Chapter VII
Crop Land Use
7.1 Introduction:

In agricultural geography, it is necessary to discuss the agricultural distributions in terms of their locale. Cropping pattern varies to a great extent in different parts of a particular region and to bring out the areal concentration and diversification of crops, the study of cropping patterns on a regional basis is necessary. This will help to determine the regional dominance of crops and to differentiate areas that have some significance with regard to crop distribution. Further, the regional dominance of a crop has some relationship to the other crops grown in the area and has a strong bearing on the degree of specialization or diversification prevailing there. To know the existing spatial relationship of crops in association with each other, the study of crop combination is necessary. This study of crop combination could be best utilized in understanding the existing agricultural situations, the land use pattern of a region and planning of crops for the future. The percentage share of food crops to non-food crops will help to identify the areas important in food grain production, i.e., the areas with higher population density and with small size of holdings. Agricultural productivity, which is the ratio of the index of total agricultural output to the index of total input, used in farm production, will show the areas backward in agriculture. Again, to increase the agricultural production in these backward areas, one important measure is to adopt multiple cropping technique, i.e., to increase the intensity of cropping.

The Kangsabati basin which occupies an area of about 9,660 km² is a region of intense agricultural activity. In this region, crop distribution is generally guided by fertility of soil and the
availability of irrigation. Other infrastructural facilities like availability of fertilizers, machineries, agricultural credit etc. also influence the cropping pattern, but physical variables are more decisive in producing the characteristic cropping pattern.

In this chapter, the study of intensity of cropping, crop combination, index of crop concentration and diversification, share of food crops to non-food crops and crop productivity have been studied in detail to know the cropping pattern which prevails in the basin against its environmental setting.

7.2 Methodology:

7.2.1 Cropping Intensity:

Cropping intensity expresses the agricultural condition of an area most clearly and the study of it is absolutely necessary for agricultural planning. Cropping intensity is influenced by several factors of which availability of irrigation water and fertilizer are the two most important ones.

Cropping intensity for each block of the basin has been calculated with the help of the formula,

\[
\frac{\text{Gross cropped area}}{\text{Net sown area}} \times 100
\]

On the basis of cropping intensity statistics determined by the above-mentioned formula, a choropleth map has been prepared, and the shading has been chosen by the ranking of cropping intensity data, as the principle of Median and Quartile range. This has divided the data into four parts.

7.2.2 Crop Combination:

A scientific device to study the existing spatial relationship of crops in association with each other is crop combination. There are a number of methods to determine the crop combination of a region like minimum deviation method of Weaver (1954),

Rafiullah introduced a new deviation formula which is suitable for delineating primary crop combinations. The formula is,

\[ d = \sqrt{\frac{D_p^2 - D_n^2}{N^2}} \]

where \( d \) is the deviation,
\( D_p \) is the positive difference,
\( D_n \) is the negative difference from the medial value of the theoretical curve value of combination and \( N \) is the number of crops in the combination.

The defect of this method is that it suffers from huge calculations.

N.P. Ayyar has grouped the crops in the following way:

- All cereals (7) .............. (C)
- All pulses (3) .............. (P)
- All oilseeds (6) .......... (O)
- All other food crops .......... (F)
- All other non-food crops ..... (N)

Then, the standard values may be obtained, such as 100 per cent for C, 70 per cent to 30 per cent for C-P and so on. The deviations of the actual percentages from the above values would be found out, squared and summation will give standard deviation. Now, the method of difference, method of summation and lower limit method have been used following Athawale's formula.

In the method of difference, if the greater difference between first and second ranking crop than the second crop is not important, that will be a case of monoculture. In the method of summation, if the percentage of first ranking crop is more than the average of theoretical value for first and second crops, then it is a case of monoculture.
Betal H.R. sets out Weaver's method after taking mean and standard deviation of different crops. Then, he calculated a range to determine the scale of distinctiveness following Nelson's method. The range is as follows,

\[
\begin{align*}
\text{Rank-III} &= \text{Mean} + 1\delta \quad (\text{standard deviation}) \\
\text{Rank-II} &= \text{Mean} + 2\delta \\
\text{Rank-I} &= \text{Mean} + 3\delta
\end{align*}
\]

On the basis of this scale of distinctiveness, the crop combinations can be computed.

