Dissection Index and Population Distribution

Dissection is the process by which the uniformity of a surface is broken up by gullying and stream incision. Dissection index, thus, is a measure of the degree to which the land surface has been carved up by erosion by streams. Like relative relief, variation of dissection index also influences spatial distribution of population. Two areas with similar relative relief may be very differently dissected, affecting population distribution in a distinct manner. This makes dissection index a second natural choice among the quantifiable aspects of the district’s topography. A rugged terrain is not very attractive for human habitation especially where agriculture is the mainstay of economy. Here in this chapter the aim is to find out how far the dissection of the land surface in Birbhum has affected population growth.

5.1 Dissection Index

The varying magnitude of dissection index within the district of Birbhum has been obtained from the ratio of the difference between the maximum and minimum altitudes in a grid, to the maximum altitude in the same area, (Fig. 10). The grids used here to map the dissection index of Birbhum are similar to those in the relative relief map. Dissection index values, expressed as percentage are placed at respective grid centres in the base map and isopleths are interpolated to prepare the dissection index map of Birbhum, (Fig. 11).

Examination of the map reveals that dissection index ranges from 0 in Nalhati II, Mayureswar II, Rampurhat II, Labpur, Nanur and Illambazar to 0.8 in Muraroi I. There is an overall similarity in the pattern of dissection index and relative relief in that in both cases the isolines exhibit a marked north east-south west trend with values decreasing from west to east. This indicates that dissection index increases from south and southeast to north and northwest. The blocks bordering Chhotanagpur plateau to the west appear to have a more heavily dissected surface than those adjoining the Ganga plains to the east. There is one notable deviation from this general pattern in Bolpur block between the Ajay and the Kopai rivers where dissection index is close to 0.4. Parts of Mayureswar I, Suri, Sainthia, Khoyrasol, Dubrajpur and Rajnagar blocks have dissection index less than 0.2. While Nalhati II, Rampurhat II, Mayureswar II, Labpur, Nanur and Illambazar in the east and south exhibit negligible dissection. It is is the northern and western parts of Rajnagar, Mahammadbazar, Rampurhat I, Nalhati and Muraroi I and II that dissection index rise to between 0.6 to 0.8. In the south of Rampurhat I and II dissection appears to be much higher than that of surrounding areas. In the south west of the district in Rajnagar, Suri I, Dubrajpur and Khoyrasol where relative relief is between 15 to 30m dissection indexes, in contrast, is below 0.2.
Fig. 10: Grid location & dissection Index

Figure in each grid centre indicates dissection index.

BIRBHUM DISTRICT

GRID LOCATION & DISSECTION INDEX

Scale

0 5 10 15km

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Fig. 11: Dissection index map

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5.2 Impact of dissection index on rural population density

When the two maps – dissection index and rural population density – are compared visually it is seen that population density decreases towards the west and southwest as dissection index increases. In the north of the district there seems to be little change in the population density with changing magnitude of dissection index. It appears that here at least three blocks with relatively high density are also the most dissected ones. Nalhati I, Muraroi I and II may be mentioned as examples. On the other hand Nalhati II, Mayureswar II and Rampurhat II with negligible dissection index value have even higher density indicating that the influence of dissection index on rural population distribution may not be very strong in those areas.

To describe the general relationship in quantitative terms or to map the distribution of varying degree of correspondence between the two phenomena the regression of population density upon dissection index may be employed. Fig. 12 shows a scatter diagram in which the rural population density i.e. (D) values have been shown along Y-axis and the dissection index i.e. (I) values (obtained at areal centres of blocks by linear interpolation from the isopleth map of dissection index) have been shown along the X-axis (Appendix A, Table B). The values of D and I at the areal centre of each block have been taken as paired values for the scatter diagram and subsequent regression analysis. The location of these paired values in the scatter diagram indicate the graphical correlation between the variables and are used for drawing the regression line or the line of best fit. This, as obtained by the method of least squares is $D_c = 522.84 + 116.94 \times I$, which shows the linear relationship of dissection index (I) with rural population density (D). Stated in statistical terms, according to this relationship a C. D. block in Birbhum with a dissection index of 0.20 is expected to support a rural population density of 546 persons per square kilometre ($D_c = 522.84 + 116.94 \times 0.2 = 546$ approximately). Similarly, a block with 0.60 dissection index value is expected to support 593 persons per square kilometre and so on.

In this way the "expected" ($D_c$) rural population densities are computed for each of the C. D. blocks. These values may be plotted at the areal centre of each block to draw a second isopleth map of population distribution. If such an attempt were made there would be two rural population density maps – one showing the actual distribution and the other representing the distribution pattern as defined by the regression line or what it would be if it were entirely dependent upon dissection index. For the purpose of knowing the strength of relationship, i.e. the degree of association between the rural population density and dissection index, Karl Pearson’s product moment correlation coefficient has been obtained. This shows that correlation coefficient ($r$) = 0.18.

The value of ($r$) is obtained by:

$$r = \frac{N \sum (D - \bar{D})(I - \bar{I})}{\sqrt{N \sum I^2 - (\sum I)^2} \times \sqrt{N \sum D^2 - (\sum D)^2}}$$

where, $r$ = correlation coefficient

$I$ = independent variable i.e. dissection index

$D$ = dependent variable i.e. rural population density

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**Fig. 12: Scatter diagram (dissection index and rural population density)**

**Scatter Diagram**

**Birbhum District**

D = 522.84 + 116.94 I

**Fig. 12**: Scatter diagram (dissection index and rural population density)
The critical value of the correlation coefficient at 10% level for a sample size of 19 is 0.389. Therefore the calculated value is non-significant. The conventional Student's t test has also been employed to test whether the correlation coefficient is significant:

\[
t = \frac{r \sqrt{n-2}}{\sqrt{1-r^2}} = \frac{-0.18 \sqrt{19-2}}{\sqrt{1-0.18^2}} = 0.77
\]

The critical value of t with 17 degrees of freedom at 5% level (two sided) is 2.11. Hence the calculated value of t is non-significant. In other words, the null hypothesis that the correlation coefficient is zero is accepted. Taking Pearson's correlation coefficient, the percentage of explained variation is equal to \( r^2 \times 100 \), i.e. \((0.18)^2 \times 100 = 3.24\). Thus only 3.24% of the total variation in D i.e. rural population density is accounted for by variation of I. The correlation coefficient value of 0.18, obtained earlier, indicates only a small positive relationship between dissection index and rural population density. In such a case the two maps showing the "relief" of actual population density and the "dissection index induced population density" will not coincide in most cases. This is supported by the high values of departure, \((D-D_c)\), of the "actual population density" surface, \((D)\), from the "dissection index – population density" surface, \((D_c)\). So the mapping of the residuals \((D-D_c)\) or standardised residuals, to show the correspondence between dissection index and rural population density in Birbhum appears redundant because even if such a map is prepared it will only serve to emphasize the fact that there is hardly any relationship between the two variables. Hence any further analysis becomes redundant.