Government of the People's Republic of Bangladesh

Ministry of Housing and Public Works

Urban Development Directorate (UDD)

Preparation of Development Plan for Fourteen Upazilas
Package-03
(Bagmara Upazila, Rajshahi District

Final Survey Report

On

Agricultural

Bagmara Upazila, Rajshahi

June, 2017

Engineering Consultants and Associates Limited
154, Monipuripara, Farmgate, Tejgaon, Dhaka-1215.
Phone: 8116214, 9110176, 9111277 Email: ecalimited@yahoo.com;
ecalimitedbd@gmail.com

Executive Summary

The Bagmara Upazila is under Rajshahi district located in the north western part of Bangladesh. The Upazila lies partly in Chalan Beel area which is the largest wetland of Bangladesh covering three districts. Chalan Beel is a famous beel which is the home of abundant natural fish and other sources. Nardas beel is also a prominent beel of the Upazila which is grown huge natural fishes. In Wet Land/ Aquatic Agriculture system crop cultivation and fish production can be carried out simultaneously by preserving biodiversity of the wetland. Land resources of this Upazila have been brought into year round vegetables, poultry and fish farms as commercial basis. It is reported that natural disaster like cyclone, hail-storm, drainage congestion, siltation, river erosion and land erosion damage crops of this Upazila. However, shifting agricultural land to non-agricultural purposes is a common phenomenon in this Upazila. The study is to determine the present scenario of agriculture practices and assessment of the potential sustainable future development of the sector. Both the primary and secondary data were reviewed for preparing the survey report. The project entitled "**Preparation of Development Plan for Fourteen Upazilas**", Package-03 is expected to contribute to achieving the objectives of the National Agriculture Policy.

The Upazila consists of 16 unions and 02 Paurashavas, 271mauzas and 40 Paura Mahalla, 50 agriculture blocks and 332 villages and 18 Wards. Bagmara Upazila falls into 03 Agro Ecological Zones: (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5) and (iii) High Ganges River Floodplain (AEZ-11). The landscape is complex and seasonally flooded. Wide range of winter and summer crops are grown in this Upazila. Betel leaf is one of the popular cash crops in this Upazila. Bagmara Upazila gets high potentials for its land and crops & fish production. The highest percentage is triple cropped area (55%) followed by double cropped area (32%), single cropped area (11%) and more than three cropped areas (2%) under Bagmara Upazila. The cropping intensity of Bagmara Upazila is 247% which is higher than average Rajshahi District cropping intensities (236%) and also higher than average National Cropping Intensities (192%).

Multiplicity of cropping systems has been one of the main features of the Upazila. Study finding shows that 28 diversified cropping pattern are practiced by Bagmara Upazila farmers. Among them the present five major cropping pattern are: Potato/Boro→T. Aus (HYV)→ Fallow (15.13%), Mustard/Boro→T.Aus (HYV)→Fallow (14.77%), Potato→ Boro→Fallow (14.17%), Boro (HYV/Hybrid)→Fallow→Fallow (10.34%) and Mustard→Boro→Fallow (6.22%). Bagmara Upazila soil and climate are suitable for diversified crop production such as, paddy, Potato, wheat, maize, jute, Mustard, chili, winter and summer vegetables, onion/garlic, pulses, sugarcane, betel leaf and different fruits. There are wetland lies in the Upazila and famous for open water capture and culture fisheries.

The present total diversified cropped area is 68223 ha of which rice cropped area are 31280 ha and the rest 487172.66 ha is covered by non-rice crops (Potato, W & S. vegetables, pulses, and oilseeds and Fruits etc.). The rice and non-rice cropped area are about 46% and 54% respectively of the total cropped area. The highest land area was used for Potato (13320ha) followed by Boro HYV (13210ha), T. Aus (11700ha), Oilseeds (6755ha) and Boro Hybrid 5550 ha). In 2016, total crop production under Bagmara Upazila is 658975.36 metric tons of which rice production is 171802.7 metric tons and non-rice production is 475460.66 metric tons. Among the rice crops the highest contributions of Boro (HYV) followed by T.Aus(HYV) and Boro (Hybrid) are about 63%, 19% and 16% respectively. The highest contribution among the non-rice crops are Potato (61%) followed by spices (16%) & winter vegetables (7%), Maize & summer vegetables (5%).Overall, rice and non-rice production difference is 26% and 74% in this upazila.

Irrigation is considered as a basic input for producing cereals and many other high value crops. Most of the farmers are dependent on irrigation. A total of 5054 machine were used for irrigation under Unions in Bagmara Upazila. Out of total machine, 861 DTW, 3031 STW and 1162 LLP along with other indigenous irrigation tools are used for lifting water. This indicates that farmers have access to irrigation water that through ground water lifting causing an adverse impact both in agricultural production and surrounding environment. Among the irrigation machine 653 DTW, 169 STW and 6 LLP has electricity facilities but 208 DTW, 2862 STW & 1156 LLP has no electricity facilities. About 84% irrigation machines under this Upazila has not given electricity which is increased the crop production cost.

Framers wanted nonstop electricity supply during Boro season. Majority of the Farmers reported irrigation drainage system of DTW 40-80% is pucca, and STW and LLP 80-100% drain is kutcha which is causes wastage of irrigation water. Farmers wanted pucca drainage system.

In rabi season mechanized irrigation can help to increase crop diversification. Study finding shows that all Unions & Paurashavas 93-100 % land area covered by irrigation water in Rabi season. This indicates that most of the farmers have access to irrigation water which is a good sign for intensive farming. But in the long term, excessive ground water lifting may cause an adverse impact both in agricultural production and in the surrounding environment. There is a need to measure the water table condition in Boro season every year. Farmers have given supplementary irrigation in drought prone and water logged areas in this Upazila.

During 2015-16, BRRI study shows that farmer's average per kg cost of Boro Tk20.07 followed by Aus Tk18.37 and Aman Tk.17.83 in the year 2015-16.Cost of per kg Boro rice production is increased Tk1.42.Department of Agriculture Marketing was estimated production cost for Boro rice Tk22.06, Aman riceTk.19.0 and Wheat Tk. 28.50 per kg in the year 2016-17. On this basis Government has declared buying rate of Boro rice Tk20.70, Aman rice Tk18.50 per kg and Wheat Tk27.02 per kg respectively in 2016. Farmers wanted and also need to ensure the profitable farm gate price for rice.

The present study was assessed financial profitability of Brinjal, Tomato, Potato and Cabbage/cauliflower vegetables production under Bagmara Upazila. Finding shows that Tomato cultivation is more profitable Tomato Tk. 1042500/-per ha followed by Brinjal Tk. 645890/- per ha, Cabbage/Cauliflower Tk. 622800 /- per ha and potato Tk 214350/-per ha respectively. Study finding clearly indicated that all four types of vegetables cultivation are profitable for farmers of Bagmara Upazila.

Study finding shows above 93% local variety rice was decreased during last ten years. The HYV/Hybrid paddy cultivation area 58% was increased. The reason for increased HYV rice cultivated area due to higher yield many farmers were cultivated HYV and Hybrid rice. Remarkable significant changed or increased during 10 years was occurred in Maize cultivation area (99%) but only 9% wheat area was increased in this Upazila. The main reason for increased maize area due to farmer's switchover cultivated less risk and high

market demand and as profitable crops. Similarly, about 17% winter vegetables and 9% summer vegetables area was increased. Among the high value crops the highest changed or increased during ten years was occurred in Betel leaf (42%) followed by oilseeds (18%), fruit gardening(15%), tuber crops (8%), pulses and spices(6%). Sugarcane cultivation area 50% is decreased. Among the other purposes remarkable significant changed were occurred in Brick field (97%) and followed by poultry farm (64%), Housing (28%) and fish cultivation (9%) respectively. The main reasons for increases land used in other purposes because of local market demand and also highly profitable. This finding clearly indicated crop land day by day has gradually decreased which will be reflected on agriculture crop production and Upazila ecosystem.

Major problems are: Water logging and sudden flood damages crops, drought and cold wave create negative impact on diversification of crops, Siltation of Baor wet lands, rivers and canals. Most of the canals/khals of the Unions & Paurashavas were found mostly closed or silted, Changes in rainfall pattern and climate change, Lack of knowledge both men and women farmers on crop production technology,

Scarcity of surface water for irrigation, Less supply of quality HYV/Hybrid crop seeds and higher cost cultivation & irrigation equipments, Inadequate drainage facilities and kutcha irrigation drainage system, Shortage of cold storage, seed store and wholesale vegetables market infrastructure, Sand filling on fertile agricultural land and unplanned expansion of housing and infrastructure, Unplanned construction of houses ,roads, and settlements, markets, industries, unplanned fish and poultry production, Over-drainage, abrupt reduction of wet land restricts open water fisheries and its breeding place, Lack of policy implementation to preserve the perennial wetland areas, Acquisition of agricultural land for non- agriculture purposes, Top soil cutting and filling sand, unplanned expansion of urban and commercial areas, Lack of potato , vegetable processing, grading and packaging facility and City migration.

Considering major constraints and problems of the area the following management practices can be taken: (1) Drainage congestion can be removed by excavating new canals and re-excavating the old canals connecting to the nearby rivers or khals, (2) Farmers need base modern crop production technological practical training,(3) Establishment of soil testing laboratory or facilities ,(4) Construction multipurpose cold storage and wholesale

market infrastructures,(4) Adapt Biodynamic/Eco-friendly crop production technology, (5) Perennial wetland should be preserved for open water fisheries and ecological balance must be maintained,(6) Need to popularize rice with fish cultivation technology which will reduced the pesticides use, (7) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry, (8)Construction of permanent structure such as roads, housing settlements etc. in the perennial water body need to be prohibited,(9) Some perennial wetlands need to be declared as a fish Sanctuary for survival of indigenous fish species, (10) land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will decrease the uses of agricultural lands to non-agricultural purpose.

Table of Content

List of Table

List of Figure

List of Abbreviations

AEO	Agriculture Extension Officer
AEZ	Agro-Ecological Zone
AVRDC	Asian Vegetable Research and Development Center
BARI	Bangladesh Agriculture Research Institute
BCR	Benefit Cost Ratio
BINA	Bangladesh Institute of Nuclear Agriculture
BRRI	Bangladesh Rice Research Institute
BSRI	Bangladesh Sugarcane Research Institute
CC	Climate Change
DAE	Department of Agricultural Extension
DTW	Deep Tube well
DS/m	Deci-Siemens/meter
FAO	Food and Agricultural Organization
GED	General Economic Division
GO	Government Organization
GoB	Government of Bangladesh
Ha	Hectare
HL	High Land
HQ	Head Quarter
HYV	High Yielding Variety
HHS	Household Survey
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan (IPMP)
KII-	Key informant Interview
LIV	Local Improved Variety
LV	Local Variety

LL	Low Land
LLP	Low Lift Pump
MoL	Ministry of Land
MHL	Medium High Land
MLL	Medium Low Land
NCA	Net Cultivable Area
NIPM	National Integrated Pest Management
NLUP	National Land Use Policy
NWP	National Water Policy
NWMP	National Water Management Plan
P^H	Negative Logarithm of Hydrogen Ion Concentration
SAAO	Sub-Assistant Agricultural Officer
SRDI	Soil Resource Development Institute
SPSS	Statistical Package for the Social Sciences
STW	Shallow Tube Well
T. Aman	Transplanted Aman
T. Aus	Transplanted Aus
ToT	Training of Trainers
UAO	Upazila Agricultural Officer
UDD	Urban Development Director
VLL	Very Low Land
UL	Upazila Livestock Officer
UFO	Upazila Fisheries Officers
WARPO	Water Resources Planning Organization
W&S	Winter & Summer

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The Bagmara Upazila is under Rajshahi district located in the north western part of Bangladesh. The Upazila lies partly in Chalan Beel area which is the largest wetland of Bangladesh covering three districts. Bagmara came into existence in 1869 as Thana and turned into Upazila in 1983. Nothing is definitely known about the origin of the Upazila name, but it is learnt that in the past this area was full of jungles and forest. There is a hearsay that while cleaning the jungles a tiger means Bagh was killed and after that this area became popularly known as Bagmara. The area of Upazila is 365. 58Sq.km; located between 24^0 30′ and 24^0 41′ north latitudes and between 88^0 41′ and 88^0 58′ east longitudes. Upazila is stands about 39 km away from Rajshahi district. The Upazila is bordering to the north with the Manda and Atrai Upazila of Naogaon district; to the east with Atrai and Natore Sadar Upazila; to the south with Punthia and Durgapur Upazila and to the west with the Mohanpur Upazila. The Bagmara (town) located at Bhabaniganj, situated on the bank of the river Fakinni. The Upazila consists of 16 unions and 02 Paurashavas, 271mauzas and 40 Paura Mahalla, 50 agriculture blocks and 332 villages and18 Wards. Chalan Beel is a famous beel which is the home of abundant natural fish and other sources. Nardas beel is also a prominent beel of the Upazila which is grown huge natural fishes. In Wet Land/ Aquatic Agriculture system crop cultivation and fish production can be carried out simultaneously by preserving biodiversity of the wetland. Wide range of crops cultivated here in rabi and kharif season like paddy, jute, wheat, mustard, lentil, onion, maize, potato, sesame, betel leaf and vegetables etc grown here. Fruits cultivated are mango, jackfruit, banana, papaya, guava etc. Land resources of this Upazila have been brought into year round vegetables, poultry and fish farms as commercial basis.

Bangladesh has divided into 30 Agro Ecological Zone based on soil, landform and climatic characteristics. Bagmara Upazila falls into 03 Agro Ecological Zones: (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5) and (iii) High Ganges River Floodplain (AEZ-11). The landscape is complex and seasonally flooded. General soil color of Bagmara Upzila is grey to

dark grey. The top soil is occupied by moderately permeable loamy soils and some parts are clayey. It is reported that natural disaster like cyclone, hail-storm, drainage congestion, siltation, river erosion and land erosion damage crops of this Upazila. However, shifting agricultural land to non-agricultural purposes is a common phenomenon in this Upazila. Improper land use causes various forms of land degradation resulting in a reduced agriculture production. Indiscriminate land conversion will impose threat to national food security. As such, land use pattern of the Upazila is changing, creating pressure on land resources and biodiversity. Protecting fertile agricultural land and to meet rational needs of other sectors are our great national challenges. To protect agricultural land, to minimize land degradation and introducing modern technology are the basic needs to cope-up with the increasing demand of food for the growing population of this Upazila.

In view of the above mentioned context, a comprehensive study was conducted in all the Unions and Paurashavas of Bagmara Upazila to assess present situation of land uses, related problems and potentialities of land for different other uses, and to find out possible coping ways to solve the problems. Therefore, considering all available parameters and characteristics of the area a sustainable land management was considered to develop better crop production.

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 2005-2016) 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 of potential sustainable future development of the sector.

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. AII information was collected by using questionnaire survey (Annex-1). The secondary data were collected and reviewed on land use

from DAE Union and Upazila Office documents. KII information was collected from 50 Sub-Assistant Agriculture Officers under 16 Unions & 02 Paurashavas through interview. Structured and semi-structured questionnaire was used for data collection (Annex-2). Data collection and consolidation occurred simultaneously. Data collection activities were completed from 01-30 December 2016. 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 for data analysis.

CHAPTER-TWO: AGRICULTURE RELEVANT POLICY FRAMEWORK

This Chapter presents a review of the national policy, legal, and regulatory framework relevant to the agriculture aspects of the Project.

2.1 National Agriculture Policy, 2013

The National Agriculture Policy, 2013 approved by the Government of Bangladesh focuses on agriculture production, alleviating poverty through generating jobs and ensuring food security. The Policy outlined nine specific objectives. Although the policy does not emphasize the coastal zone separately, all specific objectives are applicable to the development of coastal zone agriculture. The GoB will pursue programme for agro-ecologically disadvantaged regions in the hilly area, drought-prone area, Barind tract, char land, haor-baor and coastal belt with appropriate technological support. To increase water productivity and enhance irrigation efficiency through optimal use of available water resources the GoB will facilitate dissemination of water management technology. Modern irrigation, drainage and water application systems will be introduced for expanding irrigation coverage including difficult or disadvantaged areas i.e. in char, hilly areas, Barind Tract, drought-prone and saline areas. The proposed Preparation of Development Plan for Fourteen Upazilas Package: 03 are expected to contribute to achieving the objectives of the agriculture policy.

2.2 National Water Management Plan, 2001 (Approved in 2004)

The National Water Management Plan (NWMP) 2001, approved by the National Water Resources Council in 2004, envisions establishing an integrated development, management and use of water resources in Bangladesh over a period of 25 years. WARPO has been assigned to monitor the national water management plan. The major programs in the plan have been organized under eight sub-sectoral clusters: (i) Institutional Development, (ii) Enabling Environment, (iii) Main Rivers, (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, and a total of 84 sub-

sectoral programs have been identified and presented in the investment portfolio. Preparation of Development Plan for Fourteen Upazilas Package: 03 have been designed in line with this Plan and address its key objectives for the water resource management in the Bagmara Upazila areas.

2.3 The Ground Water Management Ordinance, 1985 (Ord. No. XXVII of (1985)

This is an Ordinance to manage ground water resources for agricultural production. This Act authorizes the Thana Parishad (Police Station) to grant license for installing tube wells under its jurisdiction. The Thana Parishad may grant the license if the Parishad is satisfied that the installation of the tube well applied for complies with the following points; will be beneficial to the areas where it is to be installed, or will not have any adverse effect upon the surrounding areas, or is otherwise feasible. Preparation of Development Plan for Fourteen Upazilas Package 03 has been designed in line with this Plan and addresses its key objectives for the ground water management ordinance for Bagmara Upazila.

2.4 National Land Use Policy (MoL, 2001)

The National Land Use Policy enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may not be possible through artificial land reclamation process, which is cost-effective only in the long run. Therefore, land use planning should be based on the existing and available land resources. The policy suggests establishing land data-banks where, among others, information on accreted reverie and chars will be maintained. Among the 28 policy statements of NLUP, the following are relevant to the Bagmara Upazila are: forests declared by the Ministry of Environment and Forests will remain as forest lands and re-classification of forest lands will be prevented. Preparation of Development Plan for Fourteen Upazilas Package 03 is designed in accordance with this Policy and will comply with the above listed requirements.

2.5 National Water Policy, 1999

Endorsed by the GoB in 1999, the National Water Policy (NWP) aims to provide guidance to the major players in the water sector for ensuring optimal development and management of water. According to the policy, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) are required to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks. The proposed Preparation of Development Plan for Fourteen Upazilas Package: 03 are expected to contribute to achieving the objectives of the national water policy.

2.6 National Integrated Pest Management (NIPM) Policy

IPM Action Plan supports a strategy that promotes use of biological or environmental pest control methods and reduces reliance on synthetic chemical pesticides. Agriculture, rural development and health sector projects have to avoid using harmful pesticides. Other pesticides can be used, but only as an element of an Integrated Pest Management Plan (IPMP) that emphasizes environmental and biological controls. The proposed Preparation of Development Plan for Fourteen Upazilas Package 03 is expected to contribute to achieving the reduce pesticides used in agriculture sector and increases use of other pest control methods under National IPM policy.

2.7 The Perspective Plan of Bangladesh (2010-2021) and 7 the Five Year Plan (2016-20)

Both the plans has emphasized on food production with specific targets to achieve by 2021 which will be the golden jubilee year of Bangladesh independence. The 7th Five Year Plan (2016-20) has prescribed for the transformation of agriculture into its newer and modern form which will certainly require short-and medium-term adjustments with adequate investment. These include among others (i)crop diversification with the application of innovative technology;(ii) modern forms of irrigation and fertilizer use;(iii)well integrated and developed storage facilities and transportation systems;(iv)advanced agriculture research in a wide range of products beyond its traditional focus on rice and introduction of hybrid seeds; and(v) development of

drought or flood resistant crops (GED 2010 and GED 2015). The proposed Preparation of Development Plan for Fourteen Upazilas Package: 03 are expected to contribute to achieving the objectives of the Perspective Plan of Bangladesh (2010-2021) and 7 the Five Year Plan (2016-20). .

CHAPTER-THREE: PRESENT LAND USE

3.1 Description of the Present Situation

Conservation and Sustainable Use (CSU) in the context of land resources reflecting respective use of biophysical limits and ecosystem as well biodiversity is essential in Bagmara Upazila. In Wet land/ Aquatic Agriculture System crop agriculture and fish production can be carried out simultaneously by preserving biodiversity of the wetland. Land resources of this Upazila have been brought into year round vegetables, poultry and fish farms as commercial basis. The 'Chalan Beel' is being silted up due to post monsoon seasonal flood, over extraction and other unplanned interventions. Crop production is a complex business, requiring many skills such as biology, agronomy, mechanics and marketing. Wide range of winter and summer crops are grown in this Upazila. Rice and mustard are two principal crops. Betel leaf is one of the popular cash crops in this Upazila. Fruits grow well here are mango, jackfruit, banana, papaya and guava etc. Agricultural production is highly dependent on adaptable climatic conditions. It is reported that natural disasters like cyclone, hail-storm, drainage congestion, siltation river erosion and land erosion damage crops of this Upazila. Bagmara Upazila falls into 03 Agro Ecological Zones: (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges River Floodplain (AEZ-11). The landscape is complex and seasonally flooded. General fertility is relatively poor. The top soil pH level ranges from 5.5-8.0(SRDI 1998 and BARC 1997). Both ground and surface water are available for crop production. Bagmara Upazila gets high potentials for its land and agricultural production. But overexploitation, mismanagement and changes in land use pattern are taking place at an unprecedented rate.

3.2 *Bagmara Upazil-Union Wise Farm Families*

Most of the people of Bagmara Upazila engage directly or indirectly in agriculture which is highly concentrated to land. It is the main source of their employment and income. Farmers are harnessing their live style by producing multiple crops round the year. Bagmara Upazila of Rajshahi district is potential for diversified agricultural practices. This Upazila consists of 16

Unions and 02 Paurashavas. It has 271 Mauza & 40 Paura Mahalla and 332 villages with 18 Wards. This Upazila has 50 agricultural blocks under DAE. Farm family is categorized according to farmer holding own land. There are five categories of farm family in Bangladesh. These are: landless (0.05-0.50 acre land), marginal (0.51-1.50 acre land), and small (1.51-2.50 acre land), medium (2.51-7.50 acre land) and larger (above 7.50 acre land). Union and category wise farm family under Bagmara Upazila is shown in Table 3.1. Out of 84401 farm families most are landless 16264(19.27%) followed by marginal 22642(26.83%), small 34088(40.39%), medium 10453(12.38%) and larger 954(1.13) farmers (Table 3.1 and Figure 3.1). Landless and marginal farm families occupy 19.27% and 26.83%. They are relatively poor and often cannot meet up their basic needs from existing modern crop production practices. However, with the increasing number of population the pressure on land is increasing day by day. Field survey suggested that the number of landless farm families is gradually increasing that create pressure on livelihood in the Upazila.

