Chapter V

Agricultural Land Use
5.1 Introduction:

Agriculture is the backbone of the Kangsabati basin's economy just as it is of a country like India, where more than 70 per cent of total population live in villages and depend on agriculture for their livelihood. Hence to know the basin's economy and find out measures for its improvement, the study of agriculture in all its aspects is absolutely necessary.

The primary purpose of agricultural geography is to undertake a geographical enquiry into the regional differences and spatial variations in agricultural formations and geographic associations.

A scientific approach to the analysis of spatial distribution and interrelationship in agriculture involves two equally important aspects: (i) the collection of facts and figures of agricultural relevance and (ii) collating them into a meaningful relationship which could constitute a hypothesis. Thus, the major task is to quantify agricultural characteristics and to map their spatial distribution, i.e., the degree of concentration and diversification.

The major objectives of this study of agriculture are:

(i) to understand how a particular type of agriculture has developed in a particular area,
(ii) to measure and examine the level of differences between the regions,
(iii) to demonstrate the agricultural efficiency and land capability regions,
(iv) to identify weaker areas in terms of agricultural efficiency and (v) to delimit areas of agricultural stagnation and transition.

Throughout its course, the river Kangsabati has encouraged intense agricultural activity which is the major means of livelihood of
people living in this area. From the study of the dominant and distinctive functions, it also appears that agriculture is the dominant as well as distinctive function in most blocks. The general land use map also shows that agricultural land occupy most of the area in each block. Mineral resources occur at few places only in the upper part of the basin, industries are very few in the basin area, except for the recently developing industries in and around Haldia and trade and commerce is found to a little extent in the lower part; forestry which formerly engaged a large number of people in the upper and middle parts is negligible because of huge deforestation recently. So agriculture continued to be the only occupation of most of the people in this area.

But the geography of agriculture here is much more complex due to variations in physical as well as socio-economic factors influencing agriculture. The agricultural land use is mainly guided by the availability of irrigation water. The role of physical factors seems to be more decisive than economic factors in determining the agricultural growth and production.

All these necessitate the study of agricultural land use of the basin area in detail. This chapter will include different categories of agricultural land use as percentages of total agricultural area, agricultural efficiency regions and capability regions of the basin area, which will help to identify agriculturally backward areas in the basin and the reasons for their backwardness. The coefficient of correlation between these two and other variables will help to find out the main factors affecting agriculture in this part of West Bengal.

5.2 Methodology:

First percentages of different categories of agricultural land use, e.g., net sown area, orchard, permanent pasture, current fallow, fallow other than current fallow, culturable waste and barren as well as unculturable land to total agricultural area have been calculated and isopleth maps have been drawn to show their spatial distribution. The methods of finding out agricultural efficiency regions and land capability classes are outlined below.
5.2.1 Agricultural Efficiency:

The term agricultural efficiency means the productivity of a particular unit of land. It is a scientific device to study the inherent fertility, productivity, and capability of land. Geographers and economists have long been interested in determining the efficiency of agriculture in various parts of the world. The study of it appears useful for differentiating areas that may be performing rather poorly in comparison with other areas in the field of agriculture. The need for such a differentiation is necessary in case of developing countries where available land for expansion of cultivation is insufficient and the only way to meet the increasing pressure of population on land seems to be the improvement of agricultural efficiency. The study of agricultural efficiency is also necessary to check the misuse and underuse of land.

There seems to be four approaches to the measurement of agricultural efficiency. It may be measured as (a) output per unit area, (b) output per unit of labor applied, (c) output in relation to input and (d) output expressed in terms of grain equivalents per head of population. Of these, (b) and (c) seem to require data that are not easily available.

Measurement of agricultural efficiency as output per unit area is based on acre yield index and a measure for it was evolved by Kendall in 1939. He applied the method of ranking co-efficient of yield of main crops per unit area. This method has an inherent weakness which arises from the neglect of the areal strength of crops.

Later on Sapre and Deshpande (1964) modified Kendall's method and suggested an equation by multiplying ranking of crops with that of crop land share divided by the total of crop land share.

Ganguli (1938) devised an index of agricultural efficiency by multiplying the percentages of crops share with percentages of...
Bhatia in 1967 used the above efficiency index with some modifications. He used percentage yield of crops instead of yield ranking of individual crops.

In 1968, Gupta measured agricultural efficiency by considering yield efficiency of crops by their proportionate share of land.

