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Levels of Agricultural Development and Patterns of Population Growth in Nepal

DEVENDRA PRASAD SHRESTHA*

P. HANUMANTHA RAYAPPA**

INTRODUCTION

Nepal is relatively a small land-locked country surrounded by two big neighbours China and India. It is also one of the least developed countries whose per capita income is estimated to be $ 133 in 1985-86. The average annual growth rate of Gross Domestic Product (GDP) during the period 1970-71 to 1984-85 is of the order of 2.8 percent which is closer to the annual growth rate of population which stood at 2.7 percent during the same period. About 94 percent of the total population resides in the rural areas and 90 percent of the total labour force is engaged in agriculture and allied activities. The calorie in-take of food of its people covers only 80 percent of the total nutritional requirements in 1980 (CBS, 1987). The Nepalese economy is also characterised by higher degree of income inequality as about 47 percent of the share in total income is concentrated in the hands of 10 percent of the richest households in the country (Islam, et. al., 1982).

The higher rate of growth of population has been a matter of concern to the planners in Nepal. The latest census count of 1981 recorded a total population of 15 million, indicating an increase of more than 6.7 million persons since 1952-54 whereas the corresponding increase between 1911-41 was less than a million. The annual rate of growth of population which was 1.64 percent during 1952-54 to 1961, and 2.10 percent during 1961-71, increased to a level of 2.66 percent during 1971-81. Based on past trends of population growth it has been predicted that the population of Nepal will be doubled by the end of this century (CBS, 1987).

This spurt in the rate of growth of population during 1971-81 has been attributed to the rapid fall in the mortality level without a corresponding decline in fertility which has remained almost constant at a high level (CBS, 1987). The crude death rate has shown a significant and consistant decline from about 27 during 1952/54-1961 to 21 by 1961-71 and further declined to 14 during 1971-81. However, this decline in CDR has not been followed by a corresponding decline in crude birth rate as it has been ranging between 40 and 42 from 1952/54 to 1981. During this period the effect of net international migration in the population growth of Nepal has been considered as negligible (CBS, 1987).

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* *Mr. Shrestha is a Lecturer at Central Department of Economics, Tribhuvan University, Kirtipur, Kathmandu, Nepal.*

** *Prof. Rayappa is the Head, Population Research Centre, Institute for Social and Economic Change (ISEC), Bangalore, India.*

The rate of growth of population in Nepal has varied by regions over time. Terai region has been experiencing relatively higher growth as annual growth rate of population in this region increased from 2.04 percent in 1952/54 to 2.39 percent during 1961-71, and to 4.11 percent during 1871-81. On the other hand, growth rate in mountain and hill region has not varied so much as it has increased from 1.42 percent during 1952/54-61 to 1.65 percent during 1971-81. Similarly, variations have been large in the growth rates of population across districts. By districts the annual rate of growth of population varied from a very high rate of 9.39 percent in Kanchanpur district of Terai region to a negative growth of 2.72 percent in Humla district of mountain region during 1971-81.

The economy of Nepal is predominated by agriculture as its contribution to the GDP is to the extent of 62 percent in 1985-86. Agricultural sector accounts for 75 percent of the exports of the country and absorbs nearly 91 percent of the total labour force. However, a few significant developments in different aspects of the agricultural sector in recent years cannot be overlooked. Some of the major changes are with regard to cultivated area, cropped area, cropping intensity, use of high yielding varieties, use of chemical fertilizers, use of agricultural machinery like tractors, pumpsets, etc. In spite of these developments, gains in agricultural production are not very impressive. The agricultural production has grown at an annual rate of 1.5 percent during 1970-71 to 1984-85 whereas population growth has been at about 2.7 percent per annum during the same period. Only after 1980, agricultural production has started gaining some momentum and during the Sixth Five-Year Plan period (1980-85), agricultural production has grown at a rate of 3.2 percent per annum. What is noteworthy, however, is that most of the increase in agricultural production has been due to expansion of cropped area rather than increase in its productivity, as productivity has almost remained constant (HMG/Ministry of Finance, 1986).

The objective of this paper is to understand the patterns of population growth by levels of agricultural development in Nepal. This has been attempted by analyzing data for districts of Nepal for the period 1971-81. The components of rate of total increase in population (RTI) i.e., crude death rate (CDR), crude birth rate (CBR), rate of natural increase (RNI) and rate of net-migration (RNM) have been estimated using indirect demographic measures for all the 75 districts of Nepal. Similarly, districts have been classified on the basis of their levels of agricultural development using factor analysis technique. Then the patterns of population growth by districts have been delineated by levels of agricultural development.

