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-04

(Saghata Upazila, District: Gaibandha; Sariakandi Upazila and Sonatala Upazila, District: Bogra)

FINAL SURVEY REPORT

AGRICULTURE SURVEY

of

Sariakandi Upazila, Bogra

June, 2017

Modern Engineers Planners & Consultants Ltd.

LETTER OF TRANSMITTAL

Ref No.: MEPC/UDD/2017/51 Date: 04.06.2017

To

The Project Director

"Preparation of Development Plan for Fourteen Upazilas" Project

Urban Development Directorate (UDD)

82 Segun Bagicha, Dhaka-1000.

Subject: Submission of the Final Agriculture Survey Report of Sariakandi Upazila, Bogra.

Dear Sir,

I have the pleasure to submit herewith the Final Agriculture Survey Report of Sariakandi Upazila, Bogra District under "**Preparation of Development Plan for Fourteen Upazilas Project**" Package No: 04 (Saghata Upazila, District- Gaibandha; Sonatala Upazila and Sariakandi Upazila, District- Bogra) for your kind information and further action.

Thanking you and assuring you of our best services.

Best Regards

…… ……

(Engr. A. Sobahan) **(Shamim Mahabubul Haque)**
Managing Director of MEPC Team Leader, Package-4

Executive Summary

The land of Sariakandi Upazila is intensively used for agriculture, housing and settlements, forest, fisheries and other infra-structural development. Sariakandi Upazila is a flood prone area located at Bogra district under Rajshahi Division. Shifting of agricultural land to non-agricultural purposes is a common phenomenon in this Upazila. 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. 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 04 is expected to contribute to achieving the objectives of the National Agriculture Policy**.**

The fertile land, topography and irrigation facilities of Sariakandi Upazila are potential & suitable for multiple crops cultivation round the year. This Upazila covers 24500 ha of net cropped area of which about 56640 ha is cultivated area. Among them, the highest land area of 15610 ha is used as double crop, 7165 ha land is followed by triple crop and remaining 1325 ha land is used as single crops and also 400ha land used for more than three crops. The average cropping intensity under Sariakandi Upazila is 228% which is less than Bogra district (260%) and higher than national average cropping intensity (190%).

Cropping patterns has given idea about agricultural product of any area farmers, which crops are cultivated in their land. Study finding shows that 14 different cropping pattern are practiced by Sariakandi Upazila farmers. Currently in Sariakandi Upazila, major cropping pattern area is Boro (HYV/Hybrid) → Fallow→T. Aman (HYV) which is practiced 31.84% of the Net Cultivable Area (NCA). Spices→ Fallow→ T. Aman is the cropping pattern, which is covering about 21.02% of the NCA. Chili→Jute→Fallow is covering about 18.37 % of the NCA. Further, Wheat/Maize→ Fallow→ T. Aman which is practiced about 4.90% of the Net Cultivable Area (NCA). Similarly Onion (HYV)→ Jute→ T. Aman which is practiced about 4.90 of the NCA. Potato/S. Potato→ Boro (HYV/Hybrid) → T. Aman which is practiced 4.49% of the Net Cultivable Area (NCA). Winter vegetables cropping pattern covering about 2.24% of the NET Cultivable Area.

Diversification of crop cultivation area depends on land types & soil fertility, crop variety and irrigation facilities and inputs availability. At present total different cultivated cropped area is 46137 ha of which rice cropped area are 22470 ha and the rest 23667 ha is covered by non-rice crops. The rice and non-rice cropped area are about 49% and 51% respectively of the total

cropped area. It is a food producing self-sufficient Upazila. Food requirement for this Upazila population is 44509mt and food surplus is 29224mt per year. Total crop production is 236999.8 metric tons of which rice production is 72943 metric tons and non-rice production is 164056 metric tons. The rice and non-rice cropped production are about 31% and 69% respectively of the total cropped production.

Irrigation is one of key factor for producing cereals and many other crops. Boro rice is completely dependent on irrigation. It is reported that during Rabi season 60-100 % land area covered by irrigation water. Farmers of Sariakandi Upazila resort to supplementary irrigation to rain fed crops when needed or during drought period. Upazila Agriculture Officer reported that misused of irrigation water due to individual level excessive setup of irrigation pump. A total of 7266 machine were used for lifting irrigation water under Sariakandi Upazila. Out of total irrigation machine, 38 DTW, 7182 STW and 46 LLP along with other indigenous irrigation tools are used for lifting water. All DTW and 488 STW and 5 LLP has electricity facilities but 6694 STW & 41 LLP has no electricity. Electricity user's farmers reported that failed or disruption of electricity supply during Boro season was their acute problem. Famers wanted nonstop electricity supply during Boro season. Others farmers wanted new electricity connection. Majority of the farmers reported irrigation drainage system DTW is katcha (90-100%) but 100% STW & LLP drain is katcha which is main cause of wastage of irrigation water. Farmers wanted pucca drainage system which will be help for increasing irrigated crops area.

Financial profitability of Brinjal, Tomato, Potato and Cabbage/Cauliflower vegetables production were assessed under Sariakandi Upazila. Tomato cultivation is more profitable (Tk. 756000 per ha) followed by Brinjal (Tk. 442800 per ha), Cabbage/Cauliflower (Tk. 288600) and potato production (Tk. 211050 per ha) respectively. Paddy production cost of Boro and Aus are Tk.18.65 and Tk.18.64 per kg, and Aman rice production cost is Tk.17.61 per kg which is less than Boro and Aus. Department of Agriculture Marketing was estimated production cost for Boro rice Tk.18.20per kg, Aman Rice Tk.18.08 per kg and Wheat Tk.23.50 per kg in the year 2015-16. 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.

Remarkable changes in land coverage of cultivated crops have been noticed over last 10 years in Sariakandi Upazila. Highest increased occurred in Pulses (343%) followed by Spices crops (287%), winter vegetables (270%), Maize (183%) and oilseeds (178%). But on the other hand, highest decreased in local variety rice (-86%) followed by summer vegetables (-69). Among the other purposes remarkable significant change occurred in poultry farm (150%) and followed by Brick field (43%), Housing (10%), Gardening (7%) and fish cultivation (2%) respectively.

The main problems in agricultural sector of Sariakandi Upazila identified are :Early and sudden flood, which damaged crops & causes waterlogging; Drought & irregular rainfall, River erosion, siltation of canals and river, katcha drainage system, indiscriminate use of water by setting up irrigation pump, less availability of different quality HYV crop seeds, lack of seed store and cold storage for vegetable, no whole sale market infrastructure, less availability of agriculture machineries and high price. There is no agro processing center and industries under Unions level.

Drainage congestion can be removed by excavating new canals and re-excavating the old canals through connecting to the nearby rivers and khals. Ensure availability of good quality crop seeds and cultivation machineries. Katcha drain need to turn into pucca drain or pipe system which will reduce the irrigation water loss or abuse and increasing the command area. The development of road communication at union level, agro-processing and marketing infrastructure is badly needed. Uninterrupted electricity supply is an important issue for ensuring timely irrigation in the area. In each Union, minimum one wholesale market infrastructure need to be constructed. In each Union, one seed store infrastructure and cold storage also needs to be established. Construction of vegetables & fruits processing, grading and packaging industry/facility need to be developed for every growth center. So that, farmers can manage appropriate price for their produced crops. The construction of embankment with sluice gates and drainage system is needed for flood control in the upazila boundary.

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List of Abbreviations/Acronyms

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
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
mt	Metric Ton
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
ULO	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

Sariakandi Upazila is a flood prone area located at Bogra district under Rajshahi Division. The Upazila is adjacent to four others Upazila namely Madarganj Upazila (Jamalpur district) at east, Gabtali Upazila (Bogra district) at west, Sonatola Upazila (Bogra district) at north and Dhunat Upazila (Bogra District) at south. The total area of Sariakandi Upazila is 408.5 square kilometer. It consists of 1 Municipality, 12 (twelve) Union Parishads and 122 Mouzas with the number of 216 villages. The major rivers of the area are Jamuna and Bangali. Jamuna River runs over the middle part of the Upazila adjoining to Kazla, Sariakandi, Karnibari, Chandan Baisha and Bohail Union from north to south. The AEZ of the district has been identified as a) Tista River Meander Floodplain AEZ-3, b) Karatoya---Bangali Floodplain (AEZ-4), and c) Active Brahmaputra-Jamuna Flood plain AEZ-7 (BARC 1997). The Upazila has 4048.82 acre khas land. The sandy land area, homogeneous topography, Char area, moderate moisture etc. are the common geographical characteristics of the study Upazila.

The land of Sariakandi Upazila is intensively used for agriculture, housing and settlements, forest, fisheries and other infra-structural development. These diversified uses of land giving financial benefits in one hand but on the other creating many problems in respect of criteria based uses and conflicts among the users. Wide range of Rabi and kharif crops grow here. Most of the people of this Upazila are directly or indirectly dependent on agriculture. It is reported that natural disasters like flood, drought, heavy rain, early rain, and hail-storm and land erosion frequently damage crops of this Upazila. However, shifting of agricultural land to non-agricultural purposes became a common phenomenon in this Upazila. Indiscriminate land conversion will impose threat to national food security. Furthermore, improper land uses affect habitats of flora and fauna and thus impact ecosystem and biodiversity. Protecting agriculture land and to meet rational needs of other sectors are our great national challenges. To protect agricultural land and minimize land degradation, introduction of modern technologies are the basic need. Ultimately, it will be a threat for coping-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 of Sariakandi Upazila to assess present situation of land uses, related problems and potentialities of land for different 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 is thought 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 to find out causes for growth or decline considering a possible quality of existing and future agricultural land in the project area. The study has also been commissioned to determine the present scenario in agriculture practices and assessment of potentials for 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. KII information was collected by using survey questionnaire (Annex-1). The secondary data were collected and reviewed on land use from DAE Union and Upazila Office documents. KII information was collected from 27 Sub-Assistant Agriculture Officers under 1 Municipality and 12 Unions through interview. Structured and semi-structured questionnaire was used for data collection (Annex-2). Data collection and consolidation occurred simultaneously. Data consolidation activities, such as editing, coding, classifying and data entry into the computer software for analysis were carried out simultaneously. Frequency tables (one, two or multiple ways) were prepared for interpretations and analyses using SPSS 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: 04 are expected to contribute to achieving the objectives of the agriculture policy.

2.2 Master Plan for Agricultural Development in Southern Region of Bangladesh, 2013

The Master Plan for Agriculture Development in the Southern Region of Bangladesh has been prepared by the Ministry of Agriculture in collaboration with the Ministry of Fisheries & Livestock and Ministry of Water Resources and with technical assistance from the Food and Agriculture Organization of the United Nations (FAO). The Plan covers three hydrological regions- south central, southwest and southeast of the coastal zone covering 14 districts. The objective of the Plan is to provide a road map for integrated agricultural development in the coastal districts of Bangladesh, aiming at sustainable food security, poverty reduction and livelihood development for the poor. The Plan particularly focuses on, among others increasing agricultural production and productivity; improving water management, infrastructure development for surface water irrigation; improving productivity of brackish water shrimp and

capture fisheries; and promoting smallholder poultry and dairy development. The Plan formulated a set of programmes and activities across all branches of agriculture and other related fields. The Plan is for 2013 to 2021.

The proposed Preparation of Development Plan for Fourteen Upazilas Package 04 is expected to contribute to achieving the objectives of the Master Plan for Agriculture Development in the Sariakandi Upazila under Northern Region of Bangladesh.

2.3 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: 04 have been designed in line with this Plan and address its key objectives for the water resource management in the Sariakandi Upazila areas.

2.4 The Ground Water Management Ordinance, 1985 (Ordinance No. XXVIT 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: 04 have been designed in line with this Plan and address its key objectives for the ground water management ordinance for Sariakandi Upazila.

2.5 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 Sariakandi Upazila area:

- Forests declared by the Ministry of Environment and Forests will remain as forest lands;
- Reclassification of forest lands will be prevented; and
- Effective green belts will be created all along the Upazila area.

Preparation of Development Plan for Fourteen Upazilas Package: 04 are designed in accordance with this Policy and will comply with the above listed requirements.

2.6 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: 04 are expected to contribute to achieving the objectives of the national water policy.

2.7 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: 04 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.

CHAPTER THREE: PRESENT LAND USE

3.1 Description of the Present Situation

Most of the people of this Upazila are directly and indirectly dependent on agriculture. The land of this upazila is intensively used for agricultural purposes. The land of Sariakandi Upazila is intensively used for agriculture, settlements, fisheries & housing, poultry and other infrastructural development. Sariakandi Upazila falls into 2 Agro-ecological zones of the Upazila are: a) Karatoya-Bangali Floodplain AEZ-4 and b) Active Brahmaputra-Jamuna Flood plain AEZ-7 (BARC1997). Wide range of crops grow here in rabi and kharif season like paddy, jute, wheat, maize, sugarcane, potato, spices, oilseeds, vegetables etc. Fruits grow well here are mango, jackfruit, coconut, banana, litchi, papaya, palm etc. Land resources of this upazila have been brought into mango orchard and poultry farms in commercial basis. It is reported that natural disasters like prolonged drought, decreasing ground water, heavy rain, early rain, erosion, cold, fog and hail-storm damage crops of this upazila. Shifting agricultural land to non-agricultural purposes and land degradation is common phenomena in this upazila. Protecting agricultural land, minimizing 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.

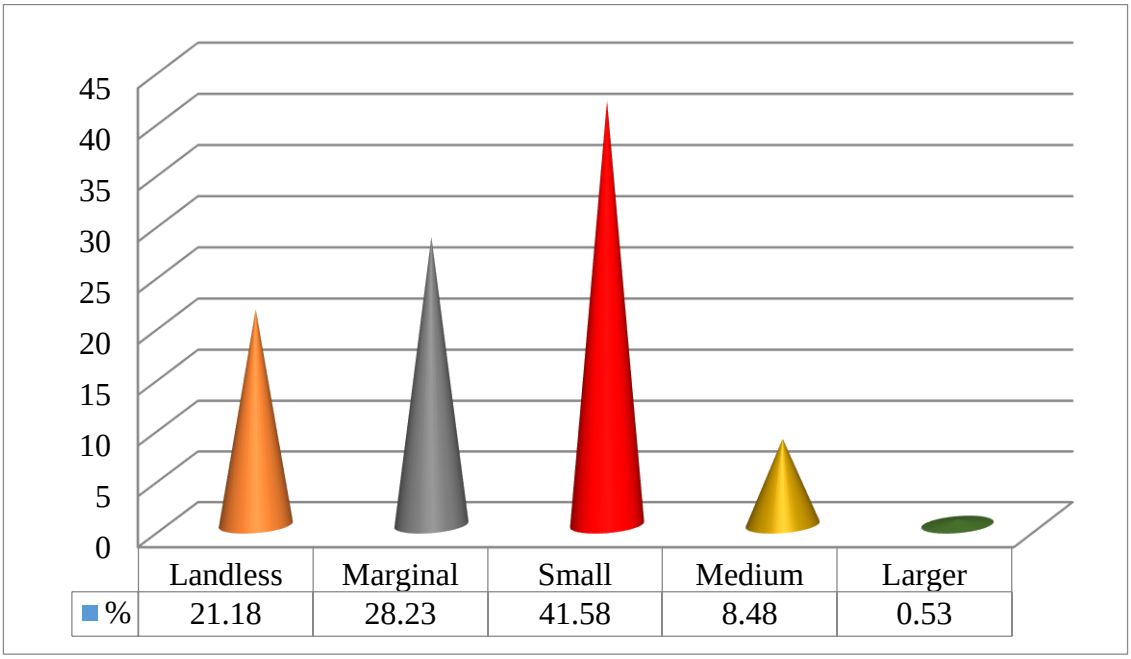
3.2 Sariakandi Upazila and Union Wise Farm Families

Farmers in Sariakandi Upazila lead their livelihood from agricultural activities. It is the major source of their employment and income. Sariakandi Upazila has 12 Unions and 1 municipality. It has 20 agricultural blocks under DAE. It has total 122 mauza and 207 villages. 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), small (1.51-2.50 acre land), medium (2.51-7.50 acre land) and larger (above 7.50 acre land). The present Union and category wise farm family under Sariakandi Upazila is shown in Table 3.1. On an average there are about 14036 land less, 18707 marginal, 27556 small, 5617 medium large and remaining 350 are larger farm families under Sariakandi Upazila. The major percentage of farm families are small farmers (42%) followed by marginal (28.00%), landless (21%), medium farmers (8%) and remaining are 1% larger farmers (Figure-3.1). It is evident that most of the farm families' fall in the small and marginal category. With the increased number of population the pressure on land is decreasing day by day. As a result, the number of small, marginal and landless farm families is gradually increasing creating pressure on livelihood in the Upazila.

