



Economic Implications
of
Population Growth in India
Upto 2000 A. D.

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FOREWORD

What will be the impact of population growth on the Indian economy if population continues to grow at a high rate upto the end of this century? Alternatively, how far the picture will change if the current efforts for population control yield tangible results? These questions have aroused the interest of many demographers, economists and other research workers. In this context, they have tried to visualise the future by following different methodologies. In the first part of this report, Mrs. Sumati Kulkarni has reviewed critically major studies of this type available for India. In the second part, she has discussed the economic implications of the three alternative paths given in the official population projections for India upto 2000 A.D. While projecting the economic performance, the long term perspective given in the Fifth Five Year Plan is kept in view. It should be pointed out that it is not the purpose of this study to predict precisely what will happen in the year 2000 A.D. It merely aims at giving an idea regarding the relative magnitude of strain that the Indian economy will have to undergo under the high fertility situation as compared to that under the reduced fertility situation. It is hoped that this study will be useful for this limited purpose and will certainly help to bring about better understanding of the economic aspects of our population problem.

J.R. RELE
DIRECTOR

ECONOMIC IMPLICATIONS OF POPULATION GROWTH IN INDIA
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I

Introduction

By the end of this century, India will be completing five decades of developmental planning and its population, if not effectively controlled, will cross the limit of 1000 million. Though the awareness regarding the urgency of population control has been increasing in India since early sixties, the awareness regarding the need to include population factor explicitly in the development planning is comparatively recent. The thought that development should be viewed as an integrated process and that population problem should be considered in the broader context of socio-economic development has gained more strength recently, particularly after Bucharest Conference in 1974.

However, the importance of research on the long term economic implications of alternative trends of population growth was realised much earlier. The pioneering study of this type for India was done by Coale and Hoover¹ as early as in 1958. The objective of the study was to get quantitative measure of the economic significance of reduction in fertility by showing the difference between the economic performance under the high fertility assumption and low fertility assumption about future course of population. Today economic benefits of low fertility situation might be considered obvious. Still, there is increasing need for such studies in order to understand the relative magnitude of difference in the economic implications of alternative population trends. Besides, though there is no doubt that Coale and Hoover study was the first very comprehensive and valuable research study of this type for India, the fact remains that it was made before the results of 1961 census were brought out and was based on the economic performance data of the first five year plan. The period covered for the study of future implications was 1956-85. In view of the further developments and especially the momentum gathered by the Indian family planning programme after 1965, there is greater need for more research on economic implications of population growth, taking into account the recent census data and data regarding the achievements of later plans. In the last one and half decade some such important attempts have been made and the period covered for the study of future implications is upto the year 2000.

¹ Ansley J. Coale and Edgar M. Hoover, Population Growth and Economic Development in Low Income Countries. A Case Study of India's Prospects, Princeton: Princeton University Press, 1958.

The object of the present study -

- (1) to review major studies in this area and to discuss their limitations (Part I);
- (2) to study the economic implications of three alternative sets of official population projections for the year 2000 A.D. made by S. Raghavachari - High 2, Medium 2, Low 1 set (Part II).

An attempt is made here to show how in order to reach the same target of economic progress, larger magnitude of effort will be required under high population projection as compared to low population projection. In order to show this, implications of three projections in terms of dependency ratios, the required rate of growth of gross domestic product, size of labour force that will be available, the likely sectoral distribution of labour force, total expected foodgrains requirements etc. have been discussed in this study.

II

Review of Major Studies Regarding Economic Implications of Population Growth in India

Macro-level research on economic implications of population growth in India done so far is mainly of the following types:

- 1) Studies with investment model approach where the object is to estimate the value of preventing an additional birth to the whole economy.
- 2) Studies, where an attempt is made to assess the effect on per capita income if a given amount is (a) spent on family planning and (b) if it is invested otherwise.
- 3) Studies, where the object is to estimate the difference in the per capita income by projecting the aggregate national income under alternative population trends. This includes two types of studies (a) studies, where projection of per capita income is based on the construction of an econometric-demographic model, which takes into account the interactions of various economic and demographic variables in the process of economic growth and thus population variable is involved explicitly in the determination of national income. (b) Studies, where national income is projected independently and population factor is taken into account only while calculating per capita income.

(i) Stephen Enke's Approach and Criticism

The pioneering work of the first type has been done by Stephen Enke. He estimated the value of preventing an additional birth by calculating the value of the streams of costs and benefits (i.e., the foregone contribution to the production which the child would have

made and the expenditure on consumption saved) throughout the life span. As the benefits and costs of avoided birth are spread over a number of years, suitable discount rate was applied to arrive at the present value of the net benefit.^{2/} By this approach Enke estimated that the value of permanently preventing a birth in India is about Rs.500 or about double the annual per capita consumption.^{3/} He also concluded that the return to investment in birth control may be as much as 100 times as high as the return to other forms of investment.

Enke's approach was severely criticised by various authors like Leibenstein^{4/}, Julian Simon^{5/} etc. The criticism consists of various strong arguments e.g., that he did not take into account the non-monetary psychological benefits of children; that the cost of family planning programme assumed by him was unrealistically low; that his results would apply to the birth prevention of not only high parity births but also to the first and second children; that the assumption that prevented birth will be of a person, who if born, would be a marginal worker would not be valid especially if the impact of family planning programme is mostly on middle class families. The main attack, however, was on the discounting procedure used by him. L Simon pointed out that Enke's method of estimation indirectly attributes all the avoided consumption of the prevented child to the social account, whereas most of it would be otherwise consumed by child's family. He says that Enke's method is internally inconsistent because the discount rate as high as 15 per cent used by him is not consistent with other governmental decisions and a lower rate would reduce the value of prevented birth by his method.

Simon has also attempted to generate an estimate for the value of an avoided birth 'on the basis of a complete and realistic macro-economic system' by using the projections given in Coale and

2/ The formula used by him was as follows:

$$\text{Net benefit of preventing a birth} = \sum_t \frac{(B_t - C_t)}{(1+r)^t} - P \stackrel{>}{<} 0$$

where B indicates benefits i.e., consumption saved per birth
 C indicates costs i.e., production foregone per birth
 r indicates discount rate
 P indicates cost of family planning programme per birth.

3/ Stephen Enke, 'The Gains to India from Population Control: Some Money Measures and Incentive Schemes', Review of Economics and Statistics, 42, May 1960, pp.175-181.

4/ H. Leibenstein, "Pitfalls in Benefit Cost Analysis of Birth Prevention", Population Studies, Vol.XXIII, No.2, July 1969, pp.161-171.

5/ J.L. Simon, "The Value of Avoided Births to Underdeveloped Countries", Population Studies, Vol.XXIII, No.1, March 1969, pp.61-69.

Hoover study. By relating the differences in numbers of births in future periods (under two alternative assumptions regarding population growth made by Coale and Hoover) to the differences in aggregate incomes that are projected by Coale and Hoover, he calculated the value of preventing a birth in India. Even at the high discount rate of 15 per cent he found the value to be \$ 114 or Rs.570 and much higher at the lower discount rates e.g. at 5 per cent discount rate the value was found to be Rs.1160 at 1956 prices.

Another important criticism against Enke's approach is that it concentrates simply on the discounted present value of an 'individual life'^{6/} and involves no recognition of the interactions of population change and economic growth. The latter can in fact be effectively done by constructing a model of economic and demographic growth where population variable is incorporated explicitly and some key variables like marginal propensity to save, capital output ratio are all functions of population.

(ii) Study by Robert Cassen

There are some studies where instead of treating expenditure on birth control as investment and calculating return to it, attempt has been made to assess the difference in per capita income in future with and without a given family planning programme. Robert Cassen^{7/} has attempted to assess the difference in per capita income after ten years from 1965, with and without a programme comparable to that being undertaken by the Government of India in 1965. He compared the two alternative population situations in 1975 (A) 630 million people and (B) 590 million people (where 40 million births are prevented over ten years). He arrived at the conclusion that the net gain from birth control in terms of per capita income will be Rs.30 i.e. Assuming national income growth rate of 5 per cent per year, he arrives at the per capita income figure of Rs.476 in case (A) and Rs.506 in case (B). He also shows that Rs.300 million - (The total annual expenditure required for preventing 4 million births every year on the basis of \$ 10 as the cost per birth prevented) - if invested for ten years otherwise will lead to increment of Rs.2 to income per head. This is on the assumption of incremental capital-output ratio of 4 and a marginal savings rate of 0.16 and no depreciation of capital. Thus he concludes that net gain from birth control of per capita income in 1975 will be fifteen times as large a return as that from other investment while according to Enke's calculations the return to investment in birth control may be as much as hundred times as high as the return to other forms of investment.

^{6/} Robert Cassen, 'Population Control: Aims and Policies' in Paul Streeton and Michael Lipton (Eds.), The Crisis of Indian Planning, London: Oxford University Press, 1968, p.258.

^{7/} Ibid, pp.259-61.

As Robert Cassen himself has pointed out what he attempted was just a 'cruder calculation'^{8/} to suggest a lower limit of the effect of reduction in population growth rate on per capita income and it is hard to make an accurate assessment of the effect without a suitable growth model but as it is very difficult to estimate accurately, many of the coefficients involved, further elaboration of such a model was not attempted.

(iii) Study by K.C. Seal

K.C. Seal^{9/} has made similar analysis not for future period but only for one year 1970-71 on the basis of the past family planning performance of the period 1951-71. He estimated that if /million the entire sum of Rs.1692/actually spent on family planning in India from 1951 to 1971, were invested in any normal development programme it would have resulted into additional per capita income of Rs.2. (In this calculation he has assumed incremental capital output ratio to be 2.0 and no depreciation of capital.) He further observes that at the same time due to the absence of family planning programme the extra addition to the total population would have brought down the per capita income by Rs.8 i.e., from Rs.625 to a lower level of Rs.617 at current prices. Thus the net gain in per capita income of India due to the family planning programme in 1970-71 was estimated by him to be Rs.6 as against Rs.2 from an alternative capital investment during 1951-71.

