POPULATION AND FOOD SUPPLY*

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1. With the second largest population of the world (439 million in 1961) India faces the twin problems characteristic of underdeveloped countries, *viz.* a high rate of population growth and a slow development of agriculture. A third problem peculiar to India is its large and uncontrolled bovine population. An attempt is made in the present paper to discuss briefly the prospects for the human population and its nutrition in the foreseeable future, *i.e.*, for a period of 50 years from 1961 to 2011, as a result of the interaction of these three factors. For obvious economic reasons and a widely prevalent religious sentiment against meat, specially beef, India's agriculture will continue to have to be crop-oriented. Milk is the only source of animal protein essential for human nutrition which is universally acceptable in the country. Additions to this source will have to come from fish and from small animals like pigs and poultry which can feed on crop residues. Any substantial increase in these sources is also a distant prospect.

2. India's land resources and their present use are shown below for the triennium around 1960-61 in million hectares :—

(1) Total geographical area	326
(2) Forests	56
(3) Barren and unculturable land	34
(4) Land put to non-agricultural use	14
(5) Culturable waste land	19
(6) Permanent pastures and grazing	14
(7) Tree crops and groves	6

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(8) Old fallow	11
(9) Current fallow	11
(10) Net area sown	133
(11) Gross area sown	153
(12) Area sown more than once	20

3. While the bulk of additional production in future has to come by raising productivity of land, there is some scope for expanding the area under cultivation partly by breaking waste land and partly cropping land more than once (double cropping). That this scope is real is seen from the experience of the first two Five Year Plans (1951 to 1960) during which the greater portion of increased agricultural production resulted from the latter source than from increased productivity of land. New land must not, however, be brought under cultivation indiscriminately, since along with agricultural crops we also need increased production of timber and other forest produce and of livestock products like milk and wool. Careful ground surveys need to be made to allocate land for optimum use. In relation to bringing new area under cultivation, we have confined our attention to waste land under items 5, 8 and 9 which total 41 million hectares. Grouping the 320 districts into which the country is divided into five main agro-climatic regions, *viz.*, Himalayan region, northern plains, coastal region, peninsular region (black soil) and peninsular region (red soil), we have examined the normal annual rainfall and the current extension of irrigation in the individual districts comprising each region. We have thus estimated that out of the waste land available, 15 million hectares can be brought under the plough, leaving behind upto 10% of the waste land for other uses. A similar examination of the extent of double cropping in the different districts of each region has led us to estimate that the area under double cropping can be increased by adopting suitable measures, by 18 million hectares. The extension of cropped area under these two categories distributed among various crops in their present proportions, an assumption that we shall adopt generally, would contribute 17 million tonnes to the production of food-grains, *i.e.*, cereals and pulses together.

4. Water is an agricultural resource as essential as land and India is fortunately well supplied with it through rainfall. Only 7% of the districts have an annual rainfall of less than 51 cm. About 20% of the districts have a rainfall between 51 and 76 cm. while

42% have a rainfall of 76 to 127 cm. and the remaining 31% over 127 cm. Thus rainfall is plentiful for nearly three fourths of the land area. Today most of the rain which comes down in a comparatively short rainy season flows off to sea, causing on the way damaging floods in several areas. A most essential requirement for increasing agricultural production in India, whether by extension of area under crops, irrigation or use of fertilizers, is to control this vast bulk of water supply by suitable conservation measures such as dams across streams, contour terraces and bunds, proper drainage, etc. and thus make it available directly or indirectly for growing crops in different seasons. A gross area of only 32 million hectares was irrigated at the end of Second Five Year Plan, but the potential for irrigation is estimated at 76 million hectares. Detailed surveys will undoubtedly show that this potential can be raised and we are assuming a potential of 81 million hectares gross, which we believe to be conservative. When this potential is achieved, we expect an additional production of 21 million tonnes of food-grains, apart from proportionate increase in other crops. The potential for contour bunding and terracing is put down as 49 million hectares, out of which only little over one million hectares was covered by the end of the Second Plan. The additional production of food-grains expected from this programme together with associated farming practices is about 7 million tonnes. Direct irrigation or indirect measures for conserving soil moisture not only give increased crop yield, but also increase the efficiency of fertilizer use. In fact, water supply and use of fertilizers have to be treated as complementary measures. The widest possible use of fertilizers is in our view the most important single contributory factor for raising the agricultural production in India. Data are being collected on the responses of various crops to fertilizers with and without irrigation under actual farming conditions in a countrywide programme and with the help of the results already available, we can project with some confidence the maximum increase in production that can be secured from nitrogen and phosphate with the present agricultural practices. For food-grains this figure is about 75 million tonnes, which is of the same order as the actual production of these crops (80 million tonnes) at the end of the Second Five Year Plan. We calculate a requirement of about 8 million tonnes of nitrogen and 6·5 million tonnes of phosphorus (P_2O_5) for all agricultural crops. When crop varieties specially responsive to fertilizers are developed, the increase in production can be stepped up further. Today, however,