In this chapter, agricultural efficiency has been calculated following the method adopted by R.B. Mondal as it needs simple calculations and relevant data is readily available. Here agricultural efficiency has been assessed in terms of cereals and pulses. The formula is as follows:

\[
AE = \frac{B \left( X_1 + X_2 + X_3 \ldots \ldots X_n \right)}{R \left( X_1 + X_2 + X_3 \ldots \ldots X_n \right)} \times 100
\]

where \( AE \) denotes agricultural efficiency,
- \( B \) is the block in particular,
- \( R \) is the region, and
- \( X_1, X_2, X_3 \) are yield of crops grown in the block region.

This value of location quotient serves here as agricultural efficiency. From the values of agricultural efficiency, lower quartile, median, and upper quartile which divided the data into four parts, were determined. A choropleth map has been prepared taking these four grades.

5.2.2 Land Capability Index:

Land capability classification is a scientific study which shows the different degrees of productivity of the land under particular ecological conditions. Yield of a particular crop in a region is the function of physical, social and economic attributes. The scientific study of these attributes is necessary for balanced agricultural development of an area. The measurement of land capability is necessary for improvement of inherent
productivity of land, which is again important as population density is increasing day by day, thereby decreasing per capita supporting capacity of land.

There are several methods of classifying land into capability classes. Storie devised land rating chart which assigns the percentage values to the characteristic soils and land features that affect land utilization. Marbut's method (1935) is based on statistical information of yield history of a particular piece of land. Morgan (1939) considered the degree of adoption of land types to various crops. Stamp (1962) has classified the land of Britain on the basis of soil properties, land use, and land values, while Chowdhury determined the capability classes on the basis of soil properties. Basically, the land capability classes of an area, according to U.S. Department of Agricultural system, are derived from soil maps of that area.

NATMO prepared a land capability map of India based on interpretation of source maps showing soil characteristics as derived from analysis of Landsat imageries. The mapping exercise is supported by fairly extensive ground truths which comprises the description of soil profiles, description of soil series identified by soil surveyors in many parts of the country, etc. Ground survey information contained in the soil maps and handbooks brought out by Raychovdhuri and others, Gobinda Rana and Gopala Rao (1978) and FAO UNESCO (1977) have been fully utilized for interpreting the imageries. Selected cloud-free imageries of suitable dates available for the period 1972 to 1975 covering the whole of India on all the four wave bands (4, 5, 6, and 7) on a scale of 1:1,000,000 have been interpreted along with the existing soil maps, geological maps, forest maps, crop maps, and physiographic maps at different scales. This land capability map prepared by National Atlas has been used in this present study along with the land capability map prepared by the author.

In the present study another method for identifying the land capability classes, following R.B. Mondal's method to some extent has been used after due consideration of all the above methods.
In this method two sets of variables have been considered to measure land capability. The positive factors include amount of rainfall, percentage of irrigated area to net sown area and soil fertility, and the negative factors include ruggedness number, average slope and forest density. All these factors are considered as determinants of land capability. The Mean and Standard Deviation values of these variables have been calculated. Then scores have been allotted to each variable in different blocks on the basis of their importance, e.g., 5 for blocks having values less than the mean, 10 for blocks having values between $\bar{x}$ and $\bar{x} + 1$ and so on. After weighing this variable on regional level, land capability index has been calculated based on the following formula:

$$\frac{R_1 + S_2 + T_3 + \ldots \ldots \ldots \ldn}{PFV}$$

$$\frac{bn1 + s12 + f + \ldots \ldn}{NFV}$$

where LCI is the land capability index, PFV is the positive factor variables, NFV is the negative factor variables, $R_1$, $S_1$, $I$ are rainfall, soil fertility and percentage of irrigated area to net sown area respectively and $\ldn$, $S_1$ and $F$ are ruggedness number, slope and forest density respectively.

On the basis of the above calculation, a choropleth map has been prepared to show the land capability classes. The median, upper quartile and lower quartile values have been calculated which divided the data into four subgroups. On the basis of this, the regions of very high, high, low and very low land capability index have been determined.
5.2.3 Correlation Analysis:

The product-moment co-efficient correlation has been calculated between land capability index and percentage of net sown area to total agricultural area and land capability index and agricultural efficiency. Mathematically, this is expressed by the formula:

$$r = \frac{N \Sigma xy - \bar{x} \bar{y}N}{\sqrt{N \Sigma x^2 - (\bar{x})^2} \sqrt{N \Sigma y^2 - (\bar{y})^2}}$$

where \( x \) is the independent variable, \( y \) is the dependent variable, and \( n \) is the number of pairs of observations.