In the next section hypothesized relationships between agricultural development and demographic indicators have been summarised. Data used and methods of analysis are presented in section three. Main findings emerging from our analysis are presented in section four followed by a brief summary in section five.

HYPOTHESIZED RELATIONSHIP

The prime interest here is to outline very briefly the relationship between agricultural development and population growth. It has been

accepted that the cause and effect relationship between agricultural development and population growth can run either way. Population growth once generated has significant influence on the agricultural sector in terms of supply of labour and demand for food. Similarly, changes in the agricultural front may influence population growth via its components. Any significant developments in agriculture may alter the course of mortality, fertility and migration components and as a result increase in the rate of growth of population.

(a) The response of fertility to agricultural development at least in its early stages is rather uncertain. The aspirations for children because of increased agricultural productivity and income may operate through perceived cost of children i.e., nurture cost, educational cost, opportunity cost, etc. A rise in income resulting from increase in wage rate due to higher labour productivity may also render rearing of children more expensive. These may also lead to changes in age at marriage, female labour force participation, migration, etc. (Mueller, 1974). Large family may also be considered as an asset where demand for family labour is on the rise. Under these circumstances there can be a rise in birth rate but it may gradually decline after a time lag. The effect of agricultural development on fertility may not be direct but indirect.

(b) Agricultural development is expected to increase availability of food thereby bringing reductions in malnutrition and decline in infant mortality (Mueller, 1974). At times, development of agriculture due to improved irrigation, and adoption of technology may also lead to outbreak of epidemics and spread of newer diseases. However, a consensus that has emerged from the available studies is the universal decline in death rates due to advancements in agriculture. A negative relationship between agricultural development and death rate is commonly observed.

(c) Due to the observed inverse relationship between agricultural development and mortality levels and uncertain relationship between agricultural development and fertility levels the nature of the relationship between agricultural development and rate of natural increase in population will also be uncertain. This relationship may not always hold true as the rate of natural increase may be more influenced by the behaviour of mortality and less of that of fertility. The observed differentials in the rates of natural increase may not be significant at least in the early stages of agricultural development as is the case in Nepal.

(d) Development of agriculture generally leads to an increase in demand for labour at least during certain seasons. When scarcity of labour is experienced in an area, natural tendency is to attract labour from neighbouring areas through increased wage levels. This may also lead to decrease in out-migration of labourers which used to be the case earlier. Reduction in out-migration and increase in the inflow of migrants including temporary and seasonal migrants will tend to add to the growth of population in the receiving areas. Generally, it has been observed that agriculturally growing areas tend to grow because of migration (Rao and Sahu, 1987).

(e) In general agricultural development and population growth tend to be positively related because of the hypothesized relationships mentioned above. Fertility behaviour in the early stages of agricultural development is not certain. However, mortality tend to be inversely related with agricultural development and net in-migration tend to be positively related with agricultural development. Therefore, total population growth rate will also be higher in the areas undergoing the process of agricultural transformation.

DATA AND METHODS

In the present study, districts have been considered as the unit of analysis. Data on demographic indicators and agricultural indicators have been obtained for 75 districts of Nepal. As far as possible, comparable data have been gathered for the districts. Data pertaining to demographic indicators refer to the period 1971-81 and agricultural development indicators refer to 1981-82. The data used and methods of analysis employed are very briefly outlined below.

Data on population size for districts were obtained from population censuses carried out by the Central Bureau of Statistics (CBS) of Nepal. The population figures adjusted for the 1981 boundaries for all the 75 districts are also available in 1971. Vital Registration System in Nepal does not cover all the districts in the country. Hence, estimates obtained by using indirect demographic techniques have been used. P/F Ratio method originally developed by Brass has been used to estimate adjusted age specific fertility rates (Brass, 1975). Using the adjusted age specific fertility rates (AASFR) adjusted crude birth rates (ACBR) have been estimated. While adopting these techniques P_2/F_2 and P_3/F_3 (P_2 and P_3 refer to children ever born of women in the age group 20-24 and 25-29, respectively. While F_2 and F_3 are estimated average cumulative fertility levels) have been considered separately as a correction factor for adjusting the age specific fertility rates. From the AASFR, ACBR has been obtained both for P_2/F_2 and P_3/F_3. The average of these two has been considered as a representative rate for the particular year. The estimates of ACBR are obtained separately for 1971 and 1981 and the average of the two has been considered as the intercensal ACBR for the period 1971-81.