The studies discussed so far have taken into account the effect of population growth on economic development only while calculating the per capita income but the growth rate of national income is assumed to be independent of the effect of population growth. Thus the effect of alternative population situations on economic development is not fully brought out. This brings us to the studies based on growth model approach.

(iv) Study by Coale and Hoover

Coale and Hoover study as mentioned earlier, is the first and most comprehensive study of economic implications of population growth in India. The period covered is 1956-86. The three sets of population projections used in this study are based on the three alternative assumptions regarding fertility -

- (A) High - Unchanged fertility during 1956-81;
- (B) Medium - a 50 per cent decline in fertility concentrated in the fifteen years after 1966;
- (C) Low - A 50 per cent fertility decline during 1956-81.

8/ Ibid, p.258.

9/ K.C. Seal, "On Alternative Efficiency of Family Planning Programme Over Other Developmental Programmes" in Studies on Population and Family Planning in India, New Delhi: Planning and Evaluation Division, Department of Family Planning, Ministry of Health and Family Planning, Government of India, 1974, pp.133-34.

In all the three cases, mortality was assumed to decline sharply with leveling off in 1970s. The death rate of 31 per 1000 in 1951 was expected to reach around 14 in 1986 in all the three cases. The total population of India in 1986 in the situations A, B, C was projected to be 775 million, 634 million and 589 million respectively. The total population in each case was converted into adult equivalent consumer units by taking into account sex-age distribution of the respective population and by giving suitable weights^{10/} (1 for males above age 10, 0.9 for females above age 10 and 0.5 for children under age 10). For projecting the economic performance under A, B, C, a model of Harrod-Domar type^{11/} was constructed by them. Effect of alternative population growth trends was incorporated by assuming that the amount of addition to the funds available for investment outlays (F) each year would be a certain proportion of increase in the per consumer income i.e., a $\left(\frac{Y}{C} - \frac{Y_0}{C_0} \right)$. Here Y indicates national income and C indicates equivalent adult consumer units.

The main finding of the study was that during the period 1956-80, the per consumer income will increase by only 38 per cent in unchanged fertility case, while in low fertility case, it would increase by 95 per cent and in medium fertility case it will increase by 70 per cent. They estimated that the total output will grow at the annual rate of 4.5 per cent in the low fertility case while it will increase only at the rate of 3.5 per cent in the unchanged fertility case. According to them the main difference in the high fertility and low fertility income projections comes from change in the composition of investment.

In their discussion on 'wider applicability of analysis' they have also taken into account the effect of larger labour force

10/ Ansley J. Coale and Edgar M. Hoover, op.cit., p.238.

11/ Ibid., p.270. The model can be represented by the following equation:

$$Y_{t+2.5} = Y_t + \frac{2.5G}{R}$$

where Y indicates national income; G indicates equivalent growth outlays which were calculated by giving different weightage to different types of investment outlays (F) according to their productivity effect; R indicated ratio between outlays and $\angle G$ increase in national income in a given period.

under unchanged fertility case in the long run. Using a Cobb-Douglas function,^{12/} which allows for substitution between labour and capital they estimated that income per consumer in the low fertility case will be nearly double the income per consumer in unchanged fertility case, by the year 2011 and thus showed that the economic advantages of reduced fertility case are distinctly not limited to a transition period before labour force growth is affected.

Even today the Coale and Hoover study remains the "most painstaking attempt at an estimate of the economic consequences of reduced fertility in India, even if its demographic basis has been overtaken by the 1961 census."^{13/} The actual population of India in 1961 and 1971, as indicated by census figures (443 and 547 million respectively) was higher than the estimates given by Coale and Hoover even under unchanged fertility case (424 and 532 million respectively). Apart from this fact and the limitation that the data regarding economic performance used by them was based on the achievements of the first five year plan, there is also some criticism regarding the saving function^{14/} used by them. They indicate greater rise in the rate of savings and hence higher growth rate of national income under reduced fertility case as compared to unchanged fertility case.

12/ Ibid, p.327.
$$\frac{Y_t}{Y_0} = \left(\frac{L_t}{L_0}\right)^m \cdot \left(\frac{K_t}{K_0}\right)^{1-m}$$
 where Y_t

indicates national income; L_t the size of labour force and K_t the cumulated stock of capital at time t , while Y_0 , L_0 , K_0 are the magnitudes at the base period 0. The coefficients m and $1-m$ express the relative effectiveness of the two factors with a given stock of capital and supply of labour for India. m was assumed to be 0.5 implying that a given per cent increase in the stock of capital or the size of labour force would be equally effective in raising the output.

13/ Robert Casson, *op.cit.*, p.258.

14/ The specific model that forms the basis of their projections of saving and income takes roughly the following form

$$S_t = P_t \left[\frac{S_{t-1}}{P_{t-1}} + \alpha \left(\frac{Y_t}{P_t} - \frac{Y_{t-1}}{P_{t-1}} \right) \right] \text{ where } S \text{ is the amount of}$$

investment (or saving), P is Population, Y is national income and α is the ratio of additional savings to increase in per capita income.

Saving function used by Coale and Hoover is based on Keynesian function. J.N. Sinha^{15/} has questioned its suitability for India and has pointed out that the conflicting evidence obtained from empirical investigations following Keynes' 'General Theory' has led to the formation of more complex hypotheses concerning saving income relationship. According to him, demographic factors do not play a significant role in determining the rate of savings in a country like India because (1) a given decline in fertility and child population ratio implies a much smaller decline in dependency burden measured in terms of ratio between the standard consumer and producer units, (2) the bulk of savings are accounted for by the top 1 or 2 per cent of the population who probably already have smaller families and further that their conventional expenditure that is linked to the family size forms a relatively small fraction of their income so that the cut into savings potential would be limited. Since the bulk of the people in LDCs are living at or below the subsistence level, the demands for adequate nutrition, housing, schooling, would constitute too pressing and heavy a charge on additional income to leave any perceptible margin for the rise in savings proportions. Besides, according to Sinha, growing intercommunication between different countries or between rural and urban areas would lead to 'Demonstration Effect' which would retard a rise in the marginal propensity to save.

There can also be disagreement about the suitability of the type of Cobb-Douglas function used by them for the projections upto the year 2011, especially about the value of m , which is of crucial importance for giving the reliable projections. They themselves have pointed out that little significance can be attached to the absolute magnitudes of income per consumer obtained in these calculations. They have emphatically disclaimed^{16/} any intention to predict the income levels after 30 years mainly due to inability to foresee the future technological advances and resource availability.

(v) Study by George B. Simmons

Another important study where growth model approach is used for assessing the impact of alternative population trends on per capita income in India is the study by George B. Simmons.^{17/} He has studied economic impact of the following two alternative population situations. (A) A base population of 514 million in 1967-68 projected forward at the rate linearly declining from 2.5

15/ J.N. Sinha, 'Macro Models and Economic Implications of Population Growth', Paper presented at the Indian Census Centenary Seminar, New Delhi, October 23-29, 1972.

16/ Ansley J. Coale and Hoover, E.M., op.cit., p.327

17/ George B. Simmons, The Indian Investment in Family Planning New York: The Population Council, 1971.

to 1.7 per cent in 1980-81 and further declining to 1.2 per cent in 1990-91. (B) The low population projection assuming that there were one million fewer births in 1968-69 than occurred under the high population situation (i.e., A). As a result, the high population estimates exceed the low population estimates by the number of survivors from the extra births in 1968-69. In order to measure the economic impact he considered three cases:^{18/}

- I) Where the time path of national income is independent of the size or growth rate of population.
- II) Following Paul Demeny or Coale and Hoover, he has incorporated the population variable in the model by making the rate of investment a function of per capita income and national income, a function of investment.
- III) He assumed that population affected income not only through savings but also through the labour services rendered and made adjustment in the model of case II to that effect by introducing age-specific labour force participation rates (r_t) and value of product of a marginal labour (MVP_t)^{19/} and by applying them to the difference between two population projections.

His estimates reveal that in the first case there are no benefits by aggregate income criterion but present value of the benefit of preventing a birth in terms of per capita income is Rs.5311 or 9.8 times the per capita income in 1967-68. In case II the present value of preventing a birth by aggregate income

^{18/} Ibid., p.21, 25, 27. The three cases are represented by the following equations:

$$\begin{aligned}
 \text{(I)} \quad Y_{Lt} &= Y_{Ht} & \text{(II)} \quad Y_{t+1} &= Y_t + P_t \left[\frac{SY_0}{P_0} + x \left(\frac{Y_t}{P_t} - \frac{Y_0}{P_0} \right) \right] \\
 \text{(III)} \quad Y_{t+1} &= Y_t + P_t \left[\frac{SY_0}{P_0} + x \left(\frac{Y_t}{P_t} - \frac{Y_0}{P_0} \right) \right] - r_{t+1} \cdot X_{t+1} \cdot MVP_{t+1} \\
 & & & - Y_t \cdot X_t \cdot MVP_t
 \end{aligned}$$

where Y indicates national income, P indicates population, S indicates rate of saving from per capita income in the initial period, x indicates marginal rate of saving out of per capita income, B indicates capital output ratio, r indicates labour force participation rate, X indicates the difference between two population projections and MVP indicates value product of a marginal worker.

^{19/} Using 1961 information he assumes that $r_{0-11} = 0.0$,

$r_{12-14} = .30$, $r_{15-20} = .50$, $r_{21-25} = .73$ and $MVP_{12-14} = .19$ AVP = 210 Rs.; $MVP_{15-20} = .25$ AVP = 280 Rs., $MVP_{21-25} = .32$ AVP = 350 Rs. at 1967-68 prices. (Average value product in 1961 was Rs.1110).

criterion was estimated to be Rs.2976 and by per capita income criterion Rs.8290. In the third case, estimated value of preventing a birth is not changed much from that in the case II because productive contribution of the relevant cohorts in the population comes only after 10 or 20 years and while calculating the present value with a reasonable discount rate, such delayed benefits do not carry much weight.

