and effective consensus on a meaning of sustainable development which reflects the realities both in the industrialized and in developing states.

11.2.28 Recommendation

11.2.28.1 Land and Housing Development

The formulation and implementation of the master plan for land and housing development encompass a comprehensive array of policies and regulations aimed at addressing various aspects crucial for sustainable urban growth.

- Housing Policy, 2004
- Draft National Urban Sector Policy
- Population Policy, 2004

- Building Construction Act, 1952
- Existing Master Plans (RAJUK, RDA, KDA, CDA Master Plan)

11.2.28.2 Disaster Management

Moreover, the inclusion of policies pertaining to disaster management, environment protection, and resource conservation underscores a holistic approach towards urban planning.

- Bangladesh National Building Code (BNBC)
- Housing Policy, 2004
- National Agriculture Policy, 1999
- Forest Policy, 1994
- National Health Policy, 2000
- Existing Master Plans (RAJUK, RDA, KDA, CDA Master Plan)

11.2.28.3 Environment Protection

The emphasis on environment protection through policies like:

- Urban Management Policy Statement, 1999
- Industrial Policy, 2005
- Housing Policy, 2004
- Population Policy, 2004
- National Agriculture Policy, 1999
- Draft National Urban Sector Policy
- National Land Use Policy, 2001
- Water Conservation Act, 2000
- Bangladesh National Building Code (BNBC)
- Existing Master Plans (RAJUK, RDA, KDA, CDA Master Plan)

11.2.28.4 Master Plan Preparation

- National Land Use Policy, 2001
- Water Conservation Act, 2000
- National Tourism Policy, 1992
- Existing Master Plans (RAJUK, RDA, KDA, CDA Master Plan)

Effective implementation and monitoring mechanisms will be crucial to realizing the objectives outlined in the master plan and ensuring the well-being of current and future generations.

11.3 Physical Planning Implication

Physical planning is the process of organizing land uses and physical activities to ensure that land is used in an orderly and effective way. The institutional and legal frameworks for physical planning include institutional frameworks, statutory frameworks, and planning law assessment frameworks. In fact, all these frameworks are to be duly examined and are to be infused and implemented so as to make all projects and plans proposed in the reviewing and updating the master plan of Ramu Upazila.

11.4 Conclusion:

The phenomenal rate of urbanization is posing a major development challenge. The cities and towns of Bangladesh, suffer from acute problems of deteriorating infrastructure in the form of poor housing, inadequate availability of drinking water, paucity of drainage and sewerage facilities, logjam of urban transport, and pollution, amongst others. Slums and squatter settlements have become integral part of urban life in the country. Chaotic urban development and the accompanying unemployment, environmental degradation, lack of basic services, crime and the proliferation of slums are major obstacles to creating better cities and better urban living conditions. This does not necessarily mean that urbanization is bad, but to meet the progress and advancement sought by the population moving to urban areas more and more, the government has to adopt policies to harness the goods that the process of urbanization bring while taking concrete actions to minimizing the inherent negative effects of delayed planning for an eventuality that cannot be stopped. Effective Legal and Institutional Framework for is very important for planned development for proper functioning of the organization and ensure better services for the citizens. The government legal and institutional Framework is very important to manage urbanization and systematic development in such a way that captures the beneficial aspects to strengthen cities and secondary towns to build in resilience and capture economic growth for the development of the country.

Chapter Twelve: Climate Change and Resilience



CHAPTER TWELVE: CLIMATE CHANGE AND RESILIENCE

12.1 Introduction

Climate change refers to long-term shifts in temperatures and weather patterns. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions. But since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil and gas. The Earth's climate is changing and the global climate is projected to continue to change over this century and beyond. The magnitude of climate change beyond the next few decades will depend primarily on the amount of greenhouse (heat-trapping) gases emitted globally and on the remaining uncertainty in the sensitivity of the Earth's climate to those emissions. With significant reductions in the emissions of greenhouse gases (GHGs), global annual averaged temperature rise could be limited to 2°C or less. However, without major reductions in these emissions, the increase in annual average global temperatures, relative to preindustrial times, could reach 5°C or more by the end of this century.

Climate change, driven by human activities, is posing significant challenges to Bangladesh. The country's vulnerability is exacerbated by its geographic location and socio-economic conditions. Building resilience is crucial for coping with the adverse effects of climate change, which include more frequent and severe extreme weather events, rising sea levels, and agricultural disruptions. A coordinated global effort, combined with local initiatives in regions like Ramu upazila, is necessary to address these challenges and ensure a sustainable future for Bangladesh.

12.2 Methodology

A methodology is a structured and scientific approach used to collect, analyze, and interpret quantitative or qualitative data to answer research questions or test hypotheses. A methodology is like a plan for carrying out research and helps keep researchers on track by limiting the scope of the research. Several aspects must be considered before selecting an appropriate methodology, such as research limitations and ethical concerns that may affect a research.

A methodology describes the techniques and procedures used to identify and analyze information regarding a specific research topic. It is a process by which researchers design their study so that they can achieve their objectives using the selected research instruments. It includes all the important aspects of research, including research design, data collection methods, data analysis methods, and the overall framework within which the research is conducted.

In case of study about climate change and resilience regarding Ramu Upazila, both primary and secondary data was used.

