

# **Chapter I**

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### **1.1. Why this study?**

Agriculture always plays a vital role in our national economy. Even today though the country is being rapidly industrialized, it is the backbone of our economy. This may be seen from the fact that agriculture is by far the largest single industry in the country and is the chief occupation of the population. About 70 per cent of the total population of the country directly engaged in agriculture and of the rural population nearly 90 per cent is directly or indirectly connected with it. Besides being the main source of food for the vast and growing population, it is also the chief source of our national income. Therefore, the future prosperity of the population and a stable self-sufficient economy is largely based on the development of agriculture on scientific basis.

As the various socio-economic problems related to agriculture so closely inter-linked and are characteristic of all parts of the country that it is not possible to suggest any single plan for their solution. There is such a variety of local, physical and social conditions that a plan suitable for one area may prove unsuitable for another. Each region has its own unique personality and as such its problems should be studied in relation to its local environment. It is out of these considerations that an agricultural land use study of Siliguri subdivision becomes useful since it analyzes the influence of local environment on agricultural land use and studies the problems in the correct perspective.

### **1.2. Scope and Choice of the Study Region**

The choice of area under study is influenced by many considerations. Firstly, it is felt that such study at micro level would provide a useful approach to obtain a more complete understanding of the problems of agriculture in the region. Secondly, the subdivision of Siliguri is a part of Terai region. Therefore, the study of agricultural land use of Siliguri Subdivision will help to a certain extent to understand the agricultural geography of Terai region. Thirdly, this region is regarded as one of the most developed agricultural areas of

