

## Original Research Article

### **A Comprehensive Appraisal of the Farming Scenario in Riverine Areas of Lower Assam, India**

#### **ABSTRACT**

The present investigation was undertaken to study the comprehensive appraisal of the farming scenario of Riverine (*Char*) areas of lower Assam based on prevailing climatic parameters, soil-site characteristics, existing cropping patterns and socio-economic conditions of the farmers. Three *Chars* of the district, viz., Faujdar *Char*, Simlabari and Bamunpara Part IV ~~was~~ were selected for the study. A multistage purposive cum random sampling design was adopted for the study. The average monthly temperature in the chars ranges from 18.9 to 28.6°C, which are usually suitable for most of the crops like *sali* paddy, maize, chilli etc. The analysis of physics-chemical parameters of the soil reveals a predominance of sand and sandy loam texture. The available N, P and K contents ranged from 84.2 to 108.5, 38.6 to 42.3 and 127.9 to 152.6 kg/ ha, respectively. The average yield efficiency percentage were observed highest (320.21%) in potato. The per cent pest infestation was recorded as 15-25% for almost all the crops studied.

**Key-words:** *Char*, cropping pattern, insect, questionnaire

**Comment [R1]:** What is 'Sali'? Explain for better understanding within the main text/

#### **INTRODUCTION**

The riverbed of the Brahmaputra is dotted with a number of riverine areas (*Chars*) all along its length in the plains of Assam. These *Chars* are formed by the suspended materials brought from the catchment areas of the rivers on account of any obstruction in the course of the rivers. Out of 3.61 lakh ha of *Char* area, an arable area of 2.42 lakh ha is supporting a large population of the farming community (GoA, 2018). The chars account for about 5 per cent of the total area of the state spreading across 14 districts, 55 blocks and around 2,300 villages (GoA, 2016). Economic backwardness limits *Char* dwellers' livelihood options. The income opportunities of farmers are severely restricted by recurring floods and erosion (Chakraborty, 2012). As per a report (GoA, 2018), the Dhubri district encompasses 480 numbers of villages in the *Char* areas covering an area of 64,767 hectares. The socio-economic backwardness is a matter of serious concern in the *Char* areas. For the majority of the *Char* dwellers, agriculture is

**Comment [R2]:** Significantly lacks global aspect of riverine people, their farming activities, their livelihood and issues they face.

Instead, directly jumping to the subject matter, introduction need to improve using background information.

the primary source of livelihood (Nath *et al.* 2021). Identification and quantification of socio-economic factors inhibiting the growth and development of *Char* farmers can pave the way to eradicate the problems of *Char* people.

Most of the *Chars* are made up of alluvial deposits, mostly silt and sand. The wide variation in physical and natural features, combined with the natural fertility of the alluvial deposits, facilitates the cultivation of a wide ~~varieties~~ variety of rabi and summer crops (Talukder *et al.* 2009). The ease of tillage operations in the *Char* land assists farmers to take up ~~of~~ various crops (Borkakati *et al.* 1999; Vadivelu *et al.* 2005).

**Comment [R3]:**  
Explain what is 'rabi'. Otherwise readers those who are not familiar to the study area go blind cannot understand such terms.

To increase agricultural productivity, considering the immediate and future opportunities of these lands, an evaluation was attempted to study the suitability and performance of the various crop. An attempt has also been made to prepare an appropriate cropping plan for further enhancement in crop productivity of in the study area.

## RESEARCH DESIGN AND METHODOLOGY

### Selection of the study area:

A preliminary survey cum Participatory Rural Appraisal (PRA) programme was carried out in 2021 in three villages of Dhubri district, *viz.*, Fauzdar *Char*, Simlabari and Bamunpara Part IV (Fig. 1). A multistage random sampling design was adopted for the study.