Weaver in his studies has taken into account the percentages of crop area to the total cropped area and has calculated deviation of actual percentage for all the possible combinations in the component areal units against a 'theoretical standard'. The theoretical standard for monoculture is 100 per cent, for two-crop combination 50 per cent, for three-crop combination 33.3 per cent and so on. Weaver considered all the crops having at least 1 per cent of the total crop area. The deviations (d), plus or minus, of the actual percentages from any one theoretical value for every set of crops are squared and summed. Each sum is divided by the number of crops in the set. The square root of this result will give us a measure of crop combination. The formula for standard deviation is as follows,

\[
\delta = \frac{\sum d^2}{n}
\]

where \(\delta\) = variance, 
\(d^2\) = square of deviation from theoretical standard, 
\(n\) = number of crops, 
\(\sum\) = summation of value of \(d^2\) in an areal unit.

Doi modified the Weaver's method of crop combination. Though the Weaver's original method is a very precise one to determine the minimum deviation, it requires much calculating work. Furthermore, as Weaver himself admits it occasionally tends to "the lowest deviation for a crop combination that includes every crop occupying as much as 1 per cent of the total
harvested crop land. The modified method solves these two problems simultaneously by substituting the standard deviation \( \frac{d^2}{n} \) with the sum of squared differences \( s^2 \). And the combination having the smallest \( s^2 \) is actually found by only consulting a one-sheet table, whose use requires the summing up of percentages instead of squaring the differences. Among the different crop combinations, the one with smallest variance is considered.

Two choropleth maps have been prepared to show the crop combination of different blocks of the Kangsabati basin following the method of Weaver and Doi.

7.2.3 Share of Food Crops to Non-food Crops:

The Kangsabati basin is primarily a food grain producing region. But in the upper part of the basin and in two or three blocks in the lower part, a considerable amount of land is under non-food crops. So, in this study an attempt has been made to explain spatial variation in the share of food crops to non-food crops in the basin using the data of the year 1985–1986.

The proportion of the cultivated area occupied by food crops and non-food crops were first calculated for each block. Next, the basin average for both food and non-food crops were estimated and the number of blocks above and below the basin average for both crops were determined. Then, two choropleth maps have been prepared choosing suitable ranges.

7.2.4 Index of Crop Concentration:

The use of the concept of concentration makes it possible to compare and associate different crop distributions on a uniform base, and it is helpful in arriving at meaningful generalization in the cropping pattern of the region under study.

In order to determine the regional concentration of crops, an index has been calculated with the following formula,
Index of concentration = \[
\frac{\text{Area under that crop in the basin}}{\text{Total cropped area in the basin}}
\]

If the index value is greater than unity, the component areal unit accounts for a share larger than it would have had if the distribution were uniform in the entire region, and therefore, the component areal unit has a concentration of the agricultural distribution under study. The values for the component areal units that show concentration are then put in an ascending array and divided into three equal parts to distinguish low, medium and high degrees of concentration. A choropleth map has been prepared to show the number of crops concentrated in each block. To show the areal distribution of different crops, a set of isopleth maps have been prepared. This brings out the regional dominance of various crops at a glance.

7.2.5 Index of Crop Diversification:

The regional dominance of a crop has some relationship to the other crops grown in the area and has a strong bearing on the degree of crop specialization or diversification prevailing there. The greater the dominance of a single crop in an area, lesser will be the diversification and vice versa.

Bhatia has evolved a formula for determining crop diversification:

\[
\text{Index of crop diversification} = \frac{\% \text{ Percentage of cultivated area under } X \text{ crop}}{\text{Number of } X \text{ crops}}
\]

where \(X\) crops are those which individually occupy 10 per cent or more of cultivated area in a block. The lower the value of the index, the higher is the degree of crop diversification. The index value, however, can not be less than 10.
Agricultural productivity is the actual performance of the land in terms of agricultural production and the actual potentiality of the land (Ramanaiah 1984).

According to Dewett, "Productivity expresses the varying relationship between agricultural output and one of the major inputs, like land or labour or capital, other complementary factors remaining the same." It was generally agreed that the yield per acre may be considered to represent the agricultural productivity in a particular region, and that other factors of production be considered as the possible causes for the variation while comparing it with other regions. Productivity of agriculture so far has been looked at from different points of view, such as productivity of land, labour and capital. These are best known partial productivity measures. Among different methods of agricultural productivity, a useful index was formulated by Hussain in 1976 in which he changed the production in money value per areal unit with the ratio of the whole region. The formula is:

\[
\text{Productivity index} = \frac{\text{Production value in money of all crops in a block}}{\text{Total cropped area in a block}} \times \frac{\text{Production value in money of all crops in the dist.}}{\text{Total cropped area in the dist.}} \times 100
\]

But, as the money value of all the important crops for all blocks in the Kangsabati basin is not available, it is not possible to use the formula.

