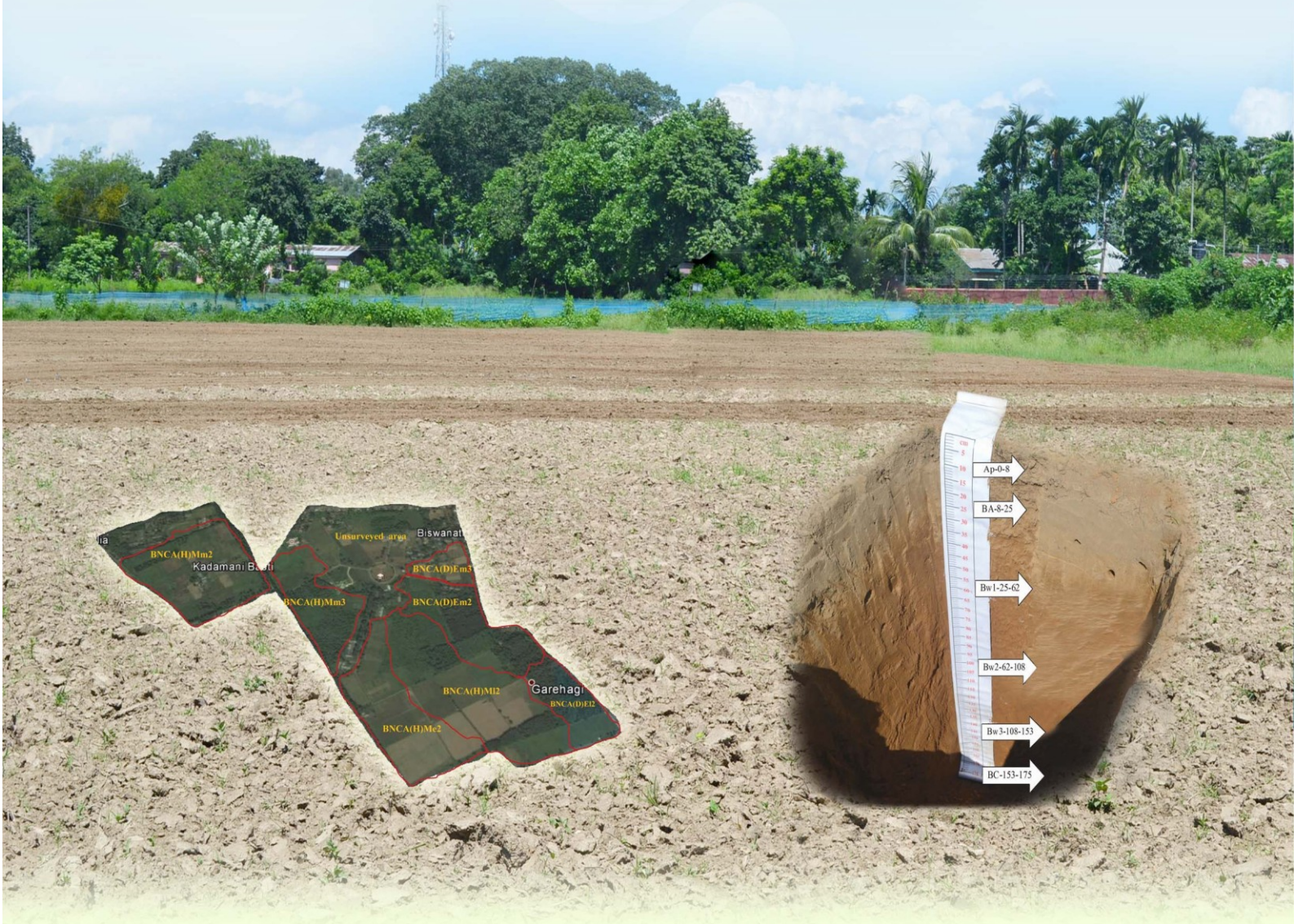
(AAU/DR/15(BU)/99/2015-16)

SOILS OF BISWANATH COLLEGE OF AGRICULTURE FARM : SURVEY AND LAND USE PLANNING



ALL INDIA COORDINATED RESEARCH PROJECT FOR DRYLAND AGRICULTURE

Biswanath Chariali Centre

Biswanath College of Agriculture, Assam Agricultural University

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All India Coordinated Research Project for Dryland Agriculture
Biswanath Chariali Centre, Biswanath College of Agriculture
Assam Agricultural University

Soils of Biswanath College of Agriculture farm : Survey and Land Use Planning
(AAU/DR/15(BL)/09/2015-16)

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Message

Soil is a unique living entity. It has its origins in physical, chemical and biological interactions between the parent materials and the atmosphere. The very existence of mankind depends on this natural resource. This resource has to be guarded against depletion of its individual intrinsic values for sustainable agricultural production. There is a growing realization on the scientific management of soil health both at the national and international level. Scientific management of soil needs location and site specific information pertaining to the nature of soil and other land resources, their constraints, potential and suitability for various crops and other uses. In this context soil survey plays an important role in exploiting the potential soil resources and basic information and principles for their better utilization.

It is appreciated that our faculty members of the Department of Soil Science, AAU Jorhat and the Scientist from AICRP(DA), BNCA, AAU Biswanath Chariali have conducted a detailed soil survey of the farm of Biswanath College of Agriculture and prepared a soil survey report covering all the aspects pertaining to scientific management of the land resource. I sincerely hope that the report will provide the desired information on the soils of the area and offer the guidelines to develop better land use planning.

(G.N. Hazarika)

FOREWORD

Soils are known to vary considerably both laterally and vertically. The proper study of variability of soils is of vital importance in explaining nutrient imbalance in soil, site to site variations in yield and in knowing the optimum agro-pedological implications. Adequate knowledge about the properties and distribution of soils is therefore a key issue to support sustainable land management, which among others, includes fertility management, crop choice and possibilities for irrigation. The information generated through soil resource inventory is generally interpreted for various grouping of soils for land capability, land irrigability and suitability of soils for different crops through evaluation procedures which helps the administrators and managers for agriculture and related developmental activities on sustainable basis.

Keeping this in view, a study was undertaken in Biswanath College of Agriculture farm under All India Coordinated Research Project for Dryland Agriculture (AICRPDA), Biswanath Chariali Centre, Assam Agricultural University (AAU), Jorhat to characterize and evaluate the soils for its capability and suitability to different types of crops. The B.N. College of Agriculture is situated in upland conditions. The college farm is located at 26°84′ N latitude and 93°13' E longitude with a total area of about 135.37 ha. Over the years, the farms under the AICRP (DA) and Horticultural orchard of the college have been intensively used for producing various crops. The farm areas are now extensively used for different experimental and demonstration purposes. In this process, improved production technologies are also being used and hence it has becomes imperative to gather information of the soils of the area in order to evaluate their capability and suitability towards these interventions.

Detailed soil survey was carried out in the of BNCA farm during the year 2014 and two tentative soil series were identified. Soil mapping has been done at phase level taking into account the most important parameters that may affect the crop production process. Soils were evaluated as per their capability and suitability to several important crops. Sincere effort has been made to document all the properties of soil that may directly or indirectly affect crop growth. User friendly soil map, land capability map and soil-site suitability map for different crops were prepared and presented in the bulletin.

It is hoped that the soil survey report on the soils of AICRPDA farm, BNCA will be able to serve the purposes towards achieving its objectives and act as a benchmark study for the entire area. It is expected that the information contained in this bulletin will be exploited by the scientist of different disciplines and extension officials for making rational land use recommendation.

The authors will remain ever grateful to Project Coordinator, (AICRPDA), CRIDA, Hyderabad and Director of Research (Agri), AAU for their guidance, encouragement and sincere support. The authors extend thankfulness to the fellow Scientists, Research Associates and other technical staff for their cooperation and help. The authors expresses there thankfulness to Sharada Offset, Biswanath Chariali for printing the report.

Authors

CONTENTS

1. INTRODUCTION

Developing a better land use planning is a very difficult proposition without having thorough knowledge about the inherent characteristics of soils, its variability and behaviour towards different management practices. It is so particularly for the alluvium derived soils due to its stratified nature. Looking to the importance of this need, it is obvious that soil survey is the unique way to achieve the goal, which provides principles and guidelines for the better management of land, through exploiting the potential soil resources in combination with consideration of environmental impact and sustainability of production.

The B.N. College of Agriculture is situated in upland conditions. Over the years, the farms under the AICRP (DA) and Horticultural orchard of the college have been intensively used for producing various crops. Unlike agricultural land of surrounding areas, the farms do not have a traditional rice based cropping system. However, there is an ample scope for production of various field crops of oilseeds, pulses and horticultural crops along with arable rice by adopting a systematic approach to achieve better productivity. The farm areas are now extensively used for different experimental and demonstration purposes. In this process, improved production technologies are also being used, but in absence of detailed soil survey report, the balanced relationship between the production function and the productivity is not possible to maintain. It is, therefore, necessary to have high intensity soil survey to ascertain the various problems and to evaluate the land for rational utilization.