As stated by the author himself^{20/} these three cases do not represent an attempt to predict the rate of income growth for India but only attempts to assess the consequences under certain conditions of alternative patterns of population growth.

It is clear that like Coale and Hoover study, even in this study in case II and III an attempt is made to incorporate population variable explicitly in the growth model and population variable is brought into picture not only for calculating per capita income but even aggregate national income is made a function of population variable through the investment function. Coale and Hoover model and model in case II are basically of the same type i.e., Harrod-Domar model, and Investment function used is also the same. Naturally the criticism, regarding the suitability of this investment function, discussed earlier in the context of Coale and Hoover study is applicable here also. As regards case III, the adjustment made does not serve much purpose as is shown by the results. Perhaps, the purpose of incorporating the effect of labour force on income growth can be served better by Cobb-Douglas function. Such models based on Cobb-Douglas function have been used in some studies e.g. by Enke in his well-known TEMPO model,^{21/} by Ruprecht for Philippines,^{22/} by Newman and Allen for Nicaragua.^{23/}

20/ George B. Simmons, op.cit., p.23.

21/ Enke Stephen, Raising Per Capita Income Through Fewer Births, Tempo General Electric Company, Santa Barbara, California, March 1968.

22/ Theodore Ruprecht, 'Fertility Control, Investment and Per Capita Output - A Demographic Econometric Model for Philippines', Contributed Papers, International Union for the Scientific Study of Population, Sydney Conference, 1967, p.90.

23/ Peter Newman and R.H. Allen, Population Growth Rates and Economic Development in Nicaragua, Report prepared for the Government of Nicaragua and USAID, 1967.

(vi) General Criticism of Growth Model Approach

Here it will be worth-while to mention the criticism levelled by some writers against the use of growth models for assessing the impact of population growth on economic development. Macro economic growth models are a set of relationships among the key economic magnitudes of a national economy so stated that the effect of changes in any one such variable on all other interrelated variables can be worked out. Two broad types of growth models have been usually employed so far by the researchers with population as a variable, to assess the impact of population growth on economic development. One is Harrod-Domar model, which assumes that the only way to increase output per capita is to increase the capital stock per capita and the role of labour force is not taken into consideration. It has been pointed out^{24/} that Harrod-Domar models have little significance from the point of view of underdeveloped countries like India. They relate to the problems concerning developed capitalist economies whose major ill is instability and cyclical fluctuations in employment and income. The problem of underdeveloped countries is not instability in growth but growth itself..... Besides, unemployment problem in the advanced economies is the result of the lack of effective demand and idleness of capital while in developing countries it is the result of lack of capital itself. It has also been pointed out that these "capital accumulation models as originally set out, were not intended to describe long run development in low income countries. To stretch them to this task is to argue that the capital accumulation mechanism at their centre is the kernel of development".^{25/}

Gunnar Myrdal has also criticised the application of these models to the economic problems of South Asian countries. According to him, this approach is 'too mechanistic and schematic'.^{26/} According to him, by overemphasising investment, it tends to direct research along lines that are unrealistic for South Asia. He has criticised Coale and Hoover study for the arbitrary selection of parameters yielding the particular range in the income differential

^{24/} D. Bright Singh, Economics of Development, Bombay: Asia Publishing House, 1971, p.51.

^{25/} W. Brian Arthur and Geoffrey McNicoll, "Large Scale Simulation Models in Population and Development: What Use to Planners", Population and Development Review, Vol.1, No.2, Dec.1975, p.255.

^{26/} Gunnar Myrdal, Asian Drama, An Inquiry Into The Poverty of Nations, Penguin Books Ltd., England, 1968, Vol.III, Appendix 7, p.2067.

associated with reduced fertility and for its inherent bias towards overemphasis on investment. His point of criticism is not the lack of empirical data for the estimation of parameters for such models but he says such models would have to contain many more parameters and account for many more interrelationships to be logically consistent and adequate to reality.^{27/}

The use of Cobb-Douglas function is suggested sometimes as more suitable to the developing countries than the Harrod-Domar type investment models. Even here, the efficacy of the model depends upon the exact estimate of the exponential coefficients in the model, indicating marginal productivity of capital and labour. It is very difficult to estimate these coefficients accurately and slight variations in them would change the results substantially. Secondly, it has been pointed out ^{28/} that "Cobb-Douglas' production function enjoys the property that no matter what the parameters, the derivative of per capita output with respect to labour is always negative. An increase in population can therefore never pay its way..... The result, therefore, has been settled in advance and built in."

In short, economic development is a complicated process which can be viewed from a variety of perspectives. Construction of a formal model requires a particular perspective to be selected with its accompanying concepts, behavioural assumptions etc. ^{29/} As Gunnar Myrdal^{30/} has pointed out, indulging in the construction of a complex model, which is theoretically adequate to the reality, in spite of the present dearth of empirical data, does not seem to be a rewarding endeavor.

(vi) Some Other Studies

Apart from studies discussed so far, there are some studies where an attempt is made to draw a picture of the Indian economy in the year 2000 A.D., assuming one particular pattern of population growth as the most likely one. In these studies no attempt is made to assess the impact of alternative population projections. Various scenarios based on alternative growth rates of national income are visualised and population is brought into picture only for calculating the per capita income.

^{27/} Ibid., p.2075.

^{28/} W. Brian Arthur and Geoffrey McNicoll, op.cit., pp.257-58.

^{29/} Ibid., p.254.

^{30/} Gunnar Myrdal, op.cit., Vol.III, Appendix 7, p.2075.

One such study is by F.A. Mhata^{31/}. For population projection, he has accepted M₂ series of Raghavachari's projections,^{32/} according to which India's population is expected to be 945 million in 2001. Then using 1973-74 data regarding the performance of Indian economy as the base, he has visualised four growth scenarios I, II, III and IV where gross domestic product increases at the annual compound rate of 3 per cent, 5 per cent, 7 per cent, & 9 per cent respectively during the period from 1973-74 to 2000-01. Then on the basis of the above given projected population figure, he has shown that the per capita income in the year 2000-01 under I, II, III, IV, will be respectively Rs.1087 (\$ 134), Rs.1793 (\$ 224), Rs.2980, (\$ 373), Rs.4922 (\$ 615). Finally using the findings of Hollis B. Chenery he has estimated, corresponding to each level of per capita income various indices for Indian economy e.g., gross national savings, gross and domestic investment as per cent of GNP, percentage of different sectors in GNP and percentage share of different actors in the total labour force. He has arrived at the conclusion that even with the most 'miraculously' high rate of economic growth of 9 per cent each year from 1973 to 2000 A.D., the per capita GDP of India will (at U.S. \$ 600) be still one of the lowest in the world and half the battle for rapid economic growth with social justice can be won with the right pattern of priorities.

Another study of similar type has been done by the Birla Institute of Scientific Research.^{33/} The study investigates the possibility of India achieving by the year 2001, a standard of living broadly commensurate with the present day average level of living of West European Countries and Japan. In concrete terms, the study explores the feasibility of raising the per capita GNP from Rs.670 (at 1970-71 prices) to different levels between Rs.20609 and Rs.33,181 (at 1970-71 prices) by the year 2001. For this purpose, the time series data of different elements of national economy has been projected by them along six different patterns viz., with GNP continuing to grow at an average annual compound rate of 3.1 per cent, 5 per cent, 10 per cent and three more rates corresponding to 10 per cent growth rate plus additional annual investments of Rs.2000 crores, 3000 crores and 4000 crores respectively being injected into the economy. Their main finding is that if India is to break the poverty barrier and achieve the targeted level of living by the year 2001, GNP must grow at an annual compound rate of at least 13.8 per cent. To achieve this, savings must grow at an annual rate of 17.4 per cent and investment at the annual rate of 17.1 per cent and the total consumption expenditure

31/ F.A. Mhata, Second India Studies, Economy, Bombay: The Macmillan Company of India Ltd., 1976.

32/ S. Raghavachari, 'Population Projections 1976-2001' in Ashish Bose, Asok Mitra, P.B. Desai, J.N. Sharma (Eds.), Population in India's Development 1947-2000, Delhi: Vikas Publishing House Pvt.Ltd., 1974, p.437.

33/ Birla Institute of Scientific Research, Economic Research Division, India 2001, New Delhi: Arnold Heinemann Publishers (India) Pvt. Ltd., 1976.

must not be permitted to exceed a growth rate of 12.8 per cent per annum. For population projections, they have adopted the assumptions of planning commission upto 1986 and have assumed that population will continue to grow at the rate of 13.68 per 1000 population during 1986-2001. This has given them the total population figure of 864.30 million which they observe is in consonance with the present population policy of the Government of India. On this basis they have worked out the estimates of per capita income and per capita consumption expenditure upto the year 2000-01 under alternative scenarios. As in the study of F.A. Mahta, they have also based the structural changes implicit in their alternative projections on the findings of Hollis B. Chenery. The study is based on a firm conviction that if a proper pattern of development is evolved, the common man in India can achieve, by the turn of this century, a fruitful level of living.

In both these studies the alternative patterns of growth in national income are visualised independently of the pattern of population growth. Population size comes into picture only as denominator while calculating per capita income and consumption. Of course, in the projection of sectoral changes, population plays an indirect role because sectoral changes are based on Chenery's findings regarding sectoral compositions corresponding to different levels of per capita income. Age distribution of the population is used only for calculating the total size of the labour force.