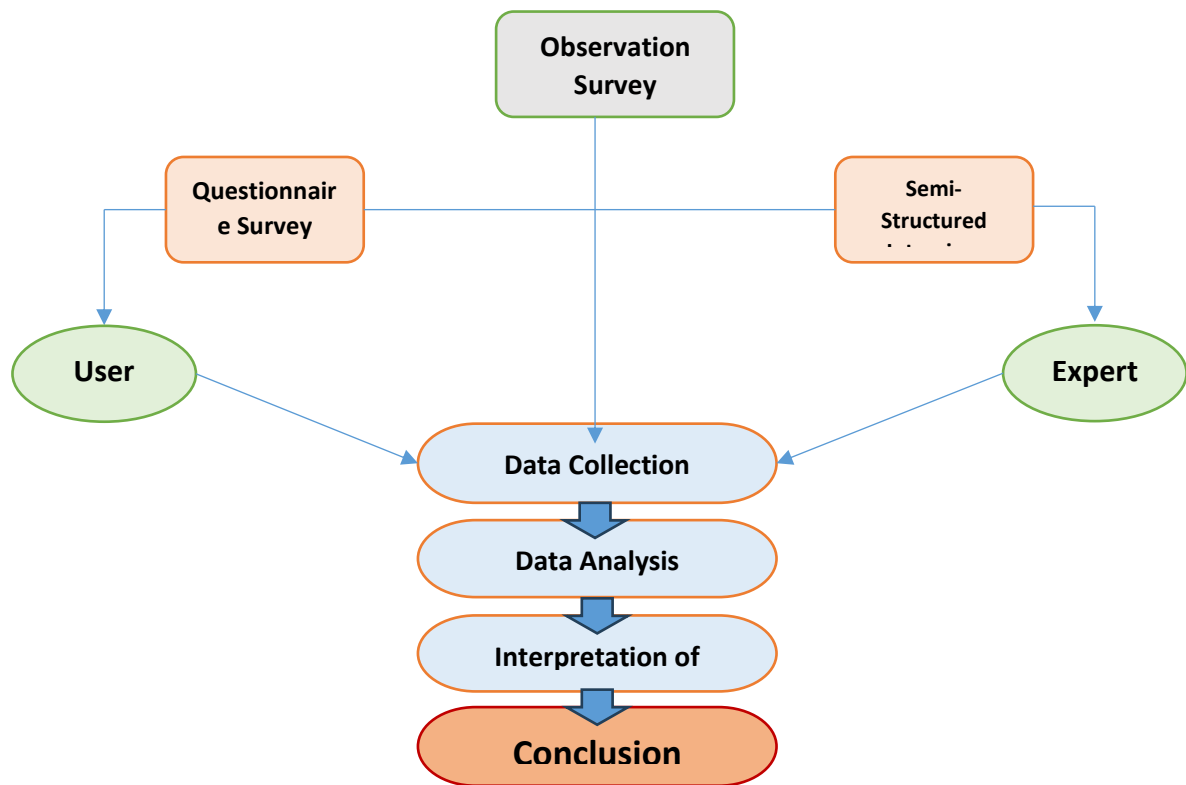


Figure 12-1: Methodology Diagram

Ramu Upazila, located in the Cox's Bazar District of southeastern Bangladesh, is subject to a tropical monsoon climate. The region's climate is influenced by its proximity to the Bay of Bengal, the hilly terrains to the east, and broader regional climate patterns. This analysis covers the past climate trends in Ramu Upazila, including temperature and precipitation patterns, and provides predictions for future climate changes based on available data.

12.3 National Policy, Rules and Legislation

Bangladesh has developed a comprehensive framework of policies, rules, and guidelines to address climate change, reflecting the country's high vulnerability to climate-related hazards such as floods, cyclones, and sea-level rise. Here are some key climate-related policies, rules, and guidelines that guide climate action in Bangladesh:

12.3.1 Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009

The BCCSAP is Bangladesh's overarching policy document for tackling climate change. It outlines the country's strategy to manage climate risks, enhance resilience, and reduce vulnerability to climate impacts. The plan is divided into six thematic areas: food security, social protection, and health; comprehensive disaster management; infrastructure; research and knowledge management; mitigation and low carbon development; and capacity building and institutional strengthening.

- **Key Focus Areas:**

- **Adaptation:** Emphasis on adapting to the adverse effects of climate change, particularly in agriculture, water resources, and health.
- **Mitigation:** Focus on reducing greenhouse gas emissions through sustainable energy, improved energy efficiency, and conservation of natural resources.

12.3.2 National Adaptation Programme of Action (NAPA) 2023-2050

NAPA was the first official document outlining Bangladesh's approach to adapting to climate change. It prioritizes urgent and immediate adaptation needs, particularly in sectors most vulnerable to climate impacts, such as agriculture, water resources, and disaster management.

- **Key Focus Areas:**

- **Community-Based Adaptation:** Projects designed to enhance the adaptive capacity of local communities through initiatives like coastal afforestation, resilient crop varieties, and disaster preparedness.
- **Early Warning Systems:** Strengthening and expanding early warning systems for climate-related hazards like cyclones and floods.

12.3.3 Bangladesh National Climate Change Policy 2018

This policy integrates climate change considerations into national development planning. It aims to enhance resilience to climate change through sustainable development and poverty alleviation strategies.

- **Key Focus Areas:**

- **Mainstreaming Climate Change:** Ensuring that climate change adaptation and mitigation are integrated into all sectors, including agriculture, industry, energy, and infrastructure.
- **Resilience Building:** Enhancing the resilience of communities, infrastructure, and ecosystems to climate impacts through targeted interventions.

12.3.4 Bangladesh Delta Plan 2100

The Delta Plan 2100 is a long-term, holistic plan focused on sustainable delta management in the face of climate change. It aims to ensure water safety, food security, and economic growth while protecting the environment and managing climate risks.

- **Key Focus Areas:**

- **Integrated Water Resources Management:** Comprehensive management of water resources to address flood risks, water scarcity, and salinity intrusion.
- **Sustainable Land Use Planning:** Promotion of sustainable land use practices to prevent land degradation and enhance agricultural productivity.

12.3.5 National Disaster Management Policy 2015

This policy focuses on disaster risk reduction and management, with a strong emphasis on climate change adaptation. It aims to reduce the impacts of natural disasters, which are exacerbated by climate change, on vulnerable communities.

- **Key Focus Areas:**

- **Risk Reduction:** Implementing disaster risk reduction strategies that account for climate change, including resilient infrastructure, community-based disaster management, and enhanced early warning systems.
- **Emergency Response and Recovery:** Strengthening the capacity for effective emergency response and post-disaster recovery in the context of climate-related disasters.

12.3.6 Bangladesh Renewable Energy Policy 2008

This policy promotes the development and use of renewable energy sources as a key strategy for mitigating climate change. It sets targets for renewable energy contributions to the national energy mix and provides incentives for the adoption of clean energy technologies.

- **Key Focus Areas:**

- **Solar Energy:** Expansion of solar power, particularly in off-grid rural areas, to reduce reliance on fossil fuels.
- **Bioenergy and Wind:** Development of bioenergy and wind power as alternative energy sources to support sustainable development.

12.3.7 National Environment Policy 2018

The National Environment Policy integrates climate change considerations into broader environmental management efforts. It emphasizes the protection of ecosystems, biodiversity, and natural resources in the context of a changing climate.