Table 3. 1: Union and Category Wise Farm Family under Bagmara Upazila

Name of Union	Landless (%) (.05-.50 acre)	Marginal (%) (.51-1.50 acre)	Small (%) (1.51-2.50 acre)	Medium (%) (2.51-7.50 acre)	Larger (%) (above 7.50 acre)	Total
Auch para	1460(25.68)	1904(33.43)	1665(29.28)	543(9.55)	117(2.06)	5686
Bara Bihanali	449(27.34)	1000 (27.34)	1487(40.65)	694(18.97)	28(0.76)	3658
Basupara	1920(32.87)	2023(34.64)	1225(20.97)	582(9.96)	91(1.56)	5841
Dwippur	410(11.40)	972(27.02)	1414(39.31)	769(21.38)	32(0.89)	3597
Ganipur	1470(22.08)	2114(31.76)	2596(37.00)	439(6.60)	37(0.56)	6656
Goalkandi	1655(30.69)	1448(26.85)	1438(26.67)	785(14.56)	66(1.23)	5392
Gobinda Para	1389(20.77)	1327(19.84)	2738(40.93)	1030(15.40)	205(3.06)	6689
Hamir Kutsha	400(8.69)	1175(25.53)	2529(54.94)	486(10.56)	13(0.28)	4603
Jhikra	1262(21.14)	551(9.23)	3633(60.85)	500(8.38)	24(0.40)	5970
Jogipara	1165(20.18)	1546(26.78)	2406(41.68)	607(10.51)	49(0.85)	5773
Kachhari Kayal Para	300(15.21)	590(29.90)	890(45.11)	180(9.12)	13(0.66)	1973
Maria	950(17.27)	1470(26.73)	2660(48.36)	392(7.13)	28(0.51)	5500
Nardas	1440(26.29)	1307(23.87)	1664(30.38)	1004(18.33)	62(1.13)	5477
Sonadnaga	480(26.35)	555(30.46)	510(27.99)	252(13.83)	25(1.37)	1822
Sreepur	360(11.92)	860(28.48)	1438(47.61)	330(10.93)	32(1.06)	3020
Subhadanga	624(11.87)	1500(28.54)	2599(49.47)	490(9.32)	42(0.80)	5255

Name of Union	Landless (%) (.05-.50 acre)	Marginal (%) (.51-1.50 acre)	Small (%) (1.51-2.50 acre)	Medium (%) (2.51-7.50 acre)	Larger (%) (above 7.50 acre)	Total
Bhawbaniganj Paurashava	460(9.97)	1600(34.66)	2016(43.67)	500(10.83)	40(0.87)	4616
Tahirpur Paurashava	70(2.44)	700(24.39)	1180(41.11)	870(30.32)	50(1.74)	2870
Total	16264(19.27)	22642(26.83)	34088(40.39)	10453(12.38)	954(1.13)	84401

Source: SAAOs & UAO Bagmara Upazila, DAE 2016

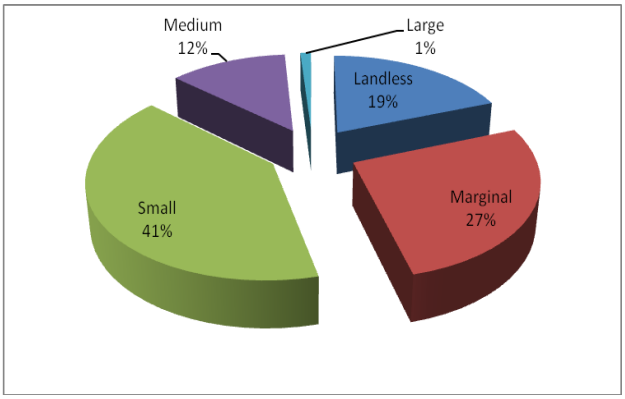


Figure 3. 1: Percentage of Category wise Farm family under Bagmara Upazila

3.3 Present Agricultural Land Use

3.3.1 Present Upazila Land Use

Land is a finite resource for most human activities including agriculture, industry, forestry, energy production, settlement, recreation, and water catchment and storage. Increased population imposes high pressure on land resources for agriculture production. Large areas of wetland commonly known as beels in Bagmara Upazila hold quite high potential for fisheries and development of crop agriculture using surface water of these water bodies. Multiplicity of cropping systems has been one of the main features of the Bagmara Upazila. Paddy, wheat, potato, onion, garlic, brinjal, mustard, sesame, betel leaf, and vegetables are the notable crops, but rice is the main crop. Land is being intensively utilized and the top surface and fertility are decreasing. Land resources are gradually degrading in Bagmara Upazila due to natural disasters and manmade reason. High pressure population, unplanned and rapid urbanization, unplanned fisheries, construction brick field, land acquisition and other infrastructural developments are

the dominant factors degrading agricultural land resources in Bagmara Upazila. The present scenario of Bagmara Upazila present different land utilized is shown in Table 3.2. Out of 36558 ha total land area are 6550 ha high land, 12180 ha medium high land, 5330 ha medium low land, and 5050ha low land respectively. Bagmara Upazila covers 29110 ha of net cropped area of which about cultivated area is 71960 ha. Out of the total cultivable land in Bagmara Upazila triple cropped area 15850 ha followed by double cropped area 9180ha, single cropped area 3290ha and more than three cropped area 690 ha (Table 3.2). Other purposes land use: Rural settlement and Homestead Vegetation (HV) 9352.55 ha, Permanent Fruit Garden 875 ha, and Fish cultivation 1375 ha, Betel Vine640ha, irrigated land area 28010ha and also permanent fallow land 1267ha. Percentage of single, double, triple cropped area used in Bagmara Upazila is shown in Figure 3.2. The highest percentage is triple cropped area (55%) followed by double cropped area (32%), single cropped area (11%) and more than three cropped area (2%) under in Bagmara Upazila. The cropping intensity of Bagmara Upazila is 247% which is higher than average Rajshahi district cropping intensities (236%). Union-wise Present Agriculture Land Use Information and Identified land Zoning of Gangni Upazila are shown in Table 3.3. There are four types of land zoning proposed for Bagmara Upazila by National Land Zoning project report 2015 which is shown in Table 3.4. These are: (1) Agriculture Zone, (2) Agriculture-Betel Vine Zone, (3) Agro-Fisheries Zone, and (4) Paurashava Area. Upazila Land used Map shown in Map 3.1. There is wide opportunity to grow different fruits, betel leaf, oil seed and winter & summer vegetables as commercial basis to export. The Upazila is considered as highly potential for commercial agriculture farming.

Table 3. 2: Bagmara Upazila Present Land Use

Sl. No.	Upazila Land use	Total Area (ha)
1.	Total Area	36558
2.	High land	6550
3.	Medium high land	12180
4.	Medium low land	5330
5.	Low land	5050
6.	Single cropped area	3290
7.	Double cropped area	9180
8.	Triple cropped area	15850
9.	More than three cropped area	690
10.	Net Cropped area	29110

Sl. No.	Upazila Land use	Total Area (ha)
11.	Total cropped area	71960
12.	Cropping Intensity (%)	247
13.	Forest	270
14	Permanent fallow land	1267
15.	Current/Seasonal Fallow Land: -Rabi fallow - Kharif-1 fallow - Kharif-2 fallow	00 3010 3020
16	Urban Built-up area	142.36
17.	Permanent fruit garden	875
18.	Betel Vine	640
19.	Irrigated land area	28010
20.	Water land (River, Ponds and others)	1375
21.	Brick Field	99.50
22.	Rural Settlement and HV	9352.55

Source : Upazila Agriculture Office Baghmara, DAE 2016

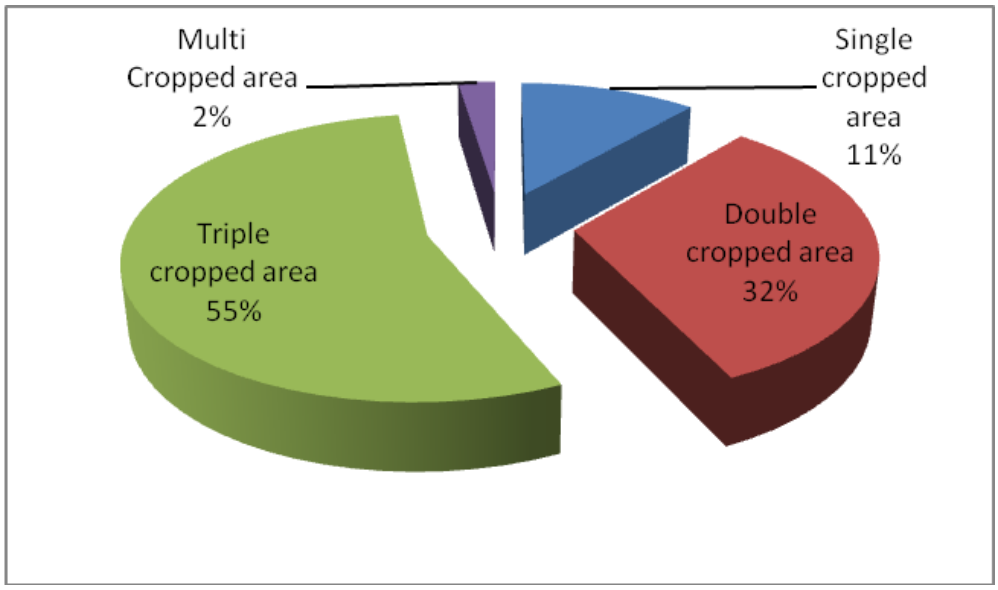


Figure 3. 2: Percentage of single, double, triple & more than three cropped land used Bagmara Upazila

Table 3. 3: Union-wise Present Land Use Information and Identified Land Zoning

Union	Area (Ha)	Top Soil Texture	Cropping Intensity (%)	Land Use (Summarized)	Area (Ha)	(%)	Recommended Land Zoning
Auch Para	2709.29	Loam to Clay Loam	237	Agricultural Land	1521.72	56.17	Agriculture Zone
				Betel Vine	133.01	4.91	
				Mango/Litchi Garden	61.11	2.26	
				Brick-field	6.54	0.24	
				Road	7.77	0.29	
				Rural Settlement & HV	704.12	25.99	
				Water Bodies	275.02	10.15	
Bara Bihanali	1410.57	Loam to Clay Loam	240	Agricultural Land	906.14	64.24	Agro- Fisheries Zone
				Betel Vine	0.17	0.01	
				Mango/Litchi Garden	11.87	0.84	
				Brick-field	0.69	0.05	
				Road	3.64	0.26	
				Rural Settlement & HV	343.94	24.38	
				Water Bodies	144.11	10.22	
Basu Para	2870.93	Loam to Clay Loam	216	Agricultural Land	1713.06	59.67	Agriculture Zone
				Betel Vine	87.50	3.05	
				Mango/Litchi Garden	40.24	1.40	
				Industrial Area	1.01	0.04	
				Brick-field	11.45	0.40	
				Road	9.81	0.34	
				Rural Settlement & HV	768.43	26.77	
				Water Bodies	239.44	8.34	
Bhabanigonj Paurashava	1269.40	Loam to Clay Loam	215	Agricultural Land	734.30	57.85	Paurashava Area
				Betel Vine	10.21	0.80	
				Mango/Litchi Garden	54.97	4.33	
				Industrial Area	0.36	0.03	
				Road	9.93	0.78	
				Rural Settlement & HV	283.78	22.36	
				Urban Built-up Area	80.76	6.36	
				Water Bodies	95.10	7.49	
Dwippur	1354.64	Loam to Clay Loam	219	Agricultural Land	927.43	68.46	Agro- Fisheries Zone
				Betel Vine	0.14	0.01	
				Mango/Litchi Garden	49.26	3.64	
				Brick-field	2.70	0.20	
				Road	3.96	0.29	
				Rural Settlement & HV	195.65	14.44	
				Water Bodies	175.50	12.96	
Ganipur	3645.79	Loam to Clay Loam	201	Agricultural Land	2071.36	56.82	Agriculture-Betel Vine Zone
				Betel Vine	348.25	9.55	
				Mango/Litchi Garden	38.20	1.05	
				Industrial Area	0.09	0.00	
				Brick-field	12.80	0.35	
				Road	15.57	0.43	
				Rural Settlement & HV	847.68	23.25	
				Water Bodies	311.84	8.55	
Goalkandi	2534.71	Sandy Loam to Loam	227	Agricultural Land	1561.92	61.62	Agro-Fisheries Zone
				Betel Vine	34.35	1.36	
				Mango/Litchi Garden	90.10	3.55	
				Brick-field	5.63	0.22	
				Road	12.62	0.50	
				Rural Settlement & HV	585.61	23.10	
				Urban Built-up Area	0.06	0.00	
				Water Bodies	244.41	9.64	
Gobinda Para	2690.90	Loam to Clay	232	Agricultural Land	1686.33	62.67	Agriculture Zone
				Betel Vine	13.94	0.52	
				Mango/Litchi Garden	19.78	0.73	
				Brick-field	14.11	0.52	
				Road	10.79	0.40	
				Rural Settlement & HV	655.35	24.35	
				Water Bodies	290.61	10.80	
Hamir Kutsha	2229.06	Loam to Clay Loam	225	Agricultural Land	1547.17	69.41	Agro-Fisheries- Zone
				Betel Vine	0.98	0.04	
				Mango/Litchi Garden	36.78	1.65	
				Road	10.29	0.46	

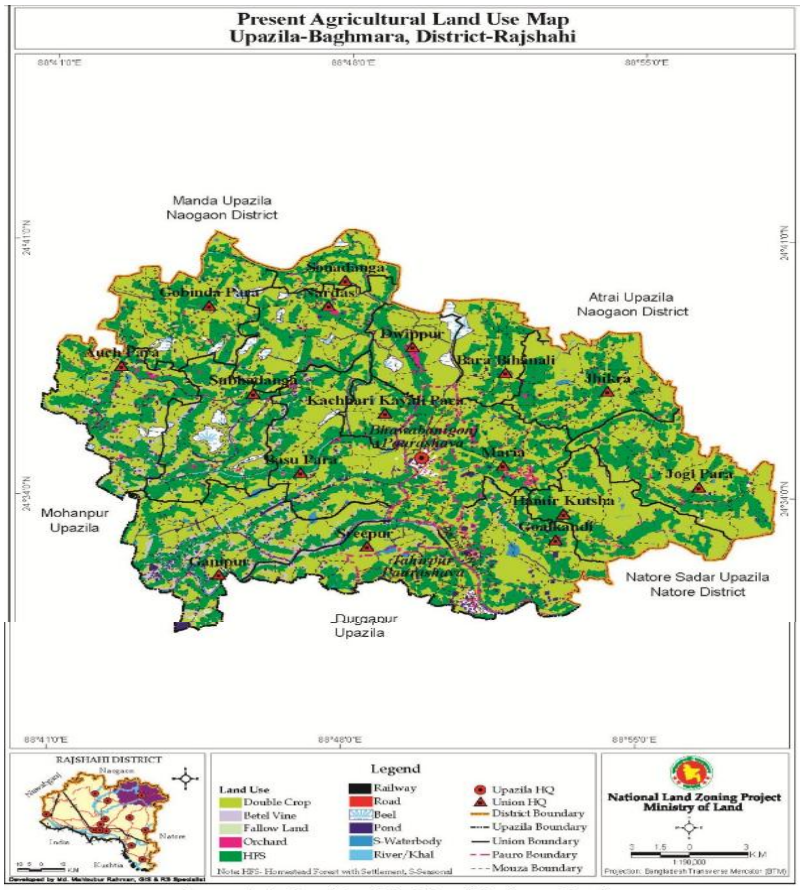
Union	Area (Ha)	Top Soil Texture	Cropping Intensity (%)	Land Use (Summarized)	Area (Ha)	(%)	Recommended Land Zoning
				Rural Settlement & HV	536.31	24.06	
				Water Bodies	97.52	4.38	
Jhikra	2430.72	Sandy Loam to Loam	245	Agricultural Land	1569.35	64.56	Agro- Fisheries Zone
				Betel Vine	2.08	0.09	
				Mango/Litchi Garden	35.60	1.46	
				Brick-field	2.86	0.12	
				Road	6.40	0.26	
				Rural Settlement & HV	680.36	27.99	
				Water Bodies	134.07	5.52	
Jogi Para	2758.18	Sandy Loam to Loam	223	Agricultural Land	1737.74	63.00	Agro- Fisheries Zone
				Mango/Litchi Garden	68.74	2.49	
				Brick-field	14.49	0.53	
				Road	13.93	0.51	
				Rural Settlement & HV	792.47	28.73	
				Water Bodies	130.80	4.74	
Kachhari Kayali Para	727.96	Loam to Clay Loam	237	Agricultural Land	478.43	65.72	Agriculture Zone
				Betel Vine	1.84	0.25	
				Mango/Litchi Garden	10.03	1.38	
				Road	4.49	0.62	
				Rural Settlement & HV	173.91	23.89	
				Water Bodies	59.24	8.14	
Maria	1901.44	Loam to Clay Loam	222	Agricultural Land	1119.54	58.88	Agriculture Zone
				Betel Vine	2.57	0.14	
				Mango/Litchi Garden	98.92	5.20	
				Industrial Area	0.52	0.03	
				Brick-field	6.48	0.34	
				Road	7.12	0.37	
				Rural Settlement & HV	557.24	29.31	
				Water Bodies	109.07	5.74	
Nardas	2330.75	Loam to Clay	187	Agricultural Land	1421.82	61.00	Agro- Fisheries Zone
				Betel Vine	10.01	0.43	
				Mango/Litchi Garden	41.68	1.79	
				Brick-field	8.78	0.38	
				Road	9.36	0.40	
				Rural Settlement & HV	575.26	24.68	
				Water Bodies	263.86	11.32	
Sonadanga	899.51	Sandy Loam to Loam	142	Agricultural Land	582.74	64.78	Agro- Fisheries Zone
				Mango/Litchi Garden	8.29	0.92	
				Brick-field	0.85	0.09	
				Road	4.66	0.52	
				Rural Settlement & HV	220.14	24.47	
				Water Bodies	82.81	9.21	
Sreepur	1152.37	Loam to Clay	203	Agricultural Land	696.82	60.47	Agriculture Zone
				Betel Vine	79.01	6.86	
				Mango/Litchi Garden	9.97	0.87	
				Road	7.12	0.62	
				Rural Settlement & HV	273.34	23.72	
				Water Bodies	86.10	7.47	
Subhadanga	2589.18	Loam to Clay Loam	228	Agricultural Land	1297.46	50.11	Agriculture Zone
				Betel Vine	138.83	5.36	
				Mango/Litchi Garden	24.64	0.95	
				Brick-field	12.13	0.47	
				Road	10.03	0.39	
				Rural Settlement & HV	748.98	28.93	
				Water Bodies	357.12	13.79	
Tahirpur Paurashava	1078.38	Loam to Clay Loam	267	Agricultural Land	569.25	52.79	Paurashava Area
				Betel Vine	43.82	4.06	
				Mango/Litchi Garden	12.68	1.18	
				Road	7.75	0.72	
				Rural Settlement & HV	254.73	23.62	
				Urban Built-up Area	61.55	5.71	
				Water Bodies	128.60	11.93	

Source: National Land Zoning Project Report, August 2015

Table 3.4: Proposed Land Zoning for Baghmara Upazila

Name of Zone	Union	Remarks
1. Agriculture Zone	Auch para, Basupara, Gobinda Para, Kachhari Kayali Para, Maria, Sreepur and Subhadanga	Considering the present agricultural land use, land suitability and peoples opinion these union are recommended as agricultural zone
2. Agriculture- Betel Vine Zone	Ganipur	Betel leaf is a high value agriculture crop and its cultivation is the main source of income for many farmers
3. Agro- Fisheries Zone	Bara Bihanali, Dwippur, Hamirkutsha, Jogipara, Nardas, Sonadanga, Goalkandi and Jhikra	Some of the area is potential for capture and culture fisheries and high production of fisheries
4. Paurashava Area	Bhawbaniganj Paurashava and Tahirpur Paurashava	Paurashava area development of urban area should be done without degradation of fertile agricultural land

Source: National Land Zoning Project Report, August 2015



Present Agricultural Land Use Map of Baghmara Upazila

Map 3. 3. Present Agricultural Land use Map of Baghmara Upazila (Source: National Land Zoning Project Report, August 2015)

3.4 Union-Wise Present Agriculture Land Use

Bagmara Upazila gets high potential for its land for crops and fish production. Total area of this Upazila is about 36,652.62 ha and consisting of 16 Unions with 02 Paurashavas and 332 villages with 18 wards. All Unions different land types, cropping pattern and land used. Bagmara Upazila Union and Paurashava wise different characteristics, physical features and contemporary land use pattern observed are as follows:

3.4.1 Auch para Union Land Use

General Description

The physical and chemical characteristics of an area have great influence on the suitability of land for different types of crops production. The land suitability mainly soil texture, land type, soil pH etc are important indicator for selecting any crops. Auch para Union consists of 23 Mauzas and 39 villages with the area of2736.84ha. The land types of this union are medium high land (50.91%), high land (19.24%), Medium low land (18.21%), and Low land (11.64%). Major lands of Auch para Union is under high land to medium low which means very suitable for multiple crops cultivation. High land and medium high lands are suitable for diversified crop cultivation including Boro, T. Aman, Mustard, Onion/Garlic and vegetables etc. Soil texture is loam to clay loam which indicates lands are suitable for different Rabi crops and Kharif crops cultivation (SAAO, 2016). Union falls into 3Agro-ecological zones are (i)Tista Meander Floodplain (AEZ-3),(ii)Lower Atrai Basin (AEZ-5),and (iii) High Ganges Floodplain (AEZ-11). Most of the areas of these unions are developed from transformed alluvial deposit by the Ganges by Padma river system. The soil P^H is 6.5-7.0. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **agriculture zone**.

Auch para Union having agriculture cultivated area of 3926ha of land of which net cropped area is 2027 ha. Out of the total cultivable land in Auch para Union double cropped area 820(40.45%)ha, triple cropped area 635(31.33%) and single cropped area 572(28.22%). At present farmers of Auch para Union 23 different cropping patterns is practiced by farmers which is shown in Table 3.5. The cropping intensity of this union is 193%%. Intensive cultivation of rabi and kharif crops by using irrigation in this Union. Major crops cultivated in

this union are: Paddy, Mustard, Potato, Onion, Wheat, Maize, Jute, Betel Leaf and Rabi & Kharif different vegetables (SAAOs, Auch para Union 2016). Many high value crops are grown in this Union.

Table 3. 5: Present Cropping Patterns of Auch para Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Auch para	2027	Potato/Boro(HYV)□T.Aus□Fallow	193	387	19.09
		Boro□ T.Aus□Fallow		61	3.01
		Boro (HYV)□Fallow□ Fallow		163	8.04
		Potato/Maize□ T.Aus□ Fallow		110	5.43
		Potato□ Vegetables□ Fallow		20	0.99
		Potato□Jute□ T.Aman		30	1.48
		Potato□Jute/T.Aus□ Fallow		65	3.21
		Mustard/Boro□T.Aus□ Fallow		262	12.93
		Mustard□Boro□ Fallow		353	17.41
		Wheat□ Jute□ T.Aman		10	0.49
		Wheat□Jute□Fallow		15	0.74
		Wheat□ T.Aus□ Fallow		70	3.45
		Vegetables□Chili□Fallow		5	0.25
		Onion/Boro□T.Aus□Fallow		112	5.53
		Chili□ T.Aus □Fallow		12	0.59
		Onion□T.Aus□Fallow		48	2.37
		Garlic□T.Aus□Fallow		42	2.07
		Turmeric□Turmeric□Turmeric		12	0.59
		Betel leaf□Betel leaf□Betel leaf		43	2.12
		Onion□Vegetables□Fallow		30	1.48
		Wheat□Fallow□Fallow		45	2.22
		Vegetable□Vegetable□Vegetable		80	3.95
		Orchard□Orchard□Orchard		52	2.57
		Total		2027	100.00

Source: SAAOs of Auch para Union 2016

Major problems on Crop Cultivation

The major problems in Auch para Union crop cultivation are: (i) The canals/khals of the Union were found mostly closed or silted, (ii) Lack of farmers knowledge on modern crop production technology, (iii) No cold storage and Seed store and Lack of vegetables and fruits wholesale market infrastructure, (iv) Scarcity of surface water for irrigation, higher cost Shallow Tube Wells(STWs) and Deep Tube Wells(DTWs), (v) Non-agriculture development on agriculture

land which is reducing productive agricultural lands rapidly, (vi) Less available of quality HYV and Hybrid crop seeds and cultivation equipments, (vii) Low market price of agricultural commodities but agriculture labor crisis and high wage rate, and (viii) Lack of awareness on proper management of land and over and under use of pesticides and chemical fertilizers.

Recommendation

Agricultural productivity is measured in terms of agricultural outputs to agricultural inputs. It will increase agricultural production, generate income, increase purchase capacity and improve rural livelihoods. Considering major constraints and problems of the area the following management practices can be taken:

(1) Improvement of drainage congestion by re-excavation of canals/khals etc.

(2) Development of irrigation and others input facilities.

(3) Adapt rice and non-rice crops eco-friendly integrated farming

(4) Follow fertilizer recommendations for particular soil after test and also follow integrated pest management methods,

(5) Growing one leguminous crop (Dhaincha/Pulses/Fodder etc),

(6) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(7) Supply of quality HYV and Hybrid seed and cultivation equipments in subsidized price,

(8) Protection of valuable agricultural land by enforcement of land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3,

(9) Farmers need base modern crop production technological practical training, and

(10) Construction multipurpose cold storage and wholesale market infrastructures .

