Cropping Intensity and Population Distribution

The introduction of improved cultivation and management techniques has increased yields in this intensive agricultural environment of Birbhum. Modern technological applications, such as commercial fertilizers, pesticides, improved hybrid seeds and machinery have been responsible for phenomenal increases in yields in recent years. Improved marketing assistance, the use of cooperatives, the expansion of credit arrangements and the use of trained agricultural specialists are other factors promoting greater productivity. Where rainfall, irrigation systems and growing conditions permit, double or more crops of rice are grown each year. This multiple cropping technique requires considerable hand labour. Farmers replant a second crop using transplanted seedlings within a few days of the first harvest. Under favourable conditions it is even possible to produce a third crop from the same field. In areas unfit for more than one rice cultivation many farmers augment their cereal crops with wheat, pulses, mustard, sugarcane, potato and vegetables. Jute and other cash crops are also grown. The average holding size ranges from 0.6 to 2.56 hectares. Multiple cropping as a practice developed very rapidly in all the blocks of Birbhum in some measure owing to the phenomenal improvement in various forms of irrigation throughout the year. Introduction of quick growing high yielding variety seeds, crop protection and fertilising measures contributed to intense crop production. Intensity of cropping has more than doubled, as in some parts of the Sainthia and Nalhati blocks through efficient management of water and other resources so that the time gap between the harvesting and threshing of one crop and sowing of the next is minimised. The dependence on agriculture is high and the level of industrialisation and urbanisation is still poor so raising of two or more crops in a year is a common practice.

15.1 Crop pattern

The cropping pattern of the district did not change significantly until 1964-65, when it was possible to bring nearly 4,856.28 ha under double cropping in the command area of the Mayurakshi project. Prior to this only 809.38 ha or so could be covered by double cropping. Since 1964-65 it has been possible to assure irrigation to a larger area during rabi season and the area under rabi crop has increased by more than three times. It may be mentioned here that besides irrigation water the use of high yielding seeds, fertilisers and plant protection materials as part of new practices in intensive agricultural work was also responsible for this change in cropping pattern and higher yield. Paddy is the most important crop of the district accounting for more than 80% of the total cultivated area. Birbhum is mainly an aman paddy producing area (Photo 27) and about one tenth of the area is under other food and cash crops. Paddy is the most important crop of the district and much of it is grown in the kharif season. Growing paddy in the rabi season developed with the availability of irrigation water. Generally sugarcane, arum and ginger are grown in the kharif season and in rabi season wheat, pulses, oil seeds and vegetables of different varieties are grown.
The *am*ān or winter rice is the most important crop and bulk of the cultivable land of the district is reserved for the cultivation of this crop. The numerous bunds that are found in the fields exhibit the urgent need to hold water for this crop. The ploughing of the land starts with the first shower at the end of winter. As *am*ān paddy is chiefly grown by transplantation, the preparation of seedlings is an important activity in the cultivation of the crop. Generally the process starts in March and April (Chaitra and Baisakh months of the Bengali calendar) and harvesting starts in November (Bengali Agrahayana). The *aus* paddy is easier to grow and provides a second chance for another crop. *Aus* is often grown after *rabi* is harvested. It is generally sown broadcast but occasionally it is also transplanted. While the season for sowing varies with the rains, the sowing is normally completed between the middle of May and the end of June. Harvesting is started between 90 to 120 days from the date seeds are thrown. The rapid spread of shallow tube wells has further helped *aus* cultivation. *Boro* paddy cultivation is confined to the irrigated tracts. In Labpur block in Langaihata Bill area about 202.345 ha of land are provided with irrigation water from the Mayurakshi project for *boro* cultivation. Sowing continues from November to January. High yielding variety seeds are used everywhere.

It should be realised that the cropped area of a district does not remain constant over the years. It varies according to changes in weather conditions and other agro-economic conditions. With vast changes in irrigation practices the area under *rabi* crops has gone up significantly since 1965-66 and with the introduction of high yielding variety seeds the agriculture of the district has entered a new phase of intensive cultivation.

The intensity of cropping refers to the number of crops raised in a field during an agricultural year. It is a measure of land use efficiency, which is defined as ‘extent to which the net sown area is cropped or resown’. The total cropped area as percentage of net sown area, gives a measure of land use efficiency, which really means the efficiency of cropping (Singh, 1974). In Birbhum district cropping intensity ranges from 102 per cent in Khoyrasol and Suri I blocks to 174 per cent in Rampurhat II block. The average cropping intensity for the whole district comes to about 139 per cent marking 11 numbers of blocks above the regional average and the remaining 8 numbers of blocks below the average in 1996-97.