- **Key Focus Areas:**

- **Sustainable Natural Resource Management:** Promoting the sustainable use of natural resources, including forests, wetlands, and water bodies, to mitigate climate impacts.
- **Pollution Control:** Implementing measures to control pollution and reduce environmental degradation, which are critical to building resilience to climate change.

12.3.8 National Action Plan for Clean Cookstoves 2013

This plan aims to reduce greenhouse gas emissions and improve health outcomes by promoting the adoption of clean cookstoves. It is part of Bangladesh's broader strategy to address indoor air pollution and mitigate climate change.

- **Key Focus Areas:**

- **Promotion of Clean Technologies:** Encouraging the widespread use of clean cookstoves and alternative fuels in households.

- **Public Awareness Campaigns:** Educating the public about the health and environmental benefits of clean cooking solutions.

12.3.9 Nationally Determined Contributions (NDCs) under the Paris Agreement

Bangladesh's NDCs outline the country's commitments to reducing greenhouse gas emissions and enhancing resilience to climate change as part of the global effort under the Paris Agreement. The NDCs focus on both mitigation and adaptation strategies.

- **Key Focus Areas:**
 - **Emissions Reduction:** Targeted reductions in emissions from key sectors, including energy, transport, and agriculture.
 - **Adaptation Priorities:** Strengthening resilience in vulnerable sectors such as water resources, agriculture, and infrastructure.

12.4 Climatic Condition of Ramu

12.4.1 Past Climate Trends

12.4.1.1 Temperature Trends

- **Historical Temperature Data:** Over the past few decades, Ramu Upazila has experienced a gradual increase in average annual temperatures. Data from the Bangladesh Meteorological Department (BMD) indicates that the average temperature in the region has risen by approximately 0.5°C to 1.0°C over the last 30 years.
- **Seasonal Temperature Variations:**
 - **Summer (March to June):** Summers are typically hot and humid, with average temperatures ranging from 28°C to 34°C. The hottest months are April and May, with peak temperatures occasionally reaching 38°C to 40°C.
 - **Monsoon (June to September):** The monsoon season sees slightly lower temperatures due to cloud cover and frequent rainfall, with averages between 26°C and 30°C.
 - **Winter (December to February):** Winters are mild and dry, with average temperatures ranging from 12°C to 20°C. However, minimum temperatures can occasionally drop to 10°C during cold spells.
- **Heat Waves:** The frequency and intensity of heatwaves in Ramu have increased, particularly in the pre-monsoon period. These heatwaves have significant impacts on agriculture, water resources, and human health.

A climatic map has been developed for Ramu for anticipated the climatic zone, which are given below:

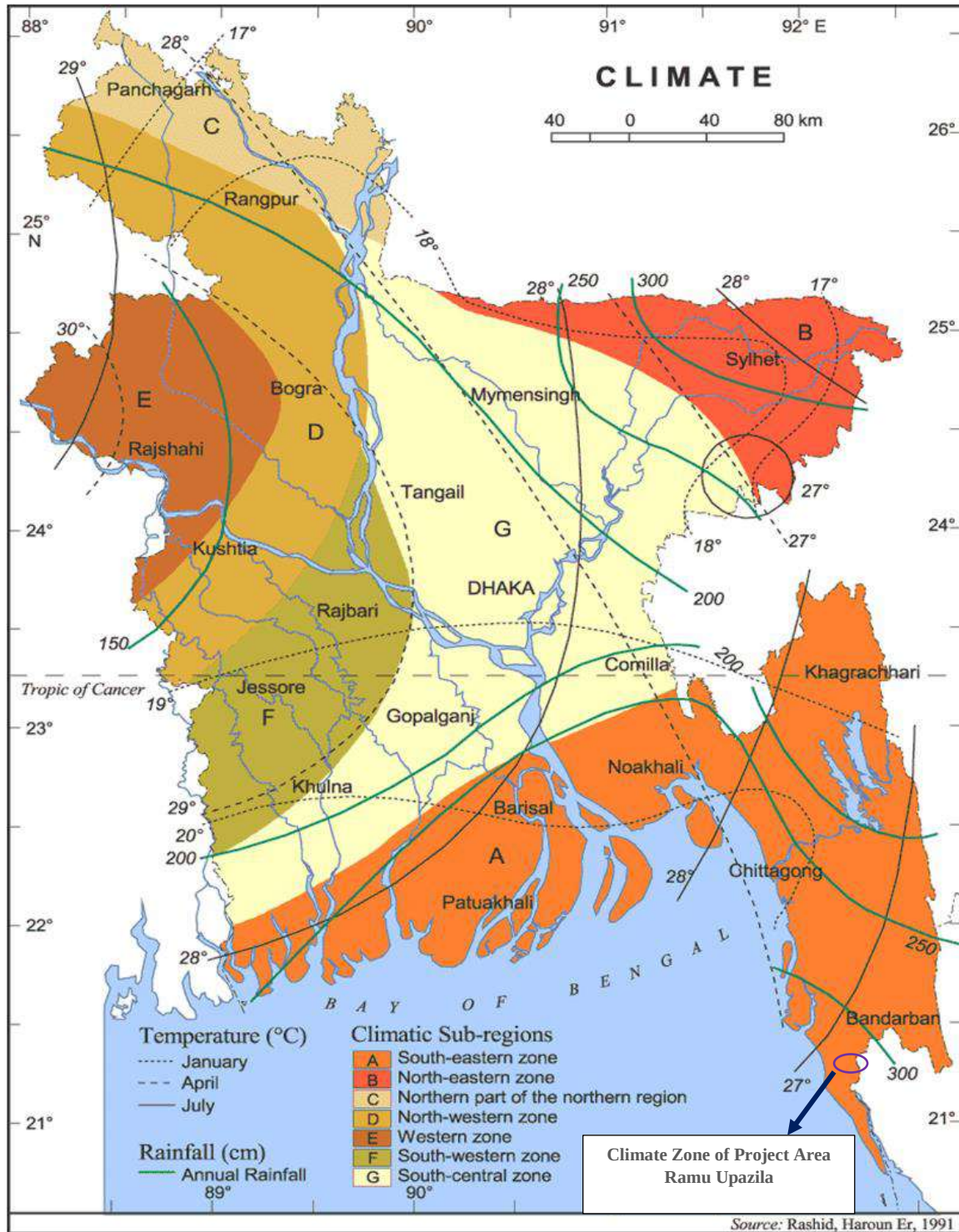


Figure 12-2: Climatic map of Ramu

Long-term average monthly temperature data (1998-2023) has been collected from Cox's Bazar weather station of Bangladesh Meteorological Department. In Cox's Bazar weather station, the highest average recorded temperature in this weather station was 37.5°C in May. The lowest average recorded temperature was found in the month of January which was 10.3°C. Average monthly temperature graphs show that this area faces high temperature from

April to October and lowest temperature during winter remains from November to February in the year (1-2).

