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Demographic Transition Theory and Developing Countries—A Case Study of India*

Introduction

IN the post World War II period the theory of demographic transition, initially developed nearly a half-century ago, was the bright theoretical light representing the revealed wisdom of demographic science. It was based on the 19th century Western European experience of demographic change. Since then it has been subjected to increasing critical examination. Its explanatory variables and predictive power have been questioned with the help of recently collected and reconstituted micro-level demographic data from more than 700 administrative units of Europe on a standardized basis under the direction of Professor Coale of the Office of Population Research at Princeton University. In his recent presidential address to the Population Association of America, Charles B. Nam, while discussing the scientific status of the theory of the demographic transition and the intellectual capital invested in it, surmised that ". . . while the animal [the Theory] is still alive, we are today not certain of its species or its life expectancy."[1]

The theory is less scientific in a 'scientific sense'; rather, it represents a descriptive interpretation of the demographic change over time in a particular region. Essentially, it states that both a population's fertility and its mortality will decline from high to low levels as a result of fundamental economic and

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1. Charles B. Nam, "The Progress of Demography as a Scientific Discipline," *Demography*, Vol. 16, No. 4 (November, 1979) : 485-92; Presidential Address delivered at the annual meeting of the Population Association of America, Philadelphia, April, 1979.

social development. Furthermore, decline in mortality usually precedes decline in fertility. Stage I is characterized by an equilibrium of population size determined over a long-term period by high birth and high death rates. It is believed that control of mortality level is beyond the means of pre-industrial societies and pronatalism is highly institutionalized with little or no increase in total population. For example, in Finland during 1785-1790, the recorded birth rate was 38 per thousand and the death rate was 32 per thousand. Stage II is an experience of declining mortality, but with fertility remaining at the previous level. It is also termed the stage of population explosion. Finland during 1825-1830 recorded a 25 percent decline in mortality level, reaching 24 per thousand, with the birth rate remaining unchanged over the previous 40 years. The natural increase in population over the same period jumped from 0.6 percent in 1785-1790 to 14 percent in 1825-30. In Stage 111, birth rate gradually declines on account of the weakening of pronatal, traditional institutions against the increasing demand of the new institutions for fewer children. Finland readied this Stage III in 1910-1915 with a birth rate of 29 per thousand and a death rate of 17 per thousand. The last stage, or Stage IV, is characterized by a low death rate and a low birth rate when the idea of conscious control of fertility embraces the whole society and the use of modern contraceptive methods is widespread. In 1970-1976 Finland's birth rate reached a low level of 13 per thousand and the death rate a level of 10 per thousand. In completing the demographic transition, Finland's rate of natural increase in Stage IV sharply declined to a mere 0.3 per annum from a high of 1.2 percent during Stage III (1910-1915).[2]

New Findings. The new information is derived from (i) the micro-level studies in depth bused on family reconstitutions data from local parish registers of baptisms, weddings, and burials kept by Catholic and Protestant clergymen extending as far back as the 17th and even the 16th century; (ii) the macro-level studies based on conventional demographic sources; and (iii) social history records; and it suggests the following four broad observations : *(a)* the past was largely characterized by natural fertility; the deliberate practice of family limitation was mostly absent among most of the population; *(b)* The transition from high to low fertility level represented a shift from natural fertility to family limitation. It occurred rapidly and it was an irreversible process once it was under way; *(c)* The onset of long-term fertility decline took place under a wide variety of socioeconomic and demographic conditions; *(d)* Differences

2. For Finland data, see Arthur Haupt and Thomas T. Kane, *Population* ***Handbook*** (Washington. D. C. : Population Reference Bureau. Inc., 1960), p. 58; and, for **summaries of** the theory, see F. W. Noteste n in *Preceedings of the Eighth International Conference* ***on*** *Agricultural Economics* (London : Oxford University Press, 1953) : 15-31.

in the start and in the speed of the fertility decline seem to have been determined more by the cultural setting than by socioeconomic conditions.[3]

II. Population Trends

At a recent symposium on "World Fertility" sponsored by the U.S. Association for the Advancement of Science in 1978, its Chairman, Nick Eberstadt, predicted on the basis of the current rate of growth that the world's population by the year 2000 will range from 5.5 to 5.8 billion. Only a year earlier, in 1977, the projected world population for the turn of the century was placed at 6.25 billion by the Population Division of the United Nations. And not much earlier, Philip M. Hauser had projected that "world population could easily reach 7 billion and possibly exceed this number" by the end of the current century.[4]

This significant decline in projected population was attributed to an unexpected sharp decline in fertility in some developing countries. The birth rate of the developing world, as a whole, declined by 14-15 percent, from 42 per thousand in 1970 to 35-36 per thousand in 1977. It is suggested that family planning is reaching the poorest of the poor—that 40 percent group that contributes over 60 percent of the world's annual births. From the longer term point of view, the world population is projected to reach 11 billion in the third quarter of the next century. The Population Reference Bureau estimates the 19SO world population at 4.414 billion—developed countries 1.1 billion, and less developed countries 3.3 billion. When the stationary population is reached in the next century, the developing world will have a total population of 9.6 billion, representing 87 percent of the world total then. In contrast, the population of the industrialized countries will reach a stationary level of 1.4 billion by the turn of the present century. In other words, the developing world will experience a very significant growth in its population in the next three or four decades.

Developed Nations. The recent sharp fertility decline in the developed nations during the last twenty years or so can be described as a part of long-term dynamic change as characterized by the Demographic Transition Theory, provided that the post World War II baby boom is considered as a short-term deviation

3. Ansley J. Coale, "The Demographic Transition Reconsidered," in International Union for the Scientific Study of Population (IUSSP), *International Population Conference : Liege 1973.* Vol. 1 (Liege, Belgium : IUSSP, 1973) : 53-72; and Etienne van de Walle and John Knodel, "Europe's Fertility Transition : New Evidence and Lessons for Today's Developing World," *Population Bulletin,* Vol. 34, No. 6 (February, 1980) : 1-43.

4. Philip M. Hauser, World Population : "Retrospect and Prospect," in National Academy of Sciences, *Rapid Population Growth : Consequences and Policy Implications,* Volume II Research Papers (Baldmore : The Johns Hopkins Press, 1971) : 103-22.

to recover the postponed births during the war years and the preceding economic depression of the 1930s. The European socialist and nonsocialist developed countries represent two different subsets in terms of fertility and mortality levels. It therefore seems appropriate to discuss them separately.

In terms of total fertility rate (TFR)[5], there was a 49 percent decline over a short period from 1960 to 1978—TFR dropped from 3.6 to 1.8. In 1978 in 17 developed countries out of a total of 24 in this group, the fertility level was at or above the replacement level.[6] Over the same 18 year period, the weighted average crude birth rate declined from 20 per thousand in 1960 to 14 per thousand in 1978; the corresponding weighted average death rate declined from 10 to 9 per thousand.[7] The magnitude and universality of the fertility decline is very striking. In the Netherlands, total fertility rate fell from 3.09 in 1965 to 1.59 in 1978, and in West Germany the lowest rate of 1.39 was recorded in the same year. Nuptiality patterns have also changed. The mean age of first marriage for females is at an all-time low of 22.0-22.5 years. Formal marriages after a "trial period" or after the women have become pregnant are increasing rapidly. The number of divorces has increased (in Sweden in 1975, over 50 percent of marriages terminated in divorce) and the number of remarriages has also increased. Reviewing world population trends, Leon Tabah observed that "fertility is far less influenced than in the past by economic, social or religious factors."[8]

The socialist developed countries, as a group, have not experienced the same fertility trends. In almost all the countries the fertility was at or slightly above the replacement level. The German Democratic Republic was an exception with a TFR of 1.8 in 1978. Over the last 18 years from 1960 to 1978, Poland,

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5. Total Fertility Rate (TFR) is the average number of children that would be born alive to a woman during her lifetime if she were to pass through all her childbearing years conforming to the age-specific fertility rates of a given year. During the peak "baby boom" years, the TFR in Canada rose to 3.9 b.rths per woman, and in 1976 it dipped below 1.8. In a number of developing countries, the TFR is over 7.0 per woman, and in many developed countries it is now under 2.0.

6. Replacement level fertility is the 'evel of fertility at which a cohort of women, on the average, have only enough daughters to "replace" themselves in the population. Net Reproduction Rate (NRR) of unity is equal to replacement level. NRR is the average number of daughters that would be born to a woman if she passed through her lifetime from birth conforming to the age-specific fertility and mortality rates of a given year.

In 1975 the NRR in Bangladesh was 2.18 and in Maxico 2.74; in contrast, in the United States it was 0.83. In the year 1980, some two dozen developed countries were at or below replacement level fertility.

7. World Bank, *World Development Report,* 1980 (Washington, D. C. August, 1980V

8. Leon Tabah, "Quelques traits de 1evolution demographique recente," presented at the World Fertility Survey Conference, London, July 1980; English translation of a revised version—"World population Trends, A Stocktaking," *Population and Development Review,* Vol. 6, No. 3 (September, 1980) : 355-89.

the U.S.S.R., and the German Democratic Republic experienced a 21-25 percent decline in their crude birth rates. This decline in fertility was accelerated by the liberalization of abortion in 1950, when the level of fertility was on the whole higher than that in nonsocialist Europe. However, by the mid-1960s pronatalist measures had been adopted in many countries to counteract declining birth rates. For example, in Romania, the TFR increased from 1.91 in 1965 to 2.89 in 1970, after abortion was prohibited. The divorce rate is generally higher in socialist Europe. In the Soviet Union it is one of the highest in the world, perhaps even higher than that of the United States. Important determinants of fertility decline in socialist Europe are : increase in unemployment, particularly among the young; changes in the institution of marriage; and a new attitude in the society relative to the family.[9]

Developing Nations. Because of its extreme diversity in economic, social, cultural and political settings, the developing world is characterized by a wide variety of demographic changes. In the developing countries, as a whole, during 1975-80 the weighted average crude birth rate was estimated to be 38.5 per thousand (excluding The People's Republic of China) In contrast, in the industrialized countries, it was less than half that figure—15.6 per thousand. As is well known, the developing world comprises countries with a varying level of economic development. The weighted average of crude birth rate for 38 low-income countries having per capita gross national product (GNP) less than US $360 in 1978, declined by 14.4 percent, from 48 per thousand in 1960 to 39 per thousand in 1978. Similar fertility decline, over the same 18 year period, in 52 middle-income developing countries having per capita GNP above US $360 but below US $3,500 in 1978, was 17.4 percent. Not unexpectedly, there are extreme variations in observed fertility decline during this period of 18 years, ranging from no change to 55 percent. For a group of nine countries there was no change at all, and for 29 countries the decline was more than 25 percent.[10] It is interesting to note that a recent study of 94 developing countries estimates a simple correlation of merely 0.17 between the birth rate decline during a ten-year period, 1965 to 1975, and GNP per capita in 1970[11]

In contrast to fertility trends, mortality trends are considered to be influenced by exogenous variables related to medical progress generally outside the developing world. The disparity in mortality levels between the developed world and the developing world is not as wide as in the case of fertility levels. For example, for 1978, the weighted average crude death rate for 38 low-income countries is 15 per thousand, whereas for 52 middle-income countries it is 11

9. Tabah, "World Population . . . ", p. 361.

10. *World Development Report, 1980,* Table 18, pp. 144-45.

11. W. Parker Mauldin and Bernard Berelson, "Conditions of fertility Decline in Developing Countries, 1965-75, *'-Studies in Family Planning,* Vol. 9, No. 5 (May, 1978) : 84-147.

per thousand. In contrast, for the industrialized countries, it is 9 per thousand (Table 1). In terms of life expectancy at birth, the average for the low-income

TABLE 1—TOTAL POPULATION, GROSS NATIONAL PRODUCT (GNP) PER CAPITA, CRUDE BIRTH AND DEATH RATES, 1960 AND 1978, BY GROUPS OF COUNTRIES

(Weighted average)

Groups/Countries	*Number of countries*	*1978 tola! popu-lation* (million)	*GNP per capita* US$ *(1978 prices')*	*Crude Birth Rates*		*Crude Death Rates*	
				1960	*1978*	*1960*	*1978*
Low-Income Countries[a]	(38)	1,294	200	48	39	24	15
Middle-Income[b]	(52)	873	1,250	40	35	14	11
Industrialized	(18)	668	8,070	20	14	10	9
Capital-Surplus Oil Exporters[e]	(5)	60	6,011	48	43	21	14
Centrally Planned Economies	(12)	1,352	1,190	32	18	13	7
Selected LDCs							
\. Bangladesh		85	90	51	46	25	18
2. India		644	180	43	35	21	14
3. Pakistan		77	230	48	45	23	15
4. Indonesia		136	360	47	37	23	17
5. Egypt		40	390	45	37	19	13
6. Nigeria		81	560	52	50	25	18
7. Mexico		65	1,290	45	38	12	8
8. Brazil		120	1,570	40	36	11	9
9. China		952	230	36	18	15	6

Notes, a. GNP per person of US $360 and below;
b. GNP per person of above US S360, but below U. S. $3,500;
c. Iran, Iraq, Kuwait, Qatar, Saudi Arabia.

