


Preparation of Crop Calendar on Mangalbari Town under Matiali Block, Jalpaiguri District

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Abstract— *The crop calendar in a single word is time-table providing periodical information of sowing, growing and harvesting of different crops in relation to the climatic conditions of a particular area in advance. It also enhances the crop productivity and determines the appropriate distribution of labor, application of manures in the field as well as the wholesome development of the agronomy of a specific area. The present work is an effort to highlight the present pattern of agricultural practice as well as to identify different types of crops are produced in the Mangalbari town of Jalpaiguri, West Bengal. The investigation also focuses on the assessment of crop combination, crop specialization & crop diversification in the study area to end with the preparation of crop calendar. The entire work concludes with précised suggestive measure for the development of agronomy in the area.*

Keywords— *Crop Calendar, Crop Combination, Crop Specialization, Crop Diversification, Agronomy.*

I. INTRODUCTION

'**Crop Calendar**' is a tool as well as a completion of work that provides timely information about seeds to promote local crop production. This tool contains information on planting, sowing, and harvesting menses of locally adapted crops in particular agro-ecological zones. It also provides information on the sowing rate of seeds and planting equipment, and the staple agricultural practices. This work supports many cultivators and agricultural extensionists across the world in taking correct decisions on crops and their sowing periods, respecting the agro-ecological dimensions. It also provides a solid base for emergency planning of the exoneration of farming systems after disasters.

The present paper is an attempt to study the pattern of the agricultural practices as well as the differential production varieties in the area under review. In addition to that, it highlights on the duration of crops along with their sowing and harvesting point of time organizing in a particular schedule i.e. Crop Calendar.

II. LITERATURE REVIEW

Generally, through a Crop Calendar we get to know the Crop Combination, Crop Specialization, Crop Diversification, Crop Concentration etc. At the same time, we can get an idea of the climatic characteristics there through the crop produced. The importance of a Crop Calendar in geography is huge, because most developing countries depend on the crop production, the economy of that country, like India. So, it can be said that a big part of the economy comes from the Agricultural Field. So, creating a Crop Calendar of any particular region is very important. Some Geographers and Economists worked at the macro level in the Jalpaiguri District. **Prof. Bipul Chandra Sarkar** identified the agricultural regions of Jalpaiguri at Block Level and gave a brief description. He Said, "Agriculture is the backbone of economy of the district of Jalpaiguri and the land use pattern quite differs from that of West Bengal due to its diversity in relief and climate."

Moreover, Professors of Economics **Debasis Mithiya and Kumarjit Mandal** worked on Agricultural activities on West Bengal. The concept of crop concentration or the geographic/regional concentration is based on a specific crop. Regional concentration of a specific crop reflects the distribution of its regional shares. A highly concentrated crop will be a very large part located in a small number of regions. In other words, crop concentration means the variations in the density of any crop in a region at a given point of time (**R.K Banerji, et al.**). "Therefore, crop concentration and crop diversification are the two fundamental elements of agricultural economy that determine the cropping pattern of Jalpaiguri. Consequently, knowledge about crop concentration and diversification in Jalpaguri may be considered very useful in proper agricultural land use planning. So, the knowledge of crop concentration and diversification not only provides an idea of crops that dominate a

particular region but also guides the land use planning and thereby strengthen the agricultural economy” (Basu Roy P, 2014). Researchers have worked on many other fields at micro level study in the study area previously, except Preparation of Crop Calendar. But, a large part of demand for the Jalpaiguri’s as well as West Bengal’s markets comes from the Mangalbari Town in the Dooars.

So, the present work tries to study & prepare Crop Calendar at a micro level in the Mangalbari Town. Through this crop calendar, it has been highlighted not only the Major Crops in the study area, but also the Amount of cultivated area of different crops, Production amount of crops, Type of Cultivation, Sowing-Growing-Harvesting season of crops, Economy structure etc. Besides, Literacy rate of Mangalbari Town is 62 per cent (Average) & most of the people here are clearly involved with the agricultural field.