Before we conclude the review of research done so far on economic implications of population growth in India, it is necessary to mention another recent publication, of a different type viz., 'Population in India's Development 1947-2000'.^{34/} It is a collection of 36 papers, contributed by specialists in various disciplines, with a focus on the role of population in India's development in the period 1947-2000. It is not a technical exercise in futurology. The contributors were not furnished with any particular set of population projections and were not asked to comment on the implications of future of a given rate of population growth. Obviously it was not the purpose of the book to give quantitative assessment of the economic impact of a particular set of population projections for India. The aim was only to reflect the thinking on the part of specialists in different fields on the likely course of events by the year 2000. There are six papers in the part IV which deals specifically with 'Population and Economic Growth'. Out of these, only two give a quantitative assessment of the future implications of population growth in India in terms of two specific aspects i.e., food and employment. The remaining four either discuss the wellknown controversy about the relationship between population growth and economic development or review the past performance of Indian economy. Obviously, being a different type of publication with a different aim, this cannot be compared with the studies discussed so far in this review.

^{34/} Ashish Bose, P.B. Desai, Asok Mitra and J.N. Sharma (Eds.), Population in India's Development 1947-2000, Delhi: Vikas Publishing House Pvt. Ltd., 1974.

From the review of studies made so far, it can be seen that it is not easy to get an accurate quantitative assessment of the impact of alternative patterns of population growth on economic development. Economic development being a complex process, it is difficult to isolate the effect of population variables on economic development. The relationship between demographic and economic factors is not a direct one but is the result of complex chain of actions and reactions. Enke's investment model approach suffers from various limitations mentioned earlier and is logically weak mainly because of the arbitrary element in its discounting procedure and because of the fact that its conclusions are applicable not only to prevention of the birth of third or fourth child but even the first child. Growth model approach is logically superior in the sense that it takes into account the actions and reactions between various demographic and economic variables at the macro-level. Besides, no discounting procedure is involved. However, here also the main difficulty is that ultimately the whole thing boils down to the problem of practical applicability. Particularly in case of developing countries like India, the choice of a suitable model and the accurate estimation of parameters are the crucial problems. Especially if the required data of accurate quality are not available, one has to compromise at many points and automatically an element of arbitrariness is introduced and there is a possibility that the whole analysis will become a mathematical exercise, where slight variation in parameters is likely to change the findings substantially. On the other hand, if a growth model incorporating population variables is not used and only various scenarios based on alternative growth rates of national income are visualised as done in many studies mentioned so far, the full impact of population size, growth rate and age distribution under alternative assumptions is not brought out. Use of population figure is made only for calculating per capita income.

In view of these difficulties, analysis in Part II of the present study is attempted only with the limited objective of assessing the magnitude of difference between the efforts required under alternative population situations for attaining the identical targets of economic growth in India by the year 2000. No attempt is made here to construct a formal model for reasons explained earlier. However, in order to take into account the impact of not only population size but also age-distribution, the target of economic growth to be achieved is fixed not in terms of per capita income but per adult equivalent consumer unit. The three projected figures of population in the year 2000 A.D. under alternative assumptions are converted into adult equivalent consumer units by giving suitable weights to children, female adults and male adults. The required rate of increase in gross domestic product in order to achieve the identical target of increase in income per adult equivalent consumer unit is worked out for each case. Then the implications of alternative population projections in terms of the following crucial magnitudes - (where population size and age distribution are important decisive factors) - are worked out dependency burden, required rate of increase in food production if self sufficiency is to be achieved by the end of this century, total size of the labour force, sectoral distribution of the labour

force and the required increase in the value added per worker in the agricultural and non-agricultural sector if our modest aim is atleast not to widen further the present disparities between the two sectors in respect of productivity per worker. While attempting this analysis the long term perspective of the Planning Commission given in the Fifth Five Year Plan^{35/} is broadly kept in view. Lastly the other requirements, which are primarily population related (e.g. housing, education, health) can also be estimated for the three alternative population situations. It is felt that the implications thus worked out will give a fairly good idea of the quantitative difference in the strain that Indian economy will have to undergo in order to attain a given improvement in the standard of living under alternative population situations.

III

Economic Implications of Three Alternative Population Projections for India in 2000 A.D.

(1) Population Projections Adopted for the Present Study

The present study is based on high 2, medium 2 and low 1 projections of S. Raghavachari. One reason for adopting his projections is that they are projections from Registrar General's Office.^{36/} The reason for adopting this particular set from his projections is that projections of food requirements are available for this set,^{37/} and they have been used in this study for working out the food requirements taking into account the age distribution of the population in the three alternative situations.

According to these 3 projections - high 2, medium 2 and low 1 - India's population in the year 2000-01 will be 1032.1 million, 945.4 million and 830.6 million respectively. Here, it is worthwhile to see where this set stands in comparison with the other available projections for the year 2000. Among the other

^{35/} Particularly in case of the sectoral distribution of GDP. Planning Commission, Government of India, Fifth Five Year Plan 1974-79, pp.15-22.

^{36/} S. Raghavachari, op.cit., p.437, Table 3. These projections are also given in the National Population Monograph, The Population of India, 1974, World Population Year, CICRED Series, Ministry of Home Affairs, Office of the Registrar General and Census Commissioner, India, 1974, p.127.

^{37/} V.M. Rao, Food, Second India Studies, Delhi: The MacMillan Company of India Ltd., 1975, p.18, Table 5, and p.50, Table 15.

available projections those made by World Bank^{38/} and Thomas Frejka^{39/} are of the same type in the sense that in both the cases, projection of the Indian population constitutes one part of an overall project concerned with population growth in many national and regional populations. Besides, both were undertaken prior to the availability of the 1971 census results. So they are not included in this comparison. Among the remaining, Ambannavar's^{40/} projections (1035,999 and 926 million) and operations research group's^{41/} projection under mortality I alternative (1033,999 and 972 million) are on the higher side as compared to the set we have adopted. The medium projection in our set is comparable to ORG's medium projection under mortality alternative II (942 million) but their high estimate (973 million) is lower than that in Raghavachari's H₂ estimate while their low estimate (917 million) is higher than the low 1 estimate in Raghavachari's set. If compared with the 6 alternative sets of projections given by Robert Cassen and Tom Dyson^{42/} we find that the set adopted for the present study does not come nearer to any single set among those six sets. The low 1 projection of population in the set adopted by us is lower than the low projections given by Ambannavar, O.R.G., World Bank (and also Cassen-Dyson except in the sixth set).

The assumptions on which Raghavachari's High 2, Medium 2 and Low 1 sets are based are as follows:

1) Fertility Assumption - During the period between 1966-70 and 1996-2000 general fertility rate is assumed to decline from 185 per 1000 to 136 under high 2 alternative, while under medium 2 alternative it will decline to 110 per 1000 and under low 1 alternative it will decline to 86 per 1000. In terms of birth rate, the decline will be from 39.4 per 1000 in 1966-70 to 30.4 per 1000 under high 2 alternative, to 25.7 per 1000 under medium 2 alternative and 20.9 per 1000 under low 1 alternative.

^{38/} K.C. Zachariah and R. Guca, Population Projections for Bank Member Countries, 1970-2000. Population and Human Resources Division, Development Economics Department, IBRD, 1972.

^{39/} Thomas Frejka, Reference Tables to the Future Population Growth. New York: The Population Council, 197, pp.384-393.

^{40/} J.P. Ambannavar, Population, Second India Study, Delhi: MacMillan and Company, p.54, Table 2.11.

^{41/} As quoted in Robert Cassen and Tom Dyson, "New Population Projections for India", Population and Development Review, Vol.2, No.1, March 1976, p.105, Table 3.

^{42/} Ibid., p.114, Table 7.

2) Mortality assumption is common to all the three situations i.e., expectation of life for males will increase from 48.52 years in 1966-70 to 60.52 years in 1966-2000 and for females it will increase from 46.55 years in 1966-70 to 61.30 in 1966-2000. Death rate which was 16.9 in 1966-70 will be around 9.7 during 1996-2000.

International migration being of no significance in India in recent years and with prospects of large scale migration slender under present conditions, only the future trends regarding fertility and mortality were taken into account in these projections.

(ii) Implications in Terms of Dependency Burden

From the age distributions of the respective populations given in Raghavachari's projections, the dependency ratios

(i.e., $\frac{P_{0-14} + P_{60+}}{P_{15-59}} \times 100$) were worked out. It was found that

there will be 74.27 dependents per 100 persons of the working age in High₂ projection in the year 2000 while the corresponding figures for medium and low projections will be 65.02 and 55.19 respectively. There will not be much difference in the three population situations, as far as the old age dependency (i.e. $\frac{P_{60+}}{P_{15-59}} \times 100$) is

concerned. In all the three cases there will be about 12-13 persons above 60 per 100 persons of the working age group. The difference, however, will be mainly prominent in case of young dependency burden (i.e. $\frac{P_{0-14}}{P_{15-59}} \times 100$) which was found to be 62.25,

52.48 and 42.52 per 100 persons in working age group under H₂, M₂ and L₁ situations respectively in the year 2000. This will make a lot of difference because it not only means that whatever is produced will be shared with comparatively larger number of dependents but it also means that the pattern of investment will be affected because the larger young dependency burden under High population situation means more investment in schools, hospitals etc. Of course, it is an investment in human capital but it will not have any immediate tangible effect on growth performance as this type of investment has a long gestation period.

(iii) Adult Equivalent Consumer Units Corresponding to Three Population Projections

As explained earlier, in order to bring out fully the effect of not only the size but also the age sex distribution of population under alternative projections, the High 2, Medium 2 and Low 1 population figures in the year 2000 were converted into adult equivalent consumer units (A.E.C.U.) by giving the weights 1, 0.9 and 0.5 respectively for adult males, adult females and children below age 10. The weights given are the same as used in Coale and Hoover study. However, separate figures for males and females below age 10 were available only for medium projection while for high and low projections, the age distribution by only three major groups (0-14, 15-59, 60+) was available for males and

females. Children below age 10 for high and low projections were estimated from this information by graphical interpolation.