Table 3.1: Union and Category Wise Farm Family under Sariakandi Upazila

Name of Union	Landless (%)	Marginal (%)	Small (%)	Medium (%)	Larger (%)	Total
	(.05-.50 acre)	(.51-1.50 acre)	(1.51-2.50acre)	(2.51-7.50 acre)	(above 7.50 acre)	
Bhelabari Union	567(15.51)	846(23.14)	2035 (55.68)	203(5.56)	4(0.14)	3655
Bohail Union	704(16.22)	1253(28.86)	1637(37.72)	693(15.96)	54(1.24)	4341
Chaluabari Union	420(13.64)	750(24.36)	1619(52.58)	280(9.09)	10(0.33)	3079
Chandan Baisha	1044(45.18)	513(22.20)	623(26.96)	117(5.06)	14(0.60)	2311
Fulbari Union	1908(20.01)	3131(32.83)	4208(44.12)	283 (2.97)	7(0.07)	9537
Hat Sherpur	850 (18.68)	1450(31.87)	1700(37.87)	550(12.09)	0(00)	4550
Kamalpur Union	435 (7.84)	1560(28.13)	3042(54.85)	495(8.93)	14(0.25)	5546
Karnibari Union	768(10.28)	1526(20.43)	3758(50.32)	1397(18.71)	19(0.26)	7468
Kazla Union	950(15.70)	1500(24.79)	2964(48.99)	436(7.21)	200(3.31)	6050
Kutubpur Union	1920(32.54)	1403(23.78)	1928(32.68)	644(10.91)	5(0.09)	5900
Narchi Union	410(9.01)	1065(23.41)	2652(58.29)	400(8.78)	23(0.51)	4550
Sariakandi Union	3203(44.85)	2735(38.29)	1100(15.40)	104(1.46)	0(00)	7142
Sariakandi Municipality	857(40.10)	975(45.63)	290(13.57)	15 (0.15)	0(00)	2137
Total	**14036(21.18)**	**18707(28.23)**	**27556(41.58)**	**5617(8.48)**	**350(0.53)**	**66266**

Source: SAAOs and UAO Sariakandi Upazila, DAE 2016



Source: SAAOs and UAO Sariakandi Upazila, DAE 2016

Figure 3.1: Percentage of Category wise Farm family under Sariakandi Upazila

Union-wise Present Agriculture Land Use Information and Identified land Zoning of Sariakandi Upazila are shown in Table 3.2. There are four types of land zoning proposed for Sariakandi Upazila by National Land Zoning project, August 2016 which is shown in Table 3.3. These are: (1) Agro-Fisheries Zone, (2) Agriculture-Island Char Zone, (3) Agriculture- Attached Char Land-Tourism Zone, and 4. Paurashava Area and Upazila Land used Map shown in Map 3.1.

Table 3.2: Present Land Uses and Proposed Land Zoning of Sariakandi Upazila

Union	Area (Ha)	Top Soil Texture	Cropping Intensity (%)	Land Use (Summarized)	Area (Ha)	(%)	Recommended Land Zoning
Bhelabari	1649.94	Loam to Clay Loam	226	Agricultural Land	1055.40	63.97	Agro-fisheries Zone
				Char land/Sand	94.57	5.73	
				Road	8.32	0.50	
				Rural Settlement & HV	337.00	20.42	
				Water Bodies	154.65	9.37	
Bohail	6437.33	Loam to Silt Loam	234	Agricultural Land	3751.38	58.28	Agriculture-Island Char Zone
				Fallow/Chance Crop	85.46	1.33	
				Char land/Sand	1031.72	16.03	
				Farm Land Forest	42.41	0.66	
				Road	4.72	0.07	
				Rural Settlement & HV	340.73	5.29	
				Water Bodies	1180.92	18.34	
Chaluabari	5990.67	Loam to Silt Loam	221	Agricultural Land	1608.67	26.85	Agriculture-Island Char Zone
				Fallow/Chance Crop	151.54	2.53	
				Char land/Sand	1819.69	30.38	
				Rural Settlement & HV	223.90	2.07	
				Water Bodies	2286.87	38.17	
Chandan Baisha	1129.70	Loam to Silt Loam	230	Agricultural Land	305.22	27.02	Agro-fisheries Zone
				Char Land/Sand	144.34	12.78	
				Road	4.32	0.38	
				Rural Settlement & HV	121.25	10.73	
				Water Bodies	554.57	49.09	
Fulbari	2761.99	Loam to Clay Loam	225	Agricultural Land	1784.74	64.62	Agro-fisheries Zone
				Char Land/Sand	85.58	3.10	
				Industrial Area	0.37	0.01	
				Brick -field	12.69	0.46	
				Road	17.97	0.65	
				Rural Settlement & HV	648.09	23.46	
				Water Bodies	212.55	7.70	
Hat Sherpur	2888.20		231	Agricultural Land	1219.22	42.21	Agro-fisheries Zone
				Fallow/Chance Crop	44.94	1.56	

Union	Area (Ha)	Top Soil Texture	Cropping Intensity (%)	Land Use (Summarized)	Area (Ha)	(%)	Recommended Land Zoning
		Loam to Silt Loam		Char land/Sand	794.25	27.50	
				Road	10.62	0.37	
				Rural Settlement & HV	215.63	7.47	
				Water Bodies	603.53	20.90	
Kamalpur	2380.65	Loam to Clay Loam	228	Agricultural Land	1104.99	46.42	Agro-fisheries Zone
				Char Land/Sand	192.58	8.09	
				Brick-field	1.96	0.08	
				Road	11.12	0.47	
				Rural Settlement & HV	445.70	18.72	
				Water Bodies	624.30	26.22	
Karnibari	5641.78	Loam to Silt Loam	219	Agricultural Land	2824.37	50.06	Agriculture-Island Char Zone
				Fallow/Chance Crop	161.52	2.86	
				Char land/Sand	1319.84	23.39	
				Road	7.88	0.14	
				Rural Settlement & HV	228.74	4.05	
				Water Bodies	1099.43	19.49	
Kazla	6866.77	Loam to Sandy Loam	201	Agricultural Land	2716.81	39.56	Agriculture-Island Char Zone
				Fallow/Chance Crop	319.34	4.65	
				Char land/Sand	824.04	12.00	
				Farm and Forest	39.23	0.57	
				Road	15.31	0.22	
				Rural Settlement & HV	433.43	6.31	
				Water Bodies	2518.60	36.68	
Kutubpur	1849.93	Loam to Clay Loam	236	Agricultural Land	731.31	39.53	Agro-fisheries Zone
				Fallow/Chance Crop	3.80	0.21	
				Char land/Sand	212.22	11.47	
				Road	9.85	0.53	
				Rural Settlement & HV	319.35	17.26	
				Water Bodies	573.41	31.00	
Narchi	1518.63	Clay Loam to Clay	235	Agricultural Land	1064.77	70.11	Agro-fisheries Zone
				Char land/Sand	26.12	1.72	
				Road	4.20	0.28	
				Rural Settlement & HV	299.68	19.73	
				Water Bodies	123.86	8.16	
Sariakandi	1896.41	Loam to Sandy Loam	256	Agricultural Land	655.51	34.57	Agriculture-Attached Char Land Zone
				Fallow/Chance Crop	3.50	0.18	
				Char land/Sand	313.63	16.54	
				Road	4.88	0.26	
				Rural Settlement & HV	158.09	8.34	

Union	Area (Ha)	Top Soil Texture	Cropping Intensity (%)	Land Use (Summarized)	Area (Ha)	(%)	Recommended Land Zoning
				Water Bodies	760.81	40.12	
Sariakandi Paurashava	734.93	Loam to Silt Loam	233	Agricultural Land	210.71	28.67	Paurashava Area
				Char land/Sand	90.89	12.37	
				Brick-field	3.95	0.54	
				Road	4.79	0.65	
				Rural Settlement & HV	172.31	23.45	
				Urban Built-up Area	8.14	1.11	
				Water Bodies	244.13	33.22	

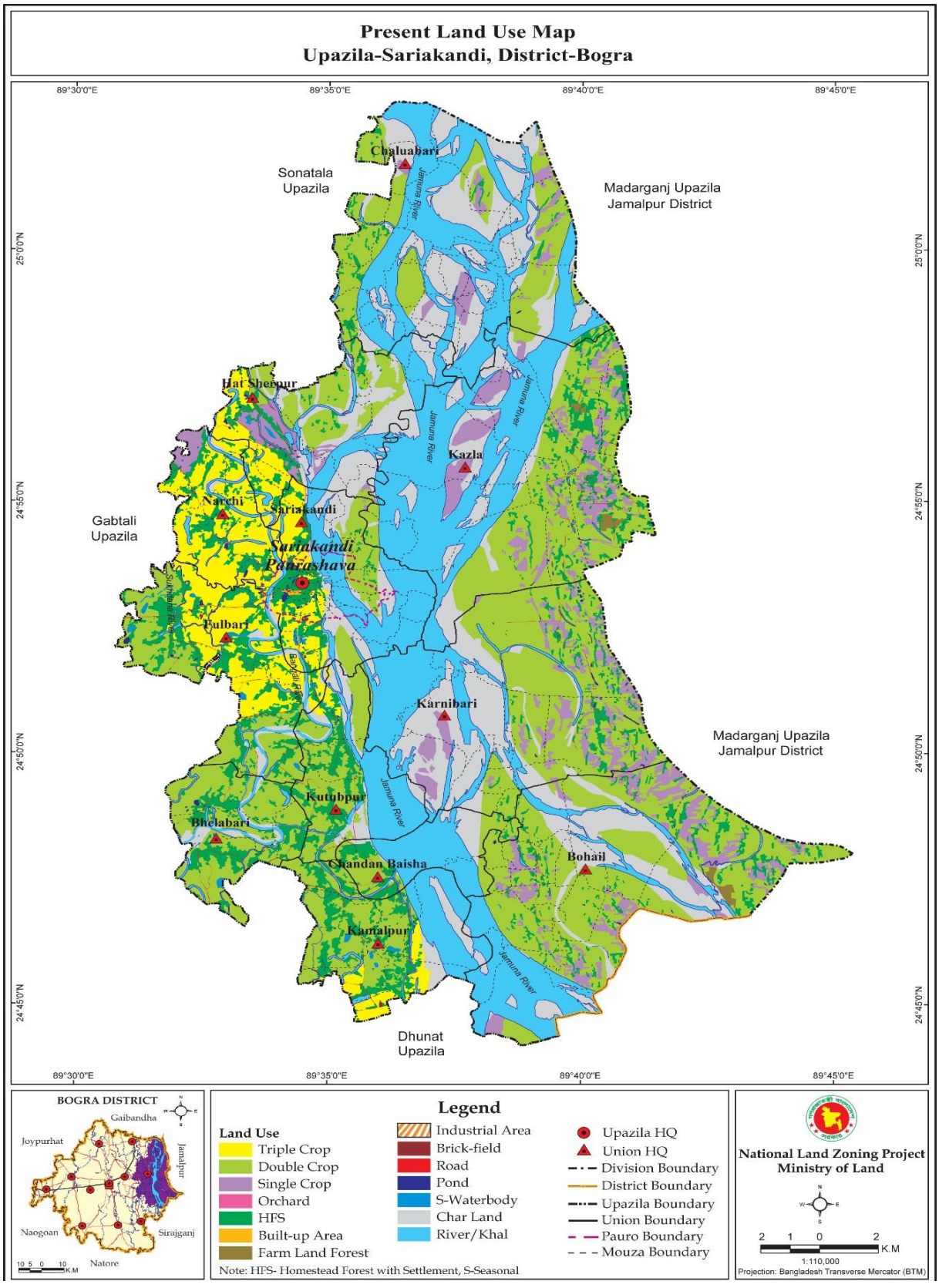
Source: National Land Zoning Project, August 2016

Table 3.3: Proposed Land Zoning for Sariakandi Upazila

Name of Zone	Union	Remarks
Agro-Fisheries Zone	Bhelabari, Chandan Baisha, Hat Sherpur, Kamalpur, Kutubpur, Fulbari and Narchi	Several Beel and wetland lie in the Upazila. It is the home of natural fish and is the source of income of many people.
Agriculture-Island Char Zone	Bohail, Chaluabari, Kazla and Karnibari	This Char land zone is identified because these unions are isolated like an island and occupy newly accreted char land in the Jamuna river which is vulnerable due to natural hazards
Agriculture-Attached Char Land Zone	Sariakandi	This zone is identified due to the fact that the chars are joined or attached with main land and vulnerable due to river erosion. Prem Jaminar ghat is an Attractive tourism place situated here.
Paurashava Area	Sariakandi Paurashava	Paurashava urban development activities should be carried out without degrading fertile agriculture land.

Source: National Land Zoning Project, July 2016

Map 3.1: Present Agricultural Land use Map of Sariakandi Upazila



3.3 Present Agricultural Land Use

3.3.1 Present Upazila Land Use

The land of Sariakandi Upazila of Bogra district is intensively used for agriculture, settlements with homestead gardening, fish culture, Dairy farm for milk production and other infra-structural developments. Diversified of cropping systems has been an important feature of the Upazila. Farmers are harnessing their livelihood by producing multiple crops round the year. At the same time, the pressure of population on land and other natural resources along with rapid urbanization is a major factor for changing land-use patterns rapidly which has adverse effect upon Upazila's agricultural land. However, there has been a positive change in adoption of modern technologies like high-yielding varieties of rice and other crops, irrigation and mechanized cultivation in this area. It is recognized that a change has taken place in production of different crops including fruit and vegetable in this region.

Sariakandi Upazila gets high potentials for its land and agricultural production. This Upazila holds an important arena in Bogra district with her natural resources and ecosystem. The present different land utilized scenario under Sariakandi Upazila is shown in Table 3.4. Major types of lands are 3850 ha high land, 11550 ha medium high land, 5420 ha medium low land and 2260ha low land and very low land 1420ha respectively. This Upazila has no permanent fallow land.

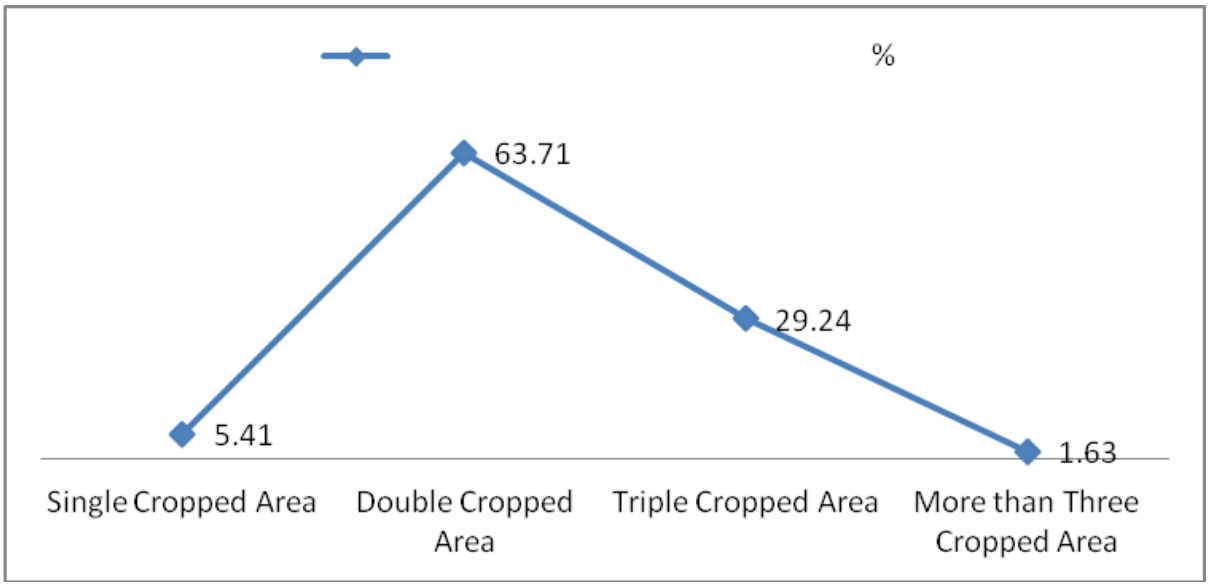
The soil PH is 5.4---7.9 and soil texture is sandy/silt loam and silt clay loam K-bearing minerals medium (SRDI February 1997). This Upazila covers 24500 ha of net cropped area of which about cultivated area is 56640 ha. The highest land area is 15610 ha is used as double crop and followed by triple crop of 7165 ha and remaining 1325 ha is used as single crops and also 400ha used for more than three crops. Other land use for Forest 235 ha and Fish cultivation 13316 ha and housing 3252 ha purposes. About 90% land is covered by irrigation. Percentage of single, double & triple cropped area used in Sariakandi Upazila is shown in Figure 3.2. The highest percentage is double cropped area (63.71%) followed by triple cropped area (29.24%), single crop area (5.41%) and remaining land (1.63%) used as more than three crops under Sariakandi Upazila. The cropping intensity of Sariakandi Upazila is 231%.