III. OBJECTIVES

- To study the general pattern of agriculture and to recognize different types of crops produce in the area;
- To assess the crop combination, identify the crop specialization & crop diversification;
- To prepare crop calendar of the particular study area;
- Finally, to suggest some measures to develop the agro-economy on the basis of result and findings.

IV. RESEARCH METHODOLOGY

Field study requires certain processes and methods within this and should be systematically followed in order to have an organized field report. The three stages include-

4.1 Pre-field Work

This involves an idea about the place before visiting it, with location, topography, soil, climate, economy etc. from secondary data source. It also involves the collection of base map (*Mouza Map*) and Topographical Sheets collected from the SOI (*Survey of India*) and other secondary information from district gazetteers & district census handbook. In addition a structured questionnaire schedule was also prepared.

4.2 Field Work

It involves the collection of both primary and secondary data from field, showing of maps and conducting primary survey with structured questionnaire schedule. Primary data were done by random sampling of house-holds nearby the agricultural fields. The agricultural pattern was observed by visiting the farmers and interviewing them.

4.3 Post-field Work

It is the most vital part of the study. The primary data collected from the field is processed and analyzed using statistical and cartographic techniques and the crop calendar is prepared with proper illustrations.

V. DATABASE

The database of the study incorporates the primary as well as the secondary data sources:

- a) The secondary data sources are different types of maps collected from Survey of India, information about the place from district gazetteers, old maps and route charts from websites, the economic backdrops and the agricultural aspects from different published and unpublished literatures.
- b) Apart from the secondary data, the entire work is based on the data and information collected from the field visit or primary data source. Structured questionnaires were generated to study the area in a comprehensive way.

VI. BRIEF LAYOUT OF THE STUDY AREA

The present study in an attempt to explain the crop concentration and diversification in agriculture of Mangalbari under Matiali Block, Jalpaiguri District of West Bengal, it’s one among the 3 towns of Matiali Block of Jalpaiguri District. As per government register, the town number of Mangalbari is 307021. The town has 1390 households.

The study area stretches within three blocks of Jalpaiguri District (i.e. Mal, Maynaguri & Matiali) extending from $26^{\circ} 25' N$ to $27^{\circ} N$ and $88^{\circ} 30' E$ to $89^{\circ} E$. Geographically the area is well known as ‘Dooars’. The total area of Mangalbari Town is 8.5^2 KMs. Out of these 4.5^2 KMs are Agricultural and Farm Lands and 4 KMs are Reserve Forests.