For the present study, Kendall's method of productivity index has been adopted. Yield of five main crops, viz., Aus, Aman, Boro, wheat and pulses have been found out. Ranks have been given to the yield of different crops separately. Summation of five ranks in each block gives the productivity index. The blocks with higher ranks have lower productivity index. A choropleth map has been prepared.
7.3 Analysis:

7.3.1 Cropping Intensity:

From the analysis of the cropping intensity map (Fig. 7.1), it appears that in general the cropping intensity increases from north to south of the basin. In most parts of Puruliya, it is between 100 per cent and 120 per cent. But, in the block of Baghmundi, cropping is more than 140 per cent (Appendix). In the blocks of Bankura, i.e., in the middle part of the basin, the existing intensity again increases up to 168 per cent. Again, it decreases in the blocks of Salbani, Medinipur, Jamboni and Jhargram after which it increases up to 172 per cent in the block of Moyna and then decreases towards southeast. Cropping intensity is influenced by a number of factors, such as soil, availability of water, fertilizer consumption, availability of agricultural labour etc. In the upper part of the basin, soil is infertile, a large part is forested and to add to it, this is mostly a drought-prone area. So, this area needs irrigation water throughout the year except in the rainy season. Infertility of soil necessitates the use of a large amount of chemical fertilizers. But, the purchasing power of the farmers is pathetically low, so much as, that they can't afford to buy the necessary fertilizers. As a result of all these reasons, agricultural density is very low which also affects cropping intensity. Compared to this, the blocks of Bankura and Medinipur are in a better position. The construction of the Kangsabati project and supply of irrigation water from it have solved the problem of irrigation to a large extent. In the lower part of the basin, flat land, high consumption of fertilizers, high agricultural density all help in the improvement of agriculture.

7.3.2 Crop Combination:

Studying the crop combination map (Fig. 7.2) of Weaver, an interesting feature is revealed, i.e., mono-crop is prevalent mostly in the upper part of the basin and also in some western blocks of Medinipur whereas a number of crop combinations is observed in the middle and lower parts. Aman remains as the first raking crop in all the blocks. In the upper part of the basin, Aman is followed by Aus
KANGSABATI BASIN
CROP COMBINATION (DOI)
1984-85

A - Amon
Au - Aus
B - Boro
F - Flower
O - Oilseeds
P - Pulses
Po - Potato
V - Vegetables
W - Wheat

Fig. 7.3
KANSABATI BASIN
PERCENTAGE SHARE OF FOOD CROPS TO TOTAL CROPPED AREA
1984-85
in most blocks whereas in the extreme south, it is followed by Boro. More than three crop combinations are observed in Baghmundi and Manbazar block of Puruliya; Simlapal and Raipur in Bankura and Binpur-I, Sankrail, Debra, Panskura-I, Tamluk-I, Mahisadal-I, Bhagwanpur-I and Nandigram-III blocks of Medinipur district. In the upper part of the basin, Aman is followed by pulses, vegetables, oilseeds, Aus, maize, wheat, sugarcane, millet etc. Boro and summer til enters into this combination in the middle part of the basin while potato and betel vine are the two important crops which enters into the combination in the lower part. This shows that as the upper part is drier than other parts of the basin and topography is rugged, pulses, maize, millet etc. are cultivated in that part. Boro is cultivated in the middle part with the help of irrigation water.

Studying the crop combination map of Doi (Fig. 7.3), it appears that mono-cropping is there in almost all the blocks of the basin. Two crop combinations are found in Manbazar-I, Simlapal, Moyna, Jhargram, Mahisadal-I, Mahisadal-II. Three crop combinations are there in Panskura-I and Panskura-II blocks. More than three crop combinations are found Baghmundi block. This implies that a number of blocks in the extreme south of the basin have more than one crop combination as the infrastructural facilities are available in that part. Only this lower part of the basin shows similarity to Weaver's map of crop combination.