India's population will consist of 860.12 million A.E.C.U. under high 2 population projection, 803.56 million A.E.C.U.s under medium 2 population projection and only 727.49 million A.E.C.U.s under low 1 population projection. By applying the percentage age distribution of 1971 census population, the age distribution of 1973-74 population was worked out. By giving the same weights as above, it was converted into A.E.C.U.s. In 1973-74, India's population consisted of 470.64 million A.E.C.U.s. This shows that in 27 years (from 1973-74 to 2000-01) number of A.E.C.U.s. is expected to increase by 82.8 per cent under H_2 situation, by 70.7 per cent M_2 situation but it will increase by only 54.6 per cent, if population growth follows the L_1 pattern. This difference has very far reaching implications in terms of the efforts required to attain a given target regarding the improvement in standard of living under the three alternative situations.

(iv) Implications In Terms of Relative Efforts required to Achieve the Identical Targets of Economic Growth

In 1973-74 per capita gross domestic product of India was Rs.783 (at 1972-73 prices). This was equivalent to GDP of Rs.957 per A.E.C.U. If our modest aim is to reach in the year 2000 the target of GDP per A.E.C.U., which is two and half times the present GDP per A.E.C.U. i.e., to reach the target per A.E.C.U. GDP of Rs.2392.5 (at 1972-73 prices), how much effort would be required under H_2 , M_2 and L_1 patterns of population growth? (All the figures of GDP, Per Capita Income etc., given in the discussion that follows are at 1972-73 prices.)

For reaching the above target, we have to reach the GDP of Rs.205783.71 crores under H_2 situation, of Rs.192251.73 crores under M_2 situation and of Rs.174051.98 crores under L_1 situation in the year 2000. GDP in 1973-74 was Rs.45050 crores. This implies that the required annual compound growth rate of GDP for the next 27 years will have to be 5.8 per cent under H_2 situation, 5.5 per cent under M_2 situation and 5.1 per cent under L_1 situation.

The Fifth Five Year Plan in its draft, had envisaged an average annual growth rate of 5.5 per cent^{43/} in GDP but in the final plan the rate envisaged is less than this i.e., 4.37 per cent.^{44/}

^{43/} Planning Commission, Government of India, Draft Fifth Five Year Plan 1974-79, Vol.1, p.27.

^{44/} Planning Commission, Government of India, Fifth Five Year Plan 1974-79, p.15.

It was emphasised in the draft plan that a higher rate of growth though very desirable from the standpoint of early removal of poverty and building up of the growth potential of the economy, has not been considered feasible. "Even the 5.5 per cent rate will call for besides much greater efficiency in planning and implementation, hard decisions, rigorous discipline and considerable sacrifice". So it seems that in the revised final version, the rate of 4.37 per cent was adopted as more realistic.

Before visualising the feasible rate in the 27 years after 1973 if we look at the past performance of the economy during the last 22 years of planning before 1973, it can be observed that Indian economy experienced, on an average the compound growth rate of 3 per cent annum.^{45/} Even in the later part of these two decades, there was nothing like spectacular improvement. During the period from 1961-62 to 1973-74 GDP at 1960-61 prices increased at the annual compound growth rate of 3.4 per cent.^{46/} Besides, it is not a picture of steady, smooth growth. Not only in the initial years of planning in India, but even in recent years, there are fluctuations e.g. against the projected overall rate of growth of 5.7 per cent per annum during the fourth plan period, the economy experienced a rate of growth of 3.2 per cent in 1969-70, 4.2 per cent in 1970-71, 1.7 per cent in 1971-72 and 0.6 per cent in 1972-73.^{47/} In such circumstances, it will be unrealistic to maintain continuously and consistently during the next two decades the rate as high as 5.8 per cent and 5.5 per cent required by the H_2 and M_2 situations. As pointed out in the draft of the fifth plan, in the past, high aims and low performance have often involved the economy in crises of disproportion.^{48/} In view of these facts and past fluctuations, the rate of 5.1 per cent for the next 27 years, required by the L_1 situation appears to be feasible and realistic.

On the contrary, if with great effort, Indian economy is able to achieve a growth rate 5.8 per cent per annum, under low population projection, consistently during the next 27 years, the economy will be able to achieve GDP per A.E.C.U., which is three times the present figure i.e., GDP per A.E.C.U. of Rs.2871 in the year 2000. However, for reaching this target, with H_2 and M_2 population situations, the economy will require an annual compound rate of growth of GDP of 6.2 and 6.5 per cent respectively consistently

^{45/} F.A. Mhata, op.cit., p.74.

^{46/} Government of India, Planning Commission, Fifth Five Year Plan 1974-79, p.15, p.98. Source: C.S.O. estimates.

^{47/} Planning Commission, Government of India, Draft Fifth Five Year Plan, 1974-79, Vol.1, p.26.

^{48/} Ibid., p.27.

for the next 27 years. These rates are even higher than the rates envisaged in the final version of the fifth plan i.e., 4.37 per cent for the fifth plan, 5.65 per cent for the sixth plan and 6 per cent for the Seventh Plan. Thus, the relative strain that Indian economy will have to undergo under H_2 situation as compared to L_1 situation is obvious from these rates.

(v) Per Capita G.D.P.

The same target in terms of income per A.E.C.U. implies different per capita income under different population projections, because the alternative situations of population growth consist of different numbers of adult equivalent consumer units depending on the assumptions regarding fertility leading to different age distributions. The target of reaching the GDP per A.E.C.U. of Rs.2392.5 at 1972-73 prices (i.e., 2.5 times the 1973-74 figure) in the year 2000, will give the per capita income of about Rs.1994 in H_2 situation, that of Rs.2034 under M_2 situation and that of Rs.2096 under L_1 situation. In 1973-74 per capita GDP was Rs.783. It means that if we succeed in reaching in the year 2000, the above mentioned target, our per capita income will increase at the compound rate of 3.5 per cent per annum for the next 27 years in H_2 situation, at the rate of 3.6 per cent in M_2 situation and at the rate of 3.7 per cent in case of L_1 situation. Thus it is clear that if we compare the situation under high and low population projection, it is possible to achieve higher rate of growth of per capita GDP in L_1 situation (3.7 per cent as compared to 3.5 per cent) inspite of the lower rate of growth of aggregate GDP (5.1 per cent as compared to 5.8 per cent) required to achieve the given target.

At present, India is among the countries with per capita GDP less than \$ 100 along with other less developed countries like Bangladesh, Nepal, Indonesia, Burma. If we reach the above mentioned target, by the year 2000, India will be in the position where countries like Republic of Korea, Iran, Malaysia are today i.e., with per capita GDP between \$ 200- 399.

(vi) Contribution of Agricultural Sector to G.D.P.

In 1973-74, the sectoral composition of GDP at factor cost indicated that agricultural sector contributed 50.78 per cent of the total GDP. The change in the sectoral composition in the perspective period (1973-1989), as visualised by the Planning Commission in the Fifth Plan⁴⁹ indicates that the percentage contribution of agricultural sector to GDP is expected to decline to 48.15 per cent in 1978-79, to 44.40 per cent in 1983-84 and to 40.25 per cent in 1988-89. If this trend is extrapolated it shows that the expected percentage contribution of agricultural sector in the year 2000 will be around 30 per cent.

49/ Planning Commission, Government of India, Fifth Five Year Plan 1974-79, p.17.

under A.D. This implies that if the target mentioned earlier (in 2000/GDP per A.E.C.U. to be 2.5 times the figure in 1973-74) is achieved, and if the trend regarding sectoral contribution as visualised by the planning commission also materialises, then the contribution of agricultural sector to GDP in the year 2000 will be Rs.617351.1 million/H₂ situation. It will be Rs.576755.2 under M₂ situation and Rs.522155.9 under L₁ situation. This implies that the annual compound growth rates for agricultural income in the next 27 years will be 4.1 per cent, 3.9 per cent and 3.5 per cent under H₂, M₂ and L₁ situations respectively. The rate of growth of value added by the agricultural sector, as visualised by the Planning Commission is 3.3 per cent for the period 1973-74 to 1978-79, 4.0 per cent for the period 1978-79 to 1983-84 and 4.02 per cent for the period 1983-84 to 1988-89. The rate required under low population projection (3.5 per cent) obviously seems to be quite feasible. The rate required under H₂ and M₂ situations are also not much higher than the rates visualised by the Planning Commission. However, whether Indian economy will be able to maintain the higher rates in the agricultural sector continuously and consistently for the next 27 years, will depend to some extent at least, on the vagaries of monsoon.

(vii) Implications In Terms of Self-Sufficiency
In Foodgrains

Self-sufficiency in foodgrains is a very crucial factor in the long term economic development of a country like India, with a large and rapidly growing population. If the demand for food is not met by the domestic production, a large amount of our scarce foreign exchange, which could otherwise be utilised for importing the machinery and technical know-how for industrial development, would have to be spent on food imports. Besides, it is also likely to affect the allocation of scarce resources of the country because due to larger food requirements, a relatively large share of investment would be required by the agricultural sector, thus limiting the expansion of non-agricultural sector to some extent. This might also come in the way of creating additional employment opportunities in the non-agricultural sector. The objective of increasing the domestic production of foodgrains assumes more importance now particularly in the context of the two important objectives viz., removal of poverty and self-reliance.

This is one of the areas where alternative patterns of future population growth have far reaching implications. The total amount of foodgrains required in future to meet domestic needs will depend on various factors such as the size and age distribution of the population, changes in the income distribution, income elasticity of demand for food and the likely changes in the pattern of consumption. On the other hand, the total foodgrains requirement, in turn, will partly determine the labour force required in agricultural sector and size of labour force that will have to be absorbed in the non-agricultural sector.