SOURCE : Compiled from *World Development Report, 1980* (World Bank, Washington, D. C. : Aug. 1980).

countries is 24 years shorter compared to the corresponding average for non-socialist developed countries.[12]

China's Experience. In the developing world, the People's Republic of China will be the first large-sized country to complete the demographic transition. In the recent past, China has experienced unprecedented demographic changes: remarkably low death rate (6.2 per thousand in 1979) and very rapid reductions in birth rate (17.9 per thousand in 1979 from 38-39 per thousand in 1964-65). Equally, its population policy has witnessed many dynamic changes since the late 1940s. The official policy advocates later marriages and reduced fertility for married couples. In the early 1970s, the common slogan was : "one is the best, two you square the account, three you make a mistake." At the recent People's Congress in September 1980, the encouragement of the one-child family (Planned Birth Ordinance with comprehensive incentives and penalties) was discussed but no legislation was passed. It is estimated by the Chinese demographers that the annual rate of population growth was 1.21 percent in 1978, down from 2.34 percent in 1971. The planned target is further to reduce the growth rate to 0.5 percent in 1985, and to zero percent by the end of the century. The goal is to keep the total national population below 1.2 billion in the year 2000.

The total population in China in 1979 is estimated to be 965 million.[13] However, the World Bank projects that China will reach a stationary population in the year 2065 with a total population of 1.555 billion. The net reproduction rate of unity is assumed for the year 2005.[14] However, the Population Division of the United Nations estimates that "stationarity will be fully achieved there (in China) around the year 2025 with a population on the order of 1.4 .billion."[15]

III. Historical Relevance

Essentially, the Demographic Transition Theory, at least the earlier version, says that the development will "take care of" demographic change in the present-day developing countries as it did in Europe. Since there are so many dissimilarities between the economic, social, religious and cultural settings of the developing nations and those of pretransition Europe, it is interesting to explore the .extent to which the same process will bring about these changes. The relevance, or lack of it, has many policy implications for the national planners as well as for the international agencies involved, directly or indirectly, with population

12. *World Development Report, 1980* Table 18, pp. 144-45.
13. Ansley J. Coale, "Population Trends, Population Policy, and Population Studies in **China,** *"Population and Development Review,* Vol. 7, No. 1 (March, 1981) : 85-97.
14. *World Development Report,* 1980, Table 17, p. 143.
15. Tabah, "World Population Trends. . .", p. 384.

policies of so many developing countries. In addition, the validation or otherwise of the theory, when confronted with the contemporary situation in developing countries, will contribute to our scientific perspective. In other words, the explanatory power of the theory has yet to be tested in many developing countries. In this exercise on; must contend with the limited nature of demographic data available for such countries. Nonetheless, it may be asked: Will there be a 'natural' decline in fertility, as predicted by the theory to occur within a reasonable period, given some realistic hopes of economic and social development ?

Michael S. Teitelbaum has suggested some factors which appear to militate against, and some which appear to favour, natural and timely decline in the developing countries. Obstacle factors include : pace and source of mortality decline; fertility levels before decline; international migration; momentum for further growth; limited opportunities for female participation in the labour force; and difficulties of providing universal education. The favourable factors are : the pace of social and economic development; methods of fertility control; later marriage and increased non-marriage; and international assistance.[16] However, the following features deserve special notice.

1. It is a well established fact that demographic transition is under way in almost all the developing countries. Mortality levels have significantly declined. The pace of mortality decline, compared to the historical experience of gradual change, has been very rapid, occurring over one or two decades. Just after World War II, mortality declined in many developing countries three to five times as rapidly as in the previous decades. The source of mortality decline is largely imported medical technology (control of major killer diseases like cholera, ma'ari i, small pox, tuberculosis, etc.) and is not directly related to economic and social deveolpment. When mortality began to decline in many of today's developing countries, the level of economic and social development was not comparable with those levels prevailing in Western Europe before the industrial revolution.[17]

2. Contemporary fertility levels in most of the less developed countries (LDCs) are much higher than in pretransition Europe, largely on account of early and near-universal marriage patterns. In contrast, the pattern of late marriage and nonmarriage was extensive in the Europe of that time. It is estimated that marital fertility during the predecline period in Europe was as high as if *not higher than,* it has been for today's developing countries.[18]

16. Michael S. Teltelbaum, "Relevance of Demographic Transition Theory for Developing Countries," *Science,* Vol. 188, No. 4187 (May 2, 1975) : 420-25.

17. World Bank, *Population Planning : Sector Working Paper* (Washington, D. C.: World Bank, March, 1972), p. 9.

18, Etienne van de Walle and John Knodel, '-Europe's Fertility Transition . . . ", p. 37.

3. There is growing statistical evidence to assert that fertility has decisively begun to fall in the Third World countries at quite different levels of development, at least as measured by conventional socioeconomic indicators. After careful analysis of relevant demographic data, W. Parker Mauldin concluded, "From 1950 to 1965 fertility declines in developing countries were limited to a relatively few, for the most part small, countries. The tempo of fertility decline increased during the next ten years, with 19 countries of half a million or more population having fertility declines in excess of 20 percent,. . Ten countries out of the 13 developing countries with a population of 35 million or more reported significant crude birth rate (CBR) declines, and the average decline of 13 percent for this size class was almost twice as large as for smaller countries."[19] Another detailed study found that fertility declined in 95 countries out of a total of 113 developing countries, measured by the total fertility rate during 1968-1975.[20]

4. It has also been noted that countries that have experiened fertility decline in recent decades have shown a more rapid pace of decline than occurred in 19th century Europe.[21] However, this finding has somewhat limited value in terms of its applicability to other developing countries in Asia and Africa as it is based on 15 developing countries in Latin America, where the level of economic development is relatively much higher.

5. As in the historical experience, the cultural factors, though hard to identify and still harder to measure in quantitative fashion, appear to play an important role in the observed fertility decline either across countries or within countries. In a recent analysis of conditions of fertility decline in 94 developing countries, the authors identified three religious and cultural traditions which are associated with high fertility levels : *(a)* Catholic, on doctrinal grounds; *(b)* Muslim, through subordination of women in the cultural traditions; and (c) Black Africa, because of the traditional status of women within the society.[22] Middle-eastern and sub-saharan Muslim countries typically exhibit less fertility decline than do other less developed countries.

Time Required for Fertility Transition. Historically, the number of years required for fertility transition, measured in terms of reduction of the annual crude birth rate from 35 to 20 per thousand, has sharply declined over the last century. In the case of nine developed countries which recorded a crude birth rate of 35

19. W. Parker Mauldin, "Patterns of Fertility Decline in Developing Countries, 1950-75," *Studies in Family Planning,* Vol. 9, No. 4 (April, 1978): 75-84.

20. Amy Ong Tsui and Donald J. Bogue, "Declining Fertility : Trends, Causes, Implications," *Population Bulletin,* Vol. 33, No. 4 (October, 1978) : 1-55.

21. Steven E. Beaver, *Demographic Transition Theory Reinterpreted : An Application to Recent Natality Trends in Latin America* (Lexington, Mass. : D. C. Heath & Co., 1975) : 84-89.

22. W. Parker Mauldin and Bernard Bereison, "Condition of Fertility Decline . . .-.", p. 111.

or less per thousand between 1875 and i899, it took 48 years, on the average, for this level of fertility change from 35 to 20 to be reached. In the case of seven other countries, which entered the level of fertility of below 35 per thousand between 1900 and 1924, it took an average of 38 years. And in the case of another five countries which entered upon a similar fertility transition between 1925 and 1949, it took only 31 years on the average. The most recent evidence for six developing countries, though not complete, broadly suggests that the number of years required for a similiar fertility transition will range from 10 to 26 years, with a mean of 15 years.[23] As we noted above, in the case of China, which undoubtedly is a unique case, a similar change in fertility took a mere 11 years—the crude birth rate of 34.4 per thousand reported for 1966 fell to a low of 19.7 per thousand in 1976.[24] As to the experience of many developing countries entering a crude birth rate of below 35 per thousand during the last quarter of the present century, 1975-2000, no precise statement can be made on the basis of either historical lessons or the recent experience of selected developing countries.

Perhaps, among the less developed regions, no other region except Latin America has been investigated in detail as to the demographic transition, for the understandable reason of the nonavailability of the necessary vital statistics. As stated above, the developing countries, as a group, represent a great diversity in their levels of economic and social development, apart from a wide diversity in their cultural and religious settings, which at times necessitates such further subcategorization of them as low-income, middle-income, and high middle-income countries. Not only was the income level (weighted average) in the 52 middle-income countries six-fold higher compared to that of the 38 low-income countries, but the income gap between the two sub-groups further widened from US $500 in 1960 to US $1,000 in 1980. Similarly, the income gap between low-

23. Dudley Kirk, "A New Demographic Transition?" in National Academy of Sciences, *Rapid Population Growth : Consequences and Implications*, Volume II Research Papers (Baltimore : The Johns Hopkins Press, 1971): 123-147; the last group of six developing countries include Sri Lanka, Chile, Hong Kong, Puerto Rico, Singapore and Taiwan. A large number of developing countries have reported crude birth rates below 30 per thousand during 1980, including : Bahamas, 25; Barbados, 16; Brunei, 28; Chile, 21; Cuba, 18; Cyprus, 19; Dominica, 21; Hong Kong, 18; Israel, 25; Puerto Rico, 23; Singapore, 17; Sri Lanka, 28; South Korea, 23; Taiwan, 25; Trinidad and Tobag", 25; Panama, 28.

See *1980 World Population Data Sheet* (Washington, D. C. : Population Reference Bureau , 1980).

24. Coale, "Population Trends . . . ", Table 1, p. 86.

Commenting on the demographic transition in China, Judith Bannister said, "If the reported data are true, China has demonstrated that rapid economic development combined with a relatively egalitarian distribution of wealth, the economic liberation of women, a rapid increase in literacy, and a determined family planning program can compress a developing country's demographic transition into a short period of less than 40 years." See Judilh Bannister, "Current Population Growth in China" (Honolulu : East-West Population Institute, November, 1978; Mimeo).

income Asian and Subsaharan African countries on the one hand, and Latin American and Caribbean countries on the other hand, was of the order of eight-fold in 1980.[25] Caution is therefore necessary when interpreting the relevance of demographic transition in the Latin American and Caribbean region for other developing countries.

In a study of demographic transition in *25* Latin American-Caribbean countries during the 1950s and 1960s, it is estimated that "declines in mortality are typically found at early stages in the development process, clearly more so than in the past experience of developed countries. Declines in birth rate come later in the development process, on the basis of present evidence at about the time the death-rate decline has largely spent itself."[28]

In another cross-sectional longitudinal analysis of the Latin American region (including Puerto Rico) with populations over 500,000, Steven E. Beaver concludes that "Although there are limits to the Theory's power, the findings suggest that transition theory works quite well in modern Latin America . . . The theory of the demographic transition has received strong empirical support in the present study."[27] While discussing the specific aspects of the theory, the author makes the following observations: *(a)* Fertility decline is in line with predictions, particularly after 1950, but comparison among Latin American countries presents difficulties; *(b)* Fertility decline has been more rapid than in northwestern Europe or Italy; *(c)* Rates of natality decline in various countries are mildly related to the corresponding rate of change of development measures; *(d)* Fertility decline is not at all related to mortality decline; and *(e)* The openness and exposure of cultures to modernizing influences, as indexed by racial composition (European, African, East Indian, and Amerindian), strongly affects the timing of socioeconomic development, mortality decline and. natality decline.

IV. Demographic Changes in India

In spite of incontrovertible statistical evidence that the developing world is experiencing a reduced population growth rate, the potential growth on account of population momentum is simply staggering. The point of inflection in the global growth rate was crossed some time in the mid-1970s, reversing a long-standing trend in human history of gradually accelerating growth that may have

25. Per capita gross national product in 1980 in low-income Asian countries was US $ 239 and in low-income Subsaharan African countries was US $216, whereas in the Latin American and Caribbean countlies in the same year it was US $1 ,775. See *World Development Report, 1980,* p. 11.

26. Frank Wm. Oechsli and Dudley Kirk, "Modernization and the Demographic Transition in Latin America and the Caribbean," *Economic Development and Cultural Change,* Vol. 23, No. 3 (April. 1975): 391-419.

27. Steven E. Beaver, *Demographic Transition Theory Reinterpreted. . . ,* pp. 147-151.

begun with the discovery of agriculture 120 centuries ago. Nearly 90 percent of the projected population increase will take place in the developing countries, where 20 percent of the population is already severely malnourished, 30 percent lack safe drinking water or simple medical services, 40 percent are unemployed or underemployed, and about 50 percent of the adults over age 15 are illiterate. Since India is very much a part of the low-income developing world, it has been chosen as a case study for the empirical testing of the Theory of the Demographic Transition.