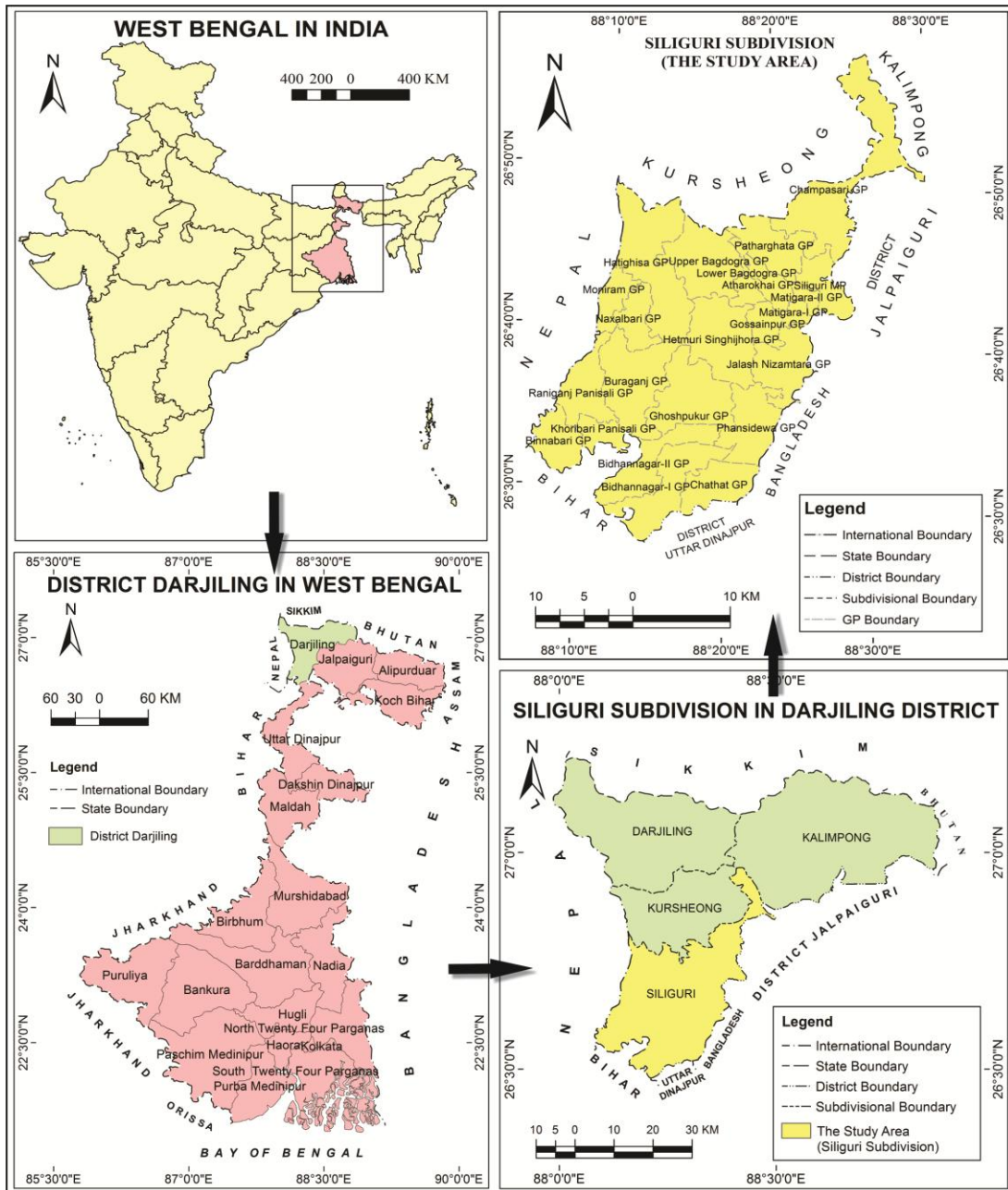


Figure 1.1 Location Map of the study area

Darjeeling District. Finally, since last few years a large area which was previously under food grains or vegetables is being devoted to tea plantation and horticulture, thereby leading to changes in the use of agricultural land.

Hence, the study of the use of land for crops and the changes in the areal strength of the same offers a scope for obtaining a more complete understanding of the agricultural land use of this subdivision in time-space perspective.

### **1.3. Hypotheses**

1. Agricultural land use pattern has changed over the decades in the study area.
2. Changing agricultural land use pattern has changed the socio-economic conditions of rural masses.
3. Modern agricultural inputs have direct impact on agricultural land use pattern.

### **1.4. Objectives**

The following objectives have been taken into consideration on the basis of the hypotheses mentioned earlier:

1. To examine the general and agricultural land use pattern in the light of physical and socio-economic conditions in the study area.
2. To analyze the changes in agricultural land use between the period of 1990-1991 to 2010-2011 in the study area.
3. To assess the level of agricultural productivity in the study area.
4. To analyze the role of agricultural inputs in the existing cropping pattern.
5. To identify the agricultural land use regions in the study area.
6. To identify major problems in agricultural development of the study area.

### **1.5. Methodology**

With the objective of analyzing the agricultural land use pattern and its spatio-temporal variation in the Siliguri subdivision a proposal has been made to analyze secondary data along with the primary data. In Siliguri subdivision various crops are cultivated but here

in this study 14 major crops forming five crop groups are considered. Table 1.1 provides the list of crops and their respective crop groups considered.

**Table 1.1** Major Crops Cultivated in Siliguri Subdivision

<b>Sl. No.</b>	<b>Crop Group</b>	<b>Crops</b>
1	Cereals	Aus, Aman, Boro, Wheat
2	Pulses	Masur, Maskalai, Khesari
3	Oil Seeds	Mustard, Linseed, Til
4	Cash Crops	Potato, Jute, Maize
5	Other crops	Different types of vegetables

*(Compiled by the Researcher)*

The study uses the secondary data for the period 1990-91 to 2010-2011. Primary data survey has been conducted in two phases: Phase I: September, 2010 and Phase II: March, 2013.

The secondary data has been collected from various sources. The physical set up of the study area are done on the basis of relief map, slope zone map, soil map, drainage map, natural vegetation map, etc. based on Toposheet 78 B/1, 78 B/2, 78 B/3, 78 B/5, 78 B/6 and 78 B/9. Socio-economic set up of the study area are analyzed and mapped by using the data published in Statistical Hand Book, Census Hand Book, District Gazetteer and Government Publications.

Landsat 7 ETM+ 1990 and 2011 has been processed using Digital Image Processing (DIP) technique, particularly by the supervised classification. In the Supervised classification technique, two satellite images with different dates are independently classified. A Supervised classification method has been carried out by using training areas. Maximum Likelihood Algorithm was employed to detect the land use types in EARDAS IMAGINE 14 version. Before the creation of classification of satellite imagery, an extensive field survey was performed throughout the study area using Global Positioning System (GPS) equipment. This survey was performed in order to obtain accurate locational point data for each land use class included in the classification scheme as well as for the creation of training sites and for signature generation.