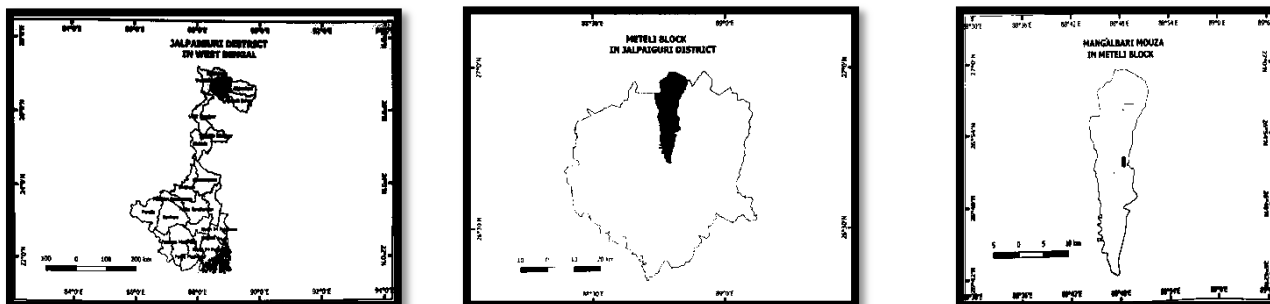


FIGURE 1: Location Map

Source: Compiled by Author

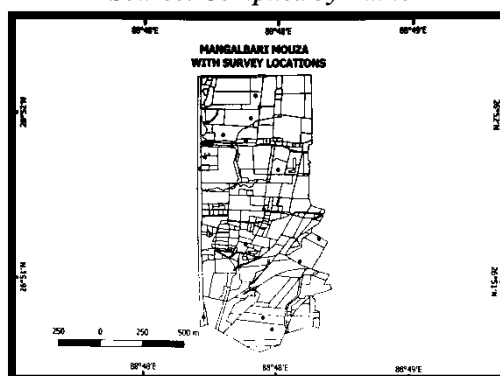


FIGURE 2: Survey Points of the Study Area

Source: Compiled by Author

6.1 Landscape

This area is almost flat nature and suitable for cultivating a variety of vegetables, although it is not suitable for the cultivation of other crops, but the crop of rice flour is cultivated throughout the year.

6.2 Climate

This region is suitable for cooler climate and for Tea cultivation. Apart from tea other crops are suitable for cultivation. The highest warmth is $29^{\circ}C$ and the minimum temperature is $18^{\circ}C$. Aman rice and many types of vegetables are good quality in this climate; there is a lot of rainfall here which is suitable for tea cultivation throughout the year.

6.3 Soil

The soil here is iron clay so it's suitable for few specific types of cultivation. Huge organic carbon concentration in the top layer facilitates cultivation of multiple types of vegetation. But leaching and sheet erosion are very prominent and as a result of high amount of rainfall amount of organic matter in soil slows down. These soils are reclaimed and are prepared again by stubble mulching process for the tea plantation & other crop production. This process involves the remnants of crops (crop residues) over the agricultural fields during fallow period.

6.4 Population

According to census 2011, Mangalbari's population is 5934, out of which, 2972 are males and the 2962 females. This town has 661 children in the age group of 0-6 Years. Among them 321 are boys & 340 are girls.

VII. RATIONALE BEHIND SELECTION OF THE STUDY AREA

The area under review has large amount of agricultural prospects as the soil is rich in organic matter and irrigational water is provided by nearby river and well water.

- a) It is evident that according to census 2011 the count of employed people of Mangalbari is 2276 while 3658 are unemployed. Again out of 2276 working individual 994 individuals are completely reliant on agriculture.
- b) Huge rainfall in the wet months in this region is the source of large amount of water for irrigation, but the method of water conservation is absent. About 99 per cent of the residents depend on the monsoon for cultivation and tank irrigation is very popular source of irrigation here. *Kharif* crops are moderate in production, but there is lot of cultivation of Rabi grains by irrigation from rivers and tube-wells.
- c) The versatile nature of crops produced here is another important reason behind the selection. Although, tea plantation is dominant in nature, but during field survey it's observed that multiple types of crops are produced here. Jute cultivation is very common along with plantation of Rubber and Betel Nuts orchards in almost every household. The cultivation of various kinds of vegetables and fruits throughout the year in the area would be suitable in the generation of the crop calendar.

VIII. ECONOMY OF THE STUDY AREA

Manufacturing of Tea is the major economy of Mangalbari. The raw material for these tea industries is tea leaf, which is abundantly produced and supplied to the factories. Moreover, the cultivation of the horticulture is also promoted thereby serving the district's economy to a large extent. Besides these, Jute and Pepper is an additional product here much of which is exported. The orchards fruits (mainly Betel nuts, Maize & Banana) draw a large quantity of export income. Hence the economy of Mangalbari is agriculture based.

Besides, there are plenty of Tea factories in the Mangalbari strengthen the economic system of local inhabitants. Now-a-days, Dooars is very famous and popular tour destination. The economy of the study area is also advanced in the tourism industry. Throughout the year, many tourists come here, but October to January to peak season. The cottage made of tin roof and cement is truly astonishing tourist here and it's said to be developed from the economic aspects of Dooars, and people here, especially the indigenous people, make cut woods from the forests & sometimes they are thumbnails from the surface for the animal species do not come in the cottage. In one word the economy of this place is strong.