3.4.2 Bara Bihanali Union Land Use

General Description

The land of Bara Bihanali Union is highly potential both fish and multiple crops production. Total area of this Union is about 1543.32 ha consisting of 16 Mauzas and 17villages. The land suitability classification or types indicates the relative suitability of land for sustained production of common agricultural crops and other uses such as fisheries, forest, urban and commercial areas adapted to the existing physical and environmental conditions. The lands types of this union are medium high land (30.37%) followed by Medium low land (29.65%), Low land (17.71%), and high land (16.63%) and very low land (5.64%). Major land types of Bara Bihanali Union are under medium high land to low land which means very suitable for multiple crops cultivation. Union falls into 3Agro-ecological zones are (i) Tista Meander Floodplain (AEZ-3),(ii)Lower Atrai Basin (AEZ-5),and (iii) High Ganges Floodplain (AEZ-11). The soil P^H is 6.0-8.0. Medium to high risk this Union due to seasonal flood. Bara Bihanali Union having agriculture cultivated area of 3130 ha of land of which net cropped area is 1300 ha. Out of the total cultivable land in this Union triple cropped area 770(59.23%) ha, double cropped area 360(27.69%) and single cropped area 160(12.31%). The cropping intensity of this union is 241%%. Major cropping patterns of this Union are: Potato/Boro→T.Aus→ Fallow followed by Boro→Fallow→Fallow and Mustard→ Boro→ Fallow (Table 3.6). Other major crops cultivated in this union are: Onion, Wheat, Maize, Jute, Betel Leaf and Rabi & Kharif different vegetables (SAAOs, Bara Bihanali Union 2016). Many high value crops are grown in this Union. Bara Bihanali unions are suitable for various fish production of Bagmara Upazila which covers 9.66% Wetland. In Wet land/Aquatic Agriculture System crop agriculture and fish production can be carried out simultaneously by preserving biodiversity of the wetland. The Bara Bihanali is one of the potential Union of Bagmara Upazila for fresh water culture fisheries mainly nursery and pond aquaculture. Nowadays, freshwater fish farming is well integrated with paddy production and the culture of certain fish species. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **Agro-Fisheries zone**

Table 3. 6: Present Cropping Patterns of Bara Bihanali Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Bara Bihanali	1300	Potato/Boro(HYV), T.Aus Fallow	241	305	23.46
		Boro (HYV), Fallow		230	17.69
		Potato/Maize, T.Aus Fallow		125	9.62
		Vegetables, Jute T.aman		15	1.15
		Potato, Jute, Fallow		25	1.92
		Potato/Onion, T.Aus Fallow		65	5.00
		Mustard/Boro, T.Aus Fallow		58	4.46
		Mustard, Boro Fallow		152	11.69
		Wheat/Maize, Chili/T.Aus, Fallow		47	3.62
		Wheat/Maize, Jute, Fallow		20	1.54
		Vegetables/Wheat, T.Aus Fallow		32	2.46
		Onion/Vegetables,T.Aus Fallow		44	3.38
		Mustard/Maize, T.Aus , Fallow		40	3.08
		Onion/Garlic, T.Aus, Fallow		61	4.69
		Turmeric		5	0.38
		Betel leaf		21	1.62
		Vegetables		30	2.31
		Orchard		25	1.92
		Total		1300	100.00

Source: SAAOs of Bara Bihanali Union 2016

Major problems on Crop Cultivation

The major problems in Bara Bihanali Union crop cultivation are: (i) Lack of farmers knowledge on modern crop production technology, (ii) No cold storage for vegetables and lack of wholesale market infrastructure (iiI) Water logging, sudden flood, river erosion and crop damage, (iv) Siltation of wet lands, rivers and canals, (v) Less available of quality HYV and Hybrid crop seeds and cultivation equipments, (vi) Water polluted due to over and under use of pesticides and chemical fertilizers,(vii) Over-drainage and abrupt reduction of wet land restricts open water fisheries and its breeding place, (viii) Lack of policy implementation to preserve the perennial wetland areas, (ix) Decrease of productive agricultural land due to unplanned construction of roads, sluice gates and other infrastructures, (x) Top soil cutting and (xi) Inadequate electricity supply during Boro crop season .

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Farmers need base modern crop production technological practical training,

(2) Construction multipurpose cold storage and wholesale market infrastructures,

(3) Adequate electricity supply during irrigation period,

(4) Perennial wetland should be preserved for open water fisheries and ecological balance must be maintained,

(5) Need to popularize rice with fish cultivation technology,

(7) Construction of potato and vegetable processing, grading and packaging industry/facility and Establishment of agro-based industry,

(8)Construction of permanent structure such as roads, housing settlements etc in the perennial water body need to be prohibited,

(9) Some perennial wetlands need to be declared as a fish Sanctuary for survival of indigenous fish species,

(10) Land using for B. aman and Boro (HYV) followed by open water fisheries which could be developed through modern management system,

(11) Improvement of drainage congestion by re-excavation of canals/khals, river etc

(12) Development of road communication system and agro based processing center, and

(13) Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented.

3.4.3 **Basupara Union Land Use**

General Description

The physical suitability of land emphasizes on the relatively permanent aspects such as soil conditions, land type and topography, hazards like erosion, drought and socio-economic

interventions etc. Basupara Union land is potential for diversified crops cultivation practices. This Union is consists of 21 Mauzas and26 villages with the total area of 2878.95 ha. The land types of this union are medium low land (29.82%) followed by medium high land (25.61%), high land (20.26%), low land (19.72%) and fallow land (4.59%). Union falls into 3 Agro-ecological zones are (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). The soil P^H is 6.0-8.0.

Basupara Union having agriculture cultivated area of 5204 ha of land of which net cropped area is 2331 ha. Out of the total cultivable land in this Union double cropped area 46.93%) followed by triple cropped area 36.04% , single cropped area 15.62%, and four cropped area 1.41%. The cropping intensity of this union is 223%. At present 17 different cropping patterns are practiced by Basupara Unions farmers. Major cropping patterns of this Union are: Potato/Boro→T.Aus→ Fallow followed by Potato/Maize→ T.Aus→Fallow and Potato→ T.Aus→ Fallow (Table 3.7). Other major crops cultivated in this union are: Onion, Wheat, Jute, Betel Leaf and Rabi & Kharif different vegetables and fruits crops (SAAOs, Basupara Union 2016). There are 65 Mango, 20 Banana, 10 Guava, 8 Litchi and 30 Papaya commercial fruits garden. Many high value crops are grown in this Union. Risk of flood is in low land areas. The sources of water are both ground and surface water used for crop production. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **agricultural zone**.

Table 3. 7: Present Cropping Patterns of Basupara Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Basupara	2331	Potato/Boro(HYV)□T.Aus□Fallow	223	735	31.53
		Boro (HYV)□Fallow□ Fallow		80	3.43
		Boro□ T.Aus□ Fallow		70	3.00
		Potato/Maize□ T.Aus□ Fallow		529	22.69
		Vegetables/Potato□ T.Aus□ fallow		30	1.29
		Potato□T.Aus□ Fallow		294	12.61
		Potato□ Boro□ Fallow		100	4.29
		Mustard/Boro□T.Aus□ Fallow		125	5.36
		Mustard□Boro□ Fallow		80	3.43
		Wheat□ Jute□ Fallow		50	2.15
		Wheat □T.Aus□Fallow		100	4.29

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Vegetables Jute Fallow		25	1.07
		Onion/Garlic T.Aus Fallow		16	0.69
		Turmeric Turmeric Turmeric		7	0.30
		Betel leaf Betel leaf Betel leaf		57	2.45
		Vegetables Vegetables Vegetables		15	0.64
		Orchard Orchard Orchard		18	0.77
		Total		2331	100.00

Source: SAAOs of Basupara Union 2016

Major problems on Crop Cultivation

The major problems in Basupara Union crop cultivation are: (i) Water logging, sudden flood, irregular rainfall and crop damage,(ii)) Less available of quality HYV and Hybrid crop seeds and cultivation equipments, (iii) Lack of farmers knowledge on modern crop production technology, (iv) Shortage of cold storage for vegetables and lack of wholesale market infrastructure, (v) Less supply of quality agriculture equipments (power tiller, tractor, power sprayer, foot pump etc) but price is high, (vi) Agricultural lands converted into non-agriculture purposes, (vii) Drought and inadequate supply of electricity ,(viii) The canals/khals of the Union were found mostly closed or silted and irrigation drainage system were found kutcha, (ix) Poor communication system, (x) lack of agro-based processing center , (xi) Increase agriculture land use for non- agriculture purposes and increase land degradation.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Improvement of drainage congestion by re-excavating the old canals, khals etc ,

(2) Ensure adequate electricity supply during irrigation period,

(3) Quality HYV and Hybrid crop seeds and equipments in subsidized price,

(4) Construction of potato and vegetable processing, grading and packaging industry/facility and Establishment of agro-based industry,

(5) Farmers need base modern crop production technological practical training,

(6) Construction of multipurpose cold storage and wholesale market infrastructures,

(7) Kutcha drainage system converted into underground pipe system,

(8) Availability of drought & cold tolerant crops varieties seeds,

(9) Maximum utilization of agricultural land as per its potentialities,

(10) Protection of valuable triple &double crop land areas by implementation of land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3, and

(11) Establishment of agro based industries and business center or market.

3.4.4 Dwippur Union Land Use

General Description

The physical and chemical characteristics of an area have great influence on the suitability of land for different types of crops and fisheries. There are many beels including famous Chalan beel, water bodies and fallow lands especially in monsoon season become potential places for open water fisheries and other bio-diversities in this Union. The area of the Union is about 1374.90 ha consisting of 7 Mauzas and 9 villages. Out of total areas 17.70% lands are wetland in this Union for both capture and culture fish production. Dwippur Union is suitable for diversified crop cultivation due to favorable land types and other characteristics. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **Agro-Fisheries zone.**

The land types of this union are medium low land (39.11%) followed by medium high land (22.57%), low land (18.76%), and high land (13.99%) and very low land (3.58%) and fallow land (1.99%). Lands, which are above normal inundation level, can provide a wide range of opportunities for growing both perennial and year round annual dry-land crops. Dwippur Union areas falls into 3Agro-ecological zones are (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). The soil P^H is 6.0-8.0. Medium to high risk this Union due to seasonal flood. Dwippur Union having agriculture cultivated area of 2412 ha of land of which net cropped area is 1099 ha. Out of the total cultivable land in this Union triple cropped area 39.85% followed by double cropped area 38.95% and single cropped area

20.93%). Major cropping patterns of this Union are: Potato/Boro→T.Aus→ Fallow followed byMustard/ Boro→T.Aus→Fallow and Boro→ Fallow→ Fallow (Table 3.8). Other major crops cultivated in this union are: Onion, Wheat, Maize, Jute, Betel Leaf and Rabi & Kharif different vegetables (SAAOs Dwippur Union 2016). Many high value crops are grown in this Union. The cropping intensity of this union is 219%. This Union is potential for agriculture and fish production.

Table 3. 8: Present Cropping Patterns of Dwippur Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Dwippur	1099	Potato/Boro(HYV) T.Aus Fallow	219	308	28.03
		Boro (HYV) Fallow Fallow		130	11.83
		Potato/Maize T.Aus Fallow		104	9.46
		Potato Maize/T.Aus Fallow		30	2.73
		Boro T.Aus Fallow		31	2.82
		Potato Jute Fallow		12	1.09
		Potato T.Aus/Til Fallow		13	1.18
		Mustard/Boro T.Aus Fallow		230	20.93
		Vegetables Chili Fallow		15	1.36
		Onion/Maize T.Aus Fallow		35	3.18
		Vegetables/Onion Jute T.Aman		30	2.73
		Lentil T.Aus Fallow		6	0.55
		Wheat Maize Fallow		25	2.27
		Wheat Jute T.Aman		20	1.82
		Maize Jute Fallow		22	2.00
		Garlic T.Aus Fallow		12	1.09
		Turmeric Turmeric Turmeric		7	0.64
		Sugarcane Sugarcane Sugarcane		8	0.73
		Betel leaf Betel leaf Betel leaf		10	0.91
		Vegetables Vegetables Vegetables		39	3.55
		Orchard Orchard Orchard		12	1.09
		Total		1099	100.00

Source: SAAOs of Dwippur Union 2016

Major problems on Crop Cultivation

The major problems in Dwippur Union crop cultivation are: (i) Less supply of quality agriculture equipments (power tiller, tractor, power sprayer, foot pump etc) but price is high, (ii) No cold storage for vegetables and lack of wholesale market infrastructure and poor communication system,(iii) Silted of wet lands and canals, (iv) Less available of quality HYV and Hybrid stress tolerant crop variety seeds, (vi Water polluted due to over and under use of pesticides and chemical fertilizers,(vii) Over-drainage

and abrupt reduction of wet land restricts open water fisheries and its breeding place, (viii) Lack of policy implementation to preserve the perennial wetland areas, and (ix) Decrease of productive agricultural land due to unplanned construction of roads, sluice gates and other infrastructures, (x) Lack of farmers knowledge on modern crop production technology,(xi) Non-agricultural development on agricultural land by unplanned infrastructure and urban expansion, (x) No agro-based processing center for vegetables, potato, spices and fruits crops, (x) Top soil cutting and (xi) Degradation of agricultural lands areas.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Farmers need base modern crop & fish production technological practical training,

(2) Construction multipurpose cold storage and wholesale market infrastructures,

(3) Adapt Biodynamic/Eco-friendly crop production technology,

(4) Perennial wetland should be preserved for open water fisheries and ecological balance must be maintained,

(5) Need to popularize rice with fish cultivation technology which will reduced the pesticides use,

(6) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(7)Construction of permanent structure such as roads, housing settlements etc in the perennial water body need to be prohibited,

(8) Some perennial wetlands need to be declared as a fish Sanctuary for survival of indigenous fish species,

(9) Ensure quality HYV& Hybrid seeds, cultivation & irrigation equipments,

(10) Establishment of agro based industries and business center or market,

(11) land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented for protection of agricultural land areas, and

(12) Increase awareness among the people and land users for conservation of land and also increase agricultural production through optimum use of land.

3.4.5 ***Ganipur Union Land Use***

General Description

Betel leaf cultivation is the main source of income for farmers of Ganipur Union. The land of Ganipur Union is highly suitable for betel leaf cultivation. Ganipur Union has about 513ha of betel leaf areas. Out of total areas 18.07% lands are for betel leaf production. Ganipur Union is also suitable for diversified crop cultivation due to favorable land types and other characteristics. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union **as Agriculture-Betel Vine Zone.** Betel requires well drained fertile soil. Water logged, saline and alkali soils are unsuitable for its cultivation. Proper shade and irrigation are essential for the successful cultivation of this crop. Betel needs constantly moist soil, but there should not be excessive moisture. Irrigation is frequent, light and standing water should not remain for more than half an hour. The area of the Union is about 3624.70 ha consisting of 28Mauzas and 32 villages. Ganipur Union areas falls into 3Agro-ecological zones are (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). **.**

The soil P^H is 6.0-8.0. Top soil texture is loam to clay loam. Land suitability is the fitness of a given type of land for a defined use. The land types of this union are high land (25.23%) followed by medium low land (22.53%), medium high land (22.34%), very low land (13.97%), low land (13.01%) and fallow land (2.92%). Lands, which are above normal inundation level, can provide a wide range of opportunities for growing both perennial and year round annual dry-land crops. Ganipur Union having agriculture cultivated area of 6456 ha of land of which net cropped area is 2839 ha. Out of the total cultivable land in this Union double cropped area 36.64% followed by single cropped area 25.01%, triple cropped area 24.30% and also four cropped area 14.05%. Major cropping patterns of this Union are: Boro→Fallow→ Fallow (21.49%) followed by Potato→T. Aus→Fallow (16.56%) and Betel leaf→ Betel leaf→ Betel leaf (18.07%) and others cropping pattern is shown in (Table 3.8). Other major crops cultivated in

this union are: Onion, Wheat, Maize, and Jute, Mustard, Chili and Rabi & Kharif different vegetables (SAAOs Ganipur Union 2016). The cropping intensity of this union is 219%%. Potato, Boro and Betel leaf are the principal crops in this Union.

Table 3.9: Present Cropping Patterns of Ganipur Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Ganipur	2839	Potato/Boro(HYV)□T.Aus□Fallow	227	75	2.64
		Boro (HYV)□Fallow□ Fallow		610	21.49
		Potato□ T.Aus□ Fallow		470	16.56
		Potato/Vegetables□ Maize/T.Aus□ Fallow		95	3.35
		Potato□ Groundnut/ T. Aus□ Fallow		170	5.99
		Potato□ Chili□ Fallow		25	0.88
		Mustard□Boro□ Fallow		230	8.10
		Mustard/Boro □ T. Aus□ Fallow		170	5.99
		Vegetables/Onion□ Jute□ T.Aman		30	1.06
		Mustard/Onion□T.Aus□Fallow		25	0.88
		Onion□ T.Aus□ T.Aman		30	1.06
		Lentil□ T.Aus□Fallow		16	0.56
		Wheat/Maize□ T.Aus□Fallow		125	4.40
		Wheat □Jute-□ T.Aman		50	1.76
		Onion□ Chi̇li□Fallow		20	0.70
		Turmeric□Turmeric□Turmeric		10	0.35
		Betel leaf□Betel leaf□Betel leaf		513	18.07
		Vegetables□Vegetables□Vegetables		80	2.82
		Bamoo□Bamboo□bamboo		40	1.41
		Orchard□Orchard□Orchard		55	1.94
		Total		2839	100.00

Source: SAAOs of Ganipur Union 2016

Major problems on Crop Cultivation

The major problems in Ganipur Union crop cultivation are: ((i) Drought and cold wave create negative impact on diversification of crops,(ii) Most of the canals and khal were silted and closed,(iii) No cold storage for vegetables and lack of wholesale market infrastructure and kutcha road communication system,(iii) Kutcha Irrigation drainage system, (iv) Farmers lack of knowledge on modern integrated crop production technology, (v) Disease problem in betel leaf crop,(vi) Lack of awareness on proper land management land and improper uses of pesticides and chemical fertilizers,(vii) Highest cost of low Low Lift Pumps(LLPs),Shallow Tube Wells(STWs), Deep Tube wells(DTWs),fuel, pesticides etc, and (ix) Cultivable agricultural lands

are reducing rapidly due to unplanned construction of houses, industries on agricultural land, (x) Sand deposition in agricultural land, land degradation and top soil cutting etc.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Development of irrigation and other input facility,

(2) Construction of multipurpose cold storage and vegetables wholesale market infrastructures,

(3) Adapt Biodynamic/Eco-friendly crop production technology through farmers training,

(4)Disease resistant betel leaf crop variety,

(5)Re-excavation of silted canals, khals and irrigation drainage need to pucca or underground pipe system,

(6)Follow fertilizer recommendation by soil testing and applied more organic manure in soil,

(7)Arrange and allocate sufficient credit for farmers,

(8) Increase awareness among the people and land users for conservation of land and also increase agricultural production through optimum use of land,

(9) Farmers training on rice with fish cultivation,

(10) Establishment of betel leaf and crops processing center or industries,and

(11) land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will minimize conversion of agricultural land to non agricultural use, and land degradation.

3.4.6 Goalkandi Union Land Use

General Description

Land type is the dominant factor guiding choice of crops and cropping patterns of Goalkandi Union. Selection of crop largely depends on topographic position of land. Many high value crop and vegetables are growing in this Union. Some of the area of this union is potential for capture and culture fisheries and high production of fisheries. Land soil characteristics of Goalkandi Union are mainly sandy to clay which better for pond preparation of good aquaculture practices. This type of soil has high water holding capacity. There are many beels, water bodies and fallow lands in monsoon season become potential places for open water fisheries and other bio-diversities in this union. Many local indigenous fish are available in this Union. There are 30 mangos, 6 litchis and 10 Banana commercial gardens were established in Goalkandi Union. Goalkandi Union is highly suitable for multiple crops and fish production due to favorable land types and other characteristics. Considering the present agricultural land use, fisheries land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **Agro-Fisheries zone**.

Goalkandi Union areas falls into 3 Agro-ecological zones are: (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11).The Union is consisting of 18 Mauzas and 27 villages with areas of2407.29ha. Out of total areas 6.32% lands are wetland in this Union for both capture and culture fish production. The agricultural land types of this union are high land (32.48%) followed by medium high land (22.99%), medium Low land (20.01.%), low land (15.65%) and very low land (5.44%) and fallow land (3.43%). The soil P^H is 6.5-7.5. Medium to high risk this Union due to seasonal flood. Goalkandi Union having agriculture cultivated area of 4290 ha of land of which net cropped area is 1882 ha. The cropping intensity of this union is 228%. Major cropping patterns of this Union are: Potato/Boro→T. Aus→ Fallow followed by Boro→Fallow→Fallow, and Mustard→ Boro→ Fallow (Table 3.9). Other major crops cultivated in this union are: Onion, Wheat, Maize, Jute, Betel Leaf and Rabi & Kharif different vegetables (SAAOs, Goalkandi Union 2016). Boro and other crops were cultivated by using ground water.

Table 3.10: Present Cropping Patterns of Goalkand Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Goalkandi	1882	Potato/Boro(HYV)T.AusFallow	228	277	14.72
		Boro (HYV)Fallow Fallow		207	11.00
		Potato/Maize T.Aus Fallow		193	10.26
		Potato Maize/T.Aus Fallow		55	2.92
		Potato/Boro T.Aus Fallow		203	10.79
		Mustard Boro Fallow		208	11.05
		PotatoT.Aus/Til Fallow		25	1.33
		Mustard/Boro T.Aus Fallow		198	10.52
		Wheat Chili Fallow		35	1.86
		Onion/ChiliT.AusFallow		44	2.34
		Onion/ Maize Vegetables Fallow		40	2.13
		Onion/Boro T.AusFallow		80	4.25
		Onion/GarlicT.AusFallow		47	2.50
		Wheat/Maize T.AusFallow		35	1.86
		WheatJute- T.Aman		111	5.90
		Onion Jute T.Aman		20	1.06
		PulsesT.AusFallow		24	1.28
		TurmericTurmericTurmeric		8	0.43
		Betel leafBetel leafBetel leaf		22	1.17
		VegetablesVegetablesVegetables		20	1.06
		OrchardOrchardOrchard		30	1.59
		Total		1882	100.00

Source: SAAOs of Goalkandi Union 2016

Major problems on Crop Cultivation

The major problems in Goalkandi Union crop cultivation are:(i) Water logging, drainage congestion, loss of bio-diversity and habitats of wild animals, water pollution due to improper uses of pesticides,(ii) Lack of farmers knowledge on modern crop production technology,(iii) Less supply of quality agriculture equipments (power tiller, tractor, power sprayer, foot pump etc but price is high, (iv) No cold storage for vegetables and lack of wholesale market infrastructure and soil testing laboratory, (v) Less available of quality HYV and Hybrid crop seeds, and low organic matter contents in soil,(vi) Over-drainage and abrupt reduction of wet land restricts open water fisheries and its breeding place, (vii) Lack of policy implementation to preserve the perennial wetland areas, and (viii) Decrease of productive agricultural land due to unplanned construction of roads, houses and other infrastructures, (ix) Inadequate supply of electricity during boro season, (x)Agriculture labor crisis and high wage, (xi) Increase

conversion rate of agriculture land into non- agriculture purposes and (xii) Top soil cutting and land degradation.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Drainage congestion can be removed by excavating new canals and re-excavating the old canals connecting to the nearby rivers or khals.

(2) Farmers need base modern crop & fish production technological practical training,

(3) Establishment of soil testing laboratory or facilities,

(4) Construction multipurpose cold storage and wholesale market infrastructures,

(5) Adapt Biodynamic/Eco-friendly crop production technology,

(6) Perennial wetland should be preserved for open water fisheries and ecological balance must be maintained,

(7) Need to popularize rice with fish cultivation technology which will reduced the pesticides use,

(8) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(9)Construction of permanent structure such as roads, housing settlements etc in the perennial water body need to be prohibited,

(10) Some perennial wetlands need to be declared as a fish Sanctuary for survival of indigenous fish species,

(11) land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will decrease the uses of agricultural lands to non-agricultural purposes.

3.4.7 **Gobinda Para Union Land Use**

General Description

Land uses and land cover of Gobinda Para is agriculture dominated. Some area of the Union is covered with wetlands for capture and culture fish production. Gobinda Para Union is consists of 27 Mauzas and 29 villages with the total area of 2701.62ha. Union falls into 3Agro-ecological zones are (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). The soil P^H is 6.0-8.0. Top soil texture is loam to clay. Crops or cropping patterns mainly depends on the topographic position of land in relation to inundation depth and its duration. Lands which are above normal inundation level can provide wide range of opportunity for growing year round crops. The lands types of this union are low land (30.08%) followed by medium high land (26.25%), medium low land (22.50%), high land (20.07%) and very low land (1.10%). The highlands are inundated by monsoon flooding but the other lands are inundated for 2-3 months in the monsoon up to maximum 120cm depending on land types.