Temporal and spatial variations of agricultural land use pattern, i.e., cropping pattern of the study area are analyzed by considering the relative percentage share of area to gross

cropped area for the two periods: 1990-91 and 2010-11. To analyze the change of cropping pattern with respect to individual crop groups, viz., cereals, pulses, oilseeds and cash crops the following formula is used:

$$\frac{(\text{Present area coverage}) / (\text{Past area coverage})}{(\text{Past area coverage})} \times 100$$

To display the pattern of shift radar diagram has been used. To analyze the significance of growth of area cultivated under individual crop compound growth rate is computed by using the following formula:

$$r = [(\sqrt[n]{P_n / P_0}) - 1] \times 100 \%$$

Where,  $r$  = Compound growth rate;  $n$  = No. of years;  $P_n$  = Component areal strength of the final year and  $P_0$  = Component areal strength of the initial year

For the purpose of measuring agricultural productivity, productivity index of individual crop at gram panchayat level has been calculated using the following relationship.

Productivity Index has been calculated using the following formula:

$$\text{Productivity Index} = \frac{Y}{Y_n} \div \frac{T}{T_n}$$

Where  $Y$  is the total production of the selected crop in gram panchayat,

$Y_n$  is the total production of the same crop at subdivision level,

$T$  is the total cropped area of the gram panchayat, and

$T_n$  is the total cropped area at subdivision level.

The yield growth trend has been analyzed using the compound growth rates.

To analyze the spatial disparities in the levels of agro-technological development the equation evolved by Dutt and Sen Gupta (1969) has been used which is further modification by Jasbir Singh (1994) and composite index values have also been derived.

The computation procedure is as follows:

$$It = \frac{I_g}{I_s} + \frac{F_g}{F_s} + \frac{H_g}{H_s} + \frac{T_g}{T_s} + \frac{P_g}{P_s} + \frac{Th_g}{Th_s}$$

Where,

$It$  = composite index of the level of agricultural technology

I = proportion of irrigated area to total cropped area  
 F = fertilizer consumption of per hectare of cultivated area  
 H = proportion of area under HYVs to total cropped area  
 T = tractors per hectare of cultivated area  
 P = pumpset implements per hectare of cultivated area  
 Th = threshers per hectare of cultivated area

g and s subscripts symbolize respectively the gram panchayat and subdivision as a whole. The above procedure is adopted to compute the index value of each gram panchayat. The summed up index values of all indicators then multiplied by 100 to derive the degree of agricultural technology.

$$\text{Degree of Agricultural technology} = \frac{\sum LQS}{N} \times 100$$

Here N indicates the number of indicators of agricultural technology.

The percentage of area involved in change for every areal unit (GP) is calculated for individual crops. The crops of leading increase and decrease have been marked in each gram panchayat to provide a comparative view of the direction of change. For the quantitative measurement of the overall change in agricultural land use pattern during 1990-91 to 2010-11, Weaver's Index (1954) is used.

$$\text{Index of change in Agricultural Land use} = \frac{A}{B}$$

Where, 'A' is the difference in percentage of crops of increase and 'B' is the difference of percentage of crops of decrease for the period under review.

The summation of the numerator and the denominator should be the same and this only be achieved if land use statistics are accurate and carefully computed. The higher the index, the more radical are the changes in the land use pattern and lower the index, the more is the stability.

Ranking of crops for the study area have been studied for two time periods: Period I (1990-91) and Period –II (2010-11). The ranking regions of different crops have been calculated by considering the relative strength of percentage share to GCA of the gram

panchayat for each crop. The crop areas have been arranged into descending order of magnitude and termed first, second, third, fourth and fifth ranks.

In the present study an attempt is made to delineate the patterns of crop combination by applying the Weaver's least (minimum) standard deviation (1954) and K. Doi's method (1959). He calculated deviation of the real Percentages of crops (occupying over 1 per cent of the cropped area) for all possible combinations in the component areal units against a theoretical standard is as follows:

- Monoculture = 100 % of the total harvested crop land in one crop.
- Two crop combination = 50 % in each of two crops.
- Three crop combination = 33.3 % in each of three crops.
- Four crop combination = 25 % in each of four crops.
- Five crop combination = 20 % in each of five crops.
- Ten crop combination = 10 % in each of ten crops.