IX. AGRICULTURE AS A PART OF ECONOMY IN THE STUDY AREA

Agriculture is the most important sector of the study area. Here many people are dependent upon agriculture as mentioned previously. Major crops are Tea, Rice, Wheat, Maize, Vegetables etc. Tea is the main important crop as the industrial sector is developed here and many large private Tea Estates are flourished here by the companies like Goodricke, Lipton etc. Apart from this, the Rice, Jute, Black Pepper, Betel Nut etc. holds the people's economy. Cultivation or the horticulture is also promoted thereby serving the district's economy to a large extent.

Farmers are habituated with indigenous methods for sowing, growing & harvesting of the crops. The Tea Estates are covered by small shading trees everywhere in between the gardens and they control the pests by wrapping the lower part of the tree trunk using yellow colored paper with special type of adhesives. Rubber plantation and Betel nut orchards amidst the tree estates is very common scenario over here. These kinds of eco-friendly procedure are very familiar here. They practice traditional techniques like stubble mulching, strip cropping, conservation tillage etc., which not only helps in fertilizing the soil but also prevents soil erosion due to heavy run-off in the area.

TABLE 1
PRODUCTION AMOUNT OF DIFFERENT MAJOR CROPS AND THEIR TYPE OF CULTIVATION AT MANGALBARI TOWN, DOOARS

Major Crops	Productive Amount (Tonnes)	Type Of Agriculture
Cereals	54.733	Sustainable Agriculture
Pulses	0.5	Sustainable Agriculture
Jute	4.00	Commercial Agriculture
Tea	53.72	Commercial Plantation Agriculture
Fruit	0.9	Sustainable Agriculture
Vegetables	1.02	Sustainable Agriculture
Others	27	Commercial Agriculture

Data Source: District Official Website of Jalpaiguri, 2020

It is evident from the above table that sale their products to the local markets however, return is insufficient.

X. CROP COMBINATION AT MANGALBARI TOWN, JALPAIGURI

10.1 Crop Combination method of Weaver

In the field of Agricultural geography **Weaver (1954)** was the first to use statistical technique to establish the crop combination of the Middle West of USA. Weaver computed the per cent of total harvested cropland occupied by each crop that held as much as 1 per cent of the total cultivated land. In his work Weaver calculated deviation of the real per cents of crops (occupying over 1 per cent of the cropped area) for all the possible combinations in the component areal units against a theoretical standard are as follows:

Monoculture = 100 per cent of the total harvested crop land in one crop.

2-crop combination = 50 per cent in each of two crops.

3-crop combination = 33.33 per cent in each of three crops.

4-crop combination = 25 per cent in each of four crops.

...

10-crop combination = 10 per cent in each of ten crops and so on.

For the determination of the minimum deviation the standard deviation method was used. The actual formula he used was excludes the square root as variance.

$$D = \text{Summation } d^2/n$$

Where d is the difference between the actual crop per cent and the appropriate per cent in the theoretical standard in a given aerial unit and n is the number of crops in a given combination.

$$\text{Monoculture} = (100 - 1\text{st crop's land use value})^2/1$$

$$2\text{-crop combination} = (50 - 1\text{st crop's land use value})^2 + (50 - 2\text{nd crop's land use value})^2/2 \text{ and so on.}$$

10.2 Crop Combination method of Rafiullah

Looking the weakness of Weaver's method which tends to include all or most of the crops and over generalization, **Rafiullah (1956)** developed a new deviation method. The technique devised by him may be expressed as follows:

$$d = (\text{summation } D^2p - D^2n) / N^2$$

Where d is the deviation, Dp is the positive difference and Dn is the negative difference from the median value of the theoretical curve value of the combination, N is the number of crops in the combination. Rafiullah's combination method is known as maximum positive deviation method. From the calculation, maximum value is taken into consideration.

$$\text{Monoculture} = (1\text{st crop's land use value} - 50)^2 / N^2$$

$$2 \text{ crop combination} = \{(1\text{st crop's land use value} - 25)^2 - (2\text{nd crop's land use value} - 25)^2\} / N^2$$

...