The correlation co-efficient thus calculated were tested for significance by Student's 't'. The formula is:

$$t = r \sqrt{\frac{n - 2}{1 - r^2}}$$

The calculated 't' was then tested in the usual way with \((n - 2)\) degrees of freedom, the significance level being .6 or 5 per cent.

5.3 Analysis:

All the physical as well as economic factors have their combined effect on the agricultural land use of the Kangesabati basin. The percentage of net sown area to total agricultural area (TAA), in general, is increasing from northwest to southeast of the basin (Fig. 5.1a). It varies from less than 40 per cent in the Puncha block of Puruliya to 99.4 per cent in Debra block of Medinipur. In most parts of Puruliya and Bankura, it is less than 70 per cent of the total irrigation area, whereas in the block of Medinipur East, it is above above80 per cent everywhere. Percentage of orchard to total agricultural area is very little and varies from 2 per cent to 4 per cent (Fig. 5.1b) over most parts of the basin. Percentage of permanent pasture to total agricultural area is maximum in the blocks of Bankura and Medinipur West (Fig. 5.1c) where it varies between 1 per cent and 3 per cent. Percentage of current fallow to total agricultural area is maximum in the block of Ranibbandh where it is above 13 per cent. It is also high in Panskura (Fig. 5.2a), Moyna and Khatra-II. In other parts, it varies from 2 per cent
to 4 per cent. Percentage of fallow land other than current fallow is maximum in Sutahata-II block of Medinipur (Fig.5.2b). The data for the blocks of Puruliya for the last three land use types are not available. Percentage of culturable waste land is maximum (Fig.5.2c) in the blocks of Puruliya where it is above 20 per cent in the block of Puncha. It varies between 5 per cent to 20 per cent in the blocks of Puruliya and then, it decreases towards southeast. In the extreme southeast, there is no culturable waste land. Percentage of barren and unculturable land is also very high in the blocks of Puruliya where it is above 40 per cent in the block of Manbazar-II (Fig.5.2d). It decreases towards southeast and is very little in the middle and southeastern part of the basin (Appendix: 5.1).

Studying all the agricultural land use maps, it can be said that the blocks of Medinipur district are in a better condition than those of Puruliya and Bankura districts. Because of the rugged and hilly terrain, a large portion of the area in the district of Puruliya is not fit for cultivation. Infertile soil, less availability of water etc. are some of the physical factors hindering the agricultural development and as a result, percentage of net sown area is also less compared to other parts. The blocks of Bankura district are in a better position than those of Puruliya district for less rugged terrain and availability of irrigation water from the Kangsabati project. The agricultural efficiency map and land capability map also show almost similar trends.

5.3.1 Agricultural Efficiency

Regions:

Four agricultural efficiency regions have been identified on the basis of quartile division (Fig.5.3).

Highly efficient area:

Within the Kangsabati basin, the blocks of Arsha, Khatra-II, Jhargram, Medinipur, Salbani, Keshpur, Debra, Narayangarh, Jamboni and Sankrail are included in this region and the efficiency value varies from 1.09 to 3.07. Arsha receives better irrigation facility than any other block in Puruliya district. It receives most of its irrigation water through tanks. Soil fertility is also high.
compared to the basin average. Khatra-II, Raipur-II and Simlapal in Bankura district, owing to assured irrigation water from the Kangsabati project, high ground water table during the summer and high fertility of soil, are getting better production than others. The zone of high efficiency areas in Medinipur West is due to assured supply of irrigation water from the Kangsabati project and also from shallow and deep tube wells. Good communication network, high fertilizer consumption, availability of agricultural credit and marketing facility are other factors responsible for better production in this part.

Moderately high efficient areas:
This region comprises the blocks of Jhalda-I, Jaipur, Puncha, Manbazar-I of Puruliya district; Ranibandh, Khatra-I and Raipur-I of Bankura district and Panskura-I, Panskura-II, Potashpur, Nandigram-I, Nandigram-II and Nandigram-III of Medinipur district. Hence the efficiency value ranges from 1.99 to 2.21. The blocks of Puruliya receive less amount of irrigation water and the supply trickles from tanks mainly. Soil fertility is moderate. The blocks of Bankura district are under the command area of the Kangsabati project. The blocks of Potashpur receive higher amount of irrigation water and the three blocks of Nandigram receive irrigation water from minor irrigation schemes. Consumption of fertilizer is very high in Potashpur. Soil fertility is also high in this part.