The present investigation will provide some basic and useful information about the soil inherent characteristics, their variation and extent of distribution within the area which are considered to be most essential prerequisite for any land use planning. It will further provide a systematic basis for the study of soil-water-crop relationship with a view to proper utilisation of the land and water resources to increase productivity, develop irrigation efficiency, soil and water conservation measures and reclaim the acidic areas

With this view the present study was undertaken with the following objectives:

1. To conduct detailed soil survey of the farmlands under AICRP (DA) and Horticultural orchard of BNCA
2. To characterize and classify the soils
3. To interpret the soils as per their suitability for better management and land use

2. GENERAL DESCRIPTION OF THE FARM:

2.1 Location and extent:

The college farm is situated in the Sonitpur district of the Northern Brahmaputra valley of Assam. It is located at 26°84′ N latitude and 93°13' E longitude with a total area of about 135.4 ha.

2.2 Physiography, relief and drainage:

Biswanath Chariali, including the college campus, is situated on the top of a tilla like raised land surrounded by comparatively lowlands making it well drained upland situation. The elevation of the area is about 104m from the mean sea level. The topography of the farm is almost flat having average slope of 0-1%. The groundwater table fluctuates between 5-15m during the year, which further enhances the drainage conditions. In addition to the deep groundwater table, the light texture of the solum also increases the percolation rate of water leading to a good drainage situation of the area.

2.3 Geology:

The soils of the investigated area are formed on the alluvium transported from the Assam Himalayas, containing fossiliferous records of successive marine geological system of all ages, by the river Brahmaputra and its northern tributaries. The soils of the area are probably the ramnents of older terrace of the alluvium of the Brahmaputra and can be termed as Residual soils (Goswami, 1960). The study area is located in the North Bank Plain Zone of Assam which is a part of the Northern Brahmaputra Valley. The Brahmaputra valley is the extension of Indo-Gangatic-Brahmaputra river system towards the eastern side. Geologically, the rocks that make up Assam is in age from very ancient early Proterozoic to the present day alluvium. Within the Brahmaputra valley, the rocks at this extreme ends can be seen at the surface, but much of those intermediate in age are buried deep under the alluvium.

The Brahmaputra valley is formed during the Pleistocene and recent periods from the sediments derived from Assam Plateau in the south and Assam Himalayas from the north (Wadia, 1966). The Assam plateau consist largely of a dissected plateau, eastern part of which exhibits intricate degree of tertiary folding. The bulk of the Assam plateau is made up of metamorphic complex and generally consists of gneisses and granite of Archaean age. On the other hand, the Assam Himalayas have quite different stratigraphical and structural make

up containing fossiliferous records of successive marine geological system representing all ages from Cambrian to Tertiary. This region is comparatively younger than Assam Plateau and consists mainly of gneisses and schists.

The Brahmaputra alluvium derived from these mountain systems is extensive and diversified. The geological nature of the deposits brought down by the Brahmaputra river is quite different from that deposited by its tributaries flowing down from the foot hills on both sides resulting in different types of alluvia. The nature of alluvium in the northern bank of the Brahmaputra therefore exhibits some differences with the southern bank deposits. This is clearly reflected in the mineralogical composition of soils as the content of resistant minerals is high in the south bank soils (Dutta and Shanwal, 2006).

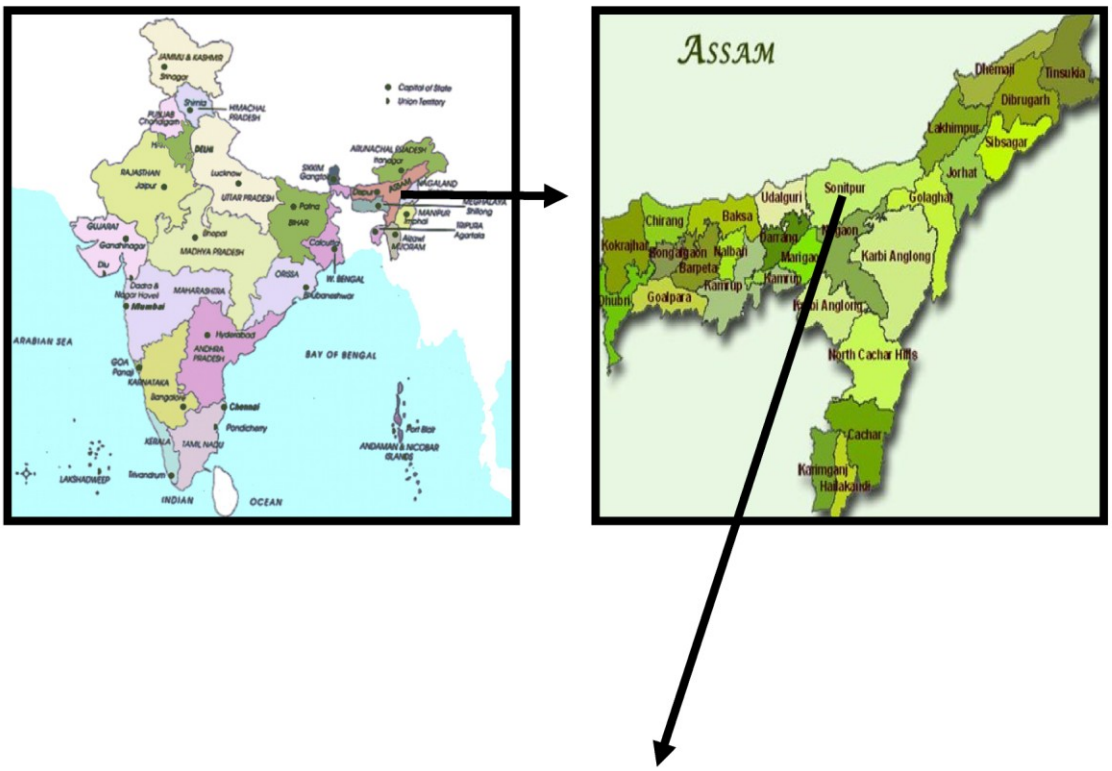
2.4 Climate:

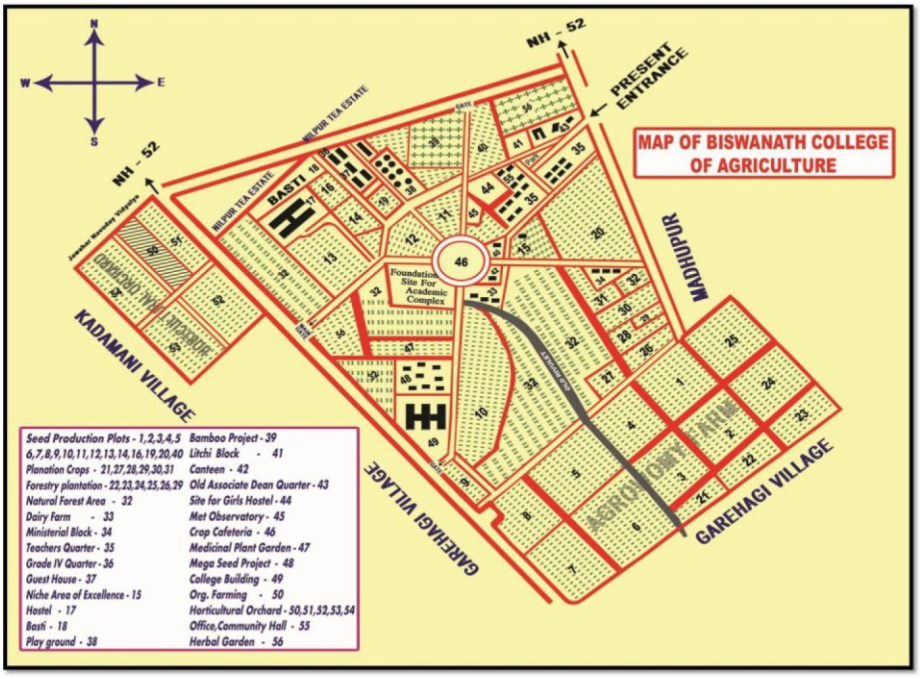
The area is enjoying humid sub-tropical humid climate and experiences hot and wet summer and cool and dry winter. Four distinct seasons are observed in the area which is identified on the basis of the different climatic parameters. These are:

Pre-monsoon season	:	March to May
Monsoon season	:	June to August
Post-monsoon season	:	September to November
Winter season	:	December to February

The mean annual air and soil temperature of the area is 23.6^0C and 24.6^0C, respectively. The mean summer and winter soil temperature are 25.16^0C and 19.74^0C. Obviously, the surveyed area qualifies for hyperthermic temperature regime as the difference between the MSST and MWST is greater than 5^0C.