The Statistical technique advocated by Rafiullah is more accurate, objective, and scientific and therefore quite popular for the delineation of crop combination regions.

TABLE 2
TOTAL AREA OF DIFFERENT MAJOR CROPS (IN HECTARES AND PER CENT)

Major Crops	Total Area of Different Crops (In Hectares)	Total Area of Different Crops (In Per cent)
Cereals	8.2005	6.34
Pulses	1.665	1.29
Vegetables	2.6315	2.03
Jute	4.792	3.70
Tea	107.1035	82.80
Fruits	0.643	0.50
Others	4.322	3.34

Data Source: Computed by Author from the District Official Website of Jalpaiguri, 2020

In Weaver's combination analysis 5 main crops of the Mangalbari town is taken into consideration which occupy more than 1 per cent area of the Gross Cropped Area. These are Cereals, Pulses, Vegetables, Jute, & Tea. By the calculation procedure following table is generalized.

TABLE 3
CROP COMBINATION FOR MANGALBARI TOWN (2020) AFTER WEAVER

S. No	Town	Mono	2 Crop	3 Crop	4 Crop	5 Crop	Remarks	Combination Crops
1	Mangalbari	295.84	1491.02	1351.23	1167.59	1013.82	Mono-crop	T

Data Source: Computed by Author

*T = Tea

Rafiullah method of crop combination is more accurate and practical in the town of Mangalbari. His Maximum positive deviation method is tabulated below:

TABLE 4
CROP COMBINATION FOR MANGALBARI TOWN (2020) AFTER RAFIULLAH

S. No	Town	Mono	2 Crop	3 Crop	4 Crop	5 Crop	Remarks	Combination Crops
1	Mangalbari	1075.84	748.16	454.76	294.82	204.29	Mono-Crop	T

Data Source: Computed by Author

*T = Tea

XI. CROP SPECIALIZATION AT MANGALBARI TOWN, JALPAIGURI

Crop specialization is done to determine the special crops in that regional unit. It is perhaps done from combination table. Up to last combination level it is counted as 100 per cent area. Again calculation is done for cropping area. Three hierarchical conditions are assumed. High specialization (more than 66.67 per cent), moderate (33.33 - 66.67 per cent) and low (less than 33.33 per cent). In the Mangalbari Town one type of crop is specialized rather than crop diversification. Following table will highlight the condition of crop specialization in the town.

TABLE 5
CROP SPECIALIZATION FOR MANGALBARI TOWN (2020) AFTER WEAVER

S. No	Town	Mono	2 Crop	3 Crop	4 Crop	5 Crop	Degree of Specialization		
							High (>66.67)	Moderate (33.33-66.67)	Low (<33.33)
1	Mangalbari	86.11	6.59	3.85	2.11	1.34	Tea	-	-

Data Source: Computed by Author

XII. CROP DIVERSIFICATION AT MANGALBARI TOWN, JALPAIGURI

Crop Diversification is a concept which is opposite to Crop Specialization. The farmers all over the world, especially in the developing countries, try to grow several crops in their holdings in an agricultural year. The level of crop diversification largely depends on the geo-climatic/socioeconomic conditions and technological development in a region. In general higher the level of agricultural technology, lesser the degree of diversification. Moreover, the rich farmers prefer to specialize in agricultural enterprise while the poor and subsistence farmers are generally more interested in the diversification of crops.

For the measurement of Crop Diversification, **Bhatia (1965)** developed a formula based on the gross cropped area. The formula has been expressed as:

$$\text{Index of Crop Diversification (ICD)} = \text{Per cent of sown area under crops} / \text{Number of 'x' crops}$$

In general it's assumed by Bhatia that 'x' crops are those crops that individually occupy 10 per cent or more of the gross cropped area in the area under study. The degree of Crop Diversification is closely influenced by the soil characteristics, soil moisture, amount of rainfall received, the availability of irrigation facilities, the accessibility of the arable land and the technology deployed by the cultivators. The areas of extreme wet or extreme dry climate are least conducive for crop diversification.