This Union having agriculture cultivated area of 4158 ha of land of which net cropped area is 1928 ha. Out of the total cultivable land in this Union double cropped area 47.20% ha followed by single cropped area 26.09%, triple cropped area 25.15% and four cropped area 1.56%. The cropping intensity of this union is 216%. Land is moderate fertile, productive and potential for agricultural uses. Soil and climatic condition of this union is suitable for diversified crop production. At present 18 different cropping patterns are practiced by farmers of Gobinda Para Unions. Major cropping patterns of this Union are: Mustard→Boro→ Fallow followed by Mustard/Boro→ T.Aus→Fallow and Potato/Boro→ T.Aus→ Fallow (Table 3.10). Other major crops cultivated in this union are: Onion, Wheat, Jute, Betel Leaf and Rabi & Kharif different vegetables and fruits crops (SAAOs, Gobinda Para Union 2016). There are 50 Mango, 6 Banana, 3 Guava, 39 Litchi and 6 Papaya commercial fruits garden in this Union. High and medium highlands areas are suitable for both agriculture and horticulture crops where criteria permit. Risk of flood is in low land areas in this union. The sources of water are both ground and surface water used for crop production. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **agricultural zone**

Table 3.11: Present Cropping Patterns of Gobinda Para Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Gobinda Para	1928	Potato/Boro(HYV)□T.Aus□Fallow	216	203	10.53
		Boro (HYV)□Fallow□ Fallow		180	9.34
		Potato□ Maize/T.Aus□ Fallow		108	5.60
		Potato/Maize□ T.Aus□ Fallow		165	8.56
		Vegetables/Potato□ T.Aus□ fallow		58	3.01
		Potato□vegetables□ Fallow		95	4.93
		Potato/vegetables□ Jute□ T.Aman		115	5.96
		Potato□Chili□ Fallow		20	1.04
		Mustard/Boro□T.Aus□ Fallow		260	13.49
		Mustard□Boro□ Fallow		290	15.04
		Wheat□ Jute□ T.Aman		93	4.82
		Wheat /Maize□T.Aus□Fallow		25	1.30
		Pulses□ T.Aus□ Fallow		15	0.78
		Onion/Garlic□T.Aus□Fallow		152	7.88
		Sugarcane□Sugarcane□Sugarcane		8	0.41
		Turmeric□Turmeric□Turmeric		11	0.57
		Betel leaf□Betel leaf□Betel leaf		25	1.30
		Vegetables□Vegetables□Vegetables		60	3.11
		Orchard□Orchard□Orchard		45	2.33
		Total		1928	100.00

Source: SAAOs of Gobinda Para Union 2016

Major problems on Crop Cultivation

The major problems in Gobinda Para Union crop cultivation are: (i) Water logging, sudden flood, irregular rainfall and crop damage,(ii) The canals/khals of the Union were found mostly closed or silted and irrigation drainage system were found kutcha,(iii) Less available of quality HYV and Hybrid crop seeds and cultivation equipments, (iv) Lack of farmers knowledge on modern crop and fish production technology, (v) Shortage of cold storage for vegetables and lack of wholesale market infrastructure (v) Less supply of quality agriculture equipments (power tiller, tractor, power sprayer, foot pump etc) but price is high, (vi) Arable agricultural lands are reducing rapidly , (vii) Drought and inadequate supply of electricity, and (viii) Lack of potato and vegetable processing, grading and packaging industry/facility and agro-based industry, (ix) Lack of soil testing laboratory,(x)Imbalance used of chemical fertilizers & pesticides, and (x) Bad communication system and top soil cutting.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Improvement of drainage congestion by re-excavating the old canals, khals etc ,

(2) Ensure adequate electricity supply during irrigation period,

(3) Quality HYV and Hybrid crop seeds and equipments in subsidized price,

(4) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(4) Kutcha drainage system converted into underground pipe system,

(5) Availability of drought & cold tolerant crops varieties, and

(6) Rice and non-rice crops integrated farming,

(7) Farmers need base modern crop and fish production technological practical training,

(8) Construction of multipurpose cold storage and wholesale market infrastructures and also development of marketing system,

(9) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping pattern. Besides, application of organic manure and bio-fertilizer can improve deficiency of soil nutrients which will increase the crop yield, and

(10) Protection of valuable agricultural lands by implementation of land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3,and

(11) Help to execute re-excavation programs for silted rivers/khals to increase water flow.

3.4.8 Hamir Kutsha Union Land Use

General Description

The land types indicates the relative suitability of land for sustained production of common agricultural crops and other uses such as fisheries, forest, urban and commercial areas adapted to the existing physical and environmental condition. The physical suitability of an area or the

suitability of land has a great influence on its multiple uses. It expresses the degree to which the sustained implementation of a land use on a certain land unit is feasible without risk to the human or natural environment. The land types of this union are medium low land (31.09%) followed by medium high land (29.89%), low land (19.73%), high land (19.24%) and very low land (0.05%). High land and medium high land is suitable for diversified crop cultivation including Boro, T. aman, Mustard, Onion and vegetables etc. Medium low land to low land areas are yielding bumper crops in Rabi season. Some of the area of this union is potential for capture and culture fisheries and high production of fisheries. Land soil characteristics of Hamir Kutsha Union are mainly sandy to clay which better for pond preparation of good aquaculture practices. This type of soil has high water holding capacity. There are many beels, water bodies and fallow lands in monsoon season become potential places for open water fisheries and other bio-diversities in this Union. Many local indigenous fish are available in this Union. Considering the present agricultural land use, fisheries land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **Agro-Fisheries zone**.

The Union is consisting of 9 Mauzas and 10 villages with areas of2191.09ha. Out of total areas about 3% lands are wetland in this Union for both capture and culture fish production. The soil P^H is 6.5-8.0. Risk of flood occurred in low land areas. Hamir Kutsha Union having agriculture cultivated area of 4170 ha of land of which net cropped area is 1880 ha. Land utilization and cropping pattern in Hamir Kutsha union depend on effective/planned use of land resources, availability of irrigation facilities, use of technologies etc. Boro and other crops were cultivated by using ground water. The cropping intensity of this union is 227%. Out of the total cultivable land in Hamir Kutsha Union three cropped area (37.23%) followed by double cropped area (32.77%), single cropped area (23.53%) and multiple cropped area (6.47%). Major cropping patterns of this Union are: Boro→Fallow→ Fallow followed by Potato/Boro→ T.Aus→Fallow, and Potato/Maize→ T.Aus→ Fallow (Table 3.11). Other major crops cultivated in this union are: Onion, Wheat, Maize, Jute, Betel Leaf and Rabi & Kharif different vegetables (SAAOs Hamir Kutsha Union 2016).

Table 3. 12: Present Cropping Patterns of Hamir Kutsha Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Hamir Kutsha	1840	Potato/Boro(HYV)T.Aus Fallow	227	295	16.14
		Potato/Boro (HYV)Fallow Fallow		148	8.10
		BoroFallowFallow		425	23.25
		Potato/Maize T.Aus Fallow		217	11.87
		Potato Maize/T.Aus Fallow		104	5.69
		Potato Jute T.Aman		45	2.46
		PotatoT.Aus/Til Fallow		20	1.09
		Mustard/Boro T.Aus Fallow		95	5.20
		Onion/Vegetables T.AusFallow		138	7.55
		Onion/GarlicT.AusFallow		90	4.92
		Vegetables/Onion JuteT.Aman		95	5.20
		WheatJute- T.Aman		100	5.47
		TurmericTurmericTurmeric		10	0.55
		Betel leafBetel leafBetel leaf		13	0.71
		VegetablesVegetablesVegetables		15	0.82
		OrchardOrchardOrchard		18	0.98
		Total		1828	100.00

Source: SAAOs of Hamir Kutsha Union 2016

Major problems on Crop Cultivation

The major problems in Hamir Kutsha Union crop cultivation are:(i) Water logging and drainage congestion,(ii) Less available of quality HYV/ Hybrid and stress tolerant crop variety seeds, (iii) Less supply of quality agriculture equipments (power tiller, tractor, power sprayer, foot pump etc but price is high, (iv) Shortage of cold storage and seed store and lack of wholesale market infrastructure, (v) Lack of farmers knowledge on modern crop production technology,(vi) Most of the canals/khals were found closed and silted,(vii) Very poor road communication system,(viii) Inadequate supply of electricity during boro season, (ix) Sudden flood damaged crops,(x) Siltation of river, canal and beels which has created negative impacts on diversification of crops, bio-diversity and capture fisheries in this union and (xi) The valuable agriculture land is reducing every year due to unplanned construction of houses, settlements, roads and for different infrastructural development activities.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Development irrigation & other inputs facilities and Kutcha irrigation drainage converted into underground pipe system,

(2) Drainage congestion can be removed by excavating new canals and re-excavating the old canals connecting to the nearby rivers or khals,

(3) Establishment of soil testing laboratory or facilities,

(4) Construction multipurpose cold storage and wholesale market infrastructures,

(5) Development of road communication system,

(6) Need to popularize rice with fish cultivation technology which will reduced the pesticides use,

(7) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(8) Farmers need base modern crop production technological practical training,

(9) Farmers need base modern crop and fish production technological practical training.

(10) land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will decrease the uses of agricultural lands to non-agricultural purposes and

(11) Ensure supply of drought, water logging tolerant and pest & disease resistance HYV/Hybrid crop seeds.

3.4.9 Jhikra Union Land Use

General Description

Jhiikra Union land and climatic condition is suitable for growing wide range of crops production. Wetland is highly suitable for capture and culture fisheries. The Jhikra is one of the potential Union of Bagmara Upazila for fresh water culture fisheries mainly nursery and pond aquaculture. The Union is consisting of 22 Mauzas and 22 villages with areas of2495.14ha. The physical suitability of land emphasizes on the relatively permanent aspects such as soil

conditions, land type and topography, hazards like drought, erosion and socio-economic interventions etc. The lands types of this union are medium high land (46.00%) followed by medium low land (27.50%), high land (14.25%), and low land (12.25%). Lands which are above normal inundation level can provide wide range of opportunities for growing year round crops. The soil P^H is 6.0-8.0.Top soil texture is sandy loam to loam. Land of this Union falls into 3Agro-ecological zones is (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). Risk of flood occurred in low land areas. Jhikra Union having agriculture cultivated area of 4926 ha of land of which net cropped area is 2000 ha. Land uses and cropping patterns depend on irrigation and other inputs facilities. Out of the total cultivable land in Jhikra Union three cropped area (54.75%) followed by double cropped area (36.85%) and single cropped area (8.40%). The cropping intensity of this union is 246%. There are 17 cropping patterns are practices by Jhikra Union farmers. Major cropping patterns of this Union are: Potato/Boro→T.Aus→ Fallow followed by Potato/Maize→ T.Aus→Fallow, and Mustard→ Boro→ Fallow (Table 3.12). Boro and T.Aus .Potato and Maize are the principal crops. There are 35 Mango, 15 Banana,9 Litchi and 10 Papaya commercial fruit garden. This Union has facility for throughout the year in the permanent water bodies but in the flood plain areas capture fisheries are abundant in the monsoon season. Many local indigenous fish are available in this Union. Considering the present agricultural land use, fisheries land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **Agro-Fisheries zone**.

Table 3. 13: Present Cropping Patterns of Jhikra Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Jhikra	2000	Potato/Boro(HYV)□T.Aus □Fallow	246	845	42.25
		Boro□Fallow□Fallow		140	7.00
		Potato/Maize□ T.Aus□ Fallow		260	13.00
		Potato/Groundnut□ T.Aus□ Fallow		15	0.75
		Onion/Chili□ T.Aus□ Fallow		10	0.50
		Wheat/Maize□T.Aus□		30	1.50
		Potato/Onion□T.Aus□ Fallow		45	2.25
		Mustard/Boro□T.Aus□Fallow		173	8.65
		Mustard/Maize□T.Aus□Fallow		140	7.00
		Mustard □ Boro□ Fallow		220	11.00
		Garlic □T.Aus□Fallow		17	0.85

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Vegetables/Wheat Jute Fallow		10	0.50
		Wheat Jute- Fallow		20	1.00
		Turmeric Turmeric Turmeric		8	0.40
		Vegetables Vegetables Vegetables		40	2.00
		Bamboo--> Bamboo-->Bamboo		5	0.25
		Orchard Orchard Orchard		22	1.10
		Total		2000	100

Source: SAAOs of Jhikra Union 2016

Major problems on Crop Cultivation

The major problems in Jhikra Union crop cultivation are:(i) Most of the canals/khals were found closed, Water logging and drainage congestion,(ii) Higher cost of STW and DTW, Tractor and Foot Pump and pesticides etc, (iii) Shortage of quality HYV and Hybrid crop seeds, (iv) Lack of farmers knowledge on modern crop production technology, (v) No cold storage, seed store and lack of wholesale market infrastructure, (vi) Kutcha and bad road communication system, (vii) Siltation of wetlands and sudden flood damaged crops,(viii) Water is polluted due to improper use of pesticides, (ix) The valuable agriculture land is reducing every year due to unplanned construction of houses, settlements, top soil cutting, roads and for different infrastructural development activities, (x) Agriculture labor crisis and high wage rate, (xi) Climate changes (Clod wave, changes in rainfall pattern, temperature fluctuate),and(xii)Lack of policy implementation to preserve the perennial wetland areas.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1)Perennial wetlands need to be preserved for open water fisheries and ecological balance must be maintained,

(2) Development irrigation & other inputs facilities and Kutcha irrigation drainage converted into underground pipe system,

(3) Drainage congestion can be removed by excavating new canals and re-excavating the old canals connecting to the nearby rivers or khals,

(4) Construction multipurpose cold storage and wholesale market infrastructures,

(5) Development of pucca road communication system,

(6) Adapt modern farming techniques and also rice & non-rice crops integrated farming system,

(7) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(8) Farmers need base modern crop and fish production technological practical training,

(9) Ensure supply of drought, water logging tolerant and pest & disease resistance HYV/Hybrid crop seeds.

(10) Used balance dose of chemical fertilizers and incorporate organic manure in the soil by changing present cropping pattern, and

(11) Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented for protecting present double and triple agriculture land area .

3.4.10 **Jogi Para Union Land Use**

General Description

Land suitability is the fitness of a given type of land for a defined use. The land may be considered in its present condition or after improvement. Jogi Para Union land and climatic condition is suitable for growing multiple crops production. It is one of the potential Union of Bagmara Upazila for fresh water culture fisheries mainly nursery and pond aquaculture. The Union is consisting of 18 Mauzas and 19 villages with areas of2842.91ha. Crops and cropping patterns are depends on types on land. The land types of this union are medium high land (40.89%), medium low land (23.52%), low land (19.07%), and high land (16.52%). Lands which are above normal inundation level can provide wide range of opportunities for growing year round crops. High land and medium high land is suitable for diversified crop cultivation including Boro, T.Aus, Maize and Vegetables etc. The soil P^H is 6.5-7.5.Top soil texture is sandy loam to loam. Land of this Union falls into 3Agro-ecological zones is (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11).

Crops and cropping patterns depend on land types, soil fertility, irrigation and other inputs facilities. Multiplicity of cropping system has been one of the main features of this Union. Jogi Para Union having agriculture cultivated area of 5280ha of land of which net cropped area is 2360 ha. Major cropping patterns of this Union are: Potato/Boro→T. Aus→ Fallow (23.52%) followed by Boro→ Fallow→Fallow (17%), and Mustard/ Boro→T.Aus→ Fallow (11.65%) and others cropping pattern is shown in Table3.13. Boro and T. Aus, Potato and Maize are the principal crops. This Union has facility for throughout the year in the permanent water bodies but in the flood plain areas capture fisheries are abundant in the monsoon season. Total 108.43ha wetland is available in this Union. Many local indigenous fish are available in this Union. Considering the present agricultural land use, fisheries land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **Agro-Fisheries zone.** Risk of flood occurred in low land areas. The cropping intensity of this union is 225%.

Table 3. 14: Present Cropping Patterns of Jogi Para Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Jogi Para	2360	Potato/Boro(HYV)□T.Aus □Fallow	225	555	23.52
		Boro□Fallow□Fallow		400	16.95
		Potato/Maize□ T.Aus□ Fallow		264	11.19
		Potato□Maize/T.Aus□Fallow		40	1.69
		Potato□ Mungbean/T.Aus□Fallow		60	2.54
		Potato/Boro□ T.Aus□ Fallow		50	2.12
		Vegetales/Potato□Maize/T.Aus□Fallow		25	1.06
		Potato□Jute□Fallow		20	0.85
		Potato□ Groundnut/T.Aus□ Fallow		27	1.14
		Wheat/Maize□T.Aus□Fallow		174	7.37
		Vegetables□ Chili□ Fallow		8	0.34
		Mustard/Boro□T.Aus□Fallow		275	11.65
		Onion/Maize□T.Aus□Fallow		55	2.33
		Mustard □ Boro□ Fallow		90	3.81
		Onion/Maize□Vegetables□Fallow		45	1.91
		Garlic □T.Aus□Fallow		25	1.06
		Vegetables/Wheat □Jute□Fallow		82	3.47
		Pulses□T.Aus□Fallow		74	3.14
		Pulses/wheat□Jute/Til-□ T.Aman		30	1.27
		Turmeric□Turmeric□Turmeric		10	0.42
		Vegetables□Vegetables□Vegetables		15	0.64
		Bamboo--> Bamboo-->Bamboo		11	0.47

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Orchard□Orchard□Orchard		25	1.06
		Total		2360	100.00

Source: SAAOs of Jogi Para Union 2016

Major problems on Crop Cultivation

The major problems in Jogi Para Union crop cultivation are:(i) Sudden flood occurred and damage crops, (ii) Drought and inadequate supply of electricity, (iii)Most of the canals/khals were found closed, Water logging and drainage congestion and kutcha irrigation drainage, (iv) No cold storage, seed store and lack of wholesale market infrastructure, (v) Higher cost of STW and DTW, Tractor and Foot Pump and pesticides etc, (vi) Lack of farmers knowledge on modern crop and fish production technology, (vii) Water is polluted due to improper use of pesticides, (viii) The valuable agriculture land is reducing every year due to unplanned construction of houses, settlements, top soil cutting, roads and for different infrastructural development activities, (ix) Agriculture labor crisis and high wage rate, and(x)Lack of policy implementation to preserve the perennial wetland areas,(xi) Lack of capital and higher price of inputs is barriers to its higher production, and (xii) Lack of agro processing center and market facilities.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1 Ensure availability of drought, cold tolerant crops variety seeds,

(2) Water congestion can be removed by excavating new canals and re-excavating the old canals connecting to the nearby rivers or khals,

(3) Development irrigation & other inputs facilities and Kutcha irrigation drainage converted into underground pipe system and uninterrupted power supply to irrigation pump,

(4) Construction multipurpose cold storage and wholesale market infrastructures,

(5) Development of pucca road communication system,

(6)Development of agricultural marketing system,

(7) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(8) Farmers need base modern crop and fish production technological practical training,

(9 Arrangement of sufficient agriculture loan at low interest rate,

(10) Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will decrease the uses of agricultural lands to non-agricultural purposes, and

(11) Perennial wetlands need to be preserved for open water fisheries and ecological balance must be maintained,

3.4.11 **Kachhari Kayali Para Union Land Use**

General Description

Kachhari Kayali Para Union is potential for diversified agricultural crops cultivation practices. The soil of this Union are suitable for transplanted rice other crops cultivation. There are about 11% wetlands lies in the Union and famous for both capture and open water capture fisheries. Kachhari Kayali Para union is consists of 4 Mauzas and 6 villages. Union falls into 3Agro-ecological zones are (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). The soil P^H is 6.0-8.0. Top soil texture loam to clay loam. The land types of this union are medium low land (36.95%) followed by high land (27.74%), medium high land (21.69%), low land (10.59%), and very low land (4.59%). Soil is moderate to highly fertile, productive and potential for agricultural uses. The landscape is complex and seasonally flooded. Generally, flood occurred in low land areas. High and medium high land areas are suitable for both field crops and horticultural high value crops.

In agriculture, multiple cropping is the practice of growing two or more crops in the same space during a single growing season. It can take the form of double-cropping in which a second crop is planted after the first has been harvested. This Union having agriculture cultivated area of 1483 ha of land of which net cropped area is 628 ha. Out of the total cultivable land in this

Union triple cropped area 42.67% followed by double cropped area 35.67%, single cropped area 17.67% and four cropped area 3.99%. The cropping intensity of this union is 236%. Major cropping patterns of this Union are: Potato/Boro→T.Aus→ Fallow (45%) followed by Potato/Maize→ T.Aus→Fallow (15%) and Boro→ fallow→ Fallow (14%) and other cropping patterns are shown in Table 3.14. Boro , Potato and T.Aus are principal crops.

Mango, Banana, Guava, Litchi and Papaya fruits are cultivated as commercial garden. The sources of water are ground and surface water used for crop production. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **agricultural zone**.

Table 3. 15: Present Cropping Patterns of Kachhari Kayali Para Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Kachhari Kayali Para	628	Potato/Boro(HYV)□T.Aus□Fallow	236	280	44.59
		Boro (HYV)□Fallow□ Fallow		86	13.69
		Vegetables/Potato□ Maize/T.Aus□ Fallow		16	2.55
		Potato/Maize□ T.Aus□ Fallow		91	14.49
		Boro□T.Aus□ Fallow		12	1.91
		Mustard/Boro□T.Aus□ Fallow		45	7.17
		Onion□ Jute□ Fallow		30	4.78
		Wheat/Maize□ Jute□ T.Aman		26	4.14
		Onion/Garlic□T.Aus□Fallow		12	1.91
		Turmeric□Turmeric□Turmeric		3	0.48
		Betel leaf□Betel leaf□Betel leaf		7	1.11
		Vegetables□Vegetables□Vegetables		8	1.27
		Orchard□Orchard□Orchard		12	1.91
		Total		628	100.00

Source: SAAOs of Kachhari Kayali Para Union 2016

Major problems on Crop Cultivation

The major problems in Kachhari Kayali Para Union crop cultivation are: (i)Less supply of quality equipments (power tiller, tractor, thresher, power sprayer, foot pump) and also high price, (ii) Lack of farmers knowledge on modern crop production technology and financial problems for adaption of modern technology,(iii) lack of cold storage , seed store and lack of wholesale market infrastructure and soil testing facilities, (iv) Drought and inadequate supply of electricity,(v) The canals/khals of the Union were found mostly closed or silted and irrigation

drainage system were found kutcha, (vi) Siltation of river, canals, beels which has created negative impact on diversification of crops, bio-diversity and capture fisheries, and (vii)Agricultural productive lands (double and triple crop lands) converted into non-agriculture purposes,(ix) Over and under used chemical fertilizers and pesticides and (x) Top soil cutting, sand deposition and land degradation.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Large scale women farmers training on vegetables and crop production technology,

(2) Ensure quality HYV and Hybrid different crop seeds and cultivation& irrigation equipments in subsidized price and availability of drought & cold tolerant crops varieties,

(3) Improvement of drainage congestion by re-excavating the river, old canals, khals etc.

(4) Construction of multipurpose cold storage and wholesale market infrastructures,

(5) Ensure adequate electricity supply during irrigation period,

(6) Establishment of soil testing laboratory,

(7) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(8) Kutcha drainage system converted into underground pipe system, and

(9) Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will decrease the uses of agricultural lands to non-agricultural purposes,

(10) Arrangement for sufficient bank loan and

(11) Help to execute re-excavation programs for silted rivers/khals to increase water flow, and

(12) Development of inter-agency cooperation.

3.4.12 **Maria Union Land Use**

General Description

Maria Union lands are suitable for agricultural crop cultivation due to land types and other characteristics. The medium high land and high land areas are free from monsoon flood and suitable for diversified crops throughout the year. There are about 4% wetlands for capture and culture fish production in this union. The lands types of this union are medium low land (33.60%) followed by low land (23.30%), medium high land (22.13%), high land (16.89%), and very low land (4.08%). Maria union is consists of 20 Mauzas and 30 villages with the area of1842.11ha. The lands of this Union falls into 3 Agro-ecological zones are: (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). The soil P^H is 6.0-8.0. Top soil texture loam to clay loam. Soil is moderate to highly fertile, productive and potential for multiple agricultural crops cultivation. Betel leaf is high value agriculture crop cultivated extensively in the highland area and it is the source of income for many farmers. The land of this union is potential for various fruit production. There are 30 Mango, 50 Banana, 100 litchi, 10 Guava and 15 Papaya commercial fruit gardens.

