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Some Aggregate Measures Of Population Distribution Of Nepal

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Introduction

The most common measure of population distribution is the crude density of population (P/A) which relates the number of people to unit area. Physiographic density (P/CA) is often used to provide a more discerning picture of population distribution in an area primarily because it relates the number of people not to total land area *per se* but to the total cultivated or arable area. Both these measures suffer from several limitations the most notable being the fact that density presumes an even distribution of population over the given area. The evenness or skewness of population distribution (i e. relative dispersal or concentration of 'population) relative to an attribute such as total land area or total cultivated land is not reflected in the notion of density, though inferences can and often are derived. This note seeks to examine the population distribution of Nepal in 1971 and 1981 with the help of two related aggregate measures of population distribution: the Gini Coefficient and the Dissimilarity Index. A comparison of these measures will then be made with respect to density figures for both 1971 and 1981. The emphasis will be in analysing the relative dispersal or concentration of population in Nepal, and among ecological as well as development regions in the last decade.

Methodology

Two particular and related measures of distribution of any two variables over space, which have been used both by geographers as well as economists,

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and sociologists, are the Gini Coefficient (GC) and the Dissimilarity Index (DI). Both these measures are derived from the Lorenz Curve which depicts the cumulative percentages of the variables in each axis against which observations of x, y per unit are plotted. A 45 degree line from the origin shows the condition of distribution. The greater the departure of Lorenz Curve from the diagonal the greater is the dissimilarity in distribution and consequently the higher the concentration.

The Gini Coefficient is a ratio of the proportion of areas lying between the diagonal and the Lorenz Curve to the total area of the triangle below or above the diagonal Gini Coefficient can have a value of 0 to 1, the former is regarded as a measure of a perfectly ubiquitous distribution of the two variables in question, while the later indicates an absolute concentration in the distribution of a variable relative to the other. Therefore, the lower the Gini Coefficient the greater the relative similarity of distribution and vice versa. The computational algorithm for the Gini Coefficient is;

$$GC = \left(\sum_{i=1}^{n} x_i \; y_{i+1}\right) - \left(\sum_{i=1}^{n} x_{i+1} \; y_i\right) \text{ where,}$$

x_i = cumulative proportion of variable x
y_i = cumulative proportion of variable y
n = the number of units

The Dissimilarity Index (DI), defined as "the maximum vertical distance between the diagonal the curve" is a measure of the level of areal association in the distribution of any two variables DI indicates the maximum observed deviation from the diagonal. Expressed, often in percentage, the DI value ranges from 0 to 100. The smaller the value the greater the degree of areal association and vice-versa. In general, DI is defined

$$DI = \frac{\sum (x_i - y_i)}{} \times 100 \text{ where}$$

x_i and y_i are uncumulated percentages for each variables.

The utility of both these related measures lies in the base units that are employed. These measures do not distinguish between two contrasting spatial patterns within each areal unit but only provide summary aggregate measures for examining the distribution of the two variables.

In the present exercise population distribution in 1971 and 1981 by districts and the distribution of total land area and cultivated land area for 1971 and 1981 by districts have been used as the two variables. The population data are taken from the Population Census, 1971 and 1981 and the data for total land area as well as cultivated land have been derived from the APROSC data bank.

Analysis of Gini Ratios

Table 1 presents the Gini Coefficients for the country as a whole and for the three ecological regions for 1971 and 1981. The coefficients have been computed for (a) the distribution of population and land area and (b) for the distribution of population and cultivated areas for both the time periods.

Table 1: Gini Coefficients- Population and Land Area and Population and Cultivated Area, 1971 and 1981.