For the determination of the minimum deviation the standard deviation method was used:

$$SD = \sqrt{\frac{\sum d^2}{n}}$$

Where, d = the difference between the actual crop percentages in a given areal unit and the appropriate percentage in the theoretical standard and n = number of crops in a given combination.

As Weaver pointed out, the relative, not absolute value being significant, square roots were not extracted so, the actual formula used was as follows:

$$d = \frac{\sum d^2}{n}$$

Least value of the combination will be taken for consideration.

Weaver's technique was subsequently modified by Doi (1959). The Doi's formula is as follows:

$$(\sum d^2)$$

Where,  $(\sum d^2)$  = sum of the squares deviations.

The combination having the smallest  $(\sum d^2)$  will be the crop combination. But it is not required to calculate  $(\sum d^2)$  for each combination, as it can be found only by consulting a table provided by Doi which presents critical values for different element at various



cumulative percentages. If the percentage held by a single crop is lower than the critical value, the crop is dropped from the combination and vice versa.

In order to identify spatial pattern of crop diversification in present study Bhatia's method has been adopted. Bhatia (1965) has evolved a simple formula by taking into account the cropped area, to make an objective measurement of crop diversification. The formula is:

$$\text{Index of Crop Diversification} = \frac{\text{Percent of sown area under } x \text{ crops}}{\text{Number of } x \text{ crops}}$$

Where,  $x$  crops are those crops that individually occupy 5% or more of the cultivated area in a regional unit.

The results of the analysis have been presented by different types of cartograms, choropleth maps by ArcGIS to provide pictorial view.

The primary data have been collected through selective survey by questionnaire method. This questionnaire comprises crops grown in the field, mode and method of agricultural practices, types and sources of irrigation, use of fertilizers, marketing facilities of agricultural commodities. To study the social and economic condition of the farming communities' household survey has been done through questionnaire. The spot inquiries of the cultivators and agricultural labours during fieldwork helped to gather realistic picture of existing pattern of agriculture at village level in the subdivision.

### **1.6. Sources of Data**

The main body of the data for present study has been collected from two sources, viz., primary and secondary.

Primary data has been collected from the sample village personally through household questionnaires. Information collected through interviews and personal correspondence on various aspects of socio-economic conditions will be added to this body of data.

Secondary data sources has included the published reports and abstracts such as socio-economic review and district statistical abstracts, district census handbook, district gazetteer, agricultural annual plan published by Agricultural Department of subdivision,

season and crop reports published by government of West Bengal, etc. Secondary data regarding the present study will also be collected from Agricultural Block Offices, B.L. & L.R.O. and D.L. & L.R.O. offices, Gram Panchayat Offices, Soil survey Department and Irrigation Department, etc. Other secondary sources of information for the compilation of the maps are Survey of India Toposheet, Satellite imageries from USGS, District Planning Map Series.

### **1.7. Limitations:**

The present study encompasses the available data for crops at Gram Panchayat level to depict the picture of the existing agricultural pattern as well as to provide a changing pattern of Siliguri Subdivision. Mostly accessible and available data and information have been taken into consideration for analytical, incisive and meaningful description as well as analysis. Sometimes it has been found that the published data varied from one source to another source because the data collected by the various Govt. offices have been tabulated according to their needs. This type of problem mainly accentuated while engaged in fieldwork.

Not all the time the updated data and accurate information in fulfilling the objectives was readily available. Hence, the researcher has confined the study based on the data available from published and Govt. sources. The statistical approach for representing the data obtained from secondary sources is limited by their quality and degree of accuracy, although every care will be taken to do away the discrepancies and anomalies.

### **1.8. Review of Literature**

i) Barakade A. J., Dr. Tonape L.B and Dr. Lokhande T. N., in their paper, “Agricultural land use pattern in Satara district of Maharashtra”, analyzed that the distributional pattern of crops in any region is an outcome of predominance of certain crop or combination of crops. The soil and other natural environmental factors, along with the socioeconomic factors, affect the cropping pattern in study region. The statistical techniques provide accurate techniques. For the study of agriculture land use and cropping pattern various methods have used by scholar, scientists and agricultural scientists.