This Union having agriculture cultivated area of 3595 ha of land of which net cropped area is 1420 ha. Out of the total cultivable land in this Union triple cropped area 50.35% followed by single cropped area 22.53%, double cropped area 14.44% and four cropped area 12.68%. The cropping intensity of this union is 253%. Major cropping patterns of this Union are: Potato/Boro→T.Aus→ Fallow (35%) followed by Potato/Maize→ T.Aus→Fallow (13%) and Mustard/Boro→ T.Aus→ Fallow (8%) and Other cropping patterns in this union is shown in Table 3.15. Boro , Potato and T. Aus are principal crops and wide range rabi crops are cultivated. The sources of water are ground and surface water used for crop production.

Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **agricultural zone**.

Table 3. 16: Present Cropping Patterns of Maria Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Maria	1420	Potato/Boro(HYV)□T.Aus□Fallow		493	34.72

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Boro (HYV)Fallow Fallow	253	75	5.28
		Potato Maize/T.Aus Fallow		89	6.27
		Potato/ Maize T.Aus Fallow		181	12.75
		Vegetable/PotatoMaize/T.AusFallow		105	7.39
		Potato/MaizeVegetablesFallow		69	4.86
		PotatoJuteFallow		11	0.77
		Mustard/Potato Boro Fallow		30	2.11
		Mustard/BoroT.Aus Fallow		115	8.10
		Wheat T.Aus Fallow		20	1.41
		Onion/Chili T.Aus Fallow		52	3.66
		Onion/MaizeT.AusFallow		26	1.83
		Vegetable/OnionT.AusFallow		88	6.20
		Vegetable/Onion/wheatJuteT.aman		15	1.06
		SugarcaneSugarcaneSugarcane		6	0.42
		LentilT.Ausfallow		7	0.49
		Turmeric/ZingerTurmericTurmeric		8	0.56
		Betel leafBetel leafBetel leaf		9	0.63
		OrchardOrchardOrchard		21	1.48
		Total		1420	100.00

Source: SAAOs of Maria Union 2016

Major problems on Crop Cultivation

The major problems in Maria Union crop cultivation are: (i) The canals/khals of the Union were found mostly closed or silted and irrigation drainage system were found kutcha, (ii) lack of cold storage , seed store and lack of wholesale market infrastructure,(iii) Less supply of quality equipments (power tiller, tractor, thresher, power sprayer, foot pump) and also high price, (iv)Inadequate budget and facilities for men and women farmers crop production technological training and farmers financial problems for adaption of modern technology, (v) Drought and inadequate supply of electricity, (vi) Siltation of river, canals, beels which has created negative impact on diversification of crops, bio-diversity and capture fisheries, (vii)Agricultural productive lands converted into non-agriculture purposes, (viii) lack of soil testing facilities and farmers used imbalance doses of chemical fertilizers and pesticides,(ix) Less market price for produce crops and (x) Top soil cutting , land degradation and reduced agricultural land.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1)Sufficient number of different crop variety demonstration in farmers field and also more women farmers training on vegetables and crop production technology,

(2) Improvement of drainage congestion by re-excavating the river, old canals, khals etc, and Kutcha drainage system converted into underground pipe system and help to execute re-excavation programs for silted rivers/khals to increase water flow,

(3) Construction of multipurpose cold storage and wholesale market infrastructures,

(4) Ensure quality HYV and Hybrid different crop seeds and equipments in subsidized price and availability of drought & cold tolerant crops varieties,

(5) Ensure adequate electricity supply during irrigation period,

(6) Establishment of soil testing laboratory,

(7) Construction of potato and vegetable processing, grading and packaging industry/facility and establishment of agro-based industry,

(8) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping pattern,

(9) Land degradation especially agricultural land degradation is becoming more severe. So, appropriate measure need to be taken to control the unplanned & unwanted interventions responsible for land degradation, and

(10) Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will decrease the uses of agricultural lands to non-agricultural purpose, and

(11) Development of inter-agency cooperation.

3.4.13 **Nardas Union Land Use**

General Description

The Nardas is one of the potential Union of Bagmara Upazila for diversified crop production and also fresh water culture fisheries mainly nursery and pond aquaculture. Nardas beel is a prominent beel of the Upazila located in the Nardas Union. Paddy fields and seasonal water bodies, canal is promising and potential resources for fresh water aquaculture in Nardas Union. The agriculture and fisheries are the major sources of nutrition, income generation, employment and livelihood in this union. The area of the Union is about 2385.83 ha consisting of 17 Mauzas and 18 villages. Out of total areas 9.23% lands are wetland in this Union for both capture and culture fish production. The land types of this union are low land (36.71%), followed by medium high land (29.83%), high land (18.75%), and medium low land (14.71%). Nardas Union is suitable for Boro & T.Aus and high value crops (vegetables, betel leaf, and mustard) and fruits cultivation due to favorable land types and other characteristics. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **Agro-Fisheries zone**.

Nardas Union areas falls into 3Agro-ecological zones are (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). The soil P^H is 5.5-7.0. Both surface and underground water are used for crop cultivation. Nardas Union having agriculture cultivated area of 2852 ha of land of which net cropped area is 1756 ha. Out of the total cultivable land in this Union single cropped area 49.32% followed by double cropped area 38.95% and triple cropped area 11.73%. Major cropping patterns of this Union are: Boro→Fallow→ Fallow (46%) followed by Mustard/ Boro→T. Aus→Fallow (10%) and Vegetables→ vegetables→ Vegetables (6%) and others cropping system is shown in (Table 3.16). The cropping intensity of this union is 164%. This Union is medium to high risk due to seasonal flood. There are 55 Mangos, 6 Banana, 3 Litchi and 3 Guava commercial gardens in this Union.

Table 3. 17: Present Cropping Patterns of Nardas Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Nardas	1756	Potato/Boro(HYV)□T.Aus□Fallow	164	88	5.01

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Boro (HYV)Fallow Fallow		808	46.01
		Potato/Maize T.Aus Fallow		95	5.41
		Potato Maize/T.Aus Fallow		50	2.85
		Onion Jute Fallow		80	4.56
		Potato Jute T.Aman		35	1.99
		MustardBoro Fallow		58	3.30
		Mustard/Boro T.Aus Fallow		180	10.25
		Vegetables Chili Vegetables		13	0.74
		Onion/VegetablesT.AusFallow		30	1.71
		Vegetables/Onion Jute T.Aman		10	0.57
		Wheat T.AusFallow		107	6.09
		WheatJute- Fallow		40	2.28
		GarlicJuteT.aman		15	0.85
		TurmericTurmericTurmeric		9	0.51
		Betel leafBetel leafBetel leaf		10	0.57
		VegetablesVegetablesVegetables		105	5.98
		OrchardOrchardOrchard		23	1.31
		Total		1756	100.00

Source: SAAOs of Nardas Union 2016

Major problems on Crop Cultivation

The major problems in Nardas Union crop cultivation are: (i) Water logging, (ii) Less supply of quality HYV and Hybrid crop seeds and agriculture equipments (power tiller, tractor, power sprayer, foot pump etc but price is high, (ii1) Lack of cold storage& seed store and also lack of wholesale market infrastructure, (iv) Kutch road communication system,(v) Deposition of silt in river mouth and wet lands and also canals, and kutch irrigation drainage system,(vi Lack of soil testing facilities,(vii) Over-drainage and abrupt reduction of wet land restricts open water fisheries and its breeding place, (viii) Lack of policy implementation to preserve the perennial wetland areas, and (ix) Decrease of productive agricultural land due to unplanned construction of roads, houses, market and other infrastructures, (x) Lack of farmers knowledge on modern crop and fish production technology, and (xi) Less use of organic fertilizer but increase inorganic fertilizers and pesticides and (x) Top soil cutting and land degradation.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Ensure supply of quality HYV and Hybrid different crop seeds,

(2) Re-excavation of silted wetland, rivers and canals to increase water flow,

(3) Farmers need base modern crop and fish production technological practical training,

(4) Construction multipurpose cold storage, seed store and wholesale market infrastructures,

(5) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping pattern and application of organic and bio-fertilizer can improve deficiency of soil nutrient,

(6) Perennial wetland should be preserved for open water fisheries and ecological balance must be maintained,

(7) Need to popularize rice with fish cultivation technology which will reduced the pesticides use,

(8) Construction of potato and vegetable processing, grading and packaging industry/facility and Establishment of agro-based industry,

(9) Construction of permanent structure such as roads, housing settlements etc in the perennial water body need to be prohibited,

(10) Some perennial wetlands need to be declared as a fish Sanctuary for survival of indigenous fish species,

(11) land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented for protection of agriculture lands, and

(12) Increase awareness among the people and land users for conservation of land and also increase agricultural production through optimum use of land.

3.4.14 **Sonadanga Union Land Use**

General Description

In Wetland/Aquatic Agricultural System crop agriculture and fish production can be carried out simultaneously by preserving biodiversity of the wetland. Land resources of this union have been brought into year round vegetables & high value crops, fruits, poultry and fish farms as commercial basis. For favorable physic-chemical and biological condition of different ecosystem (river, beel, paddy field, floodplain, aquaculture pond etc.) and intensive stocking of fingerlings

with free of cost in open water bodies (river, canal, beel etc.) are play an important role for potential productivity of Sonadanga Union. The area of the Union is about 2385.83 ha consisting of 8 Mauzas and 8 villages with the area of 1049.80ha. Out of total areas 9.18% lands are wetland in this Union for both capture and culture fish production. The land types of this union are low land (51.41%) followed medium high land (22.94%), medium low land (21.76%), and high land (3.88%). Considering the present agricultural land use, land types, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **Agro-Fisheries zone**.

The agriculture and fisheries are the major sources of nutrition, income generation, employment and livelihood in this union. Sonadanga Union is highly suitable for potato, Boro & T.Aus and high value crops vegetables cultivation due to favorable land types and other characteristics. The soil P^H is 6.0-8.0. Texture soil is sandy loam to loam. Medium to high risk this Union due to seasonal flood. Both surface and underground water are used for crop cultivation. This Union having agriculture cultivated area of 1190 ha of land of which net cropped area is 850 ha. The cropping intensity of this union is 140%. Out of the total cultivable land in this Union single cropped area 68.23% followed by double cropped area 23.53% and triple cropped area 8.24.73%. Major cropping patterns of this Union are: Boro→Fallow→ Fallow followed by Potato/ Boro→Fallow→Fallow and Mustard→ Boro→ Fallow and others cropping pattern is shown in (Table 3.17). Due to lack of knowledge farmers used over and under doses of pesticide which is polluted water.

Table 3. 18: Present Cropping Patterns of Sonadanga Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Sonadanga	850	Potato/Boro(HYV)T.AusFallow	140	87	10.24
		Potato/Boro (HYV)Fallow Fallow		153	18.00
		BoroFallowFallow		300	35.29
		Potato/Maize Maize/ T.Aus Fallow		20	2.35
		Potato Jute Fallow		9	1.06
		Potato Chili Fallow		19	2.24
		MustardBoro Fallow		145	17.06
		Mustard/Boro T.Aus Fallow		30	3.53
		Onion/Maize Vegetables fallow		9	1.06
		Onion/ChiliT.AusFallow		6	0.71
		Vegetables/Onion T.Aus Fallow		10	1.18

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Maize T.Aus Fallow		15	1.76
		Wheat Jute/T.Aus- Fallow		30	3.53
		Garlic T.Aus Fallow		6	0.71
		Turmeric Turmeric Turmeric		3	0.35
		Vegetables Vegetables Vegetables		3	0.35
		Orchard Orchard Orchard		5	0.59
		Total		850	100.00

Source: Sonadanga of Union 2016

Major problems on Crop Cultivation

The major problems in : Sonadanga Union crop cultivation are: (i) Siltation of wetlands, rivers canals and Water logging, (ii) kutch irrigation drainage system & insufficient electricity supply during boro crop season,(iii) Less supply of quality HYV and Hybrid crop seeds and agriculture equipments (power tiller, tractor, power sprayer, foot pump etc but price is high, (iv) Lack of cold storage& seed store and also lack of wholesale market infrastructure, (v) Kutch and poor road communication system,(vi) Less market price of agricultural produce crops,(vii) Over-drainage and abrupt reduction of wet land restricts open water fisheries and its breeding place, (viii) Lack of policy implementation to preserve the perennial wetland areas, and (ix Most of the old canals of the union were found closed due to construction of unplanned housing, market and other infrastructures which are creating barriers to natural water flow and causing drainage congestion. (x) Lack of farmer's knowledge on modern crop production technology,(xi) Agricultural land areas decreased, (xii) less use of organic fertilizer but increase inorganic fertilizers and pesticides ,and (xiii)Top soil cutting, sand deposition and land degradation is acute problem.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Ensure supply of quality HYV and Hybrid drought, pest & disease resistant, early variety different crop seeds and cultivation & irrigation equipments,

(2) Re-excavation of silted wetland, rivers and canals to increase water flow and removal of water congestion,

(3) Integrated pest management technology need to implement for reducing pesticides water pollution.

(4) Construction multipurpose cold storage, seed store and wholesale market infrastructures,

(5) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping pattern and application of organic and bio-fertilizer can improve deficiency of soil nutrient,

(6) Perennial wetland should be preserved for open water fisheries and ecological balance must be maintained,

(7) Need to popularize rice with fish cultivation technology which will reduced the pesticides use,

(8) Construction of potato and vegetable processing, grading and packaging industry/facility and Establishment of agro-based industry,

(9) Farmers need base modern crop and fish production technological practical training, (10)Construction of permanent structure such as roads, housing settlements etc in the perennial water body need to be prohibited,

(11) Some perennial wetlands need to be declared as a fish Sanctuary for survival of indigenous fish species,

(12) land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will be protect the agricultural lands.

3.4.15 **Sreepur Union Land Use**

General Description

Land is the most valuable resource among all the natural resources of a country which provides food, shelter including life saving elements to her ever increasing population. Sreepur Union lands are suitable for agricultural crop cultivation due to land types and other characteristics. The medium high land and high land areas are free from monsoon flood and suitable for diversified crops throughout the year.

The land types of this union are medium low land (40.95%) followed low land (26.48%), medium high land (21.90%), high land (10.48%), and very low land (0.19%). There are about 8 % wetlands for capture and culture fish production. Sreepur union is consists of 11 Mauzas and 12 villages with the area of1129.15 ha. The soil P^H is 6.1-7.9. Top soil texture loam to clay. Soil is moderate to highly fertile, productive and potential for multiple agricultural crops cultivation. Risk of flood occurred in low land areas. Betel leaf is high value agriculture crop cultivated extensively in the highland area and it is the source of income for many farmers. High and medium highland areas are suitable for both agriculture and horticulture where criteria permit. There are 12 Mango, 5 Banana, 100 litchi, and 2 Papaya commercial fruit gardens. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **agricultural zone**.

This Union having agriculture cultivated area of 2046 ha of land of which net cropped area is 1005 ha. Out of the total cultivable land in this Union double cropped area 45.28% followed by triple cropped area 29.15% and single cropped area 25.5%. . Boro, Potato and T. Aus are principal crops and wide range Rabi crops is cultivated. The sources of water are ground and surface water used for crop production. Major irrigation device are LLP, STW and DTW. The cropping intensity of this union is 203%. Major cropping patterns of this Union are: Boro→Fallow→ Fallow (26%) followed by Boro→T. Aus→Fallow (22%) and Mustard/Boro→ T.Aus→ Fallow (11%) and Other cropping patterns in this union is shown in Table 3.18.

Table 3. 19: Present Cropping Patterns of Sreepur Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Sreepur	1005	Potato/Boro(HYV)□T.Aus□Fallow	204	74	7.36
		Boro (HYV)□Fallow□ Fallow		260	25.87
		Boro□ T.Aus□ Fallow		220	21.89
		Potato/ Maize□ T.Aus□ Fallow		70	6.97
		Maize□ T.Aus□Fallow		10	1.00
		Lentil □Til□vegetables		9	0.90
		Mustard/Boro□T.Aus□ Fallow		105	10.45
		Wheat□ Jute□ Fallow		40	3.98
		Wheat□Chili□ Fallow		45	4.48
		Onion/Boro□T.Aus□Fallow		30	2.99
		Vegetables □Vegetables□ Vegetables		56	5.57

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Betel leaf□Betel leaf□Betel leaf		60	5.97
		Orchard□Orchard□Orchard		26	2.59
		Total		1005	100.00

Source: SAAOs of Sreepur Union 2016

Major problems on Crop Cultivation

The major problems in Sreepur Union crop cultivation are: (i) lack of cold storage , seed store and lack of wholesale market infrastructure, (ii) The canals/khals of the Union were found mostly closed or silted and irrigation drainage system were found kutcha, (iii) Drought and majority irrigation pump were not connected electricity and also inadequate supply during Boro season, (iv) Lack of knowledge both men and women farmers on crop production technology and farmers financial problems for adaption of modern technology,(vi)Scarcity of surface water for irrigation, higher cost of Low Lift Pumps (LLP),STW and DTW, (vii) Siltation of river, canals, beels which has created negative impact on diversification of crops, bio-diversity and capture fisheries,(viii) Less supply of quality HYV and Hybrid seeds,(ix) Crop production cost is high and Less market price for produce crops, and (x) Lack of awareness on proper management of land and imbalance use pesticides and chemical fertilizers and less use of organic manure which reduce the soil fertility,(xi) The agricultural land reducing every year due to Unplanned construction of houses, settlements, markets, and different infrastructural development.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1)Ensure quality HYV and Hybrid different crop seeds in less price,

(2)Develop irrigation facilities by re-excavating the river, old canals, khals etc, and Kutcha drainage system converted into underground pipe system,

(3) Sufficient number of different crop variety demonstration in farmers' field and also more women farmers training on vegetables and crop production technology,

(4) Construction of multipurpose cold storage and wholesale market infrastructures and agro based industries,

(5) All electricity connection for irrigation pumps and Ensure adequate electricity supply during irrigation period,

(6) Development of road communication and marketing system,

(7) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping pattern, and chemical fertilizer need to be use as per recommendation,

(8) Land degradation especially agricultural land degradation is becoming more severe. So, appropriate measure need to be taken to control the unplanned & unwanted interventions responsible for land degradation, and

(9) Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will decrease the uses of agricultural lands to non-agricultural purpose,

(10) Development of inter-agency cooperation, and (11) Re-excavated silted river, canals/khals for increasing water flow.

3.4.16 **Subhadanga Union Land Use**

General Description

Land uses and land cover of Subhadanga Union is agriculture dominated. Agricultural land resources have been brought into high value crops and fruit cultivation as commercial basis. Subhadanga union is consists of 11 Mauzas and 12 villages with the area of1129.15 ha. The lands of this Union falls into 3 Agro-ecological zones are: (i) Tista Meander Floodplain (AEZ-3), (ii) Lower Atrai Basin (AEZ-5), and (iii) High Ganges Floodplain (AEZ-11). The Union is highly suitable for freshwater capture and culture fisheries. This Union occupying about 34% wetland which is intensively used for captures and culture fish production. Union lands are suitable for diversified agricultural crop cultivation due to land types and other characteristics. The land types of this union are medium high land (35.02%), high land (29.13%), medium low land (23.55%), low land (12.07%), and very low land (0.23%). The soil P^H is 6.0-8.0. Top soil texture loam to clay loam. Soil is moderate to highly fertile, productive and potential for multiple

agricultural crops cultivation. Risk of flood occurred in low land areas. Betel leaf is high value agriculture crop cultivated extensively in the highland area and it is the source of income for many farmers. There are above 11 % lands used for Betel leaf production in this Union. There are 15 Mango commercial fruit gardens. Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed this union as **agricultural zone**.

Crop production is a complex business, requiring many skills such as biology, agronomy, mechanics and marketing. Chemical and physical properties of soils are the determining factors for grain output. They are the indicating factors for the capacity for water retention, carbon sequestration, plant productivity, waste remediation and other functions for the cropping pattern for this Union. This Union having agriculture cultivated area of 4478 ha of land of which net cropped area is 1962 ha. Out of the total cultivable land in this Union triple cropped area 49.74% followed by double cropped area 28.75%, and single cropped area 21.51%. Major cropping patterns of this Union are: Mustard/Boro→T.Aus→ Fallow (20%) followed by Boro→Fallow→Fallow (19%) and Potato/Boro→ T.Aus→ Fallow (13%) and Other cropping patterns in this union is shown in Table 3.19. The cropping intensity of this union is 228%. The sources of water are ground and surface water used for crop production. Major irrigation device are LLP, STW and DTW. The river, canal and beel were silted which has created negative impacts on diversification of crops, bio-diversity and capture fisheries production.

Table 3. 20: Present Cropping Patterns of Subhadanga Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Subhadanga	1962	Potato/Boro(HYV)T.AusFallow	228	256	13.05
		Boro (HYV)Fallow Fallow		372	18.96
		Potato Maize/T.Aus Fallow		125	6.37
		Potato/ Maize T.Aus Fallow		115	5.86
		Potato/BoroT.AusFallow		100	5.10
		Vegetables/PotatoVegetable/ T.Aus Fallow		60	3.06
		PotatoJuteT.Aman		30	1.53
		PotatoTil/T.Aus Fallow		17	0.87
		Mustard/BoroT.Aus Fallow		401	20.44
		MustardBoroFallow		80	4.08
		Wheat T.Aus Fallow		40	2.04

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Chili T.Aus Fallow		18	0.92
		Wheat Jute T.Aman		35	1.78
		Onion/Garlic T. Aus Fallow		39	1.99
		Vegetables /Onion Jute T.Aman		20	1.02
		Turmerine Turmerine Turmerine		15	0.76
		Betel leaf Betel leaf Betel leaf		220	11.21
		Orchard Orchard Orchard		19	0.97
		Total		1962	100.00

Source: SAAOs of Subhadanga Union 2016

Major problems on Crop Cultivation

The major problems in Subhadanga Union crop cultivation are: (i) Water logging and most of the canals/khals of the Union were found mostly closed or silted and irrigation drainage system were found kutcha, (ii) Lack of knowledge both men and women farmers on crop production technology and farmers financial problems for adaption of modern technology, (iii) lack of cold storage , seed store and lack of wholesale market infrastructure, (iv) High cost of Low Lift Pumps (LLP),STW and DTW, (v) Less supply of quality HYV and Hybrid seeds and equipments(power tiller, tractor, power sprayer etc.), (vi) Crop production cost is high and Less market price for produce crops, (vii) Lack of awareness on proper management of land and imbalance use pesticides and chemical fertilizers and less use of organic manure which reduce the soil fertility,(vii)Less number of different crop varietal result demonstration in farmers field, and(vii) Arable agricultural land reducing every year rapidly, (ix) Top soil cutting and land degradation, and (x) lack of agro based processing center and industries.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Sufficient number of different crop variety demonstration in farmers field and also more women farmers training on integrated crop management and integrated pest management for vegetables and crop production technology,

(2)Develop irrigation facilities by re-excavating the river, old canals, khals etc, and Kutcha drainage system converted into underground pipe system,

(3) Ensure quality HYV and Hybrid different crop seeds and cultivation equipments in less price,

(4) Construction of multipurpose cold storage and wholesale market infrastructures,

(5) Development of road communication and marketing system,

(6) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping pattern,

(7)Protection of valuable agricultural land by enforcement of Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 which will decrease the uses of agricultural lands to non-agricultural purpose,

(8) Construction of potato and vegetable processing, grading and packaging industry/facility and Establishment of agro-based industry,

(9) Farmers need base modern crop and fish production technological practical training,

3.4.17 **Bhawaniganj Paurashava Land Use**

General Description

The land of Bhawaniganj Paurashava is intensively used for agriculture, settlements, urban expansion, poultry farm, fruits production, capture and culture fisheries and other infrastructural development activities. Increased population imposes high pressure on land resources for agricultural production. . Considering the present agricultural land use, land suitability and people's opinion by National Land Zoning project, August 2015 was identified and proposed Bhawaniganj **as Paurashava zone**. Improper land use causes various forms of land degradation resulting in a reduced agriculture production, affect flora & fauna habitat and thus impact ecosystem and biodiversity. The land suitability classification types indicates the relative suitability of land for sustained production of common agricultural crops and other uses as mango garden, fisheries, social forest, urban and commercial areas. Bhawaniganj Paurashava is consists of 23 Paura Mahalla and 9 wards with the area of1307.28 ha. This Union having agriculture cultivated area of 2770 ha of land of which net cropped area is 1050 ha. Out of the total cultivable land in this triple cropped area 73.33% followed by double cropped area 14.29%, and single cropped area 11.43% and four cropped area 0.95%. The cropping intensity

of this union is 264%. Major cropping patterns of this Union are: Potato/ Boro→T.Aus→ Fallow (44%) followed by Potato/Maize→T. Aus→Fallow (16%) and Mustard/Boro→ T.Aus→ Fallow (15%) and Other cropping patterns in this union is shown in Table 3.20. Boro, Potato and T. Aus are principal crops and wide range Rabi crops is cultivated. The sources of water are ground and surface water used for crop production. Major irrigation device are LLP, STW and DTW. The land types of this union are medium high land (41.75%) followed by high land (26.95%), medium low land (24.35%), and low land (6.96%). There are above 5 % wetlands for capture and culture fish production. The soil P^H is 6.0-8.0. Top soil texture loam to clay loam. Soil is moderately fertile, productive and potential for multiple agricultural crops cultivation. Flood risk is less. About 21 ha land used for Betel leaf cultivation under this Paurashava. There are 70 Mango, 20 Banana, 7 litchis, 25 Guava, and 17 Papaya commercial establish fruit gardens.