		Mountain	Hill	Tarai	Nepal
Population and Land Area	1971	0.14	0.1	0.29	0.38
	1981	0.12	0.1	0.25	0.43
Population Cultivated Area	1971	0.1	0.11	0.01	0.21
	1981	0.22	0 001	0.07	0.001

The table reveals that in terms of the distribution of population and land area, the population of Nepal is spatially more concentrated in 1981 than in 1971 indicated by a Gini Coefficient of 0 43 in 1981 compared to 0.38 in 1971. This can perhaps be explained by the proportional as well as absolute increase in the Tarai population, and the consequent increase in the density of population in the Tarai region in the last decade. However, in terms of the three ecological regions, the distribution of population and the distribution of land area appear slightly more ubiquitous in the Mountain and the Tarai region in 1981 compared to 1971. The distribution of population relative to land area in the Hill region appears to have remained the same during both the periods.

A comparison of the distribution of population relative to cultivated area, however, presents a different picture. Table 1 reveals that for Nepal as a whole there is almost a perfect proportional distribution of population relative to cultivated area in 1981 compared to 1971. The Gini Coefficient for 1971 is 0.21 which indicates a differential distribution of population and cultivated area. It is 0.001 for 1981 which indicates a near perfect proportional distribution of population and cultivated area in the country. There appears to be a better spatial distribution of population relative to cultivated in the Hill region in 1981 compared to 1971. This is exactly the opposite of what seems to be taking place in the Mountains and the Tarai. In both these ecological regions the concentration of population in cultivated land has slightly increased in the last decade.

The Dissimilarity Index computed for the country as a whole and the ecological regions is shown in Table 2.

Table 2: Dissimilarity Index 1971 and 1981

		Mountain	Hill	Tarai	Nepal
Population and Land Area	1971	33	28	26	27
	1981	33	28	22	29
Population and Cultivated Area	1971	17	14	0.4	20
	1981	33	16	9	2.9

Table 2 reveals that the DI has remained more or less stable for the Mountain and Hill region during the intercensal decade. A higher areal association of population and land area is observed for the Tarai region for 1981 compared to 1971. For the country as a whole, however, the dissimilarity between the distribution of population and land area has increased only slightly from 27% to 29%.

Compared to the areal association between population and lan darea, the association of population and cultivated land has changed, dramatically in some cases, in the 1971–1981 period. Dissimilarity in the distribution of population in cultivated land has increased from 17% to 33% in the Mountain from 14 to 16% in the Hills and from 0. 4% to 9% in the Tarai. For Nepal as a whole the degree of areal association between the distri-

bution of population and cultivated area has increased rather dramatically in the intercensal period indicated by a DI of 2.9% in 1981 compared to 20% in 1971. It should be noted that the DI measures the maximum deviation from a perfect distribution in the Lorenz Curve.

The picture that emerges from above exercise raises several questions. Why, for example, has the Gini ratio for population and cultivated area gone down so dramatically when the ratio for population and land area has increased only slightly, Why has the Dissimilarity Index for all the ecological regions shown increases while the index for Nepal as a whole decreased ? The explanation to these questions emerge from the analysis of the data for 1971 and 1981 which indicate certain interesting changes in man-land relationships in different ecological regions of Nepal.

During the intercensal decade 1971-1981 the population of Nepal increased by. 3. 466 million over the 1971 population of 11. 555 million giving a growth rate of 2.66% per annum. While in 1981 the Mountain, Hill and Tarai regions experienced a percentile increase of 14. 43, 17. 98 and 80.75 over the 1971 population in respective regions, the percentile share of national population in the intercensal period dropped in both the Mountains from 9. 85 to 8 67 and in the Hills fiom 52, 54 to 47. 68, Consequently, the share of the Tarai region in the national population increased fiom 37. 6 in 1971 to 43. 65 in 1981. For Nepal as a whole, therefore, the Gini ratio increased from 0. 38 to 0.43 (Table 1) while for the Tarai the ratio slightly decreased as a result of increases in population in western and the far-western Tarai. In the Hills the growth and distribution of population relative to land area appears to have remaind more or less constant during the decade despite increases in the magnitude of population. A slight decrease in the Gini ratio for the Mountain region can perhaps be best explained by the relatively low percentile increase in population in these districts and by the loss of population in absolute terms in some of the mountain districts notably, Rasuwa, Manang and Humla. The Dissimilarity Index for population and land area in 1971 and 1981 can also be explained in a similar light bearing in mind that the index just describes the maximum deviation from the diagonal or perfect distribution.