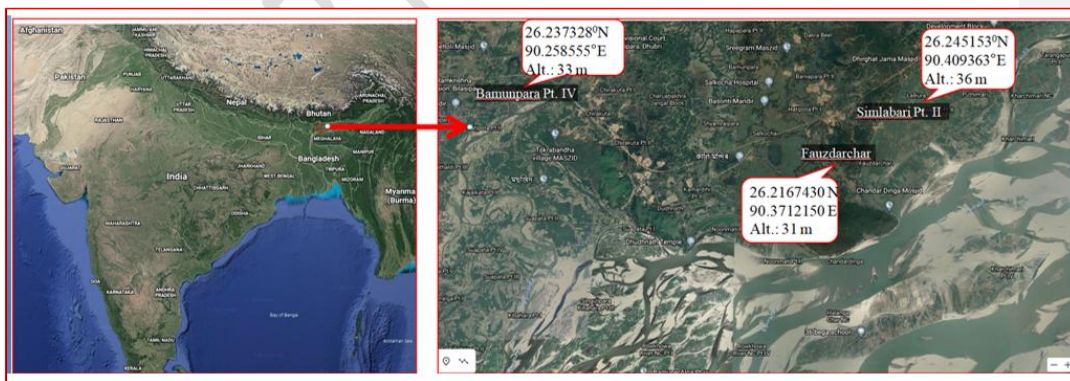


Fig. 1: Location of the study areas with GPS coordinates

### Period of Study:

Necessary information ~~were~~ was collected based on a survey using a standard questionnaire during the first quarter of 2021 through multiple visits to the study area.

Secondary data from various sources viz., District Agricultural Office, ~~Deptt.~~ Dept. of Economics and Statistics, Assam Agricultural University, Jorhat are used to corroborate demography, land tenure system, crop activity, land use and cropping pattern, farming system and price of inputs and outputs, the maximum and minimum area under certain crops, net benefit and ~~cost~~ cost-benefit analysis. ~~Average~~ The average yield efficiency percentage (AYEP) was calculated as:

$$\text{AYEP} = \frac{\text{Average crop yield per ha in the given area}}{\text{Mean crop yield per ha in the state}} \times 100$$

Soil samples (0- 15 cm) were collected from the study areas and analysed in the laboratory of the Department of Soil Science, SCS College of Agriculture, Assam Agricultural University, Rangamati, Dhubri, Assam. Particle size distribution, soil reaction, organic carbon, and available N, P, and K were estimated following standard methods.

#### Chart 1:- Survey Area:

Sl. No.	Village	GPS Coordinates
1.	Faujdar Char	26.2167430 N, 90.3712150 E, Alt.: 31 m
2.	Bamunpara part IV	26.237328 <sup>0</sup> N, 90.258555°E, Alt.: 33 m
3.	Simlabari	26.245153 <sup>0</sup> N, 90.409363°E, Alt.: 36 m

**Comment [R4]:**

Reference to the text is missing.

## RESULTS AND DISCUSSION

### Climate:

The Char areas visited receive an average annual rainfall of 1,856 mm. About 63.19, 26.38, 6.95 and 3.48 per cent of the annual rainfall occurs in the monsoon, pre-monsoon, post-monsoon and winter seasons, respectively. The rainfall during the period from November to February is sporadic and unreliable (Fig. 2). The occasional rainfall that occurs during this period helps to replenish the moisture deficiency of soils. However, such rainfall depending on its timing and intensity may also cause damage to the standing rabi crops. The average monthly temperatures in the chars vary between 18.9 and 28.6°C, which are usually suitable for most crops.

**Comment [R5]:**

What are these rabi crops?

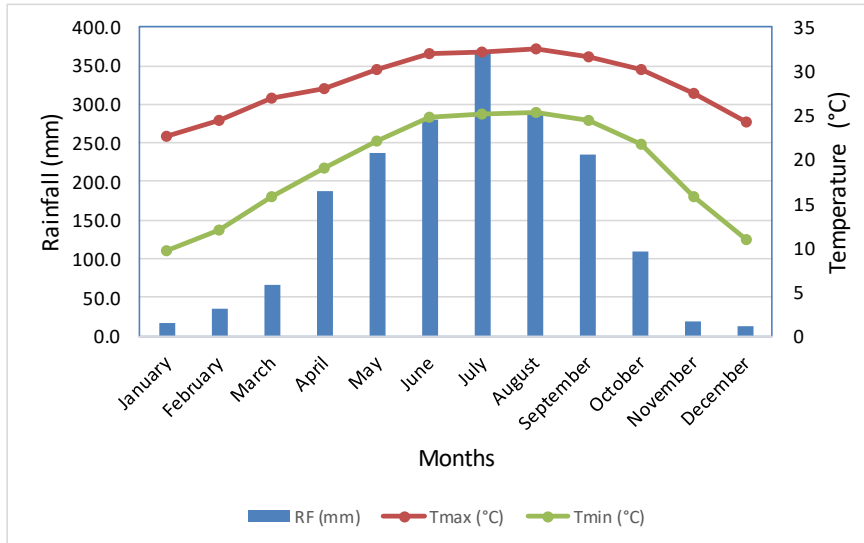


Fig. 2. Weather parameters prevalent in Char areas [average of ten years (2012 – 21)]

Comment [R6]:

Source of data?