Total production of foodgrains in 1973-74 was 104.7 million tonnes. During the period of nearly two decades (1949-50 to 1970-71), index of foodgrains production increased by 83 points.^{50/} The average rate of growth of foodgrains production during the period 1949-1960 was 3.5 per cent per annum and during the period 1960-1972 it was 2.6 per cent per annum and the average rate of growth of foodgrains production during the total period from 1949-50 to 1971-72 was 2.8 per cent per annum.^{51/} The per capita availability of foodgrains increased from 395.1 grammes per day in 1950-51 to 466.9 grammes per day in 1970-71.^{52/}

There have been various attempts to estimate the foodgrains requirements of Indian population in the year 2000. They vary according to (a) the particular population projection and (b) the criterion regarding the daily per capita requirement of food adopted as the basis for the projections of food requirements.

On the basis of the criterion of 485 grammes per day per adult male, Vyas^{53/} has estimated the foodgrains requirements in the year 2000 to be 169 million tonnes for the higher population projection (i.e., 956 million people estimated by Zachariah and Guca) and 153 million tonnes for the lower population projection (i.e., 864 million, National Commission on Agriculture). On the basis of the per capita daily consumption of 470 grammes (the maximum that has been possible in the years of plenty during the period 1956-73) - Bhatia^{54/} has estimated foodgrains requirements in the year 2000 to be 159.9 million tonnes for the lower estimate of population (i.e., 803 million) and 167.8 million tonnes for the

50/ Directorate of Economics and Statistics, Bulletin of Food Statistics, 22nd Issue, Ministry of Agriculture, Government of India, 1972.

51/ V.M. Rao, Food, Second India Studies, Bombay: The MacMillan Company of India Ltd., 1975, p.60, Table 19.

52/ Directorate of Economics and Statistics, op.cit.,

53/ V.S. Vyas, "Land Use" in Ashish Bose et al., (Eds.) Population in India's Development, Delhi: Vikas Publishing House Ltd., p.176.

54/ B.M. Bhatia, "Food, Famine and Population" in Ashish Bose et.al., (Eds.), Population in India's Development, Delhi: Vikas Publishing House Ltd., p.228.

higher estimate of population (850 million). Rao^{55/} has given four sets of estimates of foodgrains requirements in the year 2000, each one for the three alternative population situations viz., H_2 , M_2 and L_1 from Raghavachari's set (i.e., 1032.1 million, 945.4 million and 830.6 million respectively). The criteria regarding food consumption adopted by him for the four sets are based on the study of the present consumption pattern of the four different classes - lower poor, poor, middle and rich in the rural and urban areas of India. His minimum estimates for the three alternative population situations are based on the choice of the present middle class pattern of consumption as the norm and on the assumption that in the year 2000 everybody in the rural and urban areas will conform to this norm. According to this criterion, the foodgrains requirements in the year 2000 will be 184 million tonnes, 208 million tonnes and 228 million tonnes under L_1 , M_2 and H_2 population situations. His other three sets give the demand based requirements. They are based on the alternative assumptions regarding the change in the income distribution upto the year 2000. The maximum estimates of foodgrains requirements given by his A_3 set for the three population situations (L_2 , M_2 and H_2) are 210 million tonnes, 239 million tonnes and 261 million respectively. His A_3 set is based on the assumption, that in the year 2000, there will be no population in the lower poor class and the percentage of population in the poor, middle and rich classes will be 20, 40 and 40 respectively.

It can be clearly seen that among the available estimates of foodgrains requirements in the year 2000, estimates given by Rao are the only estimates where the differences in consumption pattern of various classes and the likely changes in the income distribution are taken into account. However, in the present study it was felt necessary to take into account one additional factor i.e., the difference in foodgrains requirements caused by the different age distribution under alternative population situations. For this purpose, norm-based and demand-based foodgrains requirements per adult equivalent consumer unit in the year 2000, were worked out from Rao's estimates for the medium population. It shows that according to the normbased criterion of Rao, in the year 2000, the daily requirement will be 605 grammes per person but in terms of A.E.C.U. it means daily 710 grammes per A.E.C.U. According to his A_3 set (maximum demand) of demand-based requirements, in the year 2000, the daily requirement will be 693 grammes but in terms of A.E.C.U. it ^{per} means 814 grammes per A.E.C.U. These two criteria when applied to the number of A.E.C.U.s. under our H_2 , M_2 and L_1 situations, the following results are obtained.

A) If in the year 2000, everybody in the rural and urban area conforms to the norm of the present middle class consumption pattern of foodgrains (i.e. 710 grammes per day per A.E.C.U.), the total requirement of foodgrains production for self-sufficiency will be 223 million tonnes under H_2 population situation, 208 million tonnes under M_2 situation and 188 million tonnes under L_1 situation.

B) Alternatively, if we take into account the increase in the demand due to change in the income distribution, according to which in the year 2000, there will be nobody in the lower poor class and the percentage of population in the poor, middle and rich classes will be 40, 40 and 20 respectively then on an average we will require 814 grammes per A.E.C.U. It means that India will be self-sufficient in food, if it is able to produce 255 million tonnes under H_2 population situation, 239 million tonnes under M_2 population situation and 216 million tonnes under L_1 population situation.

C) The long term perspective given by Planning Commission in the fifth five year plan, shows that the plan targets will raise the per capita availability of foodgrains from 520 grammes per day in 1973-74 to 620 grammes per day in 1978-79 and 663 grammes per day in 1985-86.^{56/} If this trend is extrapolated, it shows that the expected per capita daily requirement in the year 2000 will be 735 grammes per person. When applied to the three alternative population situations it shows that by this criterion India can be self-sufficient in foodgrains production by the year 2000, only if it produces 277 million tonnes under H_2 situation, 253 million tonnes under M_2 situation and 223 million tonnes under L_1 situation. The estimates are higher than even the demand-based estimates given above. The difference in the age distributions of the three population situations is not taken into account here; the criterion adopted is of per capita requirements not per A.E.C.U. requirements.

Out of these three sets of the estimates of foodgrains requirements, if our aim is to meet fully the requirements according to the set A (norm-based), then we will have to increase our domestic production for the next 27 years at the annual compound rate of 2.9 per cent under H_2 situation, 2.7 per cent under M_2 situation and only 2.2 per cent under L_1 situation. For the B set, the corresponding rates are 3.3 per cent, 3.1 per cent and 2.7 per cent. On the other hand, if the perspective given by the planning commission is to be followed (Set C), the corresponding rates are 3.7 per cent, 3.3 per cent and 2.9 per cent under H_2 , M_2 , L_1 situations respectively. As mentioned earlier, the annual rate of growth of foodgrains production was 3.3 per cent during 1949-60 and it was even less than that during 1960-72 i.e., 2.6 per cent. Even after the onset of green revolution, our history of foodgrains production is full of ups and downs. Besides, green revolution has been successful only in certain parts of India like Punjab. Major breakthrough has not been achieved in respect of crops like rice. In view of these facts, there is no guarantee that we shall be able to maintain continuously for the next 27 years (from 1973-74) the rate of 3.7 per cent or higher

56/ K.C. Majumdar, "Planning Performance and Perspective" in Ashish Bose et al. (Eds.), Population In India's Development, Delhi: Vikas Publishing Co., p.195.

than that. Achieving the higher rate of increase in food production will depend not only on the increasing use of fertilisers and more irrigation but also on a large number of institutional changes. The latter is likely to be a slow process. In this situation, the required rate under L_1 situation even for the maximum requirement set (C set) seems to be quite within the reach, the rate for M_2 situation (3.3 per cent) seems to be feasible with some more strain but if we have to cope up with the H_2 population situation, then meeting the requirements according to the perspective planning targets (C set), seems to be quite difficult.

An attempt was also made to examine what will be the percentage contribution of foodgrains sector to the total agricultural income, (GDP in the agricultural sector as given in Section VI). If the foodgrains requirements given in set A (Norm-based) are met by the domestic production, then at 1972-73 prices, foodgrains sector will contribute about 37-38 per cent of total agricultural income in the year 2000. If the requirements given in B set (Demand-based) are met by the domestic production, then the corresponding percentage will be about 43. However, if the target requirements according to this planning commissions' perspective are met, then the corresponding percentage in the year 2000 at 1972-73 prices will be about 46 per cent. The corresponding percentage in 1973-74 was 42.4 per cent.^{57/}

(viii) Size of the Labour Force

One common argument that is usually made is that if there are more mouths to be fed under the situation of a rapidly growing population, more hands are also available for contribution to the production. If the dependency load is higher in case of large and rapidly growing population, the labour force size is bigger comparatively. Though there is some truth in this argument it is necessary to examine the relative magnitude of this difference and its effect on our efforts for growth in terms of required increase in the value added per worker for achieving the given target.

The future size and growth of the labour force will depend upon the size and age distribution of the population and the likely change in the age specific labour force participation rates for males and females. Size and age-distribution of the population will depend upon our alternative assumptions regarding the future course of fertility and mortality. The likely changes in the labour force participation rates will depend upon various socio-economic changes such as spread of education, increasing school enrolment, change in the status of women, effect of growing prosperity on women's attitude to work etc. These changes will have more effect on the labour force participation in early age-groups and the female participation in the labour force. Besides, these changes will have differential impact on the participation rates in agricultural and non-agricultural sector,

^{57/} Calculated from figures in the Annexure III, Draft Fifth Five Year Plan 1974-79, Vol.I, p.36.

and in rural and urban areas. It is very difficult to estimate precisely the future labour-force participation rates taking into account all these complex changes. However, it is not our purpose to estimate precisely the future size of the labour force but we just want to get a fairly good idea regarding the difference in the size of labour force under alternative population situations, if the identical assumptions regarding the likely changes in the labour-force participation rates are made.