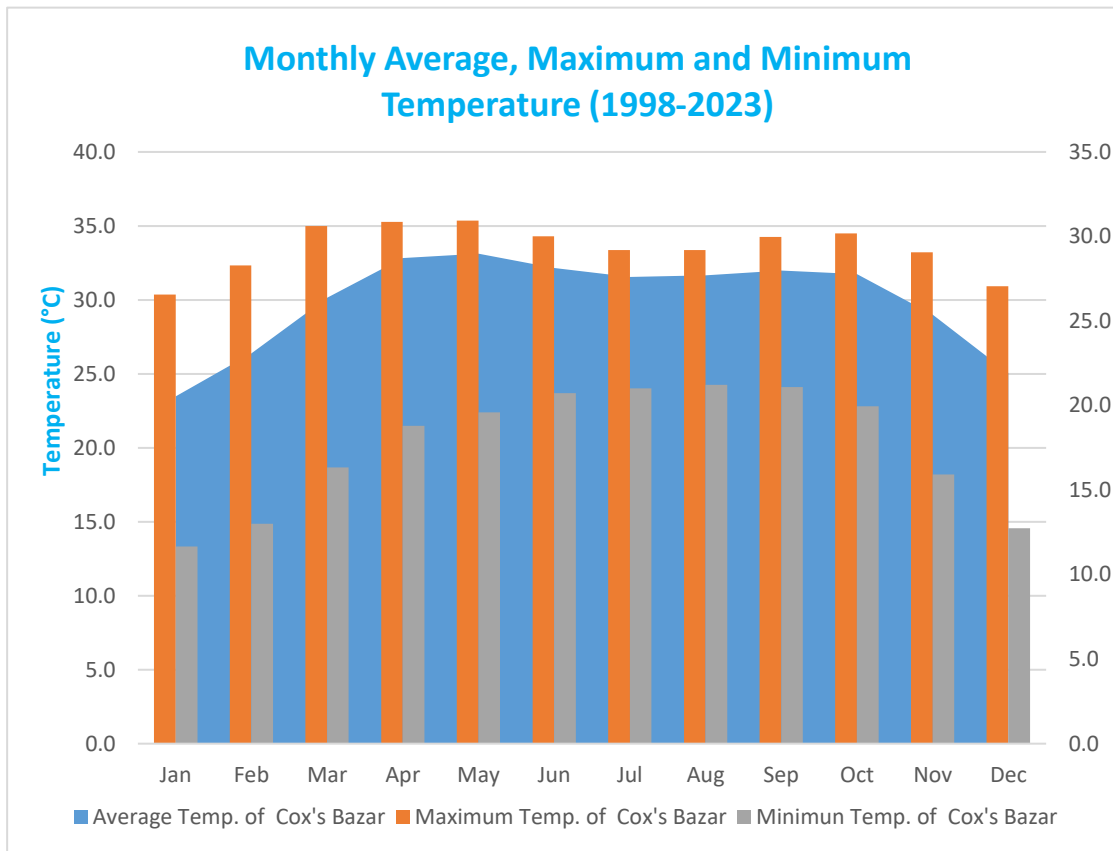


Figure 12-3: Monthly Average, Maximum and Minimum Temperature of Cox's Bazar

12.4.1.2 Precipitation Patterns

- **Annual Rainfall:** Ramu receives an average annual rainfall of around 3,000 to 3,500 millimeters, with significant year-to-year variability. The majority of the rainfall occurs during the monsoon season, which accounts for nearly 80% of the total annual precipitation.
- **Monsoon Onset and Duration:** The monsoon typically begins in late May or early June and continues until September. However, the onset and duration of the monsoon have become more erratic in recent years, with delayed starts and extended periods of heavy rainfall.
- **Intense Rainfall Events:** The frequency of intense rainfall events, where over 100 millimeters of rain falls within a 24-hour period, has increased. Such events lead to flash floods, landslides in hilly areas, and waterlogging in low-lying regions.
- **Dry Season:** The dry season, from November to February, is characterized by minimal rainfall, leading to water scarcity and challenges in maintaining agricultural productivity. This season has shown a slight decrease in rainfall over the past decades.

The graph (Figure 1-3) shows a clear seasonal pattern, with the highest rainfall occurring during the monsoon season from June to August, reaching a peak in July with an average of

826 millimeters. Rainfall gradually decreases from September onwards, reaching its lowest point in December with an average of 12 millimeters. The overall trend indicates a significant difference in rainfall between the wet and dry seasons, with the monsoon months receiving substantially more rainfall compared to the rest of the year.