7.3.3 Share of Food Crops to Non-Food Crops:

Food crops are dominant over non-food crops in most blocks of the Kangsaabati basin. Only in ten blocks, the share of food crops are below the basin average (Fig. 7.4). Most of them occur in the upper and middle part of the basin. Blocks of Panskura, Tamluk-I, Mahisadal and Nandigram-III have share of food crops below the basin average. The blocks of Jhalda-I and Jhalda-II, Jaipur, Puruliya-I, Puncha and Manbazar-II blocks of Puruliya district, Binpur-II, Jhargram, Kharagpur-I, Sabong, Narayangarh, Dantan-I, Dantan-II and Potashpur blocks of Medinipur district have very high share of food crops. In the upper part of the basin, because of
KANGSABATI BASIN
PERCENTAGE SHARE OF NON-FOOD CROPS TO TOTAL CROPPED AREA 1984-85

IN PERCENT

Fig. 7.5
KANGSABATI BASIN
CROP CONCENTRATION
1984-1985

NO. OF CROPS CONCENTRATED

5-6 (high)
3-4 (moderate)
1-2 (low)
No concentration

Fig. 6
KANGSABATI BASIN
CONCENTRATION OF RICE
1984-85

Fig. 7.7
non-availability of irrigation water and other infrastructural facilities, it is not possible to cultivate more than one crop in a year. That is why the most important food crop, Aman, is cultivated in most blocks.

Share of non-food crops above basin average is found in a number of blocks of Puruliya district (Fig.7.5). It is also above average in two blocks of Bankura district, and also in the extreme southern part of the basin. It is above average in Baghmundi, Arsha, Balarampur, Manbazar-I and Banduan blocks of Puruliya. Arsha and Balarampur blocks get some amount of irrigation water. Availability of agricultural machineries is maximum in the blocks of Arsha. In the blocks of Raipur and Simlapal again, non-food crops are above basin average. Here, cultivation of secondary crops is possible with the help of irrigation water. Commercial floriculture is important in the blocks of Panskura-I and Panskura-II and as a result, share of non-food crops is above basin average and covers more than 16 per cent of the total cropped area (Appendix 7.1).

7.3.4 Crop Concentration:

From the study of the map of concentration of crops (Fig.7.6), it appears that the highest concentration is found only in three blocks in the upper part, viz., Baghmundi, Barabazar and Khatra-I. In most blocks, low concentration, i.e., concentration of one to two crops is observed. There is no concentration of crops in the blocks of Banduan, Jhargram, Sabeng and Pingla. Moderate concentration is found in the extreme northwest and southeast of the basin.

Concentration of rice is found in the upper and middle parts of the basin (Fig.7.7) except for a patch in the western, northwestern part parts in the blocks of Baghmundi, Balarampur, Arsha, Barabazar and Manbazar-I, and also in Banduan block. Again, rice concentration is found in a zone in the south-central part in the blocks of Salbani, Medinipur, Kharagpur-I and Kharagpur-II, Keshiary, Narayangarh, Dantan-I and Dantan-II and also in Mayna.

Concentration of wheat (Fig.7.8a) is observed in a number of blocks Puruliya district, viz., Arsha, Jaipur, Jhalda-II, Baghmundi,
KANGSABATI BASIN
CONCENTRATION OF DIFFERENT CROPS
1984-85

Fig. 7.8
Balarampur, Barabazar and Manbazar-II, and in Khatra-II, Simlapal, Raipur-I and Raipur-II, in Debra, Kharagpur-I, Jamboni and Binpur-I.

Oilseeds are concentrated mainly in the upper and middle parts of the basin (Fig.7.8b) in the blocks of Hura, Baghmundi, Barabazar, Manbazar-II, Khatra-II, Simlapal, Raipur, Ranibandh and also in Salbani, Medinipur, Debra and Panskura-I blocks in the lower part.

Concentration of pulses are observed in the extreme upper and lower parts of the basin (Fig.7.8c). Pulses are concentrated in most blocks of Puruliya, which are extremely drought-prone except for the blocks of Puruliya-I, Puruliya-II, Hura, Puncha, Bandhan and Balarampur. In the southeast, it is concentrated on all blocks of Medinipur East district.

Vegetables, which need irrigation water, are mostly concentrated in the middle and lower parts of the basin (Fig.7.8d) for availability of water in those parts. In the upper part, it is concentrated in the blocks of Baghmundi and Balarampur. In the middle part, the blocks of Khatra-II, Simlapal, Raipur-I, Raipur-II, Medinipur and Salbani have concentration of vegetables. In the southeast, concentration of vegetables are found in Dantan-I, Panskura-II, Tamluk-I and Nandigram-II.

From the study of all these, it can be said that concentration of rice is found in areas where plenty of water is available, whereas concentration of wheat, pulses and oilseeds are observed in comparatively drier areas. Vegetables are concentrated in areas which get some amount of irrigation water (Appendix).