The first population census in undivided India was taken between 1867 and 1872. The total population was counted to be 206 million, but the census quality description varies from 'incomplete' to 'tolerably reliable'. The second census, which was taken in 1881, is considered complete and of good quality. Since then, censuses have been taken regularly every ten years.

The pre-census period estimates, as expected, differ. Kingsley Davis estimates India's population at 140 million at the time of Alexander the Great's invasion of India in 327-326 B.C.[28] But an estimate for the seventh century A. D. is a mere 37 million, based on the observations of the Chinese Bhudhist Hiuen Tsang, who visited India at that time.20,-£At the time of the Moughal Emperor Akbar's death, economic historian W. H. Moreland puts the national population at 100 million for mid-medieval India (around 1600 A.D.).[SO] After careful evaluation of the estimates prepared by Moreland, Ajit Das Gupla suggests a revised figure of 115 million for the year 1600, 154 million population for 1800 and 189 million for 1850, "built up by the historical-component technique from varying growth rates of major components."[31]

The history of population growth since 1871, based on the census data, is characterized by a significant change around 1921. A modest but highly irregular growth rate has been registered over the last five decades, from 1871 to 1921. With an actual decline in total population during 1891-1901 and 1911-1921, the national population increased by 20 percent only. Davis estimates India's population within its present boundaries at about 209 million in the year 1871.[88] Over the last century, the total population jumped almost threefold, reaching

28. Kingsley Davis, *The Population of India and Pakistan* (Princeton, N. J. : Princeton University Press, 1951), p. 24.

29. J. C. Russell, "The Population of Hiuen Tsang's India (A. D. 629-C45)", *Journal of Indian History'* Vol. 47 (August, 1969): 367-383.

30. W. H. Moreland, *India at the Death ofAkbar : An Economic Study* (London : Macmillan and Co., Limited, 1920), p. 22. The author says that ". . .we are justified *in concluding* that there must have been at the least somewhere about 100 millions of people in India in order to carry on the activities disclosed by contemporary authorities."

31. Ajit Das Gupta, "Study of the Historical Demography of India," in D. V. Glass and 'Rodger Revelle (eds.). *Population and Social Change* (London : Edward Arnold, 1972), pp. 419-435.

32. Kingsley Davis, *The Population ofIndia .. . ,* p. 24.

548 million in 1971. And, according to the latest figures available for the 1981 census, the national population is placed at 684 million, with a decennial growth rate of 24.75 percent during the last decade, 1971-1981.[33]

India's population growth prior to World War II does not appear to be anything unusual when compared to global experience. The average rate of increase of India's population of 0.60 percent per year from 1871 to 1941 is slightly less than the corresponding rate for the whole world of 0.69 percent from 1850 to 1940. In its earlier stages of economic development, Japan's population grew by 120 percent from 1871 to 1940, and in the British Isles it grew by 79 percent during 1821 to 1891.[34]

Data Sources. The demographic data on India are available from four other sources, apart from the decennial censuses : (a) the Civil Registration System since 1876; *(b)* the National Sample Surveys since 1950; *(c)* the Sample Registration System since 1964-65; and *(d)* various other macro- and micro-studies.

The most important source of demographic statistics is the series of official decennial censuses. Although no specific questions designed to generate independent estimates of fertility and mortality are included in the census questionnaire, these censuses provide figures for the total size, intercensus population growth and estimates of fertility and mortality through the analysis of age/sex data. The population enumerated pertains to the official reference date, usually sunrise on March 1. However, some areag are enumerated before the official date, such as snowcovered remote areas, representing a minor fraction of one percent of the national population. Regular population censuses have been held in India since 1881. These efforts constitute an enormous administrative task, involving over a million enumerators. Every household is expected to be listed and visited by an enumerator. In contrast, it may be noted that the developed countries obtain similar demographic data through mail-questionnaire. In the last official census of the People's Republic of China in 1953, every household head was required to report to the census registration office.

The question of the reliability of the census data in India produces a mixed reaction among researchers. As far as the determination of the total population size is concerned, it is termed of reasonably good quality given the experience of other developing as well as developed countries. The post-enumeration check conducted by the Census Office in 1961 and 1971 revealed an undercountof 0.7 percent and 1.7 percent respectively. Robert Cassen observes that "census in many other countries exhibits similar proportional undercount."[35] In the last

33. Registrar General, India, Government of India, *Census ~of India 1981 : Provisional Population Totals,'* Series I'(New.Delhi*: March, 1981), p. 3.

34. R. H. Cassen, *India': Population, Economy, Society (New* York : Holmes 1978), p. 7.

35. Robert Cassen, "India's Human Resources," in *India: Occasional Papers,* World Bank Staff Working Paper, No. 279;(Washington, D. C. : November, 1978),'p. 132.

U. S. Census of 1970, five million persons are reported to have been missed, amounting to a 2.5 percent undercount.[36] The experience of the latest U.S. 1980 census is no different.

The age-sex distributions, which are based on census sample tabulation (for example, for 1971, the data are based on 10 percent rural and 20 percent urban sample), rank rather low on the score of the United Nations Age-Sex Accuracy Index. The estimated rank is 50 and 40 for the 1961 and 1971 censuses respectively. However, it may be pointed out that the United Nations Age-Sex Accuracy Index primarily treasures net age misreporting and net coverage error.

The vital rates, as estimated by the Census Actuary for 1951 from the census data, have been noted for their remarkable accuracy by eminent demographers Ansley J. Coale and Edgar M. Hoover.[37] The authors arrived at almost identical rates for 1951 based on a different technique of Lotka's stable population model.

During British rule in India, a Registration of Births and Deaths Act was passed in 1886. Since its implementation was grossly deficient, it failed to produce any reliable figures. After careful examination of the death rate data for British India during 1911-1947, Davis estimates that the amount of underregistration certainly exceeds 30 percent at all times, and is probably of the order of 53 percent.[38] Nearly a century later, a compulsory registration of births and deaths Act was enacted in 1969. However, the data from the system continues to be deficient.

In order to meet the ever growing demand for reliable vital statistics, a national Sample Registration Scheme (SRS), first on a pilot basis in five states, was introduced in 1963-61. It was extended in 1955 to cover all the states in India with a rural sample of about 2,400 village; and an urban sample of 1,300 blocks, together covering over 3.1 million people. It was a stratified one-stage random sample in the villages and a two-stage random sample in the 2,700 towns and cities. Emphasizing the importance and need for 'refined estimates' of fertility and mortality at the state and sub-state level, the Working Group on Population Policy has recently recommended the enlarging of the sample size of the Sample Registration Scheme from 6,000 units to 10,000 units at an additional annual cost of Rupees 4.1 million.[39]

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36. Peter K. Francese, "The 1980 Census : The Counting of America," *Population Bulletin*, Vol. 34, No. 4 (September, 1979), p. 3. The author states that "For 1980, the Census Bureau will hire more than a quarter of a million enumerators and spend almost $1 billion to see that the coverage of what are expected to be about 222 million people is even closer to the elusive 100%.

37. S. N. Agarwala, *Some Problems of India's Population*, (Bombay : Vora and Company, 1966), p. 40.

38. Kingsley Davis, *The Popu'ation of India* . . ., p. 34.

39. Planning Commission, Government of India, *Working Croup on Population Policy : Interim Report* (New Delhi : 1979), p. 35.

According to the dual record system of the SRS, a resident (usually part-time) enumerator in each village or block compiles a complete record of births and deaths. This record is then matched with the events reported to the supervisory staff (full tim;) during a retrospective survey of events during the preceding six months; unmatched and partially matched events of births and deaths are verified.[40] In spite of enormous adminisrative efforts, a scientifically designed sample scheme, and the dual record system, the scheme is not perfect and suffers from undercount, which the Registrar General describes as 'unavoidable'!- A field check by the SRS itself showed an undercount of births by 7.7 percent and of deaths by 9.2 percent in the urban areas of Andhra Pradesh for 1973.[41] Another independent researcher asserts that the SRS is approximately 8 percent deficient in its coverage of live births.[4'] Having pointed out the limitations, we must stress that most researchers are of the view that the SRS provides the 'best' set of vital statistics available on India on a regular basis.

In 1949 a national sample survey organization was established to provide essential and basic economic, social, and demographic data for economic planning purposes in India. These reports of a continuing series are based on a single interview of a large, national sample. For example, the fertility data was obtained from 34,000 rural and 6,000 urban couples throughout India.[43] Through various demographic questions, as part of a larger survey, in selected rounds, valuable information has become available on fertility, mortality, family planning practices, age at marriage, and internal migration etc.[44] The quality of survey data is considered much better than that available from civil registration or census report, but below that of the Sample Registration Scheme. The

fEditor's comment : The author has referred to the quality of SRS data. These references were made at a time when SRS was in the initial stages of implemeniaiion.

40. For details of the SRS, see: (i) B. L. Agarwal, "Sample Registration in India," *Demography,* Vol. 4, No. 1 (1967) : 374-387; (ii) Pravin Visaria and Anrudh K. Jain, *India : Country Profiles* (New York : The Population Council, 1976), p. 15; and (iii) Joan W. Linger and H. Bradley Wells, *Organization and Methods of the Dual Record System in India,* Scientific Report Series No. 9 (Chapel Hill, N. C. : The University of North Carolina Laboratories for Population Statistics, 1973).

41. Robert Cassen, "India's Human Resources," p. 134.

42. V. Soni, "The Role of Vasectomies in the Indian Family Planning Program: A Demographic Analysis" (University of London, Ph D. Thesis, 1975; unpublished), quoted by Robert Cassen, "India's Human Resources," p. 134.

43. Ministry of Finance, Government of India, *Couple Fertility,* The National Sample Survey Report No. 7 (New Delhi : Manager of Publications, 1955).

44. Ministry of Finance, Government of India, *Tables with Notes on Family Planning,* National Sample Survey Report No. 116 (New Delhi : Manager Publications, 1970). Fora general discussion of demographic information available from the National Sample Survey Reports, see N. C. Das and N. Bhattacharya, "National Sample Survey : An Appraisal of Demographic Data," in *Population Statistics in India,* edited by Ashish Bose, Devendra B. Gupta and Gaurisankar Raychaudhuri (New Delhi : Vikas, 1977) : 38-62.

quality appears to suffer from recall lapse and under-reporting of vital events. Death rates are reported to suffer more from this recall lapse than do the corresponding birth rates.[45]

From time to time various *ad hoc* micro and macro studies have been made by research institutes, individual scholars, government departments and international agencies in order to gain better understanding of various elements of demographic dynamics in India at local, regional and national levels. A most comprehensive and careful investigation based on field work during 1953-59 and the 1969 follow-up survey of a rural area in northern Punjab was conducted under the joint auspices of Harvard University, the Rockefeller Foundation, and the Government of India.[46] Another prominent example is of a survey conducted in southern Mysore State jointly by the United Nations and the Government of India.[47] The International Institute for Population Studies, Bombay, has prepared extensive bibliographies on research in India. The number of citations under each topic is continuously growing.[48] The Registrar General recently conducted an extensive survey based on the national random sample of 230,012 ever-married women to "study the pattern and differential in fertility for different socio-economic levels.[48] Various fertility measures, such as total fertility, general marital fertility, and total marital fertility are classified by level of education, per capita monthly expenditure, and religion. While various fertility measures appear reasonably convincing, the estimated mortality rates appear to be rather on the low side.

Mortality Behaviour. The crude death rate in India is estimated to have remained almost unchanged during three decades between 1881 and 1921. In the next thirty-year period, 1921-1951, it is believd to have begun to decline gradually. And in the last three decades, the rate of decline accelerated. It is projected to reach the level prevailing in the contemporary industrialized nations by the end of the century.

45. Pravin Visaria and Anrudh K. Jain, *India : Country Profiles* p. 15. Also see R. B. Chari, "Vital Statistics System in India," paper prepared for the Conference on Vital Statistics in Asia, Manila, May, 1977 (unpublished). Chari says, "Data for vital events have also been collected in various rounds of the National Sample Survey but are considered to be of lower quality than data from the Sample Registrat'on Scheme."

46. John B. Wyon and John E. Gordon, *The Khanna Study : Population Problems in the Rural Punjab* (Cambridge, Mass. : Harvard University Press, 1971).

47. United Nations, *The Mysore Population Study*, ST/SOA/Series A (New York : United Nations, 1961).

48. Asha A. Bhende, Tara Kanitkar and G. Rama Rao, *Teaching and Research in Population Stud.es* (Bombay : International Institute for Population Studies, 1976); also see S. N. Agarwa'a, *India's Population Problems*, pp. 23-39.

49. Vital Statistics Division, Office of the Registrar General, *Fertility Differentials in India 1972* (New Delhi : 1976), p. 2.