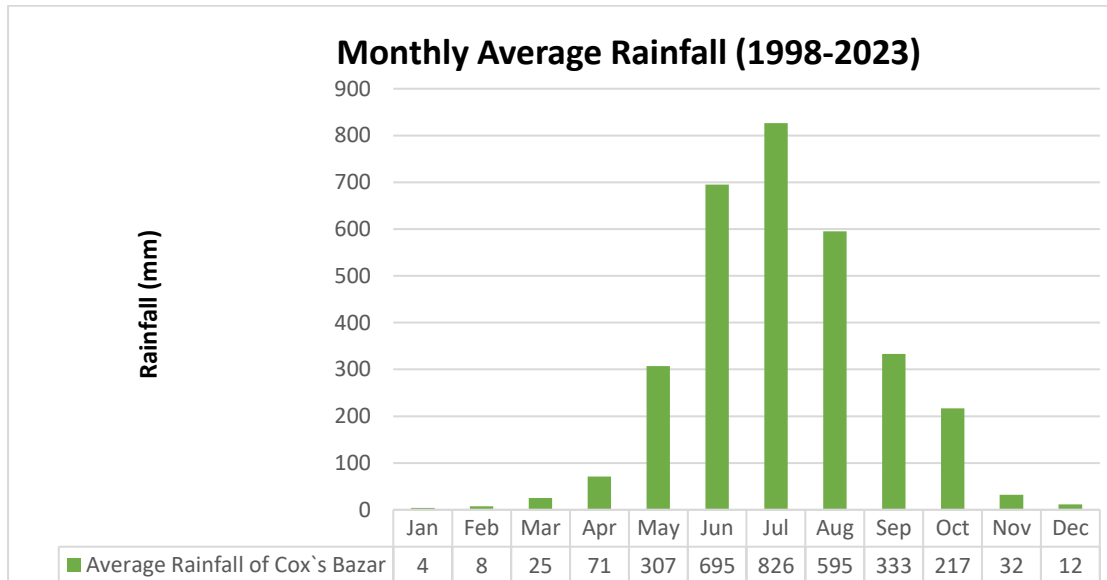


Figure 12-4: Average Monthly Rainfall of Cox's Bazar

12.4.1.3 Humidity

The statistical data of humidity from 1998 to 2023 indicates that humidity in the Cox's Bazar Weather Station area maximized in June to October in the year which is ranges from 85.77 to 82.46%. On the other hand, humidity falls around 69.04% in Cox's Bazar weather station in March (Figure 1-4

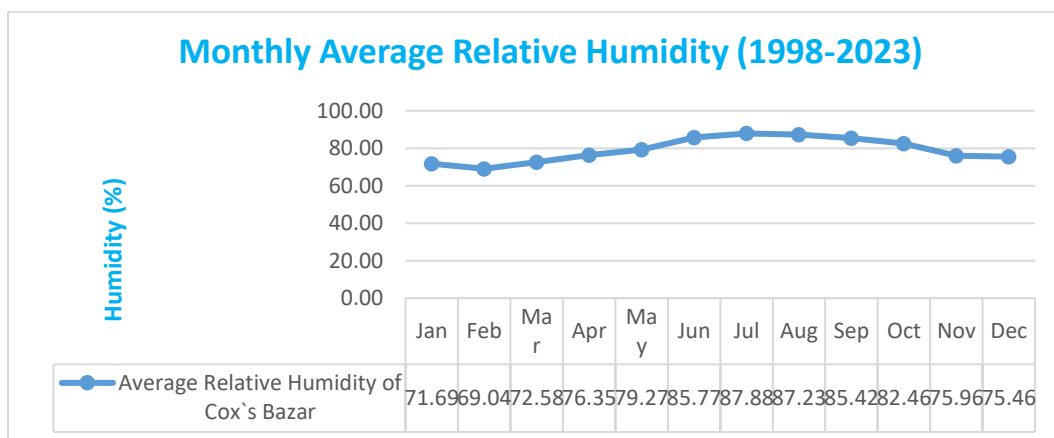


Figure 12-5: Monthly Average Relative Humidity of Cox's Bazar

12.4.1.4 Wind Speed

The statistical wind speed data of Cox's Bazar Weather Station (Figure 1-5) shows that average wind speed maximum value is 5.30 knots to 5.61 knots in April to June month and the minimum wind speed value was 4.31 knots in the month of December. In Figure 5-6 wind rose diagram for Cox's Bazar is illustrated.

Average Wind Speed (1998-2023)

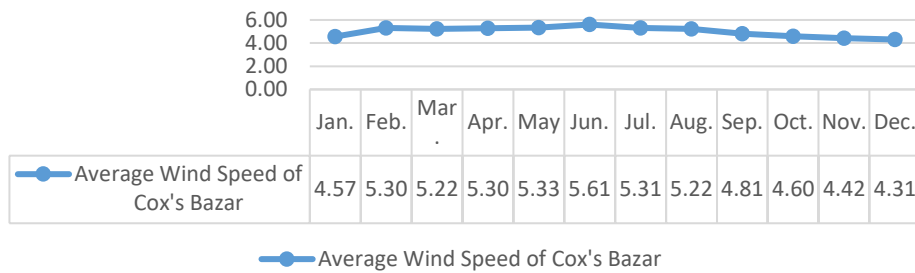
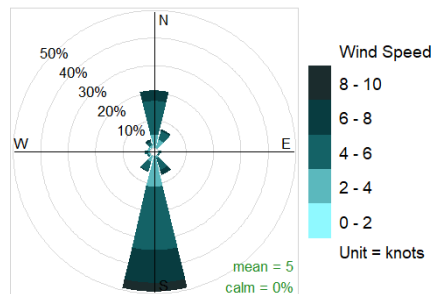


Figure 12-6: Average Monthly Wind Speed of Cox's Bazar

Monthly Average Wind Direction in Cox's Bazar (1998-2023)



Frequency of counts by wind direction (%)

Figure 12-7: Wind Rose Diagram for Cox's Bazar

12.4.1.5 Cyclones and Storm Surges

Cyclone Frequency: Ramu Upazila is vulnerable to tropical cyclones originating in the Bay of Bengal. The frequency of cyclones impacting the region has remained relatively steady, with major events occurring every few years. However, the intensity of both tropical cyclones and storm surges are likely to increase with rising sea surface temperatures and sea level with more cyclones reaching severe or super-cyclone status.

Historical Impact: Cyclones such as Cyclone Sidr (2007) and Cyclone Amphan (2020) have caused significant damage in the region, leading to loss of life, destruction of homes, and extensive damage to agricultural lands. Storm surges associated with these cyclones have exacerbated coastal erosion and salinity intrusion.

Storm Surges: The height of storm surges has increased due to rising sea levels and stronger cyclones. These surges contribute to flooding in coastal areas and salinization of agricultural lands and freshwater resources.

12.4.1.6 Flood Event

Ramu has frequently experienced floodwaters rising up to 2-3 meters in low-lying areas, causing inundation across large sections of farmland and rural communities. During major flood events like those in 1998 and 2007, almost 60-70% of Ramu's total land area was

affected, with lasting impacts on local agriculture, infrastructure, and livelihoods. Efforts to mitigate these impacts through embankment construction and flood control systems have been ongoing, but the area's proximity to rivers and tidal influences continues to make it highly susceptible to future floods.