Less efficient areas:
The blocks under this category are Jhalda-II, Baghmundi, Hura, Manbazar-II, Puruliya-I, Puruliya-II of Puruliya district and Binpur-I, Binpur-II, Keshpur, Pingla, Tamluk-I, Mahisadal-I and Bhagwanpur-I of Medinipur district. Among these blocks, the blocks of Jhalda-II and Baghmundi are mostly forested. Soil fertility is poor in Puruliya-I, Puruliya-II, Manbazar-II and Hura. Consumption of fertilizer is also negligible. Very little supply of irrigation water coupled with little rainfall and poor soil fertility are responsible for low productivity of crops and hence low agricultural efficiency. The blocks of Medinipur hardly get the required amount of irrigation water and their soil fertility is very poor as well.
KANGSABATI BASIN

LAND CAPABILITY MAP
(Based on Land Sat Imageries)

LANDS SUITABLE FOR CULTIVATION

- Very good land
- Good land
- Moderately good land
- Land with some limitations
- Unsuitable for cultivation

LANDS SUITABLE FOR FORESTRY & GRAZING

- Suitable for forestry & grazing

Least efficient areas:

This includes the blocks of Balarampur, Barabazar and Banduan of Puruliya district, Patamadah block of Bihar and Kharagpur-II, Sabong, Moyna, Sutahata-II, Nandigram-III and Mahisadal-II of Medinipur district. In the blocks of Puruliya and in Patamadah, soil fertility is poor, a large part of the blocks are hilly and forested. In Banduan, the supply of irrigation water is poor. All these causes attribute a very low agricultural efficiency in this part. In the blocks of Medinipur, except for Kharagpur-II, waterlogging is a perennial problem. The areas remain waterlogged for almost all the year round. Annual inundation by flood water deters the growth of rabi crop reducing agricultural efficiency.

5.3.2 Land Capability Classification:

To begin with, the map prepared by the National Atlas and Thematic Mapping organisation on the basis of landsat imageries (Fig.5.4) has been analysed. It is observed that in most blocks of Puruliya moderately good land with a few patches of very good land occurs. But, in the middle and lower parts of the basin, good as well as very good lands are observed. Land unsuitable for cultivation are found in the Banduan block of Puruliya and Patamadah block of Singhbhum district, Bihar, which are hilly and forested. In the lower part, land with some limitations are observed along the river Kaliaghai which is a flood-prone area and in the western part of Medinipur which is partly forested. From the map, it appears that the land capability, in general, increases from north to south of the basin.

On the basis of three positive factors, viz., rainfall, soil fertility and irrigation facility and three negative factors, viz., slope, ruggedness number and forest density affecting the land capability, another land capability index map has been prepared (Fig.5.5) by the author. Studying the map, it appears that here also land capability, in general, increases from the upper to the lower part of the basin with a few exceptions.

Regions of very high land capability index:

Blocks having land capability index of 1.68 and above come under
this category. It comprises the blocks of Keshpur, Debra, Mayna, Narayangarh, Dantan-I, Dantan-II, Panakura-II, Sutahata-II and Nandigram-I of Medinipur. Situated on flat land, these blocks are devoid of forest cover. Land capability is very high in these blocks because of their fertile soil and availability of sufficient water for irrigation.

Region of high capability index:
Blocks having land capability index between 1.25 and 1.66 come under this category which includes the block of Barabazar in Puruliya, blocks of Khatra-II, Simlapal, Raipur-I and Raipur-II in Bankura and a large number of blocks of Medinipur West, viz., Kharagpur-I and Kharagpur-II, Sankrail, Keshiary, Sabong, Pingla, Tamluk-I, Panakura-I and Potaashpur in Medinipur East. In Barabazar block, land with very little undulations and little forest cover and high percentage of irrigated area to net sown area are responsible for high land capability index. Blocks of Bankura are enjoying the irrigation facility from the Kangsabati project while in the blocks of Medinipur, high average rainfall is the most important factor affecting the land capability.

Region of low capability index:
Most of the blocks of Puruliya district, viz., Arsha, Jaipur, Puruliya-I, Puruliya-II, Hura, Puncha, Manbazar-I and Balarampur have low land capability index which varies from 0.56 to 1.25. Ranibandh block of Bankura and Binpur-I, Jhargram, Salbani, Medinipur, Mahisadal, Nandigram and Bhagwanpur-I of Medinipur district are situated in this zone. In the blocks of Puruliya, rainfall is very scanty. Scarcity of irrigation water is acute. Soil fertility is moderate to high in some blocks like Arsha and Balarampur. Percentage of irrigated area to net sown area is very little. The forest cover in the blocks like Jhargram and Binpur is hindering the agricultural development.
Region of very low land capability index:

Blocks having land capability index below .56 come under this category. These blocks of Puruliya district are densely forested. Infertile soil, rugged terrain, very little rainfall coupled with less irrigation facility are hindering the agricultural development. In Binpur-II, infertile soil and scanty rainfall are largely responsible for very low land capability index.