LOCATION OF THE STUDY AREA





The average annual rainfall of the area is about 2000 mm. Monsoon season receives the maximum amount of precipitation (51.7%). The area qualifies for Udic soil moisture regime as the soil moisture control section is not dry for 90 cumulative days. The month wise average rainfall, temperature (max. and min.) and evaporation data are given in Table 1. The Ombrothermic diagram is shown in Figure 1.

2.5 Natural Vegetation:

Natural vegetation of the area is mostly moist sub-tropical semi-evergreen forest. In some area, the dominancy of moist deciduous forest has been observed. The common species of trees, shrubs and weeds found in nearby areas are presented under Table 2.

2.6 Agriculture and present land use:

Unlike the surrounding area, BNCA farm does not have traditional rice based cropping system. The farm area is used extensively for cultivation of various crops, particularly pulses and oilseeds. A small area of about 0.2 ha has been now brought under upland rice cultivation. Some of the area is also utilized for testing and verification of technologies with special reference to pulses, oilseeds and plantation crops. Horticultural crops are also kept in view for such technologies.

As there are no irrigation facilities except in few areas under Horticultural orchard, all the crops are cultivated under rainfed situations. Now rain water harvesting structures are constructed in farms under AICRP (DA) for demonstration purposes. The common practices like application of fertilizers, manures and other plant protection measures are widely followed to boost up the production. A considerable area of the farm is utilised for seed production particularly of mustard. The present land use under different crops according to seasons under Agronomy and Horticulture Divisions is given in Table 3 and Table 4.

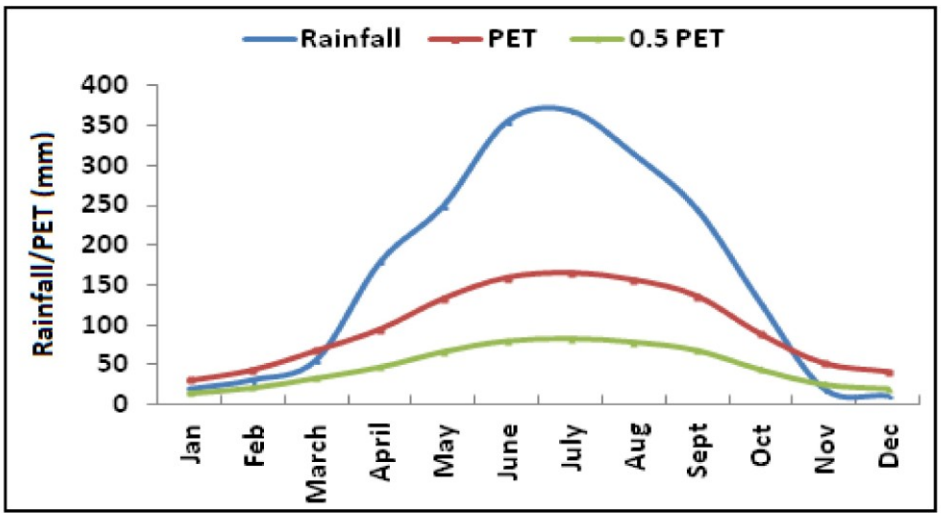


Fig 1: The Ombrothermic diagram of Biswanath Chariali

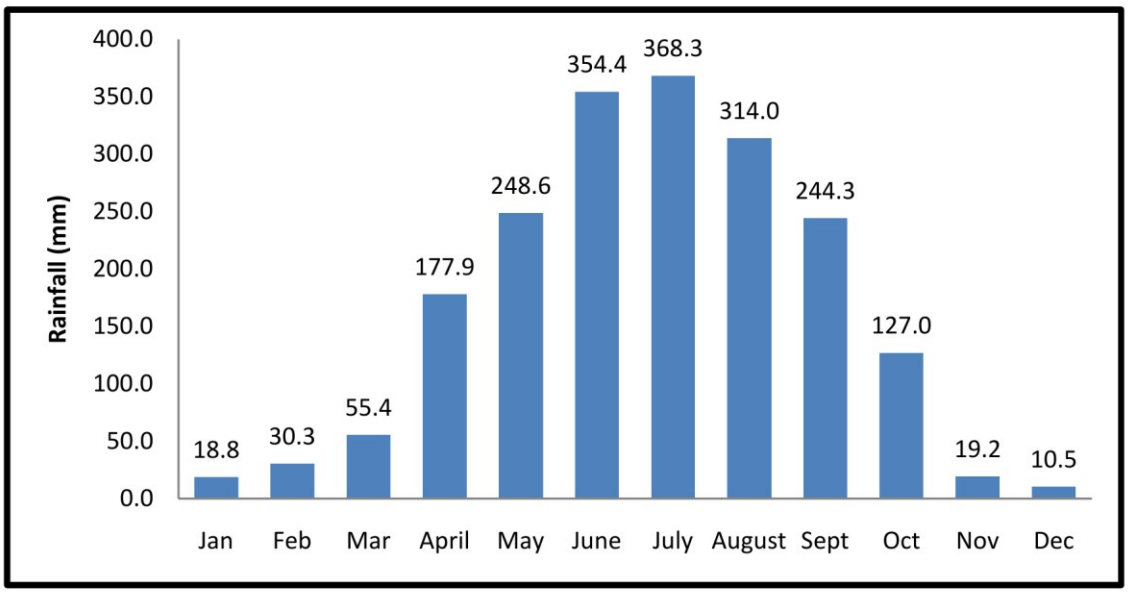


Fig 2: Average annual precipitation over Biswanath Chariali

Table1: Month wise average Rainfall, Max. and Min temperature and Evaporation of Biswanath Chariali

Month	Rainfall(mm)	T Max(^{0}C)	T Min(^{0}C)	Evaporation(mm)
Jan	18.5	23.5	8.3	1.7
Feb	29.7	25.9	12.1	2.4
Mar	54.2	28.6	15.8	3.4
April	180.0	28.3	18.9	3.8
May	249.5	30.8	22.1	4.1
June	357.4	31.3	24.5	3.8
July	368.7	32.0	25.5	3.8
August	319.2	32.3	25.0	3.6
Sept	244.9	31.6	23.9	3.3
Oct	126.7	30.1	20.3	3.0
Nov	18.9	27.5	14.5	2.2
Dec	10.2	24.8	9.4	1.8

Table 2 : Natural vegetation found in the nearby areas:

Sl. No.	Common Name	Scientific name
Trees		
1.	Pipal	*Ficus religiosa*
2.	Baniyon	*Ficus benghalensis*
3.	Mango	*Mangifera indica*
4.	Jackfruit	*Artocarpus heterophylus*
5.	Neem	*Azadiracta indica*
6.	Bogori	*Zisiphus jujube*
7.	Bamboo	*Bambusa spp.*
8.	Simalu	*Bombax ceiba*
9.	Moj	*Albizzia lucida*
10.	Ajar	*Legerostromia floreginae*
11.	Dudhkurohi	*Hollecine antidysentrica*
12.	Sonaru	*Cassia fistula*
Grass/Shrubs/Weeds		
13.	Thatch	*Imperata cylindrica*
14.	Germany bon	*Eupatorium odoritum*
15.	Mekenia	*Mikanea seandens*
16.	Carpet grass	*Exonopus compressus*
17.	Gahori bon	*Borreria hispida*
18.	Dhapat tita	*Clerodendron infortunatum*
19.	Bobosa bon	*Eleusine indica*
20.	Nilaji bon	*Mimosa pudica*

Table 3: Different crops grown in the season 2014-15 under Agronomy Division:

Sl. No.	Crops	Area
1	Toria	3.0 ha
2	Sesame	3.0 ha
3	Blackgram	1.0 ha
4	Dhaincha	0.5 ha
5	Jute	2.0 ha
6	Linseed	1.0 ha
7	Crop cafeteria	0.2 ha
8	Greengram	1.0 ha
9	Sunhamp	1.0 ha

Table 4: Different crops grown in the season 2014-15 under Horticulture Division

Sl. No.	Crops	Variety	Area
1	Guava	Allahabad Sabeda	0.2 ha
		L-49	
		Lalit	
2	Mango	Mallika	0.75 ha
		Lengra	
		Phajli	
		Dasheri	
		Maldah	
3	Assam Leman	Local	0.2 ha
4	Arecanut	Local	0.5 ha
5	Coconut	Kerela Dwarf	0.75 ha
		T X D	
		Kamrupa	
6	Litchi	Muzaffarpur	0.5 ha
		Chinese Green	
		Seedless	

2.7 Transportation and marketing facilities:

The college campus is only four kilometres away from the town of Biswanath Chariali and is linked with NH 52 by metal road. The distance of Biswanath Railway station is about 8 km. So, the farm has no problem in both communication and transportation. The college has its own vehicle and the product can be easily transported to the nearest market. Moreover, the college farm produces quality seeds of different crops which are picked up by

the Assam State Seed Certification Agency. Difficulty arises in storage of the produce as the institute does not have any scientific storage facility.