Comment [R7]:

What is 'Sali' ?

Rice is a thermal sensitive crop with a temperature suitable for growth varying by the growth phase of the crop (Wassman *et al.* 2009). The day temperature up to 35°C and night temperatures of up to 25°C are suitable for rice growth during the *sali* paddy growing period. At tillering, the crop requires a higher temperature than in other stages of its growth. The crop requires 26.50-29.50°C for flowering. At ripening rice requires 20-25°C. Rice grows well in areas receiving average annual rainfall of 1000-1500 mm or more. The prevailing weather conditions at the visited chars were well within the suitable ranges for *sali* paddy.

Chilli grows well in areas with temperatures of 18-27°C during the day and 15-18°C during the night (Doorenbos and Kassam, 1979). A warmer night temperature above this range induces earlier flowering. The weather condition during the chilli growing winter months are congenial in the Char areas of Dhubri. Well aerated and well-drained soil condition of the visited Char areas also supports proper growth, flowering and fruiting of chillies.

A temperature range of 18-20°C is the optimum for the germination of maize seeds (Doorenbos and Kassam, 1979). The crop can tolerate hot and dry atmospheric conditions so long as sufficient water is available to the plant. It is also relatively tolerant to water deficits during the vegetative and ripening stages. Maize grows well in most soils except very sandy soil. The suitable agro-ecological conditions of Char areas support excellent crop growth of maize.

Jute is a tropical crop growing under a wide ~~variation~~-variety of climatic conditions. The optimum range of temperature required is 18-33°C. The crop is basically self-pollinated and needs long daylight for its growth. It grows well with an annual rainfall of 1,500 mm or more, with the occurrence of at least 250 mm of rainfall during each ~~of the months of~~ March, April and May (Banglapaedia, 2006).

#### Soil characteristics:

The soils in the study areas have an irregular relief of stratified sandy and silty deposits. The soils form under a diverse set of environmental conditions including vegetation, relief, drainage and age of sedimentation, which together lead to different patterns of soil fertility, crop suitability, land use and agronomic practices. The soil samples were collected during our field visits from the Fauzdar, Bamumparapart IV and Simlabari *chars*. The physio-chemical parameters of the soils of the three *Chars* under study (Table 1) indicated that soils contain sand in a large proportion and the texture varied from sand to loamy sand. ~~Meager~~-~~Meagre~~ quantities of ~~the~~ organic matter (0.38 to 0.51%) in the areas can be attributed to the recent deposit of sand in the top layer. The overall nutrient status of the soils was found to be medium to high (Table 2). The available N, P and K contents ranged from 84.2 to 108.5, 38.6 to 42.3 and 127.9 to 152.6 kg/ ha, respectively. Such soils are usually suitable for many crops. *Char* soil is usually productive as it benefits greatly from seasonal flooding through nitrogen fixation by blue-green algae and bacteria. The flooding also benefits through the addition of organic matter and nutrients from the decomposed flora and fauna. The seasonal fluctuation between aerobic and anaerobic soil conditions also makes phosphorus and possibly potash more readily available to plants (Brammer, 2000).

**Table 1: Physical and chemical characteristics of soil.**

Location	Colour	Sand	Silt	Clay	Texture	pH	OC (%)
Fauzdar <i>Char</i>	10YR7/1	85.8	10.7	3.5	Loamy sand	6.7	0.48
Bamunpara part IV	10YR7/1	78.6	12.5	8.9	Loamy sand	6.8	0.51
Simlabari	10YR6/1	92.4	3.5	4.1	Sand	6.5	0.38

**Comment [R8]:**

If you are abbreviating terms, first time you should express the whole. From second time onwards you can use only the abbreviation.

**Comment [R9]:**

Munsell color description describe 10YR7/7 as yellow colour. Likewise, author must describe the colour instead of providing the colour code.

Reader outside the field may not know what color is indicated by the code.

**Comment [R10]:**

Ibid.

colour description.

**Comment [R11]:** Ibid.

colour description.