By comparing the number of survivors in each group over the consecutive decennial censuses, it is estimated that the intercensus crude death rate fluctuated between 41 and 47 per thousand between 1881 and 1921, declined to 36 per thousand between 1921 and 1931, and was of the order of 31 per thousand between 1931 and 1941.[5a] For the next decade, 1951-61, it is estimated by the Registrar General to have been 27 4 per thousand. Starting from 21 per thousand in 19 *A*, the crude death rate further dropped to 16 per thousand in 1971. According to the Sample Registration Scheme, it is estimated to have reached a low level of 14 per thousand in 1978 (Appendix Table 1). The Working Group on Population Policy has recently recommended a target of crude death rate of 9 per thousand by the turn of the century.[61]

The Theory of the Demographic Transition suggests that the initiation of, mortality decline is caused by the improvement in general socioeconomic conditions. The prevailing equilibrium between birth and death rates in a given society is disturbed, in earlier stages, by the availability of better food and an improvement in nutritional level; and, in later stages, by the spread of preventive and curativ.5 medicine. In the case of India, it can be said that, prior to 1921, there was no significant improvement in the general economic and social conditions, particularly in the vast rural areas where four-fifths of the national population lived. But, in the next three decades, general improvements in the availability of medical services with effective measures to control major killer diseases (malaria, cholera, small pox etc.), have contributed to an observed sharp decline in the mortality level, which declined by nearly one-third during the same period. The recent post-1950 mortality decline is attributed partly to economic factors and partly to the expansion of medical services, including the supply of pure drinking water under the various five-year economic development plans. Since there has not been any noticeable improvement in the economic condition of the population below the poverty line (40-45 percent of the total population), it seems rather difficult to attribute any meaningful credit to the socioeconomic factors as compared to the health services.

As to the future mortality trend, there are two opposite schools of thought. One school of thought is that mortality in India "has reached a plateau around which it fluctuates; there seems to be little or no downward trend."[52] This view is also supported by the recent United Nations data on mortality in the less developed regions. Whereas in its 1968 assessment of the world population prospects it anticipated an average annual increase in life expectancy at birth over a five-year period, 1965-70 to 1970-75, to be 0.58 years, in its similar 1978 assessment of world population trends, the actual annual increase is reported to be only •

50. Kingsley Davis, *The Population of India* . . . , p. 85.
51. *Planning Commission, Working Croup . . . , p. 4.*
52. R. H. Cassen, *India : Population, Economy* .. . , p. 114.

0.40 for the same regions.[53] After carefully examining the mortality and socio-economic trends, Davidson R. Gwatkin concludes that "developing country mortality trends have become much more fragile and uncertain," and wonders if the post World War era of the 1950s and 1960s, with high annual increases in life expectancy of the range 0.60 to 0.70 years, has come to an end.[54] In complete disregard of this growing evidence of the slowing down of the mortality trend in India, the recent target of the Planning Commission that India will reach a mortality level of below 10 per thousand before the end of the century must be interpreted cautiously.

Fertility Behaviour. In general, in today's developing countries, the marital fertility rates are found to be much lower than those prevailing in 19th century Europe. For example, if the married women in India in the 1950s had borne children at the same age-specific fertility rates as married women in Sweden in the 1870s, India's crude birth rate would have been W per thousand instead of the actual 42 per thousand. Alternatively, if India's marital rates of the 1950s had been combined with the Swedish marital patterns of the 1970s, India's crude birth rate would have been reduced to about 18 per thousand, the same as is currently observed in most of the developed countries.[53] In the prime reproductive age groups, according to the 1961 Indian census, the percentage of married females was 70 percent among those 15-19 years old, 92 percent among those 20-24, and 94 percent among the 25-29 group (Table 2 and Chart 1). In contrast, given Sweden's long tradition of late marriage, only 20 percent of the females were married in the age group of 20-24, and 47 percent in the age group of 25-29 in the year 1900.[58]

From Chart 2 it is evident that in 1971 compared with 1961 the proportion of females married was significantly higher after age 25-26 years for every five-year age group. A similar trend is observed for Kerala State. This may be explained by (i) a significant increase in life expectancy at birth for both males and females; and (ii) a gradual increase in widow remarriages with general social and economic development. According to the census data, the expectation of life at birth for females jumped from 31.7 years in 1941-51 to 40.6 years in 1951-61, and further to 46.5 years in 1961-71. The mean age at widowhood for

53. United Nations, Population Division, *World Population Trends and Prospects by Country*, 1950-2000 (New York : 1979).

54. Davidson R. Gwa kin, "Indications of Change in Developing Country Mortality Trends : The End of an Era?" *Population and Development Review,* Vol. 6, No. 4 (December, 1980): 615-644.

55. Joginder Kumar, "A Comparison Between Current Indian Fertility and Late Nineteenth Century Swedish and Finnish Fertility," *Population Studies,* Vol. 25, No. 2 (1971) : 269-282.

56. Murray Gendell, "Sweden Faces Zero Population Growth." *Population Bulletin,* Vol. 35, No. 2 (June, 1980), p. 14.

TABLE 2—MARRIED FEMALES, BY AGE-GROUP, INDIA AND KERALA STATE, 1961 AND 1971

(Percentages)

Age-group	*India*			*Kerala*		
	1961	*1971*	*Percentage change 1971/1961*	*1961*	*1971*	*Percentage change 1971 1 1961*
1. 15-19 years	69.6	55.5	—20.3	25.8	18.1	—29.9
2. 20-24 years	91.8	88.9	— 2.1	72.2	64.2	—11.1
3. 25-29 years	94.2	95.0	+ 0.8	84.2	85.5	+ 1.5
4. 30-34 years	91.5	94.1	+ 2.8	84.2	86.9	+ 3.2
5. 35-39 years	87.1	91.4	+ 3.8	81.4	85.1	+ 4.5
6. 40-44 years	77.7	84.2	+ 8.4	73.5	78.8	+ 7.2
7. 45-49 years	69.8	78.1	+ 11.9	67.9	72.9	+ 8.8

SOURCE : Census data quoted in :

K. Srinivasan, T. K. Roy, and Sulabha Ghogale, *Family Planning Targets by States for India*, Vol. 1 : Methodology and Input Data (Bombay : International Institute for Population Studies, December, 1980), pp. 54-55.

females is also increasing, though very gradually. It is estimated to be 34.8 years, based on the sample 1971 census data for those widowed before the age of 45 years, whereas the corresponding figure for 1951-61 is 34.0 years. Similarly, the mean age at leaving the fertile union, ended either by the death of either partner or when the female reaches the age of 45 years, increased from 42.0 years during 1951-61 to 42.3 years during 1961-71.[57] Three surveys of rural areas of India during the late 1950s "show that of the females who get widowed, 25 to 38 per cent get married".[58]

A detailed study of the total fertility rate in India indicates a significant decline of 12.4 percent between 1971-72 and 1976, with a somewhat higher decline of 15.9 percent in the urban areas. In the rural areas, where four-fifths of the national population lives, the total fertility rate declined from 5.74 in 1971-72 to 4.96 in 1976, a reduction of 13.6 percent. In terms of age-specific fertility rates, all age groups above 24-29 years have shown significant reductions, ranging from 16 to 48 percent. The rural sample suggests a much higher decline when compared to the corresponding urban sample. The most produc-

57. S. N. Agarwala, *Population* (New Delhi : National Book Trust, 1977), pp. 38-39 and 42.

58. S.N. Agarwala, *Some Problems of India's Population*, (Bombay : Vora and Co., 1966), p. 86.

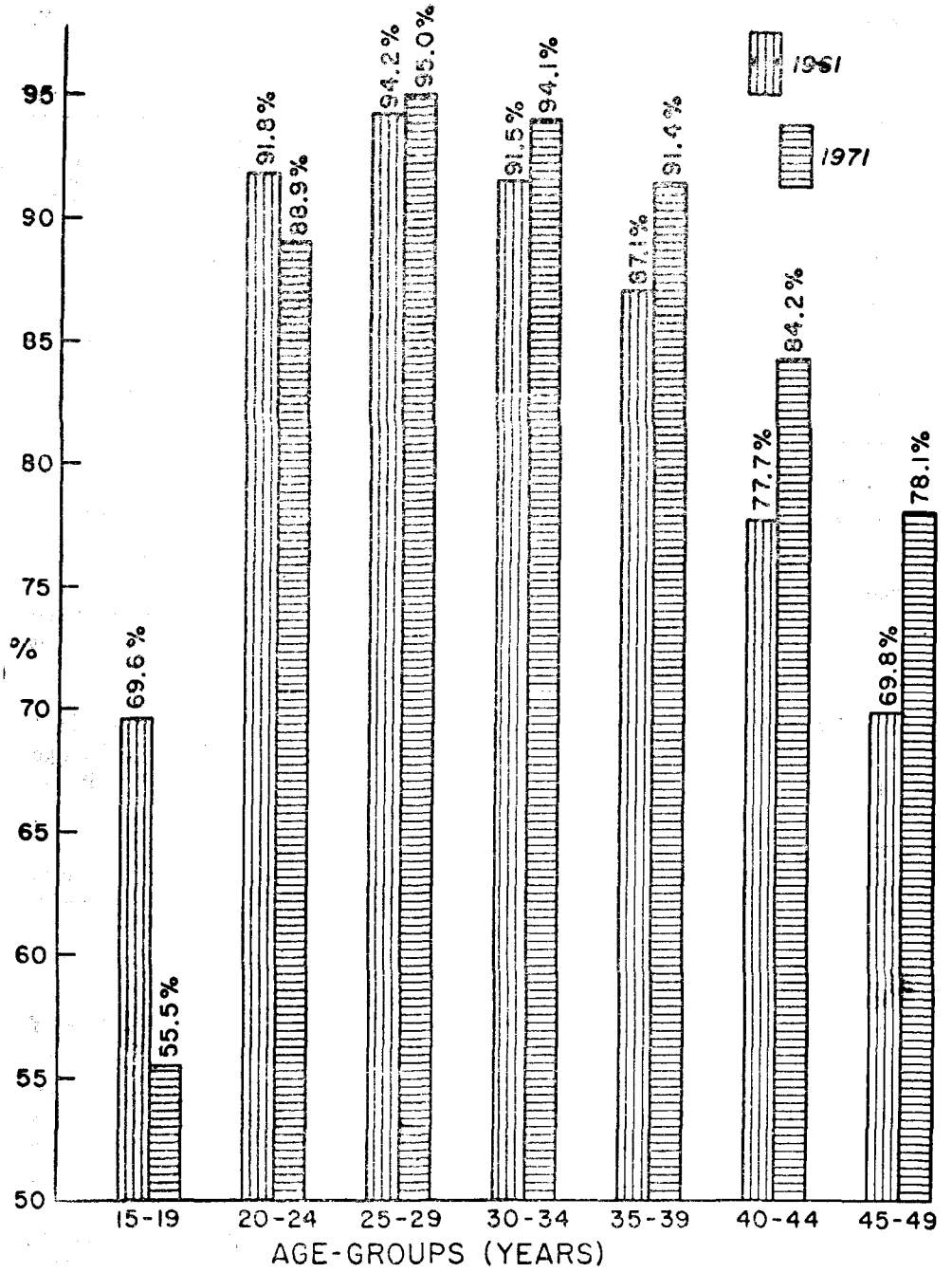
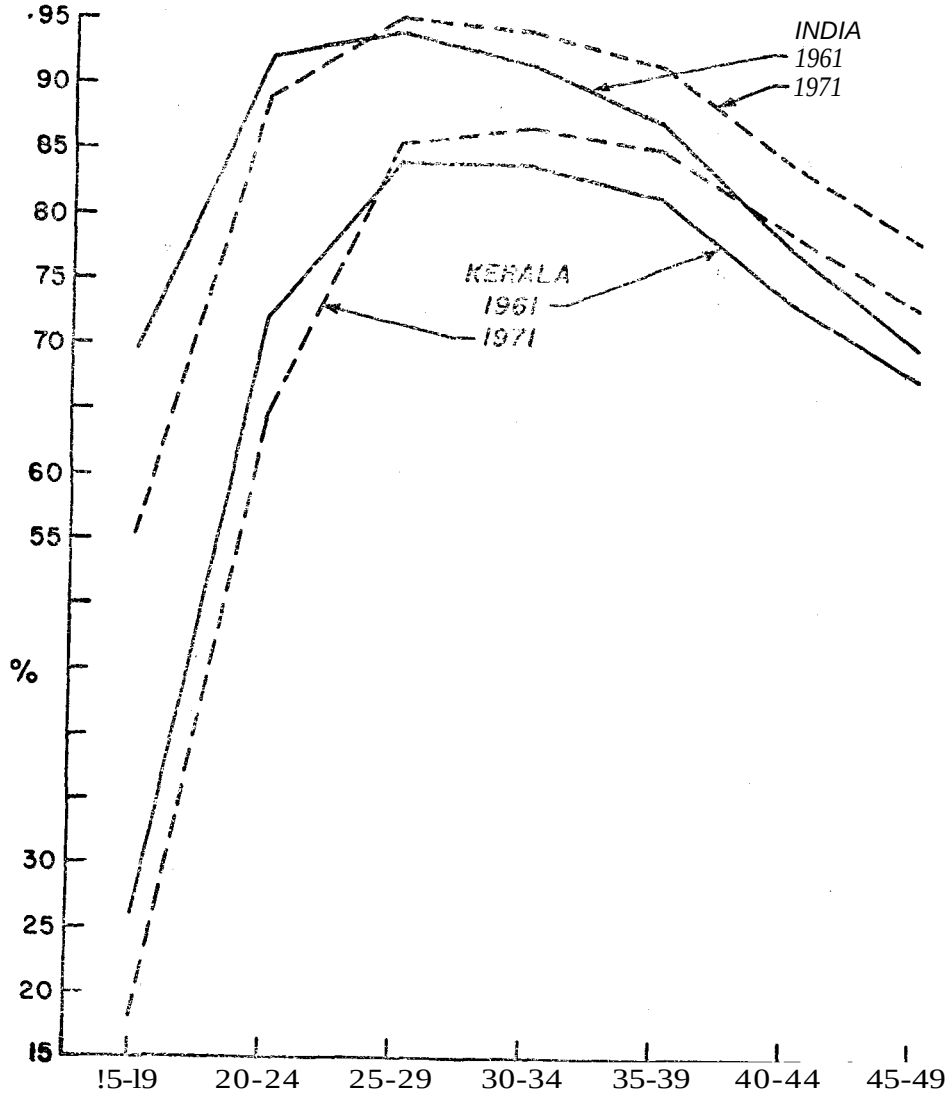


Chart 1 : Proportion married Females, by Age-Group, India, 1961 and 1971.