3. SOCIO ECONOMIC CONDITION AND CONSTRAINT:

3.1. Socio-economic condition:

A socio-economic survey was carried out in the suroundimg village *viz. Garehagi, Kadamoni, Bamgaon, Kumolia* of Biswanath Chariali to understand the socio-economic conditions and to identify diagnostic constraint affecting the productivity of different crops, in the area so that appropriate technology can be generated in order to maintain sustainable agricultural production.

The survey reveals that agriculture is the main occupation of the most of the people of the villages. Majority of the farmers belong to marginal to small category having 1 to 2 ha of land. Rice is the major food crop grown in the area. Besides rice, pulses, oilseeds and different kinds of vegetables are extensively grown. The villages under survey are well known for the production of various summer and winter vegetables. A substantial amount of income is generated by the villagers from vegetables.

All crops in the area are cultivated under rainfed conditions. A few numbers of farmers have their own wells to irrigate their land through lift irrigation. Few farmers have diesel pumpset to irrigate their land through lift irrigation. Due to lack of irrigation facility and few other factors, majority of the farmers grow only one crop a year that results in low cropping intensity in the area. The main crop rotations followed are:

1. Paddy-Fallow
2. Paddy-Paddy
3. Paddy-Mustard
4. Paddy-Vegetables

3.2. Major Constraints in Crop Production:

Major constraints related to crop production in the area observed during socio-economic survey are as follows:

1. The adoption of modern technology by the farmers is very poor inspite of the presence of an agricultural college.
2. Lack of irrigation facility is another important factor as soil moisture stress during the *rabi* season is a common phenomena.
3. Certified HYV are not readily available either from market or from government agency and sometimes these are not reliable.
4. Decline in the soil fertility has been reported by the farmers. Application of fertilizers is not based on the soil test values. Besides, use of organic manure is also very limited because of its unavailability. Though soil testing facility is available in the BNCA, farmers in general are not approaching the college for advice.
5. No practice of mechanised farming has been observed. The farmers have less number of livestock to meet their own requirement of animal power. Moreover, the bullocks are mainly of local breed with low draft capability.
6. Plant protection measures are not scientific. The lack of technical know-how among the farmers is noticed in this respect.
7. Attitude and willingness of the people towards adoption of scientific farming is also a major factor to be considered for overall development of the socioeconomic condition.

4. SOILS OF THE AREA

4.1 Soil Survey Technique

Detailed survey of the BNCA farm was carried out using 1:4000 scale (1cm = 40m) base maps supplied by the Physical Plant Unit of BNCA. During the survey, the farm was first traversed and studies on the landscape characteristics were carried out. For demarcation of soil boundaries, the area was traversed and soil was studied by taking post hole auger observation at a regular interval of 100 to 200 m depending upon the land situation. All the existing geomorphological situations of the area were covered during the traversing. Each auger sample up to a depth of 1.20 m was studied for morphological characteristics like colour, texture, structure, consistency and horizon thickness. On the basis of variation in these soil characteristics during traversing, soil profile sites were selected. Each exposed soil profile was carefully examined and described by using terminology as outlined in the Soil Survey Manual (All India Soil and Land Use Survey Organization, 1971) and later used for identification of soil series. Soil Series is the conceptual unit which includes soil bodies (Pedons) that differ only within a permissible range of morphological, physical, chemical and mineralogical properties. Therefore soils that have profiles almost alike, make up a soil series except for some surface characteristics.

After completing the detailed examination of the soil profiles and correlating their features, two tentative soil series designated as DAF (Dry Land farm, BNCA) and HOR (Horticultural Orchard, BNCA) were identified, particularly on the basis of horizon differentiation that reflected on the profile development trend. As the study area was very small with similar overhead climatic situations and having level topography, there was no scope of any drastic variation that happened to be observed during the survey. The difference in the horizonation of the profile observed in the two tentative series, was mainly due to the effect of localised variation. The cross section of the two series is shown in the Figure 3. Other important characteristics, generally considered for series identification, texture of the series control section, depth of the soil, drainage conditions are almost same within the investigated area.

Horizon wise soil samples were collected from each representative pedon of the two soil series and processed. Samples were analysed for basic physico-chemical properties using standard laboratory procedures. Based on the morphological, physical and chemical properties of soils collected from the representative pedons, soils were classified as per the guidelines of Keys to Soil Taxonomy (Soil Survey Staff, USDA, 2014).

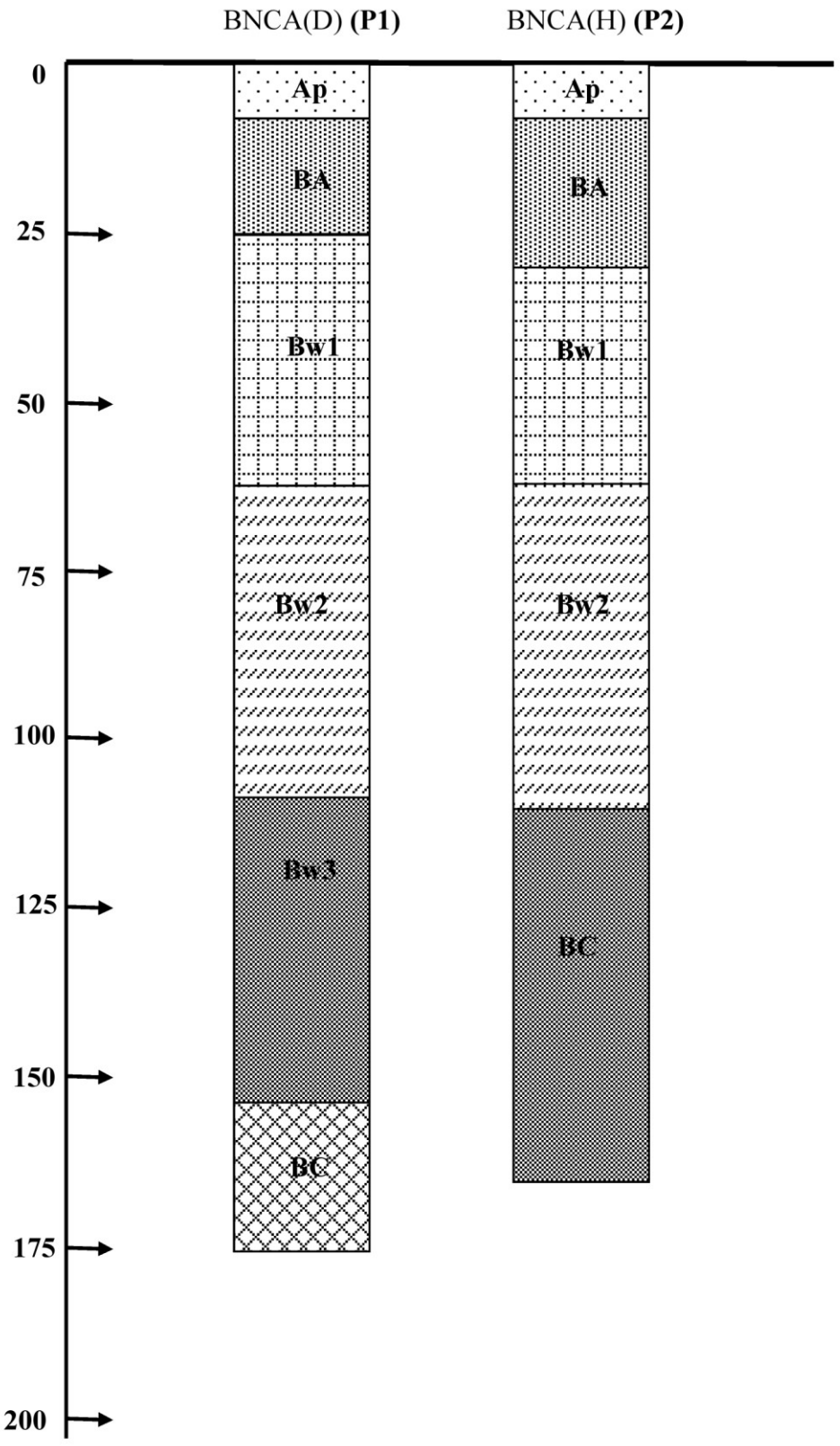


Fig 3: Cross Section of the two representative pedons of Series BNCA(D) and BNCA(H)

4.2 Description of Soil series

4.2.1 Series: BNCA(D) :Dry Land Farm, BNCA

This series is a member of fine loamy, mixed mineralogy, hyperthermic family of **Typic Dystrudepts**. The soils of this series is very deep, very well drained and showed the evidences of development of a cambic horizon.