12.4.1.7 Salinity Intrusion

Ramu Upazila, like many coastal regions of Bangladesh, faces increasing threats from salinity intrusion, which is exacerbated by both climate change and human activities. According to projections from the Bangladesh Delta Plan (BDP) 2100 and studies analyzing climate impacts, salinity intrusion in the area is expected to worsen due to factors such as rising sea levels, reduced freshwater inflows, and more frequent storm surges.

Salinity is present in Chakmar Phul and Rashidnagar Union, and it increases as tidal waters rise. In the Tidal Alanala Union, excessive tidal water flows into the Nandakhali, raising salinity levels. When water overflows the branch river dam, it leads to the destruction of crops like vegetables and paddy. This overflow also increases salinity in parts of Khunia Palang Union. Salinity is particularly noticeable during the Rabi season, mainly from October to March.

Presently, surface water salinity levels in Ramu vary seasonally, with peak salinity observed during the dry season (October to May). During this period, saline water from the Bay of Bengal infiltrates the rivers and water bodies of the region. In some parts, salinity levels can exceed 5 parts per thousand (ppt) in dry seasons.

12.4.2 Future Climate Predictions

12.4.2.1 Temperature Projections

- **Projected Warming:** According to climate models from Sixth assessment report of IPCC, the average temperature in Ramu Upazila is expected to increase by 1.5°C to 2.5°C by 2050 under a medium to high greenhouse gas emissions scenario. This warming trend will likely result in more frequent and severe heatwaves.
- **Impact on Seasons:**
 - **Extended Summers:** Summers are expected to become longer and hotter, with an increased number of days exceeding 35°C.
 - **Warmer Winters:** Winters will become shorter and warmer, with a reduction in the number of cold days. This could impact crop cycles and the prevalence of certain diseases.

12.4.2.2 Precipitation Projections

- **Monsoon Variability:** The monsoon season is expected to become more erratic, with variations in the onset, duration, and intensity of rainfall. Some models predict a shorter but more intense monsoon season, leading to increased risks of flooding.
- **Increased Rainfall Extremes:** The frequency and intensity of extreme rainfall events are projected to rise, which could result in more frequent flash floods, landslides, and waterlogging.

- **Dry Season Aridity:** The dry season may become drier, exacerbating water scarcity and increasing the risk of drought. This would pose significant challenges for water-dependent agriculture and livelihoods.

12.4.2.3 Humidity

Ramu Upazila is expected to experience higher humidity levels in the future due to climate change. Rising global temperatures will increase the atmosphere's capacity to hold moisture, leading to more humid conditions, especially during the monsoon season. This could result in greater heat stress, increased risk of crop diseases, and potential impacts on health and infrastructure. The region's proximity to the Bay of Bengal may further intensify humidity, particularly during extreme weather events like cyclones. Adaptation strategies will be crucial to managing these future humidity challenges.

12.4.2.4 Wind Speed

Future wind speeds in Ramu Upazila, like other climatic factors, are expected to be influenced by broader changes in regional and global climate patterns. Here's an overview of what might be anticipated:

- **Monsoon Winds:** The South Asian monsoon, which brings significant seasonal winds to Bangladesh, may become more intense due to climate change. This could lead to stronger monsoon winds during the wet season, potentially increasing the average wind speed in Ramu Upazila.
- **Cyclone Activity:** Bangladesh is vulnerable to tropical cyclones, which bring extremely high wind speeds. Climate models predict that while the frequency of cyclones might not increase significantly, the intensity of these storms could rise. This means future cyclones affecting Ramu could bring even higher wind speeds, posing greater risks to life and infrastructure.
- **Pre-Monsoon and Monsoon Seasons:** During the pre-monsoon (April to June) and monsoon seasons (June to September), wind speeds may increase due to the intensified pressure gradients associated with a warmer climate. This could lead to stronger winds as the region experiences shifts in atmospheric circulation patterns.
- **Dry Season:** Wind speeds during the dry season (November to April) might show less significant changes, but localized weather patterns could still lead to periods of increased winds, particularly in coastal areas.
- **Storm Surges and High Winds:** Future storm surges associated with cyclones may be accompanied by extremely high wind speeds, increasing the risk of coastal erosion, damage to infrastructure, and threats to safety in Ramu Upazila.

12.4.2.5 Cyclone and Storm Surge Risks

- **Stronger Cyclones:** The intensity of cyclones affecting Ramu Upazila is expected to increase, with a higher likelihood of Category 4 and 5 storms. These stronger cyclones will bring more destructive winds, heavier rainfall, and larger storm surges.
- **Rising Sea Levels:** Sea level rise, projected to be between 0.5 to 1.0 meters by 2100, will exacerbate the impact of storm surges, leading to more extensive coastal flooding and salinity intrusion into freshwater and agricultural areas.

- The Bay of Bengal is a favorable breeding ground for cyclones. About 5.5% cyclonic storms (wind speed greater than or equal to 62 km/hr) form in the Bay of Bengal and about 1% of the global total of cyclonic storms hit Bangladesh. Cyclone is a vortex of low-pressure system; Bay of Bengal having sea surface area with 27°C temperature, shallow water in the north Bay, the northward-converging nature of the Bay and high astronomical tides are some of the factors that made the country more prone to tropical cyclone events.
- Ramu Upazila in Cox's Bazar District being very close to the Bay of Bengal is highly vulnerable to tropical cyclones. However, being a hilly region, Ramu is less vulnerable to storm surges. The map showing the tracks of cyclones over the past 50 years clearly indicates that Ramu Upazila is in the high-risk zone of cyclones.

12.4.2.6 Salinity Intrusion

- Based on IPCC models and climate projections for Bangladesh, sea levels are projected to rise by 0.5 to 1 meter by the year 2100, leading to greater intrusion of saline water. The BDP 2100 anticipates that this will result in up to a 20-30% increase in salinity in coastal rivers, including those affecting Ramu, by 2050.
- During severe storm surges and cyclone events, such as those modeled after Cyclone Sidr (2007), salinity levels may spike up to 15-20 ppt, posing significant risks to freshwater resources, agriculture, and drinking water supplies in Ramu.