SOURCE: TABLE 2.

Chart 2 : Proportion married females, India and Kerala State, 1961 and 1971.

tive age group of 20-24 years shows almost no change, but the urban 15-19 years age group recorded an increase of 25 percent in its fertility rate (Table 3 and Chart 3). This is perhaps explained by improved health services in the

TABLE 3—AGE-SPECIFIC TOTAL FERTILITY RATES IN INDIA, 1971-72 AND 1976[a] : TOTAL, RURAL AND URBAN

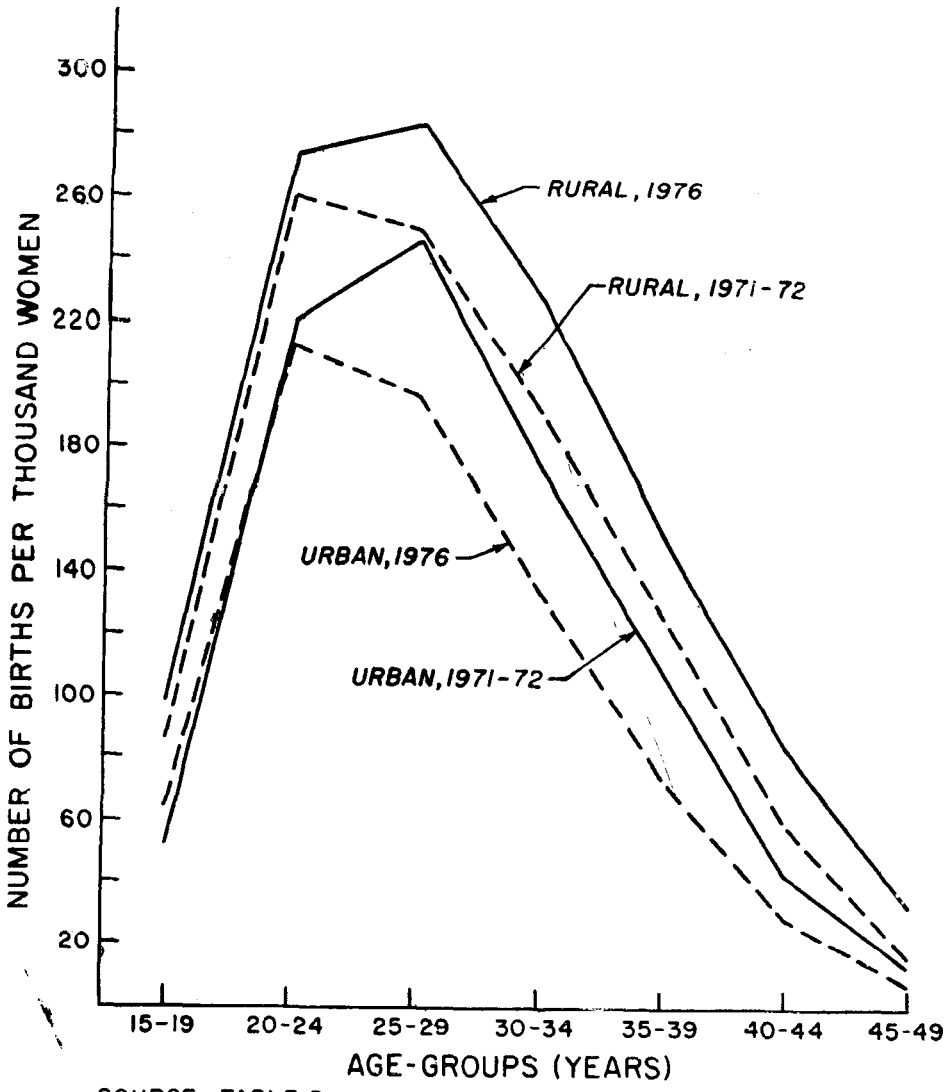
TFR and age group	*Total*			*Rural*			*Urban*		
	1971-72	*1976*	*Percentage change*	*1971-72*	*1976*	*Percentage change*	*1971-72*	*1976*	*Percentage change*
Total Fertility Rate : all age groups	5.34	4.68	—12.36	5.74	4.96	—13.6	4.28	3.60	—15.89
1. Age group 15-19 yrs	89	83	— 6.74	98	87	—11.2	52	65	+25.00
2. Age group 20-24 yrs	260	250	— 3.85	274	260	— 0.05	221	214	— 3.17
3. Age group 25-29 yrs	261	239	— 8.43	283	251	—11.31	247	197	—20.24
4. Age group 30-34 yrs	215	180	—16.28	227	191	—15.86	173	134	—22.54
5. Age group 35-39 yrs	141	116	—17.73	151	126	—16.56	108	74	—31.48
6. Age group 40-44 yrs	74	53	—28.38	83	59	—28.92	43	29	—32.56
7. Age group 45-49 yrs	29	16	—44.83	33	17	—48.48	13	8	—38.48

a, Number of births per thousand women;

1971-72 data from Fertility Survey by the Registrar General, India conducted in 16 states and union territories;

1976 data : Sample Registration Scheme data, excluding the states of West Bengal and Bihar.

SOURCE : Unpublished data made available to the National Academy of Sciences, Committee on Population and Demography, Panel on India, "1979 Workshop in New Delhi." *Quoted in World Fertility Chart*. Population Reference Bureau, Washington, D. C. : January, 1981.



SOURCE: TABLE 3.

Chart 3 : Age-specific total fertility rates, rural and urban, India, 1971-72 and 1976.

urban areas during the last three decades, and an increase in the mean age at marriage for females from 15.5 years in 1961 to 17.2 years in 1971.

During the decade of 1961-71, the proportion of women married fell by over 20 percent in the age group 15-19 years. But in the most productive age group of 20-24 years, the similar decline was only 2 percent. In the remaining age-groups, there were marginal increases perhaps on account of significant increase

in life expectancy at birth, which jumped from 32 years in the 1940s to 45 years in the 1960s and to 49.9 years in 1971. Increases observed in the rate of widow remarriages during the post-Independence period must have contributed to this change in the proportion of women married.

Forward Projections. In spite of the well known professional hazards of making long-term population projections, there is no dearth of individual researchers and agencies, both domestic and international, who have, in the recent past, made detailed population projections for India. For a comparative analysis, the following studies are examined : Planning Commission and Registrar General (1979), Appendix Table 2; Raghavachari (1974), Appendix Table 3; Ambannavar (1975), Appendix Table 4; Cassen (1978), Appendix Table 5; Tsui and Bogue (1978), Appendix Table 6; United Nations (1979), Appendix Table 7; World Bank (197)), Appendix Tables 8 and 9; and United States Bureau of the Census (1979), Appendix Table 10.

For lack of necessary demographic data, earlier work in India was rather mechanical in the nature of projecting past trends into the future. With the improvement of the data base, the various sets of estimates prepared by the Expert Committee on Population Projections (in 1968 and again in 1972) have made use of the component method. The estimates made by this Committee and used by the Planning Commission and other agencies in their work (Projection III) are "based on current thinking of family planning : birth rate may reach a level of 30 points by 1982-83 . . . reduction beyond that level may be an onerous task . . . reduction of one point every two years was assumed."[59] Similarly, Raghavachari and Ambannavar have made use of the same component method with varying assumptions as to fertility and mortality behaviour.

Raghavachari's medium series are based on the assumption that the crude birth rate of 25 per thousand is achieved by the end of the century (Appendix Table 3). In Ambannavar's estimates, the level of fertility declines logarithmically and net reproduction rate of unity is achieved in the next century by the year 2026. In terms of crude birth rate, the projected level for the year 2001 is 24 per thousand (Appendix Table 4).

Cassen assumes six different paths of fertility decline in terms of total fertility rate (TFR) depending upon the number of years required to reach a level of TFR of 2.5, starting from a TFR of 6.1 during 1965-70. Similarly, four different paths of mortality decline, in terms of increase in expectation of life at birth, are projected. Seriously discounting the probability of rapid mortality and fertility decline, Cassen adds that "we would expect the immediate future to be bracketed by projections F_3 and *MI* (attainment of TFR 2.5 during the next 40

59. Registrar General, India, Government of India, *Report of the Expert Committee on Population Projections* (New Delhi : Controller, Department of Publications, 1979), p. 3.

years during years 2005-2010 and increase in expectation of life at birth by one year every five years) and by F_4 and $M_{1\cdot5}$ (attainment of TFR of 2.5 in a 30-year period during 1995-2000 and increase in expectation of life at birth by one year every five-year period).[80] In terms of crude birth rate, it is estimated that a low level of 20 per thousand would be achieved by the turn of the centuary.

Like Cassen, Tsui and Bogue assume in their medium series that the TFR will reach 2.89 in the year 1999-2000, starting from a high level of 5.67 in 1968 (Appendix Table 6). Their projections consider socioeconomic factors as well as the family planning program effort, and are based on annual declines in TFRs relative to two factors : *"(a)* current fertility level, and *(b)* current strength of the family planning program effort."[61]

The estimates prepared by the United Nations utilize patterns of fertility decline observed in Asian countries. It was assumed that, once a fertility decline began, the gross reproduction rate[62] would decrease by 5 percent in the first five-year period, by *10 percent in* the next two five-year periods, and by 15 percent during each of the following three five year periods. And after this cumulative 30-year period, fertility level would decline more slowly. Mortality decline, measured in terms of life expectancy at birth, is a function of its le\el. Quinquennial gain of 2.5 years in life expectancy is assumed before mortality level of life expectancy at birth of 55 years for both sexes is reached; and after that level gains are gradually reduced (Appendix Table 7).

The World Bank estimates express mortality behaviour in terms of an increase in the expectation of life at birth for females with reference to the per capita income level of 129 member countries classified into throe groups. And, in the. assumption of future fertility trends, the starting point is the year in which net reproduction rate (NRR) of unity is likely to be achieved. The TFRs for intermediate years are calculated in three stages: *(a)* an exponential curve is fitted between the initial year and the year in which NRR is equal to unity; *(b)* this fitted curve is used to estimate TFR for 1985; *(c)* a reverse geometric curve is-fitted to the first segment (up to 1985-90) and a geometric curve is fitted to the second segment, beyond 1985-90. India is projected to complete its fertility transition in the period of 60 years from 1965-70 to 2025-30 (Appendix Table 8)[63]Finally, the U. S. Bureau of Census projections consider the following fac-

Finally, the U. S. Bureau of Census projections consider the following factors; current level of fertility, recent trend in fertility, social and economic deve-

60. R. H. Cassen, *India: Population. . .* , p. 137.

61. Tsui and Bogue, "Declining World Fertility . . .", p. 34.

62. The gross reproduction rate (GRR) is the average number of daughters that would be born to a woman during her lifetime if she passed through her chiidbearing years conforming to the age-specific facility rates of a given year.

63. K. C. Zachariah and My Thi Vu, *Population Projections 1975-2000 and Long Term (Stationary Population),* (Washington, D. C. : World Bank, July, 1979): 212-213.

lopment, current status and impact of family planning and public health programs, expressions of "desired" family size in the population, and fertility decline assumptions made by other international agencies. However, it is pointed out that "The three fertility projection series in this report did not use any mathematical models of fertility change; instead, the assumptions were made on a judgemental basis."[64]

For analytical purposes, the fertility and mortality levels as projected by these studies over the next 30-year period, 1971 to 2001; are presented in Tables 3 through 8. These projections represent medium assumption series. Reflecting professional judgements, the diversity of opinion is apparent. The following points may be noted.