In the long term perspective given by the planning commission, it is assumed that child labour will be abolished at the earliest.^{58/} So it is assumed that in the year 2000, the labour force participation rate for the age-group 0-14 will be zero. The age-distribution by five-year age-groups is available only for the M_2 population projection and for the other two i.e. H_2 and L_1 , only the distribution by broad age-groups (0-14, 15-59, 60+) is available (for males and females separately). For the two age-groups 15-59 and 60+, the participation rates projected by Ambannavar^{59/} were borrowed. Ambannavar's rates implied the assumption that male labour force participation rate for the age-groups 15-59, will decline from 89.94 per cent in 1971 to 85.41 per cent in the year 2000 and that for the age-group 60+ will decline from 74.16 per cent to 64.79 per cent in the same period. Similarly, for females, his rates implied the assumption that the participation rate for the age-group 15-59 will decline from 44.20 per cent in 1971 to 41.50 in the year 2000 and that for the age-group 60+ will decline from 21.74 per cent in 1971 to 19.22 per cent in the year 2000.

The estimated size of the labour force in the year 2000, on the basis of the above-given labour force participation rates, will be 409.64 million under H_2 population situation, 393.44 million under M_2 situation and 371.69 million under L_1 situation. It implies that the percentage of total population participating in the economic activity will be 39.6 per cent under H_2 situation, 41.6 per cent under M_2 situation and 44.7 per cent under L_1 situation. This clearly shows that though the absolute size of the labour force will be comparatively larger under rapidly growing population, the relative advantage will be more in case of slow growth of population due to relatively larger percentage of population in the labour force.

Our estimate of the size of labour force for M_2 situation (393.44 million) is quite close to the estimate given by J.N. Sinha^{60/}

^{58/} Planning Commission, Draft Fifth Five Year Plan 1974-79, Vol.1 p-3.

^{59/} J.P. Ambannavar, Population Second India Studies, Bombay: The Macmillan Company of India Ltd., 1975, p.89. (The rates for the age-group 15-59 in 1971 and 2000 were worked out on the basis of rates given by him on page 89 and age-distribution given on pages 111 and 112.)

^{60/} J.N. Sinha, 'Population and Employment - A Long View' in Ashish Bose et.al., (eds.), Population in India's Development, Delhi: Vikas Publishing House Ltd., 1974, p.252.

(399 million) for the same population situation. The overall participation rates (labour force excluding the workers in the age group 0-14, as percentage of the total population) given in the labour force projections by the planning commission^{61/} in the Draft Fifth Five Year Plan are 31.1 per cent, 32.6 per cent, 35.2 per cent for the years 1971, 1976 and 1986 respectively. This trend by graphical extrapolation gives the participation rate around 42 per cent in the year 2000. The participation rate shown by our labour force estimate for L_1 situation (44.7) is on the higher side, but according to J.N. Sinha and other experts, 1971 participation rate (31.1 per cent) based on census data and accepted by the planning commission for projections was a gross underestimate of the real situation.^{62/} In view of this fact, the higher percentage of population in the labour force under L_1 situation, does not seem to be unrealistic.

(ix) Value Added Per Worker

On the basis of the above estimates of labour force it will be worthwhile to see how much on an average a worker will have to contribute under alternative population situations, if the given target of reaching the GDP per A.E.C.U. of two and half times the present GDP per A.E.C.U. is to be

achieved in the year 2000. The same target can be achieved, if the value added per worker in the year 2000 will be about Rs.5023 under H_2 situation, about Rs.4886 under M_2 situation and about Rs.4683 under L_1 situation (all at 1972-73 prices). The value added per worker (or productivity) was Rs.2503 in 1973-74.^{63/} This implies that the target of increase in income per A.E.C.U. which will require 101 per cent increase in the productivity per worker under H_2 situation and 95 per cent increase in the productivity per worker in M_2 situation, can be achieved by only 87 per cent increase in the productivity per worker in the next 27 years.

(x) Sectoral Distribution of Labour Force

Almost every country undergoing the process of economic development and industrialisation, also experiences the process of transfer of surplus labour force from agricultural sector to non-agricultural sector. How rapidly this transfer will take place depends on many factors such as the strategy of development, the rapidity with which the productivity (value added) per worker increases in the agricultural sector, the relative income difference in the two sectors, the extent to which more and more job opportunities are created

^{61/} Planning Commission, Government of India, Draft Fifth Five Year Plan, 1974-79, Vol.1, p.3.

^{62/} J.N. Sinha, op.cit., p.253.

^{63/} F.A. Mhata, op.cit., p.111.

in the non-agricultural sector. Generally, the productivity in the non-agricultural sector increases faster as compared to the productivity in the agricultural sector.

In 1973-74, the ratio between the value added per worker in the agricultural sector to that in the non-agricultural sector was 1:3.085.^{64/} 1) Even if our modest aim is to maintain this ratio (at 1972-73 prices) and not allow to widen this disparity further, and (2) if we have to achieve the target of GDP per A.E.C.U. in the year 2000 mentioned earlier and (3) if at that time the contribution of agricultural sector to the total GDP is going to be 30 per cent as discussed earlier then the labour force required in the agricultural sector^{65/} will be 233.79 million under the H₂ situation, 224.55 million under M₂ situation and 212.13 million under L₁ situation. The magnitude of labour force that will be absorbed in the non-agricultural sector will be 175.85 million, 168.89 million and 159.56 million under H₂, M₂ and L₁ situations respectively. This implies that about 57 per cent of the labour force will be required in the agricultural sector. Thus if the present ratio between the value added per worker in these two sectors is to be maintained, then we will be able to reduce the percentage of labour force in the agricultural sector from the present one around 70 per cent to 57 per cent. Out of the total increase in the labour force, from 1973 to 2000, under H₂, M₂ and L₁ situations, only 45.2 per cent, 44.3 per cent and 42.8 per cent, respectively will be required in agriculture. Thus the jobs will have to be created in the next 27 years in the non-agricultural sector for about 126 million under H₂ situation, for about 119 million under M₂ situation and for about 109 million under L₁ situation.

(xi) Required Increase In The Productivity Per Worker

If the distribution of labour force between the agricultural and non-agricultural sector in the year 2000 is as described above, then in order to achieve the given targets regarding GDP and the contribution of agricultural sector, the productivity per worker in the agricultural

64/ F.A. Mehta, *op.cit.*, Productivity per worker in the agricultural sector was Rs.1585 and that in the non-agricultural sector was Rs.4889 (Based on the figures in Table 7.3, p.109.)

$$\frac{65/ \text{Agricultural Income}}{\text{Agricultural Labour Force}} \cdot (3.085) = \frac{\text{Non-agricultural Income}}{\text{Non-agricultural Labour Force}}$$

$$\text{i.e. } 3.085 \frac{AI}{AL} = \frac{NAL}{NAL} \cdot \frac{AL}{3.085 AI} = \frac{L - AL}{I - AI} \quad AL(I - AI) = 3.085 AI(L - AL)$$

$$\therefore AL = \frac{3.085 L \cdot AI}{I + 2.085 AI}$$

sector will have to be Rs.2640.62 under H₂ situation, Rs.2568.49 under M₂ situation and Rs.2461.49 under L₁ situation. The productivity per worker in the agricultural sector in 1973-74 was Rs.1585 as mentioned earlier. This implies that in order to achieve the same target of the increase in the GDP per A.E.C.U. upto the year 2000, we will have to increase the productivity per worker in the agricultural sector by 66.6 per cent under H₂ situation, by 62.0 per cent under M₂ situation but only by 55.3 per cent under L₁ situation. The corresponding required change in productivity or value added per worker in the non-agricultural sector will be 82.5 per cent, 77.5 per cent and 70.1 per cent respectively under H₂, M₂ and L₁ situations. The change in productivity at a greater speed in the non-agricultural sector is expected because usually the productivity in the agricultural sector increases more slowly due to the unorganised nature of the sector and the institutional changes required for important improvements.

(xi) Other Implications

Similarly other implications of alternative population situations in terms of the required savings, required health facilities etc. can be examined. The trend regarding saving ratio given in the long term perspective in the fifth five year (12.2 per cent, 15.7 per cent, 19.0 per cent and 20.0 per cent respectively in 1973-74, 78-79, 83-84, 85-86) if extrapolated, shows that the expected saving ratio in the year 2000 will be about 25 per cent. This implies that the per capita saving required in order to achieve the target regarding GDP per A.E.C.U. in the year 2000, will be about Rs.498 in H₂ situation, about Rs.508 in M₂ situation and about Rs.523 in L₁ situation. Though it means the larger amount of savings in L₁ situation, savings as percentage of per capita GDP will be the same as H₂ or M₂ situation and it should be easier under L₁ situation because of the lower dependency burden as given in Section II. In a country like India, where large portion of the savings comes from the household sector, dependency burden is expected to make some difference regarding the capacity to save.

In other respects, where the requirements are directly related to population, the difference caused due to alternative population situations can be easily seen e.g., if health needs are calculated on the basis of norms laid down by the Midalhar Committee (Health Survey and Planning Committee),^{66/} the required number of doctors in the year 2000 will be 2.9 lakh under H₂ situation, 2.7 lakh under M₂ situation and 2.4 lakh under L₁ situation. The requirements regarding hospital beds will be 10.3 lakh beds, 9.4 lakh beds and 8.3 lakh beds under the three respective population situations.

In short, the analysis made so far shows that in order to achieve the same improvement in the standard of living upto the year 2000, comparatively much larger effort would be required under the

^{66/} One doctor for a population of 3500 and one hospital bed for a population of 1000.

situation of rapid population growth, inspite of the larger size of the labour force that it would make available.

IV

Summary and Conclustions

The first part consists of a critical review of major studies done so far with the objective of assessing the impact of alternative trends of future population growth in India on the economic development. Various studies with growth model approach or investment model approach have been reviewed briefly in this part.

In the second part an attempt is made to examine how much extra effort will be required on the part of Indian economy, under the situation of rapid population growth as compared to slow population growth, in order to achieve a given improvement in the standard of living from 1973-74 to the year 2000-01. For this purpose, High 2, Medium 2, and Low 1 sets from Raghavachari's population projections were adopted as the basis for further analysis (High 2 - 1032.1 million, Million 2 - 945.4 million and Low 1 - 830.6 million in the year 2000).