To map the varying intensity of cropping in all the blocks of Birbhum, the area under different crops in different seasons has been considered for 1996-97. Naturally, this will exceed the net cultivated area. The ratio between net sown area and gross cropped area in each block conveys some idea about the cropping intensity in that period. As has been stressed earlier this ratio is not constant over years, but varies according to weather and other agro-economic conditions. These figures have been utilised to draw a choropleth map of cropping intensity in Birbhum for years 1996-97 (Fig. 42). It may be observed that, cropping intensity varies widely from one part of the district to another. In the four cropping seasons — winter, *rabi*, summer, *bhadoi* — a large variety of crops are grown in different intensity in different blocks. In the eastern part of the district Rampurhat II, Mayureswar I & II, Sainthia, Suri II and Bolpur-Sriniketan blocks appear to have maximum cropping intensity. In Muraroi i

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Fig. 42: Cropping intensity (1996-97)

BIRBHUM DISTRICT

Legend

Cropping Intensity

- 1.6 - 1.8
- 1.4 - 1.6
- 1.2 - 1.4
- 1.0 - 1.2
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& II, Nalhati I and Rampurhat I in the north west of the district and Nanur in the south east cropping intensity is between 1.4 to 1.6. Low cropping intensity is found in the south western part of the district and also in Nalhati II block in the north east.

15.2 Relationship between cropping intensity and rural population density

When the two maps of rural population density and cropping intensity are compared visually the nature of correspondence between the two becomes apparent. In general, population density rises from southwest to east and northeast of the district and increase in cropping intensity follows the same trend. However cropping intensity is not consistently high in the blocks in the north where some of the highest rural densities occur. Where the density of population ranges between 500 to 600 persons per sq km the cropping intensity is very high. In the south the population density is between 400 and 500 persons per sq km from Khoyrasol block in the southwest to Bolpur-Srinketan in the east but there is great variation in cropping intensity. In Rajnagar and Mahammadbazar cropping intensity is fairly low which coincides with relatively sparse rural population. It should be remembered however that cropping intensity varies to some extent from year to year and as such this map represents one possible combination only. Such visual comparison of maps conveys only a vague idea about the relationship between the two phenomena. It is felt that the data can be statistically analysed for results of more precise nature.

As an initial step towards such analytical study, the regression of density of rural population on cropping intensity of each block has been employed. Fig. 43 shows a scatter diagram in which the rural population density, i.e. D have been shown along the Y-axis and cropping intensity, i.e. P have been shown along the X-axis (Appendix 1, Table L). It should be noted that the values of D and P at the areal centre of each block have been taken as paired values for the scatter diagram and the subsequent regression analysis. The paired values in the scatter diagram show the graphical correlation between the variables and have been utilised to draw the regression line, i.e. the line of best fit. The regression line obtained by the method of least squares is \[ D_c = 282.39 + 191.44 P \], which shows the linear relationship between cropping intensity (P) and rural population density (D). Stated in statistical terms, according to this relationship a block in Birbhum with cropping intensity 1.6 is expected to support a rural population density of 589 persons / sq. km. (approximately).

In a similar manner the "expected" (D_c) rural population density of each block is computed. The values thus obtained may be plotted at the areal centre of each block and isopleths may be drawn through them. If such an attempt were made there would be two population density maps – one showing the actual distribution and the other depicting what the density distribution pattern would be if it were entirely dependent on cropping intensity as defined by the trend line, i.e. the regression line. For the purpose of determining the strength of relationship, i.e. the degree of association between the rural population density and the cropping intensity the Pearson product moment correlation coefficient has been employed. This shows that the correlation coefficient (r) is + 0.32. The value of r is obtained by:
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Scatter Diagram
Birbhum District

Fig. 43: Scatter diagram (cropping intensity and rural population density)

D = 282.39 + 191.44 P

P i.e. Proportion of Gross Cropped Area to Net Sown Area

D i.e. Rural Population Density (persons / sq km)
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\[ r = \frac{N \sum P \cdot D - (\sum P)(\sum D)}{\sqrt{N \sum P^2 - (\sum P)^2} \times \sqrt{N \sum D^2 - (\sum D)^2}} \]

where, \( r \) = Correlation coefficient  
\( P \) = Independent variable, i.e. cropping intensity  
\( D \) = Dependent variable, i.e. rural population density  
\( N \) = Number of pairs of observed values.  
\( \Sigma \) = Summation

For a sample size 19 the critical value of the correlation coefficient at 1% level (two-tailed) is 0.575. Therefore this correlation coefficient is not significant. The more conventional student's 't' test is also applied. The value of 't' works out as follows:

\[ t = \frac{r \sqrt{(n-2)}}{\sqrt{1-r^2}} \]

The value of 't' at 5% level (two-tailed) with 17 degrees of freedom is found to be 2.11. But here the value of 't' is 1.39. Hence the correlation coefficient is not significant at that level. Taking the Pearson correlation coefficient, the explained variation = \( r^2 \times 100 = 0.32^2 \times 100 = 10.24 \). Thus only about 10% of the total variation in D i.e. rural population density can be accounted for by the variation in P i.e. cropping intensity in different blocks in 1996-97. Since the correlation coefficient of + 0.32 does not indicate perfect positive relationship of cropping intensity with rural population density, the maps showing the 'relief' of actual population density and 'cropping intensity - population density' will not match perfectly. This is supported by the relatively high values of departure, (D-Dc), of the actual population density from the 'cropping intensity - population density'. In such a case mapping the residuals i.e. (D-Dc) values, to show the correspondence between the two variables appears unnecessary. Hence, any further analysis becomes redundant.