Table 3.4: Present Land Used under Sariakandi Upazila

Sl. No	Upazila Land use	Total Area (ha)
1	Total Agricultural land	24500
2	High Land	3850
3	Medium high land	11550
4	Medium low land	5420
5	Low land	2260
6	Very Low land	14200
7	Net cropped area	24500

Sl. No	Upazila Land use	Total Area (ha)
8	Single cropped area	1325
9	Double cropped area	15610
10	Triple cropped area	7165
11	More triple cropped area	400
12	Total cropped area	56640
13	Cropping Intensity (%)	231
14	Irrigated land area (%)	90
15	Forest area	235
16	Housing	3252
17	Water land (River, Ponds and others)	13316

Source: UAO Sariakandi Upazila, DAE 2016



Source: UAO Sariakandi Upazila, DAE 2016

Figure 3.2: Area coverage by Crop Pattern in Sariakandi Upazila

3.4 Union-Wise Present Agriculture Land Use

Sariakandi Upazila has 12 Unions and 1 Municipality present lands used are given below.

3.4.1 Bhelabari Union Land Use

General Description

Land type is the dominant factor for choices of crops and cropping patterns of any area. Selection of crops or cropping patterns largely depends on the topographic position of land in relation to seasonal inundation depth and its duration. Lands which are above normal inundation level can wide range of opportunities for growing both perennial and year round dry-land crops (Banglapedia 2003). Bhelabari Union having agriculture cultivated area of 2530ha of land of which net cropped area is 1120 ha. The land types of this union are medium high land (37.97%), Medium low land (36.27%) and Low land (25.76%) and soil texture is

sandy loam to silt loam and clay loam which indicates lands are suitable for different Rabi crops and Kharif crops cultivation(SAAO,2016). Union falls into 2 Agro-ecological zones are (i) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil P^H is ranges from 5.5-6.5. This Union is highly suitable for cultivation of Boro (HYV/Hybrid), T. Aman (HYV), wheat, Mustard, Jute, Potato and vegetables and fruits production. This Union has 5 Mango, 10 Banana, 1 Guava and 10 Papaya commercial garden (SAAOs 2016).

Present Agriculture Land Use

Lands of this union are above normal inundation level can wide range of opportunities for growing year round crops. Bhelabari Union about 70% lands are used for agriculture and 20% used as urban area. Boro (HYV) is the main irrigated crops cultivated by using ground water and surface water. Ten cropping pattern are practiced under Bhelabari Union which is shown in Table 3.5. The cropping intensity of this union is 226%. Boro (HYV/Hybrid) and T. Aman (HYV) and T. Aus (HYV) are the principal crops under this Union. Major crops cultivated in this union are: paddy, Jute, Wheat, Chili, Potato, Mustard and Rabi & Kharif different vegetables and different fruits (SAAOs, Bhelabari Union 2016).

Table 3.5: Present Cropping Patterns of Bhelabari Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	Percentage of NCA
Bhelabari	1120	Boro(HYV)→Fallow→T. Aman(HYV)	226	635	56.70
		Boro (HYV)→Fallow→ Fallow		65	5.80
		Boro→ Jute→ T. Aman		214	19.11
		Wheat→T. Aus/Jute→T. Aman (HYV)		70	6.25
		Mustard→Boro (HYV)→ T. Aman		100	8.93
		Potato→Boro (HYV)→ T. Aman		8	0.71
		Chili→ Boro→Jute		10	0.89
		Pulses→Fallow→ T. Aman		3	0.27
		Spices→ Fallow→ T. Aman		5	0.45
		Vegetable→Vegetable→Vegetable		10	0.89
		Total		1120	100

Source: SAAOs of Bhelabari Union 2016

Major Problems on Crop Cultivation

The major problems in Bhelabari Union crop cultivation are: (i) Flood and Water Logging, (ii) katcha drainage system (iii) Most canals and river silted (iv) Less availability of quality HYV seeds, (v) Lack of cold storage and vegetable cool-chamber (vi) Lack of vegetables and fruits market infrastructure (vii) Less availability of power tiller/tractor, harvester, sprayer and foot

pump and high price,(viii) Lack labor during planting and harvesting crops and wage rate is high, (ix) Low market price of agricultural commodities and (x) Farmers lack of modern technological knowledge (SAAOs, Bhelabari Union 2016).

Recommendation

(1) Drainage congestion can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Union. Excavated canals could accommodate flood water and thus help to improve the flooding condition of the Union. (2) Ensure improve quality HYV crop seeds (3) wholesale market infrastructures development and also road communication system at local level, (4) Katcha irrigation drainage system needs to convert into pucca or underground pipe system. (5) Ensure appropriate price for produced crops (6) Technological training for farmers (7) Establishment of seed store and cold storage for vegetables (SAAOs, Bhelabari Union 2016).

3.4.2 Bohail Union Land Use

General Description

Land of this Union falls into 2 Agro-ecological zones are (i) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil P^H is ranges from 5.5-7.5. This Union lands are used for agriculture (59%), fish cultivation (ponds & rivers) (22%), Settlement (13%) and others purposes. Bohail Union having agriculture cultivated area of 8898ha of land of which net cropped area is 4218 ha. The land types of this union are medium high land (50.33%), Medium low land (35.21%) and Low land (14.46%) and soil texture is sandy loam to silt loam and loam which indicates lands are suitable for different Rabi crops and Kharif crops cultivation(SAAO,2016). Fertile land of this Union is highly suitable for multiple crops cultivation (SAAOs 2016).

Present Agriculture Land Use

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 crop has been harvested. In the cultivation of rice, multiple cropping requires effective irrigation, especially in areas with a dry spell in Bohail Union. Boro (HYV) is the main irrigated crops cultivated by using ground water. At present 15 cropping patterns are practiced under Bohail Union which is shown in Table 3.6. The cropping intensity of this union is 211%. Chili, Onion, Maize, Jute and Potato are the principal cash crops under this Union. Major crops cultivated in this union are: paddy, Wheat, Mustard and Rabi & Kharif different vegetables (SAAOs, Bohail Union 2016).

Table 3.6: Present Cropping Patterns of Bohail Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	Percentage of NCA
Bohail	4218	Boro(HYV)→Fallow→T.Aman(HYV)	250	285	6.76
		Boro (HYV)→Fallow→ Fallow		346	8.20
		Boro (HYV)→ T.Aus → T.Aman		138	3.27
		Wheat→Jute→T.Aman (HYV)		457	10.83
		Maize→ Fallow-→ T.Aman		595	14.11
		Mustard→Boro (HYV)→ T.Aman		314	7.44
		Potato/→ Boro (HYV)→ T.Aman		148	3.51
		Chili→ jute-→Fallow		518	12.28
		Chili→ T.Aus→ Fallow		720	17.07
		Chili→Boro→ Jute---Fallow		92	2.18
		Sweet Potato→Jute→Fallow		75	1.78
		Pulses→T.Aus→ Fallow		200	4.74
		Spice(onion)→ Fallow→ T.Aman		148	3.51
		Onion/Turmeric→Fallow→Fallow		112	2.66
		Vegetable→Vegetable→Vegetable		70	1.66
		Total		4218	100.00

Source: SAAOs of Bohail Union, 2016

Major Problems on Crop Cultivation

The major problems in Bohail Union crop cultivation are: (i) Early Flood & Rainfall which damage crops (ii) Katcha irrigation drainage system & damaged road system, (iii) Most of the old canals and river silted, (iv) Less availability of quality HYV seeds, (v) Lack of seed and cold storage, (vi) Lack of vegetables and fruits market infrastructure, (vii) Water logging, (viii) Interrupted electricity supply during Boro crop season, (ix) Farmers lack of modern technological knowledge, and (x) Low market price of agricultural produced products (SAAOs, Bohail Union 2016).

Recommendation

(1) Ensure improve quality HYV crop seeds, (2) Uninterrupted electricity supply is an important issue for ensuring timely irrigation in the area, (3) Wholesale market infrastructures development and also road communication system at local level, (4) Crop production technological farmers training, (5) Drainage congestion can be removed by excavating and re-excavating the new & old canals by making connection to adjacent rivers and khals of the Union. Excavated canals could accommodate flood water and thus help to improve the flooding condition of the Union, (6) Katcha irrigation drainage system needs to convert into pucca or underground pipe system which will reduce the water loss, (7) Ensure appropriate price for

produced crops, (8) Establishment of seed store and cold storage for vegetables (SAAOs, Bohail Union 2016).

3.4.3 Chaluabari Union Land Use

General Description

The land of Chaluabari Union is very fertile and potential for growing diversified crops Rabi, Kharif-1 and Kharif-11 season crops. The soil texture is sandy loam to silt loam and loam and the soil PH is ranges from 5.5-7.5. This Union lands are used for agriculture (58%), fish cultivation (ponds & rivers) (20%), Settlement (10%) and sand (12%). Chaluabari Union having agriculture cultivated area of 5180ha of land of which net cropped area is 2645 ha. The land types of this union are high land (9.45%) medium high land (20.79%), Medium low land (51.61%) and Low land (18.15%). Majority lands are above inundated level which is suitable for different Rabi crops and Kharif crops cultivation (SAAO, 2016).

Present Agriculture Land Use

In the cultivation of rice, multiple cropping requires effective irrigation, especially in areas with a dry spell in Chaluabari Union. Boro (HYV) is the main irrigated crops cultivated by using ground and surface water. Fifteen cropping patterns are practiced under Chaluabari Union which is shown in Table 3.7. The cropping intensity of this union is 196%. Chili, Onion, Maize, Jute and Potato are the principal cash crops under this Union. Major crops cultivated in this union are: paddy, Wheat, Mustard and Rabi & Kharif different vegetables (SAAOs, Bohail Union 2016).

Table 3.7: Present Cropping Patterns of Chaluabari Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
Chaluabari	2645	Boro(HYV)→Fallow→T.Aman(HYV)	196	210	7.94
		Boro (HYV)→Fallow→ Fallow		244	9.22
		Boro (HYV)→ T.Aus → T.Aman		109	4.12
		Wheat→Jute→T.Aman (HYV)		153	5.78
		Maize→ T.Aus→ T.Aman		273	10.32
		Mustard→Boro (HYV)→ T.Aus		82	3.10
		Potato/→ Boro (HYV)→ T.Aman		32	1.21
		Chili→ jute-→Fallow		158	5.97
		Chili→ T.Aus→ Fallow		337	12.74
		Chili→Boro→ Jute---Fallow		188	7.11
		Sweet Potato→Jute→Fallow		153	5.78
		Pulses→T.Aus→ Fallow		369	13.95

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area(ha)	% of NCA
		Groundnut→ Fallow→ Fallow		75	2.84
		Onion→Jute→ T.Aman		209	7.90
		Vegetable→Til→Fallow		20	0.76
		Vegetables→Vegetables→ Vegetables		33	1.25
		Total		2645	100

Source: SAAOs of Chaluabari Union, 2016

Major Problems on Crop Cultivation

The major problems in this Union are: (i) Natural and man-made hazard like-water stagnation and drainage congest, (ii) Flood s occurred frequently and cause huge damage to natural vegetation and agricultural crops, (iii) Less availability of quality HYV seeds, (iv) Lack of seed & cold storage and wholesale market infrastructure, (v) Farmers lack of modern technological knowledge, (vi) Low organic matter content in soil, soil moisture deficiency during dry months which are restricting intensive crop cultivation, (vii) The valuable agricultural land is reducing every year due to unplanned construction of houses and settlement, industries and different infrastructural development, and (viii) Low market price of agricultural produced products (SAAOs, Chaluabari Union (2016).

Recommendation

(1) Development of irrigation facility, proper and planned uses of land as per its criteria could ensure better yields of agricultural crops (2) Drainage congestion can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Union. Excavated canals could accommodate flood water and thus help to improve the flooding condition of the Union (4) Ensure improve quality HYV crop seeds (5) wholesale market infrastructures development and also road communication system at local level (6) Season wise crop production technological farmers training (7) Ensure availability of quality both chemical and organic fertilizers and encourage farmers for cultivation of leguminous crops (8) Ensure appropriate price for produced crops (9) Construction of seed store and cold storage for vegetables (10) Zoning of land as per present uses and potentialities and their successful implementation through the enforcement of land zoning low would help to control land degradation as well as ensure proper uses of agricultural land.

3.4.4 Chandan Baisha Union Land Use

General Description

Multiplicity of cropping systems has been one of the main features of the Union. Farmers are harnessing their livelihood by producing various crops round the year. Agricultural Land Use rice and other crops, irrigation and mechanized cultivation in this area. It is recognized that a change has taken place in production of different crops including fruit and vegetable in this Union. The soil texture is sandy loam to silt loam and loam and the soil P^H is ranges from 5.5-7.5. Out of total lands this Union is used for agriculture (60%), fish cultivation (ponds & rivers) (25%), Settlement (6%) and sand (7%) pond (2%). Chandan Baisha Union having agriculture cultivated area of 1640 ha of land of which net cropped area is 770 ha. The land types of this union are high land (9.09 %), medium high land (20.78%), Medium low land (54.55%) and Low land (15.58%). Majority lands are above inundated level which is suitable for different Rabi crops and Kharif crops cultivation (SAAO, 2016).

Present Agriculture Land Use

There has been a positive change in adoption of modern technologies like high- yielding varieties of Chandan Baisha Union under Bogra district. The cropping intensity of this union is 218%. Chili, Onion, Wheat Jute and Potato are the principal cash crops under this Union. Major crops cultivated in this union are: paddy, Maize, Mustard and Rabi & Kharif different vegetables (SAAOs, Chandan Baisha Union 2016).Boro (HYV) is the main irrigated crops cultivated by using ground. At present 12 cropping patterns are practiced under Chandan Baisha Union which is shown in Table 3.8.

Table 3.8: Present Cropping Patterns of Chandan Baisha Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	Percentage of NCA
Chandan Baisha	770	Boro(HYV)→Fallow→T.Aman(HYV)	218	310	40.26
		Boro (HYV)→Fallow→ Fallow		30	3.90
		Boro (HYV)→ B.aman→ T.Aman		40	5.19
		Wheat→Jute→T.Aman (HYV)		209	27.14
		Maize→ T.Aus→ T.Aman		12	1.56
		Mustard→Boro (HYV)→ T.Aman (LV)		40	5.19
		Potato/→ Boro (HYV)→ T.Aman		30	3.90
		Chili→ jute-→Fallow		20	2.60
		Pulses→Fallow→ T.aman		40	5.19
		Spices(Onion)→Jute→ Fallow		14	1.82
		Vegetable→Til→Fallow		15	1.95

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	Percentage of NCA
		Vegetables→Vegetables→ Vegetables		10	1.30
Total				**770**	**100.00**

Source: SAAOs of Chandan Baisha Union 2016

Major Problems on Crop Cultivation

The major problems in this Union crop cultivation are: (i) River erosion & risk of sudden flood (ii) Drought and Water logging (iii) Scarcity of surface and underground water for irrigation, higher cost of LLPs, DTWs and DTWs in the local markets are the major problems for intensive irrigation in the area(iv) Katcha irrigation drainage system (v) Less availability of quality HYV seeds (vi) Farmers lack of modern technological knowledge and(vii) Low market price of agricultural produced products (viii) Interrupted electricity supply during peak period of Boro crop season (ix) Lack of vegetables and fruits market infrastructure and cold storage (SAAOs, Chandan Baisha Union 2016).