1. There is no agreement as to the 'accurate' level of crude birth rate in the base year of 1971. The highest rate of 40.5 per thousand is reported by the World Bank and the lowest of 36.9 per thousand is estimated by the Indian Planning Commission (Table 4). Both studies offer arguments supporting their respective positions. It is highly instructive that demographic data of reason-

TABLE 4—PROJECTED FERTILITY LEVEL IN TERMS OF CRUDE BIRTH RATE, 1971-2001, INDIA"

Author ofprojections	*1971*	*1976*	*1981*	*1986*	*1991*	*1996*	*2001*
1. Planning Commission (1980)	36.90	34.40	31.52	28.46	24.64	21.36	20.24
2. Raghavachari, "Medium-2 series"	37.12	33.98	31.46	29.06	27.50	26.26	24.86
3. Ambannavar, "Medium series"	38.60	35.80	35.54	31.26	28.80	26.30	24.10
4. Cassen, "Medium series" (Mi.g, F_4)	38.60	34.70	31.32	28.32	25.40	22.16	19.60
5. United Nations, "Plausible series"	39.52	37.58	35.64	33.18	30.48	27.54	24.40
6. World Bank	40.46	36.72	33.82	32.40	30.54	28.26	25.80
7. U. S. Bureau, "Medium series"	39.00	36.15	33.04	31.00	29.44	28.08	26.88
8. Tsui and Bogue, "Medium series"	40.10	37.10	34.34	31.78	28.76	25.96	22.76

Note. a. For purposes of comparison, the missing data for specific years have been calculated by linear interpolation. For example, the U. S. Bureau projections were made for the years 1980, 1985, and so on; the required data for the years 1981, 1985 and so on have been interpolated.

SOURCE : Ca'cu'ated from Appendix Tables 1 to 10.

64. U.S. Bureau of the Census, *Illustrative Projections of World Population to the 21st Century* (Washington, D. C. : January, 1979), p. 15. See also U.S. Bureau of the Census, *World Population 1979 : Demagraphic Estimates for the Countries and Regions of the World* Washington, D. C. : October, 1980).

able accuracy do not come easily, at least not in India even after a full century of census taking.

2. In order to facilitate comparison, Table 5 displays projected reductions in the fertility levels in terms of percentages, by decades and over a 30-year

TABLE 5-PROJECTED FERTILITY DECLINE IN TERMS OF CRUDE BIRTH RATE, INDIA, 1971-2001, IN NATIONAL AND INTERNATIONAL SELECTED STUDIES

(Percentages)

Authors	*1971-81*	*1981-91*	*1991-2001*	*1971-2001*
I. Planning Commission	14.6	21.8	17.9	45.1
2. Raghavachari, Medium-2 series	15.2	14.4	9.6	33.0
3. Ambannavar, Medium series	7.9	18.9	16.3	37.6
4. Cassen, Medium (M1.5, F_4) series	18.7	18.9	22.8	49.2
5. United Nations, "Plausible" series	9.8	14.5	19.9	38.3
6. World Bank	16.4	9.7	15.5	36.2
7. U. S. Bureau, Medium series	15.3	10.9	8.7	31.1
8. Tsui and Bogue, Medium series	14.4	16.3	20.9	43.2

SOURCE ; Calculated from Appendix Tables 1 to 10

period, 1971-2001. During the decade of 1971-81, the United Nations project a modest decline of 9.8 percent against a 14-18 percent decline projected by all other studies. And, over a 30-year period, the lowest decrease in fertility is predicated by the U. S. Bureau of the Census estimates of 31 percent, while Cassen and the Planning Commission project the highest decline of 49.2 percent and 45.1 percent respectively.

3. The pace as well as the pattern of fertility transition over the 30-year period is characterized by a great diversity (Table 5). While Tsui and Bogue, and Ambannavar, project almost a uniform rate of decline in each five year period, the United Nations expect the pace of decline to accelerate and to reach about a 50 percent higher level in the last five-year period, 1996-2001. In contrast, the World Bank and the U. S. Bureau of the Census project the rate of fertility transition to decrease by about 40-50 percent over the same period (Table 6).

4. In terms of projected level of fertility for the year 2001, the most conservative estimates are those made by the U. S. Bureau of the Census (27 per thou-

TABLE 6—PROJECTED ANNUAL FERTILITY DECLINE IN TERMS OF CRUDE BIRTH RATE, 1971-2001, INDIA"

Authors of Projection	*1971-76*	*1976-81*	*1981-86*	*1986-91*	*1991-96*	*1996-2001*
1. Planning Commission (1980)	0.50	0.58	0.61	0.76	0.66	0.23
2. Raghavachari, "Medium-2 series"	0.63	0.50	0.48	0.31	0.25	0.28
3. Ambannavar, "Medium series"	0.56	0.45	0.46	0.49	0.50	0.44
4. Cassen, "Medium series[1]' (Mi.$_5$, F_4)	0.78	0.68	0.60	0.58	O.f5	0.51
5. United Nations, "Plausible series"	0.39	0.39	0.49	0.54	0.59	0.63
6. World Bank	0.79	0.58	0.28	0.37	0.45	0.49
7. U. S. Bureau, 'Medium series"	0.57	0.62	0.41	0.31	0.27	0.24
8. Tsui and Bogue, ''Medium series"	0.60	0.55	0.51	0.61	0.56	0.64

Note. a. For purposes of comparison, the missing data for specific years have been calculated by linear mferpo/at.'on. For *example,* the U. S. Bureau projections were made for the years 1980, 1985 and soon; the required data for the years 1981, 1985 and so on have been interpolated.

SOURCE : Calculated from Appendix Tables 1 to 10.

TABLE 7—PROJECTED MORTALITY LEVEL IN TERMS OF CRUDE DEATH RATE, 1971-2001, INDIA"

Author of Projections	*1971*	*1976*	*1981*	*1986*	*1991*	*1995*	*2001*
1. Planning Commission (1980)	14.90	15.00	13.04	11.64	10.42	9.31	8.65
2. Raghavachari, "Medium-2 series"	15.88	13.PO	12.30	10.80	10.24	9.84	8.80
3. Ambannavar, "Medium series"	16.20	14.30	11.CO	10.72	9.54	8.68	8.10
4. Cassen, "Medium (Mj.s, F_4) scries"	16.90	15.40	14.02	12.90	11.96	11.12	10.32
5. United Nations, "Plausible series"	16.10	16.64	13.10	11.68	1038	9.24	8.14
6. World Bank	16.20	14.70	13.50	12.68	12.04	11.44	10.72
7. U. S. Bureau, "Medium series"	17.00	15.60	12.40	10.90	9.82	8.88	8.24
8. Tsui and Bogue, "Medium series"	16.32	15.12	13.95	1256	12.25	11.46	10.90

Note. a. For purposes of comparison, the missing data for specific years have been calculated by linear interpolation. For example, the U. S. Bureau projections are made for the years 1980, 1985 and so on; the required data for 198! and 1985 and so on have been interpo'ated.

SOURCE : Calculated from Appendix Tables 1 to 10.

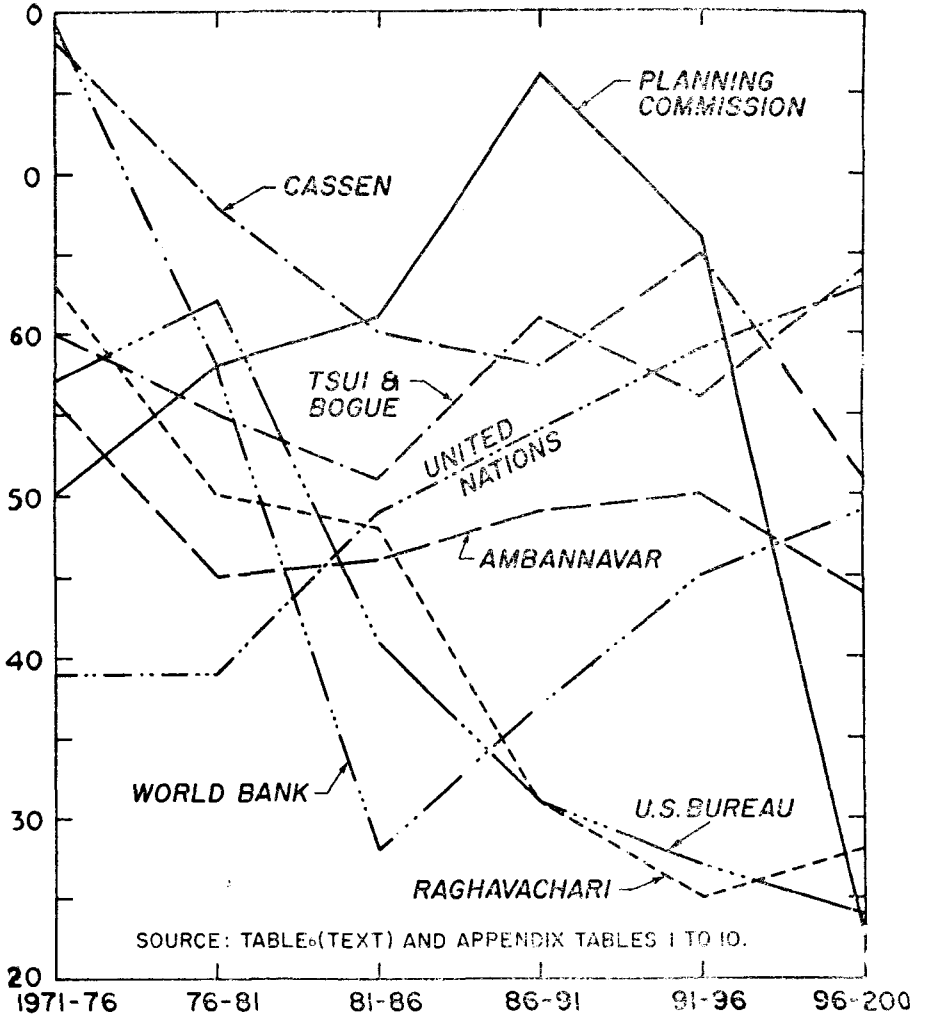


Chart 3 : Projected Annual Decline in Crude Birth Rate, India, 1971-2001 A. D.

sand), followed by those of the World Bank (26 per thousand), and the United Nations (24 per thousand). However, Cassen and the Planning Commission project the lowest level of the crude birth rate to be 20 per thousand (Table 4). If we accept a crude birth rate of 37 per thousand for 1971 as an accurate measure of prevailing fertility level in India, then the crucial question searching for an answer is : Will the crude birth rate over a period of 30 years decline by 17 points, given the recent past experience of a decline of 3.6 points between 1970 and 1978 ? Does the answer fall in the area of scientific investigation or does

it lie in the realm of wisdom derived from personal judgement for the demographic dynamics ? One is tempted to recall Kenneth Boulding's characterization that "population studies is an 'insecure' rather than a 'secure' science, for its theoretical framework does not provide an adequate base for explaining or predicting change within its field."[65]

5. There is relatively less disagreement among the authors as to the level of mortality for the base year 1971. The lowest figure of 14.9 per thousand is estimated by the Planning Commission and the highest is reported by the U. S. Bureau of the Census, 17.0 per thousand (Table 7). Similarly, for the year 2001, the projected level of mortality displays the same order of disagreement among various studies.

6. In terms of percentages decline in the crude death rate over a 30-year period, 1971-2001, the highest decline is projected by the U.S. Bureau of the Census—51.5 percent, and the lowest by the World Bank—33.8 percent (Table 8). All authors project a decline ranging from 11 to 21 percent during the next two decades.

7. There seems to be almost a unanimity in projections of the pattern of decline in the pace of mortality. The rate of decline gradually decreases from 1976-81 onward in every five-year period, but there is a significant diversity among various estimates. For example, the United Nations and the Planning Commission project the rate of decline during 1986-91 to be almost twice as high as that projected by the World Bank and by Tsui and Bogue (Table 9).

V. Summary Conclusions

1. Demographic change in India, when examined within the framework of the theory of demographic transition, suggests that only at a very broad level of generality may it be said that the theory is applicable. Of course, the empirical validation or otherwise would be possible only when transition, particularly the fertility transition, was fully completed.

2. Mortality transition appears to fit the pattern reasonably well if the projected decline in the next two decades continues and the crude death rate falls below 10 per thousand by the end of the century. A gradual decline was observed between 1921 and 1941, accelerated rapid decline between 1941 and 1971, and again very slow change during the 1970s

3. There appears to be no validation of the hypothesis that fertility declines, with a lag, in response to the mortality decline which ensures that the "insurance births" against high infant mortality rates are no longer necessary. Morta-

65. Nick Eberstadt, "Recent Declines in Fertility in Less Developed Countries, and What 'Population Planners' May Learn from Them," *World Development,* Vol. 8 (1980): 37-60.