Similarly, for estimating crude death rate (CDR) Trussel variant of the original Brass Method of estimating child mortality is adopted (Trussel, 1975). This technique is used to obtain estimates of proportion dead among children ever born to women in each of the age group 15-19 to 45-49. This information was used to estimate the probability of dying (qx) and probability of surviving children by age x (l_x) corresponding to the age of women by using Trussel multipliers (U.N., 1983). It is assumed here that the "West" model of the Coale and Demeny Model Life Table is representative of true mortality patterns of Nepal. Using the average of l_3 (probability of surviving from birth to age 3) and l_5 (probability of surviving from birth to age 5) the mortality level was identified for 1971 and 1981, separately, for both sexes following the "West" model. l_3 and l_5 correspond here to women in the age group of 25-29 and 30-34, respectively. Age-specific death rates corresponding to identified

level of mortality are then applied to the age distribution of population of 1971 and 1981 censuses for male and female separately to arrive at the total number of deaths in 1971 and 1981. Average of these deaths during 1971-81 are divided by mid-year population of 1971-81 to obtain CDR. After having obtained ACBR and CDR, the balancing equation procedure is used to arrive at the rate of net-migration. The difference between ACBR and CDR provides us the rate of natural increase.

In order to arrive at the levels of agricultural development of districts 12 indicators (list of indicators selected is provided in the following page) have been considered. These data have been obtained both from published and unpublished sources such as Department of Food and Agricultural Marketing Services, Central Bureau of Statistics, Agricultural development Bank, Agricultural Input Corporation, etc. Factor analysis technique has been employed to obtain the dimensions of agricultural development in Nepal. Varimax factor loading matrix (extracted after following the criterion of eigen value greater than one) has been multiplied by the standardised data matrix to obtain the factor scores for all the 75 districts. Factor scores thus obtained represent the levels of agricultural development of each district and they have been used to categorize 75 districts into three levels - High, Moderate and Low - each having 25 districts in the descending order. Factor analysis technique has been widely used to analyse the regional differences in the levels of development (Berry, 1960; Adelman and Morris, 1967; Pal, 1975).

RESULTS

The factor loadings in Table 1 indicate the net correlation between each factor and the observed variable. The sum of squared factor loadings or the communality of each variable indicates the proportion of the total unit variance explained by all the factors taken together. From the table it is clear that the three factors taken together explain 69 percent of the total variance. Factor 1 has high loadings with seven variables and explains 39 percent of the total variance. This factor represents a dimension of agricultural inputs or assets. Factor 2 has high loadings with four variables and explains 19 percent of the total variance. This factor represents a dimension of agricultural yield. The third factor has high loading with only one variable and explains 11 percent of the total variance.

All the 75 districts have been classified into three levels of agricultural development based on factor scores for Factor 1 and Factor 2, separately. As mentioned earlier, factor scores have been used to classify all the districts into three levels of agricultural development. The unweighted average rates for all the demographic indicators for the districts falling within each level of development have been worked out and are presented in Table 2. These results present some interesting patterns of population growth by levels of agricultural development in Nepal.

The behaviour of crude death rate by each level of agricultural development is as expected. The average crude death rate for low, moderate and high categories are 20.65, 17.02 and 14.29, respectively. The inverse relationship between levels of agricultural development and crude death rate can be clearly seen here. This is true for both Factor 1 and

List of Agricultural Development Indicators Selected

1. Cultivated area per agricultural worker in hectares.
2. Cropping intensity i.e. ratio of cropped area to cultivated area.
3. Investment on farm mechanization and irrigation per hectare of cropped area.
4. Investment on farm mechanization and irrigation per agricultural worker.
5. Number of cooperatives per agricultural worker.
6. Consumption of chemical fertilizers per hectare of cropped area.
7. Use of high yielding varieties of seeds (paddy, wheat and maize) per hectare of cropped area in these crops.
8. Yield of paddy per hectare.
9. Yield of maize per hectare.
10. Yield of wheat per hectare.
11. Percentage of irrigated area to total areable land.
12. Gross value of agricultural output per agricultural worker.

Table 1
Rotated Factor Loadings on Agricultural Variables

	Variables	Factor Loadings of Factor 1	2	3	Communality
1.	Cultivated area per agricultural worker in hectares	0.825	-0.322	-0.020	0.786
2.	Cropping intensity	0.074	0.117	0.889	0.809
3.	Investment on farm mechanisation and irrigation per hectare of cropped area	0.870	0.196	0.158	0.821
4.	Investment on farm mechanisation and irrigation per agricultural worker	0.930	-0.025	0.224	0.916
5.	Number of cooperatives per agricultural worker	0.747	0.223	-0.238	0.664
6.	Consumption of chemical fertilisers per hectare of cropped area	-0.049	0.650	0.009	0.425
7.	Use of high yielding varieties of seeds (paddy, wheat and maize) per hectare of cropped area in these crops	0.530	0.258	-0.418	0.523
8.	Yield of paddy per hectare	-0.187	0.824	0.090	0.725
9.	Yield of maize per hectare	0.291	0.760	0.049	0.666
10.	Yield of wheat per hectare	0.415	0.744	-0.069	0.731
11.	Percentage of irrigated area to total areable land	0.558	0.105	0.385	0.470
12.	Gross value of agricultural output per agricultural worker	0.817	0.097	-0.073	0.683
	Explained variance	4.645	2.314	1.262	8.221
	Percentage of explained variance	38.707	19.285	10.516	68.509
	Cumulative variance (percent)	38.707	57.992	68.509	-