Recommendation

The suggested management practices for improving crop production are: (1) Construction embankment for flood control, (2) Uninterrupted electricity supply is an important issue for ensuring timely irrigation in the area, (3) wholesale market infrastructures development and also road communication system at local level, (4) Farmers need base modern crop production technological training, (4) Drainage congestion can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Union, (5) Ensure availability of improve quality HYV crop seeds, irrigation and cultivation modern machineries in local market, (6) Construction of seed& cold storage for vegetables and agro-base industries, (7) Introduction of drought tolerant varieties of crops are very important for higher yields and production (SAAOs, Chandan Baisha Union 2016).

3.4.5 Fulbari Union Land Use

General Description

Agricultural Land use rice and other crops, irrigation and mechanized cultivation in this Union. It is recognized that a change has taken place in production of different crops including fruit and vegetable in this Union. Land of this Union falls into 2 Agro-ecological zones are (i) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil texture is sandy loam to silt loam and loam and the soil PH is ranges from 5.5-6.5. Major lands this Union is used for agriculture (82%), Settlement (11.51%) and sand (1%), pond

and forest purposes. Fulbari Union having agriculture cultivated area of 4651 ha of land of which net cropped area is 1969 ha. The land types of this union are high land (22.85 %), medium high land (37.84%), Medium low land (28.34%) and Low land (10.97%).There are many commercial fruits gardens in this union. Such as 25 Mango, 19 litchi, 31 Guava, 22 Banana and 23 Papaya garden were established in Fulbari Union (SAAO, Fulbari 2016).

Present Agriculture Land Use

Multiplicity of cropping systems has been one of the main features of the Union. The land is intensively used for food crops, vegetables and fruits production. Major crops cultivated in this union are: paddy, Maize, Chili, Onion, and Wheat, Mustard Jute and Potato and Rabi & Kharif different vegetables. The cropping intensity of this union is 236% (SAAOs, Fulbari Union 2016). Boro (HYV) is the main irrigated crops cultivated by using ground and surface water. At present 13 cropping patterns are practiced under Fulbari Union which is shown in Table 3.9.

Table 3.9: Present Cropping Patterns of Fulbari Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Fulbari	1969	Boro(HYV)→Fallow→T.Aman(HYV)	236	1280	65.01
		Boro (HYV)→Fallow→ Fallow		66	3.35
		Boro (HYV)→ B.aman→ T.Aman		4	0.20
		Wheat→Jute→T.Aman (HYV)		91	4.62
		Wheat→Jute→ Fallow		38	1.93
		Boro(HYV)→ T.Aus→ T.Aman		86	4.37
		Mustard→Boro (HYV)→ T.Aman(LV)		128	6.50
		Potato/→ Boro (HYV)→ T.Aman		85	4.32
		Chili/Boro→ jute-→Fallow		91	4.62
		Pulses→Fallow→ T.aman		17	0.86
		Spices(Onion)→Jute→ Fallow		24	1.22
		S. Potato→Fallow→T.Aman(HYV/LV)		14	0.71
		Vegetables→Vegetables→ Vegetables		45	2.29
Total				**1969**	**100.00**

Source: SAAOs of Fulbari Union 2016

Major Problems on Crop Cultivation

The major problems in Fulbari Union crop cultivation are: (i) During field survey it was found that most of the old canals of the union had been closed due to human interventions like construction of houses, markets and other infrastructures which are creating barriers to natural flow of water and causing drainage congestion in the area, (ii) Lack of electricity, (iii) Katcha irrigation drainage system which is decrease of command crop area, (iv) Road katcha and damaged, (v) Less availability of quality HYV seeds, (vi) Farmers lack of modern

technological knowledge, (vii) Lack of vegetables and fruits market infrastructure, (viii) Less availability of agricultural machineries, and (ix) Deficiencies of essential plant nutrients, drought and risk of flood are the other common problems restricting intensive crop cultivation in the union (SAAOs, Fulbari Union 2016).

Recommendation

(1) Improvement of irrigation system and katcha drain converted into pucca drain which will reduce the loss of irrigation water and increase the command area, (2) Development of irrigation facility, proper and planned uses of land as per its physical and chemical characteristics could help to control land degradation and ensure better yields of agricultural crops, (3) Season wise farmers need base crop production technological training, (4) Drainage congestion can be removed by excavating and re-excavating the new & old canals by making connection to adjacent rivers and khals of the Union. Excavated canals could accommodate flood water and thus help to improve the flooding condition of the Union, (5) Ensure availability of improve quality HYV crop seeds, both chemical and organic fertilizers and encourage farmers to cultivate leguminous crops for increasing the soil nutritional condition, (6) Construction of seed store and cold storage for vegetables, (7) Wholesale market infrastructures development and also road communication system at local level, (8) Arrangement for soil test and recommendation for farmers, and (9) Construction of embankment for flood control (SAAOs, Fulbari Union 2016).

3.4.6 Hat Sherpur Union Land Use

General Description

Land used mostly depends on land topography. The lands of this Union is intensively used for agriculture (60%) followed by river/canals (17%), settlement (15%) and sand (5%), forest (2%) & pond (1%) respectively. Hat Sherpur union having agriculture cultivated area of 4150 ha of land of which net cropped area is 1800 ha. The land types of this union are high land (5.56 %), medium high land (47.22%), Medium low land (38.89%) and Low land (8.33%). Hat Sherpur Union Land of this Union falls into 2 Agro-ecological zones is (i) a) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil texture is sandy loam to silt loam and loam and the soil PH is ranges from 5.5-7.5 (SAAO, Hat Sherpur 2016).

Present Agriculture Land Use

Diversified cropping patterns have been one of the main features of the Union. The land is intensively used for food crops, vegetables and fish production. Major crops cultivated in this union are: paddy, Maize, Mustard Jute, Potato, Chili, Onion, Wheat, pulses and Rabi & Kharif

different vegetables. The cropping intensity of this union is 230% (SAAOs, Hat Sherpur Union 2016).Boro (HYV) is the main irrigated crops cultivated by using ground and surface water. At present 14 cropping patterns are practiced under Hat Sherpur Union which is shown in Table 3.10. Major two cropping patterns are Boro (HYV/Hybrid)→Fallow→ T. Aman (HYV) covered by 33.33% of the NCA and Chili→ Boro (HYV)→Jute which is covered 14% of the NCA.

Table 3.10: Present Cropping Patterns of Hat Sherpur Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Jorgacha Union	1800	Boro(HYV)→Fallow→T.Aman(HYV)	230	600	33.33
		Boro (HYV)→Fallow→ Fallow		150	8.33
		Wheat→Jute→T.Aman (HYV)		125	6.94
		Maize→Jute→ T.Aman		20	1.11
		Boro(HYV)→ T.Aus→ T.Aman		80	4.44
		Mustard→Boro (HYV)→ T.Aman(LV)		60	3.33
		Potato/→ Boro (HYV)→ T.Aman		50	2.78
		Chili/Boro→ jute-→Fallow		125	6.94
		Pulses→Fallow→ T.aman		100	5.56
		Onion→Jute→ Fallow		150	8.33
		Chili→Boro→ Jute		250	13.89
		S. Potato→Fallow→T.Aman(HYV/LV)		30	1.67
		Vegetables→Vegetables→ Vegetables		35	1.94
		Orchard→Orchard→Orchard		25	1.39
Total				**1800**	**100.00**

Source: SAAOs of Hat Sherpur Union, 2016

Major Problems on Crop Cultivation

The major problems in Hat Sherpur Union crop cultivation are: (i) The union faces shallowly to moderately deep monsoon flooding which causes moderate crop damage of summer vegetables and paddy in almost every year, (ii) Water stagnation/congestion drainage & katcha irrigation drainage system, (iii) Silted canals and river and sand deposited during flood, (iv) Less availability of quality HYV seeds, (v) Farmers lack of modern technological knowledge, (vi) Lack of vegetables and fruits market infrastructure, (vii) Katcha and damaged road, (viii) Less availability of agricultural machineries, and (ix) Lack labor during planting and harvesting crops and wage rate is high (SAAOs, Hat Sherpur Union 2016).

Recommendation

(1) Drainage congestion can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Union. Excavated canals could accommodate flood water

and thus help to improve the flooding condition of the Union, (2) Ensure improve quality HYV crop seeds, (3) Construction of seed store and cold storage for vegetables, (4) Improvement of irrigation system and katcha drain converted into pucca drain, (5) Wholesale market infrastructures development and also road communication system at local level, (6) Technological farmers training, and (7) Farmers crops production training (SAAOs, Hat Sherpur Union 2016).

3.4.7 Kamalpur Union Land Use

General Description

Land used mostly depends on land topography. The land of Kamalpur Union is very fertile and potential for multiple crops cultivation. Major lands of this Union is intensively used for agriculture (83.25%) followed by settlement (8.75%) and river/canals (5%), sand (2%) & pond (1%) respectively. Union falls into 2 Agro-ecological zones is (i) a) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil texture is sandy loam to silt loam and loam and the soil PH is ranges from 5.5-7.5(SAAO, Kamalpur 2016). Kamalpur union having agriculture cultivated area of 400 5ha of land of which net cropped area is 1825 ha. Major land types of this union are high land (34.25 %), medium high land (41.64%), Medium low land (16.99%) and Low land (7.12%). Most of lands are above seasonal flood inundation level and can provide a wide range of opportunity for growing both perennial and year round annual dry-land.

Present Agriculture Land Use

Cropping patterns depends on land types, irrigation and other inputs facilities. Major crops cultivated in this union are: paddy, maize, mustard, jute, potato, chili, onion, wheat, pulses and Rabi & Kharif different vegetables. Boro (HYV) is the main irrigated crops cultivated by using ground. Total 12 cropping patterns are practiced under Kamalpur Union which is shown in Table 3.11. Major two cropping patterns are Boro (HYV/Hybrid)→Fallow→T.Aman (HYV) covered by 41% of the NCA and Mustard→ Boro(HYV)→T.Aman which is covered about 21% of the NCA. The cropping intensity of this union is 219% (SAAOs, Kamalpur Union2016).

Table 3.11: Present Cropping Patterns of Kamalpur Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Kamalpur		Boro(HYV)→Fallow→T.Aman(HYV)		934	51.18
		Boro (HYV)→Fallow→ Fallow		10	0.55
		Wheat→Jute→T.Aman (HYV)		70	3.84
		Maize→T Aus→ T.Aman		175	9.59

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
	1825	Boro(HYV)→ T.Aus→ T.Aman	219	13	0.71
		Mustard→Boro (HYV)→ T.Aman(LV)		375	20.55
		Potato/ Boro (HYV)→Jute→ T.Aman		180	9.86
		Chili/Boro→ jute-→Fallow		12	0.66
		Pulses→Fallow→ T.aman		11	0.60
		Spices →Jute→ Fallow		15	0.82
		Vegetables→Vegetables→ Vegetables		20	1.10
		Orchard→Orchard→Orchard		10	0.55
Total				**1825**	**100.00**

Source: SAAOs of Kamalpur Union, 2016

Major Problems on Crop Cultivation

The major problems in Kamalpur Union crop cultivation are: (i) Silted canals and river, (ii) Sudden flood, (iii) Water logging and katcha drainage system, (iv) Higher cost of irrigation tools like LLPs, STWs and DTWs in the local market and lack of electricity are the problems for intensive irrigation in the peak season, (v) Farmers lack of seed treatment technological knowledge, (vi) Lack of vegetables market infrastructure, (vii) Katcha and damaged road, (viii) Less availability of agricultural machineries, (ix) lack of seed store and cold storage for vegetables, (x) Less availability of quality HYV seeds, and (xi) The most alarming situation is that the potential agricultural land decreasing rapidly due to unplanned construction of markets, industries and other infrastructural development activities in the area (SAAOs, Kamalpur Union 2016).

Recommendation

(1) Construction of Embankments with sluice gates and drainage, (2) Seed and seedling treatment technological farmers training, (3) Availability of drought and submerged crop variety seeds, (4) Drainage congestion can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Union. Excavated canals could accommodate flood water and thus help to improve the flooding condition of the Union, (5) Construction of seed store and cold storage for vegetables, (6) Improvement of irrigation system and katcha drain converted into pucca drain, (7) wholesale market infrastructures development and also road communication system at local level, (8) Establishment of seed store and cold storage for vegetables and other crops, and (9) The valuable agricultural land unplanned uses should be stopped immediately by imposing land zoning law and other regulatory measures by the concerned authority.

3.4.8 Karnibari Union Land Use

General Description

From the agricultural view, this union is suitable for diversify agriculture and fish cultivation. The highest lands of this Union is intensively used for agriculture (58%) followed by river/canals (20%), sand (12%), & settlement (10%) respectively. Karnibari union having agriculture cultivated area of 6858ha of land of which net cropped area is 3041 ha. The types land of this union are high land (9.57 %), medium high land (27.10%), Medium low land (37.88%) and Low land (25.45%).Union falls into 2 Agro-ecological zones is (i) a) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil texture is sandy loam to silt loam and loam and the soil P^H is ranges from 5.5-7.5(SAAO, Karnibari 2016).

Present Agriculture Land Use

Total 16 cropping patterns are practiced under Karnibari Union which is shown in Table 3.12. The cropping intensity of this union is 226% Major three cropping patterns are Chili/ Boro (HYV/Hybrid)→Jute→Fallow covered by 13.48% of the NCA and pulses→T.Aus (HYV)→Fallow which is covered about 13% of the NCA and also Chili→T.Aus –Fallow which is covered 12% of the NCA(SAAOs, Karnibari Union 2016). Boro (HYV) is the main irrigated crops cultivated by using ground. Farmers are cultivated Chili, Maize and Jute as principal cash crops in this Union.

Table 3.12: Present Cropping Patterns of Karnibari Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Karnibari	3041	Boro(HYV)→Fallow→T.Aman(HYV)	226	242	7.96
		Boro (HYV)→Fallow→ Fallow		279	9.17
		Wheat→Jute→T.Aman (HYV)		176	5.79
		Maize→T Aus→ T.Aman		314	10.33
		Boro(HYV)→ T.Aus→ T.Aman		241	7.93
		Mustard→Boro (HYV)→ T.Aman(LV)		48	1.58
		Potato/ Boro (HYV)→ T.Aman		25	0.82
		Chili/Boro→ jute-→Fallow		410	13.48
		Chili→ T.Aus→ Fallow		376	12.36
		Pulses→ T.Aus→ fallow		395	12.99
		Onion →Jute→ T.Aman		193	6.35
		Spices(Garlic/Turmeric)→Fallow->T.Aman		53	1.74
		Groundnut→ Fallow→ Fallow		87	2.86
		S. Potato→ Jute-- Fallow		175	5.75

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
		Vegetables→Vegetables→ Vegetables		12	0.39
		Orchard→Orchard→Orchard		15	0.49
Total				**3041**	**100**

Source: SAAOs of Karnibari Union 2016

Major Problems on Crop Cultivation

The major problems in this Union crop cultivation are (i) Water stagnation and drainage congestion in the medium low land areas during rainy season mainly hampering seed bed of T.Aman (HYV) and its timely cultivation, (ii) Drought and risk of sudden flood which is damage crops, (iii) Katcha and damaged road, (iv) Lack of vegetables market infrastructure, (v) Less availability of agricultural machineries and high price, (vi) Low organic matter and soil moisture deficit the dry months are the other common problems restricting intensive rain fed crop cultivation in the union, (vii) Farmers lack of modern crop production technology, and (viii) lack of seed store and cold storage for vegetables (SAAOs, Karnibari Union 2016).

Recommendation

(1) Drainage congestion can be removed by Excavation and re-excavating the new & old canals by making connection to adjacent rivers and khals of the Union. Excavated canals could accommodate flood water and thus help to improve the flooding condition of the Union, (2) Development of irrigation facility, proper and planned use of land as per its criteria could be ensure better yields of agriculture, (3) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping patterns. Besides, application of organic manure and bio-fertilizer can improve deficiency of soil nutrients, (4) Construction of seed store and cold storage for vegetables, (5) Improvement of irrigation system and katcha drain converted into pucca drain, and (6) Wholesale market infrastructures development and also road communication system at local level.

3.4.9 Kazla Union Land Use

General Description`

Kazla union having agriculture cultivated area of 9540ha of land of which net cropped area is 4620 ha. Major land types of this union are high land (5.95%), medium high land (20.45%), medium low land (54.12%) and low land (19.48.45%). The soil texture is sandy loam to silt loam and loam and the soil P^H is ranges from 5.5-7.5.Union falls into 2 Agro-ecological zones is (i) a) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). (SAAO, Kazla 2016). The soil of this Union is fertile and potential for diversified

crops cultivation.