1) The dependency ratios in the year 2000 will be 74.27, 65.02 and 55.19 under situations H_2 , M_2 and L_1 respectively. Main difference will be due to young dependency ratio which will be 62.25 under H_2 , 52.48 under M_2 and 42.52 under L_1 .

2) In order to bring into picture the effect of not only size but age distribution of the population, the target was fixed not in terms of per capita GDP but in terms of increase in the GDP per adult equivalent consumer unit. Population was converted into adult equivalent consumer units by giving weights 1, .9 and .5 to adult males, adult females and children below 10 respectively. Population will consist of 860.12 adult equivalent consumer units in 2000 A.D. under H_2 situation while under M_2 and L_1 situation the number will be 803.56 units and 727.49 units.

3) GDP per adult equivalent consumer unit was Rs.957 in 1973-74. In order to increase it by 2.5 times (i.e. to reach GDP per A.E.C.U. of Rs.2392.5 in the year 2000), total GDP should increase at the annual compound rate of 5.8 per cent for the next 27 years under H_2 situation, For reaching the same target of GDP per A.E.C.U., GDP should increase at the annual compound rate of 5.5 per cent under M_2 situation and at the rate of 5.1 per cent under L_1 situation.

4) Still, it will give higher per capita GDP in the year 2000 under L_1 situation (Rs.2096) as compared to H_2 situation (Rs.1994) i.e., per capita income of Rs.783 in 1973-74 will increase at the annual compound rate of 3.5 per cent in H_2 situation while it will increase at the rate of 3.7 per cent L_1 situation, if the above given rates of increase in GDP are achieved.

- 5) If the trend regarding sectoral distribution of GDP given in long term perspective in the fifth plan is extrapolated, contribution of agricultural sector to GDP is expected to be about 30 per cent in the year 2000. This means that if the above target is reached, agricultural income will increase at the rate of 4.1 per cent under H₂ situation and at the rate of 3.9 per cent and 3.5 per cent under M₂ and L₁ situation respectively.
- 6) Total labour force under H₂, M₂ and L₁ is expected to be 409.64 million, 393.44 million and 371.69 million respectively (on the assumptions that (a) there will be no child labour by the year 2000, as planning commission has visualised, (b) labour force participation rates for age-groups 15-59 and 60+ will be 85.41 per cent and 64.79 per cent respectively for males and 41.50 per cent and 19.22 per cent respectively for females (borrowed from Ambannavar's projections) in the year 2000. Though the absolute size of the labour force will be larger under H₂ situation, labour force as percentage of total population will be larger under L₁ situation (44.7 under L₁ while 39.6 under H₂).
- 7) In order to reach the same target of GDP per A.E.C.U. as given above, value added per worker will have to be increased by 100.7 per cent under H₂ situation, by 95 per cent under M₂ situation and by only 87 per cent under L₁ situation.
- 8) The present ratio between the value added per worker in agricultural sector and that in non-agricultural sector is 1:3.085. Even if our modest aim is just to maintain this ratio and not to further widen these disparities, and if the above mentioned targets regarding GDP and agricultural sector are to be achieved, then about 57 per cent of labour force will be in the agricultural sector i.e., the labour force required in agricultural sector under H₂, M₂ and L₁ situations will be 233.79 million, 224.55 million and 212.13 million respectively in the year 2000. This means that the labour force which will have to be absorbed in the non-agricultural sector will be 175.85 million, 168.89 million and 159.56 million under H₂, M₂ and L₁ respectively.
ion
- 9) These implications about the sectoral distribution of GDP and labour force given above mean that value added per worker in the agricultural sector will have to be increased by 66.6 per cent under H₂, by 62 per cent under M₂ and by only 55.3 per cent under L₁. Similarly value added per worker in the non-agricultural sector will have to be increased by 82.5 per cent under H₂, by 77.5 per cent under M₂ and by only 70.1 per cent under L₁.
- 10) If the criterion of 710 grams of foodgrains per day per adult equivalent consumer unit (middle class pattern of consumption today) is assumed as a norm, the foodgrains requirements in the year 2000 will be 223 m. tonnes, 208 m. tonnes and 188 m. tonnes under H₂, M₂, and L₁ situations respectively. If it is assumed that the income distribution will change in such a way that there will not be any population in the lower poor class, and the distribution of population in the poor, middle and rich class will be 20, 40 and 40 per cent respectively then the available research shows that the total demand for foodgrains

of such population (as determined by the present pattern of consumption of these classes) will be met if 814 grammes per day, per A.E.C.U. are supplied. If this criterion is adopted then the requirements of foodgrains under H_2 , M_2 and L_1 will be 255, 239 and 216 million tonnes respectively.

This means that if self-sufficiency in food is to be achieved by 2000 according to the norm based criterion, then foodgrains production will have to be increased at the annual compound rate of 2.9 per cent under H_2 situation, at the rate of 2.7 per cent under M_2 situation and at the rate of 2.2 per cent under L_1 situation and foodgrains sector will contribute about 37 per cent of total agricultural income. If self-sufficiency in food is to be achieved by demand based criterion, then food production will have to be increased at the annual compound rate of 3.3 per cent per annum H_2 situation, 3.1 per cent per annum in M_2 situation and 2.7 per cent in L_1 situation and foodgrains sector will contribute about 43 per cent of total agricultural income.

All these implications reveal that much more effort will be required to reach the same improvement in the standard of living under the situation of rapid population growth as compared to that under slow population growth.

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APPENDIX

Economic Implications of Alternative Population Situations in India in 2000 A.D. Under Certain Identical Assumptions

(A)	Population in 2000 A.D. (Million)	Adult Equivalent Consumer units in 2000 A.D. (Million)	Gross Domestic Product in 2000 A.D. (if GDP per A.E.C.U. in 2000 A.D. is 2.5 times that in 1973) Million Rs.	Annual Compound Growth Rate of GDP (1973-2000) Per cent	Per Capita GDP in 2000 A.D. Rs.	Annual Compound Growth Rate of Per Capita GDP (1973-2000) Per cent	Total Contribution of Agricultural sector to GDP in 2000 A.D. (if it is 30% of GDP) Million Rs.	Annual Compound Growth Rate of Agricultural GDP (1973-2000) Per cent	Dependency Ratio in 2000 A.D. Per cent
H ₂ Projection	1032.1	860.12	2057837.10	5.8	1993.83	3.5	617351.13	4.1	74.3
M ₂ Projection	945.4	803.56	1922517.30	5.5	2033.55	3.6	576755.19	3.9	65.0
L ₁ Projection	830.6	727.49	1740519.82	5.1	2095.50	3.7	522155.94	3.5	55.2

(B)	Population situation in 2000 A.D. (Million)	Labour Force* in 2000 A.D. (Million)	Labour Force as percentage of total population in 2000 A.D.	Value Added Per Worker in 2000 A.D. (Rs.)	Per cent increase in value added per worker (1973-2000)	Agricultural** Labour Force in 2000 A.D. (Million)	Non-agri-cultural Labour Force in 2000 A.D. (Million)	Value added per worker in agriculture in 2000 A.D. (Rs.)	Per cent increase in value added per worker in agricultural sector (1973-2000) Rs.	Value added per worker in non-agricultural sector in 2000 A.D. (Rs.)	Per cent increase in value added per worker in non-agricultural sector (1973-2000)
H ₂	409.64	39.6	5023.53	100.7	233.79	175.85	2640.62	66.6	8191.56	82.5	
M ₂	393.44	41.6	4886.43	95.2	224.55	168.89	2568.49	62.0	7968.28	77.5	
L ₁	371.69	44.7	4682.72	87.1	212.13	159.56	2461.49	55.3	7635.77	70.1	

* If the participation rates in 2000 A.D. for age-groups 0-14, 15-59, and 60+ are 0, 85.41, 64.79 per cent respectively for males and 0, 41.50, 19.22 per cent respectively for females.

^ If (1) the target regarding GDP in col.3 of A is to be reached, (2) the target regarding agricultural GDP in col.7 of A is to be reached, (3) the present ratio between value added per worker in agricultural and non-agricultural sectors i.e. 1:3.085 is maintained upto 2000 A.D.

Appendix (Contd.)

(C)

Population Situation in 2000 A.D.	Foodgrains Requirements in 2000 A.D. (Million tonnes) Under Criterion*			Required annual compound Rate of Increase in Foodgrains Production (1973-2000)		
	A	B	C	A	B	C
H ₂	223	255	277	2.9	3.3	3.7
M ₂	208	239	253	2.7	3.1	3.3
L ₁	188	216	223	2.2	2.7	2.9

* A If in 2000 A.D., everybody conforms to the the norm of present middle class consumption pattern i.e. 710 grammes per day per adult equivalent consumer unit (Norm-based).

B If in 2000 A.D., the percentage of population in lower poor, middle and rich classes is 70, 40, 40, 20 respectively and demand is to be met according to the present needs of these classes i.e. on an average demand will be 814 grammes per day per adult equivalent consumer unit (Demand-based).

C On the basis of the criterion of 735 grammes per day per capita in 2000 A.D. (which is based on the extrapolation of the trend regarding per capita availability of foodgrains given by Planning Commission upto 1985-86).

Sources: For Population Projections, S. Raghavachari, 'Population Projections 1976-2001' in Ashish Bose et.al. (eds.) Population in India's Development 1947-2000, Delhi: Vikas Publishing House, 1974.

For other assumptions - 1) Planning Commission, Government of India, Draft Fifth Five Year Plan 1974-79, Vol.1.

2) Planning Commission, Government of India, Fifth Five Year Plan 1974-79.

3) V.M. Rao, Food, Second India Studies, Bombay: Macmillan Company of India Ltd., 1975.