**Table 2: Nutrient status of the soil.**

Location	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Faujdar Char	108.5	38.6	134.4
Bamunpara part IV	122.7	42.3	152.6
Simlabari	84.2	40.5	127.9

**Production status of various crops:**

The yield performance of summer rice (6600 kg/ha) is superior in the study area compared to *sali* rice (5400 kg/ha) owing to favourable prevalent weather conditions during the summer season. It is observed that the average yield efficiency of summer and *sali* rice are 254.53 and 250.00 per cent, respectively compared to the state average (Table 3). Among various pulses grown in *Char* areas, black gram exhibits great promise with 175.59 AYEP. In the case of oilseed crops, the AYEP of rapeseed, lentil, niger and sesamum are 194.49, 117.80, 161.29 and 84.51, respectively. Jute is a popular crop among the farmers and performs reasonably well in the *Char* areas with an AYEP of 162.31. The performance of potatoes (AYEP: 320.21) is very encouraging and suitable soil and climatic conditions might be attributed for to such higher yield in the study area. Chilli, though cultivated extensively by the *Char* dwellers and resulted in better yield compared to the state average (AYEP: 146.99), the incidence of pests and diseases are of major concern for realizing the potential yield.

**Table 3: Average yield efficiency percentage of major crops.**

Crops	Av. yield in the study area(kg/ha)	Av. yield in State (kg/ha)	Av. yield efficiency percentage (AYEP)
Sali rice	5400	2160	250.00
Summer rice	6600	2593	254.53
Rapeseed	1200	617	194.49
Back gram	1050	598	175.59
Green gram	900	753	119.52
Lentil	900	764	117.80
Niger	900	558	161.29
Sesamum	600	710	84.51
Jute	3600	2218	162.31
Potato	24000	7495	320.21

**Comment [R12]:**

Data sources? State level data probably taken from secondary source.

Chilli (green)	1439	979	146.99
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### Recommended land use pattern:

The factors like soil and climate along with food security, market price and local cultivation practice are the major determinants of crops and cropping system in the *Char* areas. The *Char* areas under study have three overlapping cropping seasons, viz., *rabi*, summer and *kharif*. The *rabi* season is usually during a flood-free period, but the latter part of the summer and the early part of the *kharif* seasons coincide with the flood period. Chilli, maize, jute, rice, peanut, wheat, millets, oilseeds, onion, garlic, sugarcane, peas and pulses are the crops grown in the *Char* areas. The crops are more diversified during the *rabi* season because of the favourable climate during this period.

Rice is a common crop in every *Char*. *Sali* rice is cultivated by the farmers in ~~mediumland-medium and~~ in spite of the great risk of flood damage, as the monsoon ensures the water requirement of the crop without irrigation. *Boro* rice (Summer paddy) is also common in all the *chars* under the study. *Ahu* rice (pre-monsoon season) is also found in most of the *chars*. Hybrid maize is also popularly grown in the study area. Jute is the single most dominant crop in the summer season in most of the *chars* of the Dhubri district. Sesame is grown in the pre-monsoon (April-June) season in ~~the char areas~~ the *char* areas under the study. Different kinds of vegetables are grown, though pumpkin is more popular. Onion, chilli, and mustard are traditionally cultivated in *chars* during the *rabi* season (dry period). The spices like chilli, black cumin and coriander are found to grow extensively. Lathyrus, cowpea, soybean and watermelon are also cultivated in the study area to a limited extent.

The dominant cropping pattern, however, varies from *Char* to *Char*. Several cropping patterns are followed in every *Char*. However, most of the patterns have at least one fallow season, though, in a few patterns, two or three crops are also grown, especially in the medium high land. ~~Number~~ The number of crops in the *rabi* season (dry period; November - March) is much higher than that in summer (April-June) or *kharif* season. The cropping patterns suggested for the *Char* areas are as follows:

1. Direct seeded early summer rice (February to May) - transplanted late winter rice (August to November)
2. Summer vegetables (February to May) - transplanted late winter rice (August to November) -

**Comment [R13]:**

What is Lathyrus? A kind of legume, provide scientific name.

potato/pea (December to February)

3. Summer vegetables (February to May) - transplanted late winter rice (August to November) - groundnut/pea (December to February)