Table 3. 21: Present Cropping Patterns of Bhawaniganj Paurashava

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Bhawaniganj Paurashava	1050	Potato/Boro(HYV)T.AusFallow	264	461	43.90
		Boro (HYV)Fallow Fallow		84	8.00
		Potato/ Maize T.Aus Fallow		168	16.00
		Mustard/Boro T.Aus Fallow		158	15.05
		Onion/MaizeT.AusFallow		40	3.81
		Lentil T.Aus Fallow		5	0.48
		Onion/Chili T.Aus Fallow		10	0.95
		WheatJute T.Aman		21	2.00
		Onion /Garlic T. Aus Fallow		15	1.43
		Vegetables /OnionJute Fallow		42	4.00
		VegetablesVegetables Vegetables		8	0.76
		TurmerineTurmerineTurmerine		5	0.48
		Betel leafBetel leafBetel leaf		21	2.00
		OrchardOrchardOrchard		12	1.14
		Total		1050	100.00

Source: SAAOs of Bhawaniganj Paurashava 2016

Major problems on Crop Cultivation

The major problems in Bhawaniganj Paurashava crop cultivation are: (i) Lack of integration and cooperation among the line agencies and also the lacking of urban facilities, (ii) Water congestion, canals/khals of the Paurashava were found mostly closed or silted, (iii) Shortage of

cold storage and lack of wholesale vegetables market infrastructure, (iv)Less supply of quality HYV and Hybrid seeds & equipments and higher cost of Low Lift Pumps (LLP),STW and DTW, (v) Crop production cost is high and Less market price for produce crops, (vi) The agricultural land reducing every year due to Unplanned construction of houses, settlements, markets, and different infrastructural development , (vii)Drainage congestion in some areas created livelihood hazard, (viii) Top soil cutting and sand deposition and (ix) Expansion of unplanned urban areas.

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1)The urban area need to be well planned and should have all facilities for the dwellers,

(2) Ensure quality HYV and Hybrid different crop seeds in less price,

(2)Drainage congestion can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Paurashava,

(3) Sufficient number of different crop variety demonstration in farmers field and also more women farmers training on vegetables and crop production technology,

(4) Construction of multipurpose cold storage and food stores,

(5) Increase number farmer school of Integrated Pest Management (IMP) and Integrated Crop Management (ICM),

(6) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping pattern,

(7) Need to be established agro processing center and soil testing laboratory,

(8) Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will decrease the uses of agricultural lands to non-agricultural purpose and

(9) Development and strengthen of inter-agency cooperation.

3.4.18 **Tahirpur Paurashava Land Use**

General Description

The land capability classification indicates the relative suitability of land for sustained production of common agricultural crops, fisheries and other uses adapted to the existing physical and environmental condition. The physical suitability of an area or the suitability of land has a great influence. The land of Tahirpur Paurashava is suitable for multiple agriculture crops cultivation due to favorable land types and other characteristics. This Paurashava consists of above 8% wetland for capture and culture fish production. Huge natural fishes are grown in this wetland and the livelihood of many people depends on fishing. Farmers also grow different crops and vegetables in the winter season. Betel leaf is a high value agriculture crops cultivated extensively in the highland areas and it is the source of income for many farmers. The medium high land and high land areas are free from monsoon flood and suitable for diversified crops throughout the year. The land types of this Paurashava are medium high land (41.22%) followed by high land (22.74%), medium low land (21.40%), and low land (14.64%). Tahirpur Paurashava is consists of 17 Paura Mahalla and 9 wards with the area of1121.86 ha. The Agro-ecological zones of the Union are Lower Atrai Basin (AEZ-5), and High Ganges Floodplain (AEZ-11). The Atrai basin comprises 15% of total land occupying low lying area and Old Ganges river floodplain comprises 85% land of total Paurashava. The soil P^H is 6.1-7.9. Top soil texture loam to clay loam. Soil is moderate to highly fertile. Paurashava is less risk of flood. High and medium highland areas are suitable for both agriculture and horticulture where criteria permit. There are 20 Mango, 5 Banana, 2 litchis, 4 Guava and 10 Papaya commercial establish fruit gardens. Considering the present agricultural land use, land suitability and people's opinion and also Paurashava area development of urban area need to be done without degradation of fertile agricultural land by National Land Zoning project, August 2015 was identified and proposed this union as **Tahirpur Paurashava zone**.

Tahirpur Paurashava having agriculture cultivated area of 1893 ha of land of which net cropped area is 807 ha. Out of the total cultivable land in this Union double cropped area 55.51% followed by triple cropped area 39.53%, and single cropped area 4.96. Major cropping patterns

of this Union are: Mustard→Boro→ Fallow (17%) followed by Onion→Jute→Fallow (16%) and Boro→ T.Aus→ Fallow (12%) and other cropping patterns in this union is shown in Table 3.21. Mutard, Boro, Onion and T. Aus are principal crops and wide range Rabi crops is cultivated. The sources of water are ground and surface water used for crop production. Major irrigation device are LLP, STW and DTW. About 85% land is cultivated by the power tiller. The cropping intensity of this union is 235%.

Table 3. 22: Present Cropping Patterns of Tahirpur Paurashava

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Tahirpur Paurashava	807	Boro (HYV)→ Fallow→ Fallow	235	66	8.18
		Boro→ T.Aus→ Fallow		100	12.39
		Potato/ Maize→ T.Aus→ Fallow		70	8.67
		Vegetables/Potato→ Maize/T.Aus→ Fallow		40	4.96
		Potato→ Til/T.Aus → Fallow		25	3.10
		Mustard→ Boro→ Fallow		140	17.35
		Onion→ Jute→ Fallow		125	15.49
		Onion→ T.Aus→ Fallow		100	12.39
		Pulses→ T.Aus→ Fallow		12	1.49
		Chili→ T.Aus→ Fallow		16	1.98
		Wheat→ Jute→ Fallow		15	1.86
		Onion /Garlic→ T. Aus→Fallow		10	1.24
		Vegetables → Chili→ Fallow		11	1.36
		Vegetables→ Vegetables→ Vegetables		30	3.72
		Turmerine→ Turmerine→ Turmerine		8	0.99
		Betel leaf→ Betel leaf→ Betel leaf		14	1.73
		Bamboo→ Bamboo→ Bamboo		7	0.87
		Orchard→ Orchard→ Orchard		18	2.23
		Total		807	100.00

Source: SAAOs of Tahirpur Paurashava 2016

Major problems on Crop Cultivation

The major problems in Tahirpur Paurashava crop cultivation are: (i) Water logging, canals/khals of the Paurashava were found mostly closed or silted, (ii)Less supply of quality HYV and Hybrid seeds & equipments and higher cost of Low Lift Pumps (LLP),STW and DTW, (iii) Shortage of cold storage and lack of wholesale vegetables market infrastructure, (iv) Farmers lack of knowledge on modern crop production and Crop production cost is high and Less market price

for produce crops, (v) Lack of integration and cooperation among the line agencies and also the inadequate urban facilities, (vi) The agricultural land reducing every year due to Unplanned construction of houses, settlements, markets, and different infrastructural development, (vii)Top soil cutting and sand deposition, (viii) Lack of sustainable long term development urban plan, and (ix) Inadequate electricity .

Recommendation

Considering major constraints and problems of the area the following management practices can be taken:

(1) Ensure quality HYV and Hybrid different crop seeds and equipments in less price,

(2) Develop irrigation facilities by re-excavating the river, old canals, khals etc, and Kutcha drainage system converted into underground pipe system,

(3) Sufficient number of different crop variety demonstration in farmers field and also more women farmers training on vegetables and crop production technology

(4) Construction of multipurpose cold storage and wholesale market infrastructures,

(5) Electricity connection for all irrigation pumps and ensure adequate electricity supply during irrigation period,

(6) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping pattern,

(7) Land degradation especially agricultural land degradation is becoming more severe. So, appropriate measure need to be taken to control the unplanned & unwanted interventions responsible for land degradation, and

(8) Land zoning law, village improvement act and Preparation of Development plan for Fourteen Upazila project, Package-3 need to be implemented which will minimize conversion of double and triple cultivated agricultural land to non agricultural use,

(9) Arrange and allocate sufficient credit for farmers, and

(10) Development and strengthen of inter-agency cooperation,

(11) Establishment of agro processing center and

(12)The urban area need to be well planned and should have all facilities for the dwellers .

Land Used for Single, Double & Triple Crop Area

Multiplicity of cropping systems has been one of the main features of the Bagmara Upazila. Farmers are harnessing their life style by producing various crops round the year. Crop production is a complex business, requiring many skills such as biology, agronomy, mechanics, marketing and also irrigation facilities etc. This Upazila has suitable environment, land types and irrigation facilities (both surface and ground water) for crops and fish production. In agriculture, multiple cropping is the practice of growing two or more crops in the same land during a single growing crop season. It can take the form of double cropping, in which a second crop is planted after the first has been harvested. Generally, triple or four crops cultivated areas cropping intensity is high. All 16 Unions and 02 Paurashavas percent of land used for single, double, triple and four crops under Upazila are shown in Table 3.22 and Figure 3.3.

Study finding shows that out of 16 unions and 02 Paurashavas, only Sonadnaga and Nardas highest percent lands (about 49-68%) used for single crops and others unions less than 30% land used for single crop cultivation. Similarly, about 4-14% land used for four crops under five unions. The Unions are: Kachhari Kayali Para, Hamir Kutsha , Goalkandi, Maria and Ganipur. Study finding shows that 5 Unions and 01 Paurashava highest lands used for double crops (40-55%) which are Auch para, Basupara, Goalkandi, Gobinda Para, Sreepur and Tahirpur Paurashava. Similarly, 4 Unions and 01 Paurashava highest land used for tripl crops (Table 3.22). Among all the unions and Paurashavas the lowest cropping intensities were found in Sonadnaga Union (140%) and Nardas union (164%) and others unions and also Paurashavas cropping intensities from 193-264%). Data of Table 3.21 and Figure 3.3 shows that 14 Unions and 2 Puarashavas of Bagmara Upazila cropping intensities are higher than the national average cropping intensities 192% (Krishi Diary 2017). This finding clearly indicated Bagmara Upazila lands & environment are highly potential for diversified crop production.

Table 3.23: Union Wise Land Used of Single, Double & Triple cropped Area under Bagmara Upazila

Name of Union	Present Land Used in ha (%)						
	Cultivated Area	Single Cropped Area	Double Cropped Area	Triple Cropped Area	Four Cropped area	Net Cropped Area (ha)	Cropping intensity (%)
Auch para	3926	572(28.22)	820(40.45)	635(31.33)	00	2027	193
Bara Bihanali	3130	160(12.31)	360(27.69)	770(59.23)	10(0.77)	1300	241
Basupara	5204	364(15.62)	1094(46.93)	840(36.04)	33(1.41)	2331	223
Dwippur	2412	230(20.93)	428(38.95)	438(39.85)	3(0.27)	1099	220
Ganipur	6456	710(25.01)	1040(36.64)	690(24.30)	399(14.05)	2839	227
Goalkandi	4290	311(16.52)	843(44.79)	619(32.89)	109(5.79)	1882	228
Gobinda Para	4158	503(26.09)	910(47.20)	485(25.15)	30(1.56)	1928	216
Hamir Kutsha	4170	433(23.53)	603(32.77)	685(37.23)	119(6.47)	1840	227
Jhikra	4926	168(8.40)	737(36.85)	1095(54.75)	00	2000	246
Jogipara	5280	535(22.67)	735(31.14)	1065(45.13)	25(1.06)	2360	225
Kachhari Kayali Para	1483	111(17.69)	224(35.67)	268(42.67)	25(3.99)	628	236
Maria	3595	320(22.53)	205(14.44)	715(50.35)	180(12.68)	1420	253
Nardas	2852	866(49.32)	684(38.95)	206(11.73)	00	1756	164
Sonadnaga	1190	580(68.23)	200(23.53)	70 (8.24)	00	850	140
Sreepur	2046	257(25.57)	455(45.28)	293(29.15)	00	1005	204
Subhadanga	4478	422(21.51)	564(28.75)	976(49.74)	00	1962	228
Bhawbaniganj Paurashava	2770	120(11.43)	150(14.29)	770(73.33)	10(0.95)	1050	264
Tahirpur Paurashava	1893	40(4.96)	448(55.51)	319(39.53)	00	807	235
Total	64259	6702(23.04)	10500(36.10)	10939(37.61)	943(3.24)	29084	**221**

Source: SAAOs and UAO Bagmara Upazila, DAE 2016

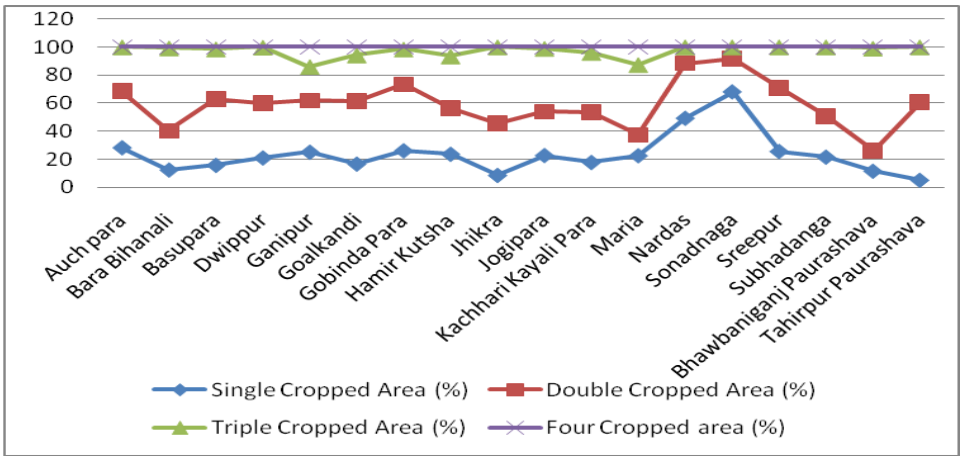


Figure 3.4: Percent of Union Wise Single, Double, Triple & Four Cropped area under Bagmara Upazila

CHAPTER-FOUR: CROPPING PATTERN AND CROPPING INTENSITIES

4.1 Cropping Pattern

The physical and chemical characteristic of an area have great influence on the suitability of land for different types of crop production. Multiplicity of cropping system has been one of the main features of the Bagmara Upazila. Farmers are harnessing their livelihood by producing various crops round the year. Land utilization and cropping pattern in Bagmara Upazila depend on effective/planned use of land resources, availability of irrigation facilities, and use of modern technologies etc. A cropping pattern is the yearly sequence and spatial arrangement of crops and fallow on a given area. Mixed farming involves the raising of crops, animals and trees. Multiple cropping is the growing of more than one crop on the same land in the period of a year, and sole cropping, or solid planting, is when one crop variety is grown at normal density, alone and in pure stands. The repeated growing of the same sole crop on the same land is monoculture, and crop rotation is the repetitive cultivation of an ordered succession of crops or crops and fallow on the same land. 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.

Land type is the dominant factor guiding choice of crops and cropping patterns of Bagmara Upazila. The scenario of present cropping pattern under Bagmara Upazila is predominantly Potato, Mustard, Boro (HYV/Hybrid), T. Aus (HYV) & T. Aman (HYV/LV) rice, Jute, Wheat, Maize, Vegetables, Onion/Garlic Oilseeds, Pulses, Spices, Chili, Betel leaf, vegetables and orchard etc. are also included in cropping pattern . Detailed Upazila cropping patterns by season are presented in Table 4.1. Study finding shows that 28 diversified cropping pattern are practiced

by Bagmara Upazila farmers. Among them the present five major cropping pattern are: Potato/Boro→T. Aus (HYV)→ Fallow (15.13%), Mustard/Boro→T.Aus (HYV)→Fallow (14.77%), Potato→ Boro→Fallow (14.17%), Boro (HYV/Hybrid)→Fallow→Fallow (10.34%) and Mustard→Boro→Fallow (6.22%) and others cropping pattern are also shown in Table 4.1.

Study finding of present cropping patterns clearly indicated that Bagmara Upazila soil and climate are suitable for diversified crop production such as, paddy, Potato, wheat, maize, jute, mustard, chili, winter and summer vegetables, onion/garlic, pulses, sugarcane, betel leaf and different fruits (Mango, Litchi, Papaya and Guava) production. There are wetland lies in the Upazila and famous for open water capture and culture fisheries. Upazila head quarter is characterized by mixed uses of land.

Table 4. 1: Present Cropping pattern under Bagmara Upazila

Major Cropping Pattern			Area(ha)	Contribution %
Rabi	Kharif-1	Khari-2		
Potato	Boro	Fallow	4125	14.17
Boro	Fallow	Fallow	3010	10.34
Potato/Maize	T. Aus/Maize	Fallow	2085	7.16
Potato/Boro	T.Aus (HYV)	Fallow	4405	15.13
Potato/Vegetables	Vegetables	Fallow	430	1.48
Vegetables/Potato	Maize/T.Aus	Fallow	500	1.72
Potato/Maize	Vegetables	Fallow	850	2.92
Potato	Jute	T.Aman	670	2.30
Potato	Til/T.Aus	Fallow	160	0.55
Potato/Groundnut	Groundnut/T.Aus	Fallow	85	0.29
Mustard/Boro	T.Aus	Fallow	4300	14.77
Mustard	Boro	Fallow	1810	6.22
Potato/Wheat/Vegetables	Chili	Fallow	300	1.03
Wheat	Jute	T. Aman	630	2.16
Wheat	T. Aus	Fallow	730	2.51
Maize	T. Aus	Fallow	410	1.41
Vegetables/Onion	T.Aus	Fallow	700	2.40
Onion/Maize	T. Aus/Vegetables	Fallow	800	2.75
Chili/Onion	T. Aus	Fallow	220	0.76
Onion/ Boro	T.Aus	Fallow	950	3.26
Vegetables/Onion	Jute	T.Aman	450	1.55
Garlic	T.Aus	Fallow	350	1.20
Pulses	T.Aus	Fallow	140	0.48
Spices(Turmeric/Zinger	Turmeric/Zinger	Turmeric/Zinger	232	0.80

Major Cropping Pattern			Area(ha)	Contribution %
Vegetables	Vegetables	Vegetables	63	0.22
Betel leaf	Betel leaf	Betel Leaf	640	2.20
Sugarcane	Sugarcane	Sugarcane	25	0.09
Orchard	Orchard	Orchard	40	0.14
Total			29110	100.00

Source: SAAOs and UAO, Bagmara Upazila, DAE 2016, Note: Rabi Season= Month of November-February, Kharif-1 Season= Month of March-June and Kharif-2 Season= Month of July- October.

4.2 Cropping Intensity

Diversified crops cultivation depends on land type, topography, chemical and physical properties of the soil and irrigation facilities and also climatic conditions of the area. The soil and climatic conditions of Bagmara Upazila is highly suitable for more than three or four crops cultivation. This suitability and facility will increase the cropping intensity of the area. Cropping intensity is the number of times a crop is planted per year in a given agricultural area. It is the ratio of effective crop area harvested to the physical area. 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.

The present 16 Unions wise and 02 Paurashavas cropping intensity is shown in Figure-4.1. The average cropping intensity under Bagmara Upazila is 221% which is higher than cropping intensity of 5 Unions and also less than 11 Unions and 02 Paurashavas(Fig.4.1). The highest cropping intensities were occurred in Bhawbaniganj Paurashava (264%), Maria Union (253%) and Jhikra Union (246%) and lowest cropping intensity under Sonadnaga (140%) and Nardas Union (164%).The average cropping intensity under Bagmara Upazila is 221% which is less than Rajshahi district cropping intensities 246% and also higher than national average cropping intensity 192% (Krishi Diary 2017). Figure 4.1 shows that all the 14 unions & 02 Puarashavas under Bagmara Upazila cropping intensities are higher than national average cropping intensity

(192%) but only 2 Unions are less than national average cropping intensities (140-164%). Study finding clearly indicated that markedly increase crop diversification in this Upazila and it is attributed to agriculture and prevailing socio-economic situations of the farming community.

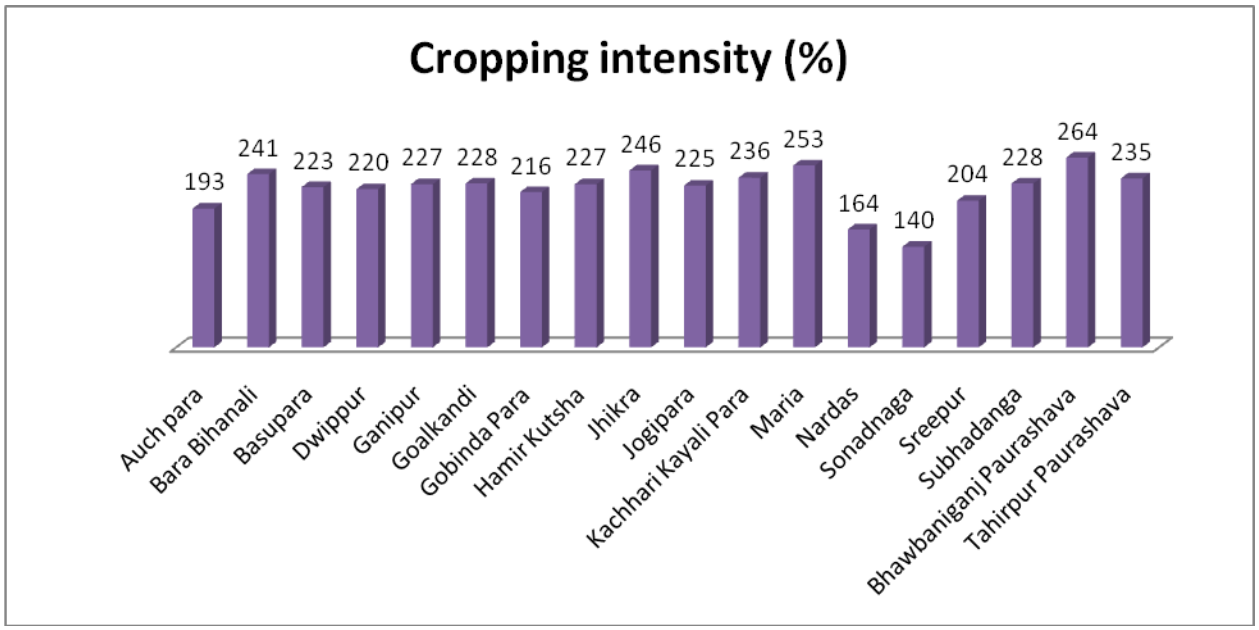


Figure 4. 1: Union wise Cropping Intensities under Bagmara Upazila

4.3 Present Cropped Area

Land utilization and cropped area depends on effective planned use of land resource, availability of irrigation facilities, soil fertility & topography, use of modern crop production technologies and marketing etc. In Bagmara Upazila soil and climatic conditions are suitable for growing wide range of both tropical and temperate crops. Rice, potato, mustard, Jute, Wheat, Maize, winter and summer vegetables, chili, pulses, Bete leaf and various fruits crops are grown in 16 Unions and 02Paurashavas under this Upazila. The present scenario of different cropped area, yield rate and production levels are shown in Table-4.2. The present total diversified cropped area is 68223 ha of which rice cropped area are 31280 ha and the rest 487172.66 ha is covered by non-rice crops (Potato, W & S. vegetables, pulses, and oilseeds and Fruits etc.). The rice and non-rice cropped area are about 46% and 54% respectively of the total cropped area. The highest land area was used for Potato (13320ha) followed by Boro HYV (13210ha), T. Aus

(11700ha), Oilseeds (6755ha) and Boro Hybrid (5550 ha) and also other crops cultivated area are shown in Table 4.2.