we can see the prospect of such seed becoming available for maize only and we have taken this into account by adding about 2 million tonnes to increased production. An important recent introduction in Indian agriculture is the chemical control of pests and diseases of crops. This programme is in its infancy, but an increase in crop yield by 10 to 15% from this source is not an unrealistic estimate. Chemical protection of crops will be accelerated as use of fertilizers goes up, but we have not calculated the expected gain in production from this source, as it can be offset against unavailability of an estimated $12\frac{1}{2}\%$ of food-grain production for human consumption through use as seed, cattle feed and losses in storage, transport, etc. We thus see a reasonable potential, as for as present technological knowledge goes in the context of Indian conditions, of additional availability of 122 million tonnes of food-grains for human consumption over the corresponding figure at the end of the Second Five Year Plan or a total availability of 192 million tonnes. With improvement in agricultural technology, this figure is likely to be raised further by some margin. We believe that the necessary effort for achieving this availability will be made both through conscious plannning and increasing pressure of population. Even today both factors are significant in contributing to greater agricultural production.

5. On the question of population growth in India, we agree generally with the position taken by Coale and Hoover (1958) in regard to the likely course of mortality and fertility rates in underdeveloped countries with low income. They show that mortality can decline relatively rapidly and at a low cost even under these conditions with the help of antibiotics, public health services and sanitation. Fertility, however, takes longer and is more difficult to control and is related to the standard of living. There is consequently a considerable time lag between the decline of mortality and fertility. With the present low level of availability of public health services, the extremely poor state of sanitation in rural India, where the bulk of the population resides, the incidence of malnutrition in an appreciable fraction of the population and also taking into account that the sub-tropical conditions set a lower limit to mortality, it is difficult to imagine that mortality rates as small as those prevalent in Western Europe or Noth America will be attained in India during a foreseeable future. Considering the prevalent mortality rate in India of 19·4 and examining this figure in countries similarly situated we believe that a reduction in mortality rate to a level below 10

would be unrealistic and would rather place it between 11 and 12. With a high infant mortality, the economic necessity of bearing many children so that some may survive and of large families to provide the much needed manual labour for a peasant agriculture has turned into a traditional belief against any kind of birth control. For every girl the chief aim is to marry and raise a family and social prestige is attached to women with several children. In this situation much sustained effort by way of propaganda, education and action in the rural areas on the part of the public authorities must be forthcoming before any sensible impact can be made on present fertility level. Today, this activity is mostly confined to some urban areas and has influenced only educated urban population to some extent, but this population is practically an insignificant fraction of India's population. We, therefore, feel like Coale and Hoover that there is no possibility of any downward change in fertility at least for a couple of decades, *i.e.*, upto 1981. We have the further benefit of the census results for 1961 in strengthening our view, as the actual population in 1961 surpassed all earlier projections including that of Coale and Hoover. In the hope that public action for family planning and other contributory economic factors will develop sufficiently to start influencing fertility towards the end of this period, we assume that from 1981 onwards, fertility will decline linearly over the next 30 years to half its current level. With our two assumptions concerning mortality and fertility rates, we have projected the Indian population over five decades beginning from 1961.

6. Details of our calculations will be published elsewhere, starting with the Indian life tables for 1951 to 1960 based on 1951 and 1961 censuses, an annual increase of 0·5 year in the expectation of life at birth was assumed until this expectation reached about 55 years. By utilizing United Nations model life tables (1956) for interpolating age specific mortality levels and corresponding survival ratios, the expected quinquennial population was estimated. The projected values for population and its more important features are shown below:—

Year	1961	1966	1971	1976	1981	1986	1991	1996	2001	2006	2011
Population (million)	439	490	551	625	713	811	910	1010	1107	1197	1275
Growth rate (%)	1·98	2·20	2·39	2·55	2·67	2·62	2·33	2·09	1·85	1·58	1·28
Fertility	195	195	195	195	187	171	154	138	122	106	98
Death rate	19·4	19·1	16·9	15·3	13·8	12·4	12·2	12·1	12·0	11·9	11·8

In the course of 50 years, the population would be nearly trebled. The growth rate of population, high as it is already, will rise still further to the peak value of 2·67 by 1981, in spite of a steadily declining mortality and will start going down when fertility begins to decline.

7. According to the livestock census in 1961, the total number of bovines in the country was 227 million comprising 176 million cattle and 51 million buffaloes. Among the three categories of animals, *viz.*, adult males, adult females and young-stock, the number of cattle included the largest number of adult males, *viz.*, 73 million, while among buffaloes adult females formed the largest number, which was 25 million. In the absence of any kind of vital statistics for livestock, as also any reliable long term trend in their numbers, it is extremely difficult to project with confidence the number of bovines over five decades. We have, however, done this by taking into account the growth rates of different categories of animals among cattle and buffaloes between the latest two quinquennial livestock census for 1956 and 1961. These two censuses were both accurately done and had a nearly complete coverage. The calculated growth rates ranged from 17·0 for adult females to 22·4 for adult males among cattle and from 22·8 to 33·8 for these two categories of animals among buffaloes. If these growth rates persisted in the future, the livestock population in the year 2011 would be 766 million, comprising 552 million of cattle and 214 million of buffaloes. Taking into account all animal feeds, such as crop residues, grains and other concentrates, fodder and grazing, that is estimated to become available by that time, it would appear impossible to feed this vast number of livestock at the current levels of feeding, inadequate as they are, and the result would be that the present per capita availability of milk of about 120 gm. per day will be reduced to 86 gm. The alternative of growing sufficient fodder to maintain even the current level of feeding for these numbers also appears an impossible proposition, as it would mean diverting a prohibitively large proportion of irrigated land to fodder production. The only feasible solution would be to control the number of livestock in such a manner that they are put to efficient use and are capable of being fed adequately with available resources. At present the male livestock is used for draft in cultivation and transport and there is on an average one pair of adult bovine males to every 3·4 hectares of cultivated area in the country. According to the numbers projected for the year 2011, there will be a pair for only 1·1 hectare of the cultivated area.