12.5 Impacts and Adaptation Strategies

12.5.1.1 Impacts on Agriculture

- **Crop Yields:** Rising temperatures and changes in rainfall patterns are likely to reduce crop yields, particularly for heat-sensitive crops like rice. Increased salinity from storm surges will further degrade soil quality, making agriculture more challenging.
- **Water Resources:** Water scarcity during the dry season will impact irrigation, leading to lower agricultural productivity. Increased demand for water during hotter summers will strain existing water resources.
- **Pest and Disease Outbreaks:** Warmer and wetter conditions could lead to an increase in pest

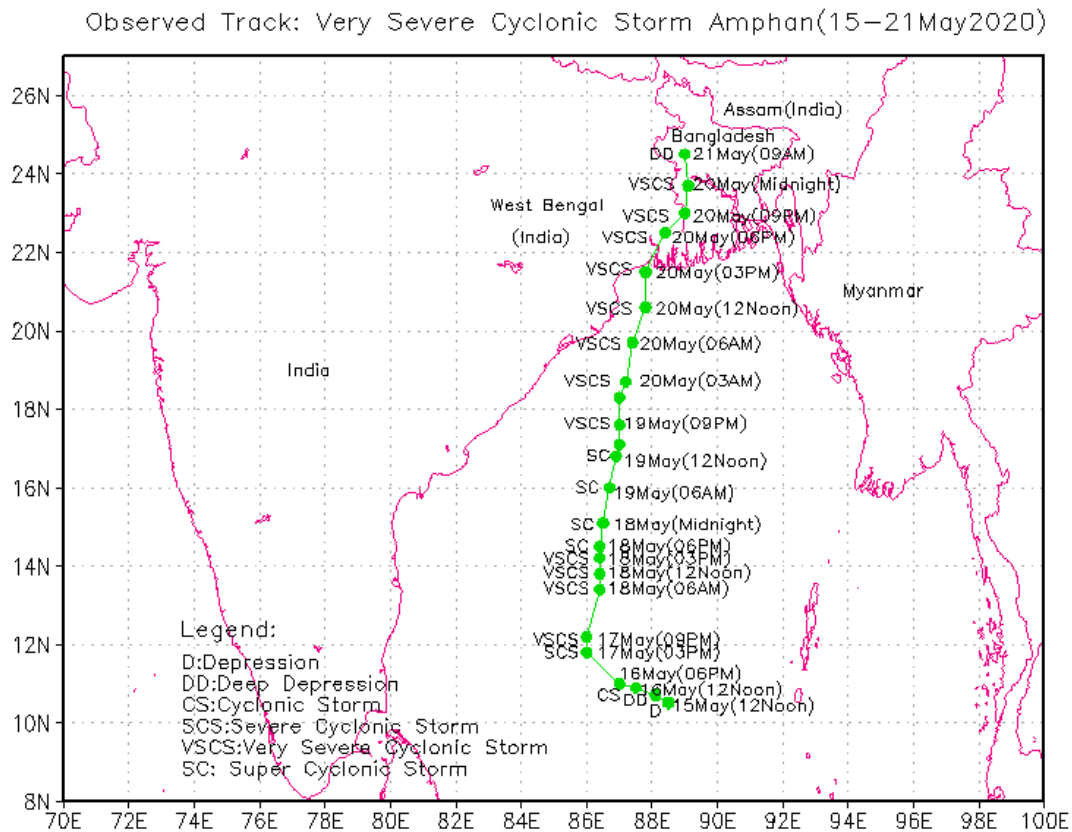


Figure 12-8: Cyclone Tracking map

12.5.1.2 Impacts on Livelihoods and Human Health

- **Livelihood Vulnerability:** The agricultural and fisheries sectors, which are the primary sources of income for most of Ramu's population, will be severely affected by climate change. This could lead to increased poverty and food insecurity.
- **Health Risks:** Higher temperatures and increased humidity will contribute to the spread of vector-borne diseases like dengue and malaria. Heatwaves and extreme weather events will also pose direct health risks, particularly to vulnerable populations such as the elderly and children.

12.5.1.3 Adaptation Strategies

- **Climate-Resilient Agriculture:** Promoting the use of drought-resistant and salinity-tolerant crop varieties, improving irrigation efficiency, and adopting sustainable farming practices can help mitigate the impact of climate change on agriculture.
- **Disaster Risk Reduction:** Strengthening early warning systems for cyclones and floods, building more resilient infrastructure, and enhancing community preparedness are critical for reducing the risks associated with extreme weather events.
- **Water Management:** Developing water conservation and storage systems, such as rainwater harvesting and the construction of reservoirs, will be essential for managing water resources during the dry season.

- **Mangrove Restoration:** Restoring and expanding mangrove forests along the coast can provide natural protection against storm surges and help mitigate coastal erosion.
- **Public Health Interventions:** Enhancing healthcare infrastructure, increasing access to clean water and sanitation, and implementing public health campaigns to address heat-related illnesses and vector-borne diseases will be important for protecting human health.
- To combat the rising salinity, the **Bangladesh Climate Change Strategy and Action Plan (BCCSAP)** recommends the introduction of salt-tolerant crop varieties, improved irrigation systems to flush out salt, and the construction of embankments and polders to control saline water intrusion during high tides and storm surges.

12.6 Major Findings

Cyclone has both direct and indirect effects on human life and socio-economic development of a country. Bangladesh is one of the most cyclone prone countries in the world. The geographical location and climatic condition of the country are responsible for cyclone and other natural disasters. During the last 100 years, Bangladesh has experienced 53 major cyclones. Though cyclone affects almost every part of the coastal Bangladesh, but intensity and frequency of cyclone is dangerous in Ramu Upazila of Cox's Bazar district. This Upazila is more vulnerable to cyclone than other places of the district. Due to poor disaster management system and ignorance of the physical plan, every year the country has experienced not only huge economic loss but also lives. The major findings from the climate change assessment in Ramu upazila are outlined below.

1. Rising Temperatures:

- **Past Trends:** Historical data indicates a gradual increase in average temperatures in Ramu Upazila, reflecting broader regional warming trends. Summers have become hotter, with more frequent and intense heatwaves.
- **Future Predictions:** Temperatures are expected to continue rising, leading to more extreme heat events, particularly during the pre-monsoon and monsoon seasons. This will increase heat stress for both the population and agriculture.

2. Increasing Humidity:

- **Past Trends:** Humidity levels in Ramu have been consistently high due to its coastal location and tropical climate, with slight increases observed during the monsoon season.
- **Future Predictions:** Humidity is projected to rise further as global temperatures increase, leading to more uncomfortable and potentially dangerous conditions, especially when combined with rising temperatures.