Typifying Pedon	:	P_1
Location	:	AICRPDA Experimental Farm
Latitude	:	26°43′26.1″ N
Longitude	:	93°08′29.8″ E
Altitude	:	223 ft
Physiographic position	:	Occurs on level land
Drainage and Permeability	:	Well drained with good permeability
Present land Use and vegetation	:	Cultivation of various crops including pulses, oilseeds, potato, rice etc.
Geology	:	Alluvium
Distribution and Extent	:	33.8 ha and 24.9% of the total area

Morphological Properties of the Representative Pedon (P1)

Horizon	Depth (cm)	Description
Ap	0 - 8	Yellowish brown 10YR5/4 M; sandy clay loam; fine weak sub angular blocky structure; hard, friable, slightly sticky, slightly plastic; many fine roots with pH 5.4
BA	8 - 25	Yellowish brown 10YR5/6 M; sandy clay loam; fine weak sub angular blocky structure; hard, friable, sticky, plastic; many fine roots with pH 4.9
Bw1	25 - 62	Strong brown 7.5YR5/6 M; clay loam; moderate,

		medium sub angular blocky structure; hard, friable, sticky, plastic; common fine roots with pH 4.5
Bw2	62 - 108	Strong brown 7.5YR5/8 M; clay loam; moderate, medium sub angular blocky structure; hard, friable, sticky, plastic; few fine roots with pH 4.4
Bw3	108 - 153	Strong brown 7.5YR5/8 M; silty clay loam; moderate, medium sub angular blocky structure; hard, friable, sticky, plastic; few fine roots with pH 4.8
BC	153 - 175	Strong brown 7.5YR5/6 M; silty clay loam; moderate, medium sub angular blocky structure; hard, friable, sticky, plastic; with pH 4.9

Fig 4: Landscape of AICRPDA farm

Fig 5: Representative Pedon (P1): BNCA(D) series

Physico-chemical properties of the Representative Pedon (P_1) of BNCA(D) Series

Table 5: Particle size distribution of the soil

Horizon	Depth (cm)	Particle Size Distribution (%)			silt/ silt +clay
		Sand	Silt	Clay	
Ap	0 - 8	52.0	22.0	26.0	0.46
BA	8 -25	45.0	24.0	31.0	0.44
Bw1	25-62	27.0	37.0	36.0	0.51
Bw2	62-108	32.0	30.0	38.0	0.44
Bw3	108-153	25.0	40.0	35.0	0.53
BC	153-175	20.0	49.0	31.0	0.61

Table 6: Soil pH, organic carbon (OC) and exchange acidity of the soil

Horizon	Depth (cm)	pH	OC (g kg^{-1})	Ex. Acidity (c mol $(p^+)kg^{-1}$
Ap	0 - 8	5.4	18.0	0.80
BA	8 -25	4.9	14.0	0.70
Bw1	25-62	4.5	10.0	1.50
Bw2	62-108	4.4	8.0	1.15
Bw3	108-153	4.8	7.0	1.10
BC	153-175	4.9	6.0	1.15

Table7 : Exchangeable cation, CEC and Per cent Base Saturation (PBS) of the soil

Horizon	Depth (cm)	Ca	Mg	Na	K	Total exchangeable cations	CEC	PBS (%)
		c mol $(p^+)kg^{-1}$						
Ap	0 - 8	3.18	2.28	0.06	0.13	5.65	10.2	55.4
BA	8 -25	2.75	2.21	0.15	0.13	5.24	9.6	54.6
Bw1	25-62	1.96	1.64	0.19	0.09	3.88	8.8	44.1
Bw2	62-108	1.54	1.21	0.19	0.14	3.08	9.1	33.8
Bw3	108-153	1.61	1.03	0.08	0.07	2.79	8.3	33.6
BC	153-175	1.35	0.94	0.07	0.05	2.41	8.7	27.7

4.2.2 Series: BNCA(H): Horticultural Orchard, BNCA

This series is a member of fine loamy, mixed mineralogy, hyperthermic family of **Typic Dystrudepts**. The soils of this series are very deep, very well drained and showed the evidences of development of a cambic horizon.

Typifying Pedon	:	P_2
Location	:	Horticultural Orchard, BNCA
Latitude	:	26°43′29.1″ N
Longitude	:	93°7′40.3″ E
Altitude	:	222 ft
Physiographic position	:	Occurs on level to gently sloping land
Drainage and Permeability	:	Well drained
Present land Use and vegetation	:	Production of vegetables, oilseeds, fruits etc.
Geology	:	Alluvium
Distribution and Extent	:	101.9 ha and 75.1% of the total area

Morphological Properties of the Representative Pedon (P_2)

Horizon	Depth (cm)	Description
Ap	0 - 8	Dark yellowish brown 10YR4/4 M; sandy clay loam; fine weak sub angular blocky structure; slightly hard, friable, sticky, slightly plastic; many fine roots with pH 4.7
BA	8 - 30	Yellowish brown 10YR5/8 M; clay loam; medium moderate sub angular blocky structure; hard, friable, sticky, plastic; many fine roots with pH 4.6
Bw1	30 - 62	Strong brown 7.5YR 5/8 M; clay loam; medium moderate sub angular blocky structure; hard,

		friable, sticky, plastic; common fine roots with pH 4.8
Bw2	62 - 110	Strong brown 7.5YR 5/6 M; clay loam; medium moderate sub angular blocky structure; hard, friable, sticky, plastic; few fine roots with pH 4.8
BC	110 - 165	Strong brown 7.5YR 5/6 M; silty clay loam; medium moderate sub angular blocky structure; hard, friable, sticky, plastic with pH 5.2

Fig 6: Landscape of Horticultural Orchard, BNCA

Fig 7: Representative Pedon (P_2): BNCA(H) series

Physico-chemical properties of the Representative pedon (P_2) of series BNCA(H)

Table 8: Particle size distribution of the Soil

Horizon	Depth (cm)	Particle Size Distributin (%)			silt/ silt +clay
		Sand	Silt	Clay	
Ap	0 – 8	51.0	26.0	23.0	0.53
BA	8 – 30	36.0	36.0	28.0	0.56
Bw1	30 – 62	30.0	40.0	30.0	0.57
Bw2	62 – 110	25.0	43.0	32.0	0.57
BC	110 - 165	21.0	51.0	30.0	0.63

Table 9: Soil pH, organic carbon (OC) and exchange acidity of the Soil

Horizon	Depth (cm)	pH	OC (g kg^{-1})	Ex. Acidity (c mol $(p^+)kg^{-1}$
Ap	0 – 8	4.7	21.5	0.91
BA	8 – 30	4.6	14.1	1.38
Bw1	30 – 62	4.8	10.3	1.25
Bw2	62 – 110	4.8	7.4	1.42
BC	110 - 165	5.2	5.1	1.05

Table 10: Exchangeable cation, CEC and Per cent Base Saturation (PBS) of the Soil

Horizon	Depth (cm)	Ca	Mg	Na	K	Total exchangeable cation	CEC	PBS (%)
		c mol $(p^+)kg^{-1}$						
Ap	0 – 8	3.05	1.59	0.03	0.15	4.82	11.3	42.6
BA	8 – 30	2.14	1.66	0.17	0.04	4.01	10.5	38.2
Bw1	30 – 62	2.37	1.78	0.11	0.05	4.31	8.8	49.0
Bw2	62 – 110	1.89	1.48	0.22	0.12	3.71	8.3	44.7
BC	110 - 165	2.07	1.38	0.08	0.14	3.67	9.5	38.6

4.3 Soil Mapping and Preparation of Legends

Soil mapping was done at phase level taking into account the important properties that influence the crop productivity. As the study area was very small and had similar climatic situations and with a level topography, there was no scope of any drastic variation that happened to be observed during the survey. The variation was observed on the texture of the series control section (SCS, 25-100 cm) of the two series. The series BNCA(D) contained 37.01% clay in its SCS while it was 30.88% in the SCS of BNCA(H). Baring this textural variation, no differences was noticed in other series differentiating properties like profile development trend, drainage conditions, physiography, soil moisture and temperature regime etc.