4. Summer rice/summer pulse (February to May) - fallow – potato/vegetables/~~toria~~/wheat/pea (December to February)

5. Groundnut/melons (February to May) – fallow – early pulse/vegetables (December to February)

6. Summer rice (February to June) – fallow – sweet potato (September to February)

Different cropping patterns may be suggested for the *Char* areas under ~~the~~ study ~~on the basis of~~ based on soil suited to crops, ~~socio~~ socio-economic conditions, length of growing period of crops, ~~the~~ prevailing pattern of flooding, BC ratio, etc. Crop diversification relying on ~~the~~ introduction of new cultivars and adoption of locally ~~adoptable~~ adaptable agro-technologies may be suggested to address these issues. It is worth mentioning that, wheat is excluded as one of the major crops ~~of in~~ the study areas due to problems associated with threshing, storage, pre-harvest sprouting, etc. Concurrently, late transplanted winter rice may be a viable alternative for such locations. To evade the flood, two crops before and after its occurrence could be suggested. Moreover, ~~the~~ choice of the crop is mainly driven by the market demand, soil types, and available resources at the disposal of the farmers. It is expected that implementations of the suggested cropping pattern would enhance the productivity of crops in the areas under study.

#### Major insect pests:

Farmers, input dealers, extension officials and NGO staffs identified pests and diseases as hazards to crop production and storage across all the chars. The occurrence of pests and diseases in the fields is linked ~~with to the~~ weather. In the events of cold, fog, cloud, drizzle, hot, and seasonal weather change, the incidences of pests and diseases increase. The quality of seed, its processing/treatment before sowing, the occurrence of flood in the previous monsoon and the soil condition also factors in pest and disease incidences. Chilli is more affected than maize and jute. Plant, stem and root rotting, plant and root turning into yellow colour, leaf curl, leaf turning into white colour, formation of root nodule, and cutting of roots and plant bases are the pests- and disease-related hazards for chilli. Cutworm, aphid, thrips, mite, leaf curl virus and anthracnose are among the major pests and diseases for chilli. Maize is affected by different pests and diseases including cutworm, stem borer, aphid and leaf blight at its early growth stage

#### Comment [R14]:

What is toria? Mustered or rapeseed? Readers may confuse. So, explain.

and jute by hairy caterpillar, semi-looper and stems rotting at the mid-stage. Insects and rodents also destroy the stored chili and jute.

The major insect pests along with per cent infestation in all the surveyed *Char* villages of the district are depicted in Table 4. From the investigation, it was recorded that in all the crops pest infestation was recorded as 15-25%. The data were collected using simple random sampling in all the crop fields. ~~Majority~~ The majority of the farmers use pesticides for controlling ~~the~~ pests.

**Table 4: Major insect pests with per cent infestation.**

Crop	Major insect pests	% infestation
Sali rice	Yellow stem borer	20-25
	Leaf folder	20-23
	Case worm	15-18
	Gundhi bug	30-35
	Whorl maggot	15-20
Summer rice	Yellow stem borer	15-20
	Leaf folder	15-22
	Case worm	12-15
	Gundhi bug	25-30
Rapeseed	Aphids	30-35
	Saw-fly	15-20
Back gram	Aphids	20-25
	Pod borer	15-20
Green gram	Aphids	20-25
	Pod borer	18-20
Potato	Cut-worm	15-20

**Comment [R15]:**  
Since there are local names, it is advised to provide scientific names for insect pests.

	Red ant	20-25
	Mole cricket	20-25
Jute	Bihar hairy caterpillar	15-20
Tomato	Fruit borer	25-30
	Aphids	15-20
	White-fly	15-20
Okra	Jassids	20-25
	White-fly	15-20
	Fruit borer	15-25
Brinjal	Shoot and fruit borer	20-25
Chilli	White-fly	15-20
	Fruit borer	20-25
Cole crops	Cut-worm	15-20
	Diamond-back moth	10-15
	Aphids	15-20
Maize	Cut-worm	15-20
	Maize borer	20-25

(Data represents the average of three *Char* villages)

## CONCLUSION

In view of the findings of the present study, some tangible measures may be adopted focusing ~~in-on~~ the areas of soil testing, IPM, capacity building, infrastructure facilities, etc in the *Char* areas of the district. Multiple cropping and intercropping should be actively encouraged. Mobilization of institutional support for the creation of permanent assets, assured and timely availability of critical inputs, market linkage, credit facilities, etc is the need of the hour. It is expected that the socioeconomic standard of the farmers in the study area can be uplifted with

**Comment [R16]:**  
What is IPM?

the introduction of modern technologies and other amenities in conjunction with the recommendations provided. However, further investigations encompassing a larger study area with higher numbers of parameters concerning the socioeconomic status of the community may be advocated.

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### Comment [R17]:

References are limited only to the study area. Thus, significant pieces of literature are missing. Expand the use of more and most relevant literature outside India/Bangladesh. Global aspect towards the field of research need to demonstrate.

UNDER PEER REVIEW