The interpretation of the Gini ratio for population and land area is simplified by the fact that the total land area of the country in 1971 and. 1981 and for different districts- which is the basic unit for computation- have been taken as the same.

The interpretation of the Gini ratio for population and cultivated area presented in Table 1 is slightly more complicated by the fact that both the parameters- population and cultivated land- have changed in the intercensal decade.

If the figures for cultivated land by district provided by the APROSC data bank for 1971 and 1981 are taken as indications (which is doubtful in some cases), the distribution of cultivated area in both the periods as follows:

Table 3: Distribution of Cultivated Land by Ecological Region, 1971 and 1981

	Total Land Area In sq. Km.	Cultivated Land 1971 in ha.	Cultivated Land 1981 in ha.	Per cent Change 1971–1981
Mt.	51, 817 (35. 21)	97, 500 (5. 0)	157,339 (5. 9)	61. 37
Hill	61, 345 (41. 68)	589, 300 (30. 25)	1, 128, 386 (42. 35)	91. 48
Tarai	34, 901 (23. 11)	1, 261, 300 (64. 75)	1, 379, 053 (51. 75)	9. 34
Nepal	147, 181 (100.0)	1, 948, 100 (100.0)	2, 664, 778 (100.0)	36. 79

Source: APROSC Data Bank, 1984

In 1971 nearly 13. 23% of the total land area is believed to have been under cultivation. This figure increased to 18. 1 in 1981. The proportional share of cultivated land as well as the magnitude of cultivated area in different ecological regions changed dramatically between 1971 and 1981. In 1981 there was a 61. 37% increase in cultivated area in the Mountain region over the 1971 figure. In the Hill region the increase was over 91%. The increase was least in the Tarai, only 9. 34%. Consequently, the share of Mountain. and Hills in the total cultivated area of the country increased from 5. 0% to 5.9% and from 30. 25% to 42,35% in the intercensal decade. The share of the Tarai decreased from 64.75% in 1971 to 51. 75% in 1981. Two processes appear to have been operative during the decade: one, the increase in cultivated area was phenomenal in the Hills. Land hunger arising from lowered productivity and increasing population contributed to the expansion in cultivated area. Two, while Hill-Tarai migration (complemented by immigration from across the border) was responsible for the dramatic increase

in Tarai population a commensurate expansion in cultivated area did not take place in Tarai. During the intercensal decade the Hills experienced an increase of 589. 086 hectares of cultivated area while the increase in the Tarai was only 117, 753 hectares. As a result of the dramatic increases in cultivated area during the intercensal decade, the density of population per cultivated square kilometer in the Mountain and Hill region declined from 1. 167. 80 to 828.08 and from 1, 030. 27 to 634. 81 respectively (Table 4). Tarai region experienced an increase in physiographic density from 344. 56 to 475. 45. For Nepal as a whole the density decreased from 593. 19 to 563. 75. The crude density, however, increased in all the ecological regions from 21. 97 to 25. 14 in the Mountains, from 98. 97 to 116. 77 the Hills and from 127. 75 to 192.74 in the Tarai and from 78. 52. to 102. 07 for the country as a whole.

Table 4: Crude Density and Density in Cultivated Area, 1971-1981, (per square Km.)

Region	1971		1981	
	Crude	Cultivated Area	Crude	Cultivated Area
Mountain	21. 97	1167. 80	25. 14	828. 08
Hill	98. 97	1030. 27	116. 77	634, 81
Tarai	127. 75	344. 56	192. 74	475. 45
Nepal	78. 52	593. 16	102. 07	563. 75

It is only in the light of these facts that the Gini ratios in Table 1 can be iuterpreted. Substantial increase in cultivated area in the Hills has reduced the Gini ratio from 0. 11 in 1971 to 0. 001 in 1981 indicating a near-perfect proportional distribution of population and cultivated area. In the Tarai the ratio has gone up slightly, indicative of the fact that if the rate of bringing more marginal land under the plough remains as it is with migration unabated, the ratio will rise through time. The ratio for the Mountain region shows a higher increase than in the Tarai- a pointer that the Mountain region will, in the lack of any possibility of increases in cultivated area in the future show a higher ratio of population concentration relative to arable land in the future. Nepal as a whole shows a near-perfect distribution. The probability of this maintaining in the future is however, unlikely for several

reasons the foremost being the continued increase in population which cannot be matched by increases in cultivated area in the Hill-Mountain as well as the Tarai.