Present Agriculture Land Use

Crops and cropping patterns depends on land types and seasonal flood inundation level. Those land above seasonal flood level possible to cultivate three or more than three crops in same land. The cropping intensity of this union is 206%. At present 18 cropping patterns are practiced under Kazla Union which is shown in Table 3.13. Major three cropping patterns are Onion→Jute→T. Aman covered by 13% of the NCA, Pulses→T. Aus –Fallow which is covered 11% of the NCA and Chili/Boro→ Jute→Fallow which is covered about 10% of the NCA (SAAOs, Kazla Union 2016). Boro (HYV) is the main irrigated crops cultivated by using ground. Farmers are cultivated Onion, Chili, Maize and Jute as principal cash crops in this Union.

Table 3.13: Present Cropping Patterns of Kazla Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Kazla	4620	Boro(HYV)→Fallow→T.Aman(HYV)	206	260	5.63
		Boro (HYV)→Fallow→ Fallow		391	8.46
		Wheat→Jute→T.Aman (HYV)		216	4.68
		Maize→T Aus→ T.Aman		410	8.87
		Boro(HYV)→ T.Aus→ T.Aman		257	5.56
		Vegetables→Boro (HYV)→ T.Aus		120	2.60
		Mustard→Boro (HYV)→ T.Aman(LV)		50	1.08
		Potato/ Boro (HYV)→ T.Aman		170	3.68
		Chili/Boro→ jute-→Fallow		475	10.28
		Chili→ T.Aus→ Fallow		355	7.68
		Pulses→ T. Aus→ fallow		505	10.93
		Onion →Jute→ T.Aman		586	12.68
		Spices(Garlic/Turmeric)→Fallow→T.Aman		100	2.16
		Groundnut→ Fallow→ Fallow		150	3.25
		S. Potato→ Jute-- Fallow		215	4.65
		Vegetable→Til→ Fallow		120	2.60
		Vegetables→Vegetables→ Vegetables		70	1.52
		Orchard→Orchard→Orchard		170	3.68
Total				**4620**	**100**

Source: SAAOs of Kazla Union 2016

Major Problems on Crop Cultivation

The major problems in Kazla Union crop cultivation are: (i) Most of the old canals of the union were found closed due to construction of unplanned housing, markets and other infrastructures

which are creating barriers to natural water flow and causing drainage congestion, (ii) interrupted electricity supply during Boro crop season, (iii) Less supply of quality crop seeds, (iv) Katcha and damaged road, (v) Less availability of agricultural machineries, (vi) No seed store and cold storage and also wholesale market infrastructure, (vii) Farmers lack of modern crop production technology and problem of capital, (viii) Land degradation especially potential agriculture land degradation is becoming more severe, and (ix) Less price of produce crop (SAAOs, Kazla Union 2016).

Recommendation

(1) Drainage congestion can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Union. Excavated canals could accommodate flood water and thus help to improve the flooding condition of the Union, (2) Ensure availability of quality crop seeds, both chemical and organic fertilizers and modern machineries (both cultivation & irrigation) in subsidized price (3) Crop production technological farmers training (4) Uninterrupted electricity supply during Boro crop season (5) Improvement of irrigation system and katcha drain converted into pucca drain or pipe system (6) wholesale market infrastructures development and also road communication system at local level (7) Appropriate measures with motivation and awareness building program should be taken immediately to control the unplanned and unwanted interventions responsible for land degradation.

3.4.10 Kutubpur Union Land Use

General Description`

The land of Kutubpur Union under Sariakandi Upazila is intensively utilized for agriculture (75%) followed by urban area (15%), canal/river (5%), forest (2%), sand (2%) and pond (1%) respectively. Kutubpur union having agriculture cultivated area of 3185ha of land of which net cropped area is 1425 ha. Out of total land different types of this union lands are high land (5.61 %), medium high land (46.53%), Medium low land (29.47%) and Low land (18.39%). Union falls into 2 Agro-ecological zones is (i) a) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil texture is sandy loam to silt loam and loam and the soil P^H is ranges from 5.5-7.5.The soil of this Union is fertile and potential for diversified crops cultivation (SAAO, Kutubpur 2016).

Present Agriculture Land Use

Farmers of Kutubpur Union are grown various crops of Rabi, Kharif-1 and kharif-11 season. Major cultivated crops are: Paddy, Jute, Potato, Chili, Pulses, Mustard and winter & summer different kinds of vegetables. Boro (HYV) is the main irrigated crops cultivated by using ground. At present 11 cropping patterns are practiced under Kutubpur Union which is shown

in Table 3.14. Major three cropping patterns are Boro→Fallow→T.Aman covered by 58% of the NCA, Boro→Jute→T.Aman which is covered 9% of the NCA and Mustard→Boro→T.Aman which is covered about 7% of the NCA .The cropping intensity of this union is 224% (SAAOs, Kutubpur Union 2016). Some commercial fruits garden was established by farmers of Kutubpur union. These are 6 mango, 10 banana, 5 litchi, 2 guava and 10 papaya garden.

Table 3.14: Present Cropping Patterns of Kutubpur Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Kutubpur	1425	Boro(HYV)→Fallow→T.Aman(HYV)	224	825	57.89
		Boro (HYV)→Fallow→ Fallow		50	3.51
		Wheat/Maize→Jute→T.Aman (HYV)		80	5.61
		Boro(HYV)→ Jute→ T.Aman		130	9.12
		Mustard→Boro (HYV)→ T.Aman(LV)		100	7.02
		Potato/ Boro (HYV)→ T.Aman		40	2.81
		Chili→ jute-→Fallow		30	2.11
		Pulses→ Jute→ T.Aman		20	1.40
		Spices →Fallow->T.Aman		30	2.11
		Vegetables→Vegetables→ Vegetables		95	6.67
		Orchard→Orchard→Orchard		25	1.75
Total				**1425**	**100**

Source: SAAOs of Kutubpur Union 2016

Major Problems on Crop Cultivation

The major problems in Kutubpur Union crop cultivation are: (i) water logging and drainage congestion (ii) Katcha irrigation drainage system (iii) Essential plant nutrient deficiency in soil and risk of flood (iii) Less availability of quality crop seeds and agricultural machineries (Power tiller, Tractor, Harvester and power sprayer) (iv) No electricity in char area for irrigation pump (vii) Farmers lack of modern crop production technology (viii) lack of seed store and cold storage for vegetables and no wholesale market infrastructure (ix) Rapid conversion of agricultural lands to other uses is a major man-made cause for reducing agricultural lands in this union (SAAOs, Kutubpur Union 2016).

Recommendation

(1) Solar energy operated water pump need to be set in Char area. (2) Construction of embankment with sluice gates and drainage for solves the flood problems (3) Drainage congestion can be removed by re-excavating the old canals by making connection to adjacent rivers and khals of the Union (4) Ensure availability of quality crop seeds (5) Season wise

farmers need base crop production technological training (6) Construction of seed store and cold storage for vegetables (7) Improvement of irrigation system and katcha drain converted into pucca drain or pipe system (8).wholesale market infrastructures development and also road communication system at local level (9) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping patterns (SAAOs, Kutubpur Union 2016).

3.4.11 Narchi Union Land Use

General Description`

There are 20 Mango, 5 Litchi, 20 Banana, 5 Guava and 3 papaya commercial fruit garden was established by farmers. This Union falls into 2 Agro-ecological zones is (i) a) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil texture is sandy loam to silt loam and loam and the soil P^H is ranges from 5.5-7.5.The soil of this Union is fertile and potential for multiple crops cultivation (SAAO, Narchi 2016). Narchi union having agriculture cultivated area of 3441ha of land of which net cropped area is 1571 ha. Types of lands are high land (21.32 %), medium high land (42.33%), Medium low land (27.95%) and Low land (8.40%).

Present Agriculture Land Use

Crops and cropping patterns depends on land topography, seasonal flood level and irrigation facilities. At present 12 cropping patterns are practiced under Narchi Union which is shown in Table 3.15. Major three cropping patterns are Boro→Fallow→T. Aman covered by 36% of the NCA, Mustard→Boro→T. Aman which is covered about 16% of the NCA and Boro (HYV)→ Jute→ T.Aman is covered 10% of the NCA. Farmers of Narchi Union are grown various crops of Rabi, Kharif-1 and kharif-11 season. Major cultivated crops are: Paddy, Jute, Potato, Chili, Pulses, Mustard and winter & summer different kinds of vegetables. Boro (HYV) is the main irrigated crops cultivated by using ground and surface water. The cropping intensity of this union is 219% (SAAOs, Narchi Union 2016).

Table 3.15: Present Cropping Patterns of Narchi Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Narchi		Boro(HYV)→Fallow→T.Aman(HYV)		570	36.28
		Boro (HYV)→Fallow→ Fallow		55	3.50
		Boro(HYV)→Jute→ T.Aman		160	10.18
		Wheat→Jute→T.Aman (HYV)		80	5.09
		Boro(HYV)→ T.Aus→ T.Aman		77	4.90

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
	1571	Mustard→Boro (HYV)→ T.Aman(LV)	219	250	15.91
		S. Potato→ Fallow→ T.Aman		60	3.82
		Potato→Boro→ T.Aman		74	4.71
		Boro→ Jute→ Chili		90	5.73
		Spices →Fallow->T.Aman		52	3.31
		Vegetables→Vegetables→ Vegetables		63	4.01
		Orchard→Orchard→Orchard		40	2.55
Total				**1571**	**100**

Source: SAAOs of Narchi Union 2016

Major Problems on Crop Cultivation

The major problems in Narchi Union crop cultivation are: (i) In the medium high land areas, drainage congestion during rainy season hampers timely cultivation of T.Aman (HYV) crop and damages summer vegetables (ii) Silted canals and rivers and risk of flood (iii) Water logging (iv) Katcha irrigation drainage system (v) Less supply of quality crop seeds (vi) lack of seed store and cold storage for vegetables (viii) Lack of vegetables market infrastructure (ix) Farmers lack of modern crop production technology (x) Scarcity of surface and ground water due to lack of electricity supply problem (xi) Rapid conversion of agricultural lands to other uses is a major man-made cause for reducing agricultural lands in this union (xii) Less availability of agricultural machineries (Power tiller, Tractor, Harvester and power sprayer) (SAAOs, Narchi Union 2016).

Recommendation

(1) Increase electricity connection for irrigation pumps and uninterrupted electricity supply during Boro crop season (2) Improvement of drainage system (3) Re-excavating the old canals by making connection to adjacent rivers and khals of the Union (4) Ensure availability of quality crop seeds (5) Technological farmers training (6) Construction of seed store and cold storage for vegetables (7) wholesale market infrastructures development and improvement road communication system at local level (8) Ensure availability of quality seeds and agricultural modern machineries in the local market (9) Zoning of land as per present uses and potentialities and their successful implementation through the enforcement of land zoning law would help to control land degradation as well as to ensure proper uses of agricultural land.

3.4.12 Sariakandi Union Land Use

General Description`

Types of lands are high land (20 %), medium high land (30%), Medium low land (40%) and Low land (10%). Out of total lands 80% used for agriculture followed by settlement 10%, Sand 3%, and forest 2%, and canal/river 2%, urban area 2% and pond1% respectively. There are 4 Mango, 2 Litchi, 5 Banana, 2 Guava and 6 papaya commercial fruit garden was established by farmers. Sariakandi union having agriculture cultivated area of 3833ha of land of which net cropped area is 1756 ha. This Union falls into 2 Agro-ecological zones is (i) a) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil texture is sandy loam to silt loam and loam and the soil P^H is ranges from 5.5-7.5 (SAAO, Sariakandi 2016).

Present Agriculture Land Use

The soil of this Union is fertile and potential for multiple crops cultivation. Farmers of Sariakandi Union are grown various crops of Rabi, Kharif-1 and kharif-11 season. Major cultivated crops are: Paddy, Jute, Potato, Chili, Pulses, Mustard and winter & summer different kinds of vegetables. Boro (HYV) is the main irrigated crops cultivated by using ground and surface water. The cropping intensity of this union is 218% (SAAOs, Sariakandi Union 2016). At present 11 cropping patterns are practiced under Sariakandi Union which is shown in Table 3.16. Farmers practiced dominant three cropping patterns are: Wheat/Maize→Jute → T. Aman is covered about 25% followed by Mustard→Boro→T. Aman which is covered about 21% of the NCA and Boro (HYV)→ Jute→ T. Aman is covered 17% of the NCA.

Table 3.16: Present Cropping Patterns of Sariakandi Union

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Sariakandi Union	1756	Boro(HYV)→Fallow→T.Aman(HYV)	218	200	11.39
		Boro (HYV)→Fallow→ Fallow		50	2.85
		Boro(HYV)→Jute→ T.Aman		300	17.08
		Wheat/Maize→Jute→T.Aman (HYV)		430	24.49
		Boro(HYV)→ T.Aus→ T.Aman		80	4.56
		Mustard→Boro (HYV)→ T.Aman(LV)		370	21.07
		Pulses→Fallow→T.Aman		30	1.71
		S. Potato→ Fallow→ T.Aman		15	0.85
		Potato→Boro→ T.Aman		21	1.20
		Spices(Onion,chili) →Fallow->T.Aman		235	13.38

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
		Vegetables→Vegetables→ Vegetables		25	1.42
Total				**1756**	**100**

Source: SAAOs of Sariakandi Union 2016

Major Problems on Crop Cultivation

The major problems in Sariakandi Union crop cultivation are: (i) Sudden flood and drought causes of huge damage of field crops and other vegetation (ii) River erosion(iii) Most of the old canals of the union were found closed due to construction of unplanned housing, markets and other infrastructures which are creating barriers to natural water flow and causing drainage congestion(v) Katcha irrigation drainage system (vi) Lack of electricity, low organic matter contents in soil, soil moisture deficit during the dry month which is major problems of intensive crop cultivation (vii) Less supply of quality crop seeds (viii) lack of seed store and cold storage for vegetables (ix) No wholesale market infrastructure (x) Farmers lack of modern crop production technology (xi) Less availability of agricultural machineries (Power tiller, Tractor, Harvester and power sprayer) (xii) Rapid conversion of agricultural lands to other uses is a major man-made cause for reducing agricultural lands in this union (SAAOs, Sariakandi Union 2016).

Recommendation

(1) Drainage congestion can be removed by excavation and re-excavating the new & old canals by making connection to adjacent rivers and khals of the Union (2) High quality seed production and availability (2) Development of irrigation facility, uninterrupted power supply, proper planned uses of land as per its physical and chemical characteristics could help to control land degradation and ensure better yields of agriculture crops (3) Innovation of flood resistance variety and ensure availability in union level (4) Kutch irrigation drainage needs to underground pipe system which is increase the command crop area (5) Need base technological farmers training (6) Construction of seed store and cold storage for vegetables, wholesale market infrastructures development and improvement road communication system at local level (7) To increase the organic matter contents in soil, leguminous crop cultivation could be suggested in the present cropping patterns (8) Construction of embankment with slice gates and culvert (9) Appropriate measures with motivation and awareness building program should be taken immediately to control the unplanned and unwanted interventions responsible for land degradation.

3.4.13 Sariakandi Municipality Land Use

General Description`

Major types of Sariakandi Municipality lands are high land (13 %), medium high land (26%), Medium low land (33%) and Low land (28%). Municipality land are utilized multiple purposes. The present scenario of land used for agriculture (60%) followed by settlement (25%), canal/river (5%), Sand (3%), pond (3%) and urban area (3%), and forest (0.5%) & non classified (0.5%) respectively. Sariakandi Municipality having agriculture cultivated area of 563ha of land of which net cropped area is 214 ha. This Union falls into 2 Agro-ecological zones is (i) a) Karatoya-Bangali Floodplain (AEZ-4) and (ii) Active Brahmaputra-Jamuna Floodplain (AEZ-7). The soil texture is sandy loam to silt loam and loam and the soil P^H is ranges from 5.5-7.5 (SAAO, Sariakandi Municipality 2016).

Present Agriculture Land Use

The soil of this Municipality area is very fertile and potential for diversified crops cultivation. Farmers of Sariakandi Municipality are grown various crops of Rabi, Kharif-1 and kharif-11 season. Boro (HYV) is the main irrigated crops cultivated by using ground water. The cropping intensity of this union is 263% (SAAOs, Sariakandi Municipality 2016). At present 12 cropping patterns are practiced under Sariakandi Union which is shown in Table 3.17. Farmers practiced dominant three cropping patterns are: Boro (HYV)→Jute → T. Aman is covered about 23% followed by Wheat→Jute→T.Aman which is covered about 19% of the NCA and Mustard→Boro(HYV)→T.Aman is covered 14% of the NCA. Major cultivated crops are: Paddy, Jute, Potato, Chili, Pulses, and Mustard, spices and winter & summer different kinds of vegetables.