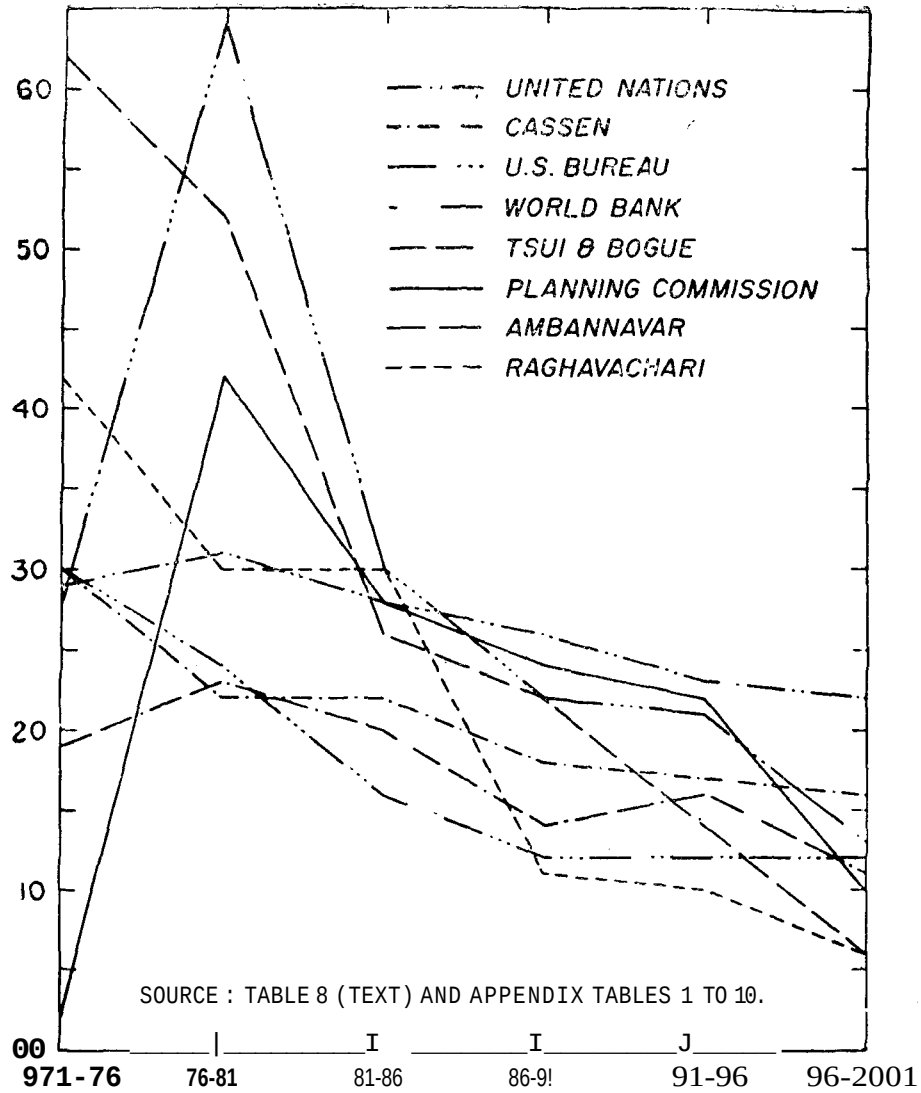


Chart 4 : Projected Annual Mortality Decline In Terms of Crude Death Rate, India, 1971-2001 A.D.

lity rate dropped off by more than 50 percent before any noticeable change was observed in the national crude birth rate in the mid-1960s.

4. The observed fertility decline of about 25 percent during the last 15 years can be attributed both to the reduction in the proportion of women married

TABLE 8—PROJECTED MORTALITY DECLINE IN TERMS OF CRUDE DEATH RATE, INDIA, 1971-2001, IN NATIONAL AND INTERNATIONAL STUDIES

(Percentages)

Authors	*1971-81*	*1981-91*	*1991-01*	*1971-2001*
1. Planning Commission	12.5	20.1	17.0	41.9
2. Raghavachari, Medium-2 series	22.5	17.1	14.1	44.6
3. Ambannavar, Medium series	28.4	17.8	15.1	50.0
4. Cassen, Medium ($Mi._5$ F_4) series	17.0	14.7	13.7	38.9
5. United Nations, Plausible series	18.6	20.8	21.6	49.4
6. *World Bank*	16.7	10.8	11.0	33.8
7. U. S. Bureau, Medium series	27.1	20.8	16.1	51.5
8. Tsui and Bogue, Medium series	14.5	12.2	11.0	33.2

SOURCE : Derived from Appendix Tables.

TABLE 9—PROJECTED ANNUAL MORTALITY DECLINE IN TERMS OF CRUDE DEATH RATE, 1971-2001, INDIA"

Author of projections	*1971-76*	*1976. 81*	*1981-86*	*1986-91*	*1991-96*	*1996-2001*
1. Planning Commission (1980)	0.02	0.42	0.28	0.24	0.22	0. 10
2. Raghavachari, "Medium-2 series"	0.42	0.30	0. 30	0.11	0. 10	0.06
3. Ambannavar, "Medium series"	0.62	0.52	0.26	0.22	0. 14	0.06
4. Cassen, "Medium ($M_{1.5}$ F_4) series"	0.30	0.22	0.22	0.18	0.17	0.16
5. United Nations, "Plausible series"	0.29	0.31	0.28	0.26	0. 23	0.22
6. World Bank	0.30	0.24	0.16	0.12	0. 12	0. 12
7. U. S. Bureau, "Medium series"	0.28	0.64	0.30	0.22	0.21	0. 13
8. Tsui and Bogue, "Medium series"	0.19	0.23	0,.20	0.14	0. 16	0. 11

Note. a. For purposes of comparison, the missing data for specific years have been calculated by linear interpolation. For example, the U. S. Bureau projections were made for the years 1980, 1985 and so on; the required data for 1981, 1985 and so on have been interpolated.

SOURCE : Calculated from Appendix Tables 1 to 10.

and to the decline in age-specific fertility rates. For lack of the necessary detailed data, it is not possible at present to estimate the contribution of each of the above two variables to the observed fertility decline.

5. There is growing statistical evidence that the contribution of social development, as opposed to industrial and agricultural development, 'explains' a greater share of the State variation in fertility decline during 1961-71.

6. The new evidence for Europe has suggested that fertility decline took place under a wide variety of socioeconomic conditions and different cultural and language settings. Similarly, in the case of India, it is noticed that significant declines in fertility and mortality rates have taken place in different regions. For example, in Kerala State the latest crude birth rate is 25.1 per thousand, and the crude death rate is 7.3 per thousand. In this State, the income per capita is not much higher than the corresponding national average. But the index of female literacy in this State is highest in the country—259 (India = 100).[66] On the other hand, Punjab and Haryana States have experienced unprecedented growth in the gross value of their agricultural output, popularly described as the Green Revolution. Their annual compound growth rate is calculated to be 16.2 percent during 1961-62 to 1971-72 (at current prices).[67] In Punjab, the estimated crude birth rate for 1978 is 29.4 per thousand, while in Haryana it is 33.4 per thousand. Perhaps the level of social development, as measured by the level of female literacy, explains, at least partially, the less rapid fertility transition in these two States when compared to Kerala State; the index of female literacy in Punjab is 137 and Haryana it is 90.

66. According to the latest 1981 census, 24.88 percent of females (including the 0-4 years age group) in the country were literate. The corresponding figures for selected Slates are : Kerala, 64.48% ; Punjab, 34.14% ; and Haryana, 22.43%.

See *Census of India 1981*, Statement 13, p, 46.

67. D. P. Chaudhri, *Education, Innovation and Agricultural Development: A Study of North India*, 1961-72 (London : Croom Helm, 1979), Table 3.1, p.22.

APPENDIX

TABLE 1—CRUDE BIRTH AND DEATH RATES PER THOUSAND, INDIA, RURAL, URBAN, TOTAL, 1970-1978*

Year	Crude birth rate			Crude death rate		
	Rural	Urban	Total	Rural	Urban	Total
1970	38.9	29.7	36.8	17.3	10.2	15.7
1971	38.9	30.1	36.9	16.4	9.7	14.9
1972	38.4	30.5	36.6	18.9	10.3	16.9
1973	35.9	28.9	34.6	17.0	9.6	15.5
1974	35.9	28.4	34.5	15.9	9.2	14.5
1975	36.7	28.5	35.2	17.3	10.2	15.9
1976	35.8	28.3	34.4	16.3	9.5	15.0
1977	34.3	27.8	33.0	16.0	9.4	14.7
1978	34.6	27.7	33.2	15.3	9.3	14.1

* Sample Registration Scheme data based on continuous enumeration and six-monthly cross-check survey. The rural sample is composed of 150 units in each State; unit is defined as a village or a segment of it with population of 2,000 or more in 1961. The urban sample varies from 60 to 100 blocks, according to State population.

SOURCE : Registrar General, Census, Government of India, *Sample Registration Bulletin*, Vol. XIII, No. 2 (December, 1979), p. 2.

TABLE 2—ESTIMATES AND PROJECTIONS OF VITAL RATES IN INDIA AS PREPARED BY THE WORKING GROUP ON POPULATION POLICY (1979)

Period	Crude birth rate per 1,000	Crude death rate per 1,000	Life expectancy at birth (years)	Net reproduction rate	Infant mortality rate per 1,000 live births	Average family size (number of children)	Total population (million)	Population growth rate per cent
1940's	39.9	27.4	32.0	—	—	—	318	—
1960's	41.1	18.9	45.0	—	—	—	—	2.24
1977	32.9	14.7	—	—	—	—	—	1.82
1978	33.0	14.0	—	1.67	120	4.2	634	—
1981-86	29.5	11.6	—	—	—	—	—	—
1983	—	—	—	—	—	—	697	—
1986-91	27.0	10.4	—	—	—	—	—	—
1988	—	—	—	—	—	—	761	—
1991	—	—	—	—	—	—	799	—
1996	21.0	—	—	—	—	—	—	—
2001	—	9.0	64.0	1.00	60	2.3	—	—
2050	—	—	—	—	—	—	1,200	—

SOURCE : Derived from Planning Commission, Government of India, *Working Group on Population Policy : Interim Report* (New Delhi : March, 1979).

TABLE 3—DEMOGRAPHIC PROJECTIONS FOR INDIA FOR 25-YEAR PERIOD, 1976-2000, AS PREPARED BY RAGHAVACHARI (1974)

Period	*General fertility rate (Medium 2)*	*Crude birth rate (Medium-2)*	*Crude death rate (Medium-2)*	*Life expectancy at birth (years)*	
				Male	*Female*
1971	—	—	—	47.00	45.60
1966-70	185	39.4	16.9	48.52	46.55
1971-75	167	35.6	15.2	51.27	49.55
1976-80	150	32.9	13.2	53.77	52.55
1981-85	135	30.5	11.7	56.02	53.50
1986-90	122	28.1	10.6	58.02	57.80
1991-95	116	27.1	10.0	59.52	59.80
1996-2000	110	25.7	9.7	60.52	61.30

Notes. The author made different sets of projections, high, medium and low, based on attaining crude birth rate of 30, 25, and 20 respectively by the year 2001 A.D., and mortality decline measured by increase in life expectancy at birth, as a function of the corresponding level of life expectancy, separately for males and females, as follows :

Male		*Female*	
life expectancy level (years)	*annual increase*	*life expectancy level (years)*	*annual increase*
48.5 to 51.3	0.55 years	46.5 to 49.6	0.60 years
51.3 to 53.8	0.50 ,,	49.6 to 62.6	0.60 ,,
53.8 to 56.0	0.45 ,,	52.6 to 55.3	0.55 ,,
56.0 to 58.0	0.40 ,,	55.3 to 57.8	0.50 ,,
58.0 to 59.0	0.30 ,,	57.8 to 59.8	0.40 ,,
59.0 to 60.5	0.20 ,,	59.8 to 61.3	0.30 ,,

MEDIUM-2 : The author states that, "the medium set represents the most plausible course of population growth (p. 433)."

SOURCE : S. Raghavachari, "Population Projectoin, 1976-2001," in *Population in India's Development 1947-2000*, eds. Ashish Bose *et al.* (Delhi : Vikas Pulishers, 1974), pp. 431-44.

TABLE 4—DEMOGRAPHIC ESTIMATES AND PROJECTIONS FOR INDIA, 1971-2026 AS PREPARED BY JAIPAL P. AMBANNAVAR (1975) "MEDIUM PROJECTIONS"

Period	Expectation of life at birih (years)			Crude birth rate	Crude death rate	Gross Repro-duction rate	Gross Fertility rate	Total Popula-tion (million)
	Male	Female	Persons					
1946	33.4	33.6	33.5	41.7	29.2	—	189.3	—
1956	39.4	38.6	39.0	43.3	24.1	—	201.1	—
1966	46.7	44.3	45.5	40.4	18.6	—	191.9	—
1971	49.9	47.6	48.7	38.6	16.2	2.667	184.1	548
1971-76	—	—	—	37.3	15.1	—	177.1	—
1976	52.9	50.6	51.8	—	—	—	—	612
1976-81	—	—	—	34.8	13.1	2.494	164.1	—
1981	55.9	53.6	54.8	—	—	—	—	683
1981-86	—	—	—	32.7	11.5	2.307	151.5	—
1986	58.4	56.5	57.5	—	—	—	—	759
1986-91	—	—	—	30.3	10.2	2.107	138.6	—
1991	60.9	53.4	60.1	—	—	—	—	839
1991-96	—	—	—	27.8	9.1	1.894	124.9	—
1996	62.9	61.8	62.3	—	—	—	—	921
1996-2001	—	—	—	25.3	8.4	1.694	111.4	—
2001	64.9	64.2	64.5	24.1	8.1	—	105.1	1,003
2001-06	—	—	—	23.1	7.8	1.521	100.0	—
2006	66.4	66.1	66.2	—	—	—	—	1,082
2006-11	—	—	—	21.1	7.5	1.374	90.7	—
2011	67.9	67.9	67.9	—	—	—	—	1,159
2011-16	—	—	—	19.5	7.3	1.254	83.5	—
2016	68.9	69.3	69.1	—	—	—	—	1,231
2021	69.9	70.6	70.3	—	—	—	—	1,299
2026	—	—	—	16.5	8.0	—	72.6	—

Notes. Mortality decline, measured in terms of increase in life expectancy in birth, is assumed to be a function of its level : between 1971-81 increases by 0.60 years annually; between 1981-91 increases 0.50 years annually; between 1991-2001 increases by 0.40 years and so on …

Fertility is based on the assumption that the net Reproduction Rate of unity will be achieved by year 2026; it declines logarithmically—1971-76, by 6.5%; 1976-81, by 7.0%; 1981-86 by 7.5%; 1986-91 by 8.0%; 1991-96 by 7.5%; 1996-2001 by 6.5%, and 2001-06 by 5.5%; … and 2016-21 by 2.5%; and 2021-26 by 1.5%.