The computed Gini ratios and Dissimilarity Index for the three ecological zones by five development regions for 1971 and 1981 appears in Table 5 and 6. The interpretation of both these measures requires a great deal of caution because the number of units in each development region by ecological zone varies considerably. This inevitably affects the magnitude as well as reliability of the computed coefficients. Therefore only a summary description of the tendency of distribution will be attempted here.

Table 5: Gini Coefficients, Development Regions by Ecological Zones 1971 and 1981.

	Eastern		Central		Western		Mid-Western		Far-Western	
	PA	PCA	PA	PCA	PA	PCA	PA	PCA	PA	PCA
Mountain										
1971	.07	.18	.12	.08	.17	.24	.001	.18	.01	.04
1981	.04	.07	12	.29	.04	.13	.03	.06	.03	.23
Hill										
1971	.06	.32	.001	.04	.14	.01	.09	.09	.01	.001
1981	.03	.28	.02	.02	.11	.02	.06	.04	.01	.09
Tara:										
1971.	11	.08	.21	.05	.12	.06	.03	.09	.02	.23
1988.	001	.05	.20	.04	.03	16	.02	.02	.07	.02

In Tables 5 and 6, PA denotes the coefficients for population and land area while PCA denotes the coefficients for population and cultivated area.

The results indicate that the distribution of population relative to land area is more ubiquitous in 1981 compared to 1971 in all the ecological zones of the Eastern and Western Development regions. The pattern is similar in other development regions with a few exceptions. In the Central hills, Mid-Western mountains and Far-Western Tarai slightly increased proportional concentration of population in land area is discernible.

Table 6: Dissimilarity Index, Development Regions by Ecological Zones 1971 and 1981.

	Eastern		Central		Western		Mid-Western		Far-Western	
	PA	PCA	PA	PCA	PA	PCA	PA	PCA	PA	PCA
Mountain										
1971	7	13	2	7	17	24	48	33	2	12
1981	6	5	17	25	3	11	46	6	2	25
Hill										
1971	1	37	31	8	14	6	23	15	4	14
1981	7	23	32	21	11	17	15	4	13	10
Tarai										
1971	9	1	16	5	16	5	2	9	2	23
1981	2	5	16	6	14	12	2	2	6	2

In terms of the distribution of population relative to cultivated areaa differential pattern emerges. In the Eastern Development Region the mountain and the Tarai districts show a slightly better proportional distribution of the two variables in 1981 while the Eastern hills show a lightly increased concentration of population in cultivated area compared to 1971. In the Central Development Region the Central mountains show a disproportional distribution of population and cultivated area while in the Central hills and the Tarai quite the reverse appears to hold, In the Western Development Region it is the Western mountains that show a tendency towards a more ubiquitous distribution of population and cultivated area while the hills and the Tarai show an opposite trend. All the ecological zones of the Mid-Western Development Region display a tendency towards better proportional distribution of the two variables. The pattern is different in the Far-western Development Region. Here increased proportional concentration of population in cultivated area is seen in the mountains and the hills while the Tarai displays a tendency towards a relatively better spatial distribution of the two variables.

In conclusion it appears that the migratory trend from the mountain and hill regions to the Tarai together with the disproportionate increase in cultivated land in the hills fuelled by land hunger and the cultivation of

marginal lands in the last decade has resulted in an apparantly more ubiquous distribution of population in cultivated area in the country. The present situation, however, appears to be destabilising by its very nature because of the limited scope for the expansion of cultivated area in the hill/mountain region and the consequent migratory trend that in all likelihood will continue unabated to the Tarai region in the future.