3. Variable Rainfall Patterns:

- **Past Trends:** Rainfall patterns in Ramu have shown increasing variability, with some years experiencing intense monsoons leading to floods, while others see below-average rainfall, affecting water availability. Flash floods occurred due to heavy rain in short duration in the hilly regions, impacting villages at the foothills. This has

disrupted food production and daily life in the affected areas. Besides landslides occurred in most unions of Ramu Upazilla during monsoon for heavy rainfall.

- **Future Predictions:** Climate models suggest that Ramu will experience more erratic and intense rainfall during the monsoon season, increasing the risk of flooding. Dry seasons may become drier, leading to potential water scarcity

4. Increased Cyclone Intensity:

- **Past Trends:** Ramu Upazila has been periodically impacted by cyclones, which bring destructive winds, heavy rains, and storm surges. Minor impacts of low pressure were observed in coastal areas, particularly in the Khuniapalng Union. While the damage was minimal in areas further from the coast, markets, homes, and properties near the shore suffered significant destruction. The frequency of these events has remained relatively stable, but their intensity has been increasing.
- **Future Predictions:** Cyclones affecting Ramu are expected to become more intense due to warming sea surface temperatures in the Bay of Bengal. This will likely lead to stronger winds, higher storm surges, and more severe flooding.

5. Rising Sea Levels:

As part of coastal Bangladesh, Ramu faces increasing risks from sea level rise, projected to rise between 0.5 to 1 meter by 2100 under high-emission scenarios. The IPCC's 6th report confirms that sea-level rise is contributing to saline water intrusion, particularly during the dry season, reducing agricultural productivity and freshwater availability in the region. Salinity intrusion affects over 30% of agricultural lands in coastal areas like Ramu.

- **Past Trends:** The coastal areas of Ramu have experienced gradual sea-level rise, contributing to increased salinity in soils and water, particularly in areas near the Bay of Bengal. Rashinagar, Chakmarkul, and Joarinala Unions are close to the coast, experiencing salinity for 2-3 months each year.
- **Future Predictions:** Sea-level rise is expected to accelerate, exacerbating coastal erosion, flooding, and saltwater intrusion into freshwater sources and agricultural lands. This will challenge local agriculture and freshwater availability.

6. Erosion and Riverbank Instability:

- **Past Trends:** Kawarkhop, Fotekharkul, Rajarkul, Kochchopia, Gorjonia union surrounded by the Bakkhali River. Riverbank erosion along the Bakkhali River has been a persistent issue, driven by changes in rainfall patterns and increased river flows during the monsoon season. Flash flood occurred in Eidgarh-eidga river of Eidgarh union, Goalipalang river of Khuniapalng union, Ramaitya river of Rashidnagar union and Dochari river of Kachchapia union while excess rainfall in the hilly regions. Both sides of these river banks are eroded
- **Future Predictions:** With more intense rainfall and potentially stronger monsoons, erosion is expected to worsen, threatening agricultural land, infrastructure, and homes near riverbanks.

7. Impacts on Agriculture:

- **Past Trends:** Changes in temperature, humidity, and rainfall have already begun affecting agricultural productivity, with more frequent crop failures and reduced yields in certain years.
- **Future Predictions:** Agriculture in Ramu is likely to face greater challenges, with increased risks of crop diseases due to higher humidity and more frequent extreme weather events. Farmers may need to adopt more resilient crop varieties and practices to cope with these changes.
- Both the IPCC and BDP 2100 highlight that Ramu's agriculture, particularly rice, is under stress due to rising temperatures and unpredictable rainfall patterns. Crop yield losses of up to 20% are predicted for rice and jute due to heat stress and erratic weather, while saline water contamination will further reduce productivity in salt-sensitive crops.

8. Vulnerability to Flooding:

- **Past Trends:** Long-term flooding does not occur as 50% of the land is elevated. However, short-term waterlogging happens in some areas due to flash floods particularly during the monsoon season, affecting homes, infrastructure, and agriculture. Flash flood occurred in Eidgarh-eidga river of Eidgarh union, Goalipalang river of Khuniapalng union, Ramaitya river of Rashidnagar union and Dochari river of Kachchapia union while excess rainfall in the hilly regions.
- **Future Predictions:** Flood risk is expected to rise due to more intense monsoons, sea-level rise, and potential changes in river flows. Effective flood management and infrastructure adaptation will be critical.
- Ramu is highly vulnerable to increased flooding from intensified monsoons and cyclone activity. According to the BDP 2100, flooding frequency will likely increase, with more intense rainfall events leading to flash floods. The IPCC report also notes that tropical cyclones are expected to intensify, increasing the risk of storm surges, exacerbating erosion, and affecting livelihoods.

12.7 Recommendations for Future Climate Change Adaptation and Mitigation Measures for Ramu Upazila as per BDP 2100

- Protecting Ramu from storm surges, tidal flooding, and erosion.
- Mitigating the impact of salinity intrusion on agriculture and freshwater supplies.
- Reducing crop loss due to climate-induced stressors such as heat, drought, and salinity.
- Enhancing natural defenses against floods and salinity intrusion while protecting biodiversity.
- Ensuring freshwater availability for drinking, agriculture, and industry.
- Reducing the loss of life, property, and livelihoods during climate-induced disasters such as cyclones and floods.
- Reducing dependency on fossil fuels and mitigating greenhouse gas emissions.
- Supporting livelihoods and reducing poverty in vulnerable communities affected by climate change.
- Preventing unplanned development in high-risk areas and ensuring sustainable land use.
- Strengthening local capacities for climate change adaptation and environmental management.

12.8 Conclusion

Ramu Upazila faces significant challenges due to climate change, with rising temperatures, erratic rainfall patterns, stronger cyclones, and rising sea levels posing serious threats to the region's environment, economy, and population. However, with proactive adaptation strategies, it is possible to mitigate some of these impacts and build resilience in the face of climate change. Long-term planning, community engagement, and the integration of traditional knowledge with modern technology will be key to ensuring the sustainable development of Ramu Upazila in the coming decades. To ensure sustainable adaptation and resilience, institutional framework and capacity-building aspects should be addressed, including proper local and national governance. Besides, a cumulative relationship among various components is a prerequisite to ensuring the development of resilient capacity.