General Fertility Rate (GFR) = Annual births per 1,000 females, 15-44 years.

SOURCE : Jaipal P. Ambannavar, *Second India Studies : Population* (Delhi : Macmillan, 1975), Tables 1.7, 2.2. 2.5 and 2.17.

TABLE 5-DEMOGRAPHIC PROJECTIONS FOR INDIA FOR A 35-YEAR PERIOD, 1970-2005, AS PREPARED BY CASSEN (1978) : SELECTED VARIANTS

Period	Crude birth rate		Crude Death rate		Total fertility rate	Life expectancy at birth (years)					
						Male			Female		
	F_4M_L	F_t $M_{1.5}$	F_4 M_1	F_4 $M_{1.5}$	F_4	M_1	$M_{1.5}$	M_2	M_1	$M_{1.5}$	M_2
1966-70	—	—	—	—	6.1	48.0	48.0	48.0	—	—	—
1971	—	36.8	—	—	—	—	—	—	—	—	—
1971-75	36.9	36.8	16.9	16.3	5.258	49.1	50.0	50.8	47.2	48.2	49.1
1975	37.0	37.0	17.0	17.0	—	—	—	—	—	—	—
1976-80	33.1	33.3	15.7	14.8	4.532	50.2	51.9	53.6	48.4	50.3	52.2
1981-85	30.2	30.0	14.8	13.5	3.906	51.2	53.8	56.2	49.6	52.4	55.2
1986-90	27.4	27.2	14.1	12.5	3.368	52.3	55.6	58.8	50.8	54.4	58.1
1991-95	24.3	24.0	13.4	11.6	2.903	53.4	57.4	61.3	52.0	56.4	60.9
1996-2000	21.0	20.8	12.8	10.8	2.500	54.4	59.1	63.6	53.2	58.3	63.5
2001-2005	20.7	18.8	12.7	10.3	2.5COO	55.5	60.8	65.9	54.4	60.2	65.9

Notes. Total fertility rate, starting from 6.1 during 1965-70, is assumed to decline to 2.5 after 60 years (F_1), 50 years (F_2), 40 years (F_3), 30 years (F_4), 25 years by 1991-95 (F_5), and 20 years by 1986-90 (F_6). Similarly, mortality decline, measured as annual increase in life expectancy at birth is assumed to increase by 0.2 years (M_1), by 0.35 years ($M_{1.5}$), by 0.50 years (M_2), and by 0.70 years (M_3). Seriously discounting the probability of mortality decline path of M_2 *and* M_3, the author adds that "we would expect the immediate future to be bracketed by projections F_3 M_1 and F_4 $M_{1.5}$-" (P- 137.)

SOURCE : R. H. Cassen, *India : Population, Economy, Society* New-York : Holmes, 1978), pp. 132-40.

TABLE 6-SELECTED DEMOGRAPHIC MEASURES, ESTIMATED AND PROJECTED, FOR INDIA BY TSUI AND BOGUE

Year or period	*Crude birth rate*			*Crude death rate*			*Total fertility rate*			*Total population (medium)* million
	High	*Medium*	*Low*	*High*	*Medium*	*Low*	*High*	*Medium*	*Low*	
1968	—	—	—	—	—	—	—	5.671	—	—
1975	37.7	37.7	37.7	15.4	15.4	15.4	—	5.241	—	607
1979-80	35.3	35.3	35.3	14.3	14.3	14.3	—	—	—	—
1980	—	—	—	—	—	—	—	5.038	—	677
1984-85	33.0	32.4	31.5	13.3	13.2	13.1	—	—	—	—
1985	—	—	—	—	—	—	—	—	—	748
1989-90	30.5	29.3	27.5	12.5	12.4	12.2	—	—	—	—
1990	—	—	—	—	—	—	—	—	—	813
1994-95	*28.2*	*26.6*	*24.3*	*11.7*	*11.6*	*11.5*	—	—	—	—
1995	—	—	—	—	—	—	—	—	—	888
1999-2000	25.5	23.4	20.6	11.2	11.1	10.9	3.206	2.886	2.472	—
2000	—	—	—	—	—	—	3.212	—	—	951
2025	—	—	—	—	—	—	2.306	—	—	—

Notes, a. U. S. AID Office data.

SOURCES : (I) Amy Ong Tsui and Donald J. Bogue, "Population Projections for the World. 1975-2000," (Mimeo.; University of Chicago Community and Family Study Center, October, 1977);

(2) Amy Ong Tsui and Donald J. Bogue. "Declining World Fertility : Trends, Causes, Implications," *Population Bulletin,* Vol. 33, No. 4 (October, 1978) : 1-56.

TABLE 7—DEMOGRAPHIC ESTIMATES AND PROJECTIONS FOR INDIA FOR 50-YEAR PERIOD 1950-2000. AS, PREPARED BY THE UNITED NATIONS (1979)

(Based on "most plausible assumptions")

Period	*Crude birth rate per 1,000*	*Crude death rate per 1,000*	*Life expectancy at birth (years)*		*Gross reproduction rate*	*Annual rate of growth per cent*
			Male	*Female*		
1950-55	40.5	24.2	39.4	38.0	—1.62	
1955-60	42.7	22.0	42.4	41.0	—2.07	
1960-65	42.7	19.6	45.3	44.0	— 2.31	
1965-70	40.9	17.5	47.8	46.5	_ 2.34	
1970-75	38.6	15.6	50.0	48.7	—2.31	
			Projections			
1975-80	36.9	14.0	52.0	51.0	2.55	2.29
1980-85	34.8	12.5	54.1	53.4	2.35	2.23
1985-90	32.1	11.1	56.4	55.8	2.10	2-10
1990-95	29.4	9.9	58.8	57.9	1.85	1-95
1995-2000	26.3	8.8	61.0	61.0	1.60	1.75

SOURCE: Population Division, Department of International Economic and Social Affairs United Nations, *Demographic Estimates and Projections for the World, Regions and Countries as Assessed in 1978* (Provisional Report), New York : January, 1979.

TABLE 8-DEMOGRAPHIC PROJECTIONS FOR INDIA, 1975 TO 2125-30, AS PREPARED BY THE WORLD BANK (JULY, 1979)

Years/Period	*Crude birth rate*	*Crude death rate*	*Life expectancy at birth, years*		*Total fertility rate*	*Net Reproduction Rate*	*Total Population (million)*
			Male	*Female*			
1975	—	—	—	—	—	—	608
1975-80	34.6	14.1	51.29	50.80	4.982	1.782	—
1980	—	—	—	—	—	—	673
1980-85	33.3	13.1	52.41	52.80	4.626	1.709	—
1985	—	—	—	—	—	—	745
1985-90	31.8	12.4	53.46	54.80	4.241	1.616	—
1990	—	—	—	—	—	—	821
1990-95	29.7	11.8	53.35	52.71	3.829	1.499	—
1995	—	—	—	—	—	—	898
1995-2000	27.3	11.2	55.11	58.54	3 456	1.387	—
2000	—	—	—	—	—	—	973
2000-05	24.8	10.5	56.78	60.32	3.120	1.282	—
2025-30	17.6	9.4	64.32	68.22	2.226	1.000	1,285
2050-55	14.6	11.1	69.74	73.62	2.127	1.000	1,495
2075 80	13.7	12.6	72.45	76.16	2.097	1.000	1,588
2100-05	13.4	12.8	73.55	77.18	2,086	1.000	1,623
2125-30	13.3	13.0	73.90	77.50	2.083	1.000	1,638

Note. Future course of mortality is assumed in terms of increase in expectation of life at birth for females with reference to per capita income level of 129 member countries classified into three groups. And in the assumption of future fertility trends the starting point is the year in which net reproduction rate is likely to reach unity. The total fertility rates for intermediate years are calculated in three steps : (i) an exponential curve is fitted between initial year and the year in which net reproduction rate is equal to unity; (ii) this fitted curve is used to estimate total fertility rate for 1985; (ii!) reverse geometric curve is fitted to first segment (up to 1985-90); and a geometric curve is fitted in the second segment, beyond 1985-90.

SOURCE : K. C, Zachariah and My Thi Vu, *Population Projections, 1975-2000 and Long Term (Stationary Population),* World Bank, Washington, D. C. : July, 1979, pp. 212-13.

TABLE 9-DEMOGRAPHIC ESTIMATES AND PROJECTIONS FOR INDIA, 1955-2000, AS PREPARED BY THE WORLD BANK (1979)

Period	*Crude birth rate*	*Crude death rate*	*Total fertility rate*	*Life expectancy at birth (years)*	*Infant mortality rate (0-1 aged)*	*Total population* (million)
1955-60	44.1	—	—	41.7	—	—
1960	43.0	21.0	—	43.0	139	—
1965-70	41.3	—	—	47.2	—	—
1970-75	39.9	—	—	49.5	—	—
1975	36.0	15.0	5.700	50.0	122	—
1977	35.0	14.0	5.000	51.0	—	632
1980-85	—	—	4.513	—	—	—
1995-2000	26.3	—	3.353	—	—	—
2000	—	—	—	—	—	973

Notes. The Bank assumes the same rate of Total Fertility decline as projected by the U. N. estimates. But the rates are accelerated for counties having higher per capita GNP in 1975, and deemed having "stronger" family planning effort in the same year.

SOURCES : (1) K. C. Zachariah, "Revised Population Projections, 1975-2000" (World Bank. Washington, D. C. : 1977);

(2) World Bank, *World Development Report, 1978* (Washington, D. C.: August, 1978);

(3) World Bank, *World Development Report, 1979* (Washington, D. C.: August, 1979);

(4) World Bank, *World Atlas of the Child* (Washington, D. C. : 1979).

TABLE 10—DEMOGRAPHIC ESTIMATES AND PROJECTIONS FOR INDIA, 1950-2000 AS PREPARED BY THE U. S. BUREAU OF THE CENSUS (1979)

Medium Series

Year	*Total population* (million)	*Crude birth rate per million*	*Crude death rate per million*	*Total fertility rate*	*Life expectancy at birth (years)*	
					Male	*Female*
1950	370	—	—	—	—	—
1955	404	—	—	—	—	—
1960	446	—	—	—	—	—
1961	455	—	—	—	—	—
1970	554	—	—	—	—	—
1971	566	39.0	17.0	5.700	—	—
1975	617	36.9	14.4	5.300	51.5	50.6
1976	630	—	—	—	—	—
1977	643	35.00	—	—	—	—
1978	655	33.0-34.0	15.0	—	—	—
1980	690	33.9	12.7	4.675	53.8	53.4
1985	764	31.3	11.1	4.175	56.3	56.5
1990	844	29.7	10.1	3.875	58.4	59.1
1995	929	28.3	9.2	3.650	60.5	61.7
2000	1021	27.1	8.4	3.500	62.5	64.3

Note. These projections are based on the component method. The base population data were derived from the 1971 census, after adjustment for 2.7 percent underenumeration. The estimated crude birth rate of 39.0 per thousand for the year 1971 is estimated by inflating the Sample Registration Scheme data by 5 percent. The estimated total fertility rate of 5.7 in 1971 is simply judged to decline to 3.5 in the year 2000. Similarly, a target life expectancy at birth is chosen for the year 2000 and life expectancies for the year between 1975 and 2000 are graphically interpolated. In summary the authors of the Report say that "The three fertility projection series in this report did not use any mathematical models of fertility change; instead, the assumptions were made on a judgemental basis" (p. 15).

SOURCE : U. S. Bureau of the Census, *Illustrative Projections of World Population to the 21st Century*, Special Studies Series, P-23, No. 79 (Washington, D. C. : January, 1979); U. S. Bureau of the Census, *World Population 1979 : Recent Demographic Estimates for the Countries and Regions of the World* (Washington, D. C. October, 1980).