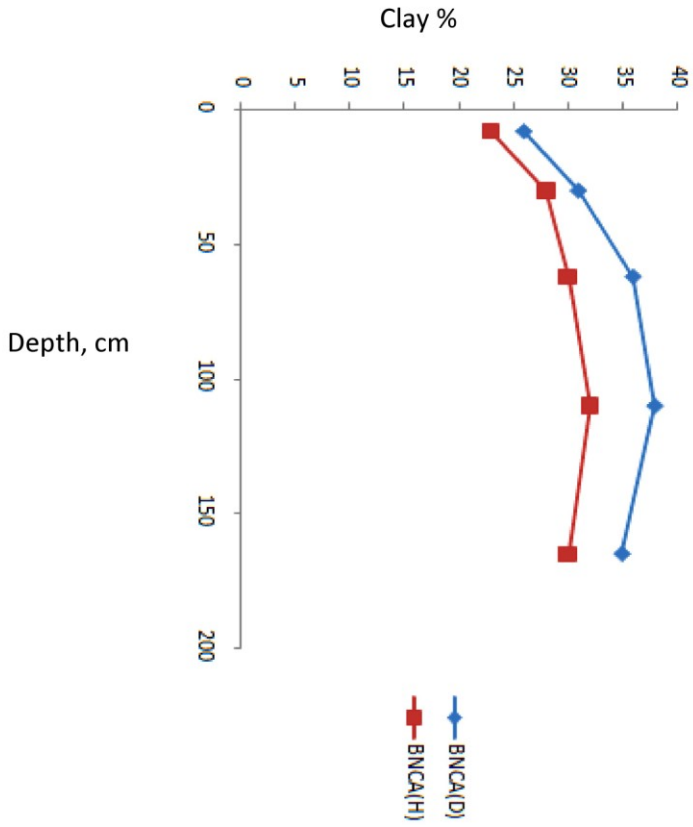


Fig 8: Vertical Distribution Patter of Clay in the Two identified Series

At the phase level, only two soil characters and conditions namely surface texture and soil reaction in terms of soil acidity have been considered as no variation was observed on slope percentage and soil erodibility of the area. These characters and conditions are showing in the map with appropriate legends. The legends proposed by Sehgal et. al., (1987) and Sehgal (2003) are taken for this purpose with slight modification wherever necessary. The details of the legends used in the study is described in **appendix I.** Combination of all these features forms a soil mapping unit composed of different legends which was demarcated on the soil map. The map was digitized using GIS technique and the area under each soil mapping unit was evaluated. The detail Soil Map along with the appropriate legends are presented under Fig 9.

The sequence of legends representing different properties and condition in a soil mapping unit is follows as under:

1. Series Name
2. Texture of the series control section (25-100 cm)
3. Surface texture
4. Soil reaction

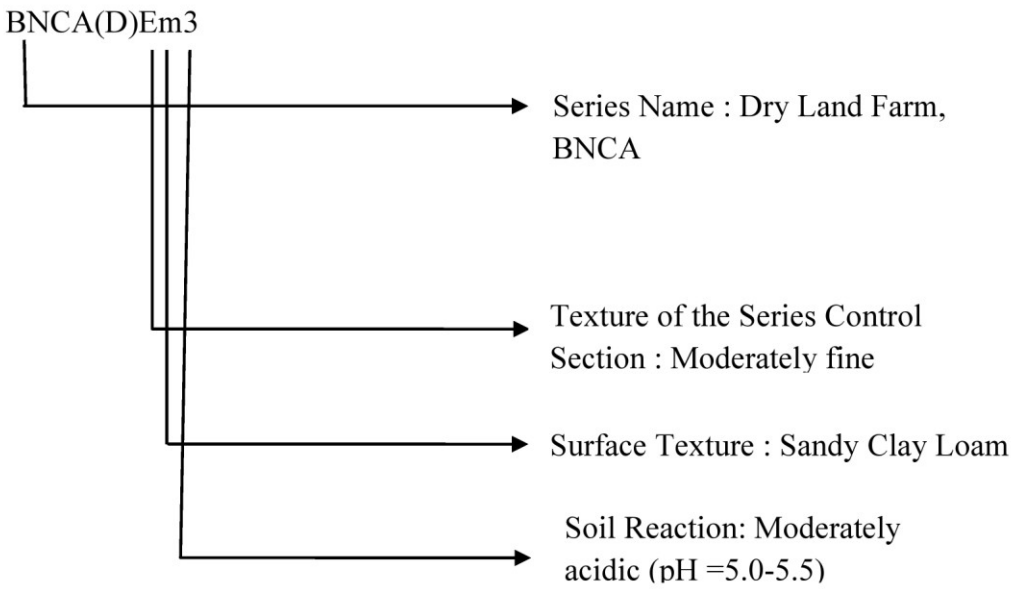


Fig 9: A diagrammatic representation of a single representative mapping unit

Table11: Description of Soil Mapping Units

Sl No.	Soil Mapping Unit	Description of Soil Mapping Unit	Area (ha)	% of total area
1.	BNCA(D)Em3	Soils of Dry Land farm series with very well drained condition, moderately fine texture in the series control section, sandy clay loam surface texture and moderately acidic (pH 5.0-5.5).	4.3	3.2
2.	BNCA(D)Em2	Soils of Dry Land farm series with very well drained condition, moderately fine texture in the series control section, sandy clay loam surface texture and strongly acidic (pH 4.5-5.0).	16.7	12.3
3.	BNCA(D)El2	Soils of Dry Land farm series with very well drained condition, moderately fine texture in the series control section, loam surface texture and strongly acidic (pH 4.5-5.0).	12.8	9.4
4.	BNCA(H)Mm2	Soils of Horticultural Orchard series with very well drained condition, moderately fine texture in the series control section, sandy clay loam surface texture and strongly acidic (pH 4.5-5.0).	29.7	21.9
5.	BNCA(H)Mm3	Soils of Horticultural Orchard series with very well drained condition, moderately fine texture in the series control section, sandy clay loam surface texture and strongly acidic (pH 4.5-5.0).	13.9	10.2
6.	BNCA(H)Me2	Soils of Horticultural Orchard series with very well drained condition, moderately fine texture in the series control section, clay loam surface texture and strongly acidic (pH 4.5-5.0).	26.8	19.7
7.	BNCA(H)Ml2	Soils of Horticultural Orchard series with very well drained condition, moderately fine texture in the series control section, sandy clay loam surface texture and strongly acidic (pH 4.5-5.0).	31.5	23.2

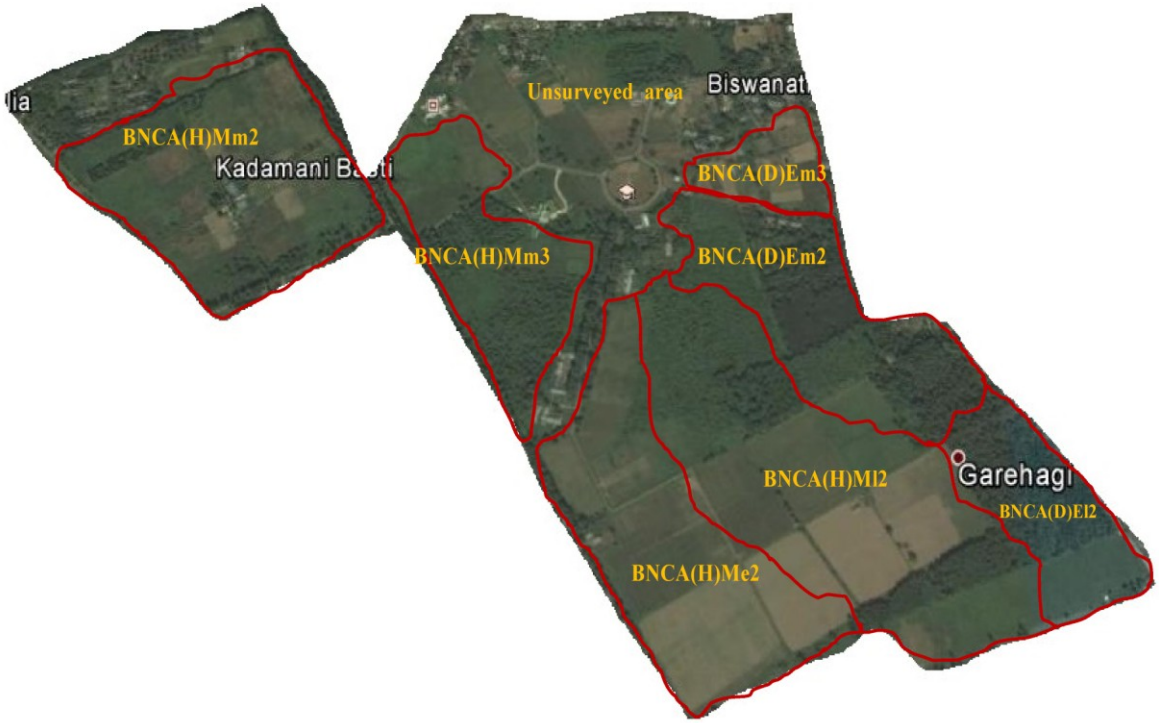


Fig 10: Soil Map of the Farms of B.N. College of Agriculture, AAU, Biswanath Chariali

5. SOIL SURVEY INTERPRETATION

There are total seven soil mapping unit has been identified at the phase level mapping of the study area. Attempt has been made to interpret each of these mapping units for various purposes relevant to the objectives of the programme. Survey interpretation is the last and final phase of soil survey. On the basis of different characteristics and information obtained during the survey, the lands are evaluated in terms of different interpretative system in order to ensure proper and rational utilization of land and also to help people to make their judicious decision to sustain production without deteriorating the land quality. The soil survey interpretation may take a variety of forms depending upon its basic needs and objectives. In the present study, first attempt has been made to evaluate the land in terms of land capability. Secondly, effort has also been made to evaluate the suitability of land for different crop based on the climatic parameters, site characteristics and soil properties. In addition to these evaluations, the soils of the area are also evaluated for its suitability to irrigation management. The important climatic parameters required for evaluation of the land for its suitability to various crop along with all the relevant site characteristics of the mapped soils are presented under Table 12.