According to the Bhatia's concept (1965) there is very low diversification in Mangalbari Town. Only Tea crop occupies more than 10 per cent of the gross cropped area. So, there is clearly seen that the one specialization crop is Tea (82.80 per cent).

But, **Jasbir Singh (1976)** has modified the technique of Bhatia. In his modified technique, the crops, which occupy individually less than 5 per cent, are not considered for calculating the index of diversification.

According to the Jasbir Singh's concept (1976) there is also very low diversification in Mangalbari Town but, Tea and Cereals crops are occupy more than 5 Per cent of the gross cropped area. So, there is clearly seen that the two specialization crops are Tea and Cereals at the Mangalbari Town, Jalpaiguri.

$$*ICD = (82.80 \text{ per cent} + 6.34 \text{ per cent}) / 2 = 44.57 \text{ per cent.}$$

XIII. CROP CALENDAR AT MANGALBARI TOWN, JALPAIGURI

Crop calendar is the fundamental element of Agricultural Geography because it helps to know cropping model of a region in a very comprehensive manner as it provides knowledge about concentration, rotation and diversification of agriculture in a simple and single graphic representation of a region.

Crop concentration refers to the spatial density of individual crop or it may be stated as the variation in the density of any crop in a region at a fixed time span. On the other hand, crop diversification means cultivation of various crops in a particular soil regime. Thus, it refers to growing of varieties of crops either in a region or in the same agricultural field.

Total Area Of Different Major Crops In Per Cent ('Pc')
Pie Chart

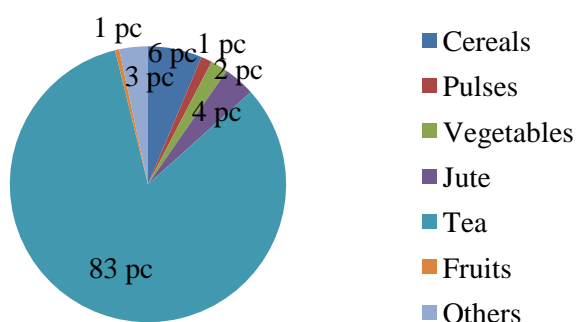


FIGURE 3: Total Area of Different Major Crops in Per cent.
(Source: Compiled by Author)

Basically, during the period of Green Revolution in the late sixties, there was a surge for diversified agricultural system to rejuvenate agricultural economy and for that purpose; it becomes necessary to diversify the cropping pattern to country's growing demand and to increase income by earning foreign exchange. Consequently, crop concentration and diversification do not only provide that idea of a region dominated by particular crop but also play a role of guide to strengthen agricultural economy and land-use planning.

Crop Calendar assists the economic planners in proper agricultural land-use planning. The crop calendar is also efficient in assessing the exact timings of sowing, growing, and harvesting of a particular crop along with the climatic elements such as temperature, rainfall and relative humidity for the beneficiaries, mainly the cultivators of the area.

TABLE 6
AVERAGE TEMPERATURE (in °C), RAINFALL (in mm), AND RELATIVE HUMIDITY (in Per cent) IN THE STUDY AREA (MANGALBARI TOWN, DOOARS)

Months	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature (in °C)	17.25	20.29	24.46	26.47	21.64	28.72	29.05	28.44	27.97	26.45	23.10	19.70
Rainfall (in mm)	8.17	4.15	17.30	119.75	201.15	371.68	512.08	405.37	372.90	125.07	15.75	00.00
Relative Humidity (in Per cent)	88	81	74	75	75	84	87	90	81	83	79	79