7.3.5 Index of Crop Diversification:

Diversification of crops is maximum in the extreme northwest, southeast and central parts of the basin where the value is as high as 70 and above (Fig.7.9). Diversification is minimum in most of the blocks of Puruliya and a zone in the south-central part of
the basin where concentration of primary crop rice is observed. Diversification is low in the south-central part and increases on both sides in the south and north. Crop diversification is maximum where multiple cropping is possible and high concentration of crops, i.e., concentration of five to six crops is observed (Appendix).

7.3.6 Crop Productivity:

Lastly, the crop productivity map has been studied to find out the areas backward in agricultural production (Fig. 7.10). Crop productivity is very low so far as yield of five main crops are concerned in the blocks of Puruliya, Dalarampur, Darabazar and Patamadah in the upper part; Binpur-II in the middle and Sabong, Moyna and Sutahata-II in the southern part where it is below 99.5. Very high productivity of above 151 is observed in Arsha, Puruliya, Bura, Puncha, Manbazar-I, Ranibandh and Raipur in the upper part and Salbani, Medinipur, Kharagpur-II, Narayangarh, Dantan-II and Tamluk-I in the lower part. Elsewhere medium to low productivity is observed. Among these blocks, Arsha receives better irrigation facility than other blocks of Puruliya district. Soil fertility is also high in the blocks of Puruliya whereas assured supply of irrigation water helps in higher productivity of crops. Soil is also fertile. The blocks of Medinipur get water from the Kangsabati project and also from shallow and deep tube wells (Appendix).

The causes of low productivity in some blocks of Puruliya are infertile soil, rugged, hilly and forested terrain, lower supply of irrigation water etc. In the lower part, annual inundation by flood water prohibited the growth of rabi crops and crop productivity is also very low in this part.

7.4 Conclusion:

Studying the above crop land use, it may be said that the upper part of the basin is backward compared to the lower part so far as crop productivity, cropping pattern etc. are concerned. The upper part of the basin is hilly and forested. The soil is of gneissic type and though there are a number of streams, most of them are
non-perennial in character. All these adverse physical factors have a dampening effect on agriculture in this part.

Scarcity of water is the main problem in the upper part. Construction of 'jhor bandhs' in the hilly part and dug-wells in the undulating part can solve the problem to a certain extent. Another serious problem of this part is intense soil erosion. For the conservation of soil, a number of measures such as contour bunding, bench terracing, and development of grass-lands have been taken up. A large amount of culturable waste-land can be brought under cultivation if the infrastructural facilities like irrigation water, fertilizer, credit etc. can be made available. Drought resistant crops like Kurthi, Kodo etc. and early maturing varieties of crops can profitably be cultivated in drought-prone areas which will bring diversification in the cropping pattern also.

A cropping pattern needs to be evolved on the basis of dry land farming and this would require appropriate varieties of crops, the economical use of water and an increase in the cropping intensity through inter-cropping. The most important aspect is the prevention of loss of moisture from the soil and in this respect mulching is very important. Perhaps, the most important type of mulch in the semi-arid lands is soil or dust mulch created by stirring the surface of the soil to keep it loose to absorb rain water during the infiltration.

Among different dry-land crops, wheat is important, but it has to depend on irrigation for a good yield. The geographical requirement of barley includes a lower temperature, higher ground and lower moisture than wheat and is grown both as an irrigated and a dry crop. Among the pulses, gram is the most important and can thrive well in the zones having less than 1,000 mm annual rainfall. Bajra is a typical dry-land food and fodder and is an unirrigated, unmanured rainfed crop of a dry environment with less than 750 mm of annual rainfall and poor soil. Jowar is a poor soil and poor monsoon crop largely confined to a 500-1,000 mm annual rainfall belt. Linseed requires a well-drained loamy soil, rape and mustard are grown in areas with more than 1,000 mm of rainfall. Groundnut, castorseed
cotton, sugarcane, sesamum and oilseeds are some other dry-land crops. All these crops can profitably be cultivated in the dry area of Puruliya district.

During the dry season, the fields are cropless and the farming population remain idle. This calls for alternative fruitful employment. One improvement measure is the introduction of HYV (high yielding variety) of wheat, maize, jowar and Bajra. Another measure is DPAP (drought-prone area programme), consisting of package schemes for the optimum development of local resources in agriculture, which is already operating in Puruliya district.

On the contrary, the lower part of the basin has favourable physical conditions. Flat and fertile land along with availability of fertilizer, agricultural machinery and other infrastructural facilities have helped in the agricultural development. Modern techniques of cultivation and introduction of high yielding varieties of crops can make this part agriculturally prosperous. The most serious problem of this part is flood at regular intervals. Flood protection measures of the Kangsabati project has to some extent minimised the problem and there is need for better flood protection programme.

References