Table 12: Climate and Soil-Site characteristics of Mapped soils

Characteristics	Soil mapping Unit						
	BNCA(D)Em3	BNCA(D)Em2	BNCA(D)El2	BNCA(H)Mm2	BNCA(H)Mm3	BNCA(H)Me2	BNCA(H)Ml2
A. Climatic characteristics							
i.Total Rainfall (mm)	1968.7	1968.7	1968.7	1968.7	1968.7	1968.7	1968.7
ii. Rainfall during growing season (mm)	1874.5	1874.5	1874.5	1874.5	1874.5	1874.5	1874.5
iii. Length of Growing season (days)	249	249	249	249	249	249	249
iv. Mean Temperature -growing season (^{o}C)	26.2	26.2	26.2	26.2	26.2	26.2	26.2
v. Mean maximum Temperature -growing season (^{o}C)	30.6	30.6	30.6	30.6	30.6	30.6	30.6
vi. Mean minimum Temperature -growing season (^{o}C)	21.8	21.8	21.8	21.8	21.8	21.8	21.8
vii. Mean Relative Humidity -growing season (%)	76.5	76.5	76.5	76.5	76.5	76.5	76.5
B. Site characteristics							
i. Slope %	0-1	0-1	0-1	0-1	0-1	0-1	0-1
ii. Erosion hazard	1	1	1	1	1	1	1
iii. Drainage condition	5	5	5	5	5	5	5
iv. Flooding	Occurrence of flooding nil						
C. Soil characteristics							
i. Soil texture	E	E	E	M	M	M	M
ii. Soil Depth	Deep throughout						
iii. CEC (cmol $p^{+}kg^{-1}$)	9.0	9.0	9.0	8.7	8.7	8.7	8.7
iv. pH	4.4	4.4	4.4	4.8	4.8	4.8	4.8
v. PBS (%)	38.88	38.88	38.88	51.43	51.43	51.43	51.43
vi. OC % (surface)	0.90	0.90	0.90	0.91	0.91	0.91	0.91
vii. EC (dsm^{-1})	Negligible throughout						

5.1 Land capability classification

It is a system of classifying a land according to its capability for practical land use. Under this system, lands are grouped in to defined classes based on its capability. The grouping of soils into capability classes and subclasses is done on the basis of their capability to produce crops, pasture biomass without adversely affecting the productivity over a long period of time.

The Land Capability Classification is an interpretive grouping made primarily for agricultural purposes. Cultivable soils are grouped according to their potential and limitations for sustained production of the commonly cultivated crops. Lands suited to cultivation are grouped in class I to class IV according to the degree of limitations. Lands in class V to class VII are suited to silviculture and pasture. Class VIII lands are suited neither to agriculture nor forestry. Several factors are considered for determining the Land Capability Classes. According to Klingebiel and Montgomery (1961), the most important factors considered for this purpose are Depth of soil, stoniness, rockiness, texture and structure of soil permeability, relief as expressed by slope, extent of erosion, susceptibility to overflow and flooding and degree of wetness, presence of toxic salts, alkali and other unfavourable chemical properties such as pH, gypsum etc. and severity of climate (temperature and moisture). Land capability classes are further divided into subclasses that represent groups of soils having the same kind of dominant limitation for agricultural use. Four kinds of limitations are recognized at subclass level: 'e' for water or wind erosion; 'w' for drainage problems, wetness, or overflow, ‘s’ for soil limitations affecting plant growth; and 'c' for limitation due to climate.

The soils of the entire BNCA farm including both AICRPDA farm and Horticultural orchard is grouped under a single Land Capability Class because of the uniformity of the climatic and more particularly the site characteristics of the area as presented under Table 12. However, at the sub class level, soils of the area are grouped under two sub classes (IIc and IIsc) depending upon two limitations created by soil characteristic and climatic parameters. Moisture stress created by long dry spell is quite common in recent years which cause difficulty in sowing of rabi crops in the entire area. The extremely acidic condition of the soils except in one mapping unit can also be considered as a limitation for proper crop growth. The details of the capability grouping of soils are presented in Table 13 and shown under Figure 12.

5.2 Land irrigability classification

Land irrigability classification is made on the basis of important soil characteristics, namely surface texture, soil depth, available water holding capacity and permeability. The magnitude of land irrigability classification is evaluated taking into consideration the quality and quantity of water available, drainage requirement, topography and socio-economic condition of the people.

The surveyed area does not have considerable limitation for irrigation. However available water holding capacity and permeability are not favourable for surface irrigation. As the topography does not require any land grading and land levelling for irrigation, surface irrigation is expected to be economical. Considering all the soil limitation, the area is grouped under the irrigability class S2 (moderately suitable). The topography has average slope of 0-1%. Soil texture is sandy clay loam in the surface with varying amount of clay and moderately fine to fine loamy in the series control section (25-100 cm). Permeability of the soils is remarkably high (3.5 cm h^{-1}) with low water holding capacity. The water quality in the area is also suitable for crops and drainage is not a problem for the area due to high permeability and very low water table.

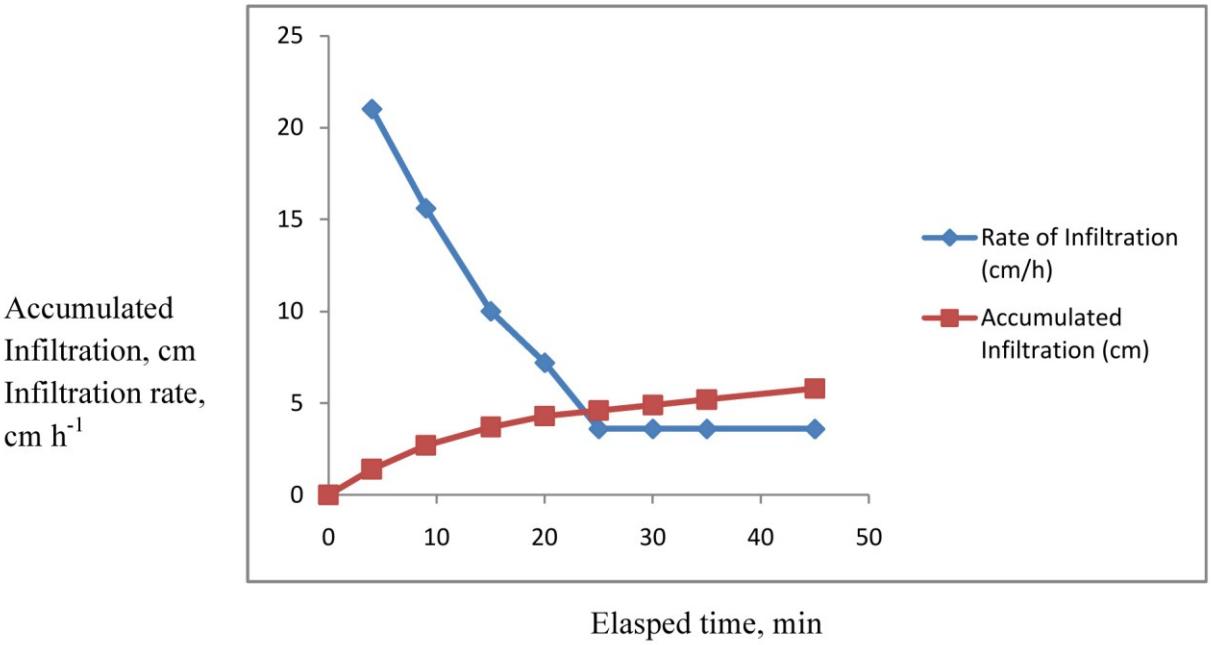


Fig 11: Infiltration Characteristic of BNCA Farm

Since the area is moderately suitable for irrigation because of the limitations related to soil characteristics, surface irrigation is not suggested for horticultural and intertilled crops. Conveyance for longer distance through earthen channel without seepage control technique must be avoided. Sprinkler and drip irrigation are the methods, which may be suitably and economically used for various crops grown in the area except rice. As there is only one irrigability class has been identified for the entire study area, it has shown along with the Land Capability Map.