4.4 Present Crop Production

Crop yield depends on soil fertility, crop variety, and irrigation facility, methods of cultivation, balance use of fertilizer, pest and weed management and also crop season. HYV/Hybrid rice or others crops gives higher yield in compared to local variety crops. In 2016, total crop production under Bagmara Upazila is 658975.36 metric tons of which rice production is 171802.7 metric tons and non-rice production is 475460.66 metric tons (Table 4.2). Among the rice crops the highest contributions of Boro (HYV) folllowed by T.Aus(HYV) and Boro (Hybrid) are about 63%, 19% and 16% respectively. The highest contribution among the non-rice crops are Potato (61%) followed by spices (16%) & winter vegetables (7%), Maize & summer vegetables(5%) respectively and other crops contribution are shown in Table-4.2. Overall, rice and non-rice production difference is 26% and 74% in this upazila. Betel leaf is a high value agriculture crop culitivated extensively in the highland areas and it is the source of income for many farmers.

Table 4. 2: Present Cultivated Area, Yield and Production under Bagmara Upazila

Crop Grown	Crop area(ha)	Yield/ha (mt)	Production (mt)	Contribution (%)
T.Aus (HYV)	11700	2.82	32994	19.20
T. Aman(LV)	10	1.9	19	0.01
T. Aman(HYV)	810	2.67	2162.7	1.26
Boro (HYV)	13210	8.2	108322	63.05
Boro (Hybrid)	5550	5.1	28305	16.48
Sub Total Rice	**31280**		**171802.7**	100.00
Summer Vegetables	**1705**	**13**	**22165**	4.55
Winter vegetables	2705	12	32460	6.66
Wheat	1590	3.6	5724	1.17
Maize	4220	6	25320	5.20
Jute	670	3.5	2345	0.48
Sweet Potato	15	25	375	0.08
Potato	13320	22.35	297702	61.11
Spices (Onion & Garlic etc)	5088	15.52	78965.76	16.21
Oil seeds (Mustard, Til, Groundnut)	6755	1.3	8781.5	1.80
Betel Leaf	640	18.3	11712	2.40
Pulses	170	1.31	222.7	0.05
Sugarcane	25	14.9	372.5	0.08

Crop Grown	Crop area(ha)	Yield/ha (mt)	Production (mt)	Contribution (%)
Fruits (Orchard)	40	25.68	1027.2	0.21
Sub-Total	**36943**		**487172.66**	100.00
Total	**68223**		**658975.36**	

Source: SAAOs and UAO, Bagmara Upazila, DAE 2016

4.5 Irrigation Facilities under Different Unions

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. The main source of water is both surface and ground water. Irrigation is the lifeline of agriculture, because without irrigation facility crops diversification or HYV /Hybrid cultivation would be impossible. For Boro rice cultivation ground water conservation and proper utilization in this Upazila is very important. This study are assessed the present scenario of irrigation facilities and problems. For irrigation purposes, generally, Deep Tube Wells (DTW), Shallow Tube Well (STW) and Low Lift Pump (LLP) and also traditional instrument are used. Union wise DTW, STW and LLP under Bagmara Upazila is shown in Table-4.3. A total of 5054 machine were used for irrigation under Unions in Bagmara Upazila. Out of total machine, 861 DTW, 3031 STW and 1162 LLP along with other indigenous irrigation tools are used for lifting water. This indicates that farmers have access to irrigation water that through ground water lifting causing an adverse impact both in agricultural production and surrounding environment. In many cases small and marginal farmers are involved in operation and maintenance of irrigation equipments. Among the irrigation machine 653 DTW, 169 STW and 6 LLP has electricity facilities but 208 DTW, 2862 STW & 1156 LLP has no electricity facilities. About 84% irrigation machines under this Upazila has not given electricity which is increased the crop production cost. Electricity user's farmers reported that failed or disruption of electricity supply during Boro season were acute problems under Bagmara Upazila. Famers wanted nonstop electricity supply during Boro season. Majority of the Farmers reported irrigation drainage system of DTW 40-80% is pucca, and STW and LLP 80-100% drain is kutcha which is causes wastage of irrigation water. Farmers wanted pucca drainage system.

Table 4. 3: Union Wise Irrigation Machine under Bagmara Upazila

Name of Union	DTW		STW		LLP		Remarks	
	ctri cit	Die sel	ctri cit	Die sel	ctri cit	Die sel	% Pucca drain	% Kutch drain
Auch para	61	12	0	15	0	130	DTW=75	DTW=25,STW&LLP=100
Bara Bihanali	33	10	0	62	0	0	DTW=40	DTW=60,STW&LLP=100
Basupara	80	06	0	75	0	60	DTW=80	DTW=20,STW &LLP=100
Dwippur	31	08	01	59	0	150	DTW=75	DTW=25,STW& LLP=100
Ganipur	59	09	0	225	0	271	DTW=25,LLP=05	DTW=75,STW=100,LLp=95
Goalkandi	27	17	0	140	0	0	DTW=80	DTW=20,STW=100
Gobinda Para	53	19	0	70	0	110	DTW=40	DTW=60,STW&LLP=100
Hamir Kutsha	18	30	29	627	0	0		DTW &STW=100
Jhikra	39	29	0	400	0	0	DTW=50	DTW=50 &STW=100
Jogipara	20	05	104	889	0	0		DTW &STW=100
Kachhari Kayali Para	21	06	0	20	0	23	DTW=65	DTW=35,STW&LLP=100
Maria	24	17	0	60	0	50	DTW=80	DTW=20,STW&LLP=100
Nardas	58	18	0	22	0	72	DTW=75	DTW=25, STW &LLP=100
Sonadnaga	04	0	0	30	0	75	DTW=40	DTW=60,STW & LLP=100
Sreepur	30	04	0	28	05	55	DTW=40,LLP=10	DTW=60,STW=100,LLP=90
Subhadanga	47	10	06	15	0	135	DTW=80	DTW=20,STW & LLP=100
Bhawbaniganj Paurashava	40	06	04	100	01	25	DTW=75	DTW=25,STW &LLP=100
Tahirpur Paurashava	08	02	25	25	0	0	DTW=30 & STW=25	DTW=70 and STW=75
Total	653	208	169	2862	06	1156		

Source: SAAOs under Bagmara Upazila, DAE 2016

Now-a- days, irrigation is considered as a basic input for producing cereals and many other high value crops. Most of the farmers are dependent on irrigation. Good coordination between land and water is required for ensuring food security. In Rabi season mechanized irrigation can help to increase crop diversification. Status of Union wise irrigation and ground and surface water used under Bagmara Upazila is shown in Table 4.4. It shows that all Unions & Paurashavas 93-100 % land area covered by irrigation water in Rabi season. Data of Table 4.4 shows that majority of Unions 1-7% land were not developed irrigation facilities and only Nardas Union 12% land were exists non irrigated area in this Upazila. This indicates that most of the farmers have access to irrigation water which is a good sign for intensive farming. But in the long term, excessive ground water lifting may cause an adverse impact both in agricultural production and in the surrounding environment. There is a need to measure the water table condition in Boro season every year. Farmers have given supplementary irrigation in drought prone and water logged areas in this Upazila.

Table 4. 4: Status of Union wise Irrigation and Ground & Surface Water Used Area

Union	Irrigated Area (%)	Non Irrigated Area (%)	Irrigated Area*						Availability of Surface Water	Drought Prone Area (in ha)	Waterlogged Area (in ha)	Remarks
			Surface Water		Ground Water							
			LLP		STW		DTW					
			No	Area (%)	No	Area (%)	No	Area (%)				
Auch para	97	3	0	0	84	15	66	85	√	0	0	• Supplemental irrigation •Waterlogging
Bara Bihanali	97	3	0	0	35	3	45	97	×	0	0	
Basupara	96	4	50	2	47	2	87	96	√	0	0	
Dwippur	99	1	15	1	60	3	36	96	√	0	10	
Goalkandi	95	5	0	0	130	13	63	87	√	0	50	
Gobinda Para	99	1	440	26	210	10	75	64	√	0	20	
Ganipur	96	4	130	24	155	29	78	47	√	0	0	
Hamir Kutsha	100	0	0	0	794	43	45	57	√	0	0	
Jhikra	100	0	0	0	625	27	62	73	√	0	15	
Jogipara	100	0	0	0	1348	87	20	13	√	0	0	
Kachhari Kayali Para	100	0	2	3	25	5	31	92	√	0	0	
Maria	98	2	40	2	80	5	32	93	√	0	10	
Nardas	88	12	88	13	22	4	63	83	√	0	0	
Sonadnaga	100	0	30	17	60	36	12	47	√	0	15	
Sreepur	99	1	15	22	8	23	30	55	√	0	5	
Subhadanga	98	2	120	22	20	6	57	72	√	0	0	
Bhawbaniganj Paurashava	93	7	40	15	25	3	35	82	√	0	0	
Tahirpur Paurashava	93	7	50	3	101	6	20	91	√	200	157	

Source: National Land Zoning Project Report, August 2015

4.6 Cultivation Practices

Bagmara Upazila is potential for diversified agricultural crops cultivation practices. Huge natural fishes are grown in wetland and livelihood of many people depends on fishing. Variety of crops grown here and most of them are high value cereals, fruits, tubers (potato), spices, and pulses. Betel vine, maize, onion, garlic, turmeric are promising cash crops. Different kinds of winter and summer vegetables which are cultivated under both rain fed and irrigation condition. Fruits grow well here are Banana, Mango, Litchi, papaya cultivation are very famous in Bagmara Upazila. Modern irrigation has created harmonization in dry season for intensive land use. Mechanizations in agriculture by using tractor, power tiller, harvester etc. has brought a radical change in agribusiness for boosting production and increased farm outputs. The main thrust of mechanization is to reduce dependence on human labor and draft/animal power for tillage,

planting, intercultural operation and harvesting crops. It contributed to timely cultivation and thus increased cropping intensity, reduce yield losses and wastage. Use of machines has also cut down the cost of threshing. All the SAAOs and UAO reported that about 80% farmers used power tiller, 15% farmers used tractor and 5% farmers used bullock during land preparation. Generally per hector cultivation cost is Tk. 6500-7000/-. 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.Aus rice practiced 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. A very few farmers used compost or cow dung. 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.

4.7 Major Types of Crops Cultivated

High value Crop Betel Leaf (Pan): The soil and climate of Bagmara Upazila is highly suitable for betel leaf cultivation. The betel leaf or pan is the leaf of vine grows in the plant which is evergreen and perennial creeper. Since it is a creeper, it needs a compatible tree or a long pole for support. Betel requires well-drained fertile soil. Waterlogged, saline and alkali soils are unsuitable for its cultivation. The farmers prepared the barouj in which to betel grow. The barouj is fenced with bamboo sticks and coconut leaves. The soil is plowed into furrows of 10 to 15 meters length, 75 cm in width and 75cm depth. Oil cakes, manure, and leaves are thoroughly incorporated with the topsoil of the furrows and wood ash. The creeper cuttings are planted at the beginning of the monsoon. Proper shade and irrigation are essential for the successful cultivation of this crop. Betel needs constantly moist soil, but there should not be excessive moisture. Irrigation is frequent and light and standing water should not remain for more than half an hour. Betel leaf farming yields vary by region and vine variety. Generally, pan produce 32-40 lac leaf per ha/year. Betel leaf is one of the popular items host generously offer guests in village homes and town in Bangladesh. No village party gets enthusiasm without being served with betel leaf. There is high demand as its quality is very good here, so its cultivation is gaining

popularity in recent time. Some Betel leaf cultivators urged that government support like easy loan and technical assistances can promote cultivation of the cash crop. Betel leaf farming can earn foreign currency and one change his fate by cultivating it even on 15 decimals of land.

Rice: Rice is a primary crop and a staple food of this Upazila. The rice production has significantly increased with the adoption of modern rice varieties and introduction of latest appropriate technological innovation and technology as follows:

=> Replacement of local varieties by modern HYV/Hybrid varieties in Boro, T. Aus and T. Aman season where possible;

=> Increase modern HYV and Hybrid variety Boro area;

=> Increase rain fed T. Aus area;

=> Use of quality seeds

=> Increase irrigation facilities for rice production.

Jute: It is a primary and one of the main cash crops of this Upazila. Jute is an eco-friendly fiber. Jute cultivation requires less labor and less input. Despite the relative decline in importance of jute in agriculture, potential still exists for the fiber to increase its contribution to the economy through productivity increases and diversification. Yield increase, availability of better quality seeds, and improved provision of extension and credit support to grower's for this crop. Jute leaf is a common and favorable vegetable item to the farmer. Market price and demand of jute more or less are increasing every year.

Maize Cultivation: Maize is third important cereal after rice and wheat. It is a versatile crop and is more nutritious and requires less irrigation. Low risk in maize production is another privilege taken by farmers. Marginal and poor farm families are showing interest in maize cultivating. This is possible due to the adaption of modern maize varieties since production has been expanding fast. Its price, demand, and supply are increasing in domestic market. Pop-corn as an alternative food has been getting priority. It has diversified usages in small business and poultry feed production. Farmers can earn more by maize cultivation. Lack of capital as well as

high price of inputs is a barrier to its higher production. Maize cultivation is becoming profitable than other cereals among farmers in Bagmara Upazila.

Potato: Potato, a tuber crop, is cooked and eaten as a vegetable. In the context of nutrient, potato is comparable with rice and wheat. It is widely cultivated in winter with huge potential in this area. The soil and climate conditions of Bagmara area are favorable for potato production. UAO reported that 13320ha land potato was cultivated under Bagmara Upazila in 2016.Sunny land with cool and moisture in soil is appropriate for potato cultivation. But unavailability of quality inputs (seeds, fertilizer and pesticide), lack of knowledge on proper cultivation techniques and finally low investment capacity of the farmers are some of the major challenges in potato farming.

Oilseed crops: Mustard, Groundnut, and Til are popularly cultivated in Bagmara Upazila. UAO reported that 6755 ha of lands used for Mustard crops cultivation under this Upazila in 2016. Mustard as an oilseed crops takes first place in respect of cultivated area in Bangladesh. Farmers of Bagmara Upazila generally cultivate mustard before Boro cultivation. Mustard oilcake is a nutritious food for cattle. This oilcake also used as organic fertilizer and the dry mustard plants can use as fuel.

Vegetables: Tomato, Sweet potato, Brinjal, Radish, Cauliflower, Cabbage, Bean, Chili, Lalshakh, Loncho, Kolmi, Peas, Kochu, Bitter gourd, Pumpkins, Gourd, Rai- Shakh, Ladies finger, Palong, Spinach, Cucumber etc. Potato is a tuber crop which cooked and eaten as a vegetable. Encouraging homestead level vegetables cultivation could be alternative source of household income generation. It is widely cultivated in winter with huge potential in Bagmara Upazila. The soil and climate conditions of this Upazila area are favorable for multiple vegetables production. But unavailability of quality inputs (seeds, fertilizer and pesticide), lack of knowledge on proper cultivation techniques and finally low investment capacity of the farmers are some of the major challenges in vegetables farming.

Spices: Bagmara Upazila is one of the potential for spices crop production under Rajshah district. The important spices are Chili, Turmeric, Ginger, Onion & Garlic etc. The soil and climate conditions of this Bagmara Upazila are favorable for Chili and Onion production. There is wide

opportunity to grow onion & garlic as commercial basis to meet up internal demand and also to export.

Fruits: At present 875 ha of lands consists of permanent fruit garden under this Upazila. Different types of fruits are grown, such as Mango, Jackfruit, Litchi, Banana, Coconut, Betel Nut, Country Goose Berry, Guava, Plum, Kul, & Papaya etc. Many farmers have established commercial gardening of Mango, Litchi, Papaya and Guava etc.

Conversion of Agriculture Land to Non-Agriculture

Agricultural land denotes the land suitable for crop production. It is one of the main resources in agriculture. Many high value crops are grown in Bagmara Upazila. There is wide opportunity to grow Jute, onion, garlic, pulses, turmeric, betel leaf and vegetables as commercial basis to export. “Non-agricultural land” means such land which is used for different purposes and is not connected with agriculture. Such kind of land can be called non-agricultural land, if any developmental activity is carried over on the land and makes land unfit for crop production. In Bagmara Upazila a substantial amount of agricultural land had been shifted to a non-agricultural one viz construction of houses, brickfield, sawmill, industry, road, market and other infrastructures. Absence of proper sustainable long-term planning converts the arable land to other uses rapidly. The major components of transforming agricultural land to non-agricultural purposes are as follows:

=>Non –agricultural development activities on agricultural land.

=>New or existing infrastructure and urban expansion.

=>Construction of brick fields and new settlements in agricultural land.

=>Acquisition of agricultural land for non-agricultural purposes.

Plate 1: Farmer Betel Leaf Field

Plate 2: Betel leaf prcessing for marketing

Plate 3: Farmer Brinjal Field

Plate 4: Mustard Crop Field

Plate 5: Spraying pesticide in cauliflower Field

Plate 6: Farmer Chili Field

Plate 7: Farmer Sowing Potato

Plate 8: Harvested T. Aman Rice Field

Plate 9: Banana & Fish Cultivation

Plate 10: Farmer vegetable Field

Plate11: Maize Crop Field

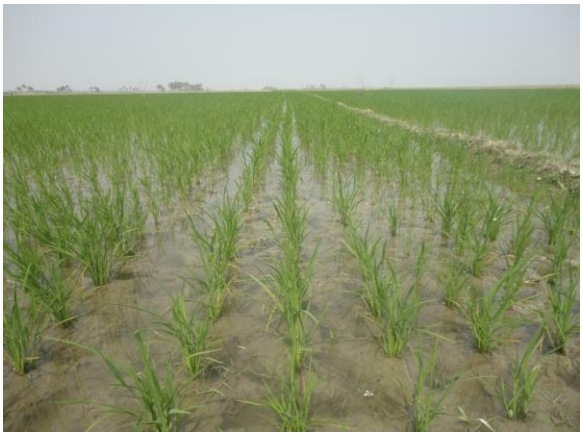


Plate 12: Boro Rice Crop Field

Plate 13: Distribution of Fruit Tree Plant

Plate 14 : Demo of Quality Rice Seed Production

Plate 15: Discussion with DD for Agri-data

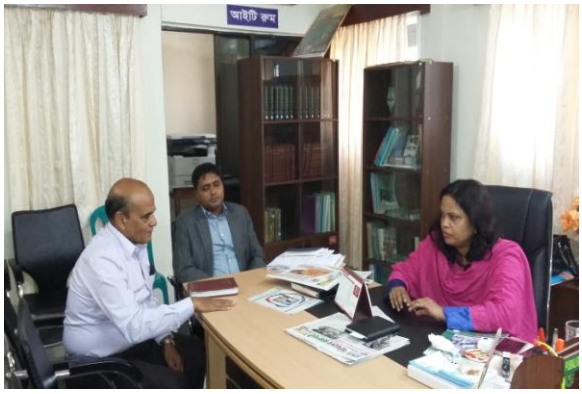


Plate 16: Discussion with UNO about Project

Plate 17: Discussion with Upazila Statistical Officer

Plate 18: Meeting with all SSAOs

Plate 19: Agri-Consultant briefing to SAAOs

Plate 20: UAO Given Instruction to SAAOs

Plate 21: Discussion with Fisheries Officer

Plate 22: Fill-up the Data Form by SAAOs

CHAPTER FIVE: PRODUCTION COST OF RICE AND VEGETABLES

5.1 Cost of Rice production

Bangladesh has achieved the self-sufficient in rice production in 2012. In terms of individual crops, rice continuous to dominate the agriculture sector-occupying more than three fourths of cropped area. The production cost 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 and 2015-2016 were conducted survey all over the country in three rice seasons (Boro, Aus and Aman paddy). BRRI study findings show that Boro and Aus farmers per kg rice production cost is Tk 18.65 and Tk.18.64 and Aman rice production cost is Tk17.61 which is less than Boro and Aus. During 2015-16, BRRI study shows that farmer's average per kg cost of Boro Tk.20.07 followed by Aus Tk.18.37 and Aman Tk.17.83 in the year 2015-16 (Table 5.1).Cost of per kg Boro rice production is increased Tk.1.42.

Department of Agriculture Marketing was estimated production cost for Boro rice Tk.18.08 per kg, Aman Rice Tk.18.20 per kg and Wheat Tk.23.50 per kg in the year 2015-16 and also production cost was calculated for Boro Tk. 22.06, Aman riceTk.19.0 and Wheat Tk. 28.50 per kg in the year 2016-17. Table 5.1 shows that farmers production cost of Boro, Aman and wheat is increased in 2016-17 in compared the rice production cost of 2015-16. Generally, Government has declared the buying rate of Boro, Aman and Wheat from farmers every year. On this basis Government has declared buying rate of Boro rice Tk.20.70, Aman rice Tk18.50 per kg and Wheat 27.02 per kg respectively in 2016. Similarly, Government has declared buying per kg rate of Boro rice Tk.22.60 and wheat Tk.28.50 for 2017.Bagmara 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. Fertilizers and pesticides are needed more in Boro rice production in compared to Aman rice. Farmers wanted and also need to ensure the profitable farm gate price for rice.

Table 5. 1: Cost of Rice Production (2014-16 & 2015-17)

Name of Crops	Average per kg crop production cost (Tk.) in 2014-15 (BRRI)	Average per kg crop production cost (Tk.) in 2015-16 (BRRI)	Average per kg crop production cost (Tk.) in 2015-16 (DAM)	Average per kg crop production cost (Tk.) in 2016-17 (DAM)
Boro	18.65	20.07	1808	22.60
Aus	18.64	18.37	-	-
Aman	17.61	17.83	18.20	19.00
Wheat	-	-	23.50	28.50

Source: Agriculture Economic Division, BRRI 2016, and Department of Agriculture Marketing DAM) 2016 &2017

5.2 Cost of Vegetable Production

Production of vegetables is a key factor in ensuring a continuous supply of raw materials for the development of agribusiness in horticulture. It is often argued that vegetable production in Bangladesh has comparative advantages, but despite these opportunities, agribusiness in horticulture is not flourishing commercially, especially for vegetables. The production cost 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. Farmers of Bagmara Upazila reported that major cultivation occurred in land preparation (Power tiller/tractor cost), irrigation, pesticides, fertilizers and labor. Farmers reported that per ha land cultivation cost is Tk. 7000-8000/- *(Upazila Agriculture Officer, Bagmara).* Generally, supplementary irrigation provided potatoes, Chili and others winter vegetables. Supplementary irrigation cost is 3000-5000 taka or more depends on crops and number of application. The highest supplementary irrigation provided in winter 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.5000-6000/-) and Winter & Summer vegetables fields (Taka 4000-4500/ha). Labor cost day by day increased and per day labor cost more or less Tk. 350-500 depends on crop season.

The present study was assessed financial profitability of Brinjal, Tomato, Potato and Cabbage/Cauliflower vegetables production under Bagmara Upazila which is shown in Table 5.2. Finding shows that Tomato cultivation is more profitable Tk. 1042500/-per ha followed by Brinjal Tk. 645890/- per ha, Cabbage/Cauliflower Tk. 622800 /- per ha and potato Tk 214350/- per ha respectively. Study finding clearly indicated that all four types of vegetables cultivation are profitable for farmers of Bagmara Upazila. It is important to develop business based on growing vegetables to encourage the farmers, since horticultural crops have comparative advantages in Bangladesh. Cost-benefit analysis of these crops also suggests that production of vegetables is economically viable for the country. Despite the prevailing opportunity for these crops, the country has not been able to create any successful businesses in this sector.

Table 5.2: Financial Profitability of 4 types of Vegetables Production in Bagmara Upazila

Vegetables	Yield (Kg/ha)	Price (Tk/Kg)	Gross Return (Tk/ha)	Total Cost (Tk./ha)	Net Return (Tk/ha)
Brinjal	33000	25.33	835890	190000	645890
Tomato	41000	28.5	1168500	126000	1042500
Potato	25500	15.7	400350	186000	214350
Cabbage/Cauliflower	46000	16.8	772800	150000	622800

Source: SAAOs and UAO, Bagmara Upazila 2016

Monsura Zaman, Rokhsan-Ara-Hemel and Tahmina Ferdous (2010) assessed 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.5.1). Cost of per kg and per 40kg was found approximately the highest for tomato and the lowest for cabbage and cauliflower.