Comparing the two land capability maps, it is observed that there is a sharp contrast between the two. The very good lands of the first map does not correspond with the very good lands of the second one. It indicates that though the soil factor is favourable in those blocks, viz., Jhalda-I, Simlapal, Salbani, Puncha and parts of Arsha and Barabazar blocks, other factors like slope, forest cover, little rainfall etc. are responsible for low land capability index in these parts. With the help of irrigation, the capability of land can be increased to some extent in these parts. The good lands of the first map coincide with the very good lands of the second one which indicates that soil is an important factor affecting the capability in these blocks.

On the other hand, blocks like Debra, Keshpur, Kharagpur-I, Kharagpur-II and Pingla have very high to high land capability, according to the second map, but they come under the category of land with some limitations in the first one. This is because of the availability of fertilizers, credit facility, availability of machineries, irrigation and other infrastructural facilities which help these blocks to overcome the problems of flood and poor soil fertility.

5.3.3 Correlation Analysis:

The first co-efficient value between land capability index and percentage of net sown area comes to +.72. This value is significant at .001 level and thus shows that there is a strong positive relation between net sown area and land capability. But
the co-efficient value between agricultural efficiency and land capability comes to +.10, which is not significant.

The regression value has also been calculated for land capability and net sown area which comes to $Y_c = 1.08 - .002x$. A scatter diagram has been prepared to show the relationship between the two (Fig. 5.5).

5.4 Conclusion:

Studying all the maps of agricultural land use, it appears that the middle and lower parts of the basin are in a favourable position than the upper and the extreme lower parts of the basin, so far as the availability of agricultural land is concerned, though there are a few exceptions. In the blocks of Puruliya, a sizeable amount of culturable wasteland is observed which can be brought under cultivation with the help of irrigation water and input of fertilizers.

In the upper part of the basin, moderate to low agricultural efficiency is observed. This is because of rugged terrain, infertile soil and availability of irrigation water. Financial condition of farmers is so poor that it hardly allows them to buy necessary fertilizers and machineries. But, above all, uncertainty of rainfall badly affects the agricultural efficiency in this part. Problem of irrigation in the blocks of Bankura and some western blocks of Medinipur in the middle part of the basin has, however, been partly solved by the supply of irrigation water from the Kangsabati project. In the lower part, flat and fertile land as well as other facilities like availability of fertilizers etc. help the growth and development of agriculture. But, in the extreme south, annual inundation is the main problem that frustrates the progress of agriculture. Flood protection programmes, if taken properly, is expected to make the lower part agriculturally prosperous.

Land capability is also a function of several physical as well as economic and social factors. Of these, soil is the most
important factor determining the capability of land. In case of first land capability classification soil is taken as the basis of classification whereas in the second one only one factor of soil, i.e., the fertility of soil has been taken into consideration, as data regarding soil erosion, soil type, water holding capacity of soil etc. are not available. Other important factors like drought and flood hazards are also neglected. Thus, there is a lot of difference between the agricultural efficiency map and the land capability map and between the two capability maps, though, in general, all of these variables are increasing from northwest to southeast of the basin. Agricultural efficiency is high in the blocks of Jhargram, Salbani and Medinipur where land capability is very low. Use of artificial fertilizers in Salbani and Medinipur and storage, marketing and transport facilities in the above-mentioned blocks help in increasing agricultural efficiency. On the other hand, in the lower part of the basin, viz., in the blocks of Moyna, Panskura, land capability is very high but the efficiency is low owing to the climatic hazards like flood. Almost every year, flood poses a serious threat to agricultural development. As the capability of land is high, efficiency can be increased with the implementation of proper flood protection measures in the area.

So, it is observed that water is the most important factor affecting the capability of land in the upper part of the basin and the capability can be increased with proper supply of water from a number of small irrigation projects. Soil fertility is low in some blocks of Puruliya and Bankura. If supplemented with artificial fertilizer, the land can be transformed into a good agricultural land. In the lower part of the basin, flood protection measures are most important for increasing the capability of land.

To sum up, it can be said that over the Kangsabati basin some blocks of Puruliya and a few blocks of Medinipur East remain agriculturally backward. In both the areas, physical factors like rugged relief in the upper part and waterlogging in the lower part hinder the agricultural development. While the scarcity of water is a common phenomenon to the upper part, excess water causes flood in the lower part. It is widely felt that dredging of the river bed
and construction of embankments can solve the problem of flood to a certain extent.

References


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