Table 13 : Land Capability and Irrigability Classes of Mapped soils

Soil Series	Mapping Unit	Present Land Use	Land Capability Subclass	Land Irrigability Classification
AICRP(DA) Farm	BNCA(D)Em3	Arable farming	IIc	S2
	BNCA(D)Em2	Arable farming	IIsc	S2
	BNCA(D)El2	Arable farming	IIsc	S2
Horticultural Orchard	BNCA(H)Mm2	Arable farming	IIsc	S2
	BNCA(H)Mm3	Arable farming	IIsc	S2
	BNCA(H)Me2	Arable farming	IIsc	S2
	BNCA(H)Ml2	Arable farming	IIsc	S2

s = Limitation in soil parameters
c = Limitation caused by climatic properties etc
S2 = moderately suitable

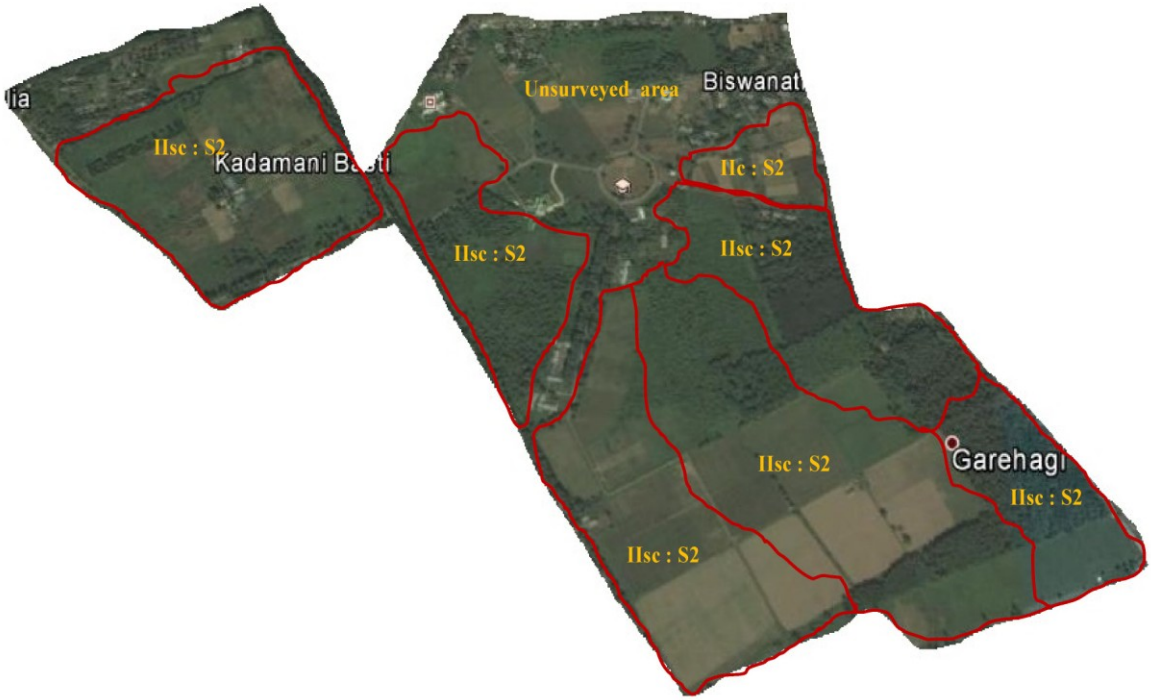


Fig 12: Land Capability and Irrigability Map of the Farms of B.N. College of Agriculture, AAU, Biswanath Chariali

5.3 Soil – Site Suitability Evaluation for Specific Crops

Productivity of a particular crop depends on land resources and the climate of the area as each plant species requires specific soil-site conditions for its optimum growth. The soil-site suitability for different crops therefore needs to be determined in order to get a profitable response from the growing crops as well as to rationalize the land use planning. These suitability models provide guidelines to decide the policy of growing most suitable crop(s), depending on the suitability or capability of each soil unit. The investigated soils of the BNCA farm are evaluated for suitability of various crops as per the guidelines of the manual of NBSS &LUP, Nagpur (2006) and presented under the Table No 14(a) and 14(b). Separate suitability map is not prepared as suitability rating for a particular crop is almost similar for the entire farm areas and therefore it can be easily identified from the soil map. However suitability map of some crops grown in BNCA farm is shown in Figures 8, 9 and 10.

Table 14a: Suitability (Present and Potential) of Mapped soil for different crops with limitations

Soil Mapping Units	Rice		Wheat		Maize		Pigeon Pea		Toria	
	Present	Potential	Present	Potential	Present	Potential	Present	Potential	Present	Potential
BNCA(D)Em3	S3w	S3w	S2lm	S1	S2lm	S1	S2lm	S1	S2lm	S1
BNCA(D)Em2	S3w	S3w	S3lm	S1	S3lm	S1	S3lm	S1	S3lm	S1
BNCA(D)El2	S3w	S3w	S3lm	S1	S3lm	S1	S3lm	S1	S3lm	S1
BNCA(H)Mm2	S3w	S3w	S3lm	S1	S3lm	S1	S3lm	S1	S3lm	S1
BNCA(H)Mm3	S3w	S3w	S3lm	S1	S3lm	S1	S3lm	S1	S3lm	S1
BNCA(H)Me2	S3w	S3w	S3lm	S1	S3lm	S1	S3lm	S1	S3lm	S1
BNCA(H)Ml2	S3w	S3w	S3lm	S1	S3lm	S1	S3lm	S1	S3lm	S1

Table 14b: Suitability (Present and Potential) of Mapped soil for different crops with limitations

Soil Mapping Units	Sesamum		Sugarcane		Potato		Citrus		Banana	
	Present	Potential	Present	Potential	Present	Potential	Present	Potential	Present	Potential
BNCA(D)Em3	S2lm	S1	S3	S1	S2lm	S1	S3	S1	S2lm	S1
BNCA(D)Em2	S3lm	S1	S3	S1	S3lm	S1	S3	S1	S3lm	S1
BNCA(D)El2	S3lm	S1	S3	S1	S3lm	S1	S3	S1	S3lm	S1
BNCA(H)Mm2	S3lm	S1	S3	S1	S3lm	S1	S3	S1	S3lm	S1
BNCA(H)Mm3	S3lm	S1	S3	S1	S3lm	S1	S3	S1	S3lm	S1
BNCA(H)Me2	S3lm	S1	S3	S1	S3lm	S1	S3	S1	S3lm	S1
BNCA(H)Ml2	S3lm	S1	S3	S1	S3lm	S1	S3	S1	S3lm	S1

S1 = Highly suitable; S2 = Moderately suitable; S3 = Marginally suitable
l = Limitation on nutrient availability
m= Limitation on moisture availability
w= Limitation on drainage

Fig 13: Soil-Site Suitability Map for Rice in the Farms of B.N. College of Agriculture, AAU, Biswanath Chariali

Fig 14: Soil-Site Suitability Map for Sugarcane and Citrus in the Farms of B.N. College of Agriculture, AAU, Biswanath Chariali

Fig 15: Soil-Site Suitability Map for Wheat, Pigeon Pea, Maize, Toria, Sesamum, Potato and Banana in the Farms of B.N. College of Agriculture, AAU, Biswanath Chariali

APPENDIXES

I. Textural Class

Sl.No	Family Class	Textural Class	Clay distribution	Symbol	
				Series Control section (25-100 cm)	Surface
1.	Moderately fine	Clay loam	25-40%	E	e
2.	Fine loamy	Sandy clay loam, clay loam, silty clay loam	27-35%	M	m
3.	Moderately fine loamy	Sandy loam, loam, silt loam (finer)	18-27%	L	l
4.	Coarse loamy	sandy loam, loam, silty loam (coarser)	< 18%	R	r
5.	Fine silty	Silty clay loam, silt loam	18-35%	Y	y
6.	Coarse silty	silty loam (coarser)	< 18%	T	t

II. Drainage Class

Class		Symbol
Extremely poor	:	0
Very poor	:	1
Poor	:	2
Imperfect	:	3
Moderately well drained	:	4
Well drained	:	5
Somewhat excessively drained	:	6
Excessively drained	:	7

III. Acidity

Class	pH range	Symbol
Extremely acidic	< 4.5	1
Strongly acidic	4.5-5.0	2
Moderately acidic	5.0-5.5	3
Slightly acidic	5.5-6.0	4

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