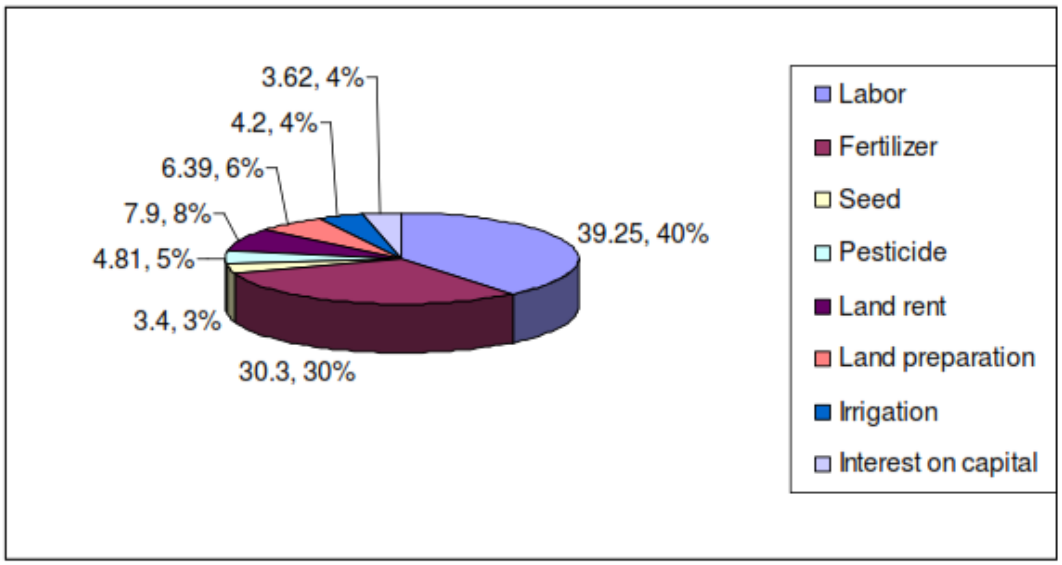


Figure 5. 1: Percentage of Major Types of Production Costs for Vegetables. (Source: ASA University Review, Vol. 4 No. 1, January–June, 2010)

Brinjal is one of the most popular and important vegetable in Bagmara Upazila. Farmers are cultivated this vegetables throughout year. 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 5.3). 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 of brinjal vegetable are 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 5. 3: 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	Sources
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	Miahet 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

CHAPTER SIX: GROWTH OR DECLINE OF AGRICULTURAL LAND DURING LAST TEN YEARS

Land is an important natural resource that provides habitat and subsistence for human being and other living organism. It is the fundamental resource base for agriculture, fisheries, industries and other economic activities. However, agricultural land of the country is decreasing at an alarming rate. Indiscriminate settlement or industrialization on agricultural land will aggravate land conversion if not used this resource optimally or sustainable planned. Decreased area of agricultural land will reduce farm production, leading to national food shortage for an increasing population. Genesis of the study generated upon a holistic realization of rapid conversion of agriculture land.

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 (2005 to 2015) from Upazila Agriculture Office and discussion with 16 Unions and 02 Paurashavs all Sub- Assistant Agriculture Officers of Bagmara Upazila and review the other documents. The growth or decline of agricultural land use during last ten years under Bagmara Upazila is shown in Table 6.1 and Figure 6.1. Table 6.1 finding shows above 93% local variety rice was 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 and Hybrid rice. The HYV/Hybrid paddy cultivation area 58% was increased. The reason for increased HYV rice cultivated area due to higher yield many farmers were cultivated HYV and Hybrid rice. Remarkable significant changed or increased during 10 years was occurred in Maize cultivated area (99%) but only 9% wheat area was increased in this Upazila. The main reason for increased maize area due to farmer's switchover cultivated less risk and high market demand and as profitable crops. Similarly, about 17% winter vegetables and 9% summer vegetables area was increased. Among the high value crops the highest changed or increased during ten years was occurred in Betel leaf (42%) followed by oilseeds (18%), fruit gardening(15%), tuber crops (8%), pulses and spices(6%). Sugarcane cultivation area significantly 50% is decreased.

Table 6.1 shows, among the other purposes remarkable significant changed were occurred in Brick field (97%) and followed by poultry farm (64%), Housing (28%) and fish cultivation (9%) respectively. The main reasons for increases land used in other purposes because of local market demand and also highly profitable. This finding clearly indicated crop land day by day has gradually decreased which will be reflected on agriculture crop production and Upazila ecosystem. To ensure food security of growing number of population, the production of rice and fish should be enhanced. Therefore, agriculture land and wetland should need to be maintained without any disturbance to attain Government vision of self-sufficiency in food production. Rational uses of agriculture land resources will help the country to attain its short term development Vision 2012 and also facilitate the process of long term development strategy to uplift Bangladesh to the row of developed countries of the world by 2050. To gain optimum benefits from land resource, need to be formulated and implemented Upazila sustainable urban and rural development planned.

Table 6. 1: Growth or Decline Agriculture Land Use during the Last 10 Years

Sl. No.	Agricultural land use	Land Use (2005) in ha	Land Use (2015) in ha	% Change
1	Paddy (local varieties)	150	10	-93.33
2	Paddy(HYV)	16320	25720	57.60
3	Wheat	1460	1590	8.90
4	Maize	2120	4220	99.06
5	Vegetables (Summer)	1510	1705	12.91
6	Vegetables (Winter)	2400	2805	16.88
7	Tuber crops	12320	13345	8.32
8	Pulse crops	160	170	6.25
9	Oilseed crops	570	675	18.42
10	Spice crops	4820	5088	5.56
11	Sugarcane	40	20	-50.00
12	Betel leaf	640	906	41.56
12	Jute	605	670	10.74
14	Fruits Garden	14320	16530	15.43
15	Fish cultivation	2708.77	3225.30	19.07
15	-Brick field	50.6	99.5	96.64
16	-Poultry farm	11	18	63.64
17	Rural & Urban settlement	7400	9495	28.31

Source: SAAOs, UAO, ULO, UFO and Upazila Statistic Office of Bagmara Upazila 2016.

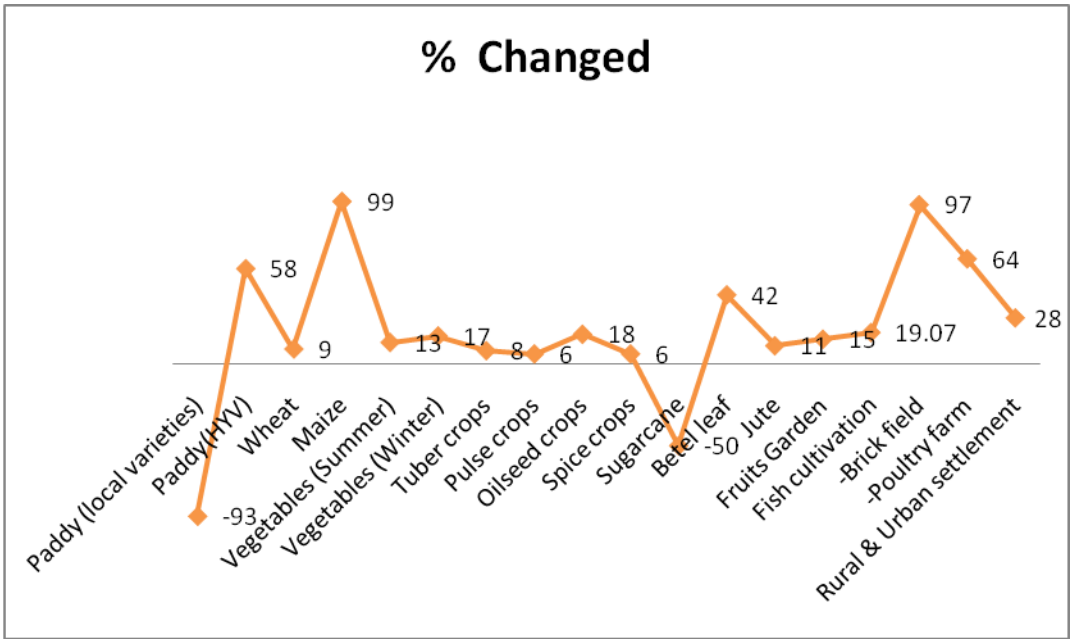


Figure 6.1: Growth or decline Agriculture Land in Bagmara Upazila during Last 10 Years (2005-2015)

CHAPTER SEVEN: MAJOR PROBLEMS OF CROP PRODUCTION IN BAGMARA UPAZILA (16 UNIONS & 02 PAURASHAVAS)

Agriculture survey and Participatory Rural Appraisal December 2016 study report findings show farmers some problems are common in different 16 unions & o2 Paurashavas under Bagmara Upazila such as water logging, drought, power failure, climate change & change in rainfall pattern and infrastructure etc. Major problems are:

- ⇨ Water logging and sudden flood causes damages crops,
- ⇨ Drought and cold wave create negative impact on diversification of crops,
- ⇨ Siltation of Baor wet lands, rivers and canals,
- ⇨ Most of the canals/khals of the Unions & Paurashavas were found mostly closed or silted,
- ⇨ Changes in rainfall pattern and climate change,
- ⇨ Lack of knowledge both men and women farmers on crop production technology and farmers financial problems for adaption of modern technology,
- ⇨ River erosion, sand deposition on agricultural land,
- ⇨ Most of old canals found closed due to siltation and unplanned infrastructure,
- ⇨ Scarcity of surface water for irrigation, higher cost Shallow Tube Wells(STWs) and Deep Tube Wells(DTWs),
- ⇨ Less supply o f quality HYV/Hybrid and stress tolerant variety crop seeds and cultivation equipments (power tiller, thresher, foot pump etc),
- ⇨ Inadequate drainage facilities and kutcha irrigation drainage system,
- ⇨ Inadequate electricity supply hampers irrigation for Boro and other irrigated crops,
- ⇨ Water pollution due to improper uses of pesticides and chemical fertilizer and also industrial waste pollution,
- ⇨ Agriculture marketing system and infrastructure are not developed,
- ⇨ Shortage of cold storage, seed store and wholesale vegetables market infrastructure,
- ⇨ Sand filling on fertile agricultural land and unplanned expansion of housing and infrastructure,

- ⇨ Lack of integration, cooperation among the line agencies and also inadequate urban facilities,
- ⇨ Using less amount of bio-fertilizers and green manure or compost,
- ⇨ Cultivable agriculture lands are reducing every year due to unplanned construction of houses ,roads, and settlements, markets, industries, unplanned fish and poultry production,
- ⇨ Over-drainage, abrupt reduction of wet land restricts open water fisheries and its breeding place,
- ⇨ Lack of policy implementation to preserve the perennial wetland areas,
- ⇨ Acquisition of agricultural land for non- agriculture purposes.
- ⇨ Top soil cutting and filling sand, unplanned expansion of urban and commercial areas,
- ⇨ Kutcha road and damaged and poor transportation facilities in most of the Unions ,
- ⇨ Change in rivers and canals morphology,
- ⇨ Lack of potato , vegetable, betel leaf processing, grading and packaging facility,
- ⇨ There is no agro processing center and industries under Unions and Upazila level,
- ⇨ City migration,
- ⇨ Arable agricultural lands are reducing due to lack of urban and rural development plan.

CHAPTER EIGHT: POLICY FRAMEWORK AND CONCLUSION

8.1 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 sustainable local need based planning and adoption of appropriate crop production measure in future to different Unions and Paurashava beneficiaries under Bagmara Upazila.

1. Developing Infrastructural Facilities: Drainage congestion or water logging can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Unions & Paurashava. Construction of embankment /dam is needed for flood control, protect river erosion and irrigation. Road network at local level, agro-processing and whole sale market infrastructure need to be developed. Re-excavation of canals and irrigation facilities need to be improved for mitigating impacts of crop production related vulnerabilities and climate change. Reconstruction of damaged water management infrastructures need to be made. In each Union, one wholesale market infrastructure needs to be constructed. Further in each Union, one seed store infrastructure need to be constructed and also multiple facilities cold storage and food store need to be established. Need to be improving Jute-retting facilities. There is a need for establishment of betel leaf processing and packaging infrastructure.
2. To Reduce the Irrigation water Wastage, proper utilization and increase the irrigated command crop area the DTW, STW and, LLP kutcha drain need to be converted into pucca drainage system or introduce underground pipe irrigation system. Uninterrupted power supply to irrigation pumps (STW & LLP). Need to be monitoring ground water table after each Boro season.
3. Farming and Adaptation Practices: Adapt modern farming techniques and Choose high yields and drought, cold & water logging tolerant and pest & disease resistant crops varieties. Rice and fish integrated farming. There is need for conducting, strengthening and

expanding crop demonstrations and block farming based on adaptation practices. Observed weather condition and followed weather forecast. 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.

4. Vegetables Production: Different types of winter and summer vegetables are grown under 16 unions&02 Paurashava areas. All the Unions are excellent suitable for vegetables cultivation round the year. There is no cold storage and large vegetable selling center (market) under 16 Unions and 02 Paurashava. As results farmers could not get good price for their produced products. There is a need for establishment of multipurpose cold storage each Union & Paurashava and development & improvement of market infrastructure.
5. Crop Production Inputs Availability: Ensure availability of quality HYV and Hybrid crop seeds, fertilizer, pesticides, cultivation and irrigation equipments in subsidized price. Information on quality seed need to be provided up to block level.
6. Availability of Crop Seeds: Drought, water logging, early variety and submergence tolerant variety of different quality HYV/Hybrid crop seeds. BRRI, BARI, BSRI and BINA have recommended drought tolerant rice, wheat, maize, potato, pulses and oilseeds. These are BRRI Dhan-71,-72, 55, -57,-66,-67 and BINA Dhan -8, BARI Wheat-25, BARI-28,29,30 Muatard-11,14,17 BARI poato-21,22, 50, widely introduce and encouraged to cultivated farmers.
7. Fertilizer Management and Soil Health: 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 different Government project. Soil testing laboratory need to be established in Upazila. Grow one leguminous crop (Dhaincha / Pulses/Fodder etc.) between two cereal crops. Incorporating organic manure in the soil by changing cropping patterns /crop rotation system need to be

practiced. DAE need to be start preparation and sale vermi-compost by farmers under this Upazila which is improves the soil health and increase the crop yield. Implementation of vermi-compost program needs to be helping financial assistance as well as technological training for farmers.

8. Pest 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 control this pests farmers were applied pesticides under or over dose. Judicious use of pesticides needs to be developing 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 different Government project.
9. Agro-based Industries: Establishment of Agro-based processing center & industries in 16 unions and 02 Paurashava. There is a need for construction of infrastructure for some agro-base processing center such as spices, betel leaf & tuber crops. Construction of potato and vegetables & fruits processing, grading and packaging industry/facility need to be developed under each Union. There is a need to integrated effort for industrial effluents and waste management.
10. Zoning of land: As per its present used and potentialities and the proper implementation of “Preparation of Development Plan for Fourteen Upazilas” Package 03 (Faridpur Sadar Upazila, Bagmara Upazila, and Gangni Upazila) which will help to control unplanned human intervention as well as to ensure proper uses of agricultural land. Ensuring planned and economic use of agricultural productive land and need to minimizing agricultural land degradation and also introducing regulatory measure like adopting land zoning law, Village improvement act and urban rural development plan are necessary to protect the agricultural land which will be ensuring ”food security” for all.
11. The following additional systems may be adapted in an innovated way for sustainable crop production and environmental conditions of Bagmara Upazila:
    - Biodynamic/eco-friendly agriculture.

- Rice and non-rice crops integrated farming
- Rice and fish integrated farming
- Grow vegetables predominantly
- Fruit tree based Agro-forestry system
- Integrated pest management
- Natural disasters adaptive, rain fed and resilience farming
- Perennial wetland need to be preserved for open water fisheries and ecological balance must be maintained.
- Some perennial wetlands need to be declared as a fish Sanctuary for survival of indigenous fish species.

Minimize conversion of agricultural land to non-agricultural use and increase awareness among the people and land users for conservation of land. Ensuring planned and economic use of agriculture land, minimize agricultural land degradation and introducing regulatory measure like adopting land zoning law are necessary to protect the agriculture land.

8.2 Conclusion

Multiplicity of cropping systems has been one of the main features of the Bagmara Upazila. Soil and weather conditions are highly suitable for different vegetables and other high value crops cultivation round the year in Bagmara Upazila. There is a need to develop vegetables wholesale market and improvement of communication system different Unions to Upazila. Farmers need modern crop and fish production technological training which will be helpful for crop diversification and proper utilization land and increase crop & fish production. For improvement of irrigation facilities kutcha drain are to be made lined channel which will reduced irrigation water wastage and increase crop production. Integrated pest management need to implement for Banana, Papaya, and orchard and vegetables cultivation and reduce the pesticide use. Electricity power supply should be ensured during Boro crop season. Construction of potato and vegetables spices & fruits processing, grading and packaging industry/facility need to be developed under each Union. Increase agriculture production through optimum use of land. Many high value crop vegetables are grown in this Upazila. There

is wide opportunity to high value different crops such as Maize, Jute, oilseeds, fruits, vegetables, spices and betel leaf as commercial basis to export.

However, alike other parts of the country, the area of agricultural land of Bagmara Upazila is declining gradually because of growing pressure of population and also unplanned industrial & market development. To ensure food supply to an increased population of the country these lands should be protected from being converted to other land uses. Protection of present triple and double cropped land is the top priority issue. Agricultural land identified in the present study should be protected by taking relevant administrative measures. Integration of people's participation and effective monitoring, evaluation, logistics through institutional frame work are essential for successful implementation of **"Preparation of Development Plan for Fourteen Upazilas**" Package 03 (Faridpur Sadar Upazila, Bagmara Upazila, and Gangni Upazila) as a versatile tool to conserve and right uses of agricultural land.

References

1. Anonymous (2017). Krishi Diary 2017: Agriculture Information Services, DAE, Khamar Bari, Dhaka.

2. Anonymous (2016). Report on Participatory Rural Appraisal (PRA) "Preparation of Development Plan for Fourteen Upazilas, Package 03, Faridpur Sadar Upazila & Bagmara and Gangni Upazila", December, 2016.

3. Anonymous (2016). Bagmara Upazila Crop Production Plan 2015-16: Upazila Agriculture Office, Bagmara Upazila, Rajshahi District.

4. Anonymous (1998). Soil Resource Development Institute 1998, Land and Soil Use Guide, Bagmara Upazila, Rajshahi District.

5. Anonymous (2015): National Land Zoning Report August 2015 of Bagmara Upazila under Rajshahi District, National Land Zoning Project (2nd Phase), Ministry of land.

6. Anonymous (2016): Report on production cost of Boro & Aman Rice and Wheat (2015-16), Department of Agriculture Marketing, Khamarbari, Dhaka.

7. Anonymous (2017): Report on production cost of Boro & Aman Rice and Wheat (2016- 17), Department of Agriculture Marketing, Khamarbari, Dhaka.

8. ASA University Review, Vol. 4 No. 1, January–June, 2010).

9. Asian Vegetable Research and Development Center (AVRDC), 2001.AVRDC–USAID Bangladesh Project: Introduction and development of adoptive technologies for sustainable year–around Vegetable production and consumption in Bangladesh. AVRDC–USAID Bangladesh Project completion report. AVRDC, Tainan, Taiwan.

10. BARC (1997): Bangladesh Agriculture Research Council, Fertilizer Recommendation Guide-1997, Farm-gate, New Airport Road, Dhaka-1215.

11. BBS (2011). District Statistics 2011 Faridpur, Statistics and Information Division, Ministry of planning, Dhaka.

12. BRRI (2016). Agriculture Economic Division, Bangladesh Rice Research Institute, Gazipur.

13. BRRI (2017). Agriculture Economic Division, Bangladesh Rice Research Institute, Gazipur.

14. EPC.1997. FAO. Horticulture baseline production and marketing survey, Vol.III. Annexure (part 1), Engineering and Planning Consultants Ltd., 43 Dilkusha C/A, Dhaka-1000.

15. GED (2010). Perspective Plan of Bangladesh 2010-2021. General Economic Division, Planning Commission, Government of Bangladesh.

16. GED (2015). Seventh Five Year Plan (2016-20) of Bangladesh. General Economics Division, Planning Commission, Government of Bangladesh, Dhaka July 2015.

17. Hasan, M. R., Bai2, H and Islam, M. A. 2014. Profitability of important summer vegetables in Keranigonj upazilla of Bangladesh, J. Bangladesh Agril. Univ. 12(1):111– 118, 2014 ISSN 1810-3030.

18. Miah, M A M., Rahman, A.K.M,M.,Haque, A KMH and Jabbar, M.A. 1998. Economics of some winter vegetables production andtheir farm level marketing in five villages of Comilla district. Bangladesh J. Agril. Res. 23(2):361-376.

19. MoA, 2013:.National Agricultural Policy, Ministry of Agriculture, Government of the People's Republic of Bangladesh.

20. MoWR, 1999: National Water Policy, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

21. MoWR, 2005: Coastal Zone Policy, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

22. Monsura Zaman, Rokhsan-Ara-Hemel and Tahmina Ferdous (2010) – Comparative Profitability of Winter Vegetable in a Selected Area of Dhaka District, ASA University Review, Vol. 4, No. 1, January-June, 2010).

23. Rashid, M.A., Rouf, F.M.A. and Alam, S.N. 2002. Economics of brinjal cultivation at Jessore region in Bangladesh. Economic Affairs, 47 (Qr.4): 215-221.

Annex- 1

Questionnaire for KII

Name---------- Designation---------- Department----------

Upazila----------District----------Mobile No.----------

Date----------

1. Category wise distribution of farm families

Sl No.	Category	No of farm family	%
1.	Land less (.05-.50 acre)		
2.	Marginal (.51-1.50 acre)		
3.	Small (1.51 -2.50 acre)		
4.	Medium (2.51-7.50 acre)		
5.	Larger (above 7.50 acre)		
	Total		

2. Present Land Use under Union

Sl No.	Type of Land use	Present land used	
		Area (ha)	%
1.	Cultivated Area		
	Single Cropped area		
	Double Cropped area		

Sl No.	Type of Land use	Present land used	
		Area (ha)	%
	Triple Cropped area		
2.	Net cropped area		
3.	Cropping intensity		

3. Relationship of Land Type and Flood Depth with Area Cultivated

Sl No.	Land type and Flood Depth. (cm)	Present	
		NCA (ha)	%
1.	High land (0-30 cm) F0		
2.	Medium high land (30-90 cm) F1		
3.	Medium low land (90-180 cm) F2		
4.	Low land (180-360 cm) F3		
5.	Very low land above (360 cm) F4		
	Total		

Source: CEIP field data and Upazila Agriculture Office, DAE

4. Major crops/cropping patterns (both improper/exhaustive and sustainable)

Season	Farming Practices
Rabi (Mid October-Mid March)	
Kharif-I (Mid March-Mid July)	
Kharif-II (Mid July-Mid October)	

Season	Farming Practices
Irrigated Farming Rabi (Mid-OctoberMid March)	
Kharif-I (Mid March-Mid July)	
Kharif-II (Mid July-Mid October)	
Name major cropping patterns	1. 2. 3. 4.

5. Crop cultivated and variety in polder area

Crop area	Name of crop	Name of variety
Cultivated crops under single crop area=		
Cultivated crops under double crop area=		
Cultivated crops under triple crop area=		
Cultivated crops under irrigated crop area=		
Cultivated crops under non crop area=		
Cultivated crops under homestead garden area=		
Orchard area=		
Seasonal Fallow land =		
How many commercial fruit garden within polder area? Yes ---------- No----------	Name of fruits garden Banana: Papaya: Coconuts: Mango: Others:	Number:

In future which crops will be profitable in your polder area:	

6. Present Crop Production and Area under polder/Upazila

Crop Area(ha)	Yield/ha	Total Production(MT)	Crop Area(ha)	Yield/ha	Total Production (MT)
Aus rice= LV = HYV =			Oilseeds=		
Aman rice= LV = HYV = Hybrid =			Mustard=		
Boro Rice= LV = HYV = Hybrid =			Sesame=		
Total Rice=			Sunflower=		
Wheat =			Groundnut=		
Maize =			Others=		
Pulses =			Winter vegetables=		
Khesari =			Summer vegetables=		
Mung bean =			Total vegetables=		
Soybean =			Fruits Watermelon=		
Cowpea =			Species=		
Chickpea=			Chili=		

Crop Area(ha)	Yield/ha	Total Production(MT)	Crop Area(ha)	Yield/ha	Total Production (MT)
Others=			Onion=		
Tuber crops=			Garlic=		
Potato=			Jute=		
Sweet potato=			Sugarcane=		
Bamboo =			Betel nut=		
Betel vine(Pan)=					

7. (a) Short term needs for better crop production under polder

1.----------2----------
3.----------4----------
5----------6----------

(b) Long term needs for better crop production under polder

1.----------2----------
3.----------4----------
5.----------6----------