Considered against the reasonable requirement of a pair of male animals for 4·05 hectares of land, the number of males in the livestock population by 2011 would be enormously in excess of the requirement. If a pair were maintained for 4·05 hectares, the number of adult males can be reduced from 248 million to 65 million in cattle and from 43 million to 11 million in buffaloes. The corresponding saving in livestock feed would enable cows and buffaloes to produce enough milk to make 240 gm. per capita available per day. The modest nutritional standards aimed at for the Indian population include an availability of 200 gm. of milk per head per day. The necessity of maintaining a large number of male livestock can be further reduced by gradually introducing mechanization in Indian agricultural and to the extent that mechanization makes progress the available feed could be diverted to the improvement of milk yield thereby raising the availability to a still higher level.

8. The food supply available for human consumption at the end of the Second Five Year Plan was not adequate to meet the modest nutritional requirements of the Indian population as recommended by the Indian Nutrition Advisory Committee (Patwardhan, 1960). For the poupulation of 439 million in 1961, the per capita availability was calculated at 2033 calories and 51·8 gm. protein per day against a physiological requirement of 2128 calories and 61 gm. protein (Panse, 1961). Allowing for wastage of food and uneven distribution among different economic groups of population the retail requirement was 2370 calories and 67 gm. protein according to Sukhatme (1962). The available supply thus represented a shortage of 14% of calories and 22% protein. In the course of 50 years the population will increase 2·90 times, while the available feed supply can be raised to 2·74 times, if the full potential of increased agricultural production, as we see it today, can be realized. The population structure will also alter, so that there would be somewhat larger proportion of adults as compared to 1961 and the nutritional needs of this population will also be slightly greater. Thus the gap between availability and requirement of food would widen further. The retail availability for the population of 1275 million in the year 2011 was calculated at 1956 calories and 50·4 gm. protein per capita per day, which would fall short of the retail requirement of 2425 calories and 66 gm. protein by 19% and 23% respectively. A particularly serious aspect of this deficiency is that the supply of milk which is an essential source of protein will be

depleted to $\frac{3}{4}$ths of its current availability which is itself sub-normal, if the cattle population continues to grow unchecked. India's population thus faces the grim prospect of being condemned to a permanent state of under-nutrition and mal-nutrition with attendant deterioration in labour productivity and of the entire national economy.

9. To avert this catastrophe, vigorous action will have to be pursued along three broad lines. The first and foremost will be to increase agricultural production speedily with the help of programmes concentrated basically on extension of irrigation and other moisture conservation measures, maximum use of fertilizer and provision of incentives to farmers to produce more through guaranteed prices of agricultural commodities, reduced cost of fertilizers and other inputs and elimination of share cropping and other harsh tenancy conditions. If the potential for production of foodgrains (and other items of food) that we have visualized is attained fully in the next 25 or 30 years, the available food supply will provide a modest standard of nutrition to a population of 980 to 1000 million that would exist at that time. This will help to increase labour productivity in various fields, create a more hopeful outlook on life in the population and make it receptive to ideas and programmes for raising the standard of life including limitation of family size. If, on the other hand, hunger persists and is possibly aggravated, all other programmes will be of no avail. The second line of advance will have to be progressive mechanization of all agricultural processes. Male livestock which is practically the only source of power for agriculture today, forms the largest proportion of the total bovine population and consumes a substantial proportion of livestock feed. First by rationalising the numbers of male livestock required for agriculture and transport and then substituting them gradually by mechanical and electrical power, a large stock of livestock feed can be diverted for convesrsion into milk, thereby improving significantly the availability of a vital ingradient in the diet of the Indian population. Mechanization will have another equally important effect. By replacing the large amount of manual labour required for present agriculture by machines, the incentive to raise large families to supply this labour will weaken and thus help population control. The third line to be adopted is direct propaganda and action for control of population through family planning in rural areas. The magnitude of this task needs to be comprehended, since family planning will make an impact on population growth only

when the idea and the means reach the vast rural population scattered in more than half a million villages. Maternity and child care has to be the spearhead of this programme, because only when women see that the children that they produce can be raised as healthy individuals without the frequent risk of their dying in infancy, the urge for procreating too many children will cease. We believe that action along these lines will be accelerated and with further advances in technology and its application, it is not yet too late to hope that India's population can still look forward to a fuller and richer life in the foreseeable future.

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