Data Source: Regional Meteorological Centre, Kolkata, 2019-20

TABLE 7
SOWING, HARVESTING AND TOTAL CULTIVATION SEASON OF MAJOR CROPS IN THE STUDY AREA (MANGALBARI TOWN, DOOARS)

Items	Season (Total)	Sowing	Harvesting
Cereals	July to December	July 1 st Week	December Last Week
Vegetables	January to December	Any Time	Any Time
Jute	December to May and July to November	July 1 st Week & December 1 st Week	November Last Week & May Last Week
Tea	July to December	July 1 st Week	December Last Week
Fruits	January to November	January 1 st Week	November Last Week
Others	January to December	Any Time	Any Time

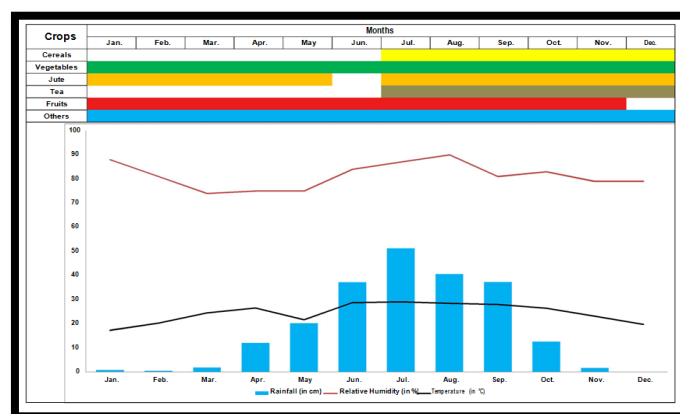


FIGURE- 4: 'ERGOGRAPH', Showing The Relationships Between Rainfall, Temperature, Relative Humidity and Cultivation of Major Crops in the Study Area (Mangalbari Town, Dooars)

XIV. RESULTS AND CONCLUSION

The crop calendar that has been prepared on the basis of secondary as well as primary data related to the agriculture in Mangalbari Town. The secondary data and information about weather elements, we have collected from the NRSC's website and crop related data of Mangalbari under Jalpaiguri district has been collected by field survey.

14.1 Climatic Characteristics

The diagram depicts that the highest temperature in the study area found to be in the month of July is 29.08°C and the lowest temperature is found to be in the month of January is 17.25°C. Rainfall scenario of the area is very unpredictable as highest rainfall (512.08 mm) is found in the month of July but in the month of December the amount of Rainfall is almost deficient. In Jalpaiguri, the highest Relative Humidity is found to the month of January (87 per cent) on the other hand, lowest Relative Humidity is (74 per cent) found in the month of March.

14.2 Pattern of Crops

The crop calendar of Mangalbari has various types of crops production throughout the year. Tea is the most dominant crop of

the area which (82.80 per cent) of the total produced crops.

The growing season is July to December. The second dominant is Cereals (6.34 per cent) of the total gross shown area. Then the amount of Jute occupies (3.70 per cent) of total gross shown area. Other crops (Viz. Black Pepper, Betel Nuts etc.) are produced in the part of study area (3.34 per cent). Few quantities of Vegetables (2.03 per cent) and Fruits (0.50 per cent) are also produced in this area. Although, the amount of Vegetables are insignificant to the total amount of crop production, but the area under review comprises production of multiple types of fruits and vegetables. In spite, some quantities of Pulses (1.29 per cent) are also produced here.

XV. SUGGESTIONS

Suggestions that are absolutely needed in the future for farming and agro-economic development in this area:

- Increase the quality of education.
- Agricultural fields will have to be used for advanced technology.
- The quantity of improved seeds and organic fertilizers should be increased.
- Many crops should be cultivated in greater quantities.
- For farmers, necessary allowance should be made from the government.
- In the field of agriculture, farmers should be encouraged.
- All the benefits will be given from the government.
- The demand of the market has to be increased and the farmers have to pay a fair price.
- Communication needs to be improved so that primary materials can be easily accessed in the nearby industries and markets.
- The fallow land must be filled through agricultural work.

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