Table 2
Levels of Agricultural Development and Demographic Indicators: Emerging Patterns

Levels of Agricultural Development	Demographic Indicators					
	CDR	ACBR	RNI	RNM	RTI	DST
1st Factor						
High	14.29	40.36	26.07	+14.37	40.79	235.14
Moderate	17.02	41.12	24.10	- 6.04	16.93	170.58
Low	20.65	42.34	21.69	- 9.22	13.50	78.00
2nd Factor						
High	14.63	40.77	26.14	+ 5.15	31.29	279.89
Moderate	17.10	42.26	25.16	- 3.22	21.94	125.44
Low	20.22	41.16	20.94	- 2.91	18.03	80.17

Note: CDR : Crude Death Rate
ACBR: Adjusted Crude Birth Rate
RNI : Rate of Natural Increase
RNM : Rate of Net Migration
RTI : Rate of Total Increase
DST : Density per sq. km.

Factor 2 as the rates are very similar in both the cases. Adjusted crude birth rate does not exhibit much variation by three levels of agricultural development and the relationship is not very clear. There is a clear trend of increase in natural rate of population growth with higher levels of agricultural development. As agricultural development has strong inverse relationship with crude death rate and hence on rate of natural increase the results are quite as expected. The rate of net in-migration is expected to be positively related with the levels of agricultural development and the results show that it is in the expected direction. A clear pattern of high net in-migration with higher levels of agricultural development can be observed from Table 2. Districts with higher levels of agricultural development also have experienced higher rates of population growth. Similarly, population density is also positively associated with the levels of agricultural development in Nepal.

Examination of zero-order correlation coefficients of the demographic indicators with factor scores of agricultural development presented in Table 3 has also confirmed the above findings. All the correlation coefficients are in the expected direction. With regard to Factor 1, except with crude birth rate, all the other coefficients are statistically significant either at 1 percent or 5 percent level. But with Factor

Table 3
Zero-Order Correlation Coefficients Between Demographic Indicators and Scores of Agricultural Development Factors

	Demographic Indicators	Correlation Coefficients with Agricultural Development	
		Factor 1	Factor 2
1.	Crude Death Rate (CDR)	-0.592**	-0.335**
2.	Adjusted Crude Birth Rate (ACBR)	-0.158	-0.120
3.	Rate of Natural Increase (RNI)	0.347**	0.173
4.	Rate of Net Migration (RNM)	0.500**	0.168
5.	Rate of Total Increase (RTI)	0.545**	0.249*
6.	Density Per sq. km. (DST)	0.254*	0.780**

*Significant at 5 percent level.
**Significant at 1 percent level.

2 only three coefficients are statistically significant either at 1 percent or 5 percent level.

There are significant regional variations in agricultural development in Nepal. Based on our analysis, 17 out of 18 districts in Terai region fall under high category and more than 50 percent of districts in hill and mountain region are in low category. Over 90 percent of districts in hill and mountain regions fall under low or moderate category. Thus we may conclude that the importance of geographic region is very much obvious in understanding the agricultural development process and hence population growth patterns in Nepal.

SUMMARY

In the present study an attempt has been made to understand the patterns of population growth by levels of agricultural development in Nepal. Districts are considered as an unit of analysis. Data pertaining to demographic and agricultural development indicators are obtained. Demographic indicators are estimated by using indirect techniques. Factor analysis technique is employed to obtain the dimensions as well as levels of agricultural development.

Our analysis has shown a clear declining patterns in crude death rate with higher levels of agricultural development. No such meaningful pattern has emerged in the case of adjusted crude birth rate. Rate of natural increase has exhibited an increasing trend with higher levels of agricultural development. Similarly, a positive association between levels of agricultural development and rate of net in-migration could be observed. As a consequence to these patterns, the rate of total increase

in population has also shown an increasing trend with higher levels of agricultural development. Density also exhibits similar relationship. All these findings have been further confirmed by the results on correlation coefficients. Because of the significant regional variations in the levels of agricultural development as well as population growth in Nepal the importance of geographic regions is very much obvious in understanding the agricultural development process and hence population growth patterns.

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