ii) Gomatee, in her paper, “Agricultural Land use Pattern in Bulandshahr District of Upper-Ganga Yamuna Doab, India”, made an attempt to analyze the agricultural land use pattern at micro level in Bulandshahr district of upper Ganga -Yamuna Doab. Cropping pattern in any region has undergone an evolutionary process. The choice of cropping system is dependent primarily on physical variables and secondarily on size of operational holding, market and transport facilities, capital, price policy of the government and techno-organizational factors. An effort has been made here to study the changing land use pattern, cropping pattern, pattern of crop diversification, crop combination and ranking of the crops in Bulandshahr district for the year 2008-09.

iii) Husain, M., in his book, ‘Systematic Agricultural Geography’, described that the major thrust of Agricultural Geography is on the description, interpretation and explanation of spatial variations of land use, cropping patterns, crop concentration, crop combination, agricultural productivity, agricultural regionalization and regional inequalities in agricultural efficiency with the set objective to formulate strategies for the planning and development of agriculture. For providing a strong theoretical base, models and theories of agricultural land use are also important components of Agricultural Geography.

iv) Mishra, R.P., and Shukla, S., in their paper, “Changes in cropping pattern in Madhya Pradesh”, analyzed the changes in land use and associated cropping pattern during 1956 and 2001. Significant changes in the land use and cropping pattern has been recorded in Madhya Pradesh. The proportion of barren and uncultivated land has decreased significantly. The proportion of gross cropped area has changed from food grains to non-food grains. These changes have prime importance because a little change in this sector may change the socio-economic scenario in a region.

v) Mohammad, N., in his book, “Agricultural land use in India: a case study”, made an attempt to study the agricultural land use of Ghaghara-Rapti Doab through local surveys in the selected villages. He tried to interpret the use of agricultural land as exists today in the 7 selected villages of Ghaghara-Rapti Doab.

vi) Pal, S., in his research work, “Spatio-temporal change of crop diversification in Murshidabad District, W.B.,” analyzed that choice of cropping system is dependent primarily on physical factors and secondarily on technological factors. Spatial and temporal pattern of crop diversification plays a vital role to understand the changing pattern of crops for area. For proper understanding of agricultural planning programme, agricultural regionalization in meso and micro level is indispensable and in this relation crop diversification play important role. Therefore author made an attempt to study the changing scenario of crop diversification during 2002-2003 and 2004-05 in Murshidabad District where more than 80% of the total population involved in agriculture.

vii) Rathod, Dr. H.B. and Naik, Prof. Dr. V.T., in their paper, “Agricultural land use cropping pattern in Yavatmal District”, made an attempt to analyzed the agricultural land use pattern in Yavatmal district which is based on primary and secondary data. Agricultural production is influenced by physical, socio-economic, technological and organization factors. An attempt also made to study the crop combination regions in Yavatmal district for the year 1981-2001 by Doi’s method. Such type of study represents real situation of cropping pattern in Yavatmal district and helps to planners and agricultural scientists for agricultural planning a district level.

viii) Sen, S., in his paper, “Spatio-temporal variation of agricultural and its regionalization in Barddhaman District, West Bengal”, discussed the temporal variation on the aspects like crop combination, crop diversification, agricultural productivity and efficiency in the 31 blocks of Barddhaman District during 1996 and 2007. Crop combination method shows the assemblage of various crops grown in an area unit. Crop diversification indicates the shift from single crop farming to multiple crop farming, from subsistence farming to commercial farming, from low value crops to high value crops. Agricultural productivity and efficiency helps to identify the reason behind agricultural land use change

ix) Todkari, G.U., Suryawanshi, S.P., and et. al., in their paper, “Agricultural land use pattern in Solapur District of Maharashtra”, analyzed the agricultural land use pattern at micro level in Solapur district based on secondary data. An endeavour is made here to study the crop combination regions in this district for year 2004-05. The crop data has

been computed with the help of Weaver's technique of crop combination. Physiography, temperature, rainfall, soil and drainage influence on agricultural land use pattern in this district.

x) Vishwakarma, D.D., in his article, "Inter and Intra-community variation in Agricultural land use in Chhindwara District, M.P.", focuses on the size of holdings and caste structure as the determinant of inter and intra-community variation in agricultural land use. Use of agricultural land depends upon the capacity of man to treat the land and manage it. Agricultural development measures and actual investment has direct relationship with the size of holdings and agricultural land use varies with the communities.

### **1.9. References**

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