Table 3.17: Present Cropping Patterns of Sariakandi Municipality

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
Sariakandi Municipality	214	Boro(HYV)→Fallow→T.Aman(HYV)	263	15	7.01
		Wheat→Jute→ T.aman		40	18.69
		Boro(HYV)→Jute→ T.Aman		50	23.36
		Maize→Jute→T.Aman (HYV)		22	10.28
		Boro(HYV)→ T.Aus→ T.Aman		10	4.67
		Mustard→Boro (HYV)→ T.Aman(LV)		30	14.02
		Pulses→Fallow→T.Aman		5	2.34
		S. Potato→ Fallow→ T.Aman		1	0.47
		Potato→Boro→ T.Aman		17	7.94
		Spices(Onion, chili)→Fallow→T.Aman		10	4.67

Name of Union	Net Cultivable Area (ha)	Major Cropping Patterns	Cropping Intensity (%)	Area (ha)	% of NCA
		Vegetables→Vegetables→ Vegetables		4	1.87
		Orchard→Orchard→ orchard		10	4.67
Total				**214**	**100**

Source: SAAOs of Sariakandi Municipality 2016

Major Problems on Crop Cultivation

The major problems in Sariakandi Municipality crop cultivation are: (i) Flood occurred frequently and cause degradation of natural vegetation and loss of agricultural crops (ii) Majority of the old canals of the union were found closed & silted due to construction of unplanned housing, brick field, markets, industries and other infrastructure development activities which are creating barriers to natural flow and causing drainage congestion problem in this union (iii) Deficiencies of essential plant nutrients drought in dry season are the common problems restricting intensive crop cultivation (iv) Katcha irrigation drainage system (v) River erosion (vi) Less availability of agricultural machineries (Power tiller, Tractor, Harvester and power sprayer), (vii) Less supply of quality crop seeds (viii) No cold storage for vegetables (ix) Lack of vegetables market infrastructure (x) Rapid conversion of agricultural lands to other uses is a major man-made cause for reducing agricultural lands in this union (xi) Less price for agricultural products (SAAOs, Sariakandi Municipality 2016).

Recommendation

(1) Construction of embankment with sluice gates, drainage system and culvert which will solve the flood and river erosion problems (2 Innovation of flood resistance crop variety and ensure availability in union level (3) Drainage congestion can be removed by excavating and re-excavating the old canals by making connection to adjacent rivers and khals of the Union (4) Development of irrigation facility, uninterrupted power supply, proper planned uses of land as per its physical and chemical characteristics could help to control land degradation and ensure better yields of agriculture crops (5) Ensure availability of quality both chemical and organic fertilizers in the local market and encourage farmers for cultivation of leguminous crops which will improve the soil nutritional status (6) Construction of seed store, cold storage for vegetables and also wholesale market infrastructures development and improvement road communication system at local level (7) High quality seed production and availability (8) The valuable agricultural land unplanned uses should be stopped immediately by imposing land zoning law and other regulatory measures by the concerned authority.

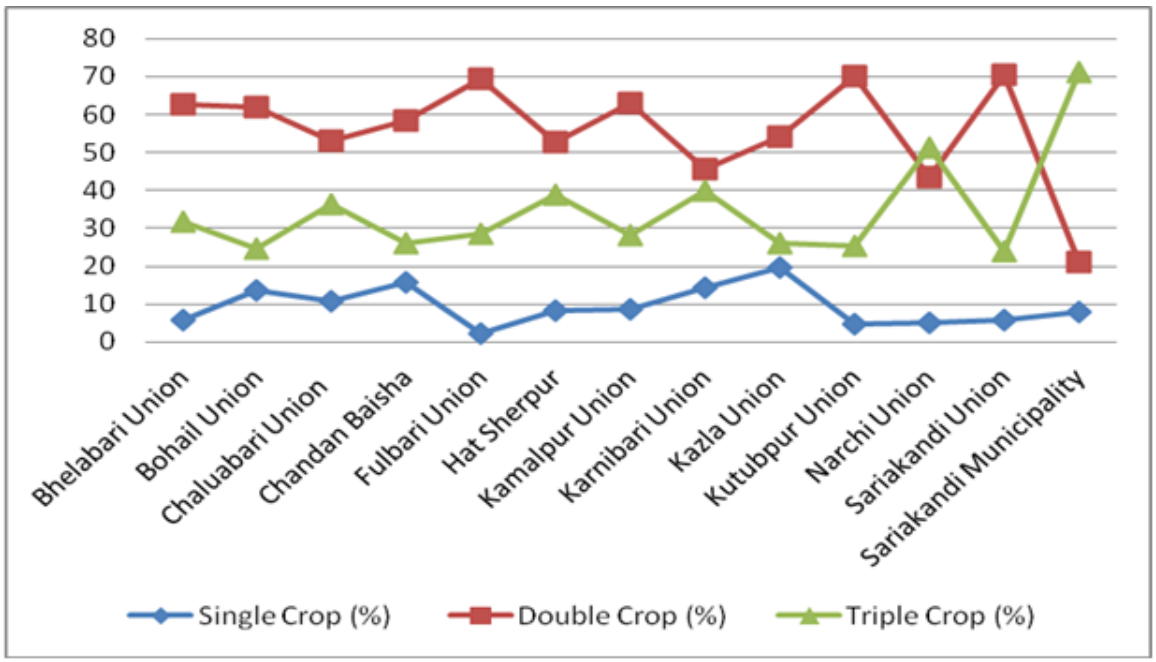


Figure 1.3: Municipality & Union wise Single, Double & Triple cropped area under Sariakandi Upazila

Single, Double and Triple Cultivated Cropped Area

Cultivation of single, double and triple crops depends on seasonal flood inundation period of land. Triple crops cultivated in that land which is above the seasonal flood level and in longer period under flood water lands single crops are grown. For all 12 Unions & 1 Municipality under Sariakandi Upazila percentage of land used for single, double and triple crops have been shown in Figure 3.3. Figure 3.3 shows that highest percentage of single cropped area were used in Kazla Union (20%) followed by Chandan Baisha Union (16%) and Bohail Union (14%), Similarly, the highest percentage of double cropped area were used in Kutubpur Union (70%) and Sariakandi Sadar Union (70%) and Fulbari Union (69%). Further, highest land used for triple crops in Sariakandi Municipality (71%) followed by Narchi Union (51%) and Karnibari Union (40%) under Sariakandi Upazila. Union Wise Land Used of Single, Double and Triple Cropped Area and cropping intensities under Sariakandi Upazila is shown in Table 3.18.

Table 3.18: Municipality and Union wise Cropped Pattern in Sariakandi Upazila

Name of Union	Present Land Used in ha (%)					
	Cultivated Area	Single Cropped Area	Double Cropped Area	Triple Cropped Area	Net Cropped Area (ha)	Cropping Intensity (%)
Bhelabari Union	2530	65(5.80)	700(62.50)	355(31.70)	1120	226
Bohail Union	8898	573(13.58)	2610(61.88)	1035(24.54)	4218	211

Name of Union	Present Land Used in ha (%)					
	Cultivated Area	Single Cropped Area	Double Cropped Area	Triple Cropped Area	Net Cropped Area (ha)	Cropping Intensity (%)
Chaluabari Union	5180	285(10.78)	1400(52.93)	960(36.29)	2645	196
Chandan Baisha	1640	120(15.58)	450(58.44)	200(25.98)	770	218
Fulbari Union	4651	42(2.13)	1364(69.28)	563(28.59)	1969	236
Hat Sherpur	4150	150(8.33)	950(52.78)	700(38.89)	1800	231
Kamalpur Union	4005	160(8.77)	1150(63.01)	515(28.22)	1825	219
Karnibari Union	6858	438(14.40)	1389(45.68)	1214(39.92)	3041	226
Kazla Union	9540	910(19.70)	2500(54.11)	1210(26.19)	4620	206
Kutubpur Union	3185	65(4.56)	1000(70.18)	360(25.26)	1425	224
Narchi Union	3441	81(5.16)	684(43.54)	806(51.30)	1571	219
Sariakandi Union	3833	100(5.69)	1235(70.33)	421(23.98)	1756	218
Sariakandi Municipality	563	17(7.94)	45(21.03)	152(71.03)	214	263

Source: SAAOs and UAO Sariakandi Upazila, DAE 2016

CHAPTER FOUR: CROPPING PATTERN AND CROPPING INTENSITIES

4.1 Cropping Pattern

Cropping patterns has given idea about any area farmers which crops cultivated in their land. 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.

Selection of crops and cropping patterns largely depends on the topographic position of land in relation to seasonal flood depth and its duration. Land types are the dominant factor guiding choice of crops and cropping patterns in Upazila as well as in the area. 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.

Lands which are seasonal flooded inundation longer period can only possible to grown single crops in a year. Lands, which are above normal inundation level, can provide a wide range of opportunities for growing both of perennial and year round annual crops in the area. The scenario of present cropping pattern under Sariakandi Upazila is predominantly Boro (HYV/Hybrid) & T. Aman (HYV/LV) Rice, Jute, potato, Wheat, Maize, Vegetables, Oilseeds, Pulses, Spices (onion, chili), Groundnut and Fruits Garden based. Detailed Upazila cropping patterns by season are presented in Table 4.1. Study finding shows that 14 different cropping pattern are practiced by Sariakandi Upazila farmers. The present major cropping pattern area is Boro (HYV/Hybrid) → Fallow→T.Aman (HYV) which is practiced 31.84% of the Net Cultivable Area (NCA). Spices→ Fallow→ T.Aman is the cropping pattern covering about 21.02% of the NCA. Chili→Jute→Fallow is covering about 18.37 % of the NCA. Further, Wheat/Maize→ Fallow→ T.Aman which is practiced about 4.90% of the Net Cultivable Area

(NCA). Similarly Onion (HYV)→ Jute→ T.Aman which is practiced about 4.90 of the NCA. Potato/S.Potato→ Boro (HYV/Hybrid) → T.Aman which is practiced 4.49% of the Net Cultivable Area (NCA). Winter vegetables cropping pattern covering about 2.24% of the NET Cultivable Area. Sariakandi Upazila land is very fertile and main crop is Boro (HYV/hybrid), T. Aman & potato, Wheat, Maize, Jute, Onion, Chili and farmers also cultivated multiple crops such as vegetables, Mustard, Groundnut, Pulses and different fruits (Mango, Litchi, Papaya and Guava) production.

Table 4.1: Present Cropping Pattern under Sariakandi Upazila

Major Cropping Pattern			Area (ha)	Contribution %
Rabi	**Kharif-1**	**Khari-2**		
Boro (HYV/Hybrid)	Fallow	T. Aman (HYV)	7800	31.84
Boro (HYV/Hybrid)	Fallow	Fallow	345	1.41
Winter vegetables	Summer vegetables	T.Aman(HYV)	190	0.78
Winter vegetables	Fallow	T.Aman(HYV)	550	2.24
Mustard/groundnut	Boro (HYV/Hybrid)	T. Aman (LIV)	455	1.86
Pulses	Jute	T.Aman	375	1.53
Wheat/Maize	Fallow	T. Aman (HYV)	1200	4.90
Potato/S.Potato	Boro (HYV/Hybrid)	T.Aman	1100	4.49
Onion	Jute	T.Aman	1200	4.90
Boro (HYV/Hybrid)	Jute	T.Aman(HYV)	800	3.27
Spices	Fallow	T.Aman	5150	21.02
Chili	Jute	Fallow	4500	18.37
Groundnut	jute	Fallow	600	2.45
Fruits Garden (Orchard)	Fruits Garden(Orchard)	Fruits Garden (Orchard)	235	0.96
Total			**24500**	**100**

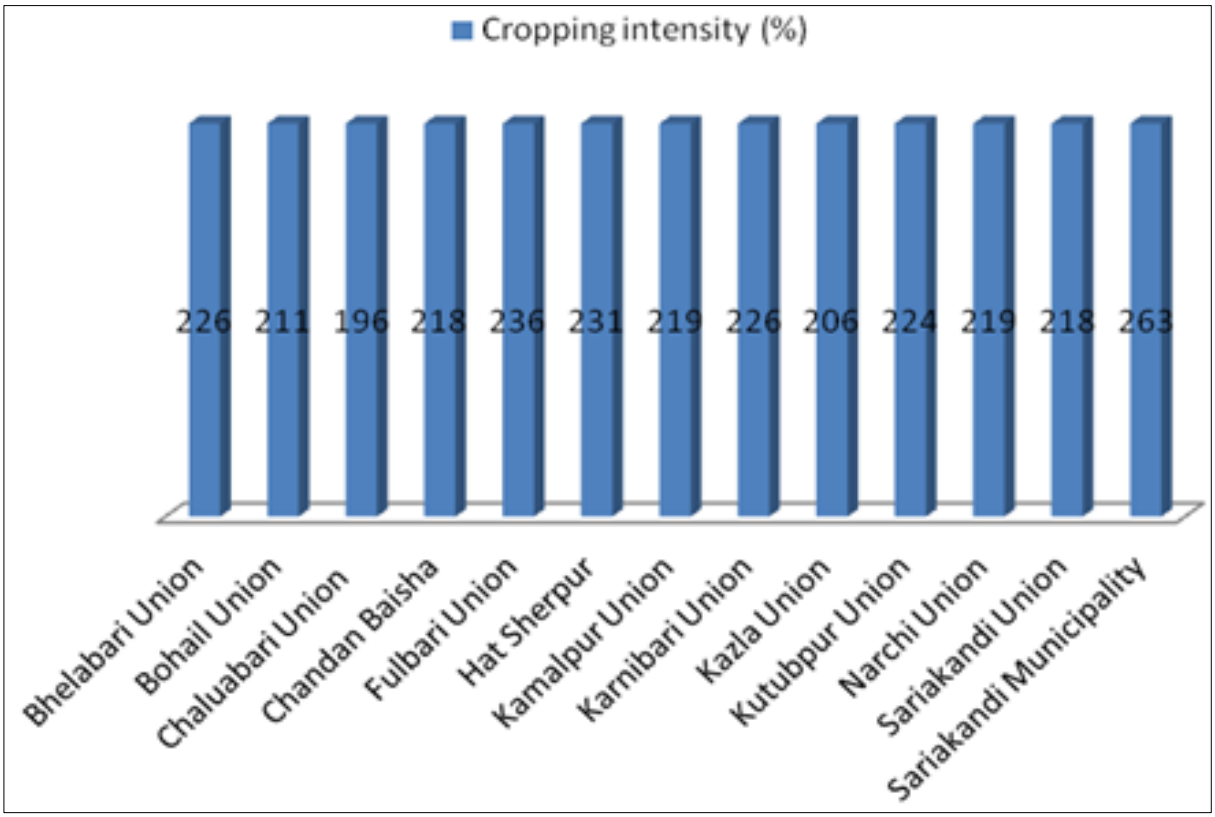
Source: SAAOs and UAO Sariakandi Upazila, DAE 2016

4.2 Cropping Intensity

It has given utilization status of agricultural land and cultivation of crops. Cropping intensity depends on land type, seasonal flood inundation period, types of crops selection for cultivation and soil. It is Index refers to the changes in the cropping intensity of crop compared to a given base year. 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.

Farmers Sariakandi Upazila is practiced multiple cropping patterns .The present Municipality (1) and Union wise (12 Unions) cropping intensity is shown in Figure 4.1. The average cropping intensity under Sariakandi Upazila is 228% which is higher than cropping intensity of 10 Unions and also less than 2 Unions and Municipality (Figure 4.1). The highest cropping intensities were achieved in Sariakandi Municipality (263%), Followed by Fulbari Union (236%) and Hat Sherpur Union (231%).The average cropping intensity under Sariakandi Upazila is 228% which is less than Bogra district (260%) and higher than national average cropping intensity (190%) (Krishi Diary 2016). It is clearly Figure 4 shows that all the 12 unions and 1 municipality under Sariakandi Upazila cropping intensities is higher than national average cropping intensity (190%).



Source: SAAOs and UAO Sariakandi Upazila, DAE 2016

Figure 4.1: Union wise Cropping Intensities under Sariakandi Upazila

4.3 Present Cropped Area

Cropped cultivated area depends on land types & soil fertility, crop variety and irrigation facilities and inputs availability etc. Major different crops cultivated under Sariakandi Upazila

are Boro (HYV/Hybrid), T. Aman (HYV/LV) and T. Aus (HYV), Jute, Wheat, Maize, potato, mustard, groundnut, Chili, Onion, winter and summer vegetables, and pulses, and various fruits crops (Banana, Litchi, Mango, Papaya). Sariakandi Upazila present scenario of rice and non-rice cropped area, yield rate and production levels are shown in Table 4.2. The present total different cultivated cropped area is 46137 ha of which rice cropped area are 22470 ha and the rest 23667 ha is covered by non-rice crops. The rice and non-rice cropped area are about 49% and 51% respectively of the total cropped area. The highest land area was used for Boro (HYV/Hybrid), T. Aman (HYV) rice, Jute and Spices crops cultivation.

4.4 Present Crop Production

It is a food producing self-sufficient Upazila. Total 73733 metric tons foods produced per year under Sariakandi Upazila. Food requirement for this Upazila population is 44509mt and food surplus is 29224mt per year (UAO 2016). Crops higher yield depends on variety, soil types, balance use of fertilizer, pest's control, irrigation, weed and other management. Hybrid crops give higher yield in compared to HYV and local variety crops. Total crop production is 236999.8 metric tons of which rice production is 72943.4 metric tons and non-rice production is 164056.4 metric tons (Table 4.2). The rice and non-rice cropped production are about 31% and 69% respectively of the total cropped production. The highest contribution among the various crops was given by Boro (HYV) & T.Aman (HYV) rice and Jute and spices (Table 4.2).

Table 4.2: Present Cultivated Area, Yield and Production under Sariakandi Upazila

Crop Grown	Crop Area (ha)	Yield/ha (mt)	Production (mt)	Contribution (%)
T. Aus (HYV)	1850	2.82	5217	7.15
T. Aman (LV)	560	1.5	840	1.15
T. Aman (HYV)	10000	3.01	30100	41.26
Boro (HYV)	9910	3.64	36072.4	49.45
Boro (Hybrid)	150	4.76	714	0.98
Sub Total Rice	22470		72943.4	100.00
S. Vegetables	190	14	2660	1.62
W. vegetables	555	20	11100	6.77
Wheat	1740	1.95	3393	2.07
Maize	1695	7.5	12712.5	7.75
Jute	7970	9.52	75874.4	46.25
S. Potato	505	14	7070	4.31
Potato	745	11.5	8567.5	5.22
Onion	1430	8	11440	6.97
Spices	5150	4.22	21733	13.25
Oil seeds (Mustard, Til, Groundnut)	1790	1.1	1969	1.20
Pulses	1662	1	1662	1.01

Crop Grown	Crop Area (ha)	Yield/ha (mt)	Production (mt)	Contribution (%)
Fruits (Orchard)	235	25	5875	3.58
Sub-Total	**23667**		**164056.4**	**100.00**
Total	**46137**		**236999.8**	

Source: SAAOs and UAO, Sariakandi Upazila, DAE 2016

4.5 Irrigation Facilities under Different Unions and Municipality Areas

Irrigation is one of key factor for producing cereals and many other crops. Boro rice is completely dependent on irrigation. In Rabi season mechanized irrigation can help to increase crop diversification. Status of Union wise irrigated and non-irrigated area covered under Sariakandi Upazila is shown in Table 4.3. It is reported that during Rabi season 60-100 % land area covered by irrigation water. Farmers of Sariakandi Upazila have given supplementary irrigation to rain fed crops when needed or during drought period. Majority of the farmers have access to irrigation water which is a good sign for intensive farming. Upazila Agriculture Officer reported that misused of irrigation water due to individual level excessive setup of irrigation pump. But in the long term, excessive ground water lifting may cause an adverse impact both in agricultural production and in the surrounding environment.

Table 4.3: Status of Union wise Irrigated and Non-irrigated Area under Sariakandi Upazila

Sl. No.	Name of Union	Irrigated Area (%)	Non-irrigated Area (%)	Remarks
1	Fulbari	100	00	
2	Karnibari	100	00	
3	Chaluabari	100	00	
4	Hat Sherpur	80	20	
5	Kajla	60	40	Rain fed crops has given supplementary Irrigation during drought period.
6	Sariakandi	70	30	
7	Kutubpur	90	10	
8	Bhelabari	100	00	
9	Chandan Baisha	75	25	
10	Kamalpur	98	2	
11	Bohail	100	00	
12	Narchi.	85	15	
13	Sariakandi Municipality	100	00	

Source: SAAOs under Sariakandi Upazila DAE 2016

The main source of water is both surface and ground water. For Boro Rice cultivation ground water conservation and proper utilization is very important. This study are assessed the present scenario of irrigation facilities and problems. For irrigation water lifting 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 Sariakandi Upazila is shown in Table 4.4. A total of 7266 machine were used for lifting irrigation water under Sariakandi Upazila. Out of total irrigation machine, 38 DTW, 7182 STW and 46 LLP along with other indigenous irrigation tools are used for lifting water. All DTW and 488 STW and 5 LLP has electricity facilities but 6694 STW & 41 LLP has no electricity. Electricity user's farmers reported that failed or disruption of electricity supply during Boro season were acute problems under Sariakandi Upazila. Famers wanted nonstop electricity supply during Boro season. Others farmers wanted electricity connection. Majority of the Farmers reported irrigation drainage system DTW is katcha (90-100%) but 100% STW & LLP drain is katcha which is causes wastage of irrigation water. Farmers wanted pucca drainage system which will be helpful for increasing irrigated crops area.

Table 4.4: Union Wise Irrigation Machine Used under Sariakandi Upazila

Name of Union	DTW		STW		LLP		Remarks	
	Electricity	Diesel	Electricity	Diesel	Electricity	Diesel	%Pucca	% Kutch Drain
Fulbari	11	0	214	540	3	10	DTW=10, STW=0 LLP=2	DTW=90, STW=100 LLP=98
Karnibari	0	0	0	770	0	0	STW=00	STW=100
Chaluabari	0	0	0	380	2	2	,STW=0	STW=100
Hat Sherpur	7	0	12	400	0	2	DTW=5	DTW=95 STW=100
Kazla	0	0	0	920	0	0	DTW=00	DTW=00, STW=100
Sariakandi	3	0	58	200	0	2	DTW=00 STW=00	DTW=100 STW=100
Kutubpur	2	0	86	767	0	0	DTW=5	DTW=95 STW=100
Bhelabari	4	0	20	330	0	5	DTW=5	DTW=95 STW=100
Chandan Baisha	0	0	4	60	0	0		STW=100
Kamalpur	2	0	9	1030	0	0		STW=100
Bohail	0	0	0	960	0	0		STW=100
Narchi	9	0	70	310	0	20		DTW=100, STW=100
Sariakandi Municipality	0	0	15	27	0	0	STW=2	STW=98
Total	38	0	488	6694	5	41		7266

Source: SAAOs under Sariakandi Upazila, DAE 2016

4.6 Cultivation Practices

The farmers of Sariakandi Upazila are famous for cultivation of Chili and Onions and Potato. Municipality and all the 12 Unions are dominated by diversified agriculture crops grown are: Boro HYV/Hybrid variety of rice and Transplanted Aman (HYV) rice, T. Aus (HYV), Sweet potato, Jute Mustard, groundnut, and different kinds of winter and summer vegetables, Spices, pulses which are cultivated under both rain fed and irrigation condition. Farmers are cultivated different vegetables such as Brinjal, cabbage, cauliflower, tomato and ladyfinger etc. All the SAAOs and UAO reported that about 80 farmers used power tiller, 16% tractor and 4 % farmers used Bullock during land preparation. Boro and T. Aman rice seedlings grown in seedbed are uprooted when they are about 30-45 days old and transplanted in the main fields. They transplanted Boro and T. Aman rice 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. 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

Main Crops

Rice and Wheat is a primary crop and a staple food of this area. Here the growth of rice production is much faster. Paddy (Boro rice (HYV/Hybrid), T.Aus (HYV) and T.Aman (HYV/LIV), Jute, Wheat, Maize, Vegetables, Mustard, Groundnut, Spices (Onion, Chili) and Pulses etc. Jute, Onion and Chili are the main cash crops of this Upazila. It 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. Farmers need to cultivate BJRI innovative variety of Jute such as HC-95, HS-14 for better yield. 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.

Maize Cultivation

Now-a day's Maize is very important cash crops in Bangladesh. 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. For getting better yield farmers need to cultivate BARI Hybrid Bhuta-1, 8, 9, 10, 11 varieties. Lack of capital as well as high price of inputs is a barrier to its higher production.

Potato

It is widely commercially cultivated in winter with huge potential in Sariakandi area. The soil and climate conditions of Sariakandi area are favorable for potato production. Both potato and Sweet potato are grown under Sariakandi Upazila. It is one of the cash crops for Sariakandi farmers. Sunny land with cool and moisture in soil is appropriate for potato cultivation. Potato, a tuber crop, is cooked and eaten as a vegetable. In the context of nutrient, potato is comparable with rice and wheat. 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

Farmers of Sariakandi Upazila generally cultivate mustard before Boro cultivation. Mustard, Groundnut, and Til are popularly cultivated in Sariakandi Upazila. Mustard as an oilseed crops takes first place in respect of cultivated area in Bangladesh. 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

The soil and climate conditions of 12 Unions and Municipality area are favorable for multiple vegetables production. 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. Encouraging homestead level vegetables cultivation could be alternative source of household income generation. It is widely cultivated in winter with huge potential in Sariakandi Upazila. 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 production.

Spices

Chili, Turmeric, Ginger, Onion & Garlic etc. are the major spices crops. The soil and climate conditions of this Sariakandi area are favorable for Chili and Onion production.

Fruits

Mango, Jackfruit, Litchi, Banana, Coconut, Betel Nut, Country Goose Berry, Guava, Plum, Kul, Papaya etc. are grown in this Upazila. Many farmers were established commercial fruit garden of Mango, Litchi, Papaya and Guava etc.

Conversion of Agriculture Land to Non-agriculture

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. Agricultural land denotes the land suitable for multiple crop production. It is one of the main resources in agriculture. Many high value crops are grown in Sariakandi Upazila. The diversified uses of land are always creating problems in respect of its criteria based uses and creating conflicts among the uses. It is predicted that the Upazila may face extreme impacts of climatic change in future. These vulnerabilities as well as opportunities call for distinctive management arrangements for proper uses of land and other resources of the Upazila.

In Sariakandi a substantial amount of agricultural land had been shifted to a non-agricultural one via construction of houses, brickfield, sawmill, industry, road, market and other infrastructures. Without proper planning convert 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 4.1: Groundnut Field

Plate 4.2: Boro Rice Field

Plate 4.3: Silted canal and Cleaning Jute

Plate 4.4: River Erosion & Silted

Plate 4.5: Homestead Garden

Plate 4.6: Brinjal Field

CHAPTER FIVE: PRODUCTION COST OF RICE AND VEGETABLES

5.1 Cost of Rice Production

Production cost is important factor for farmers, because when production cost is less than more profit will be achieved. The production cost of rice varies depending on crop season, variety (HYV/Hybrid/LV), land preparation (Power tiller/Tractor/Bullock), seeds and seedlings, manure and fertilizer, irrigation (complete irrigated (Boro Rice) and rain fed or provided supplementary irrigation), pesticide and labor. To assess farmers cost of rice production, Agriculture Economic Division of BRRI (2014-15) were conducted survey all over the country in three rice seasons (Boro, Aus and Aman paddy). BRRI evaluation findings shows that Boro and Aus farmers per kg rice production cost is Tk. 18.65 and Tk.18.64 and Aman rice production cost is Tk. 17.61 which is less than Boro and Aus (Table 5.1). Department of Agriculture Marketing was estimated production cost for Boro rice Tk.18.20 per kg, Aman Rice Tk.18.08 per kg and Wheat Tk. 23.50 per kg in the year 2015-16. On the basis of farmers crop production cost Government has declared buying rate of Boro rice Tk. 20.70, Aman rice Tk. 18.50 per kg and Wheat Tk. 27.02 per kg respectively. Farmers and DAE SAAOs reported that Boro rice per kg or per ha production cost is higher than T. Aman rice because T. Aman rice is cultivated by natural water or rain water. There is no need for supplementary irrigation for Aman rice production. Fertilizers and pesticides, weeding and labor are needed more in Boro rice production in compared to Aman rice.

Table 5.1: Cost of Rice Production (2014-15)

Name of Rice	Average per kg rice production cost (TK)	Crop season	Source
Boro	18.65	Rabi	BRRI2014-15, Agriculture Economic Division
Aus	18.64	Kharif-1	
Aman	17.61	Kharif-11	
Boro	18.20	Kharif-1	Department of Marketing 2015-16
Aman	18.08	Kharif-11	
Wheat	23.50	Rabi	
Government Buying rate from Farmers: Boro Tk.20.70/kg, Aman Tk.18.50/kg & Wheat Tk.27.02/kg.			

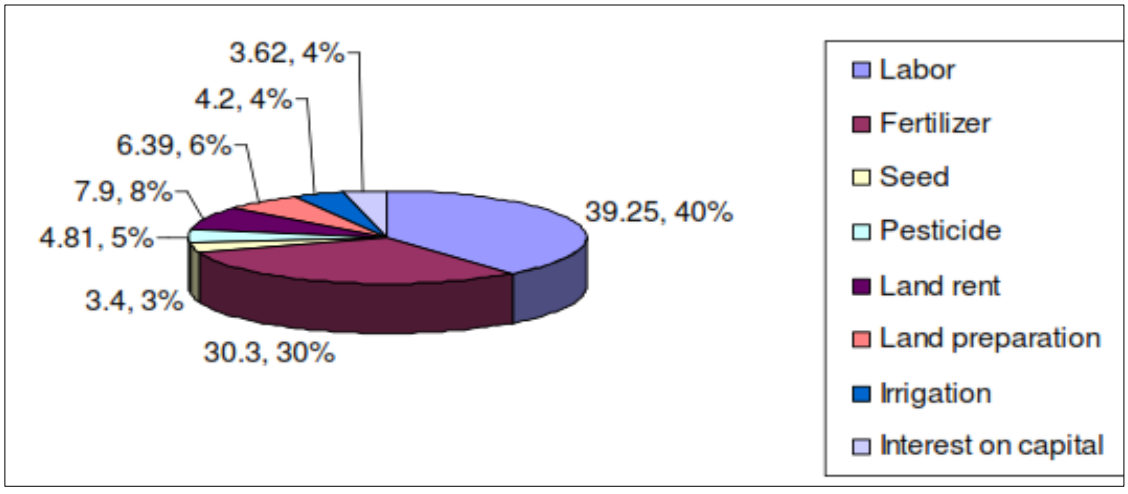
5.2 Cost of Vegetable Production

Vegetables production cost are very important for farmers. Some of the vegetables are exported to other countries and day by day internal demand also increased. Farmers and DAE field personnel reported that many farmers have moved to vegetables production instead of paddy

and others crops. 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.

Monsura Zaman, Rokhsan-Ara-Hemel and Tahmina Ferdous (2010) assess the cost of production of four winter vegetables namely cauliflower, cabbage, tomato and brinjal in five villages under Dhaka district. The study finding shows that 39.2% of the total cost was devoted to labor, 30.3% to fertilizer, 3.4% to seed, 4.8% to pesticides, 7.9 % land rent, 6.3% to land preparation, 4.2% to irrigation and 3.6% to interest on capital, whereas, the result estimated by AVRDC (2001) shows that 48.4% of the total cost was devoted to labor, 24.2% to fertilizer, 6.1% to irrigation, pesticides and 3.7% to seeds. Figure 5 Cost of per kg and per 40kg was found approximately the highest for tomato and the lowest for cabbage and cauliflower.

Farmers of Sariakandi 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.6000-7000/- *(Upazila Agriculture Office, Sariakandi).* Generally, supplementary irrigation provided potatoes, Chili and winter vegetables. Supplementary irrigation cost is 2000-3000 taka or more depends on crops and number of application. The highest supplementary irrigation provided in winter and summer vegetables crop field. The highest pesticides used in T. Aman and Boro rice fields (Tk.5000-5500/-) and W & S. vegetables fields (Taka 4000-4500/ha). Labor cost day by day increased and per day labor cost more or less Tk. 400-500 depends on crop season.



Source: ASA University Review, Vol. 4 No. 1, January–June, 2010

Figure 5.1: Percentage of Major Types of Production Costs for Vegetables

The present study was assessed financial profitability of Brinjal, Tomato, Potato and Cabbage/cauliflower vegetables production under Sariakandi Upazila which is shown in Table 5.2. Tomato cultivation is more profitable (Tk. 756000 per ha) followed by Brinjal (Tk. 442800 per ha), Cabbage/Cauliflower (Tk. 288600) and potato production (Tk. 211050 per ha) respectively. Study finding clearly indicated any kind of vegetables cultivation is more profitable for Sariakandi Upazila famers.

Table 5.2: Financial Profitability of 4 Types of Vegetables Production in Sariakandi Upazila

Vegetables	Yield (Kg/kg)	Price (Tk./Kg)	Gross Return (Tk./ha)	Total Cost (Tk./ha)	Net Return (Tk./ha)
Brinjal	22000	26	572000	129200	442800
Tomato	26000	35	910000	154000	756000
Potato	20000	21	420000	208950	211050
Cabbage/ Cauliflower	16000	25	400000	111400	288600

Source: SAAOs Sariakandi Upazila, DAE 2016

Several studies were done to estimate the financial profitability of brinjal vegetable production (Table 23). Farmers are cultivated brinjal vegetables throughout year. It was estimated compare the financial profitability of brinjal vegetable production in different region in Bangladesh. 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 pesticides and fertilizers to increase production and protect vegetables from diseases and pests. 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: Comparison of 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

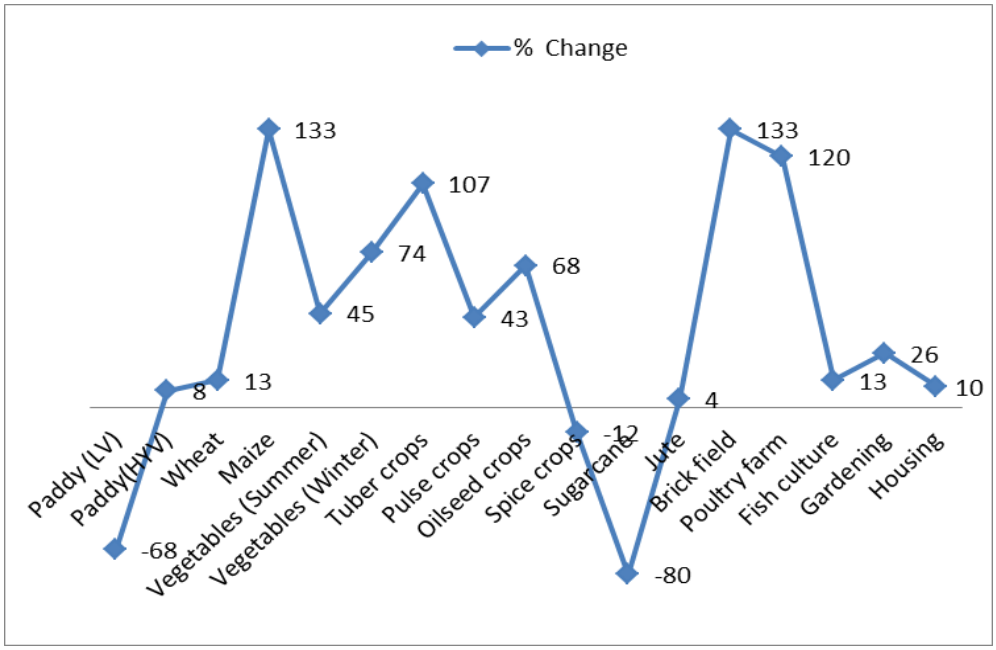
The Sariakandi Upazila land in one hand is rich in both aquatic and terrestrial resources and on the other hand is vulnerable to natural and man-made hazards like river erosion, drainage congestion, deforestation and unplanned uses for housing and industries which are the main causes of land degradation, loss of biodiversity, human lives and properties. But the fact is that these valuable resources are now under threat due to over exploitation and unplanned uses for urbanization, human settlements, and infrastructural development and meeting with demands of the people. A census on land resources reported that everyday 220 ha of arable land was converting for other uses like constructions of houses, roads, commerce and industries and for other non-agricultural activities, which is very alarming for the sustainability of land resources of our country (Banglapedia 2003). It is very important to know the present picture of agricultural land utilization for future development of sustainable plan in any area.

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 1 Municipality and 12 Unions all Sub- Assistant Agriculture Officers of Sariakandi Upazila and review the other documents. The growth or decline of agricultural land use during last ten years under Sariakandi Upazila is shown in Figure 6.1 and Table 6.1. Table 6.1 finding shows 86% 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 18% was increased. The reason for increased HYV rice cultivated area due to higher yield many farmers were cultivated HYV and Hybrid rice. Remarkable significant highest changed or increased during 10 years was occurred in Pulses (343%) followed by Spices crops (287%) and winter vegetables (270%), Maize (183%) and oil seeds (178%) increased but highest decreased in local variety rice (-86%) followed by summer vegetables (-69). The main reasons for increases are produce crop market demand and price is high. Table 6.1 and Figure 6.1 shows, among the other purposes remarkable significant changed were occurred in poultry farm (150%) and followed by Brick field (43%), Housing (10%), Gardening (7%) and fish cultivation (2%) respectively. Study finding clearly indicated crop land day by day has gradually decreased which will be reflected on overall agriculture crop production.

Table 6.1: Growth or Decline Agriculture Land Use during the Last 10 Year

Sl. No.	Agricultural land use	Land Use (2005) in ha	Land Use (2015) in ha	Percentage (%) of Change
1	Paddy (local varieties)	5065	710	-85.98
2	Paddy (HYV)	18515	21910	18.34
3	Wheat	800	944	18
4	Maize	600	1695	182.5
5	Vegetables (Summer)	620	190	-69.35
6	Vegetables (Winter)	150	555	270
7	Tuber crops	1185	1935	63.29
8	Pulse crops	375	1662	343.2
9	Oilseed crops	645	1790	177.52
10	Spice crops	1330	5150	287.22
11	Sugarcane	17	31	82.35
12	Jute	4300	7970	85.35
14	Other purposes			
	Brick field	21	30	42.86
	Poultry farm	4	10	150
	Fish/shrimp culture	13000	13316	2.43
	Gardening	220	235	6.82
	Housing	2950	3252	10.24

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



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

Figure 6.1: Percentage Changed of Land Used from 2005-2015 under Sariakandi Upazila

CHAPTER SEVEN: MAJOR PROBLEMS OF CROP PRODUCTION IN SARIAKANDI UPAZILA (12 UNIONS AND 1 MUNICIPALITY)

Agriculture survey findings and Participatory Rural Appraisal September 2016 study report findings show farmers some problems are common in different unions under Sariakandi Upazila such as flood, water logging, drought, bad communication and wholesale market and infrastructure. Major problems are:

- Sudden flood damaged crops;
- Water logging;
- Drought and irregular rainfall;
- River erosion;
- Katcha all irrigation drainage system and wastage of irrigation water;
- Misuse of irrigation water due to excessive setup of STW;
- Most of old canals and river silted;
- Less availability of quality HYV seeds;
- Lack of seed store;
- Insect pests, diseases and weeds problem;
- Lack of cold storage and vegetable cool-chamber;
- Lack of vegetables and fruits market infrastructure;
- Less availability of power tiller/tractor, harvester and foot pump and high price;
- Katcha road and damaged;
- Lack of transport facilities;
- Lack labor during planting and harvesting crops and wage rate is high;
- Low market price of agricultural commodities;
- Farmers lack of modern technological knowledge;
- Disturbance of electricity supply during Boro season;
- There is no agro processing center and industries under Unions level;
- Poor use of organic matter and soil nutrients deficiency; and
- Agricultural land decreasing due to human intervention of unplanned infrastructural development activities.

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 planning and adoption of appropriate crop production measure in future to different Unions beneficiaries under Sariakandi Upazila.

1. Developing Infrastructural Facilities

Construction of embankment with sluice gates for flood control, Excavation and re-excavation of new and old canals for solving water logging and irrigation facilities need to be improved for mitigating impacts of crop production related vulnerabilities and climate change. Road communication network at local level, agro-processing center and whole sale marketing infrastructure development, reconstruction of damaged water management infrastructures need to be made. In each Union one wholesale market infrastructure need to be constructed. Further in each Union one seed store infrastructure need to be constructed and also cold storage and food godown need to be established.

2. To Reduce the Irrigation water Wastage

Proper utilization and planned increase the irrigated command crop area the DTW, STW and LLP katcha drain need to be converted into pucca drainage system or introduce underground pipe irrigation system. Uninterrupted power supply to irrigation pumps. Need to be monitoring ground water table.

3. Farming and Adaptation Practices

Adapt modern farming techniques and Choose high yields and drought tolerant varieties. There is need for conducting, strengthening and expanding crop demonstrations and block farming based on adaptation practices. Introduction of risk resistant crop varieties in agriculture with emphasis on crop diversification should be an integral part of the TOT, farmers training and demonstrations.

4. Vegetables Production

Different types of winter and summer vegetables are grown under 12 unions and Municipality area. All the Unions are excellent suitable for vegetables cultivation round the year. There is no cold storage and large vegetable selling center (market) under 12 Unions. As results farmers could not get good price for their produced products. There is a need for establishment of cold storage each Union and development of market infrastructure.

5. Crop Production Inputs Availability

Ensure availability of quality HYV and hybrid crop seeds, fertilizer, pesticides and cultivation machineries in subsidized rate. Information on quality seed need to be provided up to block level.

6. Availability of Crop Seeds

Drought 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, Potato-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 project. Grow one leguminous crop (Dhaincha / Pulses/Fodder etc.) between two cereal crops. For increasing organic manure in the soil by changing cropping pattern /crop rotation system need to be practiced.

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 project.

9. Agro-based Industries

Establishment of agro-based processing center & industries in 12 unions and Municipality area. There is a need for construction of infrastructure for some agro-base processing center. 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 04 (Saghata, Sonatola and Sariakandi Upazila) which will be help for stopped the human unplanned infrastructural development intervention as well as ensure proper utilization of agricultural land.

11. The following additional systems may be adapted in an innovated way for sustainable crop production and environmental conditions of Sariakandi Upazila:

- Biodynamic/eco-friendly agriculture;
- Rice and non-rice crops integrated farming;
- Grow vegetables predominantly;
- Fruit tree based agro-forestry system;
- Integrated pest management;
- Natural disasters adaptive, rain fed and resilience farming;
- 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

Fertile land type and ecological conditions are suitable for different vegetables, and fruits crops and other high value crops cultivation round the year in Sariakandi Upazila. Chili and onion are important cash crops in this Upazila. There is a need to develop vegetables & fruits wholesale market and improvement of road communication system different Unions to Upazila. Farmers need improve modern crop production technological training which will be helpful for crop diversification and proper utilization land and increase crop production. For improvement of irrigation facilities katcha 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, orchard and vegetable cultivation and reduce the pesticide use. Electricity power supply should be ensured during Boro crop season. Construction of potato and vegetables & 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 mango, litchi, maize, jute and vegetables as commercial basis to export. Construction of embankment with sluice gates and drainage system which will be protected crops from early and sudden flood.

REFERENCES/BIBLIOGRAPHY

1. Anonymous (2016). Krishi Diary 2016: Agriculture Information Services, DAE, Khamarbari, Dhaka.

2. Anonymous (2016). Report on Participatory Rural Appraisal (PRA) "Preparation of Development Plan for Fourteen Upazilas, Package 04, Sariakandi & Sonatala and Saghata Upazila", March, 2016.

3. Anonymous (2016). Sariakandi Upazila Crop Production Plan 2015-16: Upazila Agriculture Office, Sariakandi Upazila under Bogra district.

4. Anonymous (2001). Soil Resource Development Institute, 1997, Land and Soil Use Guide Sariakandi Upazila, Bogra District.

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

6. Anonymous (2010): ASA University Review, Vol. 4 No. 1, January–June, 2010

7. 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.

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

9. BBS (2011). District Statistics 2011 Bogra, Statistics and Information Division, Ministry of planning, Dhaka

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

11. 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.

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

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

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

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

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

17. 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)

18. 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.

ANNEXURE

Annexure- I: 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 (0.05 - 0.50 acre)		
2.	Marginal (0.51 - 1.50 acre)		
3.	Small (1.51 - 2.50 acre)		
4.	Medium (2.51 - 7.50 acre)		
5.	Larger (above 7.50 acre)		
Total			

Present Land Use under Union

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

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

Sl. No.	Land type and Flood Depth. (cm)	Present	
		NCA (ha)	Percentage (%)
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

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

4. 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:		

5. 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=		
Others=			Onion=		
Tuber crops=			Garlic=		
Potato=			Jute=		
Sweet potato=			Sugarcane=		
Bamboo=			Betel nut=		
Bete line (Pan)=					

6. (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. ----------

Annexure-II: Agriculture Questionnaire for Urban and Rural Economy Study

Name: _____ Designation: _____

Department: _____ Name of Block: _____

Name of Union: _____ Upazila: _____

District: _____

Mobile No.: _____ Date: _____

1. Category wise distribution of Farm Families in Block

Sl. No.	Category	No. of farm family	%
1	Land less (0.05 - 0.50 acre)		
2	Marginal (0.51 - 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. Agricultural land and land Use in Block

Sl. No.	Description of agricultural land	Area (ha)
1	Total agriculture land area	
	High land	
	Medium high land	
	Medium low land	
	Low land	
2	Permanent fallow land	
3	Current/seasonal fallow land (with fallow period) -Rabi fallow	
4	-Kharif-I fallow -Kharif-II fallow	
5	Net cropped area	
6	Single cropped area	
7	Double cropped area	
8	Triple cropped area	
9	Total cropped area	
10	Cropping intensity (%)	

Sl. No.	Description of agricultural land	Area (ha)
11	Irrigated land area (%)	

3. Irrigation Facilities

Deep Tube Well (DTW) Yes---------- No---------- Number----------

Shallow Tube well (STW) Yes---------- No---------- Number----------

Low Lift Pump (LLP) Yes---------- No--------- Number----------

Others----------

4. Cultivation Practices

Power tiller----------% Used, Tractor ----------% Used

Bullock ----------% Used

5. Cropping Pattern

Sl. No.	Cropping Pattern			Area of Land	Percentage (%)
1|					
2|					
3|					
4|					
5|					
6|					
7|					
8|					
9|					
10|					
11|					

6. Cropping type and Present Crop Area & Production under Block

Crop Area (ha)	Area (ha)	Yield/ha	Crop Area (ha)	Area (ha)	Yield/ha
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			Chilli		
Others			Onion		
Tuber crops			Garlic		
Potato			Jute		
Sweet potato			Sugarcane		
Bamboo			Betel nut		
Betelvine(Pan)			banana		
Other crops			Mango		
			Papaya		

7. Growth or Decline Agriculture Land During the Last 10 year.

SL No.	Agricultural land use	Land use (2005-06) in ha	Land use (2015-16) in ha	Causes of increase or decline
01	Paddy (local varieties)			
02	Paddy (HYV)			
03	Vegetables (Summer)			
04	Vegetables (Winter)			
05	Tuber crops			
06	Pulse crops			

SL No.	Agricultural land use	Land use (2005-06) in ha	Land use (2015-16) in ha	Causes of increase or decline
07	Oilseed crops			
08	Spice crops			
09	Fruit crops			
10	Wheat			
11	Maize			
12	Sugarcane			
13	Jute			
14	**Other purposes** -Brick field			
	-Poultry farm			
	-Fish/shrimp culture			
	-Gardening/forestry			
	-Industries			
	-Housing			
	-Others			

9. Major problems to Crop Production in Block/Union

1. _____
2. _____
3. _____
4. _____
5. _____

10. Future Need for Sustainable Crop production.

a)

_____

b)

_____

c)

_____

d)

_____

e)

_____

11. Major problems related to crop production system Under Union

1.

2.

3.

4.

5.

12. Future Need for Sustainable Crop production under Union

1.

2.

3.

4.

5.

13. Conclusion and Recommendation

1.

2.

3.

4.

5.

Annexure-III: Photographs

Part-1: Photo of Discussion with SAAO

Meeting with UNO and Sub-Assistant Agriculture Officers in Sariakandi Upazila Parishad

Agriculture Expert, Project Manager and Upazila Agriculture Officer meet with UNO

Upazila Agriculture Officer is giving his speech

Agriculture Expert is lecturing to SAAOs

Agriculture Expert is collecting data

Speech about project and agriculture

Part-2: Photographs of Questionnaire survey for KII and Agriculture

Upazila Agriculture Officer